City of Canton, GA

Water Pollution Control Plant Expansion to 6 MGD

Contract Documents and Technical Specifications
Bidding Set

Volume 2 of 3

September 2020

ATKINS
Member of the SNC-Lavalin Group

in association with:

HARTWELL ENGINEERING, INC.

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EXPANSION TO 6 MGD
CITY OF CANTON, GEORGIA

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Canton Water Pollution Control Plant
Expansion to 6 MGD
City of Canton
Canton, Georgia
Project Specifications
Sign and Seal Sheet

Technical Specifications

Hector M. Casablanca, P.E.

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for
Canton Water Pollution Control Plant
Expansion to 6 Million Gallons Per Day

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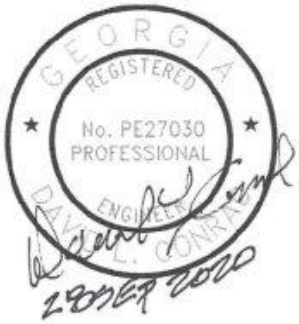

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Jeffrey N. Warmington, AIA, LEED® AP

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Tim Hartwell, P.E.

SECTION 02010

SUBSURFACE CONDITIONS

PART 1: GENERAL

1.01 DESCRIPTION

A. The following soils investigation reports have been prepared for this site and is attached as a Supplement for the Bidders' information:

1. Report of Subsurface Exploration and Geotechnical Engineering Evaluation, Canton WWTP, Canton, Georgia, December 17, 2019. Geo-Hydro Project Number 191131.20.

B. Test boring information prepared on this site is included in the report.

C. Use of Data:

1. The information was obtained solely for the Engineer's use in design and is NOT a warranty of subsurface conditions.

2. Copies of the soil investigation report can be obtained through the Engineer. The report(s) are not part of the plans and specifications for this project.

D. Bidders should visit the site and acquaint themselves with all existing conditions. Prior to bidding, bidders may make their own subsurface investigations to satisfy themselves as to site and subsurface conditions, but all such investigations shall be performed only under time schedules and arrangements approved in advance by the Owner or Engineer.

E. Test boring locations are referenced on the Boring Plans located in the Subsurface Exploration Report referenced above.

F. Quality Assurance

1. A soil engineer will be retained by the Contractor to check performance of work in connection with excavating, trenching, filling, backfilling, and grading.

2. Adjustment of work: Readjust all work performed that does not meet technical or design requirements but make no deviations from the Contract Documents without specific and written approval from the Engineer.

3. The Owner, The Engineer, and the Soils Engineer assume no responsibility for any variation between materials encountered during construction and those indicated on the boring logs nor for any variation between location of the water table encountered and that indicated on the boring logs at the date borings were taken.

PART 2: PRODUCTS (Not Used)

PART 3: EXECUTION

3.01 SUPPLEMENTS

A. The supplements listed below are part of this Specification.

1. Supplement 1, Report of Subsurface Exploration and Geotechnical Engineering Evaluation, Canton WWTP

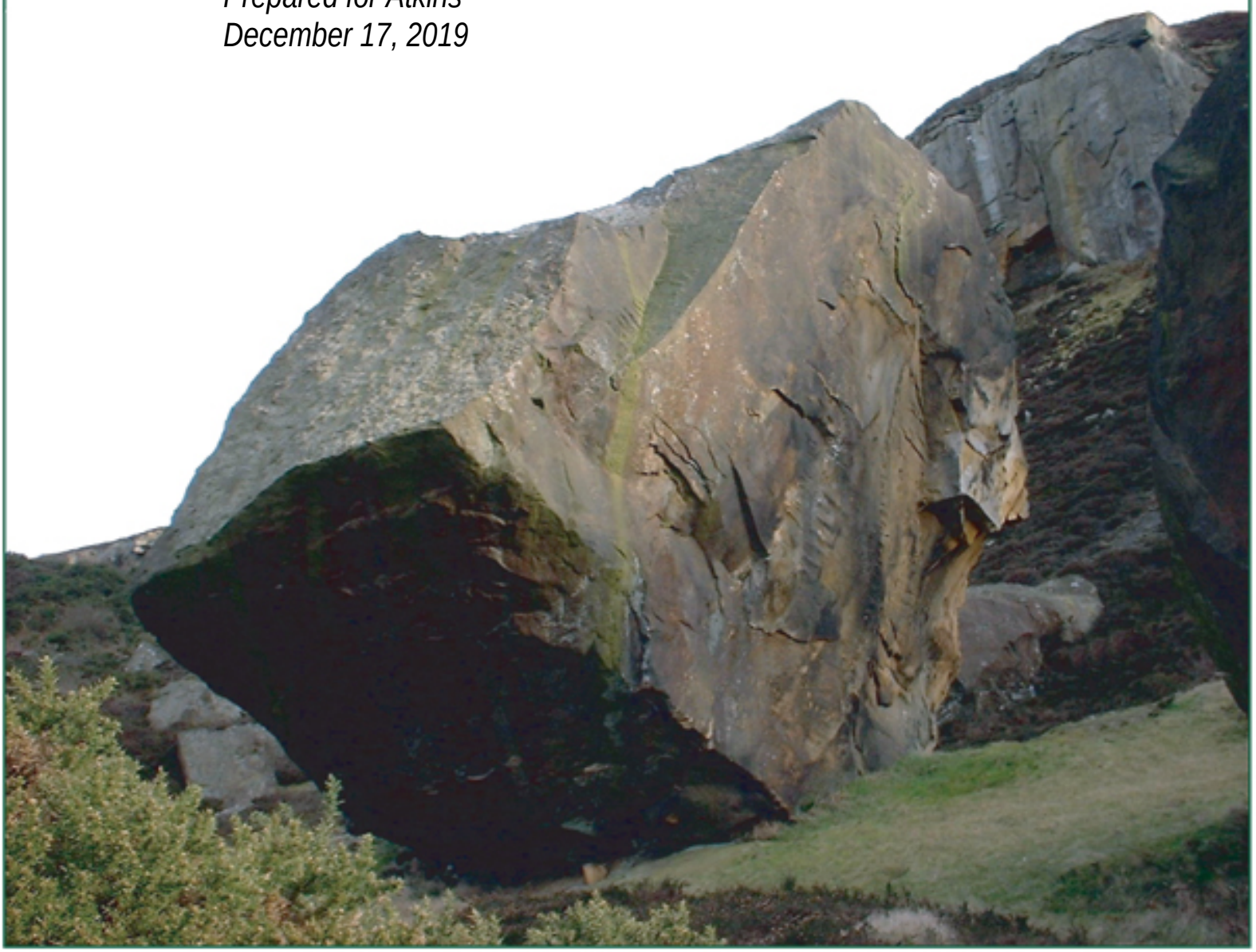
END OF SECTION

GEO HYDRO ENGINEERS

Report of Subsurface Exploration and Geotechnical Engineering Evaluation

Canton WWTP Expansion
Canton, Georgia
Geo-Hydro Project Number 191131.20

Prepared for Atkins
December 17, 2019



Mr. Hector Casablanca, P.E.
Atkins
1600 Riveredge Parkway, NW
Suite 700
Atlanta, Georgia 30328

December 17, 2019

Report of Subsurface Exploration
and Geotechnical Engineering Evaluation
Canton WWTP Expansion
Canton, Georgia
Project Number 191131.20

Dear Mr. Casablanca:

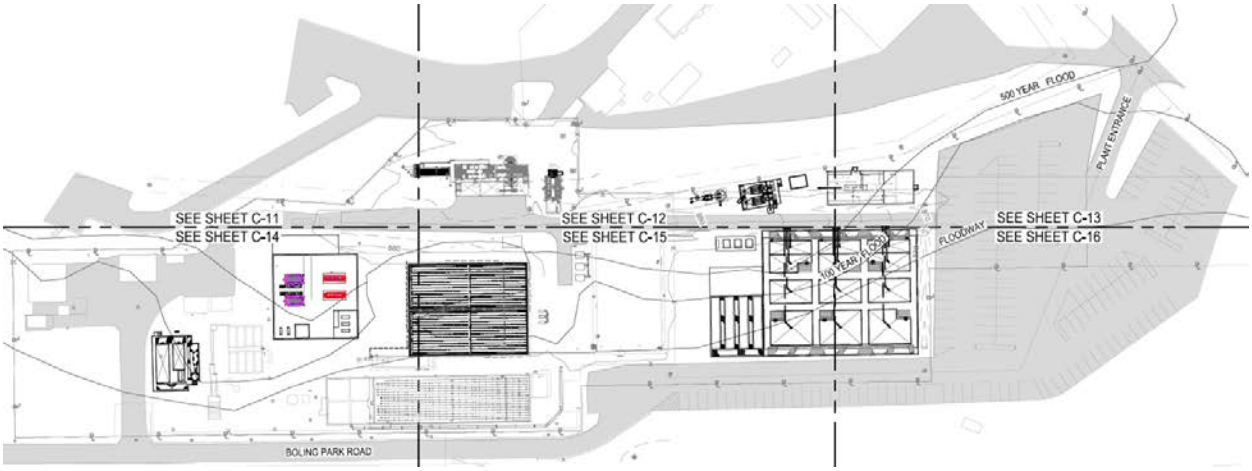
Geo-Hydro Engineers, Inc. has completed the authorized subsurface exploration for the above referenced project. The scope of services for this project was outlined in our proposal number 23804.2 dated September 17, 2019.

Project Information

We understand that the wastewater treatment plan additions will include a new administration building, new filters, pump station, various tanks, and new pavements. We understand that the administration building will be a two-story structure. We have assumed that the building will have a masonry structure with a lower-level concrete slab-on-grade floor.

At the time of this report, we have not been provided structural loading information for the building, tanks, or other structures. The structural loads assumed in this report are based on our experience with similar projects. If actual loads are found to exceed the maximums assumed in this report, please allow us the opportunity to review our recommendations and revise them as necessary.

The proposed construction will be primarily located in a grassed area southeast of the existing plant. The site plan excerpt below shows the proposed plant expansion layout.



EXPLORATORY PROCEDURES

The subsurface exploration consisted of 16 machine-drilled soil test borings performed at the approximate locations shown on Figure 2 in the Appendix. The test borings were located in the field by Geo-Hydro by measuring angles and distances from existing site reference points. The boring locations were adjusted from the planned locations to cope with sloping ground and conflicting underground utilities. The elevations shown on the test boring records were interpolated from the topographic site plan provided to us and were rounded to the nearest whole foot. In general, the locations and elevations of the borings should be considered approximate.

Standard penetration testing, as provided for in ASTM Dl586, was performed at select depth intervals in the soil test borings. Soil samples obtained from the drilling operation were examined and classified in general accordance with ASTM D2488 (Visual-Manual Procedure for Description of Soils). Soil classifications include the use of the Unified Soil Classification System described in ASTM D2487 (Classification of Soils for Engineering Purposes). The soil classifications also include our evaluation of the geologic origin of the soils. Evaluations of geologic origin are based on our experience and interpretation and may be subject to some degree of error.

Descriptions of the soils encountered, groundwater conditions, standard penetration resistances, and other pertinent information are provided in the test boring records and hand auger logs included in the Appendix.

REGIONAL GEOLOGY

The project site is located in the Northern Piedmont Geologic Province of Georgia. Soils in this area have been formed by the in-place weathering of the underlying crystalline rock, which accounts for their classification as “residual” soils. Residual soils near the ground surface that have experienced advanced weathering frequently consist of red brown clayey silt (ML) or silty clay (CL). The thickness of this surficial clayey zone may range up to roughly 6 feet. For various reasons, such as erosion or local variation of mineralization, the upper clayey zone is not always present.

With increased depth, the soil becomes less weathered, coarser grained, and the structural character of the underlying parent rock becomes more evident. These residual soils are typically classified as sandy micaceous silt (ML) or silty micaceous sand (SM). With a further increase in depth, the soils eventually become quite hard and take on an increasing resemblance to the underlying parent rock. When these materials have a standard penetration resistance of l00 blows per foot or greater, they are referred to as partially weathered rock. The transition from soil to partially weathered rock is usually a gradual one, and may occur at a wide range of depths. Lenses or layers of partially weathered rock are not unusual in the soil profile.

Partially weathered rock represents the zone of transition between the soil and the indurated metamorphic rocks from which the soils are derived. The subsurface profile is, in fact, a history of the weathering process that the crystalline rock has undergone. The degree of weathering is most advanced at the ground surface, where fine-grained soil may be present. Conversely, the weathering process is in its early stages immediately above the surface of relatively sound rock, where partially weathered rock may be found.

The thickness of the zone of partially weathered rock and the depth to the rock surface have both been found to vary considerably over relatively short distances. The depth to the rock surface may frequently range from the ground surface to 80 feet or more. The thickness of partially weathered rock, which overlies the rock surface, may vary from only a few inches to as much as 40 feet or more.

Geologic conditions in parts of at the site have been modified by previous grading activities.

SOIL TEST BORING SUMMARY

Starting at the ground surface, borings B-1, B-12, and B-13 encountered approximately 2 to 3 inches of asphalt underlain by about 2 inches of graded aggregate base. Boring B-14 encountered about 4 inches of gravel at the ground surface. The remaining borings initially encountered 2 to 4 inches of topsoil. Surface material thicknesses should be expected to vary across the site, and detailed measurements necessary for quantity estimation were not performed for this project. We recommend assuming a surface material thickness of 6 inches for planning purposes.

Beneath surface materials, borings B-2, B-3, B-4, B-5, B-7, B-8, B-9, B-10, B-12, B-14, B-15, and B-16 encountered fill materials extending to depths ranging from about 3 to 12 feet. Borings B-8 and B-12 were terminated at a depth of 10 feet without fully penetrating the fill materials. The fill was classified as silty clay, clayey silt, sandy silt, clayey sand, and silty sand with varying amounts of rock fragments. Standard penetration resistances recorded in the fill ranged from 4 to 10 blows per foot.

Beneath the surface materials or fill materials, borings B-2, B-3, B-4, B-5, B-6, B-7, B-9, B-10, B-11, B-13, B-14, B-15, and B-16 encountered alluvial (water-deposited) soils extending to depths ranging from about 12 to greater than 30 feet. Boring B-11 encountered conditions causing auger refusal at a depth of 13 feet without fully penetrating the alluvial soils, and boring B-14 was terminated at a depth of 30 feet without fully penetrating the alluvial soils. The alluvial soils were classified as silty clay, clayey silt, clayey sand, and silty sand with varying amounts of rock fragments. Standard penetration resistances recorded in the alluvial soils ranged from 3 to 40 blows per foot.

Beneath the fill materials, alluvial soils, or surface materials, all of the borings except B-8, B-11, B-12, and B-14 encountered residual soils or partially weathered rock typical of the Piedmont Region. The residual soils were classified as sandy silt and silty sand with varying mica content. Standard penetration resistances recorded in the residual soils ranged from 5 to 73 blows per foot.

Partially weathered rock was encountered in borings B-3, B-4, B-5, B-6, B-7, B-9, B-10, B-11, and B-16 at depths ranging from about 12 to 42 feet. Partially weathered rock is locally defined as residual material with a standard penetration resistance of 100 blows per foot or greater.

Conditions causing auger refusal were encountered in borings B-3, B-4, B-5, B-6, B-7, B-9, B-10, B-11, and B-16 at depths ranging from 13 to 43 feet. Auger refusal is the condition that prevents advancement of the boring using conventional soil drilling techniques. The material causing auger refusal may consist of a boulder, a lens or layer of rock, the upper surface of relatively massive rock, or other hard material.

Either at the time of drilling or twenty-four hours after drilling completion, groundwater was encountered in borings B-5, B-6, B-7, B-9, B-10, and B-16 at depths ranging from 18 to 35 feet. The borings were backfilled with soil cuttings after the final groundwater check and patched with asphalt where appropriate. It should be noted that groundwater levels will fluctuate depending on yearly and seasonal rainfall variations and other factors and may rise in the future.

Summary of Subsurface Conditions

Structure	Boring	Approx. Existing Ground Elevation	Bottom of Structure Elevation/ Finished Grade	Bottom of Fill Material		Bottom of Alluvium		Top of PWR		Depth to Auger Refusal		Groundwater	
				Approx. Depth (feet)	Approx. Elevation	Approx. Depth (feet)	Approx. Elevation	Approx. Depth (feet)	Approx. Elevation	Depth (feet)	Approx. Elevation	Depth (feet)	Approx. Elevation
Administration Building	B-1	880	882	NE	NE	NE	---	NE	---	NE	---	NE	---
	B-2	880	882	6	6	27	853	NE	---	NE	---	NE	---
Fine Screen Facility	B-3	882	878	6	6	27	855	27	855	38	844	NE	---
Pump Station	B-4	880	851	12	12	27	853	37	843	43	837	NE	---
Biological Nutrient Reactor	B-5	871	856	6	6	12	859	12	859	43	828	35*	836
	B-6	874	856	NE	NE	12	862	37	837	43	831	35*	839
Membrane Bioreactor	B-7	867	867	3	3	17	850	37	830	42	825	33*	834
Paved Area	B-8	882	882	>10	>10	NE	---	NE	---	NE	---	NE	---
UVPA	B-9	875	860	3	3	17	858	27	848	37	838	26*	849
Alternate UVPA	B-10	864	860	6	6	12	852	17	847	32	832	18*	846
Biological Nutrient Reactor	B-11	866	856	NE	NE	>13	<853	NE	---	13	853	NE	---
New Road	B-12	868	868	>10	>10	6	862	NE	---	NE	---	NE	---
	B-13	868	868	NE	NE	>30	<838	NE	---	NE	---	NE	---
Paved Area	B-14	878	878	6	6	17	861	NE	---	NE	---	NE	---
Alternate Pump Station	B-15	884	884	6	6	17	867	NE	---	NE	---	NE	---
Biological Nutrient Reactor	B-16	864	856	8	8	17	847	42	822	47	817	19	845

All Depths and Elevations in this Summary Table are Approximate
NE: Not Encountered
PWR: Partially Weathered Rock
*: Groundwater level recorded at time of drilling

EVALUATIONS AND RECOMMENDATIONS – SPECIFIC STRUCTURES

The following evaluations and recommendations are based on the information available on the proposed construction, the data obtained from the test borings, and our experience with soils and subsurface conditions similar to those encountered at this site. Because the test borings represent a very small statistical sampling of subsurface conditions, it is possible that conditions different from those indicated by the test borings could be encountered during construction.

The following sections present discussions of subsurface conditions and specific design recommendations for each of the proposed structures. Following the individual sections, we present general evaluations and recommendations that typically apply to all construction.

Administration Building – B-1 and B-2

We expect site grading for the administration building to involve less than 3 feet of mass excavation and structural fill placement. All excavations necessary for site grading and construction of shallow foundations should be feasible with typical earth moving equipment such as backhoes.

Based on the site layout provided to us, the administration building will be underlain by fill materials extending to a depth of about 6 feet. Beneath the fill, boring B-2 encountered alluvial soils extending to a depth of about 27 feet. Variations within the fill mass should be expected, and any loose or unstable fill encountered during site preparation or foundation construction should be removed and replaced with well-compacted structural fill. Based on the materials encountered in the borings, most of the existing fill and alluvial soils at the site should be suitable for reuse after proper moisture conditioning.

At the time of drilling, borings B-1 and B-2 did not encounter groundwater. For safety reasons, the borings were backfilled upon completion. We do not expect groundwater to be a hindrance to design or construction of the administration building. Regardless of groundwater conditions, subsurface drainage will be necessary behind all below-grade structures including foundation walls and the contractor should be prepared to manage surface runoff during rain events.

At the time of this report, we have not been provided structural loading information for the building. Based on our experience with similar structures, we have assumed that the building will have CMU walls or a structural steel frame. We have assumed that maximum column loads will not exceed 150 kips and maximum wall loads will be no greater than 6 kips per lineal foot.

Based on the structural loading outlined above and assuming thorough evaluation and remediation of foundation excavations, we recommend supporting the administration building on conventional shallow foundations. We recommend an allowable bearing pressure of 2,500 psf for design. The recommended allowable soil bearing pressure is based on the assumed maximum foundation loads and total foundation settlement no greater than approximately 1 inch, with anticipated differential settlement between adjacent columns not exceeding about ½ inch.

Foundation bearing surface evaluations should be performed in all footing excavations prior to placement of reinforcing steel. These evaluations should be performed by Geo-Hydro to confirm that the design allowable soil bearing pressure is available. Foundation bearing surface evaluations should be performed using a combination of visual observation, hand augering, and portable dynamic come penetrometer testing (ASTM STP-399).

Fine Screen Facility – B-3 (Primary Location) and B-15 (Alternate Location)

We expect site grading for the fine screen facility to involve approximately 4 to 6 feet of mass excavation, possibly greater if the alternate location is selected. All excavations necessary for site preparation and construction should be feasible with typical earth moving equipment such as backhoes.

Borings B-3 and B-15 encountered fill materials extending to elevations below the planned bottom-of-structure elevation for the fine screen facility. Thorough evaluation of the exposed fill materials will be necessary during construction. Depending on conditions at the bottom of the excavation, it may be necessary to extend the excavation deeper to remove unstable materials. It may also be necessary to stabilize the exposed excavation surface using crushed stone and geosynthetics as necessary to create a stable surface to support the new structure.

At the time of drilling, groundwater was not encountered in borings B-3 and B-15. Groundwater is not expected to be a hindrance to design or construction of the fine screen facility. However, subsurface drainage will be necessary behind all below-grade structures including foundation walls.

Based on the results of the test borings, the structure can be supported directly on a properly prepared subgrade at the planned bottom-of-structure elevation using a reinforced concrete mat foundation. We recommend an allowable bearing pressure of 2,500 psf for design. The recommended allowable soil bearing pressure is based on total foundation settlement no greater than approximately ¾ inch, with planar tilt not exceeding about ½ inch across the structure. Thorough evaluation of the bearing elevation will be necessary to identify any loose or unstable fill material or alluvial soils. Any loose, unstable material should be thoroughly excavated and replaced with well-compacted structural fill or graded aggregate base.

Plant Drain Pump Station – B-4 (Primary) and B-15 (Alternate)

Based on a bottom-of-structure elevation of 851, installing the new pump station will involve excavation to a depth of about 30 feet. Boring B-4 encountered partially weathered rock at an approximate elevation of 843. Although we do not expect difficult excavation conditions to be encountered, it is important to note that the depth to partially weathered rock can vary drastically in the Piedmont.

At the time of drilling, groundwater was not encountered in borings B-4 and B-15. We do not expect groundwater to be a hindrance to design or construction of the pump station.

Based on the results of the test borings, a conventional reinforced concrete mat foundation will be suitable for support of the new pump station. We recommend that the mat be designed for an allowable bearing pressure of 2,500 psf.

Biological Nutrient Reactors – B-5, B-6, B-11 and B-16

Based on the bottom-of-structure elevations provided to us, we understand that construction of the biological nutrient reactors will involve about 10 to 20 feet of mass excavation. Boring B-5 encountered partially weathered rock at a depth of about 12 feet, which corresponds to an elevation about 3 feet above the planned bottom-of-structure elevation. Boring B-11 encountered conditions causing auger refusal at a depth of 13 feet, which corresponds to an elevation about 3 feet below the planned bottom-of-structure elevation. It is important to note that the depth to partially weathered rock and rock can vary drastically in the Piedmont.

Excavation of partially weathered rock typically requires large equipment capable of ripping. Due to the leverage involved, ripping partially weathered rock from trench excavations or in deep excavations may be impractical. In some cases, rock hammers or blasting are necessary to remove partially weathered rock.

Although the surrounding borings suggest that the cause of auger refusal in boring B-11 is a lens of rock or partially weathered rock, the cause may be mass rock requiring blasting to remove. For planning and budgeting purposes, we recommend assuming that blasting will be necessary to construct the biological nutrient reactor in the area of boring B-11.

Either at the time of drilling or twenty-four hours later, none of the borings encountered groundwater within 10 feet of the planned bottom-of-structure elevations. We do not expect groundwater to be a hindrance to design or construction of the biological nutrient reactors.

Based on the results of the test borings, a conventional reinforced concrete mat foundation will be suitable for support of biological nutrient reactors. We recommend that the mats be designed for an allowable bearing pressure of 2,500 psf.

Membrane Bioreactor – B-7

Based on a bottom-of-structure elevation of 867, we expect less than 5 feet of mass excavation and structural fill placement to be necessary to construct the membrane bioreactor. Fill materials and alluvial soils should be readily removable using conventional earth moving equipment.

At the time of drilling, groundwater was encountered in boring B-7 at a depth of 33 feet. We do not expect groundwater to be a hindrance to design or construction of the membrane bioreactor.

Based on the results of the test boring, a conventional reinforced concrete mat foundation will be suitable for support of the membrane bioreactor. We recommend that the mat be designed for an allowable bearing pressure of 2,500 psf.

Ultraviolet Disinfection/Post Aeration Structure (UVPA) – B-9 (Primary) and B-10 (Alternate)

Based on a bottom-of-structure elevation of 860, the ultraviolet disinfection/post aeration structure will be supported by alluvial soils. Fill materials and alluvial soils should be readily removable using conventional earth moving equipment. However, boring B-9 was performed at the bottom of the an existing slope, and partially weathered rock may be encountered within the structure footprint at elevations above those shown on the test boring records.

At the time of drilling, groundwater was encountered in boring B-9 and B-10 at depths of 26 and 18 feet, respectively. We do not expect groundwater to be a hindrance to design or construction of the ultraviolet disinfection/post aeration structure.

Based on the results of the test borings, a conventional reinforced concrete mat foundation will be suitable for support of the ultraviolet disinfection/post aeration structure. We recommend that the mat be designed for an allowable bearing pressure of 2,500 psf.

Dewatering Building – B-14

Based on a bottom-of-structure elevation of 884, we expect minimal mass grading to be necessary within the new dewatering building footprint. Based on the results of boring B-14, we do not expect difficult excavation conditions to be encountered during construction of the dewatering building.

At the time of drilling, no groundwater was encountered in boring B-14. We do not expect groundwater to be a hindrance to design or construction of the dewatering building. However, subsurface drainage will be required behind all below-grade structures including foundation walls.

At the time of this report, we have not received any structural loading information for the dewatering building. We have assumed that the building will be a one-story structure with CMU walls or a structural steel frame. We have assumed that maximum column loads will not exceed 150 kips and maximum wall loads will be no greater than 6 kips per lineal foot.

Based on the structural loading outlined above and assuming thorough evaluation and remediation of foundation excavations, we recommend supporting the administration building on conventional shallow foundations. We recommend an allowable bearing pressure of 2,500 psf for design. The recommended allowable soil bearing pressure is based on the assumed maximum foundation loads and total foundation settlement no greater than approximately 1 inch, with anticipated differential settlement between adjacent columns not exceeding about ½ inch.

Foundation bearing surface evaluations should be performed in all footing excavations prior to placement of reinforcing steel. These evaluations should be performed by Geo-Hydro to confirm that the design allowable soil bearing pressure is available. Foundation bearing surface evaluations should be performed

using a combination of visual observation, hand augering, and portable dynamic come penetrometer testing (ASTM STP-399).

New Roadways– B-8, B-12 and B-13

Based on the results of borings B-8, B-12, and B-13, fill materials and alluvial soils will be present at the subgrade elevation for the new roadways. Fill materials and alluvial soils can vary drastically over relatively short distances. We expect areas of loose, unstable soils to be encountered during construction of the roadway, and stabilization consisting of excavation and replacement will be necessary. In some instances, crushed stone and geogrid may be necessary to facilitate remedial treatment of the subgrade soils along the new roadways. Thorough proofrolling and proper density testing and compaction observation will be critical during construction of the new roads.

EVALUATIONS AND RECOMMENDATIONS - GENERAL

Existing Fill Materials

Existing fill materials were encountered in 12 of the 16 test borings. There are several important facts that should be considered regarding existing fill materials and the limitations of subsurface exploration.

- The quality of existing fill materials can be highly variable, and test borings are often not able to detect all of the zones or layers of poor quality fill materials.

- Layers of poor quality fill materials that are less than about 2½ to 5 feet thick may often remain undetected by soil test borings due to the discrete-interval sampling method used in this exploration.

- The interface between existing fill materials and the original ground surface may include a layer of organic material that was not properly stripped off during the original grading. Depending on its relationship to the foundation and mat bearing surfaces, an organic layer might adversely affect support of footings and floor slabs. If such organic layers are encountered during construction, it may be necessary to "chase out" the organic layer by excavating the layer along with overlying soils.

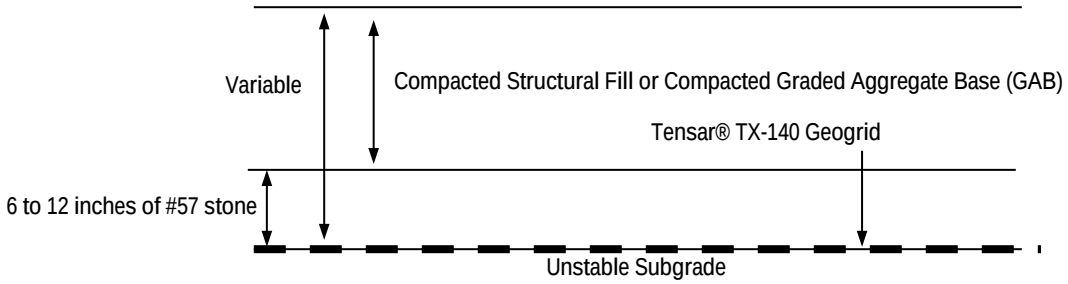
General Site Preparation

Topsoil, roots, existing above-ground and underground structures, and other deleterious materials should be removed from the proposed construction areas. All existing utilities should be excavated and removed unless they are to be incorporated into the new construction. Additionally, site clearing, grubbing, and stripping should be performed only during dry weather conditions. Operation of heavy equipment on the site during wet conditions could result in excessive subgrade degradation. All excavations resulting from rerouting of underground utilities should be backfilled in accordance with the *Structural Fill* section of this report.

We recommend, wherever possible, that areas to receive structural fill be proofrolled prior to placement of structural fill. Areas of proposed excavation should be proofrolled after rough finished subgrade is

achieved. Proofrolling should be performed with multiple passes in at least two directions using a fully loaded tandem axle dump truck weighing at least 18 tons. Proofrolling must be avoided within 10 feet of existing structures. If low consistency soils are encountered that cannot be adequately densified in place, such soils should be removed and replaced with well compacted fill material placed in accordance with the *Structural Fill* section of this report. Proofrolling should be observed by Geo-Hydro to determine if remedial measures are necessary.

The following sketch illustrates a subgrade stabilization approach using geogrid and crushed stone. We suggest considering a contingency to treat roughly 25,000 square feet of unstable subgrade using this approach. This recommendation is provided to facilitate the allocation of funds for ground stabilization during budgeting. The actual extent, thickness, and type of materials used will be different and may exceed the suggested budgetary allocation.



During site preparation, burn pits or trash pits may be encountered. All too frequently such buried material occurs in isolated areas which are not detected by the soil test borings. Any buried debris or trash found during the construction operation should be thoroughly excavated and removed from the site.

Temporary Dewatering

The volume and rate of temporary dewatering required during construction is related not only to the groundwater level, prevailing weather conditions, and the contractor's ability to successfully divert surface water runoff away from the excavation, but also the contractor's sequencing of construction activities. Construction specifications should include performance guidelines for temporary dewatering. Performance guidelines allow the contractor to select the actual means and methods of construction dewatering. The following sample specification1 could be used as a guide for development of actual specifications.

> *Control of groundwater shall be accomplished in a manner that will preserve the strength of the foundation soils, will not cause instability of the excavation slopes, and will not result in damage to existing structures. Where necessary to these purposes, the water level shall be lowered in advance of excavation, utilizing trenches, sumps, wells, well points, or similar methods. The water level, as measured in piezometers, shall be maintained a minimum of 2 feet below the prevailing excavation level. Open pumping from sumps and ditches, if it results in boils, loss of soil*

> *fines, softening of the ground, or instability of slopes, will not be permitted. Wells and well points shall be installed with suitable screens and filters so that continuous pumping of soil fines does not occur. The discharge shall be arranged to facilitate collection of samples by the Engineer*[1].

Excavation

The soil test borings encountered a variety of subsurface conditions which will require different excavation methods. It is important to note that the elevation of partially weathered rock and rock can vary drastically of relatively short distances. A more general discussion of potential excavation conditions is provided herein to address potential excavation conditions not revealed by the exploratory borings.

For discussion of excavation characteristics, the subsurface materials at the site may be placed into three broad categories: soil (fill, residuum), weathered rock, and rock. These categories, anticipated methods of excavation, and their occurrence in the soil test borings are presented as follows:

Material Category	*Excavation Method*	*Soil Test Borings*
Soil	Conventional Soil Excavators (Backhoes, front-end loaders)	Soil (SM), (SP), (SP-SM), (ML), (MH), (CL), (CH), etc.
Weathered Rock	Ripping (Single tooth ripper on D-8 bulldozer, heavy backhoes capable of ripping)	Partially weathered rock (Blow counts over 100 blows per foot, but less than 50 blows per inch)
Rock	Blasting	Material below auger refusal (Blow counts over 50 blows per inch)

For construction bidding and field verification purposes it is common to provide a verifiable definition of rock in the project specifications. The following are typical definitions of mass rock and trench rock:

- Mass Rock: Material which cannot be excavated with a single-tooth ripper drawn by a crawler tractor having a minimum draw bar pull rated at 56,000 pounds (Caterpillar D 8K or equivalent), and occupying an original volume of at least one cubic yard.

- Trench Rock: Material occupying an original volume of at least one-half cubic yard which cannot be excavated with a hydraulic excavator having a minimum flywheel power rating of 123 kW (165 hp); such as a Caterpillar 322C L, a John Deere 230C LC, or a Komatsu PC220LC-7; equipped with a short tip radius bucket not wider than 42 inches.

The foregoing definitions are based on large equipment typically utilized for mass grading. Subsequent excavations for foundations, retaining walls, and underground conduits are often performed with smaller equipment such as rubber-tired backhoe/loaders or even mini-excavators. Contractors will often request additional payment for mobilizing larger equipment than that which was anticipated during preparation of

[1] The sample specification was adapted from Construction Dewatering - A Guide to Theory and Practice, John Wiley and Sons, and is not intended for direct use as a construction specification without modifications to reflect specific project conditions

their construction bid. The amount of additional compensation, if any, and the minimum equipment size necessary to qualify for any additional compensation should be defined before the start of construction.

Blasting

In most cases rock excavation is performed by blasting. Standard blasting procedures include drilling through the materials to be blasted to introduce the explosives and covering up the area to be blasted to prevent flying debris. The area to be blasted is typically covered with several feet of soil or a blast mat. Alternatively, the existing soil overburden can be left in place, which in most cases will eliminate the need for a soil cover or a blast mat.

Blasting generates ground vibrations that can be detrimental to adjacent structures. Research by the United States Bureau of Mines and other organizations provides limits for safeguarding adjacent structures during blasting operations. A peak particle velocity of 2 inches per second is generally recognized as a conservative limit, and is the maximum peak particle velocity allowed by the Georgia Blasting Standards Act of 1978.

State and local laws require that precondition surveys of neighboring properties be performed prior to conducting blasting activities. Typical requirements are to conduct a precondition survey of structures and facilities within a 1,000-foot radius of the blast site. Vibration monitoring is also required in all four compass directions at the nearest structure not owned by the developer/owner. Some municipalities have variations of these requirements, and the local requirements should be reviewed prior to beginning blasting activities.

Reuse of Excavated Materials

Fill materials containing organics or construction debris cannot be used as structural fill and should be removed and disposed of outside the construction areas or off site. Based on the results of the test borings, the alluvial soils, residual soils, and debris-free fill materials on site appear suitable for reuse as structural fill. Depending on rainfall levels near the time of construction, the existing fill materials may have moisture contents above or below optimum as determined by the standard Proctor test (ASTM D698). Adding water or drying soil may be necessary to achieve proper compaction.

Drying soil can be time consuming and the impact of drying soil on the schedule and budget should be carefully evaluated. In some cases, wet soils may need to be disposed of offsite to maintain the schedule or expedite construction.

It is important to establish as part of the construction contract whether soils having elevated moisture content will be considered suitable for reuse. We often find this issue to be a point of contention and a source of delays and change orders. From a technical standpoint, soils with moisture contents wet of optimum as determined by the standard Proctor test (ASTM D698) can be reused provided that the moisture is properly adjusted to within the workable range (approximately +/- 3 percent of the optimum moisture content). From a practical standpoint, wet soils can be very difficult to dry in small or congested sites, particularly in the winter and spring, and such difficulties should be considered during planning and

budgeting. A clear understanding by the general contractor and grading subcontractor regarding the reuse of excavated soils will be important to avoid delays and unexpected cost overruns.

Partially weathered rock materials will be suitable for reuse as structural fill only if they break down into a reasonably well-graded material that can be satisfactorily compacted. The presence of cobble size or boulder size material, which does not break down under the action of compaction equipment, will limit the suitability of partially weathered rock materials. Engineering judgment will be required in the field to evaluate the acceptability of partially weathered rock materials for reuse as structural fill.

For planning purposes, blast rock should be considered unsuitable for use as structural fill.

Structural Fill

Materials selected for use as structural fill should be free of organic debris, waste construction debris, and other deleterious materials. The material should not contain rocks having a diameter over 4 inches. It is our opinion that the following soils represented by their USCS group symbols will typically be suitable for use as structural fill and are usually found in abundance in the Piedmont: (SM), (ML), and (CL). The following soil types are typically suitable but are not abundant in the Piedmont: (SW), (SP), (SC), (SP-SM), and (SP-SC). The following soil types are considered unsuitable: (MH), (CH), (OL), (OH), and (Pt).

Laboratory Proctor compaction tests and classification tests should be performed on representative samples obtained from the proposed borrow material to provide data necessary to determine acceptability and for quality control. The moisture content of suitable borrow soils should generally be no more than 3 percentage points below or above optimum at the time of compaction. Tighter moisture limits may be necessary with certain soils.

Suitable fill material should be placed in thin lifts. Lift thickness depends on the type of compaction equipment, but a maximum loose-lift thickness of 8 inches is generally recommended. The soil should be compacted by a self-propelled sheepsfoot roller. Within small excavations such as in utility trenches, around manholes, above foundations, or behind retaining walls, we recommend the use of “wacker packers” or “Rammax” compactors to achieve the specified compaction. Loose lift thicknesses of 4 to 6 inches are recommended in small area fills.

We recommend that structural fill be compacted to at least 95 percent of the standard Proctor maximum dry density (ASTM D698). The upper 12 inches of floor slab subgrade soils should be compacted to at least 98 percent of the standard Proctor maximum dry density. Additionally, the maximum dry density of structural fill should be no less than 90 pcf. Following Georgia DOT guidelines, the upper 12 inches of pavement subgrade soils should be compacted to at least 100 percent of the standard Proctor maximum dry density. Geo-Hydro should perform density tests during fill placement.

Earth Slopes

Temporary construction slopes should be designed in strict compliance with current OSHA regulations. The exploratory borings indicate that materials to be excavated consist of Types B and C materials as defined in 29 CFR 1926 Subpart P. Temporary excavation slopes no taller than 20 feet in residual soil above the groundwater level should be no steeper than 1H:1V. Temporary excavation slopes no taller than 20 feet in alluvial soils, fill materials, or in any soil below the groundwater level should be no steeper than 1.5H:1V. Excavation slopes taller than 20 feet should be evaluated on an individual basis by a qualified engineer.

Excavations should be closely observed on a daily basis by the contractor's "competent person" for signs of mass movement: tension cracks near the crest, bulging at the toe of the slope, etc. The responsibility for excavation safety and stability of construction slopes should lie solely with the contractor.

We recommend that extreme caution be observed in trench excavations. Several cases of loss of life due to trench collapses in Georgia point out the lack of attention given to excavation safety on some projects. We recommend that applicable local and federal regulations regarding temporary slopes, and shoring and bracing of trench excavations be closely followed.

Formal analysis of slope stability was beyond the scope of work for this project. Based on our experience, permanent cut or fill slopes should be no steeper than 2H:1V to maintain long term stability and to provide ease of maintenance. The crest or toe of cut or fill slopes should be no closer than 10 feet to any foundation. The crest or toe should be no closer than 5 feet to the edge of any pavements. Erosion protection of slopes during construction and during establishment of vegetation should be considered an essential part of construction.

General Foundation Design

Recommendations for allowable bearing pressures for specific structures have been provided in earlier sections of this report. The following paragraphs supplement, but do not supersede, foundation design recommendations outlined for specific structures.

Some of the existing soils at the project site will have an allowable bearing pressure less than the recommended design value. Therefore, foundation bearing surface evaluations will be critical to aid in the identification of such soils and to enable the development of remedial measures.

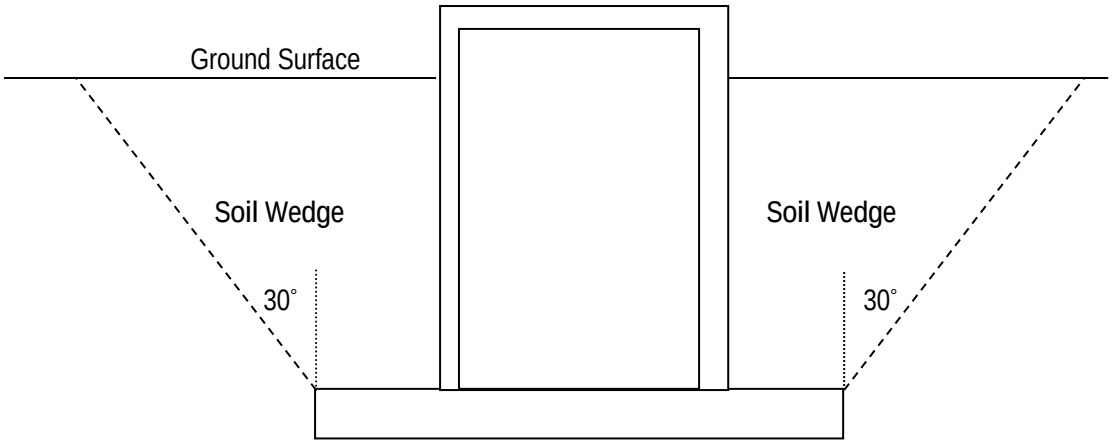
Foundation bearing surface evaluations should be performed in each foundation excavation prior to placement of reinforcing steel. These evaluations should be performed by Geo-Hydro to confirm that the design allowable soil bearing pressure is available. For mat foundations, the subgrade evaluation will serve to confirm that the mat foundation subgrade is properly prepared and does not include any loose materials.

Remedial measures should be based on actual field conditions. However, in most cases we expect the use of the stone replacement technique to be the primary remedial measure. Improving subgrade conditions in mat foundation excavations is generally limited to removing unstable soils from the mat area and replacing

the soft soils with crushed stone materials. Usually, an open-graded stone course is placed on the prepared soil subgrade to provide a uniform, clean working surface and to preserve the underlying subgrade. We suggest an 8-inch thick course of #57 stone located immediately beneath concrete mats. Concrete mat areas should be evaluated by Geo-Hydro prior to placement of crushed stone.

Uplift Design

In general, structures which will have bottom elevations below current or future groundwater levels or are in flood-prone areas should be designed to resist potential buoyant uplift forces. In some instances, uplift forces may be resisted by the dead weight of the structure itself. Where necessary, the dead weight of the structure can be effectively increased by extending the reinforced concrete mat foundation beyond the walls of the structure. This mobilizes additional weight of soil to increase the effective dead weight of the structure. The effective weight of a "wedge" of soil backfill as depicted in the following sketch can be used to calculate additional uplift resistance from soil backfill.



Earth Pressure – Large Basins and Conventional Cast-in-Place Retaining Walls

Three earth pressure conditions are generally considered for retaining wall design: "at rest", "active", and "passive" stress conditions. Retaining walls which are rigidly restrained at the top and will be essentially unable to rotate under the action of earth pressure should be designed for "at rest" conditions. Retaining walls which can move outward at the top as much as 0.5 percent of the wall height should be designed for "active" conditions. For the evaluation of the resistance of soil to lateral loads the "passive" earth pressure must be calculated. It should be noted that full development of passive pressure requires deflections toward the soil mass on the order of l.0 percent to 4.0 percent of total wall height.

Earth pressure may be evaluated using the following equation:

$$p_h = K\,(D_w Z + q_s) + W_w(Z-d)$$

where: p_h = horizontal earth pressure at any depth below the ground surface (Z).
W_w = unit weight of water

Z = depth to any point below the ground surface
d = depth to groundwater surface
D_w = wet unit weight of the soil backfill (depending on borrow sources). The wet unit weight of most residual soils may be expected to range from approximately 115 to 125 pcf. Below the groundwater level, D_w must be the buoyant weight.
q_s = uniform surcharge load (add equivalent uniform surcharge to account for construction equipment loads)
K = earth pressure coefficient as follows:

Earth Pressure Condition	Coefficient
At Rest (K_o)	0.5
Active (K_a)	0.33
Passive (K_p)	3.0

The groundwater term, $W_w(Z-d)$, should be used if no drainage system is incorporated behind retaining walls. If a drainage system is included which will not allow the development of any water pressure behind the wall, then the groundwater term may be omitted. The development of excessive water pressure is a common cause of retaining wall failures. Drainage systems should be carefully designed to ensure that long term permanent drainage is accomplished.

The above design recommendations are based on the following assumptions:

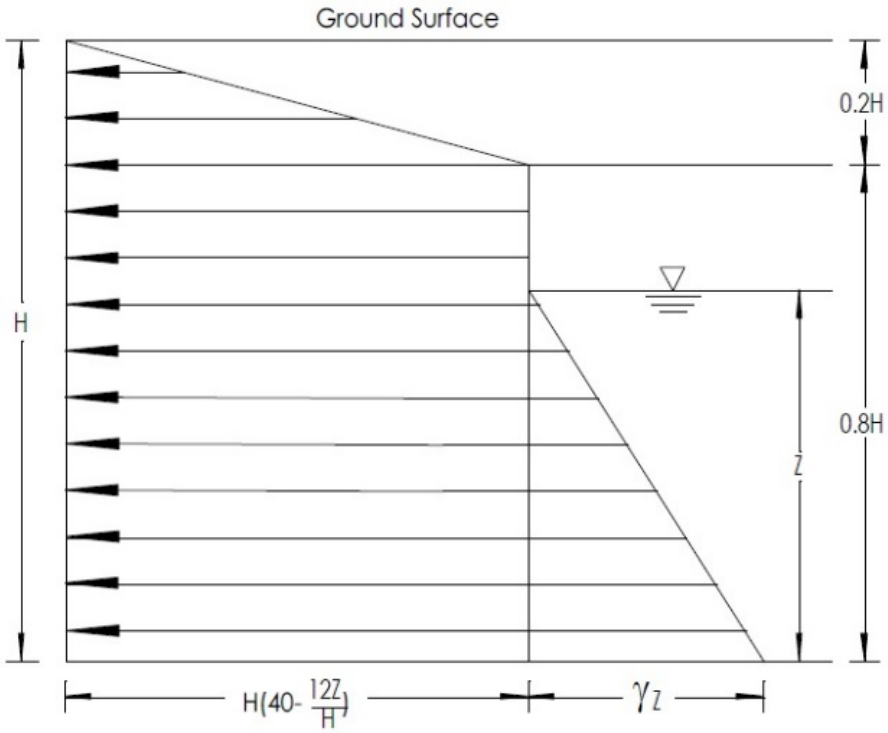
- Horizontal backfill
- 95 percent standard Proctor compactive effort on backfill (ASTM D698)
- No safety factor is included

For convenience, equivalent fluid densities are frequently used for the calculation of lateral earth pressures. For "at rest" stress conditions, an equivalent fluid density of 63 pcf may be used. For the "active" state of stress an equivalent fluid density of 42 pcf may be used. These equivalent fluid densities are based on the assumptions that drainage behind the retaining wall will allow *no* development of hydrostatic pressure; that native silty sands or sandy silts will be used as backfill; that the backfill soils will be compacted to 95 percent of standard Proctor maximum dry density; that backfill will be horizontal; and that no surcharge loads will be applied.

For analysis of sliding resistance of the base of a concrete cast-in-place retaining wall or foundation, the coefficient of friction may be taken as 0.35 for the residual soils at the project site. This is an ultimate value, and an adequate factor of safety should be used in design. The force which resists base sliding is calculated by multiplying the normal force on the base by the coefficient of friction. Full development of the frictional force could require deflection of the base of roughly 0.l to 0.3 inches.

Earth Pressure – Small Below-Grade Structures

Based on our experience, the lateral earth pressure distribution for the walls of relatively small and rigid below-grade structures, such as vaults, wets wells, etc., can be approximated by a braced wall configuration.



Where: H = Total depth of wall below the ground surface, feet
Z = Height of groundwater level above the bottom of the wall, feet
γ = Unit weight of water (62.4 pcf)
pressure units are psf

The walls of these structures may be designed for the pressure distribution shown on the diagram on the following page.

Seismic Design

Based on the results of the test borings and following the calculation procedure in the 2018 International Building Code (Chapter 20, ASCE 7-16), the *Site Class* for the site is *D.* The mapped and design spectral response accelerations are as follows: S_S=0.262, S_1=0.095, S_{DS}=0.278, S_{D1}=0.152.

Based on the information obtained from the soil test borings, it is our opinion that the potential for liquefaction of the residual soils at the site due to earthquake activity is relatively low.

Floor Slab Subgrade Preparation - Buildings

The soil subgrade in the area of concrete slab-on-grade support is often disturbed during foundation excavation, plumbing installation, and superstructure construction. We recommend that the floor slab subgrade be evaluated by Geo-Hydro immediately prior to beginning floor slab construction. If low consistency soils are encountered that cannot be adequately densified in place, such soils should be removed

and replaced with well-compacted fill material placed in accordance with the *Structural Fill* section of this report or with well-compacted graded aggregate base (GAB).

Assuming that the top 12 inches of floor slab subgrade soils are compacted to at least 98 percent of the standard Proctor maximum dry density, we recommend using a soil modulus of subgrade reaction of 120 pci for design.

Moisture Control for Concrete Slabs (Offices and Dry Storage)

To prevent the capillary rise of groundwater from adversely affecting the concrete slab-on-grade floor, we recommend that slab-on-grade floors be underlain by a minimum 4-inch thickness of open-graded stone. Use of #57 stone meeting Georgia DOT specifications for gradation is suggested. The stone must be covered by a vapor retarder. We suggest polyethylene sheeting at least 10 mils thick as a minimum vapor retarder.

In areas were floor slabs may be subjected to vehicular traffic including forklifts or other relatively heavy wheeled equipment, we recommend that slab-on-grade floors be underlain by a minimum 4-inch thickness of graded aggregate base (GAB) compacted to at least 100 percent of the modified Proctor maximum dry density (ASTM D1557). The GAB must be covered by a vapor retarder as suggested above.

* * * * *

We appreciate the opportunity to serve as your geotechnical consultant for this project, and are prepared to provide any additional services you may require. If you have any questions concerning this report or any of our services, please call us.

Sincerely,

GEO-HYDRO ENGINEERS, INC.

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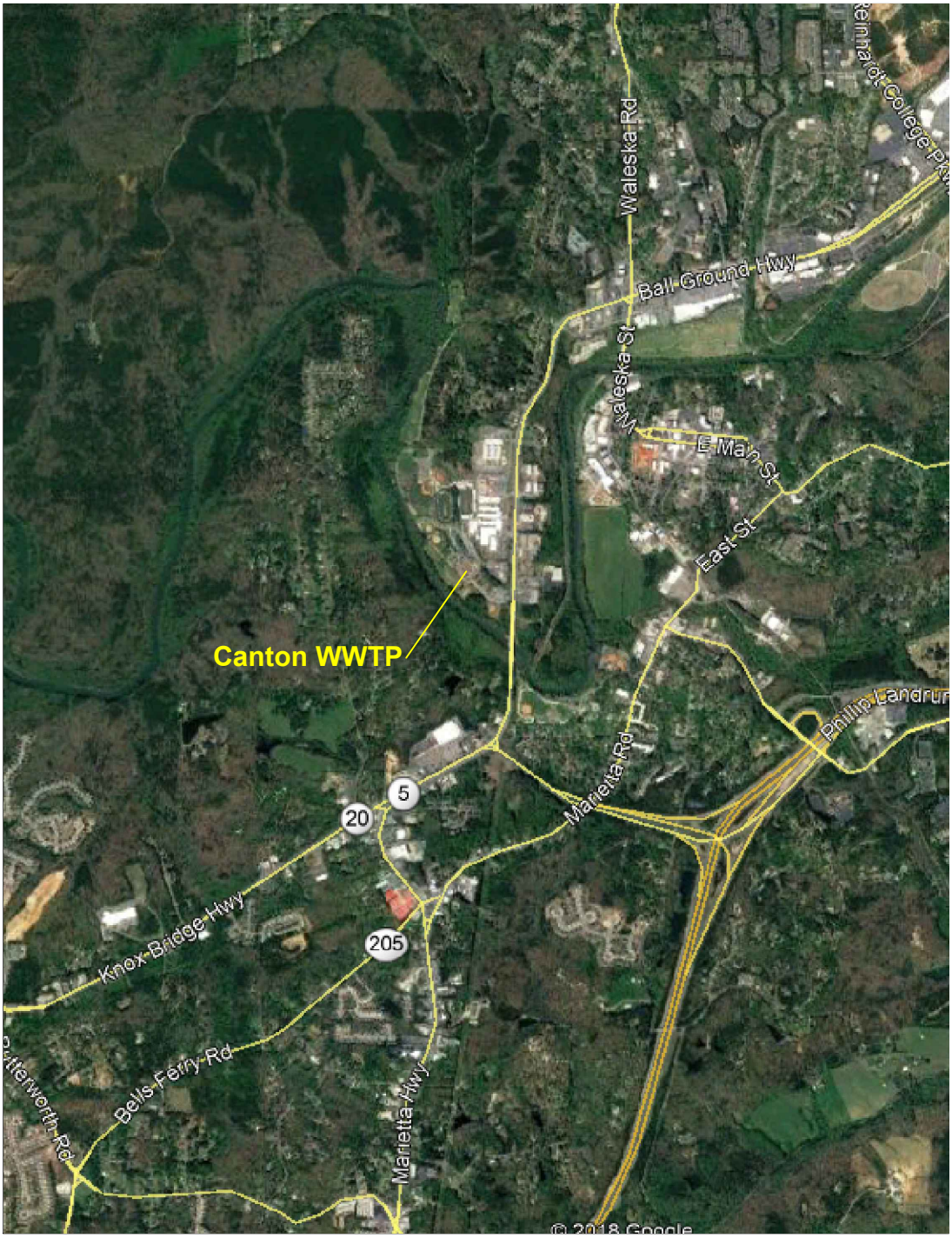
AMP/LEB/Geo-Hydro - 191131.20 - Canton WWTP Expansion - Geotechnical Report

APPENDIX



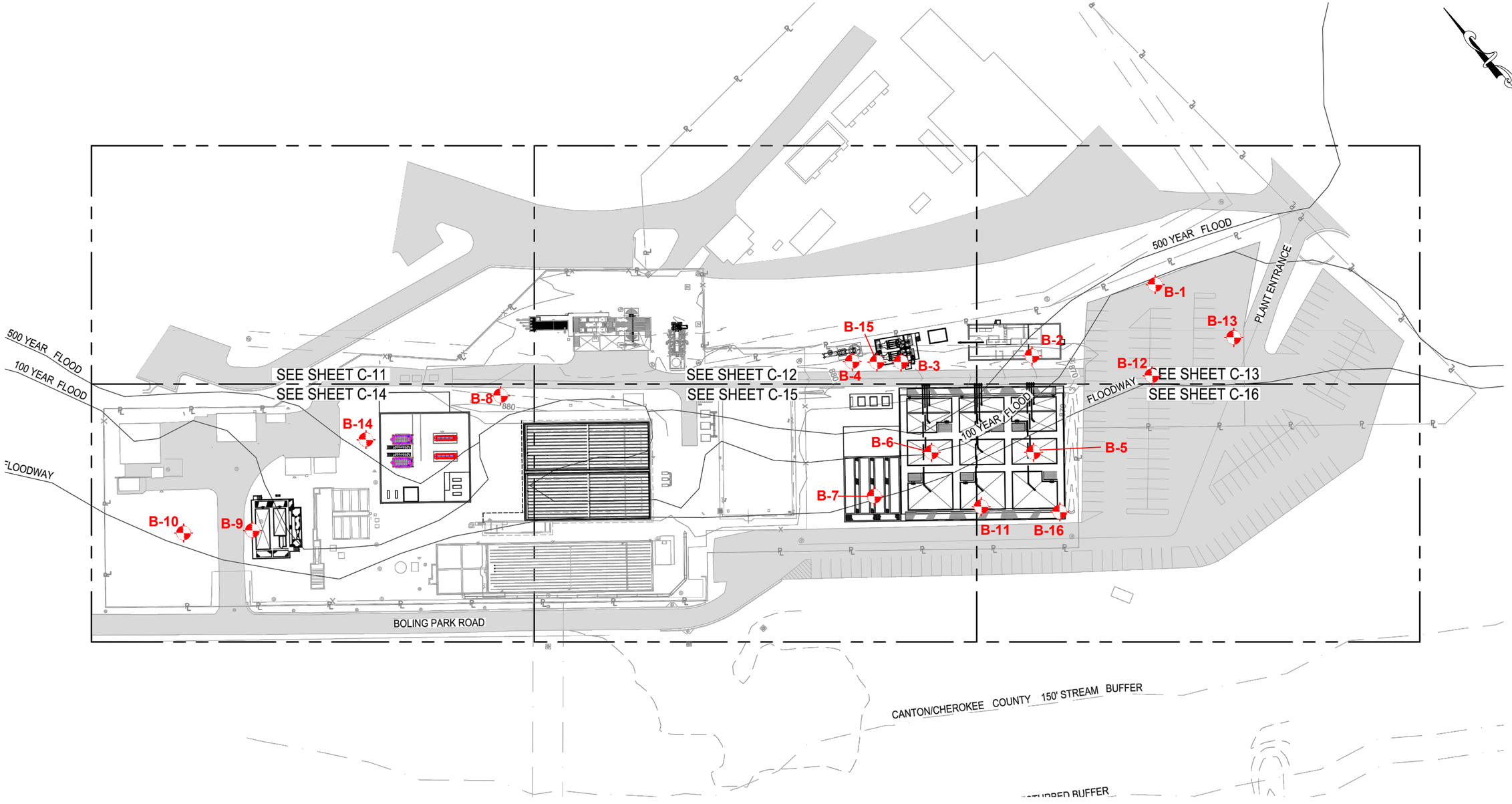
0 0.25 0.5 1 1.5

Approximate Scale, Miles

Figure 1: Site Location Plan

Canton WWTP Expansion
Canton, Georgia
Geo-Hydro Project Number 191131.20

GEO HYDRO ENGINEERS



LEGEND: Soil Test Boring

Figure 2: Boring Location Plan

Canton WWTP Expansion
Canton, Georgia
Geo-Hydro Project Number 191131.20

Symbols and Nomenclature

Symbols

▌	Thin-walled tube (TWT) sample recovered
▯	Thin-walled tube (TWT) sample not recovered
●	Standard penetration resistance (ASTM D1586)
50/2”	Number of blows (50) to drive the split-spoon a number of inches (2)
65%	Percentage of rock core recovered
RQD	Rock quality designation - % of recovered core sample which is 4 or more inches long
GW	Groundwater
	Water level at least 24 hours after drilling
	Water level one hour or less after drilling
ALLUV	Alluvium
TOP	Topsoil
PM	Pavement Materials
CONC	Concrete
FILL	Fill Material
RES	Residual Soil
PWR	Partially Weathered Rock
SPT	Standard Penetration Testing

Penetration Resistance Results	Number of Blows, N	Approximate Relative Density
Sands	0-4	very loose
	5-10	loose
	11-20	firm
	21-30	very firm
	31-50	dense
	Over 50	very dense

	Number of Blows, N	Approximate Consistency
Silts and	0-1	very soft
Clays	2-4	soft
	5-8	firm
	9-15	stiff
	16-30	very stiff
	31-50	hard
	Over 50	very hard

Drilling Procedures

Soil sampling and standard penetration testing performed in accordance with ASTM D 1586. The standard penetration resistance is the number of blows of a 140-pound hammer falling 30 inches to drive a 2-inch O.D., 1.4-inch I.D. split-spoon sampler one foot. Rock coring is performed in accordance with ASTM D 2113. Thin-walled tube sampling is performed in accordance with ASTM D 1587.

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B-1

Test Boring Record

GEO HYDRO ENGINEERS

Project: **Canton WWTP Expansion**		Project No: **191131.20**
Location: **Canton, Georgia**		Date: **11/24/19**
Method: **HSA- ASTM D1586**	GWT at Drilling: **Not Encountered**	G.S. Elev: **880**
Driller: **Freedom Drilling (Autohammer)**	GWT at 24 hrs: **N/A: Boring Backfilled**	Logged By: **BD**

Elev. (Ft)	Depth (Ft)	GWT	Symbol	Description	N
				Asphalt (Approximately 2 inches)	
				Graded Aggregate Base (Approximately 2 inches)	7
875	5			Loose to firm brown fine sandy silt (ML) (RESIDUUM)	11
					8
870	10				7
865	15				5
				Loose to firm tan and gray slightly micaceous silty fine to medium sand (SM)	
860	20				11
855	25				9
850	30				17
				Boring Terminated at 30 feet	
845	35				
840	40				
835	45				
830	50				

Standard Penetration Test (Blows/Foot)

0 10 20 30 40 50 60 70 80 90 100

Remarks:

TEST BORING RECORD SOIL TEST BORINGS.GPJ GEO HYDRO.GDT 12/17/19

B-2

Test Boring Record

GEO HYDRO ENGINEERS

Project: **Canton WWTP Expansion**		Project No: **191131.20**
Location: **Canton, Georgia**		Date: **11/24/19**
Method: **HSA- ASTM D1586**	GWT at Drilling: **Not Encountered**	G.S. Elev: **880**
Driller: **Freedom Drilling (Autohammer)**	GWT at 24 hrs: **N/A: Boring Backfilled**	Logged By: **BD**

Elev. (Ft)	Depth (Ft)	GWT	Symbol	Description	N
880	0			Topsoil (Approximately 3 inches)	
				Firm to stiff red clayey silt (ML) (FILL)	9
875	5				8
				Loose red clayey fine to medium sand (SC) (ALLUVIUM)	10
				Firm red and tan silty fine to medium sand (SM) (ALLUVIUM)	11
870	10				
865	15				13
860	20				12
				Firm brown silty fine to medium sand (SM) with rock fragments (ALLUVIUM)	
855	25				18
				Firm brown and gray micaceous silty fine to medium sand (SM) (RESIDUUM)	
850	30				19
				Boring Terminated at 30 feet	
845	35				
840	40				
835	45				
830	50				

Standard Penetration Test (Blows/Foot)

0 10 20 30 40 50 60 70 80 90 100

Remarks:

TEST BORING RECORD SOIL TEST BORINGS.GPJ GEO HYDRO.GDT 12/17/19

B-3

Test Boring Record

GEO HYDRO ENGINEERS

Project: **Canton WWTP Expansion**		Project No: **191131.20**
Location: **Canton, Georgia**		Date: **11/24/19**
Method: **HSA- ASTM D1586**	GWT at Drilling: **Not Encountered**	G.S. Elev: **882**
Driller: **Freedom Drilling (Autohammer)**	GWT at 24 hrs: **N/A: Boring Backfilled**	Logged By: **BD**

Elev. (Ft)	Depth (Ft)	GWT	Symbol	Description	N
882	0			Topsoil (Approximately 3 inches)	
880	2			Stiff brown silty clay (CL) (FILL)	9
	5			Loose brown clayey fine sand (SC) (FILL)	9
875	7			Loose to firm red clayey fine sand (SC) (ALLUVIUM)	10
	10				13
870	12			Loose to firm tan and red silty fine to medium sand (SM) (ALLUVIUM)	
	15				10
865	17				
	20				11
860	22				
	25				13
855	27			Partially weathered rock sampled as gray silty fine sand (SM) (RESIDUUM)	
	30				50/3"
850	32				
	35				50/1"
845	37			Auger Refusal at 38 feet	
	40				
840	42				
	45				
835	47				
	50				

Standard Penetration Test (Blows/Foot)

0 10 20 30 40 50 60 70 80 90 100

Remarks:

TEST BORING RECORD SOIL TEST BORINGS.GPJ GEO HYDRO.GDT 12/17/19

B-4

Test Boring Record

GEO HYDRO ENGINEERS

Project: **Canton WWTP Expansion**		Project No: **191131.20**
Location: **Canton, Georgia**		Date: **11/24/19**
Method: **HSA- ASTM D1586**	GWT at Drilling: **Not Encountered**	G.S. Elev: **880**
Driller: **Freedom Drilling (Autohammer)**	GWT at 24 hrs: **N/A: Boring Backfilled**	Logged By: **BD**

Elev. (Ft)	Depth (Ft)	GWT	Symbol	Description	N
				Topsoil (Approximately 2 inches)	
				Loose red clayey fine sand (SC) (FILL)	7
875	5				6
				Loose red and brown clayey silt (ML) (FILL)	6
870	10				6
				Loose to firm tan and gray silty fine to medium sand (SM) (ALLUVIUM)	
865	15				11
860	20				10
855	25				9
				Firm tan and gray silty fine sand (SM) (RESIDUUM)	
850	30				12
845	35				13
				Partially weathered rock sampled as gray silty fine sand (SM)	
840	40				50/3"
				Auger Refusal at 43 feet	
835	45				
830	50				

Standard Penetration Test (Blows/Foot)

0 10 20 30 40 50 60 70 80 90 100

Remarks:

TEST BORING RECORD SOIL TEST BORINGS.GPJ GEO HYDRO.GDT 12/17/19

B-5

Test Boring Record

GEO HYDRO ENGINEERS

Project: **Canton WWTP Expansion**		Project No: **191131.20**
Location: **Canton, Georgia**		Date: **11/22/19**
Method: **HSA- ASTM D1586**	GWT at Drilling: **35 feet**	G.S. Elev: **871**
Driller: **Freedom Drilling (Autohammer)**	GWT at 24 hrs: **NE (Caved at 29 feet)**	Logged By: **BD**

Elev. (Ft)	Depth (Ft)	Description	N
870	0	Topsoil (Approximately 2 inches)	
		Firm red clayey silt (ML) (FILL)	8
	5	Firm red silty clay (CL) (FILL)	7
865		Loose red silty fine to medium sand (SM) (ALLUVIUM)	8
	10	Dense brown and gray silty fine to coarse sand (SM) with rock fragments (ALLUVIUM)	35
860			
	15	Partially weathered rock sampled as gray micaceous silty fine to coarse sand (SM) (RESIDUUM)	50/4"
855			
	20	Dense to very dense gray micaceous silty fine sand (SM)	53
850			
	25		33
845			
	30	Partially weathered rock sampled as gray micaceous silty fine to coarse sand (SM)	50/2"
840			
	35 ▽		50/4"
835			
	40		50/4"
830			
	45	Auger Refusal at 43 feet	
825			
	50		

Standard Penetration Test (Blows/Foot)

0 10 20 30 40 50 60 70 80 90 100

Remarks:

TEST BORING RECORD SOIL TEST BORINGS.GPJ GEO HYDRO.GDT 12/17/19

B-6

Test Boring Record

GEO HYDRO ENGINEERS

Project: **Canton WWTP Expansion**		Project No: **191131.20**
Location: **Canton, Georgia**		Date: **11/22/19**
Method: **HSA- ASTM D1586**	GWT at Drilling: **35 feet**	G.S. Elev: **874**
Driller: **Freedom Drilling (Autohammer)**	GWT at 24 hrs: **NE (Caved at 30 feet)**	Logged By: **BD**

Elev. (Ft)	Depth (Ft)	GWT	Symbol	Description	N
870	0			Topsoil (Approximately 2 inches)	
	5			Very loose to loose red clayey fine sand (SC) (ALLUVIUM)	3
					5
865	10			Loose brown and orange silty fine to medium sand (SM) (ALLUVIUM)	6
					8
860	15			Firm to very firm brown and gray micaceous silty fine to medium sand (SM) (RESIDUUM)	7
855	20				17
850	25				14
845	30				27
840	35	▽			28
835	40			Partially weathered rock sampled as gray silty fine sand (SM) (RESIDUUM)	50/5"
830	45			Auger Refusal at 43 feet	
825	50				

Standard Penetration Test (Blows/Foot)

0 10 20 30 40 50 60 70 80 90 100

Remarks:

TEST BORING RECORD SOIL TEST BORINGS.GPJ GEO HYDRO.GDT 12/17/19

B-7

Test Boring Record

GEO HYDRO ENGINEERS

Project: **Canton WWTP Expansion**		Project No: **191131.20**
Location: **Canton, Georgia**		Date: **11/22/19**
Method: **HSA- ASTM D1586**	GWT at Drilling: **33 feet**	G.S. Elev: **867**
Driller: **Freedom Drilling (Autohammer)**	GWT at 24 hrs: **NE (Caved at 23 feet)**	Logged By: **BD**

Elev. (Ft)	Depth (Ft)	GWT	Symbol	Description	N
865	0			Topsoil (Approximately 2 inches)	
				Loose red silty fine sand (SM) (FILL)	5
	5			Loose red and brown silty fine to medium sand (SM) with rock fragments (ALLUVIUM)	8
860					5
	10				6
855				Dense brown silty fine to coarse sand (SM) with rock fragments (ALLUVIUM)	
	15				40
850				Very stiff to hard gray fine to medium sandy silt (ML) (RESIDUUM)	
	20				21
845					
	25				22
840					
	30				28
835		▽			
	35				32
830				Partially weathered rock sampled as gray silty fine sand (SM)	
	40				50/3"
825				Auger Refusal at 42 feet	
	45				
820					
	50				

Standard Penetration Test (Blows/Foot)

0 10 20 30 40 50 60 70 80 90 100

Remarks:

TEST BORING RECORD SOIL TEST BORINGS.GPJ GEO HYDRO.GDT 12/17/19

B-8

Test Boring Record

GEO HYDRO ENGINEERS

Project: **Canton WWTP Expansion**		Project No: **191131.20**
Location: **Canton, Georgia**		Date: **11/24/19**
Method: **HSA- ASTM D1586**	GWT at Drilling: **Not Encountered**	G.S. Elev: **882**
Driller: **Freedom Drilling (Autohammer)**	GWT at 24 hrs: **N/A: Boring Backfilled**	Logged By: **BD**

Elev. (Ft)	Depth (Ft)	GWT	Symbol	Description	N
882	0			Topsoil (Approximately 2 inches)	
880	2			Soft to firm brown silty clay (CL) (FILL)	4
	5				5
875					6
	8			Loose red clayey fine sand (SC) (FILL)	
872	10			Boring Terminated at 10 feet	6
870					
	15				
865					
	20				
860					
	25				
855					
	30				
850					
	35				
845					
	40				
840					
	45				
835					
	50				

Standard Penetration Test (Blows/Foot)

0 10 20 30 40 50 60 70 80 90 100

Remarks:

TEST BORING RECORD SOIL TEST BORINGS.GPJ GEO HYDRO.GDT 12/17/19

B-9

Test Boring Record

GEO HYDRO ENGINEERS

Project: **Canton WWTP Expansion**		Project No: **191131.20**
Location: **Canton, Georgia**		Date: **11/24/19**
Method: **HSA- ASTM D1586**	GWT at Drilling: **26 feet**	G.S. Elev: **869**
Driller: **Freedom Drilling (Autohammer)**	GWT at 24 hrs: **N/A: Boring Backfilled**	Logged By: **BD**

Elev. (Ft)	Depth (Ft)	GWT	Description	N
869	0		Topsoil (Approximately 2 inches)	
			Loose red clayey fine sand (SC) (FILL)	5
865	5		Loose red silty fine sand (SM) (ALLUVIUM)	6
			Loose tan silty fine to medium sand (SM) (ALLUVIUM)	9
860	10			8
855	15			10
			Firm gray slightly micaceous silty fine sand (SM) (RESIDUUM)	
850	20			13
845	25	▽		12
			Partially weathered rock sampled as gray slightly micaceous fine to medium sandy silt (ML)	
840	30			50/4"
835	35			50/2"
			Auger Refusal at 37 feet	
830	40			
825	45			
820	50			

Standard Penetration Test (Blows/Foot)

0 10 20 30 40 50 60 70 80 90 100

Remarks:

TEST BORING RECORD SOIL TEST BORINGS.GPJ GEO HYDRO.GDT 12/17/19

B-10

Test Boring Record

GEO HYDRO ENGINEERS

Project: **Canton WWTP Expansion**		Project No: **191131.20**
Location: **Canton, Georgia**		Date: **11/24/19**
Method: **HSA- ASTM D1586**	GWT at Drilling: **18 feet**	G.S. Elev: **864**
Driller: **Freedom Drilling (Autohammer)**	GWT at 24 hrs: **N/A: Boring Backfilled**	Logged By: **BD**

Elev. (Ft)	Depth (Ft)	GWT	Symbol	Description	N
860	0			Topsoil (Approximately 4 inches)	
				Firm to stiff brown silty clay (CL) (FILL)	4
	5				5
855				Loose brown silty fine to medium sand (SM) (ALLUVIUM)	7
	10				8
850				Firm gray highly micaceous silty fine to medium sand (SM) (RESIDUUM)	
	15				12
845		▽		Partially weathered rock sampled as gray micaceous silty fine to medium sand (SM)	
	20				50/4"
840					
	25				50/3"
835					
	30				50/1"
830				Auger Refusal at 32 feet	
	35				
825					
	40				
820					
	45				
815					
	50				

Standard Penetration Test (Blows/Foot)

0 10 20 30 40 50 60 70 80 90 100

Remarks:

TEST BORING RECORD SOIL TEST BORINGS.GPJ GEO HYDRO.GDT 12/17/19

B-11

Test Boring Record

GEO HYDRO ENGINEERS

Project: **Canton WWTP Expansion**		Project No: **191131.20**
Location: **Canton, Georgia**		Date: **11/22/19**
Method: **HSA- ASTM D1586**	GWT at Drilling: **Not Encountered**	G.S. Elev: **866**
Driller: **Freedom Drilling (Autohammer)**	GWT at 24 hrs: **Not Encountered**	Logged By: **BD**

Elev. (Ft)	Depth (Ft)	GWT	Symbol	Description	N
865	0			Topsoil (Approximately 2 inches)	
				Loose red and tan silty fine sand (SM) with rock fragments (ALLUVIUM)	6
	5				8
860				Firm to very firm red and tan silty fine to coarse sand (SM) with rock fragments (ALLUVIUM)	20
	10				29
855				Auger Refusal at 13 feet	
	15				
850					
	20				
845					
	25				
840					
	30				
835					
	35				
830					
	40				
825					
	45				
820					
	50				

Standard Penetration Test (Blows/Foot)

0 10 20 30 40 50 60 70 80 90 100

Remarks:

TEST BORING RECORD SOIL TEST BORINGS.GPJ GEO HYDRO.GDT 12/17/19

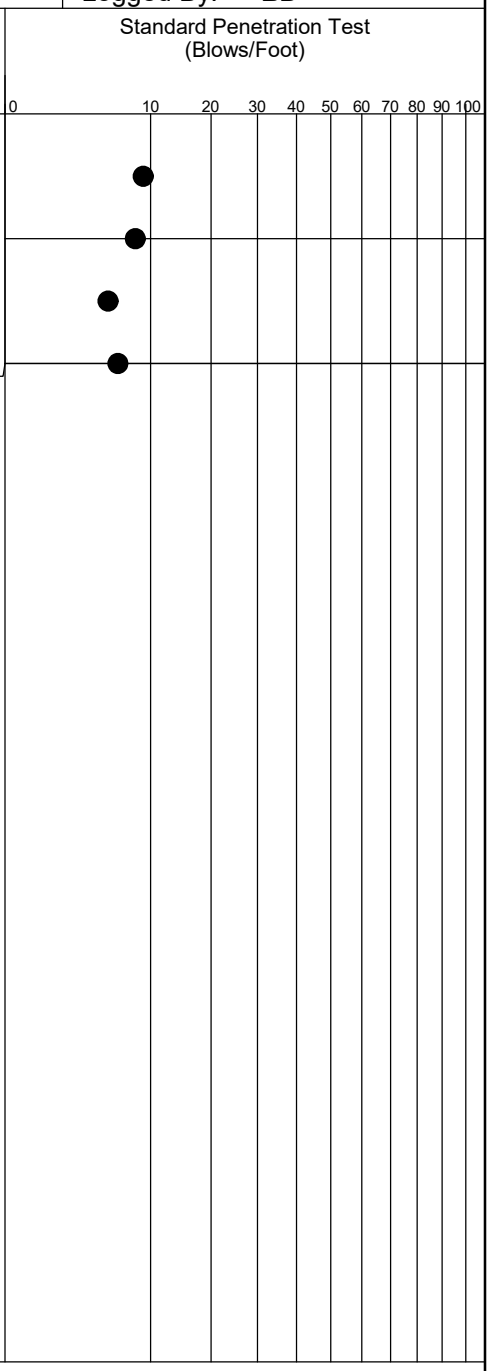
B-12

Test Boring Record

GEO HYDRO ENGINEERS

Project: **Canton WWTP Expansion**		Project No: **191131.20**
Location: **Canton, Georgia**		Date: **11/22/19**
Method: **HSA- ASTM D1586**	GWT at Drilling: **Not Encountered**	G.S. Elev: **868**
Driller: **Freedom Drilling (Autohammer)**	GWT at 24 hrs: **Not Encountered**	Logged By: **BD**

Elev. (Ft)	Depth (Ft)	GWT	Symbol	Description	N
868	0			Asphalt (Approximately 3 inches)	
				Graded Aggregate Base (Approximately 2 inches)	9
865	5			Loose brown clayey fine sand (SC) (FILL)	8
					5
860	10				6
				Boring Terminated at 10 feet	
855	15				
850	20				
845	25				
840	30				
835	35				
830	40				
825	45				
820	50				



Remarks:

B-13

Test Boring Record

GEO HYDRO ENGINEERS

Project: **Canton WWTP Expansion**		Project No: **191131.20**
Location: **Canton, Georgia**		Date: **11/22/19**
Method: **HSA- ASTM D1586**	GWT at Drilling: **Not Encountered**	G.S. Elev: **868**
Driller: **Freedom Drilling (Autohammer)**	GWT at 24 hrs: **Not Encountered**	Logged By: **BD**

Elev. (Ft)	Depth (Ft)	GWT	Symbol	Description	N
868	0			Asphalt (Approximately 3 inches)	
				Graded Aggregate Base (Approximately 2 inches)	4
865	5			Soft gray and black silty clay (CL) (ALLUVIUM)	4
				Loose black and brown silty fine sand (SM) (RESIDUUM)	9
860	10			Boring Terminated at 10 feet	16
855	15				
850	20				
845	25				
840	30				
835	35				
830	40				
825	45				
820	50				

Standard Penetration Test (Blows/Foot)

0 10 20 30 40 50 60 70 80 90 100

Remarks:

TEST BORING RECORD SOIL TEST BORINGS.GPJ GEO HYDRO.GDT 12/17/19

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Test Boring Record

GEO HYDRO ENGINEERS

Project: **Canton WWTP Expansion**		Project No: **191131.20**
Location: **Canton, Georgia**		Date: **11/24/19**
Method: **HSA- ASTM D1586**	GWT at Drilling: **Not Encountered**	G.S. Elev: **878**
Driller: **Freedom Drilling (Autohammer)**	GWT at 24 hrs: **N/A: Boring Backfilled**	Logged By: **BD**

Elev. (Ft)	Depth (Ft)	GWT	Symbol	Description	N
878	0			Gravel (Approximately 4 inches)	
875	3			Firm to stiff red clayey silt (ML) with rock fragments (FILL)	9
	5				7
870	8			Loose red and orange silty fine sand (SM) (ALLUVIUM)	8
	10				9
865	13				
	15				7
860	18			Loose to firm tan and brown silty fine to medium sand (SM) with rock fragments (ALLUVIUM)	
	20				10
855	23				
	25				11
850	28				
	30			Boring Terminated at 30 feet	14
845	33				
	35				
840	38				
	40				
835	43				
	45				
830	48				
	50				

Standard Penetration Test (Blows/Foot)

0 10 20 30 40 50 60 70 80 90 100

Remarks:

TEST BORING RECORD SOIL TEST BORINGS.GPJ GEO HYDRO.GDT 12/17/19

B-15

Test Boring Record

GEO HYDRO ENGINEERS

Project: **Canton WWTP Expansion**		Project No: **191131.20**
Location: **Canton, Georgia**		Date: **11/24/19**
Method: **HSA- ASTM D1586**	GWT at Drilling: **Not Encountered**	G.S. Elev: **880**
Driller: **Freedom Drilling (Autohammer)**	GWT at 24 hrs: **N/A: Boring Backfilled**	Logged By: **BD**

Elev. (Ft)	Depth (Ft)	GWT	Symbol	Description	N
				Topsoil (Approximately 3 inches)	
				Loose red clayey fine sand (SC) (FILL)	8
875	5				7
				Stiff red clayey silt (ML) (ALLUVIUM)	9
870	10				10
865	15				9
				Loose to firm tan and gray silty fine to medium sand (SM) (RESIDUUM)	
860	20				13
855	25				20
850	30				17
				Boring Terminated at 30 feet	
845	35				
840	40				
835	45				
830	50				

Standard Penetration Test (Blows/Foot)

0 10 20 30 40 50 60 70 80 90 100

Remarks:

TEST BORING RECORD SOIL TEST BORINGS.GPJ GEO HYDRO.GDT 12/17/19

B-16

Test Boring Record

GEO HYDRO ENGINEERS

Project: **Canton WWTP Expansion**		Project No: **191131.20**
Location: **Canton, Georgia**		Date: **11/22/19**
Method: **HSA- ASTM D1586**	GWT at Drilling: **24 feet**	G.S. Elev: **864**
Driller: **Freedom Drilling (Autohammer)**	GWT at 24 hrs: **19 feet**	Logged By: **BD**

Elev. (Ft)	Depth (Ft)	Description	N
860	0	Topsoil (Approximately 2 inches)	
		Firm to stiff red and brown clayey silt (ML) (FILL)	7
	5		10
		Firm brown slightly micaceous fine to medium sandy silt (ML) (FILL)	8
855		Loose to firm brown and tan silty fine to medium sand (SM) (ALLUVIUM)	8
	10		
850			
	15		12
845		Very firm gray silty fine to medium sand (SM) (RESIDUUM)	
	20		28
840		Dense to very dense gray silty fine to medium sand (SM)	
	25		73
835			
	30		57
830			
	35		49
825			
	40		54
820		Partially weathered rock sampled as gray micaceous silty fine to medium sand (SM)	
	45		50/4"
815		Auger Refusal at 47 feet	
	50		

Standard Penetration Test (Blows/Foot)

0 10 20 30 40 50 60 70 80 90 100

Remarks:

TEST BORING RECORD SOIL TEST BORINGS.GPJ GEO HYDRO.GDT 12/17/19

SECTION 02050

DEMOLITION AND MODIFICATIONS

PART 1: GENERAL

1.01 SCOPE OF WORK

A. Demolish, modify, remove and dispose of material, equipment and piping as shown on the Drawings and specified herein. Demolition activities include cleanup and restoration of structures, sites, equipment, and effected areas.

B. The Owner and the Engineer do not assume any responsibility for the actual condition of the structures to be demolished or modified.

C. Where applicable, this Section calls attention to certain activities necessary to maintain and facilitate continuous operation of existing facilities during and immediately following construction and does not necessarily cover all of the required activities. Exercise due concern for existing facilities operation and direct all activities toward maintaining continuous operation and minimization of operation inconvenience.

D. Demolition information provided throughout these Construction Documents are dependent on Contractor's Sequence of Construction. Contractor shall ensure that demolition activities are coordinated with the sequence of construction and ensure plant operations.

E. Blasting and the use of explosions will not be permitted for any demolition work.

1.02 RELATED WORK

A. Section 01015 Sequence of Work

B. Section 01300 Submittals

C. Section 01520 Maintenance of Plant Operations

D. Section 02200 Earthwork.

E. Section 03720 Concrete Surface Repair

1.03 GENERAL REQUIREMENTS

A. Existing Operations

1. Coordinate demolition work with the operating staff.

a. Minimize disruptions to the facility operations. Refer to Section 01520 for additional details.

B. Unless otherwise specified, materials resulting from demolition will be considered rubbish and debris and removed from the site.

C. Provide warning signs, barricades, and safety barriers to protect personnel.

D. Provide fire safety measures whenever burning torches are used.

E. Provide adequate lighting at all times during demolition.

F. Provide protective devices as well as dust and debris covers for mechanical and electrical equipment within the demolition area that will remain in place or be salvaged.

G. Notification

1. At least 48 hours prior to commencement of a demolition or removal, notify the Engineer or Construction Coordinator in writing of proposed demolition.

2. Obtain written approval from utility companies and municipal departments prior to discontinuing or interrupting utility services as part of demolition work.

3. Obtain written authorization from the Engineer before disrupting any utilities.

H. Conditions existing at the time of inspection for bidding purposes will be maintained by the Owner insofar as practicable. However, variations within a structure may occur prior to the start of demolition work.

I. Repair or remove and replace with new items those items which are to remain that are damaged due to demolition activity, at no additional cost to the Owner. Repairs shall be made to a condition at least equal to that which existed prior to start of work.

J. Access

1. Conduct demolition and modification operations and the removal of equipment and debris to ensure minimum interference with roads, streets, walks both onsite and offsite and to ensure minimum interference with occupied or used facilities

2. Special attention is directed towards maintaining safe and convenient access to the existing facilities for plant personnel and vehicles.

K. Do not close or obstruct streets, walks or other occupied or used facilities without permission from the Engineer. Closing or obstructing of roadways, sidewalks and passageways adjacent to the work by the placement or storage of materials will not be permitted and all operations shall be conducted with a minimum interference to traffic on these ways.

L. Furnish alternate routes around closed or obstructed traffic in access ways.

1.04 DEMOLITION WORK

A. Demolition of existing facilities includes but is not limited to:

1. Existing magnesium hydroxide pad and piping pending removal of leased equipment

2. Dynasand filters and associated polyaluminum chloride system

3. Portions of the UVPA Facility (cascade aerator to remain)

4. Chlorine contact and reuse pump station attached to SBR 2

5. Aerobic Digester

6. Control Building and Air Compressor Shed including existing MCC-1

B. Demolition of existing piping and equipment includes but is not limited to:

1. Reuse water meter and valve vaults

2. Existing Reuse Pumps, Alum Tank, and Alum Pumps at the existing Chemical Building

3. Diffusers and associated piping in SBR Basins 2, 3, and 4

4. Existing inlet and outlet piping associated with the existing SBRs and EQ Tank.

5. Sludge presses and electrical equipment associated with the existing Sludge Press Building

C. Remove all abandoned pipes exposed during construction activities is included in demolition requirements.

1.05 SUBMITTALS

A. Submit, in accordance with Section 01300, a demolition plan describing the proposed sequence, methods of operation, equipment, safety measures and disposal of items prior to the start of work.

B. Include in the demolition plan, the methods used to control the disruption of utilities, maintain current treatment operations, and manage traffic to and from the site.

C. Submit an inspection report to the Owner at least seven (7) days prior to demolition activities documenting current conditions, disposal methods, and anticipated duration of activities.

1.06 QUALITY ASSURANCE

A. Demolish and remove existing construction, utilities, equipment, and appurtenances without damaging integrity of existing structures, equipment, and appurtenances that are to remain.

B. Erect and maintain barriers, lights, sidewalk sheds and other required protective devices.

C. Carry out demolition activities to avoid interference with plant operations and work in the existing facilities.

1.07 DISPOSAL OF MATERIAL

A. Material and items of equipment that the Owner would like to retain will be removed or relocated prior to demolition. The remaining salvage shall become the Contractor's property and shall be removed from the site.

PART 2: PRODUCTS (Not Used)

PART 3: EXECUTION

3.01 GENERAL

A. All materials and equipment removed shall become the property of the Contractor, except for those that the Owner has identified and marked for his use. All materials and equipment marked by the Owner to remain shall be carefully removed, so as not to be damaged, cleaned and stored on or adjacent to the site in a protected place specified by the Engineer or loaded onto trucks provided by the Owner.

B. Exercise precautions for fire prevention. Make fire extinguishers approved for Class A, B. and C fires available at all times in areas where performing demolition work with burning torches. Do not burn demolition debris on site.

C. Provide safe working conditions for personnel. Provide protection from inclement weather for materials, equipment, and personnel located in partially dismantled structures. Prior to any demolition, erect a safety barricade around the entire demolition work area.

D. Erect temporary partitions to separate demolition work areas from areas to remain, to prevent dust penetration and damage to existing materials and equipment.

E. Do not disrupt foot or vehicular traffic within work area at all times during demolition operations. Provide and maintain lights, barriers, and temporary passageways for free and safe access.

F. Pollution Controls

1. Use water sprinkling, temporary enclosures and other suitable methods to limit the amount of dust and dirt rising and scattering in the air to the lowest practical level. Comply with governing regulations pertaining to environmental protection.

2. Do not use water when it may create hazardous or objectionable conditions such as ice, flooding and pollution.

G. Clean adjacent structures, facilities, and improvements of dust, dirt and debris caused by demolition operations. Return adjacent areas to conditions existing prior to the start of the work.

3.02 PRE-DEMOLITION INSPECTIONS

A. Inspect existing structures, equipment, pavement and similar items that are adjacent to the demolition area and that will remain in place.

1. Record defects and damage.

2. Notify the Engineer of items found.

B. In each area requiring demolition, clearly identify in the field the items that are to be demolished and those items that will be salvaged.

1. Schedule a walk-through with the Engineer or Owners representative to verify that the correct work has been identified.

2. Resolve discrepancies and problematic areas with the Engineer prior to proceeding.

3.03 STRUCTURAL DEMOLITION

A. Remove structures to lines and grades shown unless otherwise directed. Where no limits are shown, the limits shall be 4-in outside the item to be installed and 6-inches below the structure footer. The removal of masonry beyond these limits shall be at the Contractor's expense and these excess removals shall be reconstructed to the satisfaction of the Engineer with no additional compensation to the Contractor.

B. All concrete, brick, tile, concrete block, roofing materials, reinforcement, structural or miscellaneous metals, plaster, wire mesh and other items contained in or upon the

structure shall be removed and taken from the site, unless otherwise directed. Demolished items shall not be used in backfill adjacent to structures or in pipe line trenches.

C. After removal of part or all of masonry walls, slabs and like work which tie into new work or existing work, the point of junction shall be neatly repaired so as to leave only finished edges and surface exposed.

D. Following removal of equipment, equipment pads shall be removed to the finished floor. Burn back dowels as required. Repair per Specification Section 03720 - Concrete Surface Repair.

3.04 MECHANICAL DEMOLITION

A. Mechanical removals shall consist of dismantling and removing of existing, piping, diffusers, pumps, motors, equipment and other appurtenances as specified, shown, or required for the completion of the work. It shall include cutting, capping, and plugging as required.

B. Remove all abandoned pipes exposed during construction activities.

C. Existing process, water, chemical, gas, fuel oil and other piping not required for the new work shall be removed where shown or where it will interfere with new work. Piping not indicated to be removed or which does not interfere with new work shall be removed to the nearest solid support, capped and left in place. Chemical and fuel lines and tanks shall be purged and made safe prior to removal or capping.

D. Existing piping to be abandoned shall be cut and plugged or capped at each end. Where existing piping interferes with new piping or construction, it shall be removed beyond the limits required for the proper completion of work and the open ends plugged or capped. Unless otherwise shown, lines shall be plugged or capped at least 1 inch behind or below finished building surfaces, and at least 12 inches below outside grade surfaces.

E. The Contractor shall include in the contract price the cost of removing, refitting, and reinstalling certain pipe, fittings, and valves as shown on the Drawings.

3.05 ELECTRICAL DEMOLITION

A. Electrical removals shall consist of the removal of existing transformers, distribution switchboards, control panels, motors, conduits and wires, poles and overhead wiring, panelboards, lighting fixtures and miscellaneous electrical equipment all as shown on the Drawings, specified herein, or required to perform the work.

B. All existing electrical equipment and fixtures to be removed shall be removed with such care as may be required to prevent unnecessary damage, to keep existing systems in operation and to maintain the integrity of the grounding systems.

C. Remove conduits and wires as required and/or shown on the Drawings. All wiring in underground ductbanks shall be removed as noted on the Drawings. All direct burial cable shall be removed.

D. Poles and overhead wiring within the limits of demolition shall be abandoned as shown. Poles shall be removed from the site. The overhead wires shall be salvaged and stored. Perform this work after the proposed service has been completed and energized, and in accordance with the approved schedule.

E. All lighting fixtures shall be removed from the site. Florescent bulbs shall be removed and disposed offsite in accordance with environmental regulations.

F. Wall switches, receptacles, starters and other miscellaneous electrical equipment shall be removed and disposed of off the site as required.

3.06 CLEAN-UP

A. Following demolition, Contractor shall pressure clean all structures intended for re-use and/or requiring surface repairs. Coordinate transfer of pressure wash residuals with Owner and Operations Staff for potential disposal at Headworks.

B. Restore demolition sites to grade per Specification Section 02200 Earthwork.

C. Remove from the site all debris resulting from the demolition and cleaning operations as it accumulates. Upon completion of the work, all materials, equipment, waste and debris of every sort shall be removed and premises shall be left, clean, neat and orderly.

3.07 FIELD QUALITY CONTROL

A. Engineer will visually inspect demolition and adjacent areas for the following:

1. Completeness of demolition.

2. Completeness of clean-up.

3. Damage that may have resulted from the demolition operation.

B. New Construction shall not begin until the inspection by the Engineer or the Owners representative is completed and accepted.

END OF SECTION

SECTION 02140

DEWATERING AND DRAINAGE

PART 1: GENERAL

1.01 SCOPE OF WORK

A. Furnish, install, operate, monitor, maintain and remove temporary dewatering and drainage systems as required and lower and maintain groundwater levels below subgrades of excavations. Prevent surface water runoff from entering or accumulating in excavations.

B. Collect and properly dispose of all discharge water from dewatering and drainage systems in accordance with State and local requirements.

C. Repair damage and disturbed areas caused by dewatering and drainage system operations.

D. Remove temporary dewatering and drainage systems when no longer needed.

1.02 GENERAL

A. The Contractor shall be responsible for controlling groundwater in a manner that will preserve the strength of the foundation soils, will not cause instability of the excavation slopes, and will not result in damage to existing structures.

B. Where permeable soils are encountered at subgrade elevations the Contractor shall maintain the groundwater level a minimum of 3' below the prevailing excavation level.

C. Discharge from Construction Dewatering shall be considered a Non Point Source Discharge and shall be treated as storm water runoff. Discharge from Construction Dewatering shall be routed through an appropriate sediment filtering/storage device as required by the Manual for Erosion and Sediment Control in Georgia.

1.03 SUBMITTALS

A. Submit the temporary dewatering and drainage system designs in accordance with the section titled “Shop Drawings, Product Data, and Samples.” Dewatering system designs, as required, shall be prepared by a licensed Professional Engineer, registered in the State of Georgia, having a minimum of five (5) years of professional experience in the design and construction of dewatering and drainage systems. Submittal will be for information only.

B. The Contractor shall remain responsible for adequacy and safety of construction means, methods and techniques.

1.04 DEFINITIONS

A. Where the phrase "in-the-dry" is used in this section, it shall be defined as in situ soil moisture content of no more than two percentage points above the optimum moisture content for that soil.

PART 2: PRODUCTS

2.01 EQUIPMENT FOR DEWATERING

A. Equipment used for dewatering is optional to the Contractor.

2.02 MECHANICAL EQUIPMENT

A. Mechanical equipment used shall be in good working order and suitable for use under the anticipated conditions.

2.03 WELLS AND WELL POINTS

A. Wells and well points, if used, shall be installed with suitable screens and filters so that continuous pumping of fines does not occur.

PART 3: EXECUTION

3.01 GENERAL

A. Control surface water and groundwater such that excavation to final grade is made in-the-dry, and bearing soils are maintained undisturbed. Prevent softening, or instability of, or disturbance to, the subgrade due to water seepage.

B. Provide protection against flotation for all work.

C. The impact of anticipated subsurface soil/water conditions shall be considered when selecting methods of excavation and temporary dewatering and drainage systems. Where groundwater levels are above the proposed bottoms of excavations, a pumped dewatering system is expected for pre-drainage of the soils prior to excavation to final grade and for maintenance of the lowered groundwater level until construction has been completed to such an extent that the foundation, structure, pipe, conduit, or fill will not be floated or otherwise damaged. Type of dewatering system, spacing of dewatering units and other details of the work are expected to vary with soil/water conditions at a particular location.

3.02 MAINTENANCE OF EQUIPMENT

A. The Contractor shall maintain and operate his dewatering equipment until the permanent structure is in place.

3.03 SURFACE WATER CONTROL

A. Control surface water runoff to prevent flow into excavations. Provide temporary measures such as dikes, ditches and sumps.

3.04 EXCAVATION DEWATERING

A. Provide and maintain adequate equipment and facilities to remove promptly and dispose of properly all water entering excavations. Excavations shall be kept in-the-dry, to maintain an undisturbed subgrade condition throughout construction below grade, including backfill and fill placement.

B. Collect precipitation or surface runoff in shallow ditches around the perimeter of the excavation, drain to sump and pump from the excavation to maintain in-the-dry conditions.

C. Pipe and conduit shall not be installed in water or allowed to be submerged before backfilling. Pipe and conduit that becomes submerged shall be removed and the excavation dewatered and restored to proper conditions before reinstalling the pipe and conduit.

D. Excavations for foundations and structures shall be maintained in-the-dry for a minimum of four (4) days after concrete placement. In no event shall water be allowed to enter an excavation and rise to cause unbalanced pressure on foundations and structures until the concrete or mortar has set at least twenty-four (24) hours.

E. Dewatering and drainage operations shall at all times be conducted in such a manner as to preserve the natural undisturbed bearing capacity of the subgrade at the bottom of the excavation. If the subgrade becomes disturbed for any reason, the unsuitable subgrade material shall be removed and replaced with concrete, compacted granular fill, or other approved material to restore the bearing capacity of the subgrade to its original undisturbed condition.

F. Dewatering and drainage operations shall be conducted in a manner that does not cause loss of ground or disturbance to the pipe bedding or soil that supports overlying or adjacent structures.

3.05 UNSTABLE MATERIAL

A. No compensation for removal of unstable material below the subgrade shall be allowed if in the opinion of the Engineer, modified dewatering techniques would solve the problem and result in a suitable subgrade.

3.06 SAMPLES

A. Dewatering discharge shall be accessible for collection of samples by the Engineer.

3.07 DISPOSAL OF DRAINAGE

A. All water discharged from temporary dewatering and drainage systems shall be disposed of in accordance with the sedimentation and control plans as specified in the Contract Documents. Existing or new sanitary sewer systems shall not be used to dispose of drainage unless the written permission of the Owner is obtained.

END OF SECTION

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SECTION 02200

EARTHWORK

PART 1: GENERAL

1.01 WORK INCLUDED

A. Excavation for structures

B. Furnishing and installing graded aggregate base under all concrete slabs on grade;

C. Filling and backfilling to attain indicated grades;

D. Trenching and trench backfilling;

E. General sitework.

1.02 SITE CONDITIONS

A. The accuracy of information contained in the plans and specifications as to topography, underground structures, foundation conditions, character of soil, position and quantity of ground and subsoil water, are not guaranteed by the Owner. Bidders must satisfy themselves by personal examination and by such other means as they desire with respect to actual site conditions.

1.03 JOB CONDITIONS

A. Erect sheeting, shoring and bracing as necessary for protection of persons, structures and excavations.

B. Provide dewatering and drainage as required to accomplish work.

1.04 QUALITY ASSURANCE

A. Testing Agency.

B. In place soil compaction tests to be performed by a testing laboratory.

C. If the compaction does not meet the Specification, the Contractor shall remove the part of fill not meeting the specifications and replace it with properly compacted material and shall pay for all compaction tests made for such defective areas.

1.05 REFERENCE STANDARDS AND REPORTS

A. ASTM D698-78, Moisture- Density Relations of Soils

B. ASTM D1556-64, Density of Soil in Place by the Sand- Cone Method.

C. Report of Subsurface Exploration and Geotechnical Engineering Evaluation, Canton WWTP, Canton, Georgia, December 17, 2019. Geo-Hydro Project Number 191131.20.

PART 2: PRODUCTS

2.01 FILL MATERIAL

A. Fill material shall consist of soil or soil-rock mixture which is free from topsoil, organic matter, and other deleterious substances. Fill material shall be free of rocks larger than 3” in diameter. Large boulders, thick rock or quartz layers which are not broken down by compaction equipment will not be suitable for use in the fill.

B. Fill material shall be

1. Well Graded Sand well graded (SW)
2. Silty Sand (SM)
3. Poorly Graded Sand (SP)
4. Poorly Graded Sand with Silt (SP-SM)
5. Poorly Graded Sand with Clay (SP-SC)
6. Silt (ML)
7. Lean Clay (CL)

C. Fill material shall be subject to the approval of the Engineer.

2.02 TRENCH AND STRUCTURAL BACKFILL

A. On-site fill material used for trench and structural backfill shall meet the requirements of section 2.01 above. Material shall be free of rock or stone larger than two inches.

B. Granular material when required for trench and structural backfill shall be free from organic substance and other deleterious matter, shall be subject to the approval of the Engineer, and shall be in particle size grading within the following limits:

1. Passing the number four sieve: 100%
2. Passing the number 200 sieve: 3% Maximum

2.03 AGGREGATE BASE UNDER CONCRETE SLAB

A. Refer to Division 3 of these specifications.

2.04 NON-SPECIFIED MATERIALS

A. All other materials not specifically described but required for a complete and proper installation, shall be as selected by the Contractor subject to the approval of the Engineer.

PART 3: EXECUTION

3.01 GENERAL

A. Prior to all work of this Section, become thoroughly familiar with the site, the site conditions, and all portions of the work falling within this Section.

B. Do not allow or cause any of the work performed or installed to be covered up or enclosed by work of this Section prior to all required inspections, tests, and approvals. Should any of the work be so enclosed or covered up before it has been approved, uncover all such work at no additional cost to the Owner.

3.02 EXCAVATION

A. Excavate to grades shown on the Drawings. Where excavation grades are not shown on the Drawings, excavate as required to accommodate the installation. Extend excavation as required for proper form work construction.

B. Backfill and compact all over excavated areas as specified for fill below, and at no additional cost to the Owner unless so directed by the Engineer in which case the Contractor shall be paid the price bid per cubic yard.

C. Control grading in vicinity of structures to prevent surface water from running into excavated areas.

D. Where depressions result from, or have resulted from the removal of surface or subsurface obstructions, open the depression to equipment working width and remove all debris and soft material as directed by the Engineer.

E. Solid rock excavation

1. Notify the Engineer when rock is encountered and before its removal.

2. Where rock is encountered in pipe trenches, foundation footings, pump pits and other parts of structures, the rock shall be removed to at least 6 inches below the bottom of the pipe, footings, pump pits, and other parts of structures. Then the surface shall be brought back to grade of the bottom of the structure by backfilling in 6" layers with selected material and tamping to the same average density of the undisturbed earth adjacent thereto.

3.03 TRENCHING

A. Trench excavation shall be by open cut from the ground surface, unless otherwise called for on the plans or allowed by the Engineer. Not more than 300 feet of trench shall be opened on any line in advance of pipe laying.

B. Pipe trenches shall be straight and true to grade and in the location shown on the plans. The bottom of the trenches shall be bedded per the details shown on the plans.

C. Bell holes shall be excavated at all pipe joints for bell and spigot and mechanical joint pipe. Bell holes shall be large enough to facilitate the proper installation of all joints. No part of the pipe bell or coupling shall be in contact with sides or bottom of the trench.

D. All trenches shall be of sufficient width to provide ample working space on each side of the pipe for maintaining a straight line of pipe.

E. Water lines and force mains shall be laid at the elevations indicated. At points of interference with storm sewers and cross drains, pipe will be run under the conflicting utility.

3.04 FILL UNDER STRUCTURES

A. Prior to placing any fill material, the subgrade shall be proof-rolled in the presence of the Engineer. Any unstable areas shall be repaired and the placing of fill materials shall proceed only after inspection and approval by the Engineer.

B. Approval of the fill material by the Engineer shall be required prior to initiating filling operations.

C. No fill shall be placed or compacted in a frozen condition or on top of frozen material. No fill material shall be placed when free water is standing on the surface of the area where the fill is to be placed and no compaction of fill will be permitted with free water on any point of the surface of the fill to be compacted.

D. Scarify existing surfaces to provide bond with new material.

E. Place fill and backfill in layers not exceeding eight inches before compaction and thoroughly tamp with a sheep's foot roller unless otherwise indicated or specified. Compact material to a density of not less than 100% of the maximum laboratory dry density, as determined by ASTM D698-78. If necessary, in order to obtain the required compaction, the Contractor shall add moisture or shall air dry the material.

F. Stones in earth fill must be well distributed and no stones over 3 inches in diameter may be left within 36 inches of finished grade.

3.05 BACKFILLING AROUND STRUCTURES

A. Backfilling around structures shall not proceed until authorized by the Engineer.

B. All form work, debris and other undesirable material shall be removed prior to backfilling. Area shall be dewatered.

C. Backfill material shall be as specified in this section. Backfill shall be placed in layers of 8 inches maximum and shall be of a moisture content which will permit proper compaction. Each layer shall be compacted by mechanical tampers and special care shall be taken to prevent uneven loading or damage to the structure.

D. Compact backfill material to a minimum relative density of 95% as determined by ASTM D698 (Standard Proctor).

3.06 BACKFILLING TRENCHES

A. The backfilling of pipe trenches shall be started immediately after the pipe installation has been approved by the Engineer.

B. Backfill material shall be as specified in this section. The material shall contain no rock greater than two inches in maximum dimension.

C. Backfill shall be tamped in layers not over 6 inches thick. Tamping shall be done with mechanical tamps in such a manner as to thoroughly compact the backfill without moving or injuring the pipe. The remainder of the backfill may be placed in the trench by a machine, but the backfill shall be compacted to the top of the trench, either by pneumatic hand tamps, hydro-tamps, or other approved methods. After compaction, the dry weight per cubic foot shall be at least 90 percent of the maximum laboratory dry weight per cubic foot as determined by ASTM D698-78 in the yard and 98 percent under roads. The trench shall be backfilled and the surface brought to its original grade and profile contour.

D. In rock excavation, the backfill from the bottom of the trench to one foot above the top of the pipe shall be finely pulverized soil, free from rocks and stones. The rest of the backfill shall not contain over 75% broken stone, and the maximum sized stone placed in the trench shall not have a weight exceeding 50 pounds. Excess rock and fragments of rock weighing more than 50 pounds shall be loaded and hauled to disposal as directed by the Engineer.

3.07 FINISH GRADING

A. The Contractor shall employ a qualified person to interpret elevations and grading details shown on plans.

B. Areas to be grassed shall be spread with selected topsoil that has been obtained from site clearing. The topsoil shall be mixed into the surface and compacted suitably for planting.

C. Areas around buildings and structures shall be graded so as to prevent accumulation of water within the area.

3.08 DISPOSAL OF EXCESS MATERIAL

A. Excess material may be disposed of on site in areas selected by the Contractor and approved by the Engineer.

B. Disposal sites shall not be located in areas designated for future treatment basins.

C. Disposal sites shall be graded to be free draining, with side slopes no greater than 3:1, and to fit the existing topography.

D. Upon completion of work at the disposal sites, the areas shall be finish graded as required in this section and grassed as required in section 02486.

END OF SECTION

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SECTION 02210

SOIL EROSION AND SEDIMENT CONTROL

PART 1: GENERAL

1.01 SCOPE OF WORK

A. The contractor is responsible for implementing best management practices to prevent and minimize erosion and resultant sedimentation in all cleared and grubbed areas during and after construction. This Section covers the work necessary for the installation of structures and measures for the prevention and control of soil erosion. The CONTRACTOR shall furnish all material, labor and equipment necessary for the proper installation, maintenance, inspection, monitoring, reporting and removal (where applicable) of erosion prevention and control measures and to cause compliance with the General NPDES Permit for Storm Water Discharges from Construction Activities under this Section 02210.

B. The CONTRACTOR shall become the *primary* permittee to NPDES Permit GAR 100001. The CONTRACTOR shall submit the application for the permit and shall issue the Notice of Intent and Notice of Termination as required by the permit. Copies of application and NOI and NOT shall be submitted to the OWNER and ENGINEER.

1.02 RELATED SECTIONS

A. Excavation and Grading are included in Earthwork Section 02200.

1.03 REFERENCES

A. CONTRACTOR shall be familiar with the following reference documents and keep those at the construction site at all times. These documents need to be complied with as applicable.

1. General NPDES Permit for Storm Water Discharges from Construction Activities (the NPDES Permit).

2. Manual for Erosion and Sediment Control in Georgia, Latest Edition with Supplements.

3. State of Georgia Department of Transportation Standard Specifications, Construction of Roads and Bridges, Latest Edition (the GDOT Specifications).

4. National Stone Association, Aggregate Classification (the NSA Classification).

5. Erosion, Sedimentation and Pollution Control Plan (the Plan) as required by the NPDES Permit.

6. Comprehensive Monitoring Plan (the CMP) as required by the NPDES Permit.

1.04 DEFINITIONS

A. ENGINEER: For the purposes of this Section 02210, the term ENGINEER is synonymous with consulting engineer, licensed professional, designer, and consultant as used in permits, laws, rules, regulations, ordinances and other soil

erosion and sediment control references. For the purposes of this Section 02210, the representative may at any time during the project provide direction. This direction shall be considered equivalent to direction from the ENGINEER.

B. CONTRACTOR: For purposes of this Section 02210, the term CONTRACTOR is synonymous with general contractor, discharger, operator, primary permittee and permittee (permit holder) as used in permits, laws, rules, regulations, ordinances and other soil erosion and sediment control references.

C. Qualified Personnel: For purposes of this Section 02210, the term Qualified Personnel means a person who has successfully completed an erosion and sediment control short course eligible for continuing education units, or an equivalent course approved by Environmental Protection Division of the Georgia Department of Natural Resources and the State Soil and Water Conservation Commission.

D. Other Definitions: Definitions as listed in the NPDES Permit, Part I, B. shall apply in this Section.

1.05 REGULATORY COMPLIANCE

A. Land disturbance activities are not authorized to begin until after all required erosion and sediment control permits are obtained from the United States, the State of Georgia, and/or the City of Canton. CONTRACTOR is the Primary Permittee and Operator under the provisions of the NPDES Permit. As such, CONTRACTOR will be required to sign certain certifications as described in the NPDES Permit. CONTRACTOR shall comply with requirements specified in the Contract Documents or by the ENGINEER. CONTRACTOR shall also comply with all other laws, rules, regulations, ordinances and requirements concerning soil erosion and sediment control established by the United States, the State of Georgia, and/or the City of Canton. The following documents and the documents referenced therein define the regulatory requirements for this Section 02210.

1. NPDES Permit: The Georgia National Pollutant Discharge Elimination System (NPDES) General Permit for Storm Water Discharges Associated with Construction Activity governs land disturbance or construction activities of one (1) acre or more. On applicable sites, CONTRACTOR is responsible for complying with the terms and conditions of this permit.

2. Manual for Erosion and Sediment Control: CONTRACTOR shall follow practices and standards of the Georgia Soil and Water Conservation Commission Manual for Erosion and Sediment Control in Georgia.

1.06 SUBMITTALS

A. CONTRACTOR shall submit to the ENGINEER the proposed schedule for installation, maintenance and removal of all temporary and permanent erosion and sediment control measures. The schedule shall reflect the requirements of Paragraph 1.07 below (Sequence of Construction of Temporary Sediment Control Structures) and must show the anticipated starting and completion date for all land development activities including:

1. Installation of temporary and permanent sediment control structures

2. Stormwater management facilities

3. Timber salvage operations
4. Clearing operations
5. Grubbing operations
6. Rough and finished grading
7. Building construction
8. Landscaping, including all seeding and sodding
9. Removal of temporary sediment control structures

1.07 SEQUENCE OF CONSTRUCTION OF TEMPORARY SEDIMENT CONTROL MEASURES

A. Install all erosion and sediment control structures specified herein and shown in the Contract Documents, or as directed by the ENGINEER, as the first item of work within a given drainage area. Construction and installation of all sediment control structures shall begin down gradient of the area to be disturbed and proceed up gradient. CONTRACTOR shall at all times maintain all soil erosion and sediment control structures and practices throughout construction and until permanent grass cover is established.

1.08 PAYMENT PROCEDURES

A. Work items included within the Bid Form will be paid for at bid unit price, inclusive of all associated work. The lump sum bid shall include all **other** work covered under this Section 02210 associated with construction and include the furnishing, placement, maintenance, and removal of the silt fence, hay bales, temporary dikes and ditches, sediment traps, sediment basins, construction exits and all temporary vegetative and non-vegetative ground cover and all earthwork, labor, materials, and equipment necessary to complete the work as specified or directed by ENGINEER.

PART 2: SPECIFIC REQUIREMENTS

The requirements specified herein and shown in the Contract Documents are minimum requirements for preventing or minimizing soil erosion and sediment transport. CONTRACTOR shall install and maintain soil erosion and sediment control measures in accordance with the following criteria. Requirements set forth in the Manual for Erosion and Sediment Control in Georgia shall govern in case of conflicting information, unless clearly identified as a deviation from this Manual.

2.01 TEMPORARY INTERCEPTOR, DIVERSION, AND PERIMETER DIKES

A. Install interceptor, diversion and perimeter dikes to intercept and prevent storm water runoff from entering disturbed areas from any other up gradient area regardless of whether area is on-site or off-site. Dikes must divert runoff to a drainage ditch, sediment basin or temporary or permanent channel. Dikes shall remain in place until the disturbed area is permanently stabilized. Construct dikes of earth fill free from all perishable matter and refuse, such as scraps of forms, wire, brush, rocks larger than six (6) inches or any foreign materials. Ashes, large stones, muck or other soft materials shall not be used. Compact all dikes using

construction equipment. Dikes shall be stabilized immediately after construction with temporary seeding in accordance with Paragraph 2.09 to prevent sediment transport to downstream areas.

2.02 TEMPORARY INTERCEPTOR, DIVERSION, AND PERIMETER DITCHES

Install temporary ditches where shown on the Drawings or as directed by the ENGINEER.

A. In general, temporary ditches shall be installed parallel and contiguous to and upslope of temporary dikes. Construct ditches to the lines and cross section shown on the drawings, provided that ditches have a minimum depth of one foot and side slopes have a slope of 2H: 1V or flatter. Ditches shall be free of bank projections, trees, brush, stumps or other objectionable materials or irregularities that will impede normal flows. Downstream outlets of temporary ditches shall be constructed and stabilized prior to construction of the ditch. The outlet must discharge in such a manner as to not cause an erosion problem.

2.03 TEMPORARY SEDIMENT BARRIERS (SILT FENCE)

Install silt fence where shown on the Drawings or as directed by the ENGINEER.

A. Material Specifications: Filter fabric must meet the requirements set forth in Section 171 - Temporary Silt Fence, of the State of Georgia Department of Transportation (GDOT) Standard Specifications, Construction of Roads and Bridges, latest edition. CONTRACTOR shall submit to ENGINEER copies of delivery invoices, certifications or other documentation that the filter fabric complies with these specifications if requested by ENGINEER.

B. Installation: In general, silt fencing shall be installed on the down gradient side of all areas to be disturbed as well as the perimeter of the project site (ENGINEER may authorize an exception for a perimeter which is up gradient from all land disturbing activity). All posts used to install silt fence shall comply with the specifications in the Manual for Erosion and Sediment Control in Georgia. Posts must be placed at least 18 inches in the ground and cannot be more than 6 feet apart from one another. Fence fabric must be inserted below ground and fence fabric must be fastened to posts according to the specifications in the Manual.

C. Maintenance: In accordance with Paragraph 3.01 below, all silt fencing shall be inspected and maintenance performed, if needed, within 24 hours of inspection once every seven (7) calendar days and within 24 hours of a rainfall event that has precipitation of 0.5 inches or greater. At the earlier of (1) every 14 calendar days, or (2) when sediment reaches a depth of one half the installed fence height, all soil, silt, sediment and other material captured by the silt fence should be removed and returned up gradient on the construction site. The silt fence shall be maintained such that it minimizes sediment transport as designed.

2.04 TEMPORARY SEDIMENT BARRIERS (HAY BALES)

Install bales of hay where shown on the Drawings or as directed by ENGINEER.

A. Material Specifications: Hay bales shall be wire or nylon bound and of a rectangular shape.

B. Installation: Place bales in a row with ends tightly abutting the adjacent bales. Corner abutment is not acceptable. Embed bales in the soil a minimum of 4 inches below grade. Build up backfilled soil a minimum of 4 inches above grade on the uphill side of the barrier and conform to grade on the downhill side of the barrier. Anchor each bale in place with 1- by 2-inch wood stakes or No. 3 reinforcing bars. The first stakes shall be driven toward the previously laid bale to force the bales together. Stakes shall be 24 inches long and shall reach a minimum of 6 inches into the ground.

C. Maintenance: In accordance with Paragraph 3.01 below, all hay bales shall be inspected and maintenance performed, if needed, within 24 hours of inspection once every seven (7) calendar days and within 24 hours of a rainfall event that has precipitation of ½ inch or greater. Hay bales must be replaced one month after installation. At the earlier of (1) every 14 calendar days or (2) when sediment reaches a depth of one-half the original bale height, all soil, silt, sediment and other material captured by the hay bales should be removed and returned up gradient on the construction site. Maintain hay bales to minimize sediment transport as designed.

2.05 CONSTRUCTION EXIT

Locate construction exits as shown on the Drawings or as directed by the ENGINEER.

A. Material Specifications: A geotextile underliner, conforming to Section 881.2.05 - Plastic Filter Fabric of the State of Georgia DOT Standard Specifications, Construction of Roads and Bridges, shall be used in all instances to stabilize and support the pad aggregate. Aggregate size will conform to the National Stone Association's (NSA) R-2 classification 1½- inch to 3½-inch stone).

B. Installation: Construction exits should be located at all points where traffic will be leaving the construction site to a public or private right of way, street, alley, or parking area. All construction exits must be fully installed prior to the commencement of timber salvage, clearing, grubbing, grading or construction operations.

C. Maintenance: In accordance with Paragraph 3.01 below, all construction exits shall be inspected and maintenance performed, if needed, within 24 hours of inspection once every seven (7) calendar days and within 24 hours of rainfall event that has precipitation of 0.5 inches or greater. At the earlier of (1) thirty calendar days since construction exit was installed or last maintained, or (2) geotextile underliner is visible or if construction exit does not conform to specifications established in this Paragraph 2.05, construction exit pad shall be top dressed with NSA's R-2 (1½-inch to 3½-inch stone) such that underliner is no longer visible and exit pad conforms to specifications.

2.06 CHECK DAM

Install check dams as shown on the Drawings or as directed by the ENGINEER.

A. Installation: Install check dams in all ditches, channels or swales draining disturbed areas of one (1) acre or greater and which are not installed with permanent, non-erodible lining or a vegetative cover as specified in Paragraph 2.09. The specifications for the design criteria, materials, installation and maintenance of check dams are dependent on the upslope drainage area and are described below.

1. Check Dam for Ditches Draining Up To Two (2) Acres: Install stone check dams in ditches draining up gradient areas greater than two acres. Construct check dam with graded size 5- to 10-inch stone. Hand placement may be required to insure complete coverage of entire width of ditch.

2. Rock Filter Dam For Ditches Draining Two (2) to Fifty (50) Acres: Rock Filter dams for use with drainage areas between two and fifty acres must serve as a sediment filtering device in addition to reducing the velocity of storm water runoff. Construct rock filter dam with graded size 5- to 10-inch stone and a 3- to 8-pound stone face as shown in the Georgia Sediment and Erosion Control Manual. Check dam shall not substantially impound water. Hand placement may be required to ensure complete coverage of entire width of ditch.

B. Maintenance: In accordance with Paragraph 3.01 below, all check dams shall be inspected and maintenance performed, if needed, within 24 hours of inspection once every seven (7) calendar days and within 24 hours of a rainfall event that has precipitation of 0.5 inches or greater. Dress dams with appropriate-sized stone or additional hay bales as is necessary to maintain check dams in accordance with these specifications. At the earlier of (1) every 14 calendar days, or (2) when sediment reaches a depth of one-half the original check dam height, all soil, silt, sediment and other material captured by the dam should be removed and returned up gradient on the construction site.

2.07 INLET SEDIMENT TRAP

Install inlet sediment traps where shown on the Drawings, as directed by ENGINEER, and around all storm drain drop inlets that receive runoff from disturbed areas.

A. Material Specifications: Filter fabric used in constructing inlet sediment traps shall conform to the specifications established in Paragraph 2.03. For gravel drop inlet filters, stone shall conform to NSA's R-3 specification (3- to 6-inch stone). Baffle box inlet filters shall be constructed of 2-inch x 4-inch or 4-inch x 4-inch posts and 2-inch x 4-inch boards.

B. Installation: Install in accordance with Chapter Six of the Manual for Erosion and Sediment Control in Georgia. Excavation may only be used in combination with a filtering device such as stone or silt fence. All sediment traps should provide a minimum of 1.5 feet of sediment storage. Sediment traps must be self draining.

C. Maintenance: In accordance with Paragraph 3.01, inlet sediment traps shall be inspected and maintenance performed, if needed, within 24 hours of inspection once every seven (7) calendar days and within 24 hours of a rainfall event that has precipitation of 0.5 inches or greater. Clean and repair traps such that traps meet the specifications of this Paragraph 2.07 and minimize sediment transport. Remove sediment as necessary to provide adequate storage volume for subsequent rains.

2.08 TEMPORARY SEDIMENT BASINS AND INLETS

Install temporary sediment basins and inlets where shown on the Drawings or as directed by ENGINEER.

A. Material Specifications: Concrete used in constructing sediment basin shall be ready mixed, conforming to ASTM C 94, Alternate 2. Compressive field strength shall be not less than 2,500 psi at 28 days. Maximum size of aggregate shall be 1-

1/2 inch. Slump shall be between 2 and 4 inches. Field strength shall be assumed as equal to 85 percent of the strength of laboratory-cured cylinders. Forms used in constructing sediment basin shall have exposed surfaces of plywood; others shall be steel, matched boards, plywood, or other acceptable material. Form all vertical surfaces. Provide fillets on reentrant angles. Trench walls, large rock, or earth will not be acceptable form material. Reinforcing steel shall conform to ASTM A 615, Grade 40, deformed bars. At the option of the CONTRACTOR, approved precast units may be substituted for cast-in place units. Precast units shall conform to ASTM C 478. Submit details of proposed units to the ENGINEER for review. Concrete risers for extensions shall be a minimum of 6 inches high and of the same quality as the sections. Risers shall be reviewed by ENGINEER before installation. Mortar shall be standard premixed mortar conforming to ASTM C 387, Type S, or proportion 1 part portland cement to 2 parts clean, well-graded sand which will pass a 1/8-inch screen. Admixtures may be used not exceeding the following percentages of weight of cement: Hydrated lime, 10 percent; diatomaceous earth or other inert materials, 5 percent. Consistency of mortar shall be such that it will readily adhere to the concrete. Cast iron frames and gratings for catch basins and storm drain inlets shall be designed for AASHTO H-20 truck loadings and shall be bike-proof grates. Bearing surfaces shall be clean and shall provide uniform contact. Castings shall be tough, close-grained gray iron, sound, smooth, clean, free from blisters, blowholes, shrinkage, cold shuts, and all defects, and shall conform to ASTM A 48, Class 30.

B. Construction: Excavation of basin and backfill of any adjoining pipe trenches shall be as specified in Section 02200, Earthwork. Construct forms to the dimensions and elevations required. Forms shall be tight and well braced. Chamfer corners of forms. Prior to placing the concrete, remove all water and debris from the forms. Moisten forms just prior to placing the concrete. Handle concrete from the transporting vehicle to the forms in a continuous manner as rapidly as practical without segregation or loss of ingredients. Immediately after placing, compact concrete with a mechanical vibrator. Limit the duration of vibration to the time necessary to produce satisfactory consolidation without causing segregation. Screed the top surface of exposed slabs and walls. When the initial water has been absorbed, float the surfaces with a wood float and lightly trowel with a steel trowel to a smooth finish free from marks or irregularities. Finish exposed edges with a steel edging tool. Remove forms and patch any defects in the concrete with mortar mixed in the same proportions as the original concrete mix. Cure concrete by preventing the loss of moisture for a period of 7 days. Accomplish with a membrane-forming curing compound. Apply the curing compound immediately after removal of forms or finishing of the slabs. Protect concrete from damage during the 7-day curing period. If precast unit is used and material in bottom of trench is unsuitable for supporting unit, excavate and backfill to required grade with 3-inch minus, clean, pit-run material. Set units to grade at locations shown. Set frames and grates at elevations indicated on Drawings. Frames may be cast in, or shall be set in mortar.

C. Maintenance: In accordance with Paragraph 3.01, temporary sediment basins and inlets shall be inspected and maintenance performed, if needed, within 24 hours of inspection once every seven (7) calendar days and within 24 hours of a rainfall event that has precipitation of 0.5 inches or greater. Clean and repair basins and inlets such that they meet the specifications of this Paragraph 2.08 and minimize

sediment transport. Remove sediment as necessary to provide adequate storage volume for subsequent rains.

2.09 TEMPORARY SOIL EROSION STABILIZATION (VEGETATIVE)

This section covers work necessary for temporary stabilization of soil to prevent erosion following clearing, grubbing, grading or other construction activities in the areas identified in the Contract Documents or as directed by the ENGINEER, except wetlands. The right is reserved to modify the use, location, and quantities of the areas requiring stabilization as the ENGINEER considers being in the best interest of the Owner. During construction, the ENGINEER will designate the extent of stabilization used in each location throughout the project.

A. General Criteria: The stabilization measures specified herein shall be initiated on all disturbed areas including dikes and ditches within 24 hours of completion to minimize erosion and soil transport, provided however, that stabilization measures specified herein do not have to be initiated in the event that construction activities will resume on that portion of the site within fourteen (14) days from the date activities temporarily ceased. For cleared areas which may not receive permanent vegetative or other stabilization measure for six (6) months or less AND a suitable growing season is not available for seeding to establish an erosion retardant cover, mulch may be applied according to the specifications below.

B. Material Specifications: Seed shall be clean, delivered in original unopened packages and bearing an analysis of the contents. Guaranteed 95 percent pure with minimum germination rate of 85 percent. Summer seed mix shall be 40 percent by weight Fawn Fescue, 30 percent by weight Perennial Ryegrass, 15 percent by weight Orchard Grass, and 15 percent by weight Dutch White Clover. Winter seed mix shall be 35 percent by weight Fawn Fescue, 30 percent by weight Perennial Ryegrass, 30 percent by weight Hairy Vetch, and 5 percent by weight Dutch White Clover. Fertilizer shall be used if directed by ENGINEER. Fertilizer shall be commercial, chemical type, uniform in composition, free-flowing, conforming to state and federal laws, and suitable for application with equipment designed for that purpose. Fertilizer shall have a minimum percentage of plant food by weight for the following: Summer mix shall be 10 percent nitrogen, 10 percent phosphoric acid, and 6 percent potash; Winter mix shall be 16 percent nitrogen, 8 percent phosphoric acid, and zero percent potash. Straw mulch shall be threshed straw of oats, wheat, or rye, free from obnoxious weed seeds or obnoxious weeds, or shall be clean hay. Average stalk length shall be 6 inches. Wood waste, asphaltic emulsion, or erosion control matting such as jute, excelsior, are also appropriate for temporary stabilization. Asphaltic emulsion shall be CSS-1 as manufactured by Chevron Asphalt Company.

1. CONTRACTOR shall submit to ENGINEER certificates of inspection of seed by state or federal authorities and copies of delivery invoices or other documentation of quantities of mulch and fertilizer.

2. The CONTRACTOR shall give at least 3 days notice to the ENGINEER of the time and place of starting the following operations:

   a. Delivery of materials

   b. Planting of grass

3. The CONTRACTOR shall keep the ENGINEER advised of his schedule of operations.

C. Application: Planting and seeding shall be performed in accordance with the following schedule:

1. Summer Seeding: No earlier than April 1 and no later than October 15.

2. Winter Seeding: October 16 until weather conditions prohibit further construction operations as determined by the ENGINEER.

3. Soil Preparation: Prior to seeding operations, and after surface has been shaped, graded, and compacted, scarify surface to a minimum depth of 1 inch.

4. Seeding: All seedbeds shall be a minimum depth of 1 inch. Seedbeds shall be reviewed by the ENGINEER prior to seeding. After soil has been scarified, apply required seed mix, as specified in this section, uniformly with a cyclone seeder, drill, cultipacker seeder, or hydro seeder. When hydro seeding is the selected method of seeding, prepare and apply slurry at the rate and proportion specified below:

a. Seed Mix 100 lbs/acre

b. Fertilizer 650 lbs/acre

c. Water as necessary

The required fertilizer mix shall be uniformly applied at the time of seeding.

Upon completion of the seeding operations, apply straw mulch to a reasonably uniform thickness of 1-1/2 inches to 2-1/2 inches in depth. Mulch shall be loose enough to permit penetration of sunlight and air circulation, but dense enough to shade ground, reduce evaporation rate, and prevent or materially reduce erosion of underlying soil. Retain straw in place by applying asphaltic emulsion at a rate of 100 gallons per acre or mechanically tack the mulch into the soil to approximately 3 inches. Equipment used for tacking shall be specially designed for this use.

D. Application of Mulch Only: In accordance with Paragraph 2.09. A for areas to receive mulch only; apply at the following rates, to the following depths and according to the following specifications:

1. Dry Straw or Hay: Spread at a rate of two and one-half (2 1/2) tons per acre. Apply to a depth of six (6) to ten (10) inches. Apply uniformly and anchor as necessary.

2. Wood Waste: Spread at a rate of six (6) to nine (9) tons per acre. Apply to a depth of two to three inches. Apply wood waste only on slopes that are 3:1 or flatter. Anchoring is not necessary.

3. Jute Matting or Excelsior Netting: Apply in accordance with manufacturer’s recommendations.

4. Asphaltic Emulsion: Apply at a rate of 1200 gallons per acre. Apply uniformly.

E. Maintenance: In accordance with Paragraph 3.01, stabilized areas shall be inspected and maintenance performed, if needed, within 24 hours of inspection

once every seven (7) calendar days and within 24 hours of a rainfall event that has precipitation of 0.5 inches or greater. Apply additional stabilization materials as needed.

PART 3: EXECUTION

3.01 INSPECTIONS AND MAINTENANCE

A. CONTRACTOR shall retain the services of a Qualified Environmental Firm specializing in the NPDES compliance. That Firm shall be presently working in the State of Georgia, be knowledge of NPDES compliance requirements, and have experience in the State of Georgia on three projects. The following duties shall be performed by this Firm:

1. Perform inspections required by this Section 02210. The following areas are to be inspected and maintenance performed, if needed, within 24 hours of inspection at least once every seven (7) calendar days and within 24 hours of a rainfall event that has precipitation of 0.5 inches or greater:
    a. Disturbed areas of the construction site that have not undergone final stabilization.
    b. Erosion and sediment control structures.
    c. All locations where vehicles enter or exit the site.
    d. Material storage and construction laydown areas that are exposed to precipitation and have not been finally stabilized.
2. During inspections, the following will be observed:
    a. The conformance to specifications and current condition of all erosion and sediment control structures.
    b. The effectiveness and operational success of all erosion and sediment control measures.
    c. The presence of sediments or other pollutants in stormwater runoff at all runoff discharge points.
    d. If reasonably accessible, the presence of sediments or other pollutants in receiving waters.
    e. Evidence of off-site sediment tracking at all locations where vehicles enter or exit the site.

An inspection checklist as required by the Georgia Sediment and Erosion Control Manual shall be used for site inspection. This checklist must be completed during each inspection, dated and signed by the Firm's Qualified Person conducting the inspection. Completed inspection checklists shall be kept on-site with the Contract Documents and submitted to the OWNER on a monthly basis.

3. Perform stream monitoring as specified in the Comprehensive Monitoring Plan and required by the State of Georgia. Submit reports on a monthly basis to the Owner and the Engineer containing the results of the monthly stream monitoring.

4. Submit NOI, NOT and all other required reports as specified in the Comprehensive Monitoring Plan and required by the State of Georgia. Submit copies of all submitted reports and notices to the Owner.

B. In areas that have been finally stabilized inspections and, if necessary, maintenance by CONTRACTOR will occur at least once per month for duration of contract or project, whichever is longer.

C. In areas that deficiencies are observed, the CONTRACTOR will repair deficiencies within 24 hours of inspection.

3.02 MONITORING AND REPORTING

A. Monitoring: The CONTRACTOR shall cooperate with the Environmental Firm in the implementation of the Comprehensive Monitoring Program (CMP), which is an integral part of the Agreement.

B. Reporting: The CONTRACTOR shall cooperate with the Environmental Firm to submit a summary of the monitoring results to the EPD as required in the NPDES permit.

3.03 REMOVAL OF TEMPORARY SEDIMENT CONTROL STRUCTURES

At such time that temporary erosion and control structures are no longer required under this Section 02210, the CONTRACTOR shall notify the ENGINEER of its intent and schedule for the removal of the temporary structures, and obtain the ENGINEER's approval in writing prior to removal. Once CONTRACTOR has received such written approval from ENGINEER, CONTRACTOR shall remove as approved the temporary structures and all sediments accumulated at the removed structure shall be returned up gradient. In areas where temporary control structures are removed, the site shall be left in a condition that will restore original drainage.

3.04 NOTICE OF TERMINATION

When all construction activities have ceased, final stabilization has been implemented by the CONTRACTOR, and the site is in compliance with the NPDES permit, the Environmental Firm shall submit a Notice of Termination.

END OF SECTION

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SECTION 02270

TEMPORARY SILT FENCE

PART 1: GENERAL

1.01 DESCRIPTION

A. Work under this section shall include furnishing, installing, maintaining, and upon satisfactory completion, removing a water permeable filter fabric silt fence complete with posts and miscellaneous hardware.

B. The quantity of silt fence may be increased or decreased from what is shown on the plans, upon direction of the Engineer or local government authority. Such variations in quantity will not be considered alteration of the scope of the work.

C. Obtain proper permits from local government before land disturbing activities begin. Silt fence or other erosion control devices shall be installed prior to any land disturbing activities.

D. Temporary erosion control measures shall control erosion and sedimentation to an extent such that the turbidity of streams immediately downstream of the project shall not have an increase in turbidity of more than 50 Nephelametric turbidity units (NTU).

1.02 RELATED WORK

A. Earthwork – Section 02200

B. Grassing and Mulching – Section 02486

1.03 SUBMITTALS

A. Shop drawings and product data as described in Section 01340.

1.04 PRODUCT HANDLING

A. Protection: Use all means necessary to protect the materials of this Section before, during and after installation.

B. Storage: The fabric shall be wrapped in a heavy duty protective coating. The coating shall be capable of protecting the fabric from mud, dust, dirt, debris and sunlight. The fabric shall not be exposed to temperatures exceeding 140 degrees F.

C. Replacements: In the event of damage, immediately make all repairs and replacements necessary subject to the approval of the Engineer, and at no additional cost to the Owner.

PART 2: PRODUCT

2.01 FILTER FABRIC

A. General

1. Filter fabrics shall be composed of strong rot-proof synthetic fibers formed into either woven or nonwoven fabric. The fabric shall contain stabilizers and or inhibitors for protection against damage due to exposure to direct sunlight. The fabric shall be of stable construction. Fibers shall maintain their relative position, in the fabric, under normal handling, installation, and service. Edges of the fabric shall be finished to prevent the outer yarn from pulling away from the fabric.

2. Fabrics shall be free of defects and or flaws which would affect their physical or filtering properties.

3. Fabrics may be manufactured with pockets for posts, hems with cord, or with posts pre-attached using staples or button head nails.

4. The manufacturer shall have either an approved color mark yarn in the fabric, or label the fabric with the company's name at minimum 100-foot intervals.

B. Type A Filter Fabric

1. Type A filter fabric shall be 36" wide. Woven fabric construction shall allow slit tape yarns in one direction (warp or fill) only. The fabric shall meet the following physical and dimensional requirements.

Tensile Strength (ASTM D-4632) Warp	120 lbs.
Tensile Strength (ASTM D-4632) Fill	100 lbs.
Elongation (ASTM D-4632)	40% Max
Apparent Opening Size (ASTM D-4751)	30
Flow Rate Min	25 Gal/Min/Ft^2

2. Fabric ultraviolet stability shall conform to ASTM D-4632 after 300 hours weathering in accordance with ASTM D-4355. The fabric bursting strength shall be no less than 175 PSI when tested in accordance with ASTM D-3786 diaphragm bursting strength tester.

C. Type B Filter Fabric

1. Type B filter fabric shall be 22" wide. Type "B" shall meet the same physical requirements as type A listed above, with the exception of width.

D. Type C Filter Fabric

1. Type C filter fabric shall be 36" wide of a non-calendered woven fabric constructed of monofilament yarns or fibrillated yarn textiles only. The fabric shall meet the following physical and dimensional requirements.

Tensile Strength (ASTM D-4632) Warp	260 lbs
Tensile Strength (ASTM D-4632) Fill	180 lbs
Elongation (ASTM D-4632)	40% Max

Apparent Opening Size (ASTM D-4751)	#30
Flow Rate Min	70 Gal/Min/Ft^2

2. Fabric ultraviolet stability shall conform to ASTM D-4632 after 300 hours weathering in accordance with ASTM D-4355. The fabric bursting strength shall be no less than 175 PSI when tested in accordance with ASTM D-3786 diaphragm bursting strength tester.

E. Approved Manufacturers

1. Manufacturer’s products must either be on the Georgia Department of Transportation "Qualified Products List 36" (latest version) or have the Engineer's prior approval.

2.02 POSTS AND WOVEN WIRE SUPPORTS

A. Type "A" Fence

1. Posts shall be a minimum of 4 feet long and constructed of either wood or steel. Soft wood posts shall be at least 3" in diameter or a nominal 2" X 4" straight enough to provide a fence without noticeable misalignment. Hard wood posts shall be 1-1/2" X 1-1/2" or have a cross sectional area of no less than 2.25 inches square. Steel posts shall be "U", "T", or "C" shapes with a minimum weight off 1.3 pounds per foot, and have projections for fastening the fence to the posts. The maximum post spacing for Type "A" fencing shall be 6 feet.

B. Type "B" Fence

1. Posts shall be a minimum of 3 feet long and constructed of either wood or steel. Soft wood posts shall be at least 2" in diameter or a nominal 2" X 2" straight enough to provide a fence without noticeable misalignment. Hard wood posts shall be 1" X 1" or have a cross sectional area of no less than 1-inch square. Steel posts shall be "U", "T", or "C" shapes with a minimum weight off .75 pounds per foot. The maximum post spacing for Type "B" fencing shall be 6 feet.

C. Type "C" Fence

1. Posts shall be a minimum of 4 feet long and constructed of steel. Posts shall be "U", "T", or "C" shapes with a minimum weight off 1.3 pounds per foot, and have projections for fastening the fence to the posts. The maximum post spacing for Type "C" fencing shall be 4 feet.

2. Woven wire fence shall be used with Type "C" fence. The wire fence fabric shall be at least 32" high and have at least 6 horizontal wires. Vertical wires shall have a maximum spacing of 12 inches. The top and bottom wires shall be at least 10 gauges and all other wires shall be at least 12.5 gauge.

3. The filter fabric shall be attached to the top of the woven wire fence at the midpoint between posts.

2.03 FASTENERS FOR WOODEN POSTS

A. Wire Staples

1. Wire staples shall be 17 gauge minimum, have a crown of at least 3/4" inch wide and legs at least 1/2" long. Staples shall be evenly spaced at least 5 per post for Type "A" fence, 4 per post for Type "B" fence.

B. Nails

1. Nails shall be 14 gauge minimum, 1" long with 3/4" button heads. Nails shall be evenly spaced with at least 5 per post for Type "A" fence, 4 per post for type "B" fence.

PART 3: INSTALLATION

3.01 GENERAL

A. The contractor shall install temporary silt fence as shown on the plans specified herein, or as directed by the Engineer.

3.02 INSTALLATION

A. Excavate a trench to a depth of 6" by mechanical means. Excavate by hand if mechanical excavation is not possible.

B. Begin post installation at the center of the low point of the fencing run. Space post according to fence type and set to a depth of at least 18". Where ground conditions will not allow a depth of 18", secure posts well enough to prevent overturning by sediment loading.

C. Attach filter fabric to posts by wire, cord, pockets, staples, nails, or other acceptable means. The fabric shall overlap at least 18" at all splice joints. The filter fabric shall be attached so that 6" - 8" minimum fabric is left at the bottom to be buried.

D. Install the fabric in the trench with 2-4 inches across the trench bottom in the upstream direction; install the remaining 4-6 inches against the side of the trench. Backfill and compact so that no flow can pass under the barrier.

3.03 INSPECTION OF SILT FENCING

A. Upon completion of installation the Engineer or local government authority shall inspect the silt fencing for proper installation, flaws, defects, rips, holes, or other damage that may have occurred. The contractor shall repair or replace the damaged portions as directed by the engineer or local government authority.

3.04 MAINTENANCE OF SILT FENCING

A. The contractor shall maintain the silt fence until the project is accepted or the fence is removed. Maintenance of the fence shall include; removal and disposal of silt accumulations at the silt fence, replacement of damaged or deteriorated filter fabric, repair or replacement of fence posts, and the installation of additional fencing should the fencing installed prove to be inadequate.

B. Silt shall be cleaned out once it has accumulated to one-half the height of the silt fencing.

3.05 REMOVAL OF SILT FENCING

A. Silt fencing shall remain in place unless the Engineer or local government authority directs removal. Silt fencing that has been removed shall be the property of the contractor and may be reused at another location if in good condition. Damaged or otherwise unwanted silt fencing shall be removed from the site and disposed of properly.

B. After silt fence removal the contractor shall dress out the area and grass according to the specifications Section 02486.

END OF SECTION

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SECTION 02271

RIP RAP

PART 1: GENERAL

1.01 SCOPE OF WORK

A. The work of this section consists of furnishing and hand placing stone riprap for embankment protection.

B. All rip rap shall be installed over a geotextile fabric

1.02 SUBMITTALS

A. Submit in accordance with Section 01300.

B. Manufacturer's product data and installation instructions for geotextile fabric.

PART 2: PRODUCTS

2.01 GEOTEXTILE FABRIC

A. Fabric shall be permeable synthetic material, having the following properties:

1. Grab tensile strength, shall be 200 pounds minimum, tested in accordance with ASTM D1682.

2. Grab elongation shall be 15-50% as tested in accordance with ASTM D1682.

3. Burst strength shall be 500 lbs. as tested in accordance with ASTM D751.

B. Fabric shall be in accordance with Georgia DOT Standard Specification (latest edition), Section 710.

2.02 RIP RAP

A. Rip rap shall be well-graded angular quarry stones, sound and hard, resistant to water and weathering.

B. Stones shall be Georgia DOT Standard Specification (latest edition), Section 805 Type 3 or Type 1 as called for on the plans. Where not specifically called out use Type 3.

PART 3: EXECUTION

3.01 EXCAVATION

A. Excavate foundation as shown and as specified in the Georgia DOT Standard Specifications, (latest edition).

B. Obtain Engineer's approval of foundation before placing geotextile fabric or riprap.

C. Repair or replace fabric that has been damaged due to stone placement. Re-lay fabric that becomes displaced during stone placement.

3.02 GEOTEXTILE FABRIC

A. Place on smooth, uniform slope, loosely enough to conform to minor surface irregularities. Follow manufacturer's recommendations for making laps and for fastening and securing.

3.03 HAND LAID RIPRAP

A. Place largest rocks at bottom of slope. Arrange by hand to interlock and form a substantial bond. Rip rap shall be reasonably uniform and free from bulges, humps, or cavities. Use spalls to fill voids.

END OF SECTION

SECTION 02486

GRASSING AND MULCHING

PART 1: GENERAL

1.01 WORK INCLUDED

A. This work shall consist of ground preparation, furnishing and planting, seeding, fertilizing, sodding and mulching of all disturbed areas.

B. Areas to be grassed:

1. All graded or disturbed areas within the construction limits where natural vegetation has been removed except for areas to be paved.

2. All existing grassed areas within the final fenced area of the site shall be regrassed to meet the requirements of this specification.

1.02 RELATED WORK

Earthwork: Section 02200.

1.03 JOB CONDITIONS

Schedule work to comply with requirements for erosion control.

PART 2: PRODUCTS

2.01 SEED

GDOT Section 890.2.01.

2.02 FERTILIZER

Commercial grade.

2.03 AGRICULTURAL LIME

GDOT Section 882.2.01.

2.04 MULCH

GDOT Section 893.2.02.

PART 3: EXECUTION

3.01 STAND OF GRASS REQUIRED

It is the intent of this specification that the Contractor is obliged to deliver a satisfactory stand of perennial grass before final payment will be made. If it is necessary to repeat any or all of the work, including plowing, fertilizing, watering and seeding, the Contractor shall nevertheless repeat these operations as a part of this contract until a satisfactory stand is obtained. For the purpose of seeding, a satisfactory stand of grass is herein defined as a full cover, over the areas to be seeded, with grass that is alive and growing,

leaving no bare spots larger than one square foot. Bare spots shall be scattered and the total bare areas should not comprise more than 1/100 of any given area.

3.02 LIMING AND GROUND PREPARATION

After the area to be seeded has been brought to finished grade, lime, shall be uniformly distributed at a rate of 1 to 2 tons per acre over the seeding area, depending on soil test, with a mechanical spreader. The ground shall be prepared by plowing, disking and harrowing to a depth of at least 4 inches until these areas are friable, well pulverized and the lime is uniformly mixed with the soil. All irregularities in the surface shall be smoothed out. All roots and stones larger than 3 inches to any dimension, and all other foreign material detrimental to final grading, proper bonding or the proper growth of the planting, shall be removed.

3.03 FIRST APPLICATION OF FERTILIZER

Commercial fertilizer grades 4-12-12, 6-12-12, or 5-10-15 shall then be distributed uniformly at the rate of 1,500 pounds per acre and shall be uniformly mixed with the soil to a depth of at least 4 inches by disking, harrowing or by other methods acceptable to the Engineers. Fertilizer shall not be applied when the wind makes it difficult to get satisfactory distribution.

3.04 SEEDING

The seed shall be a mixture as shown in the table below, and shall be applied at the rates shown in the table below:

Seed Application

Season	Seed Type	Pounds per Acre
Jan. 1-May 15	Unhulled Common Bermuda	45
Jan. 1-May 15	Kentucky 31 Fescue	150
May 16-Sept. 1	Hulled Common Bermuda	75
Sept. 2-Dec. 31	Unhulled Common Bermuda	45
Sept. 2-Dec. 31	Kentucky 31 Fescue	150

The seed shall be uniformly sown by approved mechanical power drawn drills or, in small areas, by mechanical hand seeders. The seeds shall be covered and compacted to a depth of 1/8 to 1/2 inch by means of a cultipacker and an empty traffic roller or another roller weighing less than 3 tons. Broadcast seeding shall not be done when the wind makes it difficult to get satisfactory distribution.

3.05 MOISTURE

Seed shall not be sown unless the soil has the optimum moisture content or more through a depth of at least 4 inches, nor shall it be sown when there is frost in the ground. The Engineers have the authority to postpone seeding at any time when weather and moisture conditions are not favorable.

3.06 MULCH

All areas to be seeded (except those to be sprigged and over-seeded) shall be uniformly mulched in a continuous blanket immediately after seeding. The rate of application will correspond to a depth of at least three quarters of an inch and not more

than one and one half inches, according to the texture and moisture content of the mulch material. It is intended that mulch shall allow some sunlight to penetrate and air to circulate, at the same time shading the ground, reducing erosion and conserving soil moisture.

3.07 WATERING

After the seeds have been sown, the soil will be maintained in a moist state until seed germination has occurred. After germination, if there is not enough moisture in the soil to insure adequate plant growth, then water shall be applied until an adequate moisture content has been reached. Water shall not be applied when there is danger of freezing.

3.08 MAINTENANCE

The Contractor will be required to do all maintenance necessary to keep all seeded areas in a satisfactory condition until the work is finally accepted. This includes mowing, repairing washes that occur, and additional seed, fertilizer and water if they are needed. Mowing will be required at most four weeks apart during growing season.

3.09 STAND OF GRASS

If, after a suitable growth period, a satisfactory stand of grass is not evident, the unsatisfactory areas shall be reseeded, including any additional ground preparation and fertilizing necessary, using the type of seed specified.

END OF SECTION

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SECTION 02513

ASPHALT CONCRETE PAVING

PART 1: GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, equipment and materials required to complete all asphalt concrete paving as shown on the Drawings.

1.02 RELATED WORK

A. Earthwork is included in Section 02200.

1.03 SUBMITTALS

A. Submit shop drawings to the Engineer in accordance with Section 01340.

B. Samples: Provide samples of materials for laboratory testing and job-mix design

C. Test Reports: Submit laboratory reports for following materials tests:

1. Coarse and fine aggregates from each material source and each required grading:
    a. Sieve Analysis: ASTM C 136 (AASHTO 27).
    b. Unit Weight of Slag: ASTM C 29 (AASHTO 19).
    c. Soundness: ASTM C 88 (AASHTO 104) for surface course aggregates only.
    d. Sand Equivalent: ASTM D 2419 (AASHTO 176).
    e. Abrasion of Coarse Aggregate: ASTM C 131 (AASHTO 96), for surface course aggregates only.
2. Asphalt cement for each penetration grade:
    a. Penetration: ASTM D 5 (AASHTO 49).
    b. Viscosity (Kinematic): ASTM D 2170 (AASHTO 201).
    c. Flash Point: ASTM D 92 (AASHTO 48).
    d. Ductility: ASTM D 113 (AASHTO 51).
    e. Solubility: ASTM D 4 (AASHTO 44).
    f. Specific Gravity: ASTM D 70 (AASHO T 43).
3. Job-mix design mixtures for each material or grade:
    a. Bulk Specific Gravity for Coarse Aggregate: ASTM C 117 (AASHTO 85).
    b. Bulk Specific Gravity for Fine Aggregate: ASTM C 128 (AASHTO 84).
4. Uncompacted asphalt concrete mix: Maximum Specific Gravity: ASTM D 2041 (AASHTO 209).
5. Compacted asphalt concrete mix:

a. Bulk Density: ASTM D 1188 (AASHTO 166).

b. Marshall Stability and Flow: ASTM D 1559.

6. Density and voids analysis:

a. Provide each series of asphalt concrete mixture text specimens, in accordance with A.I. MS-2 "Mix Design Methods for Asphalt Concrete."

b. Use Marshall method of mix design unless otherwise directed or acceptable to the Engineer.

c. Report the quantity of absorbed asphalt cement in pounds of dry aggregate, percent air voids, and percent voids in mineral aggregate.

7. Sampling and testing of asphalt concrete mixtures for quality control during paving operations:

a. Uncompacted asphalt concrete mix.

1) Asphalt Cement Content: ASTM D 2172 (AASHTO 164).

2) Penetration of Recovered Asphalt Cement: ASTM D 5 (AASHTO 49).

3) Ductility of Recovered Asphalt Cement: ASTM D 113 (AASHTO 51)

b. Compacted asphalt concrete mix:

1) Bulk Density: ASTM D 1188 (AASHTO 166).

2) Marshall Stability and Flow: ASTM D 1559.

c. Perform at least one test for each day's paving.

1) Asphalt plant inspection: ASTM D 290.

2) Asphalt concrete materials not complying with specified requirements will not be permitted in the work.

1.04 QUALITY ASSURANCE

A. Qualifications of Asphaltic Concrete Producer

1. Use only materials that are furnished by a bulk asphalt concrete producer regularly engaged in production of hot-mix, hot-laid asphalt concrete

B. Requirements of Regulatory Agencies: Comply with applicable requirements of:

1. The City of Canton, Georgia.

2. State of Georgia, Department of Transportation, Standard Specifications for Highways and Bridges, latest edition.

1.05 JOB CONDITIONS

A. Weather Limitations:

1. Apply bituminous prime and tack coats only when the ambient temperature in the shade is above 50 degrees Fahrenheit (°F) and when the temperature has not been below 35 °F for 12 hours immediately prior to application.

2. Do not apply when the base surface is wet or contains an excess of moisture that would prevent uniform distribution and the required penetration.

3. Construct asphalt concrete surface course only when atmospheric temperature is above 40 °F, when the underlying base is dry, and when weather is not rainy.

4. Base course may be placed when air temperature is not below 30 °F and rising, when acceptable to the Engineer.

B. Grade Control: Establish and maintain the required lines and grades, including crown and cross-slope, for each course during construction operations.

C. Traffic Control:

1. Maintain vehicular and pedestrian traffic during paving operations, as required for other construction activities.

PART 2: PRODUCTS

2.01 MATERIALS

A. Crushed Aggregate Base Course - Sound, durable particles of crushed stone and screenings.

1. Coarse aggregate: Angular particles of uniform density, percentage of wear not to exceed 65 after 500 revolutions as determined by ASTM C131.

2. Fine aggregate: Angular particles produced by crushing stone that meets the requirements for wear and soundness specified for course aggregate.

3. Crushed stone shall meet the requirements of Georgia DOT Standard Specifications, latest edition, for Class A or B stone.

B. Aggregate for Asphalt Concrete - General

1. Sound, angular crushed stone or crushed gravel: ASTM D 692.

2. Sand, stone, or slag screening: ASTM D 1073.

3. Provide aggregate in gradations for various courses to comply with local highway standards.

C. Surface Course Aggregates:

1. Provide natural sand, unless sand prepared from stone, slag, or gravel or combinations are required to suit local conditions.

D. Asphalt Cement: Comply with ASTM D 946 for 85 to100 penetration grade.

E. Prime Coat

1. Cut-back liquid asphalt.

2. Medium-Curing type: ASTM D 2027, Grade MC-70.

F. Tack Coat: Emulsified asphalt.

2.02 ASPHALT-AGGREGATE MIXTURES

A. Job-mix criteria:

1. Provide job-mix formulas for each required asphalt-aggregate mixture.
2. Establish a single percentage of aggregate passing each required sieve size, a single percentage of asphalt cement to be added to aggregate, and a single temperature at which asphalt concrete is to be produced.
3. Comply with the mix requirements of local governing highway standards.
4. Maintain material quantities within allowable tolerances of the governing standards.

2.03 TRAFFIC AND PARKING MARKING MATERIALS

A. Traffic and parking lane markings shall be Thermoplastic Traffic Stripe, Section 653.2, Georgia Department of Transportation (GDOT) Standard Specifications for Roads and Bridges, latest edition.

B. Sealing Primer and the proportions used shall be as recommended by the manufacturer of the thermoplastic compound.

PART 3: EXECUTION

3.01 SURFACE PREPARATION

A. Subbase Preparation:

1. The CONTRACTOR shall remove from the area all organic substance encountered to a depth of 6-in or 8-in, as shown on the Drawings, below the surface of the proposed subgrade. The entire area shall be plowed and dragged prior to placing a stabilizing additive, if required to meet minimum bearing value.
2. Subbase shall be compacted to a minimum density of 95 percent of the maximum as determined by the Modified Proctor Density AASHTO T180 and shall have a minimum bearing value of 60 pounds per square inch.

B. Base Course:

1. Check subgrade for conformity with elevations and section immediately before placing base material.
2. Place base material in compacted layers not more than 6-inches thick, unless continuing tests indicate the required results are being obtained with thicker layers.
3. In no case will more than 8-inches of compacted base be placed in one lift.
4. Spread, shape, and compact all base material deposited on the subgrade during the same day.
5. Compact base course material to not less than 95 percent of maximum density: ASTM D 1557, Method D (98 percent maximum density: AASHTO T-180.)
6. Test density of compacted base course: ASTM D 2167.

7. One test for each 250-sq yd of in-place material shall be conducted, but in no case not less than one daily for each layer.

C. Loose and Foreign Material:

1. Remove loose and foreign material from compacted subbase surface immediately before application of paving.

2. Use power brooms or blowers, and hand brooming as required.

3. Do not displace subbase material.

D. Prime Coat:

1. Uniformly apply at rate of 0.20 to 0.5 gal/sq yd over compacted and cleaned subbase surface.

2. Apply enough material to penetrate and seal, but not flood the surface.

3. Allow to cure and dry as long as required to attain penetration and evaporation of volatile, and in no case less than 24 hours unless otherwise acceptable to the Engineer.

4. Blot excess asphalt with just enough sand to prevent pick-up under traffic.

5. Remove loose sand before paving.

E. Tack Coat:

1. Dilute material with equal parts of water and apply to contact surfaces of previously constructed asphalt concrete or Portland cement concrete and similar surfaces.

2. Apply at rate of 0.05 to 0.15 gal/sq yd of surface.

3. Apply tack coat by brush to contact surfaces of structures projecting into or abutting asphalt concrete pavement.

4. Allow surfaces to dry until material is at condition of tackiness to receive pavement.

3.02 PREPARING THE MIXTURE

A. Comply with ASTM D 995 for material storage, control, and mixing, and for plant equipment and operation.

B. Stockpiles:

1. Keep each component of the various-sized combined aggregates in separate stockpiles.

2. Maintain stockpiles so that separate aggregate sizes will not be intermixed and to prevent segregation.

C. Heating:

1. Heat the asphalt cement at the mixing plant to viscosity at which it can be uniformly distributed throughout mixture.

2. Use lowest possible temperature to suit temperature-viscosity characteristics of asphalt.

3. Do not exceed 350 °F.

D. Aggregate:

1. Heat-dry aggregates to reduce moisture content to not more than 2.0 percent.

2. Deliver dry aggregate to mixer at recommended temperature to suit penetration grade and viscosity characteristics of asphalt cement, ambient temperature, and workability of mixture.

3. Accurately weigh or measure dry aggregates and weigh or meter asphalt cement to comply with job-mix formula requirements.

E. Mix aggregate and asphalt cement to achieve 90-95 percent of coated particles for base mixtures and 85-90 percent of coated particles for surface mixture, when tested in accordance with ASTM D 2489.

F. Transporting:

1. Transport asphalt concrete mixtures from mixing site in trucks having tight, clean compartments.

2. Coat hauling compartments with a lime/water mixture to prevent asphalt concrete mixture from sticking.

3. Elevate and drain compartment of excess solution before loading mix.

4. Provide covers over asphalt concrete mixture when transporting to protect from weather and to prevent loss of heat.

5. During periods of cold weather or for long-distance deliveries, provide insulation around entire truck bed surfaces.

3.03 EQUIPMENT

A. Provide size and quantity of equipment to complete the work specified within project time schedule.

B. Bituminous Pavers: Self-propelled that spread hot asphalt concrete mixtures without tearing, shoving or gouging surfaces, and control pavement edges to true lines without use of stationary forms.

C. Rolling Equipment:

1. Self-propelled, steel-wheeled and pneumatic-tired rollers that can reverse direction without backlash.

2. Other type rollers may be used if acceptable to the Engineer.

D. Hand Tools: Provide rakes, lutes, shovels, tampers, smoothing irons, pavement cutters, portable heaters, and other miscellaneous small tools to complete the work specified.

3.04 PLACEMENT

A. Place asphalt concrete mixture on prepared surface, spread and strike-off using paving machine.

B. Spread mixture at a minimum temperature of 225 °F.

C. Inaccessible and small areas may be placed by hand.

D. Place each course at thickness so that when compacted it will conform to the indicated grade, cross-section, finish thickness, and density indicated.

E. Paver Placing:

1. Unless otherwise directed, begin placing along centerline of areas to be paved on crowned section, and at high side of sections on one-way slope, and in direction of traffic flow.

2. After first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips.

3. Complete base course for a section before placing surface courses.

4. Place mixture in continuous operation as practicable.

F. Hand Placing:

1. Spread, tamp, and finish mixture using hand tools in areas where machine spreading is not possible, as acceptable to Engineer.

2. Place mixture at a rate that will insure handling and compaction before mixture becomes cooler than acceptable working temperature

G. Joints:

1. Carefully make joints between old and new pavements, or between successive days' work, to ensure a continuous bond between adjoining work.

2. Construct joints to have same texture, density and smoothness as adjacent sections of asphalt concrete course.

3. Clean contact surfaces free of sand, dirt, or other objectionable material and apply tack coat.

4. Offset transverse joints in succeeding courses not less than 24-in.

5. Cut back edge of previously placed course to expose an even, vertical surface for full course thickness.

6. Offset longitudinal joints in succeeding courses not less than 6-in.

7. When the edges of longitudinal joints are irregular, honeycombed, or inadequately compacted, cut back unsatisfactory sections to expose an even, vertical surface for full course thickness.

3.05 COMPACTION

A. Provide sufficient rollers to obtain the required pavement density.

B. Begin rolling operations as soon after placing when the mixture will bear weight of roller without excessive displacement.

C. Do not permit heavy equipment, including rollers to stand on finished surface before it has thoroughly cooled or set.

D. Compact mixture with hot hand tampers or vibrating place compactors in areas inaccessible to rollers.

E. Start rolling longitudinally at extreme lower side of sections and proceed toward center of pavement. Roll to slightly different lengths on alternate roller runs.

F. Do not roll centers of sections first under any circumstances.

G. Breakdown Rolling:

1. Accomplish breakdown or initial rolling immediately following rolling of transverse and longitudinal joints and outside edge.

2. Operate rollers as close as possible to paver without causing pavement displacement.

3. Check crown, grade, and smoothness after breakdown rolling.

4. Repair displaced areas by loosening at once with lutes or rakes and filling, if required, with hot loose material before continuing rolling.

H. Second Rolling:

1. Second rolling shall be made by a traffic roller.

2. Follow breakdown rolling as soon as possible, while mixture is hot and in condition for compaction.

3. Continue second rolling until mixture has been thoroughly compacted.

I. Finish Rolling:

1. Perform finish rolling while mixture is still warm enough for removal of roller marks.

2. Continue rolling until roller marks are eliminated and course has attained specified density.

J. Patching:

1. Remove and replace defective areas.

2. Cutout and fill with fresh, hot asphalt concrete.

3. Compact by rolling to specified surface density and smoothness.

4. Remove deficient areas for full depth of course.

5. Cut sides perpendicular and parallel to direction of traffic with edges vertical.

6. Apply tack coat to exposed surfaces before placing new asphalt concrete mixture.

3.06 FRAME ADJUSTMENTS (IF APPLICABLE)

A. Placing Frames:

1. Surround frames set to elevation with a ring of compacted asphalt concrete base prior to paving.

2. Place asphalt concrete mixture up to 1-in below top of frame, slope to grade, and compact by hand tamping.

B. Adjust frames to proper position to meet paving.

C. If permanent covers are not in place, provide temporary covers over openings until completion of rolling operations.

D. Set cover frames to grade, flush with surface of adjacent pavement.

3.07 MARKING ASPHALT CONCRETE PAVEMENT

A. Cleaning:

1. Sweep surface with power broom supplemented by hand brooms to remove loose material and dirt.

2. Do not begin marking asphalt concrete pavement until acceptable to the Engineer.

B. Apply thermoplastic material as specified by Section 653.3, GDOT Std. Specifications.

1. Provide uniform straight edges.

2. Thickness shall be as required by Sec. 653.3.05.A.7 GDOT Std. Specifications.

3.08 CLEANING AND PROTECTION

A. Cleaning: After completion of paving operations, clean surfaces of excess or spilled asphalt materials to the satisfaction of the Engineer.

B. Protection:

1. After final rolling, do not permit vehicular traffic on asphalt concrete pavement until it has cooled and hardened, and in no case sooner than 6 hours.

2. Provide barricades and warning devices as required to protect pavement.

3. Cover openings of structures in the area of paving until permanent coverings are placed (if applicable).

3.09 EXISTING PAVING

Where existing paving is shown to be re-paved, the contractor shall remove and patch any paving damaged due to construction. Patching of damaged paving shall consist of removing all broken asphalt; installing base per the detail shown on the plans or recompacting if not damaged; installing the binder course (along with prime coat) to bring the damaged paving up to grade with the existing paving; installing the surface course over the existing paving or repaired section.

END OF SECTION

SECTION 02515

WALKWAYS

PART 1: GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, and equipment necessary to complete all concrete walkways and related items shown on the Drawings and specified herein; or where applicable if disturbed during the construction.

1.02 REFERENCED SPECIFICATIONS

A. All materials and methods of construction shall conform to the requirements of the "Georgia Department of Transportation, Standard Specifications for Road and Bridge Construction, latest edition."

1.03 SUBMITTALS

A. Submit in accordance with Section 01340, complete shop drawings showing dimensions and layouts of sidewalks and reinforcement for concrete work.

PART 2: PRODUCTS

2.01 MATERIALS

A. Concrete Materials:

1. Concrete for work under this section shall be same as specified in Division 3, but in no case less than 3,000 psi at 28 days.

2. Reinforcing bars shall be deformed type bars conforming to AASHTO M31 Grade 40. All reinforcing steel shall be shop fabricated, of size, cross-section and arrangement as described on approved shop drawings.

3. Welded wire fabric shall be as shown on the drawings and shall conform to all requirements of AASHTO M55.

4. Expansion joint material shall be 1/2-inch or 3/4-inch thickness where shown, bituminous type meeting AASHTO Spec. M-213-65.

5. Joint sealant shall be bituminous type, 1/2-inch thick conforming to AASHTO M-213-65.

PART 3: EXECUTION

3.01 INSTALLATION

A. Sub-grade shall be thoroughly compacted as specified in Earthwork Section 02200.

B. Forms shall conform to the shapes, lines and dimensions of the walkways as called for on the plans and shall be substantial com sufficiently tight to prevent leakage

of mortar. They shall be properly braced or tied together so as to maintain position and shape.

C. Finishing

1. Float concrete until 1/4-inch cement gel is brought to surface; steel trowel until dense surface is obtained.

2. Finish with broom at right angles to alignment of walk, then round all exterior edges with 3/4-inch radius after brooming.

D. Curing

1. Cover walks with sand, sawdust or shavings and keep wet for 3 days.

2. Cover walks until final clean up to prevent damage.

3. Other methods of curing may be used subject to approval of the Engineer prior to implementation.

E. Concrete walks shall be constructed to the lines, widths, grades and thickness as shown on the Drawings, but sloped not less than 1/8 inch per foot in direction of water flow. Concrete shall be placed on thoroughly compacted subgrade, having smooth surface and kept moist until time concrete is placed.

1. Expansion joints shall be installed at all intersections with other walks, at head and bottom of steps, curbs and maximum 12 feet O.C. in runs. Expansion material shall be 1/2-inch thick but not less than 1/4 inch, by depth of concrete; 3/4 inch thick where abutting curbs and gutters (if any), and at parking bays. Expansion material shall extend from bottom of walk slab to within 1/2 inch of top, to be filled with poured joint filler.

2. Dummy grooves shall be 1/2 inch, with 1/2-inch radius, spaced 4 feet O.C., installed same as expansion joints immediately following brooming.

F. Local conditions, codes, and practices shall govern all drive cuts, aprons and related curbs and gutters (if any). The Contractor shall obtain permission for, coordinate with County officials, and secure and pay for all permits, fees and licenses necessary for proper execution of the work.

3.02 CLEANUP

A. At the completion of the work, the Contractor shall clean up all scraps, rubbish and surplus materials caused by this work and haul them away from the site and leave job in a neat, clean and orderly condition.

END OF SECTION

SECTION 02612

REINFORCED CONCRETE DRAIN PIPE

PART 1: GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals necessary and install and test reinforced concrete pipe complete as shown on the Drawings and as specified herein.

1.02 RELATED WORK

A. Excavation and backfilling are included in Earthwork Section 02200.

B. Precast Concrete Utility Structures are included in Section 03400.

C. Concrete and Reinforcement are included in Division 3.

1.03 SUBMITTALS

A. Within 30 days of the Notice to Proceed submit the name of the pipe and fitting supplier and a list of materials to be furnished.

B. Submit shop drawings showing layout and details of reinforcement, joint, method of manufacture and installation of pipe, specials and fittings, and a schedule of pipe lengths by diameter for the entire job.

C. Submit with the shop drawings certification from the manufacturer that the fine and coarse aggregates used in manufacture of the concrete pipe comply with the requirements of this Section.

D. Prior to each shipment of pipe, submit the manufacturer's certification that the pipe conforms to the ASTM Standards specified herein.

E. Installation and Repair Recommendations

1. Submit manufacturer's recommended installation and repair methods and procedures.

2. Repairs shall be performed by the manufacturer using specifically trained personnel and shall proceed only after approval of the Engineer or Owner.

1.04 REFERENCE STANDARDS

A. American Society for Testing and Materials (ASTM)

1. ASTM C33 - Standard Specification for Concrete Aggregates.

2. ASTM C76 - Standard Specification for Reinforced Concrete Culvert, Storm Drain and Sewer Pipe.

3. ASTM C150 - Standard Specification for Portland Cement.

4. ASTM C361 - Standard Specification for Reinforced Concrete Low-Head Pressure Pipe.

5. ASTM C443 - Standard Specification for Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets.

6. ASTM E329 - Standard Specification for Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction.

B. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.05 QUALITY ASSURANCE

A. The manufacturer shall perform the acceptance tests specified in ASTM C76.

B. Reinforced concrete pipe manufactured for this Contract may be inspected at the plant for compliance with this Section by an independent testing laboratory provided by the OWNER. The manufacturer's cooperation in these inspections shall be required. The cost of this inspection of all pipe approved for this Contract, plus the cost of inspection of a reasonable amount of disapproved pipe will be borne by the OWNER.

C. Inspection of the pipe may be made by the Engineer or Owner after delivery. The pipe shall be subject to rejection at any time on account of failure to meet any of the requirements specified herein, even though pipes may have been accepted as satisfactory at the place of manufacture. Pipe rejected after delivery shall be marked for identification and shall immediately be removed from the job.

D. Manufacturer or supplier of reinforced concrete pipe shall store completed sections off the ground using wood blocks, pallets, or other appropriate means. They shall be placed so there will be ample space between rows and individual pieces including enough clearance above and below the stored sections to allow full view of walls and joint ends for inspection purposes.

1.06 PRODUCT DELIVERY, HANDLING, AND STORAGE

A. Materials and equipment shall be delivered, handled, and stored in accordance with Section 01600.

B. Delivery of pipe shall be coordinated with installation or shall be unloaded with proper equipment along the line of work, outside trench limits near as practicable to point of final placement, facing in proper direction and properly wedged secure. It shall be stored away from brush, poison oak or ivy and in an accessible area for inspection.

C. Reinforced concrete pipe, specials and appurtenances shall be unloaded and handled with a crane or backhoe of adequate capacity equipped with appropriate slings to protect the material from damage.

D. If damage occurs and is deemed repairable, it shall be repaired as directed by the Engineer in accordance with manufacturer's recommendations. If damage is not repairable in the opinion of the Engineer, such pipe and specials will be rejected and shall be removed and replaced at the Contractor's expense.

PART 2: PRODUCTS

2.01 REINFORCED CONCRETE PIPE

A. Except as otherwise specified herein, pipe shall conform to ASTM C76. The pipe interior shall be smooth and even, free from roughness, projections, indentations, offsets, or irregularities of any kind. The concrete mass shall be dense and uniform.

B. Cement shall be non-air-entraining Portland cement conforming to ASTM C150, Type II. The use of any admixture shall be subject to the specific approval of the Engineer.

C. Fine aggregate shall consist of washed inert natural sand conforming to the requirements of ASTM C33, except for gradation, with a maximum loss of 8 percent when subjected to 5 cycles of the soundness test using magnesium sulfate. Coarse aggregate shall consist of well-graded crushed stone or washed gravel conforming to the requirements of ASTM C33, except for gradation, with a maximum loss of 8 percent when subjected to 5 cycles of the soundness test using magnesium sulfate.

D. The 28-day compressive strength of the concrete, as indicated by cores cut from the pipe shall be equal to or greater than the design strength of the concrete. The concrete mass shall be dense and uniform. Reinforcement shall be circular for all concrete pipe. Quadrant steel shall not be used. Reinforcement shall be installed in both the bell and the spigot. At least one circumferential reinforcement wire shall be in both the bell and spigot area and reinforcement in the bell and spigot shall be adequate to prevent damage to concrete during shipping, handling and after installation. When cores indicate that reinforcing steel has less than 85 percent bond the pipe shall be subjected to a 3-edge bearing test to 13 psi to verify strength and water tightness.

E. Pipe may be rejected for any of the following reasons:

1. Exposure of any wires, positioning spacers or chairs used to hold the reinforcement cage in position, or steel reinforcement in any surface of the pipe, except as permitted in ASTM C76.

2. Transverse reinforcing steel found to be in excess of ¼ inch out of specified position after the pipe is molded.

3. Any shattering or flaking of concrete at a crack.

4. Voids, with the exception of a few minor bugholes, on the interior and exterior surfaces of the pipe exceeding ¼ inch in depth unless properly and soundly pointed with mortar or other approved material.

5. Unauthorized application of any wash coat of cement or grout. Any pipe dressing procedures shall be subject to approval of the Engineer.

6. A hollow spot (identified by tapping the internal surface of the pipe) which is greater than 30 inches. in length or wider than 3 times the specified wall thickness. Repair of such defective areas not exceeding these limitations may be made as specified in Paragraph 2.01 Q of this Section.

7. Defects that indicate imperfect molding of concrete; or any surface defect indicating honeycomb or open texture (rock pockets) greater in size than area

equal to a square with a side dimension of 2½ times the wall thickness or deeper than two times the maximum graded aggregate size; or local deficiency of cement resulting in loosely bonded concrete. Repair of such defects not exceeding these limits may be made as specified in Paragraph 2.01 Q of this Section.

8. Any of the following:

a. A crack having a width of 0.005 to 0.01 inch throughout a continuous length of 36 inches or more.

b. A crack having a width of 0.0 to 0.03 inch or more throughout a continuous length of 1 foot or more.

c. Any crack greater than 0.005 inch extending through the wall of the pipe and having a length in excess of the wall thickness.

d. Any crack showing two visible lines of separation for a continuous length of 2 feet or more, or an interrupted length of 3 feet or more anywhere in evidence, both inside and outside.

e. Cracks anywhere greater than 0.03 inch in width.

F. The pipe shall be clearly marked as required by ASTM C76 in a manner acceptable to the Engineer. The markings may be at either end of the pipe for the convenience of the manufacturer, but for any one size shall always be at the same end of each pipe length. Pipe shall not be shipped until the compressive strength of the concrete has attained 4,000 psi.

G. Pipe shall have a minimum laying length of approximately 8 feet, except for closure and other special pieces as approved by the Engineer. Have available at the site of the work sufficient pipe of various lengths to affect closure at manholes or structures that cannot be located to accommodate standard lengths. Short lengths of pipe made for closure, etc., may be used in the pipeline at the end of construction if properly spaced. The length of the incoming and outgoing concrete pipe at each structure shall not exceed 4 feet, except where the joint is cast flush with the exterior wall of the structure, where steel wall fittings are provided or where otherwise noted on the Drawings. Maximum laying length shall not exceed 16 feet, but the installation of 16-foot lengths will depend upon the ability to handle such lengths of pipe in sheeted trenches, comply with trench width requirements, maintain the integrity of the sheeting and avoid disturbance to adjacent ground. If in the opinion of the Engineer or Owner the use of 16-foot lengths is impracticable, shorter lengths shall be used.

H. Each length of pipe shall be checked against the length noted on the shop drawings. Pipe more than 1½ inch longer than that shown on the shop drawings shall not be used on this project. Variations in length of the same pipe shall not exceed ASTM C76 requirements.

I. During manufacturing, measuring devices shall be used to assure joint assembly is within the tolerance of ASTM C76 and this Section.

J. The Engineer shall have the right to take samples of the concrete after it has been mixed, or as it is being placed in the forms or molds and to make such inspection and tests thereof as he/she may wish.

K. At the start of the work, a set of test cylinders shall be taken each day on which pipe is manufactured for the project or more often if required. This may ultimately be reduced to one set of three specimens for every 50 cubic yards of concrete placed, if the uniformity of results warrants and if approved by the Engineer or Owner. At the start of the work, a relationship shall be established between ultimate strength of test cylinders stored in a standard manner as compared to cylinders steam cured with the pipe and as compared to cores taken from the corresponding finished pipe. At least five sets of tests shall be made.

L. The Engineer shall have the right to cut cores from such pieces of the finished pipe as he/she selects for inspection and such tests as he/she may wish to apply. Holes left by the removal of cores shall be filled in an approved manner by and at the expense of the manufacturer. Core drilling shall be carried out by the pipe manufacturer at his/her expense. The number of cores shall not exceed the requirements of ASTM C76.

M. Test cores may be taken for every 500 linear feet of pipe manufactured, but not less than once each day on which pipe is manufactured for the project. Cores may be reduced to one set of two per week (or possibly fewer, but not less than one set for every 1,500 linear feet), if a satisfactory relationship is established between cores and cylinders made and cured in the standard manner. This relationship shall not vary by more than 10 percent more or less from the average ratio. Cores may be drilled in any manner which will provide a smooth core face. All pipe cylinders and cores shall be 4-in in diameter. Cores shall be carefully saw-trimmed and capped in a vertical position with a sulfur cap of minimum thickness, at least one day before being tested.

N. Core testing shall conform to Standard ASTM Methods.

O. At the time of inspection, the pipe will be carefully examined for compliance with the appropriate ASTM standard, as specified herein and shop drawings. All pipes shall be inspected for general appearance, dimension, "scratch-strength," blisters, cracks, roughness, soundness, etc. All pipes will be checked for soundness by being tapped and scratched at least once on every 50 square inches of pipe surface. The surface shall be dense and close-textured. Cores also shall serve as a basis for rejection of pipe, particularly if lamination or poor bond of reinforcement is apparent.

P. The manufacturer shall use measuring devices to assure joint assembly is within tolerances of ASTM C76 and as specified herein. If, during construction, the pipes cannot be satisfactorily joined, the manufacturer shall pre-join the pipe at the plant.

Q. Repairs

1. Unsatisfactory or damaged pipe will be either permanently rejected or returned for minor repairs. Only that pipe actually conforming to the specifications and accepted will be listed for approval, shipment and payment. Approved pipe will be so stamped or stenciled on the inside before it is shipped. All pipe that has been damaged after delivery will be rejected and if such pipe already has been laid in the trench, it shall be acceptably repaired, if permitted, or removed and replaced, entirely at the Contractor's expense.

2. Pits, blisters, rough spots, breakage and other imperfections may be repaired, subject to the approval of the Engineer or Owner, after demonstration by the

manufacturer that strong and permanent repairs result. Repairs shall be carefully inspected before final approval. Non-shrink cement mortar used for repairs shall have a minimum compressive strength of 6,000 psi at the end of 7 days and 7,000 psi at the end of 28 days, when tested in 3-inch cylinders stored in the standard manner. Epoxy mortar may be utilized for repairs subject to the approval of the Engineer.

2.02 JOINTS FOR CONCRETE PIPE

A. Joints shall be concrete and rubber tongue and groove or bell and spigot type joint conforming to ASTM C361 with provisions for using a round rubber O-Ring gasket in a recess in the spigot end of the pipe. The bevel on the bell of the pipe shall be between 1½ and 2½ degrees. The diameters of the joint surfaces that compress the gasket shall not vary from the true diameters by more than 1/16 inch.

B. The round rubber O-Ring gaskets shall conform to ASTM C443 except as otherwise specified herein. Two gaskets shall be submitted to the Engineer, if requested, for tests at least 30 days before joining any the pipe.

C. The gaskets shall be designed and manufactured so that the completed joint will withstand an internal water pressure in excess of 13 psi for a period of 10 minutes without showing any visible leakage or displacement. The pipe manufacturer shall provide facilities for testing the effectiveness of the joints against leakage and one such test may be required for each 500-foot length of pipe for each type of joint manufactured.

D. The ends of the pipe shall be made true to form and dimension and the bell shall be made by casting against steel forms. The manufacturer shall inspect all pipe joint surfaces for out-of-roundness and pipe ends for squareness. The manufacturer shall furnish to the Engineer a notarized affidavit stating all pipe meets the requirements of ASTM C76, as specified herein and the joint design.

PART 3: EXECUTION

3.01 LAYING CONCRETE PIPE

A. Care shall be taken in loading, transporting and unloading to prevent injury to the pipe or fittings and the joint surfaces. Pipe or fittings shall not be dropped. All pipe or fittings shall be examined before laying and no piece shall be installed which is found to be defective.

B. As soon as the excavation is completed to the normal grade of the bottom of the trench, place screened gravel in the trench and the pipe shall be firmly bedded in this gravel to conform accurately to the lines and grades indicated on the Drawings. Screened gravel shall conform to the requirements of Section 02200. Blocking under the pipe will not be permitted.

C. Screened gravel shall be placed and compacted to give complete vertical and lateral support for the lower section of the pipe as indicated on the Drawings. A depression shall be left in the supporting gravel at the joint to prevent contamination of the rubber gasket immediately before being forced home. Before the pipe is lowered into the trench, the spigot and bell shall be cleaned and free from dirt. Gasket and bell shall be lubricated by a vegetable lubricant that is not soluble in water, furnished by the pipe manufacturer and harmless to the rubber

gasket. The pipe shall be properly aligned in the trench to avoid any possibility of contact with the side of the trench and fouling the gasket. As soon as the spigot is centered in the bell of the previously laid pipe, it shall be forced home with jacks or come alongs. After the gasket is compressed and before the pipe is brought fully home, each gasket shall be carefully checked for proper position around the full circumference of the joint. Steel inserts shall be used to prevent the pipe from going home until the feeler gauge is used to check the final position of the gasket. The jacks or come alongs shall be anchored sufficiently back along the pipeline (a minimum of five lengths) so that the pulling force will not dislodge the pieces of pipe already in place. Only a jack or come-along shall be employed to force the pipe home smoothly and evenly and hold the pipe while backfilling is in progress. Under no circumstances shall crowbars be used nor shall any of the motor driven equipment be used.

D. As soon as the pipe is in place and before the come-along is released, backfill shall be placed as indicated on the Drawings and compacted for at least one-half the length of pipe. Not until this backfill is placed shall the come-along be released. If any motion at joints can be detected, a greater amount of backfill shall be placed before pressure is released. When pipe laying is not in progress, including lunchtime, the open ends of the pipe shall be closed by a watertight plug or other approved means.

E. Carefully regulate the equipment and construction operations such that the loading of the pipe does not exceed the loads for which the pipe is designed and manufactured. Any pipe damaged during construction operations shall promptly and satisfactorily be repaired or replaced at the Contractor's expense.

3.02 CLEANING

A. Watertight plugs shall be used in open ends of pipe and branches when installation is not in progress.

B. Pipeline shall not be used as a conductor for trench drainage.

C. Contractor shall prevent earth, water, and other material from entering the pipeline.

D. Pipeline shall be cleaned with high pressure water upon completion.

END OF SECTION

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SECTION 03100

CONCRETE FORMWORK

PART 1: GENERAL

1.01 DESCRIPTION

A. Provide all labor, material and methods necessary to fabricate, erect and remove forms to construct the cast-in-place concrete structures shown on the Contract Drawings. The Work includes but is not limited to the following:

1. Form design
2. Forms
3. Shoring
4. Ties
5. Form Coating
6. Appurtenances and accessories

B. Related Work Specified Elsewhere:

1. Concrete Reinforcement – Section 03200
2. Cast in Place Concrete – Section 03300

C. Provide all labor, material and methods necessary to fabricate, erect and remove forms to provide rustication of newly constructed cast-in-place exterior exposed concrete. The Work includes but is not limited to the following:

1. Form liners
2. Appurtenances and accessories for rustication

D. Provide a fractured finish form liner to produce a surface on the newly constructed cast-in-place exposed concrete that is substantially similar (as nearly as possible) to that found on the exterior exposed concrete of the existing facilities.

E. Concrete applied to develop the rusticated surface shall be in addition to the concrete used for the flat surface application. For example, architectural ribbing shall protrude from the flat surface and shall not be considered part of the structural integrity of the surface.

F. Apply rustication to structures as shown on the Drawings.

1.02 QUALITY ASSURANCE

A. Comply with applicable standards including, but not limited to the most recent edition of the following:

1. ACI 347 – Guide to Formwork for Concrete
2. ACI 318 – Building Code Requirement for Structural Concrete and Commentary
3. APA Form V345 – Concrete Forming
4. ANSI A10.9 – Safety Requirements for Concrete and Masonry Work

5. OSHA Regulations, Part 1926, Subpart Q – Concrete and Masonry Construction

B. Design to provide satisfactory performance under the specified operating conditions.

C. Coordinate formwork design with all trades requiring the attachment of components to formwork.

1.03 SUBMITTALS

A. Comply with Section 01340 – Shop Drawings, Product Data and Samples.

B. Provide the following information:

1. Engineering data and manufacturer's literature for the following:
   a. Form ties
   b. Spreaders
   c. Bar supports
   d. Form coatings
   e. Pre-fabricated steel forms
   f. Form liners
   g. Installation instructions for form liners
2. Form Design. Provide sizing calculations for all formwork sealed by a structural engineer registered in the State of Georgia.
   a. Design all formwork necessary to construct the cast-in-place concrete shown on the Drawings. Use a licensed structural engineer registered in the State of Georgia to design the formwork.
   b. Analyze and determine the erection stresses imposed or induced upon the structure, its elements, and the supporting foundations during all phases of the construction.
3. Shop Drawings. Show the following:
   a. Termination details
   b. Back-up, rustications, reveals, and chamfer strip locations
   c. Jointing, form tie location and placement pattern
   d. Form liner layout
4. Samples of form liners. Provide 24-inch by 24-inch sample of each potential pattern indicated for approval by Owner.

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Store form materials and accessories above ground on framework or blocking.

1. Cover with a suitable waterproof covering.
2. Provide adequate air circulation and ventilation.

B. Protect form liner material and accessories from oil, dirt, and UV exposure.

PART 2: PRODUCTS

2.01 FORMS

A. General

1. For surfaces not requiring form liners that will be exposed to view when construction is complete, use the following:
    a. Prefabricated plywood panel forms
        1) Normal: Face adjacent to concrete Grade B or better.
        2) Architectural: Face adjacent to concrete Grade B or better with plastic overlay.
    b. Job-built plywood forms
    c. Prefabricated steel forms that are lined with plywood or fiberboard.
2. For surfaces that are normally submerged or not ordinarily exposed to view, plywood or lined forms are not required.
    a. Steel or unlined wooden forms may be used.
    b. Forms are required for all extended footings.
3. For surfaces requiring form liners with ribbed architectural patterns that will be exposed to view, use the following:
    a. ABS Thermoform Plastic Form liner
    b. Rating: 1,000 psf
    c. Lin. Ft. wt: 0.7 lbs
    d. Pattern: ¾” Fractured Finish at 1½” O.C.
    e. Manufacturer: Symons by Dayton Superior
    f. Attach to formwork in accordance with form liner manufacturer’s recommendation.

B. Prefabricated Steel Forms

1. Symons “Steel Ply”
2. Universal Building Products “Quick Form”
3. Simplex “Industrial Steel Frame Forms”
4. Or equal

C. Wooden Forms

1. Plywood
    a. Product Standard PS1
    b. Waterproof
    c. Resin-bonded
    d. Exterior type Douglas fir
2. Lumber
    a. Straight

b. Dressed all sides

c. Uniform width and thickness

d. Free from knots, offsets, holes, dents and other surface defects

e. Douglas fir

f. No. 2 Grade with grade stamp clearly visible

3. Fiberboard

a. ANSI A135.4, Class 1

b. Tempered

c. Waterproof

d. Screenback

e. Concrete form hardboard

4. Chamfer Strips

a. Clear white pine

b. Plane the surface against the concrete

5. Reuse of Job Built Plywood Forms allowed only when specifically approved by the Engineer.

6. Place plywood in 48-inch widths and in uniform lengths of not less than 96 inches, except where the dimension of the member is less.

a. Use plywood panels at least 5/8” thick where plywood is attached directly to studs or joists.

b. Size and space studs to prevent bulging of the plywood sheeting.

D. Urethane Formliners

1. 100% solid urethane

2. Bonded to 0.75- inch ACX plywood

3. Lengths up to 24 feet

4. Compatible expansion and contraction characteristics

5. Custom patterns

2.02 FORM TIES

A. Use the snap cone or she-bolt with cone types as manufactured by a recognized manufacturer of concrete forming accessories.

1. Form ties to be approved by the Engineer.

2. Select cones so that they leave a hole or depression in the concrete no larger than 7/8” in diameter.

3. Do not use plain snap ties or flat bar ties, unless otherwise approved by the Engineer.

B. Ties to be of a type that will accurately tie, lock, and spread the forms.

1. Select the tie spacing to withstand concrete pressures without bulging, spreading, or lifting of the forms.

2. After removal of the external tie parts, no remaining metal to be left within 1½" of any surface.

3. Ties shall be hot dip galvanized or stainless steel only. If stainless steel ties are used, metal may be within 1" of any surface.

4. Construct permanently embedded portions of form ties that are not provided with threaded ends so that the removable ends are readily broken off without damage to the concrete.

2.03 FORM COATINGS

A. Coat forms with a non-staining form release agent before concrete placement.

B. Acceptable Form Coatings

1. Nox-Crete Products Group "Nox-Crete Form Coating"

2. L&M "Debond"

3. Dayton Superior "Clean Strip (J-1)"

4. Or equal

PART 3: EXECUTION

3.01 FABRICATION AND ERECTION

A. Fabricate, erect, and remove forms as specified herein.

1. Erect forms true to line and grade in accordance with the tolerances specified in Section 03300 – Cast-in-Place Concrete.

2. Make the forms mortar tight and sufficiently rigid to resist deflection during concrete placement.

3. Make the surfaces of forms smooth and free from irregularities, dents, sags, and holes that would deface the finished surfaces.

B. Brace or tie forms as required to maintain the desired position, shape, and alignment during and after concrete placement.

1. Size and space walers, studs, internal ties, and other form supports so that proper working stresses are not exceeded.

2. Bolt form joints tightly and ensure that they bear on solid construction.

3. Construct forms so they can be removed without hammering, wedging, or prying against the concrete.

4. Space form ties in exposed surfaces uniformly and align them in horizontal and vertical rows.

5. Design and erect the forms to produce finished surfaces that are free from offsets, ridges, waves, and concave or convex areas.

C. Thoroughly clean and repair forms that are to be reused. Do not use split, frayed, delaminated, or otherwise damaged forms.

D. Place all form panels in a neat, symmetrical pattern with horizontal joints level and continuous.

1. Mate forms to previously placed walls so as to eliminate steps or rough transitions.

2. Use the largest practical size of form panel to minimize joints and to improve rigidity.

3. Maintain the appropriate pattern where formliners are used.

E. Form beams and slabs supported by concrete columns so the column forms may be removed without disturbing supports for the beams or slabs.

F. Wherever the top of a wall will be exposed to weathering, do not extend forms on at least one side above the top of the wall. Bring these forms to true line and grade. At other locations, either bring the concrete forms to true line and grade or provide a wooden guide strip at the proper location so that the top surface can be finished with a screed or template. When there are horizontal construction joints in walls, do not extend the forms more than 2’ above the joint along one side of the wall.

G. Provide temporary openings at the bottom of column and wall forms and at other points where necessary to facilitate cleaning and inspection before concrete placement.

H. Provide a ¾-in by ¾-in chamfer formed by a wood or metal chamfer strip along all salient corners and edges of beams, columns, walls, slabs, and curbs; unless otherwise shown on the Drawings.

I. Coat steel forms and forms for exposed surfaces with a non-staining form-release agent.

1. Apply just before placement of steel reinforcement.

2. Remove surplus form-release coating from the form surface.

3. Thoroughly wet wood forms for unexposed surfaces with water in lieu of coating.

a. Wet immediately before concrete placement.

b. Do not use in freezing weather. Instead use a form-release coating.

J. Take immediate corrective action if misalignment or excessive deflection of forms or screeds occurs; or if displacement of reinforcement occurs during concrete placement.

1. Ensure that the concrete maintains acceptable lines and the structure is constructed to the required dimensions and cross sections.

2. If any forms bulge or show excessive deflection in the opinion of the Engineer, remove the concrete and both rebuild and strengthen the forms.

K. Where forms are inadequately braced or improperly built, the Engineer shall stop work until defects are satisfactorily remedied.

3.02 INSERTS, EMBEDDED PARTS AND OPENINGS

A. Provide formed openings where required for items to be embedded in or passing through concrete work.

B. Locate and set items in place which will be cast directly into concrete.

C. Coordinate the forming and placing of openings, slots, reglets, recesses, sleeves, bolts, anchors, and other inserts and components of other work with the work of other sections.

D. Install accessories in accordance with manufacturer's instructions; straight, level and plumb. Ensure items are not disturbed during concrete placement.

E. Install waterstops in accordance with manufacturer's instructions

1. Make continuous without displacing reinforcement.

2. Heat seal PVC waterstop joints watertight.

3. Protect hydrophilic waterstop from rain and moisture to avoid expansion before placing fresh concrete.

3.03 FORM CLEANING

A. Clean forms as erection proceeds to remove foreign matter.

B. Clean formed cavities of debris prior to placing concrete.

C. Flush with water or use compressed air to remove remaining foreign matter. Ensure that water and debris drain to exterior through cleanout ports.

D. During cold weather, remove ice and snow from within forms.

1. Do not use de-icing salts.

2. Do not use water to clean out forms unless formwork and concrete construction proceed within heated enclosure.

3. Use compressed air or other means to remove foreign matter.

3.04 FORM REMOVAL

A. Do not remove or disturb forms until the concrete has attained sufficient strength to safely support all dead and live loads.

1. Leave shoring beneath beams or slabs in place.

2. Reinforce as necessary to carry any construction equipment or materials placed thereon.

B. Do not remove any forms without the approval of the Engineer. In general, and under normal conditions the Engineer will approve removal of forms after the following time has elapsed:

Item	**Time after Placement**
Elevated slabs and beams	14 days**
Columns and walls	Per ACI 347*
Other concrete	3 days

*Additionally, column and wall forms shall not be removed until a job cured specimen has reached a minimum strength of 3,000 psi or 90% of the design strength.

** Additionally, elevated slabs and beam forms shall not be removed until a job cured specimen has reached a minimum of 90% of the design strength.

C. When ambient air temperatures during the curing period fall below 45 °F, remove forms based on job-cured test cylinder strength only.

D. Make additional concrete cylinders to determine whether concrete has developed required strength.

1. Make in sets of three.

2. Test earlier than 28 days, as required.

E. Take care when removing forms to avoid surface gouging, corner or edge breakage, or other damage to the concrete.

1. Repair any damaged or imperfect work immediately after form removal.

2. Make repairs as specified in Section 03300 – Cast-in-Place Concrete.

3.05 FIELD QUALITY CONTROL

A. Inspect erected formwork, shoring and bracing to ensure that work is in accordance with formwork design and that supports, fastenings, wedges, ties and items are secure.

B. Do not reuse formwork more than three (3) times for concrete surfaces to be exposed to view.

C. Do not patch formwork.

END OF SECTION

SECTION 03200

CONCRETE REINFORCEMENT

PART 1: GENERAL

1.01 DESCRIPTION

A. Furnish and install steel reinforcement for all cast in place concrete required by these Contract Documents. The Work includes but is not limited to reinforcing steel, supports, ties, and all appurtenances required to properly install the material.

B. Related Work Specified Elsewhere

1. Section 03100 – Concrete Formwork.

2. Section 03300 – Cast-in-place Concrete.

1.02 QUALITY ASSURANCE

A. Design, detail, fabricate and place steel reinforcement in conformance with ACI-315, ACI- 318, ACI-350 and the CRSI Manual of Practice.

B. Do not place concrete until all steel reinforcement that will be covered is inspected in place and approved by the Engineer.

C. Provide Engineer with access to fabrication plant to facilitate inspection of reinforcement as required.

1. Provide notification of commencement and duration of shop fabrication.

2. Notify in sufficient time for inspection.

D. References

1. ACI 318 – Building Code Requirements for Reinforced Concrete.

2. ACI 315 – ACI Detailing Manual.

3. ACI 350 – Code Requirements for Environmental Engineering Concrete Structures.

4. ACI SP-66 – American Concrete Institute – Detailing Manual.

5. ASTM A185 – Welded Steel Wire Fabric for Concrete Reinforcement.

6. ANSI/AWS D1.4 – Structural Welding Code for Reinforcing Steel.

7. ASTM A615 – Deformed and Plain Billet Steel Bars for Concrete Reinforcement.

8. AWS D1 2.1 – Welding Reinforcement Steel, Metal Inserts, and Connections in Reinforced Concrete Construction.

9. CRSI – Concrete Reinforcing Steel Institute – Manual of Practice.

10. CRSI – Placing Reinforcing Bars.

1.03 SUBMITTALS

A. Submit shop drawings in accordance with Section 01340 – Shop Drawings, Product Data and Samples. Include the following information:

1. Shop drawings including bending diagrams and reinforcing schedules for all Work.

a. Show dimensions, details, notes, location, size, length, and each bar mark. Include accessories and other materials pertaining to concrete reinforcement.

b. For schedules, provide the same information and use the same general form as the Contract Drawings.

c. Detail reinforced concrete and reinforced masonry walls in elevation.

B. Submit certified test reports in accordance with Section 01340.

1. Provide written evidence that the steel reinforcement has been tested and complies with these specifications.

2. Certified mill test reports may meet this requirement if such tests are performed regularly by competent personnel with adequate test equipment.

a. If mill test results are viewed by the Engineer as questionable, the Engineer may order tests on either mill samples or delivered steel reinforcement.

b. Provide acceptable mill or laboratory tests for each 15 tons of reinforcing steel that is shipped.

c. Tests may not be conducted more than 90 days before delivery.

d. The cost of all testing is the Contractor's responsibility.

C. Submit Welders' Certificates

1. Certify that welders employed on the work have their AWS qualification within the previous 12-months

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver, handle, and store the reinforcing steel and appurtenances in accordance with Section 01600 – Delivery Storage and Handling.

B. Deliver reinforcement to the job site carefully bundled and tagged for identification.

1. Store at least 12" above ground on timber mats or other supports acceptable to the Engineer.

2. Do not allow contact between reinforcement and the ground during storage.

3. Support reinforcement so that it does not bend or deflect excessively under its own weight.

PART 2: PRODUCTS

2.01 REINFORCING BARS

A. Reinforcing bars

1. Deformed billet-steel bars.
2. Conform to ASTM A615.
3. Grade 60.

B. Reinforcing bars to be welded

1. Conform to ASTM A706.
2. Grade 60.
3. Deformed bars
4. Welding of rebar shall be in accordance with ANSI/AWS D1.4
5. Only weld rebar as indicated on the Drawings.

C. Shop-fabricate all bars and bend cold. Bars shall be free from defects and kinks and from bends not indicated on the Drawings or approved bending diagrams.

2.02 MESH REINFORCEMENT

A. Mesh reinforcement:

1. Electrically welded, cold-drawn, mild-steel, plain wire fabric conforming to ASTM A185.
2. Supply as flat sheets or mats.

B. Wire: Cold-drawn steel conforming to ASTM A82.

2.03 MECHANICAL SPLICES OR COUPLINGS

A. Mechanical splices or couplings shall only be used where shown on the Drawings or in locations approved by the Engineer prior to placement.

1. “Taper-Lock” Taper Threaded couplers, as manufactured by Dayton Superior Corporation,
2. Dywidag “Threadbar” Reinforcing System as manufactured by Dywidag Systems International, USA Inc.
3. Or equal.

2.04 DOWEL BAR SUBSTITUTES

A. Dowel bar substitutes shall only be used where shown on the Drawings or in locations approved bythe Engineer prior to placement.

1. Dowel bar splice system (DB/DI) parallel threaded couplers
2. As manufactured by Dayton Superior Corporation or approved equal.

2.05 SUPPORT CHAIRS

A. Reinforcement supports: Conform to Product Standard PS7 and CRSI Manual of Standard Practice, Class D or E.

B. Reinforcement support chairs:

1. Use stainless steel or plastic-tipped chairs when used in walls and elevated slabs.

2. Use stainless steel, hot-dip galvanized after fabrication, or plastic-tipped chairs in slabs on grade.

a. Provide at least 3-in of protection from the subgrade.

b. Pre-cast concrete blocks may be used to support bottom bars in footings and slabs on grade.

c. Do not use nails or clay bricks to support reinforcement.

2.06 TIE WIRE

A. Tie wire:

1. Conform to Federal Specification QQ-W-461

2. Black annealed steel.

3. 16-gauge minimum.

PART 3: EXECUTION

3.01 SURFACE PREPARATION

A. Thoroughly clean all reinforcement of oil, dirt, mill scale, rust scale, and other coatings that would tend to destroy or reduce its bond with concrete before placement.

1. A thin coating of orange rust resulting from short exposure will not be considered objectionable.

2. Reinforcement having heavy rust scale or a thick rust coating shall be rejected and removed from the job site.

B. When there is a considerable delay between placement of reinforcement and placement of concrete, the reinforcement shall be re-inspected prior to placement of concrete. If necessary, it shall be re-cleaned.

3.02 PLACEMENT

A. Accurately position the reinforcement.

1. Tie it with annealed wire or suitable clips approved by the Engineer at intersections.

a. Secure against displacement

b. Do not deviate from required position

2. Support the reinforcement using concrete or metal chairs, stays, spacers, hangers, or other devices acceptable to the Engineer.

B. Fasten reinforcing bars with wire ties.

1. Tie at the equivalent to 30% of all intersections with other bars or three places per bar, whichever is greater.

2. Tie bars at every intersection around the periphery of slabs.

3. Offset every other intersection at least one intersection from adjacent rows, creating a checkerboard pattern.

C. Select reinforcement supports with sufficient strength and stability to maintain the reinforcement in place throughout placement and concreting operations.

1. Do not allow supports and ties to be exposed at the face of the concrete.

2. Do not use supports that will discolor the surface of the finished concrete.

D. Prevent the movement of steel reinforcement during concreting operations. Accurately reposition any reinforcement which is displaced and return it to its proper place before completely covering with concrete.

E. Securely fasten dowels for successive work in the correct position before placing concrete. Sticking dowels after placing concrete shall not be permitted.

F. Protect exposed reinforcement that is intended to bond with future work from corrosion. Use heavy wrappings of burlap saturated with a bituminous material.

G. Do not field bend bars that are partially embedded in concrete unless approved by the Engineer.

H. Do not field cut reinforcing bars with a torch.

I. Notify Engineer when reinforcement is fixed in its final position.

1. Engineer will inspect and approve the Work.

2. Do not place concrete until placement of reinforcement has been approved.

3.03 COVER AND CLEARANCE

A. Provide the concrete cover shown below to protect embedded steel reinforcement unless otherwise indicated on the Drawings:

1. Surfaces cast against crushed rock, sand, or earth:

a. All bar sizes: 3-in

2. Surfaces exposed directly to water, sewage, backfill, or weather after form removal:

a. All bar sizes: 2-in

3. Surfaces not exposed directly to water, sewage, backfill, or weather after form removal:

a. Elevated slabs: 2-in

b. Floors, walkways, pavement: 2-in

c. Walls less than 12-in thick: 2-in

d. Walls 12 inches thick or greater: 2-in

4. Beams

a. Stirrups: 2-in

b. Principal reinforcement: 2-in

B. Provide the larger of the minimum clearances between adjacent parallel bars shown below:

1. Not be less than the nominal diameter of the bars

2. Not less than 1-½ times the maximum coarse aggregate size.

3. Not less than 1 inch in beams, 1-½ inches in columns, and 2 inches in other locations.

3.04 TOLERANCES

A. Allowable tolerances for fabricating steel reinforcement:

Item	**Maximum Tolerance**	
Sheared length of bars	+1 inch	-1 inch
Depth of truss bars	+0.0 inch	-½ inch
Outside dimensions of stirrups, ties, spirals	+½ inch	-½ inch
Location of bends	+1 inch	-1 inch

B. Allowable tolerances for placing steel reinforcement:

Item	**Maximum Tolerance**	
Concrete cover from outside of bar to finished surface	+¼ inch	-0.0 inch
Lateral spacing of bars in plane of reinforcement in beams and joists	+¼ inch	-0.0 inch
Lateral spacing of bars in plane of reinforcement in slabs and walls	+1 inch	-1 inch
Spacing of stirrups, ties, and spirals along longitudinal axis of member	+½ inch	-¼ inch
Height of bottom bars in slabs, beams and joists		
Depth: 8-in and less	+¼ inch	-¼ inch
Depth: 9 to 24-in.	+½ inch	-½ inch
Depth: 25-in and greater	+½ inch	-½ inch

3.05 SPLICES

A. Conform to the requirements of ACI 318, Chapter 7, Details of Reinforcement.

B. Lap bars as follows, unless otherwise indicated:

1. No. 6 bars or smaller – Lap not less than 38 bar diameters.

2. No. 7 bars and larger – Lap not less than 48 bar diameters.

3. Minimum lap is 12 inches.

4. Stagger splices.

5. Except where indicated on the Drawings, do not weld or tack weld reinforcement.

6. Design lapped connections to transfer the full stress between bars by bond and shear.

a. Make lapped connections at points of maximum positive or negative moment.

b. Do not splice adjacent bars at the same location.

C. Do not allow the number of bars per layer of reinforcement provided in walls and slabs to be less than the lateral dimension of the wall or slab in the plane of the reinforcement layer divided by the specified spacing.

D. Do not allow the number of stirrups, ties, or spirals provided along the longitudinal axis of a member in a given segment to be less than the length of the segment divided by the specified spacing.

E. Lap welded wire fabric reinforcement a minimum of 6 inches at joints and wire securely.

1. Extend the mesh to within 2 inches of sides and ends of slabs.

2. Offset lapped ends of welded wire fabric to prevent continuous laps.

3. Do not make splices midway between supporting beams or directly over beams of continuous structures.

END OF SECTION

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SECTION 03300

CAST IN PLACE CONCRETE

PART 1: GENERAL

1.01 DESCRIPTION

A. Provide cast-in-place concrete as indicated on the Drawings and as specified and required. Work includes but is not limited to the following:

1. Furnishing all materials, labor, equipment, and supplies.

2. Mixing, placing, testing, finishing, and curing cast in place concrete.

1.02 QUALITY ASSURANCE

A. Conform to applicable requirements of the International Building Code currently in force unless more stringent requirements are specified or shown on the Drawings.

B. Perform work in accordance with ACI 301, ACI 304, ACI 305R, ACI 306R, ACI 318, ACI 347, and ACI 350. Maintain the latest copy of these and other appropriate documents referred to therein on the project site at all times.

1. Do not exceed 1.5 hrs. between batching and complete discharge of concrete.

2. Use mechanical high-frequency internal vibrators to compact concrete during and immediately after depositing.

   a. Provide sufficient standby equipment to ensure vibration will be continuous.

   b. Only use approved external vibrators for compacting concrete when concrete is inaccessible for adequate compaction by other means.

   c. Vibrate concrete to ensure no movement of reinforcing steel from its final position.

3. Acquire cement and aggregate from same source for all work.

4. Do not use excess grout or mortar to lubricate pipelines when pumping concrete. Also, do not discharge washout water into the forms.

C. Unless otherwise indicated, use an independent testing agency hired by the Contractor and approved by the Engineer to perform all testing. Sampling shall be the Contractor’s responsibility.

D. Engineer may require additional sampling and testing by an independent testing laboratory to determine that specifications are being met. Such testing shall be the Owner’s responsibility.

E. Field sampling and testing

1. Sampling and Test Methods

   a. Aggregate

      1) Sampling: ASTM D75

2) Testing: ASTM C33

b. Cement

1) Sampling: ASTM C183

2) Testing: ASTM C150

c. Concrete

1) Sampling: ASTM C172

2) Slump Test: ASTM C143

3) Air Content Test: ASTM C231

4) Making and Curing Test Cylinders: ASTM C31

5) Compression Strength Tests: ASTM C39.

2. Testing Requirements

a. Inspect, sample, and test cement and aggregate at the batching plant. Comply with referenced standards.

b. Slump Test: Perform one test on each concrete sample tested for compressive strength.

c. Air Content: Perform one test on each concrete sample tested for compressive strength.

d. Compressive Strength Testing

1) Prepare at least 8 test cylinders for each concrete sample tested.

a) Break 2 test cylinders at an age of 7 days.

b) Break 2 test cylinders at an age of 14 days.

c) Break 2 test cylinders at an age of 28 days.

d) Hold the remaining cylinders in reserve.

2) Provide at least the following number of test cylinders:

Concrete Class	Size of Pour (cu. yd.)	No. of Samples	No. of Cylinders
Class A	1 – 4	1	8
Class A or B	4 – 100	1	8
Class A or B	101 – 200	2	16
Class A or B	201 – 300	3	24
Class A or B	Over 300	1 per 100 cu. yd. or fraction	8 per 100 cu. yd. or fraction

1.03 SUBMITTALS

A. Provide submittals in accordance with Section 01340.

B. Contractor may request the Engineer's review and approval of modifications to the cast-in-place concrete mix designs to improve performance, efficiency, quality control and quality assurance.

1. Such requests shall be developed by an independent engineering and testing firm specializing in the design, testing and placement of cast-in-place concrete.
2. The engineering and testing firm shall have a minimum of five (5) years of experience in the development and testing of various concrete mix designs to meet requirements for strength, appearance, durability, workability, watertightness, economy, etc.
3. The firm shall also maintain accreditations, certifications and laboratory approvals from at least one of the following:
    a. ACI
    b. U.S. Army Corps of Engineers
    c. ASTM
    d. CSI
    e. ASCE

C. Submit Contractor's Drawings and Shop Drawings.

1. Show reinforcing steel in accordance with ACI 315. Include bar lists and bending diagrams, placement drawings, and special details.
2. Show location, types, and details of joints.
3. Sequence of pours.
4. Working Drawings with calculations showing concrete strength to be attained at the proposed time of removal of formwork, falsework and centering.
5. Provide complete engineering and product data for the following:
    a. Admixtures
    b. Curing compounds
    c. Dyes
    d. Bonding agents
    e. Hardeners
    f. Sealers
    g. Waterstops

D. Submit certified concrete mix designs for all concrete strengths used.

1. Include proposed admixtures.
2. Provide certified laboratory or mill test reports on all aggregate and cement used in the proposed mix.
3. Provide certified laboratory test reports on the compressive strength of concrete resulting from each mix design.
4. For record purposes include the following information for each class of concrete:

a. Minimum dry weights of cement; fine and coarse aggregates;

b. Quantity, type and name of admixture; and

c. Volume of water per cubic yard of concrete that will be used in the mix.

E. Submit certified delivery tickets for all concrete provided. Show at least the following information.

1. Name and location of batch plant and name of plant inspector

2. Ticket number

3. Load number and batch number

4. Date

5. Truck number

6. Destination including name and location of project

7. Concrete type, class (strength), and design mix designation

8. Actual quantities of all materials including admixtures and amount of concrete in cubic yards

9. Time at which mixer drum was charged with cement

10. Amount of free moisture by percentage of permissible mixing water in aggregates, plus maximum amount of mixing water which can be added at job site to obtain specified water/cement ratio

11. Blank space for initials of on-site receiving party

12. Time of arrival of concrete truck on site

13. Amount of mix water added on-site

14. Time of concrete placement

F. Submit a sample delivery ticket with the concrete mix design. A mix design shall not be approved without the inclusion of a sample delivery ticket from the concrete vendor that includes all the information required by this specification.

G. Submit notarized certificates from Suppliers that each of the materials listed below comply with the Specifications and are of the gradation required for each class of concrete. Submit prior to incorporating materials into the Work. If testing is required, submit mill certificates for each test. Conform to specified ASTM Standards.

1. Portland Cement: Comply with ASTM C150.

2. Stone Aggregate for Concrete shall comply with the following:

a. Sieve Analysis. ASTM C136

b. Organic Impurities. ASTM C40. Fine Aggregate Only

c. Soundness

1) ASTM C88.

2) Do not exceed 8 percent loss for coarse aggregate and 10 percent loss for fine aggregate after 5 cycles.

d. Abrasion of Concrete Aggregate

1) ASTM C131

2) Do not exceed 10-1/2 percent loss after 100 revolutions and 42 percent loss after 500 revolutions.

e. Deleterious Materials. ASTM C33

f. Material Finer Than 200 (75um) Sieve

1) ASTM C117

2) Do not exceed 1 percent for gravel, 1.5 percent for crushed aggregate per ASTM C33.

3. If notarized certificates acceptable to the Engineer are not provided, perform the required tests at Contractor's expense using an Independent Testing Laboratory.

a. Perform tests for each 250 barrels of cement, in accordance with ASTM C150.

1) Determine the tensile strength at 7 days.

2) Tag the Cement for identification at location of sampling.

b. Test aggregate before the concrete mix is established and whenever character or source of material is changed.

1) Include a sieve analysis to determine conformance with limits of gradation.

2) Sample aggregates at source of supply or at the ready-mix concrete plant in accordance with ASTM D75.

H. Submit certified test reports for all admixtures submitted for use on the project.

I. Submit a detailed step-by-step QC plan for review and approval by the Engineer for the following items.

1. All field sampling and testing procedures related to this specification section.

2. All finishing procedures related to exposed concrete.

3. All proposed curing procedures.

J. Submit notarized test results for all aggregate to be used in the submitted mix design identifying the aggregates alkali silica reactivity potential. Test shall be conducted in accordance with the following:

1. ASTM C295.

2. ASTM C1260.

3. Where aggregate is determined to have reactive constituents through a petrographic examination and/or mortar bar tests show expansion in excess of 0.10% the mix design shall include a means of alkali silica reactivity mitigation.

4. Additional testing shall be done in accordance with ASTM C1567. Any proposed mitigation technique shall successfully limit expansion due to alkali silica reaction to less than 0.1% in accordance with ASTM C1567 for the mix design to be approved.

5. Perform testing in accordance with ASTM C1293 where pozzolans are used that contain more than 4% sodium oxide.

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver, handle, and store the products in accordance with Sections 01340

B. Ship cement to the site of the mixer plant in bulk or in paper or cloth bags, at the option of the Contractor.

1. Store immediately upon arrival in a dry, weather tight and properly ventilated building or enclosure

2. Include adequate provisions to prevent the absorption of moisture.

3. Store in a manner that will permit easy access for inspection and identification of each shipment.

4. Provide separate storage facilities for cement that are approved by the Engineer prior to arrival of the first shipment. Do not use cement that is caked or lumpy.

C. Store sand and coarse aggregates in separate stockpiles at points selected to provide maximum drainage and to prevent the inclusion of any foreign material during rehandling.

1. Construct stockpiles of coarse aggregates in horizontal layers to avoid segregation and breakage.

2. Where concrete volumes require batching of various aggregate sizes, provide a separate stockpile for each size maintained.

3. Do not use the bottom 6 inches of aggregate piles.

D. Deliver primers, bond breaking grout, mastic, epoxy, hardener, curing compound and other materials to ensure uninterrupted progress of Work.

E. Store materials in a manner that will preclude damage and permit ready access for inspection and identification.

PART 2: PRODUCTS

2.01 GENERAL

A. Concrete Classification

1. Use Class A for all reinforced concrete unless noted otherwise within the scope of ACI 318 or ACI 350.

2. Use Class B concrete for items such as pipe cradles, pipe and conduit encasement, bedding, collars, thrust blocks and non-reinforced concrete.

3. If Class is not otherwise identified, provide Class A concrete.

B. Design all Class A cast in place concrete in accordance with applicable requirements of ACI 318 and ACI 350.

C. Strength

1. Proportion mix designs according to the section on Trial Batches of ACI 318, latest edition.

a. Produce a watertight, durable concrete.

b. Develop the following minimum compressive strengths at an age of 28 days when sampled, cured, and tested in accordance with the procedures specified in ASTM C31 and C39:

Class of Concrete	Age	Average of Three Consecutive Specimens	Minimum any One Specimen
A	28 days	4,500 psi	4,000 psi
B	28 days	3,000 psi	2,500 psi

2. If the average compressive strength of three consecutive specimens falls below the minimum strength specified above, or if the compressive strength of any single specimen falls more than 500 psi below the minimum strengths specified above; the Engineer may require the following:

a. Change in mix design for the remaining portion of the work.

b. Additional curing of the affected concrete followed by cores taken in accordance with the latest editions of ASTM C42 and ACI 318, all at the expense of the Contractor.

c. If additional curing does not bring three average compressive strength of three cores taken in the affected area to at least the minimum strength specified, the Engineer may require that the Contractor strengthen the structure by means of additional concrete and steel or he may require that the Contractor replace the affected portions.

d. The cost of all such changes in mix designs and any modifications to or replacement of deficient concrete shall be borne by the Contractor at no additional cost to the Owner.

D. Consistency

1. Make consistency such that concrete can be worked readily into the corners and angles of the forms and around the reinforcement without excessive spading and without permitting the materials to segregate or free water to collect on the surface.

a. When dropped from the discharge chute, the concrete mass should flatten out at the center and spread out slowly at the edges.

b. Adjust proportions to secure the lowest water/cement ratio which is consistent with good workability and a plastic cohesive mixture.

c. Provide concrete which is within the following slump range as determined in accordance with ASTM C143.

Concrete Use	Slump in Inches
Walls	2½ – 4
Floors and Slabs	2 – 4
Beams	2 – 4
Blocks and Footings	2 – 4

Note: Do not use concrete with a slump greater than 1 inch over the specified maximum.

2. Pumped concrete:

   a. Increase the maximum concrete slump at the suction of the pump by the amount of slump loss in the pumping system up to a maximum of 1 inch above the maximum specified slump.

   b. The amount of slump loss is the difference between slump tests made at both ends of pumping system.

      1) Limit to a total loss of 1 inch.

      2) If tests indicate a loss greater than 1 inch, take corrective measures acceptable to the Engineer.

3. For thin sections and construction with limited clearance between reinforcing steel and when placement conditions preclude the use of vibrators, the Engineer may authorize the use of concrete having a slump of 5 inches.

E. Materials used in concrete shall be limited to those noted in this section of the specification. Alternate material shall be submitted for approval by the Engineer prior to submission of the concrete mix design.

2.02 PORTLAND CEMENT

A. Use standard brand of Domestic Portland cement. Do not change brand of cement during the Work without the written approval of the Engineer.

B. Comply with ASTM C150, Type II.

C. Do not use cement of dark color or resacked, lumpy or partially set cement.

D. Each sack of cement shall contain 94 pounds (net) of cement and the volume of that quantity of cement shall be 1.0 cubic foot.

2.03 AGGREGATE

A. Furnish natural aggregates from approved pits, free from opaline, chert, feldspar, mica, siliceous magnesium limestone, and other deleterious and reactive substances.

B. Comply with ASTM C33.

C. Fine aggregate

1. Fineness Modulus – 2.4 minimum and 3.0 maximum

2. Material passing No. 200 sieve – less than 3% (by weight) of the total sample.

3. Coal and lignite – less than 0.5% (by weight) of the total sample for all concrete.

D. Coarse aggregate

1. Conform to ASTM C33, Class Designation 3S

2. Maximum size of aggregate

a. No larger than one-fifth the narrowest dimension between sides of forms.

b. Less than three-quarters of the minimum clear spacing between reinforcing bars or between bars and forms.

c. Limit size to ¾-inch for pumped concrete.

2.04 WATER FOR MIXING AND CURING CONCRETE

A. Use clean, fresh, potable quality water that is free from injurious substances.

B. If water is of questionable quality, meet limits of comparison tests with distilled water in accordance with AASHTO T26.

C. The weight of water shall be considered to be 8.33 pounds per gallon.

2.05 ADMIXTURES

A. Provide an air entraining admixture conforming to ASTM C260 in all concrete.

1. Manufacturers

a. W. R. Grace “Darex AEA”

b. Master Builders “MB-VR”

c. Sika “AEA 15”

d. Boral “Boral Air 30”

e. Or equal

B. Plasticizer or Water Reducing Admixture

1. Chloride free

2. Conform to ASTM C494, Type A

3. Manufacturers

a. W. R. Grace “WRDA 35”

b. Master Builders “Pozzolith Normal”

c. Sika “Plastocrete”

d. Boral “Boral NR”

e. Or equal

C. Accelerators and Retarders

1. May be used only when authorized in writing by Engineer

2. Accelerators
    a. Calcium chloride conforming to ASTM D98
    b. Dispense as a solution
    c. Calcium chloride shall not exceed one percent (by weight) of cement content.
    d. Manufacturers
        1) W. R. Grace “Daraset”
        2) Master Builders “Pozzutec 20”
        3) Sika “Plastocrete 161 FL”
        4) Boral “Boral can”
        5) Or equal
3. Retarders
    a. Chloride free
    b. Conform to ASTM C494, Type D
    c. Manufacturers
        1) W. R. Grace “Daratard-HC”
        2) Master Builders “MBL-8”
        3) Sika “Plastiment”
        4) Boral “Boral HC”
        5) Or equal

D. High Range Water Reducers and Super Plasticizers
1. May be used only when authorized in writing by Engineer
2. Conform to ASTM C494, Type F or G
3. Manufacturers
    a. W. R. Grace “Darucem 19”
    b. Master Builders “Pozzolith 440N”
    c. Sika “Sikament 300”
    d. Boral “Boral SP”
    e. Or equal

E. Fly Ash
1. Conform to ASTM C618
2. May be no more than 20 percent of the cement plus pozzolan by weight.
    a. Consider a maximum of 50 percent of the fly ash as a cement replacement.
    b. Add a maximum of 50 percent of the fly ash weight to the cement weight to calculate the water to cement plus pozzolan ratio.

c. The water to cement plus pozzolan ratio shall be equal to the specified water to cement ratio.

3. May contain a maximum of 10 percent calcium and a maximum of 50 percent carbon by volume.

4. Manufacturer

a. Boral – Class F “Fly Ash”

b. Or equal

2.06 WATERSTOPS

A. General

1. Conform to the details shown on the Drawings.

2. Do not use split flange waterstops.

3. Provide manufactured accessories at waterstop intersections.

B. PVC waterstops

1. Conform to Corps of Engineers specification CRD-C-572.

2. Use serrated type

3. Use ribbed waterstop 6 inches wide, 3/8 inch thick, with a 1-inch outside diameter center bulb for expansion joints, unless otherwise shown on drawings.

4. Use ribbed waterstop 6-inches wide, 3/8-inches thick, with no center bulb for construction and contraction joints, unless otherwise shown on drawings.

5. Submit a manufacturer’s certificate or test report by an independent testing laboratory as evidence that waterstop complies with these specifications.

6. Manufacturer

a. Greenstreak PVC Style No. 717

b. Greenstreak PVC Style No. 679

c. Or equal

7. All PVC waterstop shall be held in place prior to pouring concrete by an acceptable means. PVC waterstop shall not be manually placed into wet concrete for any reason.

C. Non-movement construction joints with Hydrophilic Waterstop

1. Use Adeka MC2010 Hydrophilic Waterstop installed per the manufacturer’s requirements, or equal, where noted on the Drawings.

D. Compression Seals

1. Use for expansion or contraction joints in concrete slabs where noted on the Drawings.

2. Use G-Seal by Greenstreak, Style No. 628, or equal.

E. Field splices

1. Comply with manufacturers recommendations

2. Heat sealed splices:

a. Develop water tightness equal to that of unspliced material.

b. Have tensile strength of not less than 50 percent of unspliced material.

2.07 POLYETHYLENE FILM

A. Conform to Product Standard PS 17.

B. Provide minimum material thickness of 6 mils.

2.08 EPOXY BONDING AGENT

A. Epoxy adhesives shall be two-component, 100% solids, 100% reactive.

1. Suitable for use on dry or damp surfaces.

2. Provide a one-day compressive strength of not less than 5,000 psi and a 28-day strength of not less than 12,000 psi when cured at a temperature of 73^{o} F. Conduct strength testing in accordance with ASTM D695.

3. Provide a 28-day tensile strength of not less than 3,500 psi, when tested in accordance with ASTM D638.

B. Manufacturers

1. Euco Epoxy #452, and #620 by The Euclid Chemical Company

2. Sikadur 32 Hi-Mod by Sika Chemical Corporation

3. Or equal

2.09 EPOXY FLOOR SEALER

A. Use a two-component, 100 percent solid, epoxy coating that provides a smooth, tough, flexible, wear abrasion, and chemical resistant surface.

1. Sealer shall be U.S.D.A. approved for use in food processing plants.

2. Apply to all new floor slabs and other exposed horizontal concrete surfaces unless otherwise indicated on the Drawings.

3. Color sealer gray unless otherwise specified.

B. Manufacturer

1. Euclid “Euco Epoxy No. 452 LV”

2. Sonneborn-Contech “Sonoflex”

3. Sika “Sikadur Lo-Mod LV”

4. Or equal.

2.10 VAPOR BARRIER

A. Provide under all slabs poured on earth, unless otherwise noted.

1. FHA approved.

2. Multi-ply lamination of polyethylene film and glass scrim reinforced paper.

a. Form a moisture, scuff, and puncture resistant membrane.

b. Provide moisture permeance less than or equal to 0.10 perms per ASTM E96, procedure A.

B. Manufacturer

1. St. Regis Paper Company “Moistop Ultra 6-Vapor Barrier”

2. Or equal

2.11 CURING MATERIALS

A. Use only non-staining, clear or translucent curing compounds with a 100 percent resin base meeting requirements of ASTM C309, Type I, Class B.

1. Add fugitive dye in sufficient amount to produce a definite, distinguishing color.

2. Select to be compatible with liquid hardeners and epoxy sealers.

3. Manufacturers

a. W.R. Meadows Inc.” 1100 Clear Series”

b. Or equal

B. Sheet materials for curing: Comply with ASTM C171.

C. Burlap cloth made from jute or kenaf for curing shall meet requirements of AASHTO M182, Class 1.

2.12 EXPANSION JOINT FILLER

A. Filler not exposed to traffic or weather: Comply with ASTM D994.

B. Filler exposed to traffic and/or weather: Comply with ASTM D1751 or ASTM D1752.

2.13 TEMPORARY JOINT FILLER

A. Use straight, sound strips of wood of the width and depth indicated on the drawings or as approved.

B. Taper the strips slightly from face-to-back.

C. Coat with paraffin or the equivalent to seal against moisture and to promote ready removal with forms.

D. Design to produce true, straight joint edges.

2.14 JOINT SEALER

A. Hot applied: Comply with ASTM D1190.

B. Cold applied: Comply with ASTM D1850.

2.15 FIBER REINFORCEMENT

A. Monofilament polypropylene micro-fiber

B. Modulus of elasticity 800ksi or greater

C. Alkali resistant

D. Dose and mix per manufacturer's recommendations

E. Sika Fiber HP or equal

PART 3: EXECUTION

3.01 DESIGN MIXES

A. Engineer shall approve mix design prior to beginning any concreting operations.

1. Prepare mix design in accordance with ACI 318 and ACI 350 for each class of concrete used.

2. If mix design is based on trial batches, provide sufficient data to establish a standard deviation. If insufficient data is provided to establish a standard deviation, the mix must produce the following average 28-day compressive strength to be acceptable:

a. Class A: 1,200 psi greater than specified strength

b. Class B: 1,000 psi greater than specified strength

3. Include the following information with the mix design:

a. Fine aggregate (Sample per ASTM D75)

1) Source and type

2) Sieve analysis – ASTM C136

3) Magnesium sulfate soundness – ASTM C88

4) Deleterious substances – ASTM C117, C123, C142.

5) Saturated surface dry weight per cubic yard of concrete.

6) Bulk specific gravity – ASTM C128

7) Fineness modulus – ASTM C136

b. Coarse aggregate (Sample per ASTM D75)

1) Source and type

2) Sieve analysis – ASTM C136

3) Abrasion loss – ASTM C131

4) Magnesium sulfate soundness – ASTM C88

5) Deleterious substances – ASTM C117, C123, C142

6) Saturated surface dry weight per cubic yard of concrete

7) Bulk specific gravity – ASTM C127

c. Cement (Sample per ASTM C183)

1) Manufacturer, type and ASTM designation

2) Pounds per cubic yard of concrete.

3) Total gallons of water per sack (cu. ft.) of cement

4) Compressive strength at 7 and 28 days – ASTM C109

5) Chemical analysis – ASTM C114

d. Slump – ASTM C143

e. Air Content – ASTM C173 or C231

f. Unit Weight – ASTM C138

g. Time to initial set at 70 degrees F – ASTM C403

h. Compressive Strength at 7, 14, and 28 days – ASTM C192 and C39

1) Prepare 9 cylinders for each mix design

2) Cure in the laboratory

3) Test 3 cylinders at each of 7, 14, and 28 days.

i. Testing laboratory verification of the water cement ratio. Required before mix is approved.

j. Admixtures

1) Manufacturer, type, and ASTM designation

2) Certification of chloride content

3) Dosage and point of introduction into the mix

k. Pozzolans

1) Manufacturer, type, and ASTM designation

B. Unless otherwise indicated, use the following specified 28-day compressive strengths of concrete:

1. 4,500 psi (Class A) for all reinforced structural concrete.

2. 3,000 psi (Class B) for non-reinforced concrete.

3. 2,000 psi for mud mats, pipe encasement, filling voids between pipes and casing, limited site voids, soil boring voids, and for under foundations where excavated to excessive depth.

4. Lean mix concrete for filling abandoned manholes, pipes, and similar items.

a. Minimum 94 pounds of cement per cubic yard of concrete.

b. Aggregate no larger than 1 1/2-inch.

C. Mix Proportioning

1. Design Class A concrete for structures to conform to ACI 301 and the following

a. Provide air entrainment as follows:

1) 5 ±1 percent – Coarse Aggregate No. 467

2) 6 ±1 percent – Coarse Aggregate No. 57 or 67

2. Proportion all other concrete mixes in accordance with ACI 301 except as noted herein.

D. Admixtures

1. Except as specified otherwise, water reducing and retarding admixtures may be used with prior approval of the Engineer.

2. The Contractor shall be responsible for compatibility of all admixtures.

3.02 PROPORTIONING

A. Accurately proportion concrete materials and mix to produce a homogeneous and workable mixture having the consistency and minimum compressive strength specified herein.

B. Proportion concrete materials by weight. Use equipment and methods that are acceptable to the Engineer when measuring ingredients.

C. Use the minimum amount of water and cement necessary to produce a concrete mixture of the required strength and consistency.

1. Do not exceed the water-cement ratio specified herein.

2. The cement content shall not be less than that specified herein.

D. Compressive strength may not necessarily be the most critical factor in proportioning concrete mixes.

1. Other factors, such as durability and watertightness, may require lower water-cement ratios than are required to meet strength requirements.

2. In such cases compressive strength will, of necessity, be in excess of that specified.

E. Use the minimum cement content and maximum water-cement ratios as shown below:

	Maximum Aggregate Size					
Factor	Class of Concrete	2-in	1½-in	1-in	¾-in	½-in
Minimum Cement Factor, Sacks/cy	A B	6.1 5.0	6.6 5.5	7.1 5.9	7.5 6.3	7.7 6.6
Maximum Water-to-Cement, Ratio, lb./lb.	A B	0.42 0.65	0.42 0.65	0.42 0.65	0.42 0.65	0.42 0.65
Maximum Water-to-Cement Ratio, Gal./Sack	A B	4.51 7.0	4.51 7.0	4.51 7.0	4.51 7.0	4.51 7.0

F. Base the water content of the mix on the total amount of water in the mixture,

1. Include any free water in the aggregate or adhering to the surface of the aggregate.

2. Do not include water absorbed by the aggregate.

G. Determine the total volume of aggregate used in each cubic yard of concrete by recognized standards for designing concrete mixes. Use the actual screen analysis of the aggregates.

H. The proportion of fine and coarse aggregate shall be such that the ratio of the coarse to the fine based on weight shall not be less than 1.0 or more than 2.0.

3.03 MIXING CONCRETE

A. Use mixing equipment that is capable of combining the aggregates, cement, admixtures, and water within the time specified into a thoroughly mixed and uniform mass.

B. Mix concrete by one of the following methods:

1. Operation of one or more batch-type mixing plants, each with a rated capacity of ½ cubic yard or more, installed at the site of work;

2. Operation of a proportioning plant installed in the vicinity of the work and the use of transit mixers for mixing concrete and transporting it to the forms.

3. Use of ready-mixed concrete from a central mixing and proportioning plant.

4. Remote dry-mix batch plant may be used only with approval of the Engineer.

C. The mixing method selected by the Contractor shall be subject to the approval of the Engineer.

D. Provide mixing and proportioning plants with equipment and facilities to accurately measure and control the quantities of material and water used in the concrete. Include provisions to readily change the proportions to conform to the varying conditions and requirements of the work.

E. Stationary Mixed Concrete

1. Use a batch mixer of an approved type which will ensure a uniform distribution of materials throughout the mass.

a. Accurately proportion and control all materials entering the drum, including water.

b. Proportion the cement and aggregate by weight. Volumetric batching will not be allowed.

c. Equip the mixer with an automatic timing device to lock the discharge level before aggregate and cement enters the drum. Release such level only after the specified mixing time has elapsed.

d. Comply with the “Concrete Mixer Standards” adopted by the Mixer Manufacturer’s of the Associated General Contractors of America. Provide a nameplate giving the manufacturer’s rated capacity of the mixer.

2. Discharge the entire batch before recharging the mixer.

a. Do not exceed the manufacturer’s rated capacity of the mixer.

b. Mix each batch for the period indicated herein, during which time the drums shall rotate at a peripheral speed as recommended by the manufacturer.

3. Mixing time shall be as follows:

Capacity of Mixer	Mixing Time in Seconds
½ cubic yard	75
¾ to 1½ cubic yards	75
Larger than 1½ cubic yards	120

4. Measure mixing time from the time all cement and aggregates and most of the water are in the mixer.

a. Excessive over-mixing, requiring additional water to preserve the required consistency will not be permitted.

b. All of the mixing water shall be introduced before ¼ of the total mixing time has elapsed.

F. Transit Mixed Concrete

1. Conform to the following:

a. The current “Standards for Operation of Truck Mixers and Agitators of the National Ready-Mixed Concrete Association,”

b. The “Truck Mixer and Agitator Standards of the Truck Mixer manufacturers Bureau,”

c. ASTM C94.

2. Transit Mixer

a. Automatically record the number of revolutions of the drum during the mixing period.

b. Attach a metal plate on each mixer and agitator in a prominent location. Plainly mark the following:

1) Capacity of the drum in terms of the volume of mixed concrete

2) The speed of rotation for the agitating and mixing speeds of the mixing drum or mixer blades.

c. Paint an identification number on each mixer in a location that can be easily read from the batching platform.

d. Do not exceed the manufacturer’s guaranteed mixing capacity.

3. Reduce the amount of materials charged into the mixer if the concrete does not meet the uniformity requirements of this specification.

4. Completely empty the mixer drum of any previously mixed load.

a. Place the proper proportions of aggregate, cement, and water for each load of concrete in the mixer.

b. Mix the contents therein for not less than 70 or more than 100 revolutions of the drum or mixer blades. Use the speed designated by the equipment manufacturer as the mixing speed.

c. For additional drum revolutions, use the speed designated by the equipment manufacturer as the agitating speed.

d. Immediately prior to discharging the concrete, revolve the drum at the mixing speed for a minimum of three minutes.

e. Revolution of the drum shall be continuous until the concrete is completely emptied from the drum.

5. Class A concrete: Empty all wash water from the mixer before any portion of the succeeding load is placed therein.

6. Class B concrete: Empty the mixer or carry no more than 10 gallons of water in the drum.

7. Add water at the point of discharge only with the prior approval and in the presence of the Engineer and in the presence of the concrete testing representative.

   a. Mix water so added into the load for a minimum mixing time of three minutes.

   b. Do not add water to the load during transit.

8. Do not exceed 90 minutes between the time water is added to the cement and aggregate or cement is added to the water and aggregate and the time concrete is placed in the forms, except if retarding admixtures are utilized and approved by the Engineer.

   a. When allowed by the Engineer, use a water-reducing and retarding admixture whenever concrete cannot be delivered to the forms within the time period specified.

      1) Use only to supplement (not to replace) other acceptable hot weather procedures.

      2) The retarding admixture used shall not interfere with strength development and other properties of the concrete.

      3) Retarding admixture use shall be carefully controlled by the concrete supplier.

      4) Test with job site materials and demonstrate the admixture's ability under these conditions to produce the desired properties before using.

9. Add water at the job site to offset evaporation of mixing water only with the Engineer's approval and in his presence.

   a. The addition of any water during transit to offset evaporation losses is not permitted

10. Avoid prolonged mixing, even at agitating speed. Where feasible, stop the mixer and then agitate intermittently.

11. Provide the Engineer with a legible, certified weightmaster's certificate for each load of ready-mixed concrete.
    a. Provide at the time of delivery.
    b. Delivery ticket shall be identical to that submitted and approved with the concrete mix design.
    c. All information shall be entered on to the delivery ticket at the mixing plant except the following:
        1) Blank space for initials of on-site receiving party.
        2) Time of arrival of concrete truck on site.
        3) Amount of mix water added on-site.
        4) Time of concrete placement.

3.04 CONVEYING CONCRETE

A. Convey concrete from the mixer to the place of final deposit by methods that will prevent separation or loss of the materials.

B. If the concrete is to be transported more than fifty feet in carts or buggies, equip them with pneumatic tires.

1. Deliver concrete to the carts, buggies or conveyors from spouts, troughs, or mixer trucks.
2. Do not allow a free fall of more than three feet.
3. Prevent the separation or loss of ingredients.
4. Keep delivery carts, buggies, conveyor trucks or barrows on temporary runways built over the floor system. Do not allow runway support to bear upon reinforcing steel or fresh concrete.

3.05 CONCRETE PLACEMENT

A. General

1. Ensure the following before placing concrete:
    a. All reinforcement is securely and properly fastened in position and protected against displacement
    b. All items to be embedded in the concrete are in place and securely anchored in position
    c. All forms have been thoroughly coated or wetted
    d. All form ties at construction joints have been retightened
    e. Concrete surfaces to be covered have had all free water, form coating, loose concrete, and debris removed
    f. All conveyances, buggies, and barrows are clean and wetted.

2. Notify Engineer at least 24 hours prior to placing concrete.
    a. The Engineer will inspect forms, reinforcing steel, screeds, construction joints, openings, anchors, pipe sleeves, conduit, and inserts.
    b. Do not pour concrete until the condition of the forms and place of pouring has been inspected and approved by the Engineer.
    c. Wet down formwork and reinforcement before placing concrete to prevent the leaching of water from the concrete.
    d. Do not allow free standing water in the forms.
    e. Do not place concrete when the sun, wind, heat, or humidity prevents proper placement and consolidation.
    f. Do not add water or cement to the mix without the Engineer's approval or in his absence. Do not deposit partially hardened concrete.

B. Placing Concrete

1. Unless otherwise specified, place all concrete upon clean, damp surfaces, free from water.
    a. Do not place concrete upon soft mud, dry absorbent earth or rock.
    b. Do not place concrete upon dills that have not been tamped to provide ultimate settlement.
2. Maintain groundwater below subgrade until the concrete has set. When subgrade is dry earth, thoroughly dampen soil with water to ensure that no moisture is absorbed from the fresh concrete.
3. Where shown on the Drawings, directed by the Engineer or where concrete is placed against gravel or crushed rock with less than 25% of the material passing a No. 4 sieve; cover the surfaces against which concrete is cast with polyethylene film to protect the concrete from loss of water.
    a. Lap joints in the film at least 12 inches and tape.
    b. Protect the polyethylene film against puncture from the underlying crushed rock.
        1) Use a cushion of natural or imported sand complying with ASTM D1073
        2) Place the sand on top of the crushed rock.
        3) Where concrete is placed against rock, remove all loose pieces of rock and clean the exposed surface with a high-pressure hose.
4. Place concrete within 90 minutes after adding cement, aggregates, water and admixtures.
5. Dispose of concrete which has not been placed within these time limits off site.
6. Locate joints where indicated on the drawings. Seal control joints in exterior slabs.
7. Comply with ACI 301 when bonding new concrete to existing concrete.

a. Apply approved bonding compound.

b. Allow bonding compound to cure in accordance with the manufacturer's recommendations or as directed by the Engineer.

8. Place a vapor barrier under all slabs poured on earth.

   a. Extend the barrier the full area of the slab.

   b. Turn barrier up or down footings as indicated.

   c. Lap all seams at least 12 inches and seal per manufacturer's instruction.

   d. Install reinforcement with care so as not to puncture vapor barrier.

   e. Tape all cuts, tears, punctures, and pipe penetrations before pouring concrete.

9. Deposit concrete in batches in its final position to prevent segregation of the mix.

   a. The limits of each concrete pour shall be predetermined by the Contractor and approved by the Engineer. Place all concrete within such limits in one continuous operation.

   b. Do not move concrete laterally in the forms more than 5 feet.

   c. Use a crane and a bottom dump concrete bucket wherever possible.

   d. Unless authorized by the Engineer, do not drop concrete freely into place from a height of greater than 5 feet.

      1) Deposit concrete in walls by means of prefabricated, rectangular tremies, constructed in short sections and spaced laterally not over 5 feet apart.

      2) Take special care to avoid slopping concrete over forms when placing.

10. After the concrete has been deposited, distribute it over the entire area within the forms in approximately horizontal layers of not more than 18-in. deep.

    a. Bring up the layers evenly in all parts of the form.

    b. Ensure each concrete layer is still plastic when covered with the succeeding layers.

    c. Fill the forms at a rate of vertical rise of not less than 2-ft per hour or more than 6-ft per hour.

    d. Stop concrete placement if a layer of concrete reaches its initial set before the next lift is placed, or if more than 60 minutes elapses between the placing of successive concrete lifts.

    e. Prepare the surface of the previous lift in accordance with the procedures specified under Construction Joints in this Section.

11. Do not allow workmen to walk on concrete during placing or finishing with any earth or foreign matter on footgear.

    a. Use forks and shovels for hand spreading

    b. Do not use rakes.

12. Place and compact concrete in wall or column forms before any reinforcing steel is placed in the structural system to be supported by such walls or columns.
    a. Do not exceed 6 feet of vertical height for any portion of a wall or column placed monolithically with a floor or roof slab.
    b. Allow concrete in walls or columns to set at least two hours before concrete is placed in the structural systems to be supported by such walls or columns.
    c. Pour brackets, haunches and fillets monolithically with the floor or roof slab system.

C. Consolidation

1. Thoroughly consolidate concrete during and immediately after placement.
    a. Work concrete into all corners and angles and around reinforcement and embedded fixtures in a manner to fill all voids, prevent honeycombing against the forms and avoid segregation of coarse aggregate.
    b. Use spades, forks and internal vibrators to perform this operation.
2. Transmit vibration directly to the concrete. Do not transmit it through the forms.
    a. Use a vibrator with a driving mechanism that revolves at not less than 7,000 rpm.
    b. Vibrate with sufficient intensity to cause the concrete to flow and settle readily into place and to visibly affect the concrete over a radius of at least 18 inches.
    c. Supplement vibration with manual forking or spading adjacent to the forms on exposed faces in order to secure smooth, dense surfaces.
    d. Take special care to consolidate around reinforcement, pipes and other shapes built into the work.
    e. Do not use vibrators to transport concrete within the forms.
    f. Keep vibrators in motion at all times to prevent excessive vibration in one spot. The operation shall be continuous and all concrete shall be in final position before initial set has started.
3. Maintain at least one operable vibrator on site as a spare in case of equipment failure. Do not place any concrete until all vibrating equipment, including spares, are at the placement site.
4. Thoroughly consolidate concrete prior to top finishing.
    a. Remove all laitance, debris, and surplus water from concrete surfaces at tops of forms by screeding, scraping, or other effective means.
    b. Wherever the top of a wall will be exposed to weathering, overfill forms; and after the concrete has been compacted, screed off excess.

D. Placement Sequence

1. Unless otherwise indicated on the Drawings or directed by the Engineer, follow the placement sequence identified below to reduce shrinkage cracking:

a. Bottom Slab

1) Placed a center section (as outlined by the construction joints shown on the Drawings) first.

2) Not less than 72 hours after the center section has been placed, place an adjoining section.

3) Place the remaining sections alternately, first on one side and then on the other side of previously placed sections.

4) Schedule pours so that two adjacent sides of each section are free, except at closures.

b. Walls

1) Divide walls into sections by the construction joints shown on the Drawings or as submitted by Contractor.

2) Place a section near the center of each wall first.

3) Place the remaining sections alternately, first on one side and then on the other side of the previously placed section.

4) Schedule pours so that one end of each section is free, except at corner closures.

c. Footings

1) Pour all footings except wall footings in one operation with no joints unless noted otherwise on the contract drawings.

E. Special Requirements Due to Adverse Weather Conditions

1. Rain

a. Do not place concrete during rain.

b. Do not place concrete if rain is forecast unless there is sufficient time to complete the placement and finishing.

c. Protect all concrete placed prior to rain by whatever means necessary to prevent damage to finish or water entering the mix.

1) Maintain protection equipment and materials on hand prior to beginning placement operations.

2) Protect freshly placed concrete from scour by flowing water and from mud deposits or other injurious conditions.

2. Cold weather concrete placement

a. Comply with ACI 306, except as modified herein

b. Ensure the concrete temperature at the time of placing is not less than that shown in the following table for the corresponding ambient outdoor air temperature (in shade) existing at the time of placement:

Ambient Outdoor Air Temperature	Minimum Concrete Temperature
Below 35° F	70° F
Between 35 °F and 45 °F	60° F
Above 45 °F	45° F

c. Do not place concrete when the ambient air temperature at the time of placement is 45 °F or less unless specifically authorized by the Engineer.
   1) Heat the concrete in a manner acceptable to the Engineer.
   2) If the use of heated concrete is authorized, temperature of the concrete at time of placement shall not exceed 80 °F.
   3) Avoid rapid dry-out due to overheating.
   4) Avoid thermal shock due to sudden cooling or heating.

d. Maintain the air temperature surrounding the concrete at 70 °F for three days, or 50 °F for five days, or for as long as is necessary to ensure proper curing of the concrete.
   1) Prevent rapid cooling of the concrete.
   2) Leave housing, covering, or other protection used in connection with heating in place and intact at least 24 hours.
   3) Chemicals to prevent freezing shall not be permitted.

e. Do not place concrete on frozen subgrade or subgrade containing frozen materials. Ensure forms, reinforcing steel, and adjacent concrete surfaces are completely free of frost, snow and ice before placing concrete.

3. Hot weather concrete placement
   a. Comply with ACI 305 except as modified herein.
   b. Follow hot weather precautions whenever the maximum ambient outdoor air temperature (in shade) during the day exceeds 85° F.
      1) Cover reinforcing steel with water-soaked burlap so the steel temperature does not exceed the ambient air temperature immediately before embedment in concrete.
      2) Do not place concrete when hot weather conditions may result in loss of slump, flash set or cold joints.
   c. If rapid mixing water evaporation in transit causes the concrete to be delivered in an unworkable condition, initial correction may be made at the job site.
      1) Add water in the form of a cement paste having the same water to cement ratio as the batch in the truck.
      2) Operate the drum or mixer blades at mixing speed for at least 70 revolutions after the paste addition.
      3) Once need for water has been observed, subsequent additions shall be at the batching plant until the need has passed.

a) Provide a simultaneous and proportionate increase of water and cement, up to 10% of the stated quantity of each material in the batch.

b) Such increases in cement shall not constitute grounds for an increase in the contract price.

d. Do not exceed a concrete temperature of 85 °F at the time of placement.

e. Take extra caution to prevent rapid evaporation of water.

1) Cool forms by frequent wettings.

2) Protect flat work from drying winds, direct sun, and high temperatures whenever conditions of temperature and humidity are such as to cause plastic shrinkage cracking.

3) Do not use set-control admixtures in mix designs unless approved by the Engineer in advance.

f. In order to prevent plastic shrinkage cracking due to rapid evaporation of moisture, do not place concrete when the rate of evaporation, determined by using Figure 2.1.4 in ACI 305, latest edition, equals or exceeds 0.2 pound per square foot per hour.

3.06 FINISHES

A. Finish concrete surfaces as set forth in these Contract Documents and as specified in ACI 301.

B. Formed surfaces

1. Begin finishing immediately after form removal. Complete concrete finishing in that area before any other work begins.

2. Provide a smooth-rubbed finish in accordance with ACI-301 for all permanently exposed surfaces and two (2) feet below high-water elevation.

a. Clean all holes, pits or imperfections in the concrete surface with a wire brush.

b. Thoroughly wet the concrete and completely fill imperfections with damp cement mortar composed of 1 part Portland cement to 2 parts fine aggregate.

c. Make the entire surface smooth with all lines or markings smoothed over to obtain uniform appearance.

d. Prior to the commencement off concrete work the contractor shall provide a 5’ x 5’ concrete sample panel displayed vertically with a smooth-rubbed finish for approval by the Engineer. Once the smooth-rubbed finish of the sample panel has been approved all applicable concrete finishes shall meet the quality of the sample panel. If, in the opinion of the Engineer, the concrete surface is unsatisfactory, repair it as follows:

1) Thoroughly and continuously wet the entire surface.

2) Rub the surface with a No. 0 carborundum stone until all lines, markings and surplus materials have been removed from the surface. When complete, wash the surface clean with water.

3) Rubbing may be done either by hand or with power tools.

C. Unformed Surfaces

1. Buried or permanently submerged concrete not forming an integral part of a structure does not need surface treatment except as that required to remove laitance.

2. Screed the unformed surfaces of all other concrete and give it the following treatment:

   a. An initial float finish.

   b. Additional floating followed by troweling where required.

   c. Take care that no excess water is present when the finish is made.

   d. Do not use a special concrete or cement mortar topping course unless shown on the Drawings.

3. Screeding

   a. Use a straight edge and accurately and securely set screeding strips to produce an even surface.

   b. Arrange screeds so as not to interfere with the top bar reinforcement.

   c. Provide a concrete surface conforming to the proper elevation and contour with all aggregates completely embedded in mortar. Ensure surfaces are free of surface irregularities with a height or depth in excess of ¼-inch as measured from a 10-foot straight edge.

4. Floating

   a. Give screeded surfaces an initial float finish as soon as the concrete has stiffened sufficiently for proper working.

      1) Remove any coarse aggregate which is disturbed by the float or which causes a surface irregularity. Replace it with mortar.

      2) Produce a surface of uniform texture and appearance with no unnecessary working of the surface.

   b. Follow initial floating with a second floating at the time of initial set.

      1) Produce a finish of uniform texture and color.

      2) This is the completed finish for unformed surfaces unless additional finishing is specifically required.

   c. Use hand floats or suitable mechanical compactor floats.

5. Brooming

   a. Provide a non-slip surface.

   b. Perform after the second floating.

   c. For traffic areas, perform at right angles to the normal traffic direction.

6. Troweling

a. Provide a steel trowel finish for surfaces to be covered with resilient floor coverings and other surfaces designated on the Drawings.

b. Trowel finishing will not be required for floors, which are normally submerged.

c. Perform troweling after the second floating when the surface has hardened sufficiently to prevent an excess of fines being drawn to the surface.

d. Produce a dense, smooth, uniform surface free from blemishes and trowel marks.

7. Edging

a. Chamfer all permanently exposed edges of unformed surfaces.

b. Use a ¾-in approved edging tool unless other edge treatment is indicated on the Drawings.

D. Unless otherwise specified or required, provide the following finishes:

1. Curbs and equipment bases: broom finish

2. Exterior slabs: broom finish, Class B tolerance.

3. Interior slabs: troweled finish, Class A tolerance.

4. Other concrete not exposed to view: rough form finish.

E. Other concrete exposed to view: Smooth form finish with voids filled and rubbed smooth.

3.07 CURING, PROTECTION

A. Cure and protect concrete as specified in ACI 301 and as set forth in these Contract Documents.

B. Protect from loss of moisture by curing for at least 14 days following placement.

1. Begin immediately after concrete finishing is complete or forms are removed.

2. Breaking of form ties or otherwise breaking the seal between the concrete surface and the form shall be considered form removal.

C. Use water curing, membrane curing, film curing, or any other curing method acceptable to the Engineer which does not injure or discolor exposed surfaces nor destroy the bond on surfaces to receive subsequent concrete pours or protective coatings.

D. Water Curing

1. Keep concrete surfaces being water-cured constantly and visibly wet for a period of not less than 14 days.

a. Saturate concrete surfaces as quickly as possible after the initial set of the concrete.

b. Regulate the rate of water application to provide complete surface saturation with a minimum of runoff.

2. Slabs poured on grade and decks may be water-cured by the following methods:

a. Ponding. Standard canvas seep hose placed in parallel runs on 8-foot centers is recommended for ponding.

b. Covering with wet burlap sacks, sand, or sawdust and keeping this covering continually and visibly wet during this period.

3. Walls may be cured by leaving the forms tied in place and keeping the forms and all exposed surfaces of the concrete continually and visibly wet for the duration of the curing period.

E. Membrane Curing

1. Use for all interior slabs to be covered with resilient tile, carpet or left exposed and all exterior slabs, sidewalks, curbs, etc. Apply in strict accordance with the manufacturer's recommendations.

2. Apply the curing and sealing compound by power spray, roller, or squeegee.

a. Use a coverage rate not to exceed 400 sq. ft. per gallon for troweled surfaces.

b. Use a coverage rate not to exceed 300 sq. ft. for floated or broomed finishes.

3. Apply the curing and sealing compound immediately after final finishing (within 30 minutes).

a. If forms are removed before the end of the specified curing period, the curing and sealing compound or other moisture retaining method must be applied to the formed surfaces before they dry out.

b. The Engineer shall determine which method shall be used.

4. Protect the curing compound against abrasion during the curing period. If the compound will be subjected to damage from traffic or other cause, protect it with Sisalcraft paper or other means acceptable to the Engineer.

5. Reapply improperly applied Compound or compound applied without sufficient dye to produce a distinguishing color to the satisfaction of the Engineer.

F. Film Curing

1. Film curing with polyethylene sheeting may be used in lieu of water curing on concrete that will be covered later with mortar or additional concrete or will otherwise be covered or hidden from view.

2. Begin film curing as quickly as possible after initial set of the concrete.

a. Completely cover the surfaces with polyethylene sheeting.

b. Overlap the sheeting edges sufficiently to obtain proper sealing and anchorage.

1) Overlap joints between sheets at least 12 inches and seal.

2) Promptly repair all tears, holes, and other damage.

3) Anchor covering continuously at edges. Anchor on the surface as necessary to prevent billowing.

3.08 CONSTRUCTION JOINTS

A. Use construction joints only at locations indicated on the Drawings, submitted by the Contractor and approved by the Engineer or specified herein.

1. Do not use at other locations without concurrence of the Engineer.

2. Do not use vertical construction joints in walls unless specifically approved by the Engineer.

3. Lay out and conduct the work to minimize the number of construction joints.

B. Use only keyed construction joints.

1. Make keys continuous.

2. Make the key width equal to 1/3 of the thickness of the wall and the key depth equal to 1/6 of the thickness of the wall.

3. Do not use keys smaller than 3 in wide and 1½ in deep unless indicated otherwise on the Drawings.

C. Provide waterstops of the type specified where indicated on the Drawings and in all construction joints in concrete walls and slabs having one face exposed in a dry pit or room and having the other face in contact with backfill, subgrade, groundwater, or other liquid.

D. Thoroughly clean the horizontal surface immediately before placing the next lift using water or air as required.

1. Cover the concrete surface with a uniform, evenly distributed layer of cement-sand mortar to a thickness of 1-in.

2. Make the cement-sand mortar using a mixture of 1.3 parts by volume Portland Cement and 1 part by volume fine aggregate. Use a water-to-cement ratio equal to that of the concrete to follow.

3.09 EXPANSION AND CONTRACTION JOINTS

A. Provide expansion joints as shown on the Drawings. If not shown use full-depth, pre-formed, asphalt plank material conforming to ASTM D994.

B. PVC, Hydrophilic Rubber and compression seal waterstop joints

1. Install in strict accordance with the manufacturer’s recommendation and these specifications.

2. In case of conflict, use the most stringent requirement as determined by the Engineer.

C. Hydrophilic Rubber:

1. Cut coil ends square (or at proper angle for mitered corners) with shears or sharp blade to fit splices together without overlaps.

2. Seal splices using cyanacrylate adhesive

3. Seal any exposed cells of Hydrophilic Rubber using LEAKMASTER by Greenstreak or equal. Make watertight.

D. Compression Seal:

1. Seal field butt splices shall be using Greenstreak “G-SEAL” adhesive or equal.

2. Attach compression Seal to expansion board using staples or nails driven through bottom flange area of the Compression Seal.

3. Attach Compression Seal prior to concrete placement.

3.10 BONDING NEW CONCRETE TO EXISTING CONCRETE

A. Where new concrete is to be cast against and permanently bonded to an existing concrete surface, chip or cut the existing concrete back at least 1½-in or as necessary to expose sound concrete.

1. Remove loose or weathered concrete and provide a roughened surface for bonding to the new concrete.

2. Cut edges square. Feathered edges will not be permitted.

3. Remove all loose material remaining after chipping or cutting operations by sandblasting and/or stiff wire brushing.

B. Where chipping back of existing concrete is not possible and where approved by the Engineer, the surface of existing concrete may be prepared by sandblasting or acid etching.

1. Ensure the surface of the existing concrete is bare, clean, dry, and structurally sound.

2. Remove all grease, oil, wax, or other residue by scraping followed by washing with a nonionic detergent or a suitable solvent compatible with the epoxy-bonding agent to be used.

3. Remove animal fats by scrubbing with a 10% solution of caustic soda to saponify them.

C. After all loose material, grease, etc., has been removed, etch the surface of the existing concrete by either sandblasting or scrubbing with a 10%-20% solution of hydrochloric acid in water.

1. Apply etching solution at a rate of 1-quart per square yard followed by a thorough rinsing with clean water.

2. Allow the surface to completely dry before applying the epoxy-bonding agent.

3. Wear goggles, rubber boots, and rubber gloves when applying caustic soda or acids.

D. When the surface is dry and just before placing the new concrete, apply an epoxy bonding agent to the surface of existing concrete with a whitewash brush or stiff broom.

1. Spread the epoxy bonding agent evenly over the surface to be bonded, avoiding skips and holidays, to a wet film thickness of 40 to 60 mils.

2. Place the new concrete as soon as the epoxy-bonding agent becomes tacky.

3. If the epoxy-bonding agent is allowed to dry before placement of new concrete, recoat the surface with epoxy.

E. The epoxy-bonding agent shall comply with the material requirements of this specification

1. Apply the material in strict conformance to the manufacturer's recommendations.

2. Take appropriate safety precautions during the handling and use of the epoxy-bonding agent.

3.11 EMBEDDED ITEMS

A. Wherever steel, wrought or cast iron piping, fittings, valves, collars, sleeves, structural steel, electrical conduits, appurtenances and fixtures, equipment anchorages or castings are shown for embedment in the concrete, such items must be on hand before concrete is poured.

1. Accurately set embedded items in place.

2. Firmly brace items before concrete is poured around them.

3. Do not use cutouts for future installation of these items.

B. Thoroughly clean embedded items and ensure they are free from any coating, rust, scale, oil or other foreign matter.

1. Avoid embedding wood in concrete whenever possible.

2. If wood must be embedded, thoroughly wet it before the concrete is placed.

3. After placement, clean surfaces not in contact with concrete of concrete spatter and other foreign substances.

C. Install conduit between reinforcing steel in walls or slabs that have reinforcement in both faces. In slabs with only a single layer of reinforcing steel, place conduit under the reinforcement.

D. Unless installed in pipe sleeves, embed anchor bolts with sufficient threads to permit a nut and washer to be installed on the concrete side of the form or template.

1. Provide a second nut and washer on the other side of the form or template.

2. Adjust the two nuts so that the bolt will be held rigidly in the proper position.

E. Coordinate the work and ensure that all embedded items or openings are placed in the forms before concrete is placed. Also confer with subcontractors and suppliers regarding their embedment and opening requirements.

F. Set forms, sleeves, and inserts, and cast concrete to the lines and grades indicated on the Drawings and as detailed in these Contract Documents.

1. Do not exceed the maximum deviation from true line and grade shown below. Deviation in alignment of slabs or walls shall not exceed a rate of 1/8 inch in 10 feet within the tolerances specified.

Item	Maximum Tolerance (in.)	
Sleeves and inserts	+ 1/8	- 1/8
Projected ends of anchor bolts	+ 1/4	- 0.0
Anchor bolt setting	+ 1/16	-1/16
Concrete forms	+ 1/8*	-1/8*

*Or as outlined in ACI 117 and approved by the Engineer.

G. Carefully finish all slabs true to grade such that the surface is free draining and contains no depressions that can hold or collect water.

H. Regardless of the tolerances listed herein, limit deviations in line and grade to tolerances that will permit proper installation and operation of mechanical equipment and piping.

3.12 WATERPROOFING MATERIALS

A. Apply to those joints and concrete surfaces shown on the drawings.

1. Application shall be by or under the direct supervision of the manufacturer's representative.

2. Prior to application, the waterproofing manufacturer's representative shall inspect the facilities receiving waterproofing and certify:

a. Surfaces to receive the waterproofing are properly prepared and suitable for the application.

b. Waterproofing materials comply with the requirements of these specifications.

B. Surface preparation and material application shall comply with the requirements in Section 07100. Submit recommended procedures at least 30 days prior to waterproofing application.

3.13 CONCRETE EMBEDMENT AND PIPE ENCASEMENT

A. Install concrete for embedment and encasement where shown on the Drawings and at such other locations where deemed necessary to protect existing or proposed piping as determined by the Engineer.

B. Embedment and encasement of pipe shall include the following steps:

1. Remove all loose material from the trench before placing concrete. Ensure concrete will be in continuous contact with undisturbed soil on sides and bottom of trench.

2. Accurately screed a base course of concrete to such grade and elevation that the pipe will be at specified grade when pipe bells are supported on, and in contact with, the top surface of such base course.

3. Rigidly hold each length of pipe in alignment and anchor it to prevent flotation in a manner acceptable to the Engineer.

3.14 ACCEPTANCE OF STRUCTURE

A. For environmental engineering structures as defined by ACI 350, concrete strength will be acceptable if it meets the acceptance criteria of ACI 301 and ACI 350, whichever is the more stringent. The Engineer may, however, reject the concrete, if cores fail to meet the specified 28-day strength.

B. For structures other than environmental engineering structures, the concrete strength will be acceptable if it meets the acceptance criteria of ACI 301.

C. The Engineer shall be the sole judge of concrete strength acceptability. Concrete not meeting the above requirements shall be removed from the project site, disposed of properly, and replaced with concrete meeting the specified requirements.

D. All structures which contain water shall be subject to a hydrostatic leakage test in accordance with Section 2 of ACI 350.1 unless otherwise required as follows:

1. Do not begin cleaning and testing for at least 14 days after the concrete has been poured and the joints sealed.

2. Clean exposed surfaces prior to testing

   a. Thoroughly hose all surfaces to remove surface laitance and loose matter.

   b. Remove wash water and debris from structures. Do not use plant piping for removal.

3. Ensure that all concrete has attained its specified compressive strength prior to testing.

4. Provide all required piping, valves, meters, and related equipment necessary to test the structures. Coordinate with the Engineer.

5. Fill structures to be tested with potable water to the normal operating liquid level indicated on the contract drawings or otherwise provided by the Engineer.

   a. Do not exceed a filling rate of 4 feet of water depth per 1-hour period.

   b. Fill at a uniform rate with continuous monitoring.

   c. For structures with adjacent bays, fill all bays simultaneously.

   d. Empty adjacent bays alternately.

   e. Repair all running leaks that appear during filling prior to continuing.

6. Add water as necessary to keep the structure at its normal operating level indicated on the contract drawings or otherwise provided by the Engineer for 72 hours.

   a. At the end of 72 hours, it will be assumed that moisture absorption by the concrete is complete.

b. Close all valves and gates to and from the structure

c. Measure the change in water surface each day for a 5-day period. Quantitative water loss shall not exceed 0.050% of volume per day.

d. Examine exposed portions of the structure and mark all visible leaks and damp spots.

1) Damp spots shall be defined as areas where moisture can be felt on a dry hand.

2) Repair visible leaks and damp spots after the structure is dewatered.

e. Determine surface moisture evaporation using a 24-inch-deep, white colored, watertight container of not less than 10-square-foot surface area exposure.

1) Position the container to experience environmental conditions similar to the structure being tested.

2) Fill the container with a known volume of water.

3) Measure the water loss due to evaporation each day and determine the loss in gallons per square foot of surface area.

4) Use the evaporation rate determined above to calculate the quantity of water lost from the test structure due to evaporation.

5) Subtract the water loss due to evaporation from the measured water loss in the structure being tested to determine the water loss due to leakage.

f. If leakage is excessive, drain the structure.

1) Repair the leaks and damp spots.

2) Refill the structure using the procedures outlined above and re-test.

3) Continue the process until the results meet these specifications.

7. If an underdrain system is provided, inspect the underdrain manholes for evidence of leakage. If leaks are apparent, locate and repair them.

8. If leakage is excessive and leaks cannot be found through other means, seed the floor slab of each water containing structure with one bag of cement per 250 square feet of surface area.

a. Seed the structure after the test filling has reached 18-inches in depth.

b. Detect leaks in construction and expansion joints with the aid of a diver.

c. Stir cementitious deposits on the floor and observe the deposits flowing toward leaks.

d. Repair all defects.

E. All repairs, additional fillings, and testing shall be performed by the Contractor at no additional cost to the Owner.

1. Repair leaking concrete cracks in accordance with Section 03720 of these specifications.

F. The Engineer may reject any fluid retaining structure that does not meet the acceptance criteria of ACI 350.1 Section 2 and the requirements of this specification for water tightness.

1. All cost for repairs required to meet the above criteria and provide an acceptable water tight structure shall be borne by the Contractor.

3.15 DEFECTIVE WORK AND METHODS OF REPAIR

A. Remove and replace or repair all defective or damaged work as directed by the Engineer.

1. Any work which is not constructed in accordance with these Contract Documents is defective.

2. Do not patch, repair or cover defective or damaged work without prior inspection and approval of the Engineer.

B. Repair defects in formed concrete surfaces to the satisfaction of the Engineer within 24-hours of placement.

1. Replace defective concrete within 48-hours after adjacent forms have been removed.

2. Cut out and remove honeycombed or otherwise defective concrete to sound concrete. Square cut the edges to avoid feathering.

C. Conform to Chapter 9 of ACI 301, except as modified herein.

1. Do not interfere with the thorough curing of surrounding concrete.

2. Adequately cure all repair work.

D. Where authorized by the Engineer, patching conducted as specified herein may be used.

1. Permission to patch shall not waive the Engineer's right to have the defective work completely removed if the patch or repairs do not, in the Engineer's opinion satisfactorily restore the quality and appearance of the work.

2. Patching shall be conducted as follows:

a. Chip away defective areas at least 1-½" deep perpendicular to the surface

b. Wet the area and 6" around it to prevent absorption of water form patching mortar.

c. Brush a sand-cement grout consisting of one part fine aggregate to one part Portland cement into the surface, following with patching mortar.

3. Patching mortar

a. Use no more than one part Portland cement to three parts fine aggregate.

b. Use white Portland cement to replace a portion of the gray cement as determine by a trial patch.

c. Use only the minimum mixing water required for placing.

d. Re-temper the mortar if necessary without the addition of water by allowing it to stand for one hour. Mixed with a trowel during that time to prevent setting.

4. Compact the Mortar into place and screed to leave the patch higher than the surrounding surface.

a. Leave undisturbed for one to two hours to permit initial shrinkage.

b. Finish to match the adjoining surface.

c. Cure patch in accordance with this specification section.

3.16 LOADS APPLIED TO NEW CONCRETE

A. Do not impose loads upon new concrete until it has reached its specified 28-day strength.

1. Loads include, but are not limited to, earth loads, loads exerted from bracing or shoring, wind loads, hydrostatic or hydraulic loads, equipment or vehicle loads, or loads exerted by stacked materials.

B. Repair or replace concrete which has cracked or is otherwise damaged due to overloading or loading before required strength has developed, as determined by the Engineer.

END OF SECTION

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SECTION 03310

CAST-IN-PLACE CONCRETE FOR PRECAST POST-TENSIONED CONCRETE TANK BASE SLABS

PART 1: GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes form materials, reinforcement, accessories, cast-in-place concrete, and slab finishing and curing for the base slabs of the precast post-tensioned concrete tanks for the entire project. The work performed under this Section includes all labor, material, equipment, related services, and supervision required for the mixing, placing and finishing of cast-in-place concrete.

B. Related Sections include the following:

1. Section 02200 “Earthwork” for preparing the subgrade to support the tanks and for backfilling requirements.

2. Section 03420 “Precast Post-tensioned Concrete Tanks – Rectangular (ACI 350)”

3. Section 03420 “Precast Post-tensioned Concrete Tanks – Rectangular (AWWA D115)”

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Design Mixtures: For each concrete mixture. Include minimum required compressive strength.

1.04 QUALITY ASSURANCE

A. Construct and erect concrete formwork and accessories in accordance with ACI 301, ACI 347 and ACI 350.

B. Perform concrete reinforcing work in accordance with ACI 301 and ACI 350.

C. Perform cast-in-place concrete work in accordance with ACI 301 and ACI 350.

D. Conform to ACI 305R when concreting during hot weather.

E. Conform to ACI 306R when concreting during cold weather.

F. Referenced Standards:

1. ACI 117, “Standard Specifications for Tolerances for Concrete Construction and Materials”

2. ACI 301, “Specifications for Structural Concrete”

3. ACI 305R, “Guide to Hot Weather Concreting”
4. ACI 306R, “Guide to Cold Weather Concreting”
5. ACI 350, “Code Requirements for Environmental Engineering Concrete Structures”
6. ACI 350.5, “Specifications for Environmental Concrete Structures”
7. CRSI, “Manual of Standard Practice”

PART 2: PRODUCTS

2.01 FORM MATERIALS AND ACCESSORIES

A. Form Materials: At discretion of Tank Supplier.

B. Formed Construction Joints: Keyed joints as indicated on the tank Shop (Erection) drawings provided by the Tank Supplier. Provide holes in formwork to receive reinforcing across the joint.

C. Vapor Retarder: ASTM D 4397, 6 mil thick, clear polyethylene film.

2.02 NON-PRESTRESSED REINFORCING STEEL

A. Reinforcing Bars: ASTM A 615, Grade 60, deformed.

B. Welded Wire Reinforcement: ASTM A 1064, plain or deformed, flat sheet.

C. Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for support of reinforcing.

D. Fabricate concrete reinforcement in accordance with ACI 301, ACI 350 and CRSI Manual of Standard Practice.

2.03 CONCRETE MATERIALS

A. Portland Cement: ASTM C 150, Type II or Type I/II.

1. Supplementary Cementitious Materials
   a. Fly Ash: ASTM C 618, Class F.
   b. Slag: ASTM C 989, Grade 100 or 120, ground granulated blast furnace slag.

B. Fine and Coarse Aggregates: ASTM C33, 1-inch maximum size.

C. Concrete Reinforcing Fibers: ASTM C 116, high-strength industrial-grade fibers.

D. Water: Potable; free from deleterious material that may affect setting or strength of concrete.

E. Air Entraining Admixture: ASTM C 260, certified by manufacturer to be compatible with other required admixtures.

F. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures and to not contain calcium chloride or more than 0.15 percent chloride ions or other salts by weight of admixture.

1. Water-Reducing Admixture: ASTM C 494, Type A.
2. Retarding Admixture: ASTM C 494, Type B.
3. Water-Reducing and Retarding Admixture: ASTM C 494, Type D.
4. Water-Reducing and Accelerating Admixture ASTM C494, Type E.
5. High Range, Water-Reducing Admixture: ASTM C 494, Type A and F.
6. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494, Type G.

2.04 CONCRETE MIXTURES

A. Mix and deliver concrete in accordance with ASTM C 94, Option C.

B. Select proportions for normal weight concrete in accordance with ACI 301, Method 1 or Method 2.

C. Prepare design mixtures for each type of concrete required.

1. Limit use of fly ash to 20 percent replacement of portland cement by weight.
2. Limit use of slag to 30 percent replacement of portland cement by weight.
3. Limit water-soluble chloride ions to maximum percentage by weight of cement permitted by ACI 350 when tested in accordance with ASTM C 1218.

D. Furnish concrete as indicated below:

1. Compressive Strength (28 Days): 4,500 psi minimum
2. Maximum Water-Cementitious Materials Ratio: 0.42
3. Slump: 6 inches, ±1 inch utilizing high-range, water-reducing admixture.
4. Minimum cementitious content: 611 pounds per cubic yard

E. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content of 6%, ±1½%.

F. When included in design mixtures, add other admixtures to concrete mixtures according to manufacturer's written instructions.

G. Do not use calcium chloride or admixtures containing calcium chloride.

2.05 WATERSTOPS

A. Flexible PVC Waterstops: Corp of Engineers CRD-C 572 for embedding in concrete construction joints to prevent the passage of fluids through joints. Factory-fabricate corners, intersections and directional changes.

1. Profile: Ribbed without center bulb.
2. Dimensions: 6 inches by 3/8-inch-thick, non-tapered.
3. Acceptable Products:
   a. Greenstreak PVC Waterstop #679, or equal.

B. Self-Expanding Rubber Strip Waterstops: Manufactured rectangular or trapezoidal strip, bentonite-free, hydrophilic polymer modified chloroprene rubber, for adhesive bonding to concrete.

1. Acceptable Products:

a. Greenstreak Hydrotite® CJ-1030-4M, or equal.

C. Self-Expanding Extrudable Waterstops: Extrudable, swelling, bentonite-free, one-part polyurethane.

1. Acceptable Products:

a. SikaSwell® S-2, or equal

2.06 RELATED MATERIALS

A. Crack Filler: ASTM C 881, two-part, moisture-tolerant, very-low-viscosity, epoxy injection adhesive for filling cracks.

1. Acceptable Products:

a. Sikadur® 52, or equal

B. Crack Sealer: ASTM C 920, Type S, Grade NS, Class 35 one-part polyurethane, elastomeric sealant, for sealing cracks.

1. Acceptable Products:

a. Sikaflex®-1a, or equal

PART 3: EXECUTION

3.01 PREPARATION

A. Proceed with base slab construction only after unsatisfactory conditions have been corrected in accordance with Section 03420, “Precast Post-tensioned Concrete Tanks.”

3.02 FORMWORK

A. Erect formwork, shoring and bracing to achieve design requirements.

B. Provide bracing to ensure stability of formwork.

3.03 EMBEDDED COMPONENTS AND OPENINGS

A. Coordinate work of other sections in forming and setting openings, slots, keyways, sleeves, bolts, anchors, pipe sleeves and other embedded components.

B. Install concrete accessories straight, level and plumb.

C. Install water stops continuous without displacing reinforcing. Heat seal joints watertight.

D. Place construction joint forms in accordance with base slab pouring sequence.

3.04 REINFORCEMENT PLACEMENT

A. Place reinforcement, supported and secured against displacement.

B. Ensure reinforcing is clean, free of loose scale, dirt or other foreign coatings.

C. Space reinforcement bars with minimum clear spacing in accordance with ACI 350, but not less than 1-1/2 inches.

D. Place reinforcement bars and maintain cover in accordance with tolerances listed in ACI 117 and ACI 350.

3.05 PLACING CONCRETE

A. Install vapor retarder under base slab as indicated on the tank Shop (Erection) drawings provided by the Tank Supplier.

B. Ensure reinforcement, embedded components and formwork is not displaced during concrete placement.

C. Deposit concrete as closely as practicable to final position. Prevent segregation of mix.

D. Place concrete continuously between predetermined construction joints.

E. Consolidate concrete.

F. Maintain records of concrete placement. Record date, location, quantity, air temperature and test samples taken.

G. Screed base slab level. Maintain slab flatness meeting the Conventional floor surface classification as measured using the Manual Straightedge Method per ACI 117, Table 4.8.6.1, unless indicated otherwise on the tank Shop (Erection) drawings provided by the Tank Supplier.

3.06 FINISHING

A. Steel-trowel finish unformed surfaces.

B. In areas with floor drains, maintain slab level at walls and slope uniformly to drains.

3.07 CURING AND PROTECTION

A. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.

1. Concrete, except high-early strength concrete, shall be maintained above 50° F and in a moist condition for at least the first three days after placement.

2. When concrete could be exposed to more than one freezing and thawing cycle during construction, protect concrete from freezing until concrete strength of 3,500 psi is achieved. Strength shall be verified using field-cured cylinders.

B. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.

3.08 FIELD QUALITY CONTROL

A. Place no concrete for the base slab until the subgrade has been inspected and approved by the Owner's Geotechnical Engineer.

B. Perform field inspection and testing in accordance with ACI 301.

C. Testing: Owner will engage accredited independent testing and inspecting agency to perform field tests and prepare reports.

1. Testing agency will report test results promptly and in writing to Contractor, Engineer of Record and Tank Supplier.

D. Strength Test Samples:

1. Sampling Procedures: ASTM C 172

2. Cylinder Molding and Curing Procedures: ASTM C 31, cylinder specimens, standard cured.

a. When there are early-age strength requirements, strength shall be evaluated using field-cured cylinders.

3. Sample concrete and make one set of five 4" x 8" cylinders for every 50 cubic yards or less of each class of concrete placed each day and for every 5,000 square feet of surface area.

a. Make additional sets of three 4" x 8" cylinders at the discretion of the Tank Supplier when required to verify early-age strength.

E. Field Testing:

1. Slump Test Method: ASTM C 143

2. Air Content Test Method: ASTM C 231

3. Temperature Test Method: ASTM C 1067

4. Measure slump and temperature for each compressive strength concrete sample.

5. Measure air content in air entrained concrete for each compressive strength concrete sample.

F. Cylinder Compressive Strength Testing:

1. Test Method: ASTM C39

2. Evaluation and Acceptance of Concrete: In accordance with ACI 350.

3. Test three 4" x 8" cylinders at 28 days.

4. Retain two cylinders for 56 days for testing when requested by Engineer.

5. Dispose of remaining cylinders when testing is not required.

3.09 DEFECTIVE CONCRETE

A. Defective Concrete: Concrete not conforming to required lines, details, dimensions, tolerances or specified requirements.

B. Repair or replace defective concrete. Repairs will be permitted provided structural adequacy, serviceability and durability of concrete elements comply with requirements of this section.

END OF SECTION

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SECTION 03400

PRECAST CONCRETE UTILITY STRUCTURES

PART 1: GENERAL

1.01 DESCRIPTION

A. Section Includes: Requirements for providing precast concrete structures, manholes, wet wells, vaults, and other miscellaneous structures or members.

1.02 REFERENCE STANDARDS

A. All work hereinafter shall comply with current and applicable portions of the following:

1. American Concrete Institute (ACI) Publications.
2. American Society for Testing and Materials (ASTM) Publications.
3. American Welding Society (AWS) Publications.
4. ACI 318, Building Code Requirements for Reinforced Concrete.
5. Precast/Prestressed Concrete Institute (PCI).

1.03 RELATED SPECIFICATIONS

A. Submittals Section 01300.

1.04 QUALITY ASSURANCE

A. Acceptable Manufacturers and Erectors shall have had a minimum of 5 years' experience in precast structural concrete work of the quality and scope required on this project. The producer shall have an established written quality assurance program in effective operation at their plant attested to be a current enrollment of the plant in the PCI "Certification Program for Quality Control" or a Quality Control Program acceptable to the Engineer. The written Quality Control Program will be furnished to the Engineer upon request.

B. Design

1. Structural members have been indicated on the drawings and specifications by general size and depth. The structural analysis and design of these items as well as lifting devices for all precast concrete members shall be performed by the manufacturer of the precast materials and subject to review of Engineer.
2. Design shall be in accordance with ACI 318, latest edition, and under the supervision of a Professional Engineer registered in the state where the project is located.
3. Design loads shall consist of dead load, live load, impact load, and loads due to water table and any other loads which may be imposed upon the structure. Unless noted otherwise, live loads shall be for HS-20 per AASHTO standard specifications for highway bridges and design wheel loads shall be

16 kips. The live load shall be that which produces the maximum shear and bending moments on the structure.

4. Before shipment, all concrete members shall be inspected to determine that materials and workmanship conform to the requirements of these specifications and the manufacturer/vendor quality control program.

C. Allowable Tolerances

1. Dimensions and cambers shall be within the tolerances as described in PCI MNL-116, Division V, Section 5.

2. Deflection: Deflection under design live load shall not exceed calculated deflection by more than 10 percent.

D. Sampling and Testing

1. General

a. Samples and tests required below and other tests are to be made by and at the Contractor's expense. The tests shall be performed by an independent commercial testing laboratory or by the manufacturer's lab subject to review by the Engineer. Compressive strength tests for initial prestress may be performed in the manufacturer's plant laboratory. Certified copies of test reports shall be furnished as required in this Specification, and shall include all test data and results.

2. Concrete Testing

a. During the progress of the work, plastic concrete, as delivered to the casting site, shall be sampled and tested for slump, air content and compressive strength in accordance with ACI 381, Part 2, Chapter 3, and Part 3, Chapter 4. No fewer than 6 cylinders shall be made during each concreting cycle. Not more than 1 test in 10 shall fall below the specified strength.

3. Slump Tests

a. Slump tests shall be in accordance with ASTM C 143.

4. Failure to Meet Strength Requirements

a. If compressive strength tests fail to meet the above requirements, the Engineer may require load tests to be made in accordance with ACI 318. Units failing to meet requirements of the load tests shall not be used. Load tests shall be performed at the expense of the Contractor.

1.05 SUBMITTALS

A. Shop Drawings

1. Furnish complete details of design, manufacture, fabrication, installation and erection in accordance with the contract conditions. Location of all inserts and openings shall be shown.

2. Design computations shall be submitted with shop drawings for review prior to manufacture of any units and shall bear the seal of the Professional

Engineer who performed or approved the design and is registered in the state where the project is located. All design loads shall be clearly shown.

3. Each precast concrete unit shall be properly identified by a specific mark, to appear both on the shop drawings and on the manufactured unit. These identifying marks are to be clearly visible to facilitate proper erection and installation.

4. All connections, bearings, and anchorage details shall be shown on the shop drawings. The precast concrete manufacturer, subject to review of Engineer, will be permitted to modify any details shown on the drawings provided such modifications will be equally or more efficient and more consistent with the latest recommended practices of the Precast/Prestressed Concrete Institute, and at no additional cost to the Owner. All cast-in connection components shall be designed with positive anchorage which shall be accomplished by having the anchors attached to or around reinforcing steel wherever possible.

5. Design loads, used in design of the precast concrete section, shall be indicated on the shop drawings.

B. Certificates of Conformance

1. Before delivery of materials and equipment, 4 notarized certificates attesting that materials and equipment meet the requirements specified shall be submitted to the Engineer for review.

1.06 DELIVERY, STORAGE AND HANDLING

A. Delivery

1. Precast structures and members shall be inspected upon delivery to the erection site and stored in a manner that will prevent staining and damage.

2. Substantially damaged, cracked, or broken units which are deemed unsuitable for the intended use shall be rejected and removed from the site at no cost to the Owner.

3. The Engineer’s decision will be final in determining unsuitable units.

B. Handling

1. Precast concrete members shall be lifted and supported during transportation only at the lifting and/or support points shown on the Shop Drawings. Only lifting devices embedded in these sections by the manufacturer shall be used, unless specific authorization to use other lifting points is received in writing from the manufacturer.

2. Proper equipment shall be used to transport the precast concrete sections to the job site. Trucks and trailers with sufficient capacity to handle the heaviest sections specified, without overloading the access routes, must be used. Units damaged due to racking or twisting will be rejected whether damaged on site and route or at the plant.

3. Proper access on the job site shall be provided by the contractor to permit transportation units to proceed under their own power to a location accessible to erection units.

C. Storage

1. Store precast structures or members off the ground on wooden blocking, pallets, or other appropriate means away from brush, and in areas accessible for inspection.

D. Repair or Replacement

1. Repair damage or defects if Engineer deems repairable and at his direction.

2. Remove and replace at no cost to the Owner if Engineer deems damage or defects are not repairable by Contractor.

PART 2: PRODUCTS

2.01 MATERIALS

A. Reinforced Concrete Materials: As modified herein, except that slump requirement shall not apply to manholes.

B. Precast Concrete Manholes: ASTM C478 except:

1. Compressive Design Strength of Concrete

a. Minimum 5,000 psi using Type II cement.

b. Minimum compression cylinder test of 4,000 psi at time of shipment.

2. Configurations: Follow Drawings and Standard Details.

3. Joints: ASTM C443.

4. Appurtenances.

a. Steps: Manufacture standard details.

b. Bolt inserts: Follow Standard Details.

c. Embed one of following a minimum of 3 inches, to accommodate ¾-inch-diameter bolts.

1) Heckman Building Products Corporation, No. 444 Star Threaded Inserts.

2) Pennsylvania Insert Corporation, the Liberator.

3) Atlantic Concrete Products Co., Bolt Slot Insert System

4) Strut Service Company inserts.

5. Manhole Identification: Clearly marked on inside near top where applicable.

a. ASTM Specification designation.

b. Manhole setting number (bases only) and Owner project number.

c. Date of manufacture.

d. Production control number for tracking manufacture phases of item and name or trademark of manufacturer.

e. Manhole sections with flexible connectors:

1) Marked above connector openings with type and size, and type of pipe for which connector is designed.

2) Engraved or stenciled markings with waterproof paint or ink in minimum 1-inch-high letters.

f. Lined manholes: Stenciled with waterproof paint or ink markings as noted herein that cannot be easily removed from lining or epoxy coated surfaces.

6. Precast Manhole Sections

a. Approved Manufacturers:

1) Tindall

2) Old Castle

3) Or approved equal

7. Precast Concrete Grade Rings: ASTM C478, except:

a. Compressive Design Strength of Concrete: Minimum 5,000 psi using Type II cement.

b. Configurations: Follow Standard Details.

c. Rings: Drilled with holes 1½- to 2-inch diameter to accommodate frame anchor bolts.

1) Grade rings with cracks or fractures passing through height of ring and any continuous crack extending for length of 3 inches or more will be rejected.

2) Rings with damaged edges which will prevent making satisfactory joint in the opinion of the Engineer will be rejected.

3) Planes of ring surfaces: Within limits of plus or minus ¼ inch of horizontal and vertical, except for sloped adjusting grade ring to be within ¼ inch of Standard Detail.

d. Protection

1) On lined manholes: Follow manufacturer’s recommendations.

e. Approved manufacturers:

1) Atlantic Concrete Products Company

2) Americast

3) Contractors Precast Corporation

4) Hanson Concrete Products

5) Dal-Col Products, Inc.

6) Prism Precast Products, Inc.

7) Frederick Precast Concrete, Inc.

8) Or approved equal

8. Precast Concrete Vaults and Wet Well: ASTM C858
   a. Configurations: Follow drawings.
   b. Identification: Clearly mark inside of each precast concrete vault section.
      1) ASTM Designation.
      2) Structure size.
      3) Date of manufacture.
      4) Project station location and Owner project number.
      5) Name or trademark of manufacturer.
      6) Mark slabs on top and bottom surfaces.
   c. Design Mixes
      1) 5,000 psi at 28 days using Type II cement.
      2) Mix proportion: ACI 318.
   d. Approved Manufacturers
      1) Tindall
      2) Old Castle
      3) Or approved equal
   e. Vault Access Doors
      1) Vault or Hatch access doors shall be fabricated aluminum, 4 feet wide by 4 feet long, unless otherwise specified by the Engineer. Access doors shall mount flush with the surrounding area.
      2) Access doors shall be equipped with heavy brass hinges, stainless steel pins, compression spring operators, an automatic hold-open arm with release handle and a locking device, to receive a padlock.
      3) All vault access doors and hatches shall be H-20 rated traffic doors.
      4) Access doors shall be Type JD-AL as manufactured by the Bilco Company, New Haven, Connecticut, or approved equal.
   f. Ladders
      1) Ladders shall be of aluminum construction. Rung diameter shall be 1-inch minimum, with 12 inches between rungs, and 18 inches between side bars. Ladders shall exceed the requirements of CAL/OSHA and ANSI standards.
      2) Material for ladders shall be high strength 6061-T6 aluminum alloy.
      3) Appropriate Bilco, or approved equal, ladder-up safety post for each ladder installation shall be provided.

9. Miscellaneous Materials
   a. Granular Bedding: ASTM C33 coarse aggregate size number 4.

b. Weep holes: Service weight cast iron covered with non-erodible filter on earth side.

10. Manhole Ring and Cover

a. Manhole rings shall be made from gray or ductile iron and manhole cover shall be ductile iron. Castings shall be made in the USA and shall be ERGO® Access Assembly with EJ product number 41600533L01 or approved equal. Approved equal must meet the requirements of this specification.

b. Material: Manufacturer shall certify that the ductile iron conforms to ASTM A536 grade 70-50-05 or 80-55-06. Castings must contain a minimum of 85% recycled content.

c. Markings: The top of manhole covers shall have the country of origin and manufacturers identification. The bottom of the casting shall have the product name or series number, part number, production date (example: mm/dd/yy) for tracking purposes, and material quality (such as ASTM A536) to verify the materials used. Castings without proper markings shall be rejected.

d. Product Specifics:

1) Cover: Covers and grates shall be provided with a continuous vulcanized one- piece EPDM gasket with a shore durometer of 70 ±5 permanently attached to the cover. An integrated Slip Resistant surface shall be cast into the cover surface. The hinge shall have a drain to allow for proper debris and foreign object removal. The cover or grate shall positively lock at 90° to prevent accidental closure and open fully to 120°. For ergonomic purposes the cover or grate must be removable at 120°. The cover shall also include a single multi-tool lifting slot adjacent to the edge of the cover and opposite to the hinge to facilitate opening/lifting/prying once unlocked. The lifting slot must be open to the edge of the cover to allow for prying. The cover shall have no less than 6 each, 1-inch-diameter vent holes. Nominal cover diameter shall be 38” with a 36” clear opening.

2) Frame: Frame shall have a 36” clear opening. Frames shall have a minimum of four 1” holes/slots for anchoring purposes. Frames shall be 6” in height. Slots for embedment/lightening are not allowed in frame flange.

e. These castings are manufactured to withstand highway traffic loads, exceeding AASHTO H-20/HS-20 specifications (wheel loads of 16,000 pounds with a tire contact area of 8” x 20”).

2.02 SOURCE QUALITY CONTROL

A. Test Equipment: Instruments, gages, and other testing and measuring equipment of proper range, type, and accuracy to verify conformance with specification requirements.

1. Ensure equipment is calibrated and certified at annual intervals.

2. Calibrate against measurement standards with known relationship to existing national standards.

3. Calibrate and certify gages on equipment to which they belong and keep them on equipment following certification.

4. Do not use instruments, gages, testing, and measuring equipment found to be out of calibration or adjustment until applicable requirements have been met.

5. Calibration by agency regularly engaged in this type of activity.

B. Precast Manhole Testing

1. Joint and Barrel Testing: ASTM C443.

a. Plant vacuum testing: ASTM C1244.

C. Acceptance Procedure for Concrete Strength of Precast Manhole Sections: Procedure applies to acceptance and approval of precast manhole bases, riser, and cone sections, flat top slabs, and grade rings.

1. Concrete Design Mix Approval: Based on submittal specified above herein.

a. The Owner will issue approval for up to 3 years, provided design mix materials and sources are not changed and in-plant concrete testing of manhole sections continues to be accepted without rejection of more than 2 days' production in a row.

b. Every 3 years thereafter, and under failure conditions stated above resubmit concrete design mix for approval.

c. Production from mixes other than those approved will be rejected.

d. Compressive strength test: ACI 301 and ACI 318.

D. Vaults and Other Precast Concrete Structures

1. Determination of concrete compressive strength from compressive tests made on concrete cylinders.

2. Unless otherwise specified, retain independent testing facility approved by Engineer for molding, capping, and testing concrete cylinders following appropriate ASTM requirements or, at Engineer's option, make cylinders and use own equipment to test.

a. Furnish test results to Engineer.

b. Engineer may require core samples of finished products.

c. When requested by Engineer, furnish compressive test specimens for testing in addition to requirements above, and continue to monitor quality of concrete.

3. Notify Engineer at least 10 working days prior to pouring any structure.

4. The Owner may perform random or full inspections of manufacture of boxes, vaults, and precast structures to inspect:

a. Steel placement and size.

b. Overall fabrication.

c. Workmanship.

d. Other general or specific aspects of production and specification compliance.

2.03 PAINTING

A. Paint the exterior surfaces of all precast concrete structures for subgrade service, with the exception of manholes, in accordance with the following schedule:

1. Carboline Bitumastic 50: Two coats 8 to 10 mil per coat, or

2. Tnemec H.B. Tnemec 46-465: Two coats 8 to 10 mil per coat.

3. Total film thickness 16-20 mils. No additional payment for extra coats applied to meet the film thickness.

PART 3: EXECUTION

3.01 EARTHWORK

A. The Contractor shall prepare an excavation large enough to accommodate the structure and permit grouting of openings and backfilling operations.

B. The bottom of the structure shall be placed on 12 inches of compacted, crushed rock subbase, and graded level to the elevation as shown on the plans.

C. Vault excavations shall be backfilled with imported granular material to a minimum relative density of 95 percent standard proctor method as determined by ASTM D-698.

3.02 INSTALLATION

A. Openings or “knockouts” in precast concrete vaults shall be located as shown on the drawings and shall be sized sufficiently to permit passage of the largest dimension of pipe and/or flange.

B. Upon completion of installation, all voids or openings in the vault walls around pipes shall be filled with 3,000 psi non-shrink grout.

C. After the structure and all appurtenances are in place and approved, backfill shall be placed to the original ground line or to the limits designated on the plans.

D. All joints between precast concrete vault sections shall be made watertight. The plastic joint sealing compound shall be installed according to the manufacturer’s recommendations to provide a watertight joint which remains impermeable throughout the design life of the structure. The outside of the entire structure shall be coated with an approved waterproofing material.

E. Access doors shall be built up such that the hatch is flush with the surrounding surface unless otherwise specified on the drawings or by the Engineer. The Contractor is responsible for placing the cover at the proper elevation where paving is to be installed and shall make all necessary adjustments so that the cover meets these requirements.

F. Ladders shall be installed using Type 316 stainless steel capsule anchors. Ladders shall be attached a minimum of 3 places to the vault wall. Ladder shall be centered under access door opening.

3.03 FIELD QUALITY ASSURANCE

A. Perform field testing of precast concrete structures required under other sections of these specifications.

END OF SECTION

SECTION 03420

PRECAST POST-TENSIONED CONCRETE TANKS – RECTANGULAR (ACI 350)

PART 1: GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes the performance criteria, materials, design, production, and erection of rectangular precast post-tensioned concrete tanks for the entire project. The work performed under this Section includes all labor, material, equipment, related services, and supervision required for the manufacture and erection of the rectangular precast post-tensioned concrete tanks shown on the Contract Drawings.

B. Work includes, but is not limited to:

1. Biological Nutrient Reactors [BNR] 1-3
2. Membrane Bioreactor Facility [MBR]

C. Related Sections include the following:

1. Section 02200 “Earthwork” for preparing the subgrade to support the tanks and for backfilling requirements.
2. Section 03310 “Cast-in-Place Concrete for Precast Post-tensioned Concrete Tank Base Slabs” for concrete for the base slab.
3. Section 05500 “Metal Fabrications” for furnishing and installing loose hardware items.

1.03 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide rectangular precast post-tensioned concrete tanks capable of withstanding the following design loads within limits and under conditions indicated:

1. Internal Fluid Loads: 65 pcf
2. Superimposed Dead Loads: 50 PSF
3. Live Loads: 250 PSF
4. Roof Live Loads: 50 PSF
5. Basic Ground Snow Load: 5 PSF
6. Backfill Loads:
   a. Unit Weight: Wet unit weight 125 PCF
   b. Equivalent Fluid Pressure against Tank Walls: At Rest (Ko) = 0.5

7. Surcharge Loads: Truck Traffic on service Road north of BNR Tanks – Use 250 PSF Surcharge
8. Design Groundwater Elevation: EL (+) 860.0
9. 100-year Flood Elevation: EL (+) 872.0
10. Seismic Loads:
    a. Importance Factor: 1.25
    b. Risk Category: III
    c. Soil Site Classification: D
    d. Mapped Spectral Response Coefficients:
        1) Ss: 0.263-sec
        2) S1: 0.095-sec

B. General Tank Design Criteria:

1. Wall thickness shall be as required by ACI 350.
2. Backfill shall not be used to offset fluid loads.
3. Comply with ACI 350 requirements including, but not limited to:
    a. Load factors.
    b. Limits on stresses at transfer of prestress and under service load.
    c. Minimum bonded reinforcement.
    d. Concrete cover over reinforcement.
4. The tank walls shall be post-tensioned in accordance with ACI 350.
    a. Tank walls shall have horizontal post-tensioned tendons to provide residual compression stress.
    b. Minimum residual compression shall be 125 psi after allowance for all prestress losses.
5. The tank structure shall be designed to resist low to medium strength residential wastewater.
6. The tank structure shall be designed for normal environmental exposure.
7. Design rectangular precast post-tensioned concrete tanks to allow for fabrication and construction tolerances, and to accommodate deflection, shrinkage and creep of primary tank structure. Maintain structural precast concrete deflections within limits of ACI 350.
8. Flotation safety factors:
    a. When 100 year flood elevation exceeds the top of tank elevation and only using dead load to resist flotation, minimum factor of safety shall be 1.25.
    b. All other cases not included above, whether due to flood or natural groundwater, minimum factor of safety shall be 1.25.

1) Maximum allowable soil wedge angle from vertical: 30 degrees

C. Base Slab Design Criteria:

1. Design the base slab to resist all imposed loads within the allowable bearing capacity listed below.
   a. Allowable Bearing Capacity: 2500 PSF
   b. Refer to Geotechnical Engineering Report “Report of Subsurface Exploration and Geotechnical Engineering Evaluation, Canton WWTP, Canton, Georgia, December 17, 2019. Geo-Hydro Project Number 191131.20 for additional foundation design recommendations.
2. Minimum membrane slab thickness shall be six inches for prestressed and non-prestressed floors.
3. For non-prestressed membrane slabs, the minimum reinforcement in each orthogonal direction shall be 0.5 percent of gross concrete area or in accordance with ACI 350 whichever is greater.
4. For prestressed membrane slabs:
   a. Minimum residual compression in each orthogonal direction shall be 200 psi after allowance for tensile forces from internal fluid loads at the base of the wall, slab-subgrade friction, and all prestress losses.
   b. Minimum non-prestressed reinforcement in each orthogonal direction shall be 0.15 percent of gross concrete area.
5. Minimum perimeter footing thickness shall be 12 inches.
6. Frost depth: 24 inches

1.04 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Design Mixtures: For each concrete mixture. Include minimum required compressive strength.

C. Shop (Erection) Drawings:

1. Indicate stone requirements for pressure relief valves.
2. Indicate configuration, thickness, dimensions and details of cast-in-place concrete base slab.
3. Indicate size, spacing and details of all necessary base slab reinforcing.
4. Indicate plan views, elevations, sections, and details necessary to install the tank.
5. Indicate locations of all post-tensioned tendons.
6. Indicate tendon stressing sequence and force, and theoretical elongations for all post-tensioned tendons.
7. Include and locate all pipe penetrations. Indicate all penetration styles.

8. Coordinate and indicate openings required by other trades.
9. Indicate location of each precast concrete member by same identification mark placed on unit.
10. Indicate relationship of structural precast concrete members to adjacent materials.
11. Indicate locations and details of joint treatment.
12. Indicate shim sizes and grout requirements.
13. Indicate bearing pad sizes and materials.

D. Comprehensive engineering design signed and sealed by a qualified professional engineer responsible for its preparation licensed in Georgia.

1.05 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Tank Supplier and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include list of completed projects with project names and addresses, names and addresses of engineers and owners, and other information specified.

B. Material Certificates: Signed by manufacturers certifying that each of the following items complies with requirements.

1. Cementitious materials.
2. Aggregates.
3. Reinforcing materials and post-tensioning strands.
4. Admixtures.
5. Bearing pads.
6. Other components specified in Contract Documents with applicable standards.

C. Provide handling procedures, erection sequences, and temporary bracing as required for special conditions.

D. Field quality-control test reports.

1.06 QUALITY ASSURANCE

A. Tank Supplier Qualifications: A firm that complies with the following requirements and is experienced in producing rectangular precast post-tensioned concrete tanks that have a record of successful in-service performance.

1. Assumes responsibility for engineering rectangular precast post-tensioned concrete tanks to comply with performance requirements. This responsibility includes preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer.
2. Precast Tank Engineer Qualifications: A professional engineer licensed in jurisdiction where Project is located and who is experienced in providing

engineering services of the kind indicated. Engineering services are defined as those performed for designs and installations of rectangular precast post-tensioned concrete tanks.

3. Has sufficient production capacity to produce required members to meet the project schedule.

B. Tank Supplier: Subject to compliance with requirements, provide rectangular precast post-tensioned concrete tanks by Dutchland, Inc. located in Gap, Pennsylvania, or pre-approved equal.

C. Alternate Tank Supplier Pre-approval Qualifications: Alternate Tank Suppliers wishing to become pre-approved shall comply with the Tank Supplier Qualifications listed above, and the following requirements.

1. The firm shall have a minimum of 25 consecutive years in designing, producing and installing tanks of similar arrangement, size and complexity using the precast post-tensioned concrete system.

2. The firm shall document the successful installation and performance of a minimum of ten structures of equal or greater size and certify compliance of those structures will all applicable provisions of ACI 350 for a precast post-tensioned concrete structure.

3. The firm shall employ a full-time engineer on staff who meets the Precast Tank Engineer Qualifications listed above and who has served as the engineer in responsible charge of at least ten structures of equal or greater size.

4. The firm shall submit with its bid a summary sheet documenting compliance with these qualifications.

5. The firm shall submit with its bid a reference sheet listing contact names and telephone numbers of at least ten structures of equal or greater size built by the firm.

6. All firms seeking prequalification shall document a first pass leak test history of no less than 90 percent of all completed water holding basins passing the leak test on the first test over a twelve-month period.

D. Post-Tensioning Manufacturer Qualifications: Fabricating plant certified by PTI according to procedures set forth in PTI's "Manual for Certification of Plants Producing Unbonded Single Strand Tendons."

E. Post-Tensioning Installer Qualifications: A qualified installer whose full-time Project superintendent has successfully completed PTI's Level 1 Unbonded PT - Field Installation course.

1. Superintendent must receive training from post-tensioning supplier in the operation of stressing equipment to be used on Project.

F. Post-Tensioning Inspector Qualifications: Personnel performing field inspections and measuring elongations shall have successfully completed PTI's Level 2 Unbonded PT - Inspector course.

G. Design Standards: Comply with ACI 350, “Code Requirements for Environmental Concrete Structures” and the design recommendations of PCI MNL 120, “PCI

Design Handbook – Precast and Prestressed Concrete," applicable to types of structural precast concrete members indicated.

H. Quality-Control Standard: For manufacturing procedures and testing requirements and quality control recommendations for types of members required, comply with PCI MNL 116, "Manual for Quality Control for Plants and Production of Structural Concrete Products."

1. Comply with dimensional tolerances of PCI MNL 135, "Tolerance Manual for Precast and Prestressed Concrete Construction."

I. Plant Quality Control Manager Qualifications: The plant quality control manager shall be currently certified as a PCI Level 2 Plant Quality Control Technician.

J. Plant Manager Qualifications: The plant manager shall be currently certified as a PCI Level 2 Plant Quality Control Technician.

K. Referenced Standards:

1. ACI 117, "Standard Specifications for Tolerances for Concrete Construction and Materials"
2. ACI 301, "Specifications for Structural Concrete"
3. ACI 318, "Building Code Requirements for Structural Concrete"
4. ACI 350, "Code Requirements for Environmental Engineering Concrete Structures"
5. ACI 350.1, "Specification for Tightness Testing of Environmental Engineering Concrete Containment Structures"
6. ACI 350.3, "Seismic Design of Liquid-Containing Concrete Structures"
7. ACI 350.4R, "Design Considerations for Environmental Engineering Concrete Structures"
8. ACI 350.5, "Specifications for Environmental Concrete Structures"
9. ACI 423.7, "Specification for Unbonded Single-Strand Tendon Materials and Commentary"
10. ASCE 7, "Minimum Design Loads for Buildings and Other Structures"
11. AWS D1.4, "Structural Welding Code – Reinforcing Steel"
12. PCI MNL-116, "Manual for Quality Control for Plants and Production of Structural Concrete Products"
13. PCI MNL-120, "PCI Design Handbook – Precast and Prestressed Concrete"
14. PCI MNL-135, "Tolerance Manual for Precast and Prestressed Concrete Construction"
15. PTI TAB.1, "Post-Tensioning Manual"
16. PTI M10.2, "Specification for Unbonded Single Strand Tendons"

17. PTI M10.3, “Field Procedures Manual for Unbonded Single Strand Tendons”

18. PTI M55.1, “Specification for Grouting of Post-Tensioned Structures”

L. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Section 01311 “Construction Schedules and Meetings”

M. Tank designs that rely on bolted or welded connections, or ship-lap joints, for primary, fluid-retaining walls shall not be allowed.

N. Shotcrete shall not be allowed.

1.07 DELIVERY, STORAGE AND HANDLING

A. Deliver, store, and handle post-tensioning materials according to PTI's "Field Procedures Manual for Unbonded Single Strand Tendons.”

B. Deliver all precast concrete members in such quantities and at such times to assure compliance with the agreed upon project schedule and setting sequence to ensure continuity of installation.

C. Handle and transport precast concrete members in a manner to avoid excessive stresses that could cause cracking or other damage.

D. Store precast concrete members with adequate dunnage and bracing, and protect units to prevent contact with soil, staining, and to control cracking, distortion, warping or other physical damage.

PART 2: PRODUCTS

2.01 MANUFACTURERS

A. Source Limitations: Obtain post-tensioning materials and equipment from single source.

2.02 FORM MATERIALS

A. Forms: Rigid, dimensionally stable, nonabsorptive material, warp and buckle free, that will provide precast concrete surfaces within fabrication tolerances indicated; nonreactive with concrete and suitable for producing required surface finishes.

1. Form-Release Agent: Commercially produced form-release agent that will not bond with, stain or affect hardening of precast concrete surfaces and will not impair subsequent surface or joint treatments of precast concrete.

2.03 NON-PRESTRESSED REINFORCING STEEL

A. Reinforcing Bars: ASTM A 615, Grade 60, deformed.

B. Low-Alloy-Steel Reinforcing Bars: ASTM A 706, deformed.

C. Welded Wire Reinforcement: ASTM A 1064, plain or deformed, flat sheet.

D. Supports: Use bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place according to PCI MNL 116.

2.04 PRESTRESSING TENDONS

A. ACI Publications: Comply with ACI 423.7, "Specification for Unbonded Single Strand Tendon Materials and Commentary."

B. Prestressing Strand: ASTM A 416, Grade 270, 7-wire, low-relaxation, 0.6-inch-diameter strand with corrosion inhibitor conforming to ACI 423.7, with polypropylene tendon sheathing.

C. Post-Tensioning Coating: Compound with friction-reducing, moisture-displacing, and corrosion-inhibiting properties; chemically stable and nonreactive with prestressing steel, nonprestressed reinforcement, sheathing material, and concrete.

D. Tendon Sheathing:

1. Virgin high-density polyethylene or polypropylene with a minimum thickness of 50 mils.

2. Continuous over the length of tendon to provide watertight encapsulation of strand.

E. Anchorage Device and Coupler Assembly: Assembly of strand, wedges, and anchorage device or coupler complying with static and fatigue testing requirements and capable of developing 95 percent of actual breaking strength of strand.

1. Anchorage devices and coupler assemblies shall be fully encapsulated with either plastic or epoxy coating.

F. Encapsulation System: Watertight encapsulation of prestressing strand consisting of the following:

1. Wedge-Cavity Caps: Attached to anchorages with a positive mechanical connection and filled with post-tensioning coating.

2. Sleeves: Attached to anchorage device with positive mechanical connection; overlapped a minimum of 4 inches with sheathing and filled with post-tensioning coating.

3. The encapsulation system shall meet the hydrostatic pressure testing requirements of ACI 423.7, except with a hydrostatic pressure of 10 psi, instead of the specified 1.25 psi.

2.05 ACCESSORIES

A. Sheathing Repair Tape: Elastic, self-adhesive, moisture-proof tape with minimum width of 2 inches (50 mm), in contrasting color to tendon sheathing; nonreactive with sheathing, coating, or prestressing steel.

2.06 CONCRETE MATERIALS

A. Portland Cement: ASTM C 150, Type II or Type I/II.

1. For surfaces exposed to view in finished structure, use same type, brand, and mill source throughout the precast concrete production.

B. Supplementary Cementitious Materials

1. Fly Ash: ASTM C 618, Class F with maximum loss on ignition of 6%.

2. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.

C. Normal-weight Aggregates: Except as modified by PCI MNL 116, ASTM C 33, with coarse, non-reactive aggregates. Stockpile fine and coarse aggregates for each type of exposed finish from a single source (pit or quarry) for Project.

D. Water: Potable; free from deleterious material that may affect color stability, setting, or strength of concrete and complying with chemical limits of PCI MNL 116.

E. Air Entraining Admixture: ASTM C 260, certified by manufacturer to be compatible with other required admixtures.

F. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures and to not contain calcium chloride or more than 0.15 percent chloride ions or other salts by weight of admixture.

1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.

2. Retarding Admixture: ASTM C 494/C 494M, Type B.

3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.

4. Water-Reducing and Accelerating Admixture ASTM C494/C 494M, Type E.

5. High Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type A and F.

6. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.

7. Plasticizing Admixture for Flowable Concrete: ASTM C 1017/C 1017M.

2.07 STEEL EMBEDDED MATERIALS

A. Carbon-Steel Shapes and Plates: ASTM A 36/A 36M

B. Carbon-Steel Headed Studs: ASTM A 108, Grades 1010 through 1020, cold finished, AWS D1.1/D1.1M, Type A or B, with arc shields and with the minimum mechanical properties of PCI MNL 116, Table 3.2.3.

C. Deformed-Steel Wire or Bar Anchors: ASTM A 496 or ASTM A 706/A 706M.

D. Zinc-Coated Finish: For exterior steel items and items indicated for galvanizing, apply zinc coating by hot-dip process according to ASTM A 123, after fabrication.

1. Galvanizing Repair Paint: Zinc paint with dry film containing not less than 94 percent zinc dust by weight and complying with DOD-P-21035B or SSPC-Paint 20.

2.08 STAINLESS-STEEL EMBEDDED MATERIALS

A. Stainless-Steel Plate: ASTM A 666, Type 304, Type 316, or Type 201, of grade suitable for application.

B. Stainless-Steel Bolts and Studs: ASTM F 593, alloy 304 or 316, hex-head bolts and studs; stainless-steel nuts; and flat, stainless-steel washers.

C. Stainless-Steel Headed Studs: ASTM A 276, with minimum mechanical properties for studs as indicated under MNL 116, Table 3.2.3.

2.09 BEARING PADS AND OTHER ACCESSORIES

A. Provide one of the following bearing pads for structural precast concrete members as recommended by tank supplier for application:

1. Elastomeric Pads: AASHTO M 251, plain, vulcanized, 100 percent polychloroprene (neoprene) elastomer, molded to size or cut from a molded sheet, 50 to 70 Shore A durometer according to ASTM D 2240, minimum tensile strength 2250 psi per ASTM D 412.

2. Random-Oriented, Fiber-Reinforced Elastomeric Pads: Preformed, randomly oriented synthetic fibers set in elastomer. Surface hardness of 70 to 90 Shore A durometer according to ASTM D2240. Capable of supporting a compressive stress of 3000 psi with no cracking, splitting or delaminating in the internal portions of the pad.

3. High-Density Plastic: Multimonomer, nonleaching, plastic strip capable of supporting loads with no visible overall expansion.

B. Erection Accessories: Provide steel plates and brackets, clips, hangers, high density plastic shims, and other accessories required to install precast concrete members.

2.10 GROUT MATERIALS

A. Nonshrink Grout: Premixed, prepackaged, non-metallic, shrink-resistant grout complying with ASTM C 1107, Grade C. Grout shall not contain chlorides.

1. Acceptable Products:

a. SikaGrout 212®, or equal.

b. SikaGrout 328®, or equal.

2.11 PATCHING MATERIALS

A. One-component, polymer-modified, premixed patching material containing selected silica aggregates and portland cement, suitable for vertical and overhead applications. Do not use material containing chlorides or other chemicals known to be deleterious to prestressing steel or material that is reactive with prestressing steel, anchorage device material, or concrete.

1. Acceptable Products:

a. ProSpec® BlendCrete, or equal.

2.12 CONCRETE MIXTURES

A. Prepare design mixtures for each type of concrete required.

1. Limit use of fly ash to 25 percent replacement of portland cement by weight.

2. Limit use of ground granulated blast-furnace slag to 40 percent replacement of portland cement by weight.

B. Design mixtures may be prepared by a qualified independent testing agency or by qualified precast plant personnel at Tank Supplier's option.

C. Limit water-soluble chloride ions to maximum percentage by weight of cement permitted by ACI 350 or PCI MNL 116 when tested in accordance with ASTM C 1218/C 1218M.

D. Normal-weight Concrete Mixtures: Proportion mixtures by either laboratory trial batch or field test data methods according to ACI 211.1, with materials to be used on Project, to provide normal-weight concrete.

E. Precast Concrete:

1. Compressive Strength (28 Days): 5,000 psi minimum.

2. Maximum Water-Cementitious Materials Ratio: 0.40.

F. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content complying with PCI MNL 116.

G. When included in design mixtures, add other admixtures to concrete mixtures according to manufacturer's written instructions.

H. Concrete Mixture Adjustments: Concrete mixture design adjustments may be made if characteristics of materials, Project conditions, weather, test results, or other circumstances warrant.

2.13 FORM FABRICATION

A. Form: Accurately construct forms, mortar tight, of sufficient strength to withstand pressures due to concrete placement and vibration operations and temperature changes, and for prestressing and detensioning operations. Coat contact surfaces of forms with release agent before reinforcement is placed. Avoid contamination of reinforcement and prestressing tendons by release agent.

B. Maintain forms to provide completed structural precast concrete members of shapes, lines, and dimensions within fabrication tolerances specified.

1. Edge and Corner Treatment: Uniformly chamfered or as built-in on standard forms.

2.14 FABRICATION

A. Cast-in Plates, Inserts, Angles, and Other Hardware: Fabricate hardware with sufficient anchorage and embedment to comply with design requirements. Accurately position for attachment of loose hardware and secure in place during precasting operations. Locate hardware where it does not affect position of main reinforcement or concrete placement.

1. Weld headed studs and deformed bar anchors used for anchorage according to AWS D1.1/D1.1M and AWS C5.4, "Recommended Practices for Stud Welding."

B. Reinforcement: Comply with recommendations in PCI MNL 116 for fabricating, placing, and supporting reinforcement.

1. Clean reinforcement of loose rust and mill scale, earth, and other materials that reduce or destroy the bond with concrete. When damage to epoxy coated reinforcing exceeds limits specified in ASTM A 775, repair with patching material compatible with coating material and epoxy coat bar ends after cutting.

2. Accurately position, support, and secure reinforcement against displacement during concrete-placement and consolidation operations. Locate and support reinforcement by plastic tipped or corrosion resistant metal or plastic chairs, runners, bolsters, spacers, hangers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place according to PCI MNL 116.

3. Provide cover requirements in accordance with ACI 350. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position while placing concrete.

4. Install welded wire reinforcement in lengths as long as practicable. Lap adjoining pieces in accordance with ACI 350 and wire tie laps, where required by design. Offset laps of adjoining widths to prevent continuous laps in either direction.

C. Reinforce structural precast concrete members to resist handling, transportation, and erection stresses, and specified in-place loads, whichever governs.

D. Comply with requirements in PCI MNL 116 and in this Section for measuring, mixing, transporting, and placing concrete. After concrete batching, no additional water may be added.

E. Place concrete in a continuous operation to prevent cold joints or planes of weakness from forming in precast concrete members.

F. Place self-consolidating concrete with minimal vibration without dislocating or damaging reinforcement and built-in items, and minimize pour lines, honeycombing or entrapped air voids on surfaces. Use equipment and procedures complying with PCI MNL 116.

G. Comply with PCI MNL 116 procedures for hot and cold-weather concrete placement.

H. Identify pickup points of precast concrete members and orientation in structure with permanent markings, complying with markings indicated on Shop Drawings. Imprint or permanently mark casting date on each precast concrete member on a surface that will not show in finished structure.

I. Cure concrete, according to requirements in PCI MNL 116, by moisture retention without heat or by accelerated heat curing using live steam or radiant heat and moisture. Cure members until compressive strength is high enough to ensure that stripping does not have an effect on the performance of final product.

2.15 WATERSTOPS

A. Flexible PVC Waterstops: Corp of Engineers CRD-C 572 for embedding in concrete construction joints to prevent the passage of fluids through joints. Factory-fabricate corners, intersections and directional changes.

1. Profile: Ribbed without center bulb.

2. Dimensions: 9 inches by 3/8-inch-thick, non-tapered.

3. Acceptable Products:

a. Greenstreak PVC Waterstop #646, or equal.

B. Self-Expanding Rubber Strip Waterstops: Manufactured rectangular or trapezoidal strip, bentonite-free, hydrophilic polymer modified chloroprene rubber, for adhesive bonding to concrete.

1. Acceptable Products:

a. Greenstreak Hydrotite® CJ-1030-4M, or equal.

C. Self-Expanding Extrudable Waterstops: Extrudable, swelling, bentonite-free, one-part polyurethane.

1. Acceptable Products:

a. SikaSwell® S-2, or equal

2.16 RELATED MATERIALS

A. Joint/Crack Filler: ASTM C 920, Type S, Grade NS, Class 35 one-part polyurethane, elastomeric sealant, for sealing precast panel joints and minor cracks.

1. Acceptable Products:

a. Sikaflex®-1a+, or equal

B. High-Performance Joint Filler: ASTM C 920, Type S, Grade NS, Class 100/20 low-modulus, high-performance, one-part polyurethane-based, elastomeric sealant, for sealing precast panel joints subject to movement.

1. Acceptable Products:

a. Sikaflex®-15 LM, or equal

C. Sealant/Adhesive Primer: Specially formulated primer to promote adhesion of sealants and adhesives to concrete.

1. Acceptable Products:

a. Sikaflex® 429/202, or equal

D. Joint Sealant, Epoxy: High-build, two-part, protective, solvent-free epoxy.

1. Acceptable Products:

a. Sikagard® 62, or equal

E. Joint Sealant, Urethane: Liquid-applied, elastomeric, urethane.

1. Acceptable Products:
    a. CIM 1000, or equal

F. Epoxy Injection Adhesive: Two-part, moisture-tolerant, epoxy injection adhesive.

1. Acceptable Products:
    a. Sikadur® 52, or equal

G. Chemical Grout: Expanding, polyurethane, chemical grout.

1. Acceptable Products:
    a. SikaFix® HH+, or equal
    b. SikaFix® HH Hydrophilic, or equal

2.17 FABRICATION TOLERANCES

A. Fabricate structural precast concrete members of shapes, lines and dimensions indicated, so each finished member complies with PCI MNL 135 product tolerances as well as position tolerances for cast-in items.

2.18 FINISHES

A. Form Finish:

1. Standard Grade: Normal plant-run finish produced in forms that impart a smooth finish to concrete. Surface holes smaller than 1/2 inch caused by air bubbles, normal color variations, form joint marks, and minor chips and spalls are acceptable. Fill air holes greater than 1/4 inch in width that occur in high concentration (more than one per 2 square inches). Major or unsightly imperfections, honeycombs, or structural defects are not permitted. Allowable joint offset limited to 1/8 inch.

B. Smooth steel-trowel finish unformed surfaces. Consolidate concrete, bring to proper level with straightedge, float and trowel to a smooth, uniform finish.

2.19 SOURCE QUALITY CONTROL

A. Quality-Control Testing: Test and inspect precast concrete according to PCI MNL 116 requirements. If using self-consolidating concrete also test and inspect according to ASTM C 1611, ASTM C 1712, ASTM 1610, and ASTM C 1621.

B. Strength of precast concrete members will be considered deficient if units fail to comply with ACI 350 concrete strength requirements.

C. Testing: If there is evidence that strength of precast concrete members may be deficient or may not comply with ACI 350 requirements, fabricator shall employ an independent testing agency to obtain, prepare, and test cores drilled from hardened concrete to determine compressive strength according to ASTM C 42 and ACI 350.

1. Test results shall be reported in writing on the same day that tests are performed, with copies to Architect, Contractor, and precast concrete fabricator. Test reports shall include the following:
    a. Project identification name and number.

b. Date when tests were performed.

c. Name of Tank Supplier.

d. Name of concrete testing agency.

e. Identification letter, name, and type of precast concrete member(s) represented by core tests; design compressive strength; type of failure; actual compressive strength at breaks, corrected for length-diameter ratio; and direction of applied load to core in relation to horizontal plane of concrete as placed.

D. Patching: If core test results are satisfactory and precast concrete members comply with requirements, clean and dampen core holes and solidly fill with precast concrete mixture or repair material, and finish to match adjacent precast concrete surfaces.

E. Acceptability. Structural precast concrete members that do not comply with acceptability requirements in PCI MNL 116, including concrete strength, and manufacturing tolerances, are unacceptable. Chipped, spalled or cracked members may be repaired. Replace unacceptable units with precast concrete members that comply with requirements.

PART 3: EXECUTION

3.01 PREPARATION

A. General Contractor shall prepare subgrade in accordance with Section 02200 “Earthwork.”

3.02 EXAMINATION

A. Owner’s Geotechnical Engineer shall inspect and approve the subgrade supporting the tank.

B. Unsatisfactory conditions shall be corrected to the satisfaction of the Owner’s Geotechnical Engineer.

C. General Contractor shall notify Tank Supplier in writing that supporting subgrade has been approved by the Owner’s Geotechnical Engineer.

D. Proceed with base slab construction only after unsatisfactory conditions have been corrected.

E. The stone sub-base shall be prepared, leveled, and graded to within ± one inch of stone grade, as indicated on the approved Tank Supplier’s Shop (Erection) drawings.

F. Excavation shall include a minimum of four feet in plan beyond the perimeter of the approved exterior wall line.

G. Site access roads:

1. Shall be provided and maintained by the General Contractor throughout the installation of the base slab and precast tank structure.

2. Shall be cleared, leveled, stoned, and free of mud to provide 14-feet of vertical clearance and 14-feet of horizontal clearance.

3. Shall be capable of handling 80,000 pounds GVWR.

4. Shall support live loaded trucks operating under their own power.

5. Shall allow drop-deck, spread axle combinations with 53-ft trailers. This includes a 60-foot-long sweep radius for corners and egress/regress to roadways.

H. Crane and concrete pump pads:

1. Shall be provided and maintained by the General Contractor.

2. Shall be cleared, leveled, stoned, and free of mud.

3. Tank Supplier shall communicate the required locations and sizes of the pads with the General Contractor.

3.03 CAST-IN-PLACE CONCRETE BASE SLAB

A. Install the base slab in accordance with Section 03310 “Cast-in-Place Concrete for Precast Post-tensioned Concrete Tanks.”

3.04 ERECTION

A. Erect structural precast concrete level, plumb and square within the specified allowable erection tolerances. Provide temporary bracing as required to maintain position, stability, and alignment of members until permanent connections are completed.

1. Install temporary plastic spacing shims as necessary as precast concrete members are being erected.

2. Use patching material to fill voids within recessed lifting devices flush with surface of adjacent precast concrete surfaces when recess is exposed.

B. Install post-tensioning tendons as soon as practical.

C. Grouting or Dry-Packing Connections and Joints: Indicate joints to be grouted and any critical grouting sequences on Shop (Erection) Drawings. Grout open spaces at keyways, connections and joints where required or indicated with non-shrink, non-metallic grout. Retain flowable grout in place until it gains sufficient strength to support itself. Fill joints completely without seepage to other surfaces. Alternatively, pack spaces with stiff dry pack grout material, tamping until voids are filled. Promptly remove grout material from exposed surfaces before it hardens.

D. Field cutting of precast concrete members is not permitted without approval of the Precast Tank Engineer.

3.05 ERECTION TOLERANCES

A. Erect structural precast concrete members level, plumb, square and in alignment without exceeding the noncumulative erection tolerances of PCI MNL 135.

3.06 TENDON INSTALLATION

A. Inspect sheathing for damage before installing tendons. Repair damaged areas by restoring post-tensioning coating and repairing or replacing tendon sheathing.

1. Ensure that sheathing is watertight and there are no air voids.

2. Follow tape repair procedures in PTI's "Field Procedures Manual for Unbonded Single Strand Tendons."

B. Immediately remove and replace tendons that have damaged strand.

3.07 TENDON STRESSING

A. Stressing jacks and gauges shall be individually identified and calibrated to known standards at intervals not exceeding six months. Exercise care in handling stressing equipment to ensure that proper calibration is maintained.

B. Stress tendons only under supervision of a qualified post-tensioning superintendent.

C. Tendon stressing shall not begin until grout strength in the joints has attained at least 2,500 psi compressive strength.

D. Tendon stressing shall be performed in the sequence indicated on the Shop (Erection) Drawings.

E. Mark and measure elongations according to PTI's "Field Procedures Manual for Unbonded Single Strand Tendons." Measure elongations to closest 1/8-inch.

F. Tendon elongations shall be recorded and compared to the theoretical elongations indicated on the Shop (Erection) Drawings. Prestressing will be considered acceptable if gage pressures shown on stressing record correspond to required stressing force and theoretical and measured elongations agree.

G. In the event that measured elongations exceed the tolerances indicated on the Shop (Erection) Drawings, the Precast Tank Engineer shall be notified for resolution.

3.08 TENDON FINISHING

A. Strand tails may be cut once prestressing has been deemed acceptable.

B. Do not cut strand tails or cover anchorages of tendons where elongations exceed tolerances until all discrepancies have been resolved to the satisfaction of the Precast Tank Engineer.

C. Cut strand tails as soon as possible after approval of elongations.

D. The tendon tails shall be cut using hydraulic shears.

E. The strand length protruding beyond the wedges after cutting of the tendon tail shall be between 0.5-inch and 0.75-inch.

F. Wedge-cavity caps shall be installed within one working day after cutting tendon tails.

G. Patch stressing pockets within one day of cutting strand tail. Clean inside surface of pocket to remove laitance or post-tensioning coating before installing patch material. Finish patch material flush with adjacent concrete.

H. If stressing pockets are not able to be filled within ten days after tendon tail cutting, then temporary protection shall be provided.

3.09 FIELD QUALITY CONTROL

A. Place no concrete for the base slab until the subgrade has been inspected and approved by the Owner's Geotechnical Engineer.

B. Testing: Owner will engage accredited independent testing and inspecting agency to perform field tests and prepare reports.

1. Testing agency will report test results promptly and in writing to Contractor, Engineer of Record and Tank Supplier.

C. Repair or remove and replace work where tests and inspections indicate that it does not comply with specified requirements.

3.10 PROTECTION OF PRESTRESSED REINFORCEMENT

A. Do not expose tendons to electric ground currents, welding sparks, or temperatures that would degrade components.

B. Prevent water from entering tendons during installation and stressing.

C. Provide weather protection to stressing-end anchorages if strand tails are not cut within 10 days of stressing the tendons.

3.11 REPAIRS

A. Repairs will be permitted provided structural adequacy, serviceability and durability of members are not impaired.

B. Prepare and repair damaged galvanized coatings with galvanizing repair paint according to ASTM A 780.

C. Repair base slab shrinkage cracks as required for watertightness. Rout a ¼-inch vee-notch along the crack and fill the crack with epoxy injection adhesive.

D. Surface chips or spalls shall be cleaned and then patched with patching material.

E. Misaligned grout ports or connection ports in walkways may be repaired by either enlarging the existing port, or drilling a new one, as required. Coordinate with the Precast Tank Engineer to avoid internal reinforcing and hardware.

F. Damage that occurs during the shipping, installation or construction process shall be brought to the attention of the Precast Tank Engineer for resolution.

G. Additional repairs, if necessary, shall be performed as directed by the Precast Tank Engineer.

H. Remove and replace damaged structural precast concrete members when repairs do not comply with specified requirements.

3.12 CLEANING

A. Clean grout and any other deleterious material from concrete surfaces and adjacent materials immediately.

B. Clean exposed surfaces of precast concrete members after erection and completion of joint treatment to remove weld marks, other markings, dirt, and stains.

1. Perform cleaning procedures, if necessary, according to precast concrete fabricator's recommendations. Protect adjacent work from staining or damage due to cleaning operations.

2. Do not use cleaning materials or processes that could change the appearance of exposed concrete finishes or damage adjacent materials.

3.13 TIGHTNESS TESTING

A. Each cell of multi-cell tanks shall be considered a single containment structure and shall be tested individually, unless otherwise specified.

B. The General Contractor shall commence tightness testing within five business days of notification that the structure is ready for testing.

C. Testing shall be performed using the hydrostatic tightness test, which consists of two parts. Part 2 may be waived if approved by the Project Engineer-of-Record.

1. Part 1 shall be a qualitative criterion.

2. Part 2 shall be a quantitative criterion expressed as a maximum allowable volume loss of 0.05 percent per 24-hour period.

D. No backfill may be placed against the walls or on the wall footings of the containment structures to be tested, unless otherwise specified.

E. The initial filling of a new containment structure shall not exceed four feet per hour. Filling shall be continued until the water surface is at the design maximum liquid level, or either one inch below any fixed overflow level in covered containment structures or four inches in open containment structures, whichever is lower.

F. Water for the initial filling shall be provided by the General Contractor. Use potable water unless otherwise specified.

G. Part 1 – Qualitative criteria

1. If any water is observed on the containment structure exterior wall surfaces where moisture can be picked up on a dry hand, the containment structure shall be considered to have failed Part 1 of the hydrostatic test.

2. Wet areas on top of the wall footing shall not be cause to fail Part 1 unless the water can be observed to be flowing.

3. Although Part 2 of the test may begin prior to completion of repairs for Part 1, all defects causing the failure of Part 1 shall be repaired before acceptance of the containment structure.

4. The standard repair procedure for areas failing Part 1 is to inject chemical grout into the affected area. Consult with the Precast Tank Engineer before commencing any such repairs.

H. Part 2 – Quantitative criteria

1. Part 2 of the hydrostatic tightness test shall not be scheduled for a period when the forecast is for a difference of more than 35°F between the ambient temperature readings at the times of the initial and final level measurements of the water surface. The test shall also not be scheduled when the weather forecast indicates the water surface could freeze before the test is completed.

2. The vertical distance to the water surface shall be measured to within 1/16 inch from a fixed point on the containment structure above the water surface. The initial measurement shall not be taken until at least 24 hours after the tank is completely filled. Measurements shall be recorded at 24-hour intervals.

3. The test period shall be the theoretical time required to lower the water surface 3/8 inch, assuming a loss of water at the maximum allowable rate. However, the test period shall not be longer than five days.

4. In uncovered containment structures, evaporation and precipitation shall be measured.

5. At the end of the test period, the water surface shall be recorded to within 1/16 inch at the location of the original measurements. The water temperature and precipitation measurements shall be recorded.

6. The change in water volume in the containment structure shall be calculated and corrected, if necessary, for evaporation, precipitation, and temperature. If the loss exceeds the required criterion, the containment shall be considered to have failed Part 2 of the test.

I. Retesting

1. A restart of the test shall be required when test measurements become unreliable due to unusual precipitation or other external factors.

2. It shall be permitted to immediately retest a containment structure failing Part 2 of the hydrostatic test when Part 1 is passed. If the containment structure fails the second test or if not immediately retested after the first test failure, the interior of the containment structure shall be observed for probable problem areas by the Tank Supplier. The containment structure shall only be retested after the probable problem areas are repaired.

3. Containment structures shall be retested until they meet the required Part 1 and Part 2 criteria. Repairs shall be made before each retest.

J. The containment structure shall be deemed substantially complete upon successful completion of tightness testing. All final payments, including retainage, for all structural elements related to the precast, post-tensioned concrete tank, including the foundation system and cast-in-place base slab, shall be made at this time. This clause supersedes any conflicting clauses in the contract documents.

3.14 SPECIAL WARRANTY

A. The Tank Supplier shall provide a two-year structural warranty to the Owner. The warranty shall at minimum include the following items:

1. The Tank Supplier shall provide a corporate guarantee not covered by any form of insurance or bond as a warranty for the precast post-tensioned concrete tank that warrants the tank is free from structural defect due to faulty design, workmanship, or structural materials.

2. The Tank Supplier shall warrant the structural aspects of the tank for a period of two years from the substantial completion date of the precast post-tensioned concrete tank.

3. The Owner must report in a timely manner any claim to the warranty in writing to the tank manufacturer within the effective coverage dates of the warranty.

4. The Tank Supplier shall furnish, without charge to the Owner, all necessary labor and materials required to repair all structural defects subject to this warranty with a maximum cost of repair not exceeding the Tank Supplier's contract value of the tank and under the condition that the Tank Supplier has been paid in full for the project.

B. Specific Exclusions from Warranty:

1. Maintenance items (sealants, coatings, equipment, plumbing, etc.), all non-structural items.

2. Consequential damages, punitive damages, incidental costs, bodily injury, death, and damage to the property other than the tank.

3. Emptying of tanks, inspection of tanks, processing of the water/wastewater, drying or cleaning of the tanks, filling of tanks, etc. complete in preparation for, and completion of repairs.

4. Defects or issues caused by accident, abuse, misuse, storage or processing of corrosive liquids, improper maintenance, negligence, modifications, additions, or deletions not made by tank manufacturer, improper or defective application, acts of God, force majeure, untimely action by Owner to minimize damage or losses, unstable or improperly designed or constructed soil/ subgrade, or defects caused by work supplied by any party other than the Tank Supplier.

5. A loss or defect that is covered by insurance.

C. All materials and labor for work performed by the Tank Supplier which is not covered under the standard two-year limited structural warranty shall be warranted for a period of one (1) year from substantial completion of the tank per the Contract Documents.

3.15 BACKFILL

A. General Contractor shall place and compact backfill in accordance with Section 02200 "Earthwork."

B. Do not commence backfilling around the tank until the tank has been examined and approved by the Engineer of Record.

C. The General Contractor shall be responsible to protect the tank from damage by construction activity, equipment and vehicles. Damaged structures shall be repaired or replaced to the satisfaction of the Tank Supplier.

D. When backfilling against the tank, place backfill material in equal lifts and to similar elevations on opposite sides of structures in order to equalize opposing horizontal pressures, except where required for final grading.

E. The excavation shall be kept free of water by the General Contractor at all times.

END OF SECTION

SECTION 03440

SUBGRADE SERVICE CONCRETE COATING

PART 1: GENERAL

1.01 DESCRIPTION

Provide all materials, tools, labor, scaffolding and miscellaneous other items necessary to clean, and paint the exterior surfaces of precast concrete structures for subgrade service. Paint only the surfaces called for on the plans and or specified herein.

1.02 SCOPE OF WORK

A. Areas to be painted shall be the exterior surfaces of precast concrete structures, except for manholes, to be exposed to earth.

B. If noted on the plans or called for elsewhere in the specifications additional masonry surfaces exposed to earth may be coated as specified herein.

1.03 SUBMITTALS

A. Submit the manufacturer's product data sheet for each coating to be used.

B. Indicate the site location where the product is to be used and the items to be coated.

1.04 QUALITY ASSURANCE

A. Work shall be performed by skilled workmen thoroughly trained in necessary crafts and completely familiar with the specific requirements, reference standards, and methods specified herein.

B. There shall be at least one painter or foreman, fluent and literate, in the English language, on site anytime surface preparation or coating work is performed.

C. Materials for any one coating application shall be of a single manufacturer.

D. The contractor shall maintain a daily log of painting activities throughout the project. Entries into the log shall be: date, air temperature, humidity, substrate temperature, weather conditions, location and nature of work, and total number of workers. Upon request, the contractor shall produce the log for the engineer's inspection.

E. There shall be a mandatory meeting of representatives of the prime contractor, coating subcontractor, engineer, and owner, prior to any surface preparation or paint application. The purpose of the meeting shall be to review the items to be coated, the types of surface preparation and coating to be used and the location of areas to be used as quality control samples.

1.05 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in factory-sealed containers with manufacturer's labels intact and legible. Containers without legible labels shall be removed from the project site. All containers shall be subject to inspection by the engineer.

B. Paint and related materials and equipment shall be stored in a lockable metal storage container, trailer, or other securable structure. The container or trailer shall be at a suitable location on the project site away from work areas and other storage areas.

C. Store materials at a temperature between 35 degrees Fahrenheit (^{o}F) and 110 ^{o}F. Materials stored at temperatures below 50 ^{o}F shall be warmed to 50 ^{o}F before use.

D. Paint, thinner, and other materials not approved for use on this project may not be stored on the job site.

1.06 JOB CONDITIONS

A. Apply coatings only with the engineer's prior approval, when prevailing weather conditions permit. The air and substrate surface temperatures may not be below 45 ^{o}F or above 120 ^{o}F. The relative humidity may not be above 85 percent. Follow the manufacturer's recommendations if more stringent than those indicated above.

B. The Contractor shall cover or otherwise protect the finished work of other trades, surfaces not being coated concurrently, and/or surfaces, which are not to be painted. Any injury or damage to such surfaces shall be remedied to the satisfaction of the Owner at the expense of the Contractor before final acceptance, and no separate payment will be made.

1.07 REFERENCE STANDARDS

A. Steel Structures Painting Council Surface Preparation Standards (SSPC)

B. American Society for Testing Materials (ASTM)

C. American Water Works Association (AWWA)

D. National Association of Corrosion Engineers (NACE)

1.08 RELATED SPECIFICATIONS

A. Section 03400 - Precast Concrete Utility Structures

PART 2: PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Products specified herein are manufactured by the CARBOLINE Company of St. Louis, Missouri, or the TNEMEC Company, Inc., Kansas City, Missouri, and are specified as standards of quality, not necessarily as a brand preference. Equivalent materials of other manufacturers may be acceptable.

B. Materials used shall be first line products of the manufacturers specified. Manufacturer's catalogue numbers are provided for the purpose of identifying each item.

2.02 PAINT SCHEDULE

A. Exterior of Concrete Precast Structures: Note that two manufactures are listed but only one manufacturer shall be selected.

1. Carboline Bitumastic 50: Two Coats 8.0 to 10.0 mils per coat.

2. Tnemec H. B. Tnemecol 46-465: Two Coats 8.0 to 10.0 mils per coat.

B. Total Required Film Thickness: 16 to 20 mils. No additional payment will be made for extra coats required to meet the required film thickness.

PART 3: EXECUTION

3.01 SURFACE PREPARATION

The Contractor shall examine the surfaces scheduled to receive coating. Protrusions such as form burrs, sharp edges, fins and concrete spatter shall be removed. Voids and other defects at or near the surface shall be exposed and repaired. After the surface has been repaired it shall be cleaned so that no dirt, oil, grease or other contaminates that might impede adhesion of the coating is removed. The resulting surface shall be clean, dry, and have a texture with a profile not less than that of 80 grit sand paper. The concrete shall have had a minimum curing time of 28-day cure.

3.02 APPLICATION CONDITIONS

Apply coatings only when the air and surface temperatures are greater than 45 ^{o}F and less than 120 ^{o}F, the relative humidity is not above 85 percent and the surface temperature is at least 5 ^{o}F above the dew point. Follow manufacturer's recommendations regarding application conditions if more stringent than listed above. Protect all surfaces not to be coated.

3.03 APPLICATION

Apply coatings smoothly uniform in thickness free of bubbles, runs, skipped, or missed areas. Application method shall be in accordance with the manufacturer’s recommendations.

3.04 CLEAN UP

The Contractor shall cleanup at the end of each day’s work. Trash may be kept on site for final disposal at the project’s completion provided it is kept out of view and generates no offensive odors or habitat for unwanted wildlife. Upon completion, the contractor shall remove all rubbish, containers, rags and other waste materials from the site and properly dispose of them. The site shall be left in a clean condition, acceptable to the Owner. The Contractor shall adhere to all federal, state and local regulations regarding the disposal of paint containers, paint, paint contaminated rags, and other hazardous materials associated with application of paint.

END OF SECTION

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SECTION 03602

NON-METALLIC GROUT

PART 1: GENERAL

1.01 DESCRIPTION

A. This section includes requirements for providing non-metallic grout to set motors, compressors, pumps, vessels, tanks, pipe supports, and similar equipment items.

1. Apply grout where indicated on the Contract Documents or where required by the equipment or item being provided.

2. Furnish all labor, materials, water, equipment, forms and other items necessary to properly prepare, place and cure the grout.

1.02 QUALITY ASSURANCE

A. Provide components that are the standard product of a manufacturer regularly engaged in the production of the required materials.

B. Do not place any grout until the place of grouting has been inspected and approved by the Engineer.

1.03 SUBMITTALS

A. Submit Contractor's Drawings, Product Data, Samples and Shop Drawings in accordance with Section 01300 – Submittals.

1. Provide complete engineering and product data on the grout prior to any placement. Include the manufacturer's recommendations for mixing, placement and curing.

B. Submit certified test reports.

1. Provide written evidence that the grout, cement, and aggregate conforms to these specifications.

2. Certified copies of independent laboratory test results or mill test results for the grout, cement, and/or aggregate may be considered evidence of compliance provided such tests are performed in accordance with the appropriate ASTM or Corps of Engineers testing standards by experienced, competent personnel.

a. In case of doubt as to the accuracy or adequacy of mill tests, the Engineer may require testing by an independent testing laboratory on samples of grout, cement, and aggregate.

b. Such testing shall be at no additional cost to the Owner.

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver, handle, and store the equipment in accordance with Section 1600 – Delivery Storage and Handling, the American Concrete Institute and the manufacturer's instructions.

B. Store grout above ground and protect it at all times from moisture, high humidity, oil, and extremes of temperature. Do not use grout or cement which has been re-sacked or which has become caked or lumpy.

1.05 SAFETY

A. Take the proper precautions when handling epoxy resins and hardeners.

B. Perform all mixing and placement operations in well-ventilated areas.

C. Strictly adhere to the specific safety recommendations of the manufacturer.

PART 2: PRODUCTS

2.01 NON-SHRINK GROUT

A. Grout pumps, compressors, motors, and similar items of heavy equipment in place with a non-metallic, non-corrosive, non-gaseous, non-shrink grout that requires no cutback or protective coating. Provide non-shrink grout at other locations as required by the contract drawings.

B. Non-shrink grout

1. Zero shrinkage from the placement volume or initial expansion volume as determined by ASTM 827

2. An initial set time at 70 °F of not less than 45 minutes as determined by ASTM C 191.

3. A one-day compressive strength of not less than 2,000 psi and a 28-day compressive strength of not less than 9,000 psi when tested in accordance with ASTM C 109 at a flow of not less than 100 percent determined in accordance with Corps of Engineers Specification CRD-C-621.

4. Contain no corrosive irons, calcium chloride, oxidizing catalysts, gas-forming agents, harmful aluminums, or corrosive chemicals.

5. Resistant to oil, water, and sewage.

C. Provide grout premixed such that it requires only the addition of water prior to placement.

D. Deliver grout to the job site in unopened, plastic-lined bags with the manufacturer’s mixing instructions printed on the back of each bag.

E. Manufacturers

1. EUCO N-S Grout as manufactured by the Euclid Chemical Company.

2. Masterflow 713 Grout as manufactured by Master Builders Company.

3. Upcon High Flow Grout as manufactured by UPCO Division of Emhart Chemical Company.

4. Or approved equal.

2.02 FIBER REINFORCED SAND-CEMENT GROUT

A. Pipe support base plates, and miscellaneous small items of equipment in place using a sand-cement grout consisting of 1 part Portland cement, 2 parts fine aggregate, and a maximum of 4.5 gallons of water per sack (cubic foot) of cement.

1. Use Type II Portland cement conforming to ASTM C 150.

2. Use natural siliceous sand consisting of hard, clean, sharp, dense, durable, and uncoated particles for fine aggregate.

B. Ensure fine aggregate is free from organic material and injurious amounts of deleterious substances. Grade as follows:

Sieve Size no.	Percent Passing (By Weight)
4	100
8	95 to 100
16	60 to 100
30	35 to 70
50	15 to 35
100	2 to 15

C. Except, as modified herein, fine aggregate shall conform to the requirements of ASTM C 144.

D. Dry fine aggregate that is to be used with epoxy binders prior to use. Remove free moisture.

E. Provide fiber reinforcement at a minimum of 0.2 pounds per cubic yard of concrete.

2.03 EPOXY GROUT

A. Use epoxy grout in applications required high bonding or tensile strength, where shown on the Drawings, or directed by the Engineer.

B. Make epoxy grout from a two-component, 100 percent solid, polyamide epoxy binder and a fine aggregate conforming to the requirements specified herein for sand-cement grout. Provide not less than 1 part nor more than 2 parts, by weight, fine aggregate to 1 part epoxy binder.

C. Strength

1. When cured at a temperature of 73 °F, neat epoxy binder shall have a 1-day compressive strength of not less than 5,000 psi and a 28-day compressive strength of not less than 12,000 psi when tested in accordance with ASTM D 695,

2. Provide a 14-day tensile strength of not less than 3,000 psi when tested in accordance with ASTM D638.

D. Manufacturers

1. Sika “Sikadur Hi-Mod”

2. Adhesive Engineering “Concressive 1001 LPL or 101 Regular”

3. Or equal

2.04 WATER

A. Use potable water, free from oil, alkali, organic matter, and other deleterious substances.

PART 3: EXECUTION

3.01 FOUNDATION

A. Chip or sandblast the foundation prior to setting equipment or placing grout so as to expose the coarse aggregate and create a roughened condition.

1. Thoroughly clean all surfaces to be in contact with the grout, including the bottom of the base plates or soleplates, until they are free of all oil, grease, laitance, dust, curing compounds, and other foreign substances.

2. If the surface is to receive nonshrink or sand-cement grout, wash the roughened surface with liberal amounts of clean water and allow it to soak for at least 24 hours immediately prior to grouting. Remove all free water using an air hose or other suitable method prior to placement.

B. Surfaces to receive an epoxy grout shall be completely dry and free from all visible moisture.

1. Where it is impractical to obtain a moisture-free surface, the Engineer may authorize the use of epoxy grout on damp surfaces provided the epoxy formulation is moisture-compatible.

2. When applying grouts to damp surfaces, remove all free water. Select the epoxy formulation so that localized boiling of entrapped moisture due to excessive exothermic heat does not occur.

3.02 MIXING

A. Strictly adhere to the specific recommendations and instructions of the grout manufacturer in all proportioning, mixing, and placing of grout.

1. Mix the grout as close to the point of use as is practical.

2. Use a mechanical mortar mixer for mixing large quantities of non-shrink or sand-cement grout.

a. Do not mix more grout than can be placed in the time preceding initial set.

b. Discard grout that has stiffened prior to placement.

c. Add only that amount of water required to produce the necessary degree of flow ability. Do not retemper the grout mixture by adding water.

B. Accurately proportion components of the epoxy grout system and thoroughly mix them so as to produce uniform and homogenous mixture.

1. Proportioning accuracy of epoxy compounds shall be plus or minus 5 percent of the manufacturer’s specified mixing ratio.

2. Small quantities (up to one quart) of epoxy grout may be mixed by hand using spatulas, palette knives or similar devices.

3. Mix larger volumes using mechanically driven tumbling or paddle-type mixers.

   a. Paddle-type mixers shall be driven by a low speed (400-600 rpm) motor to prevent introduction of excessive entrained air into the mixture.

   b. Continue mixing until the mixture is uniform and homogenous, but in no case less than 3 minutes.

   c. Follow the manufacturer's recommended temperature range for mixing the epoxy grout in all field mixing.

C. After mixing, allow the epoxy grout to stand for approximately 5 minutes to allow initial air release.

3.03 PLACEMENT

A. Carefully place grout by troweling, ramming, or pouring, as is most suited to the application.

1. Ensure that all voids and cavities between the foundation and equipment base plate or bedplate are filled.

2. Provide air-relief holes, if necessary to eliminate entrapped air.

3. If a pourable or flowable grout is required, use suitable forms to contain the grout.

   a. Securely anchor forms and caulk them to prevent grout leakage.

   b. Place grout from one side only.

   c. Use forms of sufficient height to allow at least 6 inches of head on the grout above the bottom of the base plate on the side where the grout is placed.

   d. Place grout until it protrudes from the entire perimeter area.

   e. Locate base plates so as to provide a minimum clearance of one inch between the foundation and base plate.

      1) Maintain the temperature of the foundation and base plate or soleplate above 45 °F during placement and for at least 24 hours thereafter.

      2) Heat the foundation, base plate, or soleplate using heated enclosures, heat lamps, or radiant heater so as to achieve uniform heating. Do not use direct flame.

      3) Heat concrete structures a minimum of 4 hours prior to grouting to ensure proper heating of the concrete mass.

      4) Temperature of heated surfaces shall not exceed 100 °F at the time of placement.

4. When placing non-shrink or sand-cement grout under unusually hot or cold weather conditions, comply with ACI 305 and 306, respectively.

B. Ensure that epoxy grout formulations possess exothermal properties compatible with the anticipated substrate and placement conditions.

1. Where large masses of epoxy are involved or if ambient or substrate temperatures are high, use relatively low exothermic formulations.

2. Conversely, where very small quantities or thin films of epoxy are involved or if ambient or substrate temperatures are low, use a high exothermic formulation.

C. When pouring epoxy grout, take care to ensure that segregation of aggregate and epoxy binder or entrapment of entrained air does not occur prior to initial set. To prevent this condition, place the epoxy grout in successive lifts not to exceed 1 inch in thickness.

3.04 FINISHING AND CURING

A. Leave forms in place until the grout is hardened enough so that it cannot flow.

1. Cut off unconfined grout edges flush or beveled and trowel to produce a smooth finish.

2. Remove wedges and shims after the grout has hardened 3 days. Note that the removal of wedges and shims from column base plates and pipe support base plates is optional.

3. Regrout all voids using the same grouting material.

4. Do not pull up anchor bolts to the final torque until shims and wedges have been removed and the grout is hard enough to permit equipment operation.

B. Wet cure exposed edges of water-cured grout after placement.

1. Cover with wet burlap, wet sand, or polyethylene film for at least 7 days.

2. During cold weather, maintain the grout at a temperature that will ensure proper hardening and curing for a period of time following placement.

END OF SECTION

SECTION 03720

CONCRETE SURFACE REPAIR

PART 1: GENERAL

1.01 DESCRIPTION

A. Perform horizontal, vertical and overhead concrete surface repairs at the locations designated by the Engineer.

B. Definitions

1. Non-structural repair areas: Areas with defects that are confined to the surface (less than 1 inch in depth) and not subjected to structural loads or heavy wear.

2. Structural repair areas: Areas that are:

a. Subject to structural loading,

b. Subject to heavy wear,

c. The interior of water holding structures,

d. Below grade, or

e. Displaying defects or parts of defects that extend 1 inch or deeper into the concrete.

1.02 QUALITY ASSURANCE

A. Independent Testing Laboratory: Comply with criteria specified in ASTM E699.

B. Comply with applicable standards including, but not limited to the most recent edition of the following:

1. American Society for Testing and Materials (ASTM)

a. C78, Standard Test Method for Flexural Strength of Concrete (using Simple Beam with Third-Point Loading)

b. A82, Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.

c. C109, Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2 inch or [50 mm] cube specimens).

d. A185, Standard Specification for Steel Welded Wire Fabric, Plain, foe Concrete Reinforcement.

e. C348, Standard Test for Flexural Strength of Hydraulic Cement Mortars.

f. C469, Standard Test Method for Static Modulus of Elasticity and Poisson’s Ratio of Concrete in Compression.

g. C496, Standard Test Methods for Splitting

h. C596, Standard Testing Method for Drying Shrinkage of Mortar Containing Hydraulic Cement.

i. C666, Standard Test Method for Resistance Concrete to Rapid Freezing and Thawing.

j. C882, Standard Test method for Bond Strength of Epoxy-resin systems Used with Concrete by Slant Shear.

k. C1042, Standard Test method for Bond Strength of Latex Systems used with Concrete by slant shear.

l. Minimum Flexural Properties: 1,250 psi in 28 days in accordance with ASTM C348.

2. American Association of State Highway and Transportation Officials (AASHTO): T277, Standard Method of Test for Rapid Determination of the Chloride Permeability of Concrete. Use a Modulus of Elasticity of 4.1 to 4.5 by 10^6 psi.

1.03 SUBMITTALS

A. Include the following information:

1. Quality control submittals.

2. Manufacturer's catalog information that describes the proposed mortar system. Include:

a. Specifications.

b. A complete bill of materials that identifies all materials of construction.

c. Manufacturer's installation bulletin.

d. Manufacturer's mesh reinforcement fabric size recommendation.

e. Proposed modifications (if any) to the test methods presented in ASTM-C109 and C882.

3. Samples

a. Mesh reinforcement

b. Mesh anchor

4. Mesh manufacturer's installation instructions and allowable load criteria.

5. Description of equipment proposed for surface preparation.

B. Submit manufacturer's certificate from mortar system manufacturer for proper installation.

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver, handle, and store the equipment in accordance with Section 01600 Delivery Storage and Handling.

PART 2: PRODUCTS

2.01 CONCRETE MORTAR REPAIR SYSTEMS

A. Use for structural concrete repairs.

B. Mortar

1. Provide one component, rheoplastic, cement based, fiber reinforced, shrinkage compensated material.
    a. Gray in color.
    b. Minimum 30-minute working time.
2. Cured material mixed to a flow of 70 percent, at 5 drops shall conform to the following criteria:
    a. Minimum Slant Shear Bond Strength: 3000 psi in 28 days in accordance with “modified” ASTM C882 test method.
    b. Minimum Compressive Strength: 11,000 psi at 28 days in accordance with ASTM C109.
    c. Minimum Direct Shear Bond Strength: 650 psi in 28 days in accordance with Michigan DOT.
    d. Minimum Tensile Bond Strength (MBT In-House Test): 300 psi in 28 days.
    e. Minimum Flexural Properties: 1,250 psi in 28 days in accordance with ASTM C348.
    f. Modulus of Elasticity: 4.1 to 4.5 by 10^6 psi in accordance with ASTM C469.
    g. Maximum Permeability: 1,000 coulombs in accordance with AASHTO T277.
    h. System shall not produce a vapor barrier.
3. Extremely low permeability, sulfate resistance, easy to use and requiring only the addition of water.
4. Free of chlorides and other chemicals causing corrosion.

C. Manufacturer and Product

1. EMACO S88CA with concessive liquid (LPL) bonding agent; Master Builders Technologies Co., Cleveland, OH
2. Or approved equal.

2.02 POLYMER-MODIFICATION REPAIR MORTAR

A. Use for non-structural surface repairs.

B. One component, polymer-modified, cementitious based surface renovation mortar that is:

1. Chloride resistant.
2. Flowable.
3. Gray in color.
4. 20-minute minimum working time.

C. Provide mortar with the following properties:

1. Bond strength
    a. ASTM C1042
    b. Minimum 2,000 psi at 28 days.
2. Modulus of Elasticity
    a. ASTM C469
    b. Minimum 2.0 by 10^6 psi.
3. Compressive Strength
    a. ASTM C109
    b. Minimum 7,000 psi at 28 days.
4. Flexural Properties
    a. ASTM C348
    b. Minimum 1,200 psi at 28 days.
5. Permeability
    a. AASHTO T277
    b. 800 coulombs maximum.
6. Splitting Tensile Strength
    a. ASTM C496
7. Drying Shrinkage
    a. ASTM C596
    b. Maximum 0.1 percent at 28 Days.
8. Freeze Thaw Resistance
    a. ASTM C666
    b. 90 percent RDF at 300 Cycles.

D. Hand or low- pressure spray applied.

E. Manufacturer and Product:

1. Master Builders Technologies Co., Cleveland, O EMACE R-300, R-310 or R-320.
2. Or approved equal.

2.03 CRACK INJECTION CHEMICAL GROUT

A. Use for structural crack repairs where cracked surface will receive a hydraulic loading.

B. Chemical Grout

1. Provide a nonflammable hydrophilic polyurethane resin.
    a. Expands when in contact with water
    b. Cures into an adhesive closed cell foam

C. Manufacturer and Product

1. Hydro Active Sealfoam NF manufactured by De Neef Construction Chemicals, Inc.
2. Sikafix HH by Sika, Inc.
3. Or approved equal.

2.04 WATER

A. Clean and free from oil, acid, alkali, organic matter, or other deleterious substances.

B. Comply with federal drinking water standards.

2.05 ACCESSORIES

A. Mesh Reinforcement:

1. Welded wire fabric
2. Wire spacing and size in accordance with ASTM A185, ASTM A82, and mortar system requirements.

B. Tie Wire: 16-gauge galvanized.

C. Mesh Anchors:

1. 316 stainless steel tie wire anchors.
2. Manufacturer
    a. Hilti Fastening systems; HIT Injection System
    b. Or approved equal.

D. Finishing Aid Manufacturer

1. Master Builders, Inc., Cleveland, OH; CONFILM
2. Or approved equal.

E. Flexible Cementitious Rebar Coating Manufacturer

1. Master Builders, Inc., Cleveland, OH; EMACO P22
2. Or approved equal.

PART 3: EXECUTION

3.01 PREPARATION

A. Remove unsound, honeycombed, deteriorated or otherwise defective concrete from work with chipping hammers.

1. Limit the size of chipping hammers to 15 lbs. to reduce micro fractures.

2. Chisel edges a minimum of 1 inch deep, perpendicular to surface or slightly undercut. No feather-edges will be permitted.

3. Remove to provide for maximum thickness specified for mortar.

4. Engineer to inspect prior to patching.

B. If any of the following surface conditions exist, remove concrete to provide a minimum of 1-inch clearance around rebar. Apply and bond new mortar to entire periphery of exposed rebar:

1. Fifty percent or more of periphery around rebar is exposed during removal of concrete.

2. Twenty-five percent or more of periphery around rebar is exposed during removal of concrete and corrosion exists to the extent that loss section has occurred.

3. Bond between existing concrete and reinforcement has deteriorated.

C. Clean exposed reinforcing bars of rust and concrete, and coat with flexible cementitious rebar coating.

D. Remove laitance and contamination from the area to be filled with new mortar.

1. Use high-pressure water blasting not more than 24 hours before applying bonding agent.

2. Dampen both the area to be patched and a surrounding area at least 6 inches wide.

a. Dampen for at least 24 hours to prevent absorption of water from patching mortar.

b. Saturated surface dry (SSD) existing concrete at time of mortar application.

3.02 MESH REINFORCEMENT INSTALLATION

A. Provide reinforcement when mortar application is more than 3 inches deep unless otherwise shown and when existing reinforcement is not exposed.

B. Install mesh anchors in accordance with mesh manufacturers' printed instructions.

C. Fasten reinforcement to mesh anchors with tie wire.

D. Lap reinforcement a minimum of one mesh spacing and secure with tie wire at intervals no less than 12 inches.

3.03 POLYMER MODIFIED REPAIR MORTAR APPLICATION

A. Hand Troweling:

1. Apply a bond coat slurry of the repair mortar to SSD prepare substrate before application of the mortar.

2. Do not apply more of the bond coat than can be covered with mortar before the bond coat dries.

3. Do not retemper this bond coat.

B. Place mortar by hand and trowel to the specified surface finish.

3.04 CURING

A. Water fog nozzle all the mortar system prior to curing in accordance with mortar system manufacturer's printed instructions.

B. Commence water curing after mortar system application and when curing will not cause erosion of mortar.

C. Continuously cure mortar system for a period of 7 days.

D. Do not membrane cure unless method is part of mortar system manufacturer's printed instructions and approval is obtained from the Engineer.

E. Cure intermediate layers of mortar in accordance with manufacturer's printed instructions.

3.05 CHEMICAL INJECTION APPLICATION

A. One-quarter-inch maximum crack width.

B. Surface of all prepared cracks shall be clean and sound. Remove dust laitance, grease, curing compounds, impregnating waxes, foreign particles and disintegrated materials. Sandblast or use other approved mechanical means.

C. Crack cross section shall be damp or wet.

D. Mix only the amount of material that can be used within the pot life of the material.

E. Pressure inject cracks in strict accordance with the manufacturer's injection procedure.

F. When injection material has cured, remove the injection ports and seal portholes.

G. Clean crack surface of excess material and drips.

3.06 FIELD QUALITY CONTROL AND TESTING

A. Provide an independent testing laboratory to perform the following:

1. Secure production samples of mixed materials during construction and test for compliance with specifications.

2. Obtain actual core samples from the completed repair work and test.

3. Perform “modified” ASTM C109 and ASTM C882 tests in accordance with approved manufacturer’s test procedure modifications.

B. Construction Testing

1. Production Samples

a. Obtain mixed mortar material from shotcrete or spray equipment and produce samples. Cure samples prior to testing.

b. Test a minimum of three samples for each 1,000 square feet or portion thereof of mortar repair to be installed.

2. Core Samples of In-Place Repairs

a. Obtain and test two core samples for each 2,000 square feet or portion thereof of actual repair work.

1) Use either 2½-inch or 3-inch-diameter cores.

2) Core through cured mortar repair and into base concrete a total depth equal to at least 2.5 times repair mortar thickness

b. Saw cut the core after removal. Trim the base concrete thickness to same thickness as mortar so that the bond line is in the center of sample.

c. Epoxy bond the samples to steel plates at each end. Use a bonding agent to prevent a failure to bond to the steel plates.

d. Sustain bond line without failure or movement with a minimum of 300 psi in direct tension.

1) Use eyebolts or connectors tapped and threaded into the steel baseplate for the tension test.

2) Ensure the tension load is concentric with center of core sample.

C. Repair and fill holes where core samples have been removed using same mortar used in repair.

3.07 MANUFACTURER’S FIELD SERVICES

A. Provide mortar system manufacturer’s representative on site for installation assistance, inspection and certification of proper installation, and training of mortar system applicators.

B. Mortar System Manufacturer’s Demonstration:

1. Schedule a time for manufacturer to demonstrate repair system proposed for the Project.

a. Prepare mortar, to specified consistency, for testing and placement.

b. Initiate curing on portions of each type of surface to be repaired to include overhead and vertical applications.

2. Prepare surface area in advance of demonstration and obtain manufacture’s acceptance of preparation for each application.

3. Demonstrate

a. Mixing and application capabilities and procedures.

b. Make compression test samples during demonstration and deliver to an independent testing laboratory for testing at 1, 7, and 28 days.

1) Take a core of the demonstration placement

2) Test total tensile bond at 1 day.

3.08 PROTECTION

A. Protect adjacent surface and equipment.

3.09 CLEANUP

A. Comply with Section 01710.

B. Remove formwork, waste materials, unsound material removed from concrete surfaces, material chipped from walls, water used in preparation of application and finishing and similar items.

END OF SECTION

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SECTION 04100

MORTAR AND GROUT

PART 1: GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, equipment materials, and incidentals required to install unit masonry mortar and grout as shown on the Drawings and as specified herein

1.02 SUBMITTALS

A. Submit in accordance with Section 01300 - Submittals. Submit Shop Drawings, Product Data and Samples, complete shop drawings and product data for all materials and equipment furnished under this Section.

B. Submit certified copies of all the reports of all tests specified herein. Test reports shall be notarized certificates from the manufacturer certifying that the tested material and equipment accompanied by is of the same type, quality, manufacture, and make as that proposed to be supplied.

C. Grout for filled masonry cells shall be tested in accordance with ASTM C39.

D. Certificates for cement, quicklime, and hydrated lime.

1.03 REFERENCE STANDARDS

A. Design, manufacturing and assembly of elements of the products specified herein shall be in accordance with the standards of the organizations listed below.

B. American Society for Testing and Materials (ASTM)

1. ASTM C33 – Specifications for Concrete Aggregate
2. ASTM C39 – Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
3. ASTM C91 – Specification for Masonry Cement
4. ASTM C144 – Specification for Aggregate for Masonry Mortar
5. ASTM C150 – Specification for Portland Cement
6. ASTM C207 – Specification for Hydrated Lime for Masonry Purposes
7. ASTM C270 – Specification for Mortar for Unit Masonry
8. ASTM C331 – Specification for Lightweight Aggregates for Concrete Masonry Units
9. ASTM C404 – Specification for Aggregates for Masonry Grout
10. ASTM C476 – Specification for Grout for Masonry

11. ASTM C1019 – Standard Test Methods of Sampling and Testing Grout

C. Brick Institute of America

D. International Masonry Industry All Weather Council

E. Where reference is made to a standard of one of the above, or other organizations, the version of the standard in effect at the time of bid opening shall apply.

1.04 QUALITY ASSURANCE

A. Unless specifically specified otherwise, all quality control recommendations of the Brick Institute of America, Technical Notes, latest edition shall be adhered to as though incorporated herein

B. Only one brand of masons cement shall be used throughout the project, all masons cement shall be supplied by the manufacturer of Concrete Masonry Units

1.05 DELIVERY, STORAGE AND HANDLING

A. Deliver manufactured materials in original unopened containers displaying product name, type, and grade and where applicable, mixing instructions.

B. Store materials to prevent inclusion of foreign materials and cover to protect from moisture and contamination.

PART 2: PRODUCTS

2.01 MATERIALS

A. Prepared masonry cement shall be premixed and shall meet the requirements of ASTM C91 for type N and type S mortars, color to match concrete masonry units

B. Aggregate for mortar shall be clean, hard, natural washed sand meeting ASTM C144

C. Portland cement shall meet the requirements of ASTM C150, Type II.

D. Lime for masonry mortar shall be hydrated and meet the requirements of ASTM C207, Type S.

E. Quicklime shall meet the requirements of ASTM C5, non-hydraulic type.

F. Water shall be clean, potable and free from deleterious amounts of alkalies, acids and organic materials.

G. High bond mortar shall be used at the head and sill of all masonry openings and the top two courses of all walls.

H. Non-shrink grout manufacturers

1. Master Builders Co.; Masterflow 713.

2. Euclid Chemical Co.; Euco N-S.

3. U.S. Grout Corp.; Five Star Grout.

4. Or equal.

2.02 MORTAR AND GROUT MIXES

A. Mortar proportions for placing concrete block, bricks and unit masonry structures shall be of the following types in accordance with ASTM C270 and ASTM C91 for foundation walls, and work below grade, Type M. For all other masonry work, Type S. Mortar mix design shall utilize the proportional mix design method to achieve a 1,800-psi compressive strength for type S mortar.

B. Mortar for parging masonry walls below grade shall be composed of one part Portland cement, 1/4 part hydrated lime and three parts sand.

C. Mortar for Sewer, Storm Drain and Water Main Construction

1. Unless otherwise specified, mortar used in construction of sewers, storm drain and water main construction shall be composed of one part Type II cement and three parts masonry sand meeting requirements of ASTM C144.

D. Grout

1. Grout shall consist of a mixture of cementitious materials and aggregate with water added in sufficient quantity to produce a fluid mixture. Grout for lintels, bond beams and cells containing vertical reinforcement rods in concrete masonry units shall be Type M, 3,000 psi strength at 28 days per ASTM C270.

2. Grout Aggregate shall meet the requirements of ASTM C404.

3. Thoroughly mix mortar ingredients in quantities needed for immediate use in accordance with ASTM C476.

4. Use plasticizers or admixtures as approved by the Engineer to improve placement of grout in masonry cells.

5. Grout for CMU lintels and grouting cores to receive embedded anchors or reinforcing shall conform to ASTM C476.

6. Non-shrink grout where required shall be mixed as recommended by the manufacturer to achieve the necessary consistency for placing and to achieve a minimum compressive strength of 3,000 psi in 3 days.

PART 3: EXECUTION

3.01 MIXING

A. Mortar shall be mixed in power-drive, drum type mixer where the quantity of water can be accurately and uniformly controlled.

B. Mixing time shall be a minimum of 5 minutes, approximately 2 minutes of which shall be for mixing the dry materials and not less than 3 minutes for continuing the mixing after the water has been added.

C. When hydrated lime is used, an option to the dry mix method can be used. The hydrated lime may be converted into putty prior to mixing as an alternative.

D. Do not use mortar that has obtained its initial set or has been mixed for longer than 45 minutes.

3.02 PLACEMENT

A. Place full mortar beds on vertical joint of masonry unit already set and all contact faces of the unit to be set. Pack mortar under and around joint reinforcement before masonry unit is set.

B. Mortar shall be thumbprint hard prior to tooling any joints. Joints for all masonry units shall be 3/8-in. and concave.

3.03 FIELD TESTING

A. Test mortar properties in accordance with ASTM C270.

B. Test grout compressive strength in accordance with ASTM C1019.

END OF SECTION

SECTION 04150

MASONRY REINFORCEMENT AND ACCESSORIES

PART 1: GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, equipment materials, and incidentals required to install masonry reinforcement and accessories as shown on the Drawings and as specified herein.

1.02 SUBMITTALS

A. Submit in accordance with Section 01300 – Submittals. Submit Shop Drawings, Product Data and Samples, complete shop drawings and product data for all materials and equipment furnished under this Section.

B. Submit certified copies of all the reports of all tests specified herein. Test reports shall be notarized certificates from the manufacturer certifying that the tested material and equipment accompanied is of the same type, quality, manufacturer, and make as that proposed to be supplied.

1.03 REFERENCE STANDARDS

A. Design, manufacturing and assembly of elements of the products specified herein shall be in accordance with the standards of the organizations listed below.

B. American Society for Testing and Materials (ASTM)

1. ASTM A82 – Specification for Steel Wire, Plain, for Concrete.

2. ASTM A153 – Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

C. Where reference is made to a standard of one of the above, or other organizations, the version of the standard in effect at the time of bid opening shall apply.

1.04 DELIVERY, STORAGE AND HANDLING

A. Masonry reinforcement shall be substantially free from mill scale, rust, dirt, grease, or other foreign matter.

B. Deliver reinforcement to the job site bundled, tagged, and marked. Use metal tags indicating information corresponding to markings shown on placement diagrams.

C. Store reinforcement above the surface of the ground upon wooden platforms or other supports in a manner that will prevent damage and accumulation of dirt and excessive rust. The surface of the ground beneath all stored reinforcement shall be covered with plastic sheeting to further assure isolation from dirt and dust.

PART 2: PRODUCTS

2.01 JOINT REINFORCEMENT

A. Reinforcement shall be welded wire units prefabricated from cold drawn steel conforming to ASTM A82.

B. Provide reinforcement in straight lengths of not less than 10 feet with prefabricated corners and tees

C. Width of reinforcement shall be approximately 2 inches less than total wall width.

D. Reinforcement shall be fabricated of 9 gauge deformed longitudinal side and 9-gauge smooth cross wires flush welded at 16-inch intervals.

E. Manufacturers

1. Dur-O-Wal, Inc.
2. AA Wire Products
3. Ty-Wal Products
4. Heckman Building Products, Inc.
5. Hohmann and Barnard, Inc.
6. Or equal.

2.02 ANCHORS AND TIES

A. Adjustable Masonry Anchors

1. Weld-on adjustable anchors and ties shall be ¼-inch-diameter x 1-inch hot dipped galvanized steel.
2. Anchors shall be Heckmann Building Products No. 315 or equal.
3. Triangular ties shall be Heckmann Building Products No. 316 or equal
4. Web ties shall be Heckmann Building Products No. 318 or equal.
5. Size units to afford minimum 2 inches embedment into mortar joint.

B. Fixed Masonry Anchors

1. Masonry straps shall be 16-gauge, hot dipped galvanized steel, 1¼-inch x 1-inch x length to afford minimum 2-inch embedment into mortar joint.
2. Fixed anchors for securing masonry units to structural steel shall be weld-on anchor by Heckman Building Products No. 340 or equal.

C. Dovetail Anchors

1. Galvanized dovetail anchor slots shall be furnished for anchorage to concrete framework, walls, or ceilings.
2. Anchor slots shall be furnished with polystyrene fillers.

3. Sizes shall be coordinated with the anchors used.

2.03 CONTROL JOINTS

A. Control joints for 6-inch units shall be PVC control joints by Ty-Wal, No. 831 or equal.

B. Control joints for 8-inch units shall be PVC control joints by Ty-Wal, No. 833 or equal.

C. Control joints for 12-inch units shall be PVC control joints by Ty-Wal, No. 833 or equal.

PART 3: EXECUTION

3.01 HORIZONTAL REINFORCEMENT

A. Install horizontal wall reinforcement per plans. Additionally, install horizontal joint reinforcement in all single and double width masonry walls at 16 inches on center, vertically lapping 6-inch minimum at splices. Terminate reinforcing 1 inch short of expansion joints, control joints and openings in walls.

3.02 VERTICAL REINFORCEMENT

A. Install vertical wall reinforcement per plans

3.03 MASONRY ANCHORS

A. Install masonry anchors at 16 inches on center, vertically where the following conditions occur:

1. Masonry walls abutting steel columns.

2. Masonry wythe by-passing steel columns.

3. Masonry walls abutting concrete walls or columns.

4. Other conditions as detailed.

B. Install masonry anchors at 16 inches on center horizontally where the following conditions occur:

1. Masonry wythe by-passing steel floor or roof beams.

2. Other conditions as detailed.

C. Select from fixed or adjustable anchors as best suited to the job condition.

END OF SECTION

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SECTION 04220

MASONRY UNITS

PART 1: GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, equipment materials, and incidentals required to install unit masonry units as shown on the Drawings and as specified herein.

B. Match existing building split faced CMU pattern and size. New Solids Handling Building is to be split faced CMU.

1.02 SUBMITTALS

A. Submit in accordance with Section 01300 Submittals. Submit Shop Drawings, Product Data and Samples, complete shop drawings and product data for all materials and equipment furnished under this Section.

B. Submit certified copies of all the reports of all tests specified herein. Test reports shall be notarized certificates from the manufacturer certifying that the tested material and equipment accompanied by is of the same type, quality, manufacturer, and make as that proposed to be supplied.

C. Furnish certificate from manufacturer certifying that masonry units comply with specification requirements, including time rated fire-resistance requirements

1.03 REFERENCE STANDARDS

A. Design, manufacturing and assembly of elements of the products specified herein shall be in accordance with the standards of the organizations listed below.

B. American Society for Testing and Materials (ASTM)

1. ASTM C33 – Specifications for Concrete Aggregate
2. ASTM C39 – Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
3. ASTM C90 – Specification for Loadbearing Concrete Masonry Units
4. ASTM C91 – Specification for Masonry Cement
5. ASTM C129 – Specification for Nonloadbearing Concrete Masonry Units
6. ASTM C144 – Specification for Aggregate for Masonry Mortar
7. ASTM C145 – Specification for Solids Loadbearing Concrete Masonry Units
8. ASTM C150 – Specification for Portland Cement
9. ASTM C207 – Specification for Hydrated Lime for Masonry Purposes
10. ASTM C270 – Specification for Mortar for Unit Masonry

11. ASTM C331 – Specification for Lightweight Aggregates for Concrete Masonry Units

12. ASTM C404 – Specification for Aggregates for Masonry Grout

13. ASTM C476 – Specification for Grout for Masonry

14. ASTM C1019 – Standard Test Methods of Sampling and Testing Grout

C. Brick Institute of America.

D. International Masonry Industry All Weather Council.

E. Where reference is made to a standard of one of the above, or other organizations, the version of the standard in effect at the time of bid opening shall apply.

1.04 QUALITY ASSURANCE

A. Unless specifically specified otherwise, all quality control recommendations of the Brick Institute of America, Technical Notes, latest edition shall be adhered to as though incorporated herein

B. Only one brand of mason's cement shall be used throughout the project, all masons cement shall be supplied by the manufacturer of Concrete Masonry Units

C. Allowable Tolerances

1. Maximum variation from plumb: ¼ inch in 10 ft.

2. Maximum variation from level: ¼ inch in 20 ft.

1.05 DELIVERY, STORAGE AND HANDLING

A. Deliver, store and handle materials in a manner to prevent chipping of faces and edges.

B. Store materials above ground and under cover in a dry place. Allow for air circulation around stacked units. Units that become wet shall not be incorporated into the work and shall be removed from the site.

1.06 SITE CONDITIONS

A. Environmental Requirements

1. Do not lay masonry when the surrounding air temperature has dropped below 45 degrees Fahrenheit (°F), unless it is rising.

2. Do not lay masonry when the surrounding air temperature has dropped below 40 °F, except with written permission from the Engineer.

3. When masonry work is authorized at temperatures below 40 °F, but above freezing, provide mortar at temperature between 70 °F and 100 °F. Maintain air temperature above 40 °F on both sides of masonry for 72 hours after laying.

4. Protect masonry construction from direct exposure to wind and sun when erected in ambient air temperatures of 95 °F in the shade with relative humidity less than 50 percent.

B. Protection of Work

1. Keep walls dry during erection by covering the wall with a waterproof membrane at the end of each day or shutdown period. Protect partially completed walls not being worked on in the same manner.

2. Covering shall overhang at least 2-ft. on each side of wall and anchored securely.

3. Protect finished exposed work from stains.

4. Mortar droppings that stick to concrete block faces shall be allowed to dry, and then be removed with trowel and surface lightly scrubbed with bristled brush.

5. Care shall be given to keeping concrete block clean in areas not to be painted.

C. Install and inspect indicated mechanical and electrical work prior to enclosing or covering with masonry.

D. Coordinate installation of masonry anchors with structural system to which masonry is attached.

PART 2: PRODUCTS

2.01 CONCRETE MASONRY UNITS (CMU)

A. Concrete masonry units shall be made from portland cement and clean, well graded aggregates, free from dust or other injurious matter, and shall be thoroughly seasoned, whole, sound and free from cracks or other defects that interfere with the proper placing or impair the strength or permanence of the construction.

B. Surfaces of units which are to be plastered or stuccoed shall be sufficiently rough to provide a suitable bond; elsewhere, exposed surfaces of units shall be split face texture.

C. Hollow Load-bearing Units shall meet requirements of ASTM C90. Type I, moisture-controlled units for humid or intermediate humid conditions of use shall be provided for exterior and foundation walls. Type I, moisture-controlled units or Type II, nonmoisture controlled units shall be provided for other load-bearing walls and partitions.

D. Hollow Non-Load-Bearing Units shall be as specified for load-bearing units.

E. Solid Load-bearing Units shall meet requirements of ASTM C90. Provide Type I or II, except that units exposed to weather shall be Type I. Solid units shall be provided for masonry bearing under structural framing members as indicated.

F. Special shapes, such as closures, sill units, header units and jamb units, shall be provided as necessary to complete the work and shall conform to the applicable portions of the Specifications for the units with which they are used.

G. Sound absorbing concrete masonry units (CMU) shall meet requirements of ASTM C90 for load-bearing and non-load-bearing units. Units shall have one end of the cavities tightly closed. Slots and edges shall be straight and clean. Specially fabricated filler elements of incombustible non-fibrous material shall be factory installed if required to meet the NRC where indicated. Sound absorption qualities shall meet the criteria specified in the Special Provisions, with Noise Reduction coefficient determined in accordance with ASTM C423.

1. Sound absorbing CMU shall be nominal 8-inch x 16-inch units by wall thickness shown with a vertical slot on the exposed face.

2. NRC: 0.55, minimum performance.

H. Unless otherwise required by other sections of these Specifications, masonry units for manholes, catch basins and inlets shall meet requirements of ASTM C139.

I. Provide integral water repellant admixture for exposed CMU units. Use water-repellant admixture for mortar by same manufacturer.

2.02 BRICK

A. Brick shall match approved samples.

B. Facing brick shall meet requirements of ASTM C216, grade SW, Type FBS. Exposed face shall contain no visible cracks. Face brick shall be Utility size (4-inch x 4-inch x 12-inch nominal).

1. Special shapes, such as lip-brick at shelf angles and lintels shall be provided as required, and where shown.

C. Sewer and manhole brick shall meet requirements of ASTM C32 and shall have a high and uniform degree of resistance to frost action in the presence of moisture. Bricks used for channel lining shall be sewer brick Grade SM. All other brick utilized in water, sewer and storm drain structures and manholes shall be manhole brick, Grade MS. Approved manufacturers and type of sewer and manhole bricks are:

1. Baltimore Brick Co., solid hard flashed

2. General Shale Products Corp.

3. Glen-Gery Brick, 213 Y solid standard modular

4. Maryland Clay Products, Solid hard flashed

PART 3: EXECUTION

3.01 SAMPLE WALL

A. Construct 6-ft. long x 6-ft. high sample wall panel for concrete unit masonry to indicate the following:

1. Bonding

2. Mortar color
3. Joint tooling
4. Unit masonry color and texture
5. Reinforcement
6. Workmanship

3.02 WORKMANSHIP

A. Lay only dry masonry units.

B. Lay masonry plumb, level and true to line with accurate coursing as indicated on the Drawings.

C. Cutting of masonry shall be done with abrasive power saw.

3.03 VERTICAL AND HORIZONTAL WALL REINFORCEMENT

A. Install vertical and horizontal wall reinforcement per plans and details. Use industry standard low or high lift grouting techniques. Follow all requirements for grouting inclusive of cleaning out cells and use of witness ports to assure proper grouting of reinforced cells is achieved and inspected.

3.04 BUILDING IN OF OTHER WORK

A. Build in work of other trades indicated to be built in with masonry, including anchors, wall plugs, expansion joints and accessories, as erection progresses. Space and align built-in parts and exercise care not to displace other materials from position. Fill in spaces around built-in items with cement grout.

B. Fill hollow metal frames in masonry walls with cement grout as wall is laid. Rake back ½-in. joint between hollow metal frame and adjacent masonry to receive sealant.

C. Lay masonry to receive flashing with smooth joints free from projections that may puncture flashing materials. Provide mortar on both sides of flashing in masonry joints.

D. Unless indicated otherwise, provide minimum 8 in. of solid end bearing full height of wall from floor to bearing points for lintels, beams and other load-supporting members by either solid block or filling cores with cement grout.

E. Provide lintels and bond beams where indicated using lintel blocks laid with joints matching adjacent work. Reinforcement shall be as indicated, and block filled with concrete.

3.05 HORIZONTAL COURSING LAYOUT

A. Horizontal coursing shall have coursing bond centered in wall or panel length with equal cut pieces at each end of panel of not less than 1/2-unit length.

B. Horizontal coursing shall be laid in running bond.

3.06 MORTAR JOINTS

A. Bed joints non-rated partitions:

1. Lay first course in full bed of mortar.

2. On all other bed joints, apply mortar on face shell only of masonry unit already laid.

3. On masonry unit to be laid, apply a beveled buttering to face shell to insure full bed joints.

B. Bed joints, fire-rated partitions: Lay all courses in full bed of mortar

C. Head joints: Apply mortar to vertical face shell on both the masonry unit already laid and the unit to be laid to insure full head joint.

D. Keep bed and head joints uniform in width, except for minor variations required to maintain bond and locate returns. Standard thickness for both horizontal and vertical mortar joints shall be 3/8-in.

E. Where adjustment must be made after mortar has started to harden, remove and replace mortar with fresh mortar.

3.07 CONTROL JOINTS

A. Make joint ½-in. wide, unless otherwise indicated.

B. Stop horizontal joint reinforcement 1-in. from control joint.

C. Build in PVC control joints providing rabbet to secure shear flange of joint filler.

D. Keep remainder of joint clean and clear of mortar.

E. Provide joints

1. In running walls spaced at intervals not to exceed 25 ft. and/or as indicated.

F. Leave joint open and clean for caulking in accordance with Caulking section.

3.08 JOINT TREATMENT

A. Flush joints: Strike joints in masonry to receive finish work of trades other than painting flush.

B. Tooled joints: Strike exposed joints in standard masonry units flush and, when partially set, tool using concave tool.

3.09 POINTING AND CLEANING

A. Point mortar joints. Remove and replace units with excessive spalls or chips.

1. Upon completion of the unit masonry walls, clean surfaces of excess mortar, stains and foreign matter using an approved masonry cleaning solution.

2. The use of muriatic acid will not be allowed.

3. Test an area of ten to twenty square feet of wall surface with the cleaning solution for the inspection of and approval by the Engineer.
4. Make adequate water supply available to assure thorough pre-soaking and thorough rinsing of the wall before undertaking general cleaning.
5. Apply the cleaning solution in accordance with the manufacturer's instructions.
6. Protect adjacent areas from damage.

END OF SECTION

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SECTION 05120

STRUCTURAL STEEL

PART 1: GENERAL

1.01 DESCRIPTION

A. Provide structural steel work complete as specified and as shown on the Contract Documents.

1.02 QUALITY ASSURANCE

A. Qualifications

1. Fabricator:

a. Company specializing in performing the work of this Section with minimum 5 years documented experience.

b. Certified as an AISC Category II shop as specified in AISC Quality Certification Program Requirements.

2. Erector:

a. Company specializing in performing the work of this Section

b. Minimum 5 years documented experience.

B. Design connections not shown on the Drawings

1. Design in accordance with AISC, "Specifications for the Design, Fabrication and Erection of Structural Steel for Buildings". If not indicated, design connections to transfer full section shear capacity.

2. Prepare under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the State of Georgia.

C. Perform all welding by welders qualified in accordance with AWS D1.1 for the types of welding required.

D. Perform structural field welding and high-strength bolting under continuous inspection of representative of independent testing laboratory. Notify the Owner’s project manager or Engineer at least 24 hours in advance of needed inspections.

E. Comply with applicable standards including, but not limited to the most recent edition of the following:

1. American Society for Testing and Materials (ASTM)

a. ASTM A36 – Structural Steel

b. ASTM A53 – Hot-Dipped, Zinc-Coated Welded and Seamless Steel Pipe

c. ASTM A108 – Steel Bars, Carbon, Cold-Finished, Standard Quality

d. ASTM A123 – Zinc (Hot Dipped Galvanized) Coatings on Iron and Steel Products

e. ASTM A153 – Zinc Coating (Hot Dip) on Iron and Steel Hardware

f. ASTM A307 – Carbon Steel Externally Threaded Standard Fasteners

g. ASTM A325 – High Strength Bolts for Structural Steel Joints

h. ASTM A490 – Quenched and Tempered Alloy Steel Bolts for Structural Steel Joints

i. ASTM A500 – Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Round and Shapes

j. ASTM A501 – Hot-Formed Welded and Seamless Carbon Steel Structural Tubing

k. ASTM A572 – High Strength Low Alloy Columbium-Vanadium Steel of Structural Quality

2. American Welding Society (AWS)

a. AWS A2.0 – Standard Welding Symbols

b. AWS D1.1 – Structural Welding Code

3. American Institute of Steel Construction (AISC)

a. AISC – S326 Specification for the Design, Fabrication and Erection of Structural Steel for Buildings

b. AISC – S302 Code of Standard Practice for Buildings and Bridges

4. Steel Structures Painting Council – SSPC

1.03 SUBMITTALS

A. Comply with Section 01300 Submittals. Submit the following information:

B. Shop Drawings

1. Show complete information necessary for the fabrication of the component parts of the structure or structures. Include:

a. Location, type and size of all bolts and welds,

b. Design of connections not shown on the Drawings. Include calculations.

c. Welding technique for both shop and field.

d. Type of finish.

e. Paint system or other coatings.

f. Fabrication and erection tolerances.

2. Indicate profiles, sizes, spacing, and locations of structural members, openings, attachments, and fasteners.

3. Indicate cambers and loads

4. Indicate finishes and welds by standard symbols conforming to AWS.

C. Erection Plan and details

1. Show both design and assembly,

2. Include temporary supports and bracing, handling procedures,

3. Indicate required construction sequence, where applicable.

D. Certify that welding processes and welding operators are qualified in accordance with AWS Structural Welding Code D1.1, Section 5, "Qualifications". Include in certification that all welders employed or to be employed have satisfactorily passed AWS qualification test within the previous 36 months.

E. Manufacturer's Mill Certificate: Submit under provisions of Section 01400 certifying that products meet or exceed specified requirements.

F. Submit certified test and analyses reports for all materials supplied under this Section. Include the following:

1. Mill Test Reports. Indicate structural strength, as well as destructive and non-destructive test analyses.

2. Test reports for filler metals for welding.

3. Mechanical tests for high strength threaded fasteners and shear connectors.

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver, handle, and store the equipment in accordance with Section 01600.

B. Handle, ship and store material in a manner that will prevent distortion, bending, rusting, scraping or other damage.

1. Store material in a clean, properly drained location out of contact with the ground.

2. Replace or repair damaged material in a manner approved by the Owner’s project manager or designee at no cost to the Owner.

C. Mark weight with paint on all members.

D. Match mark all shop pre-fitted members.

PART 2: PRODUCTS

2.01 MATERIALS

A. Structural steel members: ASTM A36

B. Structural tubing:

1. Cold-formed welded and seamless: ASTM A500, Grade B.

2. Hot-formed welded and seamless: ASTM A501.

3. Furnish members full length without splices, unless otherwise noted.

C. Pipe: ASTM A53, Grade B, Schedule 40.

D. Bolts, Nuts and Washers – ANSI B18.2.1 and B18.2.2 and the following:

1. Low carbon steel bolts and nuts:
    a. ASTM A307
    b. Galvanize to ASTM A153 for use with galvanized members
2. High strength carbon steel bolts, nuts and washers for structural joints:
    a. Bolts 1-1/2-inch diameter and smaller: ASTM A325
    b. Bolts larger than 1-1/2-inch diameter: ASTM A449
3. Round washers not in contact with high strength bolt heads and nuts: ANSI B27.3 Type B
4. Beveled washers
    a. Square, smooth and sloped to contact surfaces of bolt head and nut parallel with contact surface of bolted work.
    b. Make the diameter of the hole 1/16 inch greater than the bolt size for bolts one-inch and smaller diameter, and 1/8 inch greater than the bolt size for bolts larger than one-inch diameter.

E. Castings
1. High strength steel: ASTM A148, metal types as indicated.
2. Mild to medium strength carbon steel: ASTM A27, grade as indicated.

F. Shear Connectors
1. ASTM A108
2. Minimum yield strength 50,000 psi

G. Welding Materials: AWS D1.1; type required for materials being welded.

H. Grout and concrete materials for dry-pack: Section 03602 Non-shrink Grout.

I. Painting, including surface preparation and shop coat: Section 09900 Painting.

2.02 GALVANIZING

A. Use for products which will not be painted or are specified to be galvanized after fabrication.

B. Comply with the following:
1. Products fabricated from rolled, dressed and forged steel shapes, plates and strip: ASTM A123.
2. Iron and steel hardware: ASTM A153.
3. Hot dip coating on assembled steel products: ASTM A386.
4. Use zinc dust coating meeting requirements of MIL P26915 to touch up galvanizing.

2.03 FABRICATION

A. General

1. Fabricate and shop assemble work in accordance with the following:
    a. AISC Specifications for the Design, Fabrication and Erection of Structural Steel for Buildings,
    b. Specifications for Architecturally Exposed Structural Steel,
    c. Specification for Structural Joints using ASTM A325 or A490 Bolts,
2. Straighten rolled material, if necessary, before it is laid out for fabrication
    a. Conforming to the mill tolerances provided in ASTM A6,
    b. Do not injure the material.
        1) Sharp kinks and bends will be cause for rejection of the material.
        2) Heat shrinking of low-alloy structural steel will not be permitted.
3. Shear, flame cut, and chip material as required.
    a. Flame cut edges using a mechanically guided torch or by hand.
        1) Grind exposed edges that have been flame-cut by hand to a smooth finish.
        2) Remove nicks by grinding to a depth not exceeding 1/16 inch.
    b. Shape re-entrant corners to a radius of not less than 3/4 inch and as much larger as practicable.
    c. Ensure metal being cut is not carrying stress during cutting operation.
    d. Direct flame so remaining material is not damaged.
4. Fabricate bearing stiffeners and stiffeners intended as supports for concentrated loads to provide full bearing on the flanges. Mill or grind bearing surfaces as required.
5. Machine finish all metal bearing surfaces which will be in contact with either preformed fabric, elastomeric bearing pads or grout.
    a. Make flat to within 1/8-inch tolerance in 12 inches
    b. Make flat to within 3/16 inch overall.
6. Punch or drill holes for bolts
    a. Provide holes for connection of the work of other trades.
    b. Drill or ream holes at 1/16 inch greater than the nominal diameter of the bolt.

B. Connections:

1. Use AISC specifications, latest edition, to determine the connections (unless otherwise shown on the drawings). Include the number of bolts and spacing required.

2. Follow best shop practices for shearing, punching, selecting the spacing and diameter of bolt holes, and welding.

3. Shop connections may be welded or bolted.

4. Field connections to be bolted unless otherwise indicated.

C. Members

1. Members to be free from twists, kinks, buckles, or open joints.

2. Accurately fabricate members and connections such that when assembled, the parts come together and bolt without distortion.

3. Coat unlike metals that are in contact with yellow zinc chromate as necessary to prevent corrosion.

4. Plane bearing surfaces to true beds.

5. Deliver materials in the order in which they will be required.

6. Furnish steel with one shop-applied prime coat of paint as specified in Section 09900.

D. Provide space, access, and allow time for the Owner to inspect shop welds before the fabricated steel is painted.

2.04 SHOP ASSEMBLY

A. Completely shop assemble structural steel components, as much as practical.

B. Clean surfaces of metal in contact with each other before assembly

1. Removing scale, dirt, burrs and other defects.

2. Remove oil, lacquer and galvanizing from contact surfaces of friction joints.

C. Use either welding or bolting with high strength steel bolts for all shop connections, unless otherwise shown.

1. Weld in accordance with requirements of AWS D1.1. Use minimum 1/4-inch continuous welds unless otherwise indicated.

2. Comply with AISC Specification for Structural Joints using ASTM A325 or ASTM A490 bolts when making connections using high strength steel bolts.

D. Shop paint structural steel as specified and in accordance with Section 09900.

1. Do not paint the following:

a. Zinc coated surfaces

b. Surfaces to be imbedded in concrete or mortar

c. Friction-type connections using either welded or high-strength bolts

d. Steel for temporary construction.

2. Shop apply a lead-free alkyd primer over a minimum surface preparation of SSPC SP-3 to structural steel surfaces not to be painted, contact surfaces and concealed surfaces.
    a. Paint erection marks for identification with a contrasting color after shop coat has dried.
    b. Ensure paint is dry before shipping.

PART 3: EXECUTION

3.01 INSTALLATION

A. General

1. Field assemble structural steel in accordance with AISC Manual of Steel Construction as modified herein.
    a. Erect steel members true and plumb following match marks.
    b. Thoroughly clean surfaces to be joined.
2. Provide templates and other devices as required for presetting bolts and other anchors in accurate locations.
3. Clean concrete and steel bearing surfaces.
    a. Roughen concrete surfaces and set base plates and bearing plates on steel wedges or other adjusting devices.
    b. Tighten anchor bolts after supported members have been positioned and plumbed.
    c. Cut off wedges and shims flush with edge of base or bearing plate.
    d. Dry-pack entire area remaining between bearing surfaces and plates.
4. Assemble joints using high strength steel bolts, unless other bolts are indicated,
    a. Comply with the AISC "Specifications for Structural Joints using ASTM A325 or A490 Bolts".
    b. Field welding will not be permitted except where noted or approved in advance by the Owners project manager or designee.
5. Enlarge holes to admit bolts for connections only if approved by the Owners project manager or designee. Do not make or enlarge holes by burning.
6. Do not field cut or alter structural members without prior written approval of Owners project manager or designee.
7. Provide temporary bracing as required during erection. Size to handle construction loads.

B. Erection

1. Splice only where indicated.
2. Align and adjust members after assembly and before fastening.

a. Notify the Owners project manager or designee immediately if parts do not fit, are deformed, or damaged during handling and transportation.

b. Replace such parts at no cost to the Owner.

3. Provide temporary bracing, as required, and perform permanent bolting as soon as alignment has been accomplished to ensure that the structure will be supported as the erection process progresses.

3.02 FIELD PAINTING

A. Field prepare, and paint required surfaces as specified in Section 09900.

B. Touch-up surfaces where shop coats have been damaged.

1. Remove loose shop applied coats and clean surface prior to touch-up.

2. Use paint, coatings and film thickness identical to original shop coats.

C. Clean field installed bolts, nuts, washers and adjacent areas and apply paint or coating identical to original shop coats.

3.03 FIELD QUALITY CONTROL AND TESTING

A. Perform field inspection and testing in accordance with Section 01410 Testing Laboratory Services.

B. Inspect field assembled bolted constructions in accordance with AISC Specification for Structural Joints using ASTM A325 or A490 Bolts. Use calibrated wrench method.

C. Visual inspection will be performed. In addition to visual inspection, the Owners project manager or designee may inspect field welds by a method selected from AWS D1.1.

END OF SECTION

SECTION 05200

STEEL JOISTS

PART 1: GENERAL

1.01 REFERENCE STANDARDS

A. Except as called for otherwise herein, the fabrication, design and erection of steel joists shall comply with the following:

1. AISC Steel Construction Manual Latest Edition
2. Steel Joist Institute Recommended Code of Standard Practice For Steel Joists and Joist Girders.
3. Standard Specifications Load Tables of the Steel Joist Institute, Latest Edition.

1.02 SHOP DRAWINGS

A. The Contractor shall submit shop drawings to the City's project manager or designee that shall show all details and dimensions for checking, fabrication and installation of joists. Shop drawings shall be submitted in accordance with Section 01300 – Submittals of the specifications.

B. The name of the manufacturer of the joists shall be on the shop drawings. Shop drawing shall be prepared by a Professional Structural Engineer licensed in Georgia. The shop drawings shall bear the seal and signature of the licensed Professional Structural Engineer.

C. All field welding for the attachment of steel joists shall be shown on shop drawings.

D. All permeant and temporary bridging and bracing shall be shown on the shop drawings and shall account for all phases of construction. Bridging and bracing shall include anchorage and connection details.

1.03 INSPECTION

A. All joists not manufactured by a member of the SJI or the AISC shall have 15% of the welds inspected by an inspection laboratory approved by the City's project manager or designee.

B. One copy of the inspection report shall be furnished to the City's project manager or designee and one to the Contractor.

C. Cost of inspection shall be paid for by the manufacturer.

PART 2: PRODUCT

2.01 MANUFACTURER

A. All joists shall be manufactured by one of the following:

1. A member company of the Steel Joist Institute.

2. A member company of the American Institute of Steel Construction.

2.02 SPECIAL ENDS

A. All joists designated on plans as strut joists shall be equipped with 1/4" bearing plates with two 9/16" holes each end for bolting as erection progresses.

2.03 BRIDGING

A. Bridging shall be spaced as prescribed in the SJI specifications.

B. The size and type of bridging shall be as shown on the plans.

2.04 PROVISION FOR OPENING

A. Roof openings between joists over 12" square shall be framed with 3 x 3 x 1/4" angle with vertical leg down, unless shown otherwise.

B. Vertical legs of angles shall be coped for field welding to steel joists or to other angles.

PART 3: EXECUTION

3.01 INSTALLATION

A. As structural steel is erected, strut joists shall be bolted in place with 1/2" bolts each end, then welded with 3/16" fillet weld all around.

B. As joists are erected, they shall be secured to their supports by temporary or permanent connections.

C. Except where bolted, roof joists shall be welded to steel supports with 1/4" x 2" fillet welds each side and floor joists shall be welded to steel supports with 1/4" x 2" fillet welds each side.

D. Bridging shall be installed as erection of joists progresses. Bridging shall be attached at each connection and at crossover by welding.

E. Opening framing shall be attached by welding.

F. Joists shall not be subjected to construction loads until top chords are stayed by attachment of roof deck or floor forms.

G. Where called for on plans, bottom chord or rod type extensions shall be provided.

H. Joists roofs shall not be subjected to construction loads in excess of 20 PSF.

I. Joists floors shall not be subjected to construction loads in excess of 50 PSF.

J. Ends of joist shall be extended where indicated on plans. Extension shall be in accordance with the SJI standards, Type 1, unless otherwise indicated.

END OF SECTION

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SECTION 05310

STEEL DECK

PART 1: GENERAL

1.01 DESCRIPTION

A. Provide steel roof deck and roof deck accessories and appurtenances as specified and as shown on the Contract Documents.

1.02 QUALITY ASSURANCE

A. Engage an experienced Installer who has completed steel deck similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.

B. Comply with applicable provisions of AWS D1.1 "Structural Welding Code – Steel" and AWS D1.3 "Structural Welding Code – Sheet Steel."

C. Provide steel roof deck evaluated by Factory Mutual and listed in Factory Mutual "Approval Guide" for Class 1 fire rating and Class 1-60 windstorm ratings.

1.03 SUBMITTALS

A. Comply with Section 01300 – Submittals. Include the following information:

1. Manufacturer's catalog information that describes each type of deck provided. Include
    a. Specifications
    b. A complete bill of materials that identifies all materials of construction.
2. Certified structural and erection drawings. Show:
    a. Important details of construction,
    b. Plan dimensions,
    c. Types of deck panels,
    d. Reinforcing channels, pans, deck openings,
    e. Special jointing, accessories,
    f. Size and location of anchor bolts, and
    g. Locations of connections to other work.
3. Special shipping, storage, protection, and handling instructions.
4. Manufacturer's installation instructions.

B. Submit compliance certificates for specified tests in accordance with Section 01400.

C. Submit certified test reports in accordance with Section 01400.

D. Submit manufacturer’s certificates in accordance with the Sections 01300 – Submittals, and 01400.

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver, handle, and store the equipment in accordance with Section 01600 – Delivery Storage and Handling.

B. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.

C. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.

PART 2: PRODUCTS

2.01 MANUFACTURERS

A. American Buildings Co.

B. United Steel Deck, Inc

C. Vulcraft Div. of Nucor Corp.

D. or Equal.

2.02 GENERAL

A. Fabricate roof deck panels without top-flange stiffening grooves conforming to SDI Publication No. 28 "Specifications and Commentary for Steel Roof Deck" and the following:

1. Galvanized-steel sheet shall conform to ASTM A 446, Grade A, G 90 (ASTM A 446M, Grade A, Z 275) zinc coated according to ASTM A 525 (ASTM A 525M).

2. Deck profile shall be Type WR, wide rib used in B deck configuration.

3. Profile depth shall be 1-1/2 inches (38 mm).

4. Design uncoated-steel thickness shall be Nominally 20 Gage and 0.0358 inch (0.91 mm) whichever is greater.

5. Span conditions are as indicated on the Drawings.

6. Side laps shall be overlapped or interlocking seam at Contractor's option.

2.03 ACCESSORIES

A. Provide accessory materials for steel deck that comply with requirements indicated and recommendations of the steel deck manufacturer.

B. Provide Weld washers at all deck to support puddle welds.

C. Manufacturer's standard; side lap fasteners corrosion-resistant, hexagonal washer head; self-drilling, carbon steel screws, No. 10 (4.8 mm) minimum diameter.

D. Manufacturer's standard vulcanized; Rib closure strips closed-cell, synthetic rubber.

E. Miscellaneous roof deck accessories shall be steel sheet, 0.0359-inch- (0.91-mm-) thick minimum ridge and valley plates, finish strips, and reinforcing channels, of same material as roof deck.

F. Manufacturer's standard size; Recessed sump pans single piece steel sheet 0.071-inch- (1.8-mm-) thick minimum, of same material as deck panels, with 1-1/2-inch- (38-mm-) minimum deep level recessed pans and 3-inch- (76-mm-) wide flanges. Cut holes for drains in the field.

G. Steel sheet accessories, ASTM A 446, G 60 (ASTM A 446M, Z 180) coating class, galvanized according to ASTM A 525 (ASTM A 525M).

H. Galvanizing repair paint SSPC-Paint 20 or DOD-P-21035, with dry film containing a minimum of 94 percent zinc dust by weight.

PART 3: EXECUTION

3.01 PREPARATION

A. Examine supporting framing and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance of steel deck.

B. Do not place deck panels until concrete has cured and is dry.

C. Locate decking bundles to prevent overloading of supporting members.

3.02 INSTALLATION

A. General

1. Install deck panels and accessories according to applicable specifications and commentary of SDI Publication No. 28, manufacturer's recommendations, and requirements of this section.

2. Install temporary shoring before placing deck panels when required to meet deflection limitations.

3. Place deck panels on supporting framing and adjust to final position with ends accurately aligned and bearing on supporting framing before being permanently fastened. Do not stretch or contract side lap interlocks.

4. Place deck panels flat and square and fasten to supporting framing without warp or deflection.

5. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to the decking.

6. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of decking, and support of other work.

7. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work.

B. Roof Deck Installation

1. Fasten roof deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated or arc seam welds with an equal perimeter, but not less than 1-1/2 inches (38 mm) long, and as follows:
   a. Weld diameter shall be 3/4 inch (16 mm), nominal.
   b. Weld spacing shall be in accordance with the fastening pattern indicated.
   c. Use of weld washers is required to assure quality deck welds.
2. Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding 36 inches (910 mm), using one of the following methods:
   a. Mechanically fasten with self-drilling No. 10- (4.8-mm-) diameter or larger carbon steel screws.
   b. Mechanically clinch or button punch.
3. Install deck ends over supporting framing with a minimum end bearing of 1-1/2 inches (38 mm), with end joints lapped 2 inches (51 mm) minimum.
4. Install ridge and valley plates, finish strips, cover plates, end closures, and reinforcing channels according to deck manufacturer's recommendations. Weld to substrate to provide a complete deck installation.

C. Repairs and Protection

1. Prepare and repair damaged galvanized coatings on both surfaces with galvanized repair paint according to ASTM A 780 and the manufacturer's instructions.
2. Provide final protection and maintain conditions to ensure steel decking is without damage or deterioration at time of Substantial Completion.

END OF SECTION

SECTION 05400

COLD FORMED METAL FRAMING

PART 1: GENERAL

1.01 SECTION INCLUDES

A. Formed steel stud exterior wall and interior wall framing.

B. Formed steel joist and purlin framing and bridging.

1.02 RELATED REQUIREMENTS

A. Section 06100 – Rough Carpentry- Rough Carpentry: Wood blocking and miscellaneous framing.

B. Section 07210 – Building Insulation.

1.03 REFERENCE STANDARDS

A. AISI SG02-1 – North American Specification for the Design of Cold-Formed Steel Structural Members; American Iron and Steel Institute; 2001 with 2004 supplement. (replaced SG-971)

B. ASTM A 153/A 153M – Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2005.

C. ASTM A 653/A 653M – Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2007.

D. ASTM C 955 – Standard Specification for Load-Bearing (Transverse and Axial) Steel Studs, Runners (Tracks), and Bracing or Bridging for Screw Application of Gypsum Panel Products and Metal Plaster Bases; 2007.

E. SSPC-Paint 20 – Zinc-Rich Primers (Type I, "Inorganic," and Type II, "Organic"); Society for Protective Coatings; 2002 (Ed. 2004).

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordinate with work of other sections that is to be installed in or adjacent to the metal framing system, including but not limited to structural anchors, cladding anchors, utilities, insulation, and firestopping.

1.05 SUBMITTALS

A. See Section 01300 Submittals – Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's data on factory-made framing connectors, showing compliance with requirements.

C. Shop Drawings: Indicate component details, framed openings, bearing, anchorage, loading, welds, and type and location of fasteners, and accessories or items required of related work.

1. Provide design engineer's stamp on shop drawings.

D. Manufacturer's Installation Instructions: Indicate special procedures, and conditions requiring special attention.

1.06 QUALITY ASSURANCE

A. Designer Qualifications: Design framing system under direct supervision of a Professional Structural Engineer experienced in design of this Work and licensed in Georgia.

PART 2: PRODUCTS

2.01 MANUFACTURERS

A. Metal Framing, Connectors, and Accessories:

1. Dietrich Metal Framing: www.dietrichindustries.com.

2. Marino\Ware: www.marinoware.com.

3. The Steel Network, Inc.: www.SteelNetwork.com.

4. Substitutions: See Section 01600 – Product Requirements.

2.02 FRAMING SYSTEM

A. Provide primary and secondary framing members, bridging, bracing, plates, gussets, clips, fittings, reinforcement, and fastenings as required to provide a complete framing system.

B. Design Criteria: Provide completed framing system having the following characteristics:

1. Design: Calculate structural characteristics of cold-formed steel framing members according to AISI North American Specification for the Design of Cold-Formed Steel Structural Members.

2. Structural Performance: Design, engineer, fabricate, and erect to withstand specified design loads for project conditions within required limits.

3. Design Loads: In accordance with applicable codes.

4. Deflections: Live load deflection meeting the following, unless otherwise indicated:

a. Floors: Maximum vertical deflection under live load of 1/480 of span.

b. Roofs: Maximum vertical deflection under live load of 1/240 of span.

c. Exterior Walls: Maximum horizontal deflection under wind load of 1/180 of span.

d. Design non-axial loadbearing framing to accommodate not less than 1/2 in vertical deflection.

5. Able to tolerate movement of components without damage, failure of joint seals, undue stress on fasteners, or other detrimental effects when subject to seasonal or cyclic day/night temperature ranges.

6. Able to accommodate construction tolerances, deflection of building structural members, and clearances of intended openings.

2.03 FRAMING MATERIALS

A. Studs and Track: ASTM C 955; studs formed to channel, "C", or "Sigma" shape with punched web; U-shaped track in matching nominal width and compatible height.

1. Gage and depth: As required to meet specified performance levels.

2. Galvanized in accordance with ASTM A 653/A 653M G90/Z275 coating.

B. Joists and Purlins: Fabricated from ASTM A 653/A 653M steel sheet, with G90/Z275 hot dipped galvanized coating.

1. Base Metal: Structural Steel (SS), Grade 33/230.

2. Gage and depth: As required to meet specified performance levels.

C. Framing Connectors: Factory-made formed steel sheet, ASTM A 653/A 653M SS Grade 50, with G60/Z180 hot dipped galvanized coating and factory punched holes.

1. Structural Performance: Maintain load and movement capacity required by applicable code, when evaluated in accordance with AISI North American Specification for the Design of Cold Formed Steel Structural Members; minimum 16 gage, 0.06 inch thickness.

2. Provide non-movement connections for tie-down to foundation, floor-to-floor tie-down, roof-to-wall tie-down, joist hangers, gusset plates, and stiffeners.

2.04 ACCESSORIES

A. Bracing, Furring, Bridging: Formed sheet steel, thickness determined for conditions encountered; finish to match framing components.

B. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction.

2.05 FASTENERS

A. Self-Drilling, Self-Tapping Screws, Bolts, Nuts and Washers: Hot dip galvanized per ASTM A 153/A 153M.

B. Anchorage Devices: Power actuated.

PART 3: EXECUTIONS

3.01 EXAMINATION

A. Verify that substrate surfaces are ready to receive work.

B. Verify field measurements and adjust installation as required.

3.02 INSTALLATION OF STUDS

A. Install components in accordance with manufacturers' instructions and ASTM C 1007 requirements.

B. Construct corners using minimum of three studs. Install double studs at wall openings, door and window jambs.

C. Install load bearing studs full length in one piece. Splicing of studs is not permitted.

D. Install load bearing studs, brace, and reinforce to develop full strength and achieve design requirements.

E. Coordinate placement of insulation in multiple stud spaces made inaccessible after erection.

F. Install intermediate studs above and below openings to align with wall stud spacing.

G. Provide deflection allowance in stud track, directly below horizontal building framing at non-load bearing framing.

H. Attach cross studs to studs for attachment of fixtures anchored to walls.

I. Install framing between studs for attachment of mechanical and electrical items, and to prevent stud rotation.

J. Touch-up field welds and damaged galvanized surfaces with primer.

3.03 INSTALLATION OF JOISTS AND PURLINS

A. Install framing components in accordance with manufacturer's instructions.

B. Make provisions for erection stresses. Provide temporary alignment and bracing.

C. Provide web stiffeners at reaction points.

D. Touch-up field welds and damaged galvanized surfaces with primer.

END OF SECTION

SECTION 05500

METAL FABRICATIONS

PART 1: GENERAL

1.01 DESCRIPTION

A. Provide miscellaneous metal products and metal fabrications, including appurtenances, as specified and as shown on the Contract Documents.

B. This section includes requirements for the following:

1. Miscellaneous structural steel used for framing and supports.
2. Castings.
3. Ladders.
4. Stairs.
5. Checkered safety plate.
6. Handrail and railings.
7. Aluminum grating.
8. Miscellaneous items such as anchors, safety chains, fasteners, hardware and accessories necessary to complete the work.

1.02 QUALITY ASSURANCE

A. Provide components that are the standard product of a manufacturer regularly engaged in the production of the required materials and equipment.

1. A single manufacturer shall provide all like items.
2. The manufacturer shall be responsible for the design, construction and proper operation of all components.

B. Conform to OSHA requirements for all safety related items.

C. Verify that field measurements are as indicated on the Drawings.

D. Comply with applicable standards including, but not limited to the most recent edition of the following:

1. AISC "Specification for the Design, Fabrication and Erection of Structural Steel for Buildings and Bridges" and AISC "Code of Standard Practice."
2. American Society for Testing and Materials (ASTM)
   a. ASTM A27, Steel Castings, Carbon, for General Application
   b. ASTM A36, Carbon Structural Steel
   c. ASTM A47, Ferritic Malleable Iron Castings
   d. ASTM A48, Gray Iron Castings

e. ASTM A53, Pipe, Steel, Black, and Hot-Dipped, Zinc-Coated, Welded and Seamless

f. ASTM A108, Steel Bar, Carbon and Alloy, Cold Finished

g. ASTM A123, Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

h. ASTM A167, Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip

i. ASTM A193, Alloy Steel and Stainless Steel Bolting Materials for High Temperature Service

j. ASTM A194, Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service

k. ASTM A220,Pearlitic Malleable Iron

l. ASTM A240, Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications

m. ASTM A242, High-Strength Low-Alloy Structural Steel

n. ASTM A264, Stainless Chromium-Nickel Steel-Clad Plate

o. ASTM A276, Stainless Steel Bars and Shapes

p. ASTM A307, Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength

q. ASTM A312, Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes

r. ASTM A385, Providing High-Quality Zinc Coatings (Hot-Dip)

s. ASTM A536, Specification for Ductile Iron Castings

t. ASTM A668, Steel Forgings, Carbon and Alloy, for General Industrial Use

u. ASTM B108, Aluminum-Alloy Permanent Mold Castings

v. ASTM B209, Aluminum and Aluminum-Alloy Sheet and Plate

w. ASTM B221, Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes

3. American Welding Society (AWS)

   a. AWS D1.1, Structural Welding Code – Steel

   b. AWS D1.2, Structural Welding Code – Aluminum

4. American National Standards Institute (ANSI)

   a. ANSI B18.22; Washers, Steel, Plain (Flat), Unhardened for General Use

   b. ANSI H35.2, Dimensional Tolerances for Aluminum Mill Products

5. American Water Works Association (AWWA)

   a. AWWA C203, Coal Tar Protective Coatings and Linings for Steel Water Pipelines, Enamel and Tape, Hot Applied

6. National Association of Architectural Metal Manufacturers (NAAMM)

7. 29 CFR 1910, Occupational Safety and Health Administration (OSHA)

E. Qualifications

1. Welders: Certified in accordance with AWS D1.1-92, Chapter 5.

2. Epoxy Anchor Manufacturers: Experience on at least three similar projects within the last 3 years.

3. Epoxy Anchor Installers: Trained and certified by manufacturer.

F. Welding Procedures: Follow the requirements of AWS D1.1-92 and AWS D1.2-90.

1.03 SUBMITTALS

A. Comply with Section 01300 – Submittals.

B. Submit the following information:

1. Shop drawings:

a. Show size, finish, location, required hardware and accessories, and details for all fabricated metal work, threaded fasteners and welds.

b. Show materials, construction and fabrication details, layout and erection diagrams and method of anchorage to adjacent construction.

c. Indicate welds, both shop and field, by symbols conforming to AWS Standards.

d. Prior to Submittal, coordinate Shop Drawings with related trades to ensure proper mating of assemblies.

2. Setting diagrams, erection plans, templates, and directions for the installation of backing plates, anchors, and other items.

3. Catalog descriptions of manufacturers' standard items. Show illustrated cuts of item to be furnished, scale details, capacities, dimensions and similar information.

4. Working Drawings and calculations for Contractor designed hatches and gratings.

5. Metal fabrications, including welding and fastener information.

6. Anchors

a. Specific instructions for all phases of installation including hole size, preparation, placement, procedures, and instructions for safe handling of anchoring systems.

b. Vinyl Ester and Epoxy Anchors

1) Manufacturer's past project experience data.

2) Test reports for each batch of vinyl ester or epoxy delivered to site.

3) Current test data indicating that cured adhesive anchors meet or exceed design loads.

7. Welders: Evidence of certification.

8. Signed and sealed calculations for railings and rail accessories.

9. Samples

a. Handrail and railing assembly to show joints, bends, toe plate, posts, and anchorage.

b. Grating and checkered plates: 8 inches by 8 inches.

c. Stair treads and safety nosings, 8 inches long. Include color samples of abrasive nosings.

d. Epoxy Anchors: Two (2) self-contained epoxy adhesive cartridges for each batch of epoxy delivered to site, for independent testing.

10. Record Drawings in accordance with Section 01300 – Submittals.

C. Submit manufacturer's compliance certificates for specified tests in accordance with Section 01400. Submit for each of the following:

1. Qualification of installers.

D. Submit certified test reports in accordance with Section 01400. Submit for the following:

1. Ladders: Results of load tests.

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver, handle, and store the equipment in accordance with Section 01600 – Delivery Storage and Handling.

B. Identify and match mark, if applicable, all materials, items and fabrications for installation or field assembly.

C. Wherever practicable, deliver items to Contract site as complete units, ready for installation. Include all anchors, hangers, fasteners and miscellaneous metal items needed for installation.

D. Provide adequate storage facilities at the Contract site for the protection and storage of all delivered materials.

1. Handle and store in such a manner as to not damage factory finishes.

2. Repair damaged finishes as required, at no cost to the Owner.

PART 2: PRODUCTS

2.01 MATERIALS - GENERAL

A. Structural Shapes and Bars

1. Mild steel: ASTM A36, unless otherwise indicated.

2. Corrosion resistant steel: ASTM A242.
3. Stainless steel: ASTM A276, type 316.
4. Aluminum:
    a. ASTM B221 with alloy and temper of 6061, T6.
    b. Structural members: ASTM B308 with alloy and temper of 6061, T6.
    c. Handrail: alloy 6061 or 6063 and temper as provided by the manufacturer.

B. Plate, Sheet, Strip

1. Mild steel: ASTM A36.
2. High strength steel: ASTM A242.
3. Corrosion resistant steel: ASTM A264.
4. Stainless Steel
    a. Over 1/8-inch thickness: ASTM A264 and type 316 in accordance with ASTM A240.
    b. Under 1/8-inch thickness: ASTM A167, type 316.
5. Aluminum: ASTM B209 with alloy and temper of 6061, T6.

C. Pipe and Tube

1. Mild Steel
    a. ASTM A53, type S, Grade B, black.
    b. When Used for Welding: Schedule 40 minimum.
    c. Handrail posts: Schedule 80 minimum.
2. Stainless:
    a. Welded: ASTM A312, grade TP 316L, schedule 10S minimum.
    b. Screwed Connections: ASTM A312, grade TP 316, schedule 40S
    c. Press Fits: ASTM A312, grade TP 316, schedule 5S minimum.
3. Aluminum:
    a. ASTM B221 with alloy and temper of 6061, T6.
    b. Wall thickness: Schedule 80, per ANSI H35.2 unless otherwise shown on the Drawings.

D. Mild Steel Forgings: ASTM A235, class F

2.02 CASTINGS AND FORGINGS

A. Materials

1. Gray iron: ASTM A48, grade 25 except valve and curb boxes shall be minimum class 20.

2. Malleable iron: ASTM A47, grade 35018.
3. Ductile iron: ASTM A536, grade 60-40-18.
4. Nodular iron: ASTM A220, grade 45008.
5. Steel: ASTM A27, grade 65-35.
6. Aluminum: ASTM B108 with alloy and temper of 356.0, T6.

B. Fabrication

1. Provide uniform quality, true to pattern, strong, tough, of even grain, sound, smooth, without cold sheets, scabs, blisters and sand holes, cracks or other defects.
2. Plugs, filled holes and welding will not be allowed.
3. Provide thicknesses and configurations shown on the Standard Details.
4. Sand blast as required to remove scale and sand and achieve a uniform smooth clean surface.
5. Paint with asphaltic or coal tar paint meeting requirements of AWWA C203, where indicated.
6. Provide raised letters where indicated.

C. Valve boxes

1. Comply with Standard Details
2. Use sliding type extension.
3. Lid shall be removable only by lifting straight up from the shaft shoulder.
4. Provide raised letters as indicated on the Drawings.

D. Manhole frames and covers

1. Gray or ductile iron construction.
2. Design for HS-20 loading, as defined by AASHTO, unless noted otherwise.
3. Make manhole covers self-sealing, true, and ensure that they seat at all points.
4. Comply with the Standard Details, except as indicated below.
5. Storm drain frames and covers
    a. Provide indented covers of the solid top design with pick holes.
    b. Opening diameters are shown on the Standard Details and on the Drawings.
    c. Provide raised cast letters on upper surface of cover, STORM DRAIN, at minimum height of 2 inches.

6. Electric and instrumentation manhole covers
    a. Provide indented covers of the solid top design with two drop handles.
    b. The diameter shall be 36 1/2 inches.
    c. Provide raised cast letters, minimum 2 inches in height, on upper surface of cover as follows:
        1) ELECTRIC HV for electric manholes carrying greater than 600 volts
        2) ELECTRIC LV for electric manholes carrying 600 volts and below
        3) INSTRUMENTATION for manholes on signal conduits
7. Manufacturers
    a. Neenah Foundry Co.,
    b. Dewey Brothers, Inc.,
    c. East Jordan Iron Works,
    d. Or equal.

E. Trench drain frames and grates
1. Gray or Ductile Cast iron
2. Suitable for HS-20 loading as defined by AASHTO.
3. Provide in convenient lengths for handling. Make the width as shown on the Drawings.
4. Total free open area of grate shall be approximately 0.7 square feet per linear foot.
5. Provide standard support frames, including frame end pieces, with anchor lugs for installation in cast-in-place concrete.
6. Manufacturers
    a. Neenah Foundry Co.,
    b. East Jordan Iron Works,
    c. Or equal.

2.03 MANHOLE STEPS

A. Meet requirements of ASTM C478 for manhole steps.

B. Manufacture from one of the following:
1. Minimum 1/2-inch-diameter steel reinforcing bar conforming to ASTM A615, grade 60.
2. Deforming wire complying with ASTM A496.

C. Encase manhole steps in polypropylene conforming to ASTM D4101.

2.04 LADDERS

A. Permanent fixed type custom ladders.

1. Construct of 6061-T6 Aluminum.
2. Use all welded construction.
3. Conform to the details shown on the Drawings.
    a. Space rungs uniformly. Do not exceed 12 inches between rungs.
    b. Make rungs at least 16 inches long unless shown otherwise on the Drawings.
4. Design, fabricate, and install in accordance with OSHA (1910.27) 31:4815-7, Requirements For Fixed Ladders.
5. Provide required brackets, bolts and anchors.
6. Use serrated rungs. Coat rungs with a coarse grain non-slip epoxy coating.
    a. Gray color.
    b. Apply per manufacturer’s recommendations.
7. Provide custom platform design over parapet coping.
8. Provide custom intermittent platform design for ladder distances in excess of 30 feet.

B. Provide ladders with an aluminum safety extension beneath all hatches and where ladders enter a water containing structure.

1. Design extension poles to meet requirements of ASTM B221. Use alloy and temper of 6061, T6.
    a. Provide a spring balance.
    b. Automatically lock the extension pole in the raised position.
    c. Provide a release level for unlocking.
2. Design castings to comply with ASTM B108. Use alloy and temper of 356, T6.
3. Use stainless steel hardware. Provide with safety extension for mounting to ladder.
4. Provide standard mill finish.
5. Manufacturers
    a. Ladder Up LU-4 by Bilco.
    b. Or Equal.

C. Ladder Cage

1. Provide basket guard, hoop type for all climbing heights over 20 feet and where shown on the Drawings.

a. Fabricate from 6061-T6 aluminum alloy with a mill finish.

b. Conform to ANSI A14.3

c. Assemble by welding or bolting.

2. Construction

a. Hoops - 3/8-inch by 2-1/2-inch bars:

b. Vertical bars

1) 3/8-inch by 2-1/2-inch bars.

2) Space at not more than 9 inches or 40 degrees on center.

c. Fasten hoops to the steel ladder side rails with 1/2-inch bolts or shop weld.

d. Use stainless steel fasteners for safety cages.

D. Ladder Fall Prevention System

1. Provide where shown on the Drawings.

2. Comply with OSHA regulations 1910.27 and 1926.1053 for fall prevention systems.

3. Include carrier rail, ladder-rung clamps, sleeve, and a belt or harness.

4. Manufacturer

a. Saf-T-Climb by North Safety Products of Cranston, RI 02921.

b. Or Equal.

2.05 STAIRS

A. Fabricate stairs from structural shapes and plate

1. Steel

a. ASTM A-36

b. Hot dip galvanize after fabrication

2. Aluminum

a. 6061-T6

b. Comply with Aluminum Association Specifications and Guidelines for Aluminum Structures.

B. Design

1. Minimum clear width of not less than 22 inches or as shown on the Drawings.

2. Rise angle between 30 and 50 degrees or as shown on the Drawings.

3. Rise to tread run shall conform to Table D of OSHA (1910.24) 31.4806.

C. Treads and platforms

1. Provide a non-slip surface.
2. Use an ADA compliant nosing.
3. Galvanized metal stair systems:
    a. Provide solid treads of checkered safety plate.
    b. Make landing kick plates four inches high by ¼-inch thick plate.
4. Abrasive cast aluminum stair treads
    a. Acceptable Manufacturers
        1) Wooster Products, Inc., Wooster, OH, Type 105
        2) American Safety Tread Company, Incorporated, Helena, AL, Style 804,
    b. Provide width and length shown on the Drawings. Make at least ½ inch thick.
5. May use open aluminum grating for stair treads and platforms.
6. Provide landing kick plates 4 inches high by 1/4 inch thick.

2.06 CONCRETE STAIR NOSINGS

A. Form abrasive safety nosings for concrete stair treads and landings from FS RR-T-650, nonskid tread.

1. Make 3 to 8 inches wide but less than the concrete width.
2. Use suitable anchoring devices.

B. Provide bolted-on nonskid treads for all plain metal stair treads.

2.07 HANDRAILING AND KICKPLATES

A. Fabricate railings, handrails and kickplates as indicated on the drawings

1. Fabricate from aluminum alloy
    a. Fabricate handrail and posts from minimum 1-1/2-inch-inside diameter, schedule 40 aluminum pipe.
    b. Use 6063-T-6 alloy and temper for top and intermediate railings, posts, returns and handrails.
    c. Do not exceed 20 feet between splices for railing sections.
    d. Grind all exposed welds smooth.
    e. Fabricate flanges for posts from 3/8-inch minimum thickness plate.
        1) Weld to the bottom of the posts
        2) Fasten to the stringer or concrete with two 1/2-inch-diameter stainless steel bolts.
    f. Fabricate stand-offs from not less than 3/16-inch thickness plate.

2. Conform to OSHA requirements.

3. Fabricate with all intersections and joints neatly fitted, fully welded and ground smooth and flush.

   a. Heat and bend smoothly, without distortion.

   b. Fabricate posts and stand-offs for pipe railing of the same material as the railing:

      1) Space evenly as shown,

      2) Provide anchor flanges.

   c. Use quarter round bends and welded flanges to make handrails along walls return to the wall at each end.

   d. Cope and continuously weld or mechanically connect members at all junctions.

   e. Run top rails continuously over posts.

4. Deliver all aluminum pipe railings, posts and handrails to the job protected by polyethylene tubing with a minimum wall thickness of 0.05 inch. Tubing shall remain during construction and shall be removed only when directed.

B. Interior handrails at stairs

1. Use a single rail

2. Turn 90 degrees to terminate 1/8 inch from walls.

3. Secure brackets to the walls with stainless steel expansion bolts.

4. Grout hollow walls at attachment locations in accordance with Section 04220 – Masonry Units.

5. Locate terminal brackets not more than 8 inches from the end of the handrails.

6. Make the maximum bracket spacing 6 feet on centers.

7. Provide backing plates where brackets are to be attached to gypsum board constructed partitions.

C. Frame, anchor and mount handrails and posts such that the complete structure is capable of withstanding a load of at least 200 pounds applied at any direction at any point on the top rail, exceeding or meeting OSHA requirements.

1. Do not space posts and mounts at more than 5 feet on centers.

2. Reinforce end posts as specified in this section.

D. Coatings

1. Interior aluminum pipe railings and posts, and handrails

   a. Provide a NAAMM, Architectural Class II, AAM10C22A31, clear natural coating.

2. Exterior aluminum pipe railings and posts, and handrails

a. Provide a NAAMM, Architectural Class I, AAM10C22A41, clear natural coating.

E. Safety Chain:

1. Stainless steel,

a. Type 316.

b. Minimum 9/32 inch thick.

c. Working load limit at least 2,000 pounds.

2. Provide chain with eye, snap hook, and staple across gaps formed by railing sections or other locations.

F. Contractor's Option: Use manufactured modular railings restricted to one of the following manufacturers. Prefabricated aluminum railings shall be generally as specified and as shown.

1. Universal "Uni-rail"

2. Moultrie "Wesrail"

2.08 ALUMINUM GRATING

A. Provide where shown on the Drawings. Include all required edge angles, banding, and fastening devices.

B. Design to support a uniform load of 150 pounds per square foot or as otherwise noted on the Drawings.

C. Make sections straight and provide finished and banded edges.

1. Bolt or clip down to provide a level and secure surface.

2. Cut openings as required for pipe or equipment penetrations. Band all openings.

2.09 CHECKERED SAFETY PLATE

A. Steel:

1. FS QQ-F-461, class k,

2. Flat back,

3. Standard four-way raised pattern,

4. Rolled from ASTM A36, grade A,

5. Thickness and span for 16ksi maximum fiber stress.

6. Hot dip galvanize after fabrication.

B. Aluminum:

1. ASTM B221, with alloy and temper of 6063 T6,

2. Flat back.
3. Diamond pattern.
4. Thickness and span for 16 ksi maximum fiber stress.

2.10 MISCELLANEOUS ITEMS

A. Fasteners and Anchors

1. General
   a. Use galvanized with galvanized material.
   b. Use stainless steel with stainless steel and aluminum material.
   c. Provide cadmium plated for use with all other materials.
2. Stainless Steel
   a. Bolts: ASTM A193, grade B8M.
   b. Nuts: ASTM A194, grade 811.
   c. Washers: ANSI B18.22.1 and be of the same material as the bolts and nuts.
3. Expansion anchors
   a. Comply with FS FF-S-325.
   b. Concrete
      1) Wedge type: Group II, Type 4, Class 1 or 2.
      2) Self-drilling type: Group III, Type 1.
      3) Non-drilling type: Group VIII, Type 1 or 2.
   c. Masonry
      1) Lag shield type: Group II, Type 1.
      2) Split shield type: Group II, Type 3, Class 3.
4. Vinyl Ester Adhesive Anchor Systems
   a. Use two-component type that is insensitive to moisture and designed to be installed in adverse freeze/thaw environments.
   b. Cure Temperature, Pot Life, and Workability: Compatible for intended use and anticipated environmental conditions.
   c. Container Markings:
      1) Manufacturer's name
      2) Product name
      3) Batch number
      4) Product expiration date
      5) ANSI hazard classification
      6) ANSI handling precautions.

d. Anchor Rods:

1) Stainless steel threaded rods,

2) Sized by adhesive manufacturer for design loads required and adhesive system used.

5. Headed steel anchors:

a. Fabricate from cold finished carbon steel as shown on the drawings.

b. Comply with ASTM A108.

B. Pipe Sleeves for Concrete Construction

1. Standard weight, black steel pipe,

2. Weld anchors to exterior to serve as a waterstop,

3. Size as required to accommodate passage of conduits, pipes, ducts and similar items.

C. Backing Plates

1. Use minimum 16-gauge galvanized steel

2. Secure plates in position by welding to studs or with bolts in expansion shields as appropriate.

2.11 SHOP FINISHES

A. Galvanizing.

1. Iron and Steel:

a. Hot-dip galvanized, ASTM A123.

b. Average coating weight per square foot of 2.0 ounces and not less than 1.8 ounces per square foot.

2. Ferrous Metal Hardware Items:

a. ASTM A153

b. Average coating weight of 1.3 ounces per square foot.

3. Touch-up Material for Galvanized Coatings: DRYGALV as manufactured by the American Solder and Flux company, Galvalloy, Galvion.

B. Ferrous metals other than galvanized steel, stainless steel, and cast iron

1. Shop prime with one coat of primer.

2. Select to be compatible with the appropriate painting system specified in Section 09900 – Painting.

C. Bituminous Coating: MS MIL-C-450.

PART 3: EXECUTION

3.01 FABRICATION

A. General

1. Fabricate items as indicated in the Contract Documents and as shown on approved Contractor's drawings.
    a. Comply with the following:
        1) ASTM A385-80.
        2) ASCE "Specifications for Structures for Aluminum Alloy 6061-T6, Second Progress Report of the Committee of the Structural Division on Design in Lightweight Structural Alloys."
        3) AISC "Specification for the Design, Fabrication and Erection of Structural Steel for Buildings and Bridges" and AISC "Code of Standard Practice."
    b. Straighten any work bent by shearing or punching.
    c. Press exposed edges and ends of metal smooth.
    d. Finish exposed surfaces to provide smooth, sharp, well-defined lines. Grind cut edges smooth and straight.
    e. Conceal fastenings where practical. Flush countersink where exposed.
    f. Round sharp edges to small uniform radius. Grind burrs, jagged edges, and surface defects smooth.
2. Construct connections and joints exposed to weather to exclude water.
3. Provide sufficient anchors to properly fasten of the work.
4. Provide the necessary rabbets, lugs, and brackets so the work can be assembled in a neat and substantial manner.
5. Drill metalwork and countersink holes as required for attaching hardware or other materials.
6. Fit and assemble in largest practical sections for delivery to site.
7. Weld connections and grind exposed welds smooth.
    a. Miter corners.
    b. When required to be watertight, make welds continuous.
8. Use fasteners as shown, scheduled or required by the application.
9. Provide cutouts, fittings, and anchors as required to coordinate assembly and installation with other work.
    a. Provide anchors, welded to trim, (if required).
    b. Space 6 inches from ends or corners and 24 inches on center typically, unless otherwise indicated.

B. Welding

1. Comply with AWS D1.1 or AWS D1.2, depending on the type of material being welded.

2. Use either A-233 Class E70 series electrodes or submerged arc Grade AWS-2.

3. Thoroughly wire-brush steel before fabrication to remove scale and rust.

4. Straighten by approved methods that will not injure the materials being worked.

5. Use continuous welding along the entire line of contact except where tack or intermittent welding is permitted. Where exposed, clean welds of flux and slag and grind smooth.

6. Use welders who are currently qualified as prescribed by AWS D1.1 and AWS D1.2.

3.02 INSTALLATION

A. General

1. Install miscellaneous metal and appurtenances in accordance with the instructions of the manufacturer and in accordance with the Contract Documents.

a. Comply with the AISC Specification for the Design, Fabrication and Erection of Structural Steel for Buildings and the AISC Code of Standard Practice for Steel Buildings and Bridges, where applicable.

1) Provide additional shims, washers, anchors, and corrective work as required to ensure that installation is firm, tight, anchored, in true alignment with neat fits, without distortions, unsightly fastenings, raw edges or protrusions.

2) Touch up damaged painted areas and field coat at connecting ends as required, using same paint as shop paint. Touch up galvanized items with zinc dust coating.

2. Install plumb or level, accurately fitted, and free from distortion or defects.

3. Install rigid, substantial, and neat in appearance.

4. Erect steel in accordance with applicable portions of AISC Code of Standard Practice, except as modified herein.

5. Allow for erection loads and provide temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.

6. Field weld components indicated. Perform field welding in accordance with AWS D1.1-92.

7. Obtain Authority’s project manager or designee approval prior to site cutting or making adjustments not scheduled.

8. Apply primer or galvanize coating to welds, abrasions, and surfaces not in contact with concrete after erection.

9. Apply anti-seize lubricant to the threads of all stainless steel bolts prior to installation.

    a. Use lubricant with substantial amounts of molybdenum disulfide, graphite, mica, talc, and copper.

    b. Use products manufactured by Permatex, Loc-Tite, or equal.

B. Erection Tolerances

1. Maximum Variation from Plumb: 1/4 inch per story, noncumulative.

2. Maximum Offset from True Alignment: 1/4 inch

C. Aluminum

1. Erect in accordance with the Aluminum Association specifications.

2. Do not remove mill markings from concealed surfaces.

3. After installed material has been inspected and approved, remove inked or painted identification marks from exposed surfaces not otherwise coated.

D. Pipe Sleeves

1. Provide where shown on the drawings and where pipes pass through masonry.

    a. May drill holes in lieu of sleeves in existing concrete walls.

    b. Provide a center flange for water stoppage on sleeves in exterior or water-bearing walls.

2. Use a modular mechanical seal to form a watertight seal in the annular space between pipes and sleeves.

E. Safety Chain

1. Install quick links with anti-seize lubricant at mating threads.

2. Install eye bolts with load applied to plane of eye.

3. Do not use safety chains or accessories for overhead lifting or dynamic loading conditions.

F. Non-slip stair nosings

1. Provide at the top of the stairs, in the concrete stair treads and at door sills.

2. Install flush with the finished surfaces.

G. Railing Installation

1. Expansion Joints

    a. Space at maximum interval of 54 feet on center.

        1) Locate joints within 12 inches of posts.

2) Provide at structural joints. Locate expansion joints in rails that span expansion joints in structural walls and floors supporting the posts.

b. Use slip joint with internal sleeve.

1) Extend 2 inches beyond each side of joint.

2) Provide 1/2-inch gap to allow for expansion.

c. Fasten to one side using 3/8-inch-diameter setscrew. Place setscrew at bottom of pipe.

2. Surface Mounting

a. Bolt post baseplate connectors firmly in place.

b. Use of shims, wedges, grout, and similar devices for handrail post alignment not permitted.

3. Posts and Rails

a. Set posts plumb and aligned to within 1/8 inch in 12 feet.

b. Set rails horizontal or parallel to slope of steps to within 1/8 inch in 12 feet.

c. Install posts and rails in same plane.

1) Remove projections or irregularities and provide a smooth surface for sliding hands continuously along top rail.

2) Use offset rail on stairs and platforms if post is attached to web of stringers or structural platform supports.

d. Support 1 1/2-inch rails directly above stairway stringers with offset fittings.

4. Handrail Wall Brackets

a. Support wall rails on brackets

1) Space at maximum 6 feet on centers for steel

2) Space at maximum 5 feet on centers for aluminum

3) Measure spacing on the horizontal projection.

b. Install wall anchor backing plates on solid blocking in stud walls.

5. Toeboard

a. Provide at all handrails except where 4-inch or higher concrete curbs are installed or at gates.

b. Accurately measure in field for correct length. Cut and secure to posts after handrail post installation.

c. Dimension between bottom of toeboard and walking surface not to exceed 1/4 inch.

d. Aluminum Toeboards: Provide expansion and contraction connections between each post.

6. Cleaning

a. Wash railing system thoroughly using clean water and soap. Rinse with clean water.

b. Do not use acid solution, steel wool, or other harsh abrasive.

c. If stain remains after washing, restore in accordance with manufacturer's or fabricators recommendations, or replace stained handrails.

7. Prefabricated Railings

a. Provide railing posts longer than needed and field cut to exact dimensions required.

1) Install railing with a base that provides plus or minus 1/4-inch vertical adjustment inside the base fitting.

2) If field adjustment exceeds plus or minus 1/4 inch, adjust the post length.

b. Modifications to structure where handrail is attached are not permitted.

c. Mount handrails only on completed walls. Do not support handrails temporarily by means not satisfying structural performance requirements.

H. Concrete Anchoring Systems

1. Begin installation only after concrete or masonry receiving anchors has attained design strength.

2. Do not install an anchor closer than six (6) times its diameter to either an edge of concrete or masonry, or to another anchor, unless specifically shown otherwise.

3. Install in accordance with manufacturer's specific quality control submittal instructions.

a. Hole diameters are critical to installation.

b. Use only drills recommended by anchor manufacturer.

c. Follow manufacturer's safe handling instructions.

4. Epoxy Anchors: Do not install when temperature of concrete is below 35 degrees F or above 110 degrees F.

I. Where titanium equipment is in contact with concrete or dissimilar metals, provide full-face neoprene insulation gasket.

1. Use 3/32-inch minimum thickness

2. Provide 70 durometer hardness.

3.03 FIELD PAINTING

A. Field prepare and paint required surfaces as specified in Section 09900.

B. Electrolytic Protection for Aluminum

1. Where in contact with dissimilar metals, or embedded in masonry or concrete, protect surfaces as specified in Section 09900 – Painting, System No. 27.
2. Allow paint to dry before installation of the material.
3. Protect painted surfaces during installation.
4. Should coating become marred, prepare and touch up in accordance with paint manufacturer's written instructions.

END OF SECTION

SECTION 05530

ANCHOR BOLTS AND EXPANSION ANCHORS

PART 1: GENERAL

1.01 DESCRIPTION

A. Provide expansion anchors and adhesive anchor bolts or rods for mechanical equipment as detailed on the Drawings.

B. Provide AISI Type 316 adhesive anchors to attach or anchor ladders, handrails, stairs ships ladders and structural steel shapes to hardened concrete in concealed wet wells or other highly corrosive areas.

C. Provide expansion and adhesive anchors to attach or anchor ladders, handrails, stairs, ships ladders and structural steel shapes to hardened concrete or masonry as detailed on the drawings.

1.02 QUALITY ASSURANCE

A. Engage an experienced Installer who has completed installation similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.

B. Comply with the applicable standard including, but not limited to the latest edition of the following:

1. American Society for Testing and Materials (ASTM)
    a. F593 Standard Specification for Stainless Steel Bolts, hex Cap Screws, and Studs.
    b. F594 Standard Specification for Stainless Steel Nuts.
2. Federal Specification
    a. FF-S-325 Shield, Expansion; Nail Expansion; and Nail, Drive Screw (Devices, Anchoring, Masonry).
3. Manual of Steel Construction (AISC)

1.03 SUBMITTALS

A. Comply with Section 01300 Submittals. Include the following information:

1. Include manufacturer’s catalog information.
    a. Specifications
    b. Complete bill of materials that identifies all materials of construction.
    c. Cut sheets
2. Special shipping, storage, protection, and handling instructions.
3. Manufacturer’s installation instructions.

B. Submit compliance certificates for specified tests in accordance with Section 01400.

C. Submit certified test reports in accordance with Section 01400.

D. Submit manufacturer's certificates in accordance with the Sections 01300 Submittals and 01400.

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver, handle, and store the equipment in accordance with Section 01600.

B. Protect from deterioration or damage.

PART 2: PRODUCTS

2.01 MATERIALS

A. All anchor bolts and anchor rods shall be of stainless steel meeting requirements of ASTM F593, Alloy Group I, Condition CW.

B. All nuts shall be of stainless steel meeting requirements of ASTM F594, Alloy Group I, Condition CW.

C. All washers shall meet dimensional requirements of ASTM F436. Material for washers shall be stainless steel, Type 316.

D. Expansion anchors shall meet requirements of FS FF-S-325. All expansion bolts shall be stainless steel.

1. For concrete, wedge type, Group II, Type 4, Class 1 or 2; self-drilling type, Group III, Type 1 or non-drilling type, Group VIII, Type 1 or 2

2. For masonry, lag shield type, Group II, Type 1, or split shield type, Group II, Type 3, Class 3.

E. Chemical Adhesive Anchor Systems

1. Two-component, insensitive to moisture, designed to be installed in adverse freeze/thaw environments.

2. Cure Temperature, Pot Life, and Workability: Compatible for intended use and anticipated environmental conditions.

3. Container Markings: Include manufacturer's name, product name, batch number, product expiration date, ANSI hazard classification, and appropriate ANSI handling precautions.

4. Anchor Rods: Stainless steel threaded rods, sized by adhesive manufacturer for design loads required and adhesive system used.

PART 3: EXECUTION

3.01 ANCHOR BOLT SETTING

A. Install anchor bolts after concrete or masonry has attained design strength.

B. Accurately locate and hold anchor bolts in place by templates.

C. Provide pipe sleeves for anchor bolts, when required for equipment with base-plates, to permit adjustment and grouting. Cast anchor bolts integrally with concrete. Provide pipe sleeve with an internal diameter not less than three times bolt diameter and not less than 10 bolt diameters long.

D. Install in accordance with manufacturer's specific quality control submittal instructions. Hole diameters are critical to installation, use only drills recommended by anchor manufacturer. Follow manufacturer's safe handling instructions.

3.02 ADHESIVE ANCHOR INSTALLATION

A. Drill anchor rod holes into concrete through item being supported or locate by a template. Drill all holes by a tool designed by or approved by manufacturer of anchor bolts.

B. Comply with anchor rods manufacturer’s recommendations for maximum holding power, but in no case, depth of hole be less than 4 rod diameters. Provide minimum distance between center of any anchor rod and an edge or exterior corner of concrete of not less than 6 times diameter of hole in which it is installed.

C. Do not install when temperature of concrete is below 35 degrees Fahrenheit (°F) or above 110 °F.

D. Follow specific manufacturer safe handling practices when handling and installing concrete anchors.

3.03 EXPANSION BOLT INSTALLATION

A. Drill expansion bolt holes into concrete through item being supported or locate by a template. Drill all holes by a tool designed by or approved by manufacturer of expansion anchors.

B. Comply with expansion bolt manufacturer’s recommendations for maximum holding power, but in no case shall depth of hole be less than 4 bolt diameters. Minimum distance between center of any expansion anchor and an edge or exterior corner of concrete is not less than 6 times diameter of hole in which it is installed.

END OF SECTION

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SECTION 06100

ROUGH CARPENTRY

PART 1: GENERAL

1.01 WORK INCLUDED

A. Definition: Rough carpentry includes carpentry work not specified as part of other sections and which is generally not exposed, except as otherwise indicated.

B. Types of work in this section include, but are not limited to, rough carpentry for the following:

1. Grounds
2. Nailers
3. Blocking
4. Construction Panels

C. Related Sections:

1. Architectural Woodwork is specified in Section 06400
2. Roofing is specified in Division 7 sections and drawings.
3. Toilet Accessories are specified in Section 10810.

1.02 SUBMITTALS

A. Wood Treatment Data: Submit chemical treatment manufacturer's instructions for handling, storing, installation and finishing of treated material.

B. Preservative Treatment: For each type specified, include certification by treating plant stating type of preservative solution and pressure process used, net amount of preservative retained and conformance with applicable standards.

C. For water-borne treatment, include statement that moisture content of treated materials was reduced to levels indicated prior to shipment to project site.

1.03 PROJECT HANDLING

A. Delivery and storage: Keep materials under cover and dry. Protect against exposure to weather and contact with damp or wet surfaces. Stack lumber as well as plywood and other panels; provide for air circulation within and around stacks and under temporary coverings including polyethylene and similar material.

1. For lumber and plywood pressure treated with water-borne chemicals, provide sticker between each course to provide air circulation.

1.04 PROJECT CONDITIONS

A. Coordination: Fit rough carpentry work to other work; scribe and cope as required for accurate fit. Correlate location of nailers, blocking, grounds and similar supports to allow attachment of other work.

PART 2: PRODUCTS

2.01 LUMBER, GENERAL

A. Lumber Standards: Manufacture lumber to comply with DOC PS 20 "American Softwood Lumber Standard" and with applicable grading rules of inspection agencies certified by American Lumber Standards Committee's (ALSC) Board of Review.

1. Factory mark each piece of lumber with grade stamp or grading agency

2. Provide dressed lumber, S4S, unless otherwise indicated

3. Provide dry lumber with 19 percent maximum moisture content at time of dressing for 2-inch nominal thickness or less, unless otherwise indicated.

B. Inspection Agencies: Inspection agencies and the abbreviations used to reference with lumber grades and species include the following:

1. SPIB - Southern Pine Inspection Bureau

2. WCLIB - West Coast Lumber Inspection Bureau

3. WWPA - Western Wood Products Association

C. Grade Stamps: Factory-mark each piece of lumber with grade stamp of inspection agency evidencing compliance with grading rule requirements and identifying grading agency, grade, species, moisture content at time of surfacing, and mill.

D. Nominal sizes are indicated, except as shown by detail dimensions. Provide actual sizes as required by PS 20, for moisture content specified for each use.

E. Provide dressed lumber, S4S, unless otherwise indicated.

F. Provide seasoned lumber with 19% maximum moisture content at time of dressing and shipment for sizes 2" or less in nominal thickness, unless otherwise indicated.

2.02 MISCELLANEOUS LUMBER

A. Provide all necessary wood blocking (or as directed by Architect/Engineer) to receive all architectural woodwork shelving standards, toilet accessories, sound control panels, and miscellaneous equipment panels.

B. Provide wood for support of attachment of other work including cant strips, bucks, nailers, blocking, grounds, stripping and similar members. Provide lumber of sizes indicated, worked into shapes shown, and as follows:

1. Moisture Content: 19% maximum for lumber items not specified to receive wood preservative treatment.

2. Grade: Standard Grade light framing size lumber of any species or board size lumber as required. No. 3 Common or Standard grade boards per WCLIB or WWPA rules or No. 3 boards per SPIB rules.

2.03 CONSTRUCTION PANELS

A. Construction Panel Standards: Comply with PS 1 "U.S. Product Standard for Construction and Industrial Plywood" for plywood panels and, for products not manufactured under PS 1 provisions, with American Plywood Association (APA) "Performance Standard and Policies for Structural-Use Panels", Form No. E445.

B. Trademark: Factory-mark each construction panel with APA trademark evidencing compliance with grade requirements.

C. Plywood Sheathing: Exterior, Structural 1 sheathing. Comply with “Code Plus” provisions in APA Form No. E30K, “APA Design/Construction Guide: Residential & Commercial”

D. Plywood Backing Panels: For mounting electrical or telephone equipment, provide fire-retardant treated plywood panels with grade designation, APA C-D PLUGGED INT with exterior glue, in thickness indicated, or, if not otherwise indicated, not less than l/2".

2.04 MISCELLANEOUS MATERIALS

A. Fasteners and Anchorages: Provide size, type, material and finish as indicated and as recommended by applicable standards, complying with applicable Federal Specifications for nails, staples, screws, bolts, nuts, washers and anchoring devices. Provide metal hangers and framing anchors of the size and type recommended by the manufacturer for each use including recommending nails.

B. Provide fasteners and anchorages with a hot-dip zinc coating (ASTM A 153) where rough carpentry work is exposed to weather, in ground contact, or in areas of high relative humidity.

2.05 WOOD TREATMENT BY PRESSURE PROCESS

A. Preservative Treatment: Where lumber or plywood is indicated as "P-T" or "Treated," or is specified herein to be treated, comply with applicable requirements of AWPA Standards C2 (Lumber) and C9 (Plywood) and of AWPB Standards listed below. Mark each treated item with the AWPB Quality Mark Requirements.

B. Pressure-treat aboveground items with water-borne preservatives to comply with AWPB LP-2. After treatment, kiln-dry lumber and plywood to maximum moisture content, respectively, of 19% and 15%. Treat indicated items and the following:

1. Wood nailers, curbs, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers and waterproofing.

2. Wood blocking, stripping, and similar concealed members in contact with masonry or concrete.

C. Complete fabrication of treated items prior to treatment, where possible. If cut after treatment, coat cut surfaces with heavy brush coat of same chemical used

for treatment and to comply with AWPA M4. Inspect each piece of lumber or plywood after drying and discard damaged or defective pieces.

PART 3: EXECUTION

3.01 INSTALLATION, GENERAL

A. Discard units of material with defects which might impair quality of work, and units which are too small to use in fabricating work with minimum joints or optimum joint arrangement.

B. Set carpentry work to required levels and lines, with members plumb and true to line and cut and fitted.

C. Securely attach carpentry work to substrate by anchoring and fastening as shown and as required by recognized standards. Countersink nail heads on exposed carpentry work and fill holes.

D. Use non-corrosive common wire nails, except as otherwise indicated. Use non-corrosive finishing nails for finish work. Select fasteners of size that will not penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting of wood. Pre-drill as required.

3.02 WOOD GROUNDS, NAILERS AND BLOCKING

A. Provide wherever shown and where required for screeding or attachment of other work. Form to shapes as shown and cut as required for true line and level of work to be attached. Coordinate location with other work involved.

B. Attach to substrates as required to support applied loading. Countersink bolts and nuts flush with surfaces, unless otherwise indicated.

1. Build into masonry during installation of masonry work.

2. Where possible, anchor to formwork before concrete placement.

C. Provide permanent grounds of dressed, preservative treated, key-beveled lumber not less than 1½" wide and of thickness required to bring face of ground to exact thickness of finish material involved. Remove temporary grounds when no longer required.

3.03 INSTALLATION OF CONSTRUCTION PANELS

A. General: Comply with applicable recommendations contained in Form No. E 30D, "APA Design/Construction Guide - Residential & Commercial," for types of construction panels and applications indicated. Screw to supports.

END OF SECTION

SECTION 06410

LAMINATE-CLAD WOOD CABINETS

PART 1: GENERAL

1.01 WORK INCLUDED

A. Work associated with Laminate-Clad Wood Cabinets includes, but is not limited to, the following:

1. Casework (sink cabinets, base and wall cabinets with adjustable shelves)
2. Counter Tops and Backsplashes
3. Adjustable Shelving
4. Hardware for casework, including pulls and magnetic catches
5. Plastic laminate
6. Sealant
7. Miscellaneous woodwork specialties

1.02 RELATED WORK

A. Rough carpentry is specified in Section 06100

B. Joint sealants are further specified in Section 07920

C. Finish Hardware is specified in Section 08710

D. Tempered glass for sliding glass doors is specified in Section 08810

E. Mechanical and Electrical Work are specified in Divisions 15 and 16 respectively.

1.03 SUBMITTALS

A. Shop Drawings: Submit complete shop drawings on all items showing details, materials, location in the building, and installation requirements.

B. Brochures: Submit manufacturer's descriptive literature of all items not fabricated by the woodwork manufacturer.

C. Samples: Submit samples of plastic laminate, wood veneer, melamine, and solid acrylic components from manufacturer's standard colors for color selection by the Architect/Engineer.

1.04 QUALITY ASSURANCE

A. "Quality Standards" of the Architectural Woodwork Institute shall apply and by reference are made a part of this specification.

B. All work shall conform to "Custom" grade as defined in the latest edition of the AWI "Quality Standards" unless detailed on the drawings (or specified) as a higher grade.

C. Quality Standard: Unless otherwise indicated, comply with WIC's "Manual of Millwork" for grades of interior architectural woodwork, construction, finishes, and other requirements.

1. Provide WIC-certified compliance certificate indicating that woodwork complies with requirements of grades specified.

2. Provide WIC-certified compliance certificate for installation.

D. Competence: The approved woodwork manufacturer must have a reputation for doing satisfactory work on time and shall have completed comparable work.

E. Single Source Responsibility: Provide woodwork with tops manufactured or furnished by same woodwork manufacturer for single responsibility.

1.05 DELIVERY, STORAGE AND HANDLING

A. Protect Woodwork during transit, delivery, storage and handling to prevent damage, soiling and deterioration.

B. Do not deliver woodwork until painting, wet work, grinding and similar operations which could damage, soil or deteriorate woodwork have been completed in installation areas. If due to unforeseen circumstances woodwork must be stored in other than installation areas, store only in areas meeting requirements specified for installation areas.

1.06 FIELD DIMENSIONS

A. Contractor is responsible for all details and dimensions not controlled by job conditions.

B. Show all required field measurements on shop drawings.

PART 2: PRODUCTS

2.01 WOOD

A. Plywood: substrate of natural birch veneer core plywood.

B. Hardwood: Grade I, Kiln-dried to 6-12% moisture content at fabrication.

C. Select for stability, configuration and strength.

D. Backer Board: Hardboard; ¼-inch thick complying with AHA A135.4.

2.02 LAMINATED PLASTIC

A. All laminated plastic shall meet requirements of NEMA LD3.

1. Material Thicknesses:

a. Exposed Exterior Vertical: 0.030 inch.

b. Exposed Interior Surfaces (including backs of doors): 0.020 inch.

c. Toe Space Base (Black): 0.030 inch.

d. Counter Top Horizontal Surfaces and Edges: 0.050 inch.

e. Backsplash Vertical Surfaces and Edges: 0.050 inch.

f. Drawer Fronts: 0.050 inch.

2. Acceptable Manufacturers:

a. Formica Brand

b. Wilson Art

c. Laminart

B. Melamine: Phenolic overlay applied with 200 psi at 200 degrees Fahrenheit. Provide on shelves and casework interiors unless otherwise indicated on the Drawings.

2.03 COUNTERTOPS

A. Plastic Laminate Countertops: Provide plastic laminate surfaced plywood countertops with backsplashes where shown at breakroom and as scheduled on the Drawings.

B. Chemical Resistant Plastic Laminate Countertops: Provide chemical resistant plastic laminate surfaced plywood countertops with backsplashes where shown at Lab Room and as scheduled on the Drawings.

2.04 HARDWARE

A. Hinges for 3/4" Thick Doors: Brushed chrome-plated steel, five knuckle 0.088 gage, wrap-around type allowing 270 degree swing at end of casework unit mounted with minimum four, plated #8 self-taping screws per hinge leaf. For doors up to and including 48 inches high, provide two hinges.

B. Pulls: Surface-mounted type, Stanley #4484-US26D, Epco #MC-402-US26D, or equivalent.

C. Door Catches: For doors up to and including 38 inches high provide one heavy-duty magnetic type catch, slotted for adjustment. Attach with screws.

D. Surface Bolts: Provide for inactive doors in cabinet door pairs with locks from one of the following:

1. Ives #40 x US26D x 6 inches.

2. Quality #B-6 x US26D x 6 inches.

3. Baldwin #0324 x US26D x 6 inches.

E. End Supported Shelf Standards: KV #255 AL secured with No.5 flathead screw in place of the manufacturer's standard screw/nail, or Stanley #1805 unfinished.

F. Shelf End Support Clips: Zinc-plated as manufactured by KV #256ZC or Stanley #1806-US2C.

G. Fasteners and Anchors: Wall or floor anchors, screws for joining adjacent cabinets and top fasteners.

H. Sealant: General Electric Silicone Sealant or equivalent. Refer to Section "Joint Sealants" for other requirements.

2.05 FABRICATION

A. Details shall conform to AWI (full overlay design) and or as shown on drawings. Omit dust covers.

B. Base Cabinets:

1. Backs: 1/4-inch-thick plywood, plastic laminate finish.

2. Sides: Finished exposed end panels to cabinet assemblies in field consisting of an applied 3/4-inch thick end panel with high pressure plastic laminating. Finish as follows:

a. Interior Faces of Doors: Melamine

b. Exposed Exterior End, Front Faces and Interiors: Plastic Laminate.

c. Unexposed Exterior End: Melamine

3. Bases: Provide each base cabinet with its own unit base, factory applied. Continuous bases are not acceptable.

C. Counter Tops and Backsplashes: Plywood, minimum 3/4-inch thick construction. Finishes as follows:

1. Countertop Horizontal Surface: Plastic laminate, and Chemical Resistant plastic laminate as shown on drawings.

2. Backsplash Vertical Surface: Plastic laminate to match laminate selected for horizontal surface.

3. Exposed Edges: Plastic laminate.

4. Backing Sheet: Plastic laminate.

D. Wall Cabinets:

1. Construction: Similar to base cabinets.

2. Sides, top and bottom faces, front faces, exposed ends and underside of bottom plastic laminate.

3. Back faces and all interior faces: melamine

4. Recessed tops and bottoms are not acceptable.

5. Clear openings for wall cabinets: As indicated on the Drawings.

E. Doors: Base Cabinets: 3/4-inch thick particleboard with plastic laminate finish on outside face and melamine on interior face; swing hinged, full overlap type.

F. Leveling Devices: Furnish each base cabinet with a minimum of four approved, easily accessible, adjustable leveling devices so designed to easily allow the Owner’s re-adjustment of the casework to achieve proper operation of doors and drawers after warranty period.

G. Adjustable Shelves: All exposed surfaces faced with melamine; provide notched ends on shelves to fit around adjustable shelf standards.

PART 3: EXECUTION

3.01 INSTALLATION

A. Coordinate, locate, and install wood grounds and back bracings in wall construction prior to installation of casework items.

B. Rough-in: Provide holes in casework for plumbing and electrical work using templates furnished by supplier of plumbing fixtures and electrical devices.

1. Neatly cut and accurately coordinate locations and dimensions with other trades.

2. Provide access panels where necessary.

C. Install casework plumb, level, true and straight with no distortions. Shim as required using concealed shims. Where casework abuts other finished work, scribe and cut for accurate fit. Provide filler strips, scribe strips and moldings as required, and in finish to match casework face.

D. Anchor casework securely in place with concealed (when doors and drawers are closed) fasteners, anchored into structural support members of wall construction. Comply with manufacturer's instructions for support of units.

E. Securely attach countertops to base units. Spline and glue joints in countertops; provide concealed mechanical clamping of joint. Smooth cut edges and coat with waterproof coating or adhesive.

F. Complete hardware installation and adjust doors and drawers for proper alignment and smooth operation.

3.02 CLEANING AND PROTECTION

A. Repair or remove and replace defective work as directed upon completion of installation.

B. Clean exposed and semi-exposed surfaces, touch-up finish as required. Remove and refinish damaged or soiled areas.

C. Protection: Provide final protection and maintain conditions necessary to ensure that work will be without damage or deterioration at time of acceptance.

END OF SECTION

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SECTION 07165

VAPOR BARRIERS

PART 1: GENERAL

1.01 SCOPE OF WORK

A. Provide vapor barriers under all floor slabs, concrete pads, and at other locations shown on the Drawings.

PART 2: PRODUCTS

2.01 MATERIALS

A. Vapor barrier shall be a minimum of 10 mil polyethylene film, or equivalent product as approved by the Architect/Engineer

B. Joint adhesive tape shall be compatible with the vapor barrier material and as approved by the Architect/Engineer

PART 3: EXECUTION

3.01 JOB CONDITIONS

A. Proceed with vapor barrier work only after substrate construction and penetrating work have been completed.

3.02 PREPARATION OF SUBSTRATE

A. Examine the substrate and the conditions under which vapor barrier work is to be performed. Do not proceed with the work until unsatisfactory conditions have been corrected.

B. Under structures for occupancy, soil treatment work shall be completed just prior to installation of vapor barrier.

3.03 APPLICATION

A. Vapor barrier shall be applied parallel with direction of concrete pour, lapping adjacent sides and ends a minimum of 6 inches.

B. Seal all joints in vapor barrier with continuous approved 2-inch-wide plastic tape.

END OF SECTION

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SECTION 07210

BUILDING INSULATION

PART 1: GENERAL

1.01 WORK INCLUDED

A. Extent of each type of building insulation work is shown on the drawings.

B. Applications of building insulation include, but are not limited to, the following:

1. Glass-fiber insulation at exterior walls and soffits.

2. Extruded polystyrene board insulation where rigid exterior wall insulation is indicated on the Drawings.

3. Mineral fiber (acoustical) insulation blankets.

1.02 RELATED WORK

A. Gypsum board partitions to receive acoustical insulation are specified in Section 09260.

1.03 QUALITY ASSURANCE

A. Fire Ratings: Comply with fire-resistance and flammability ratings as shown and specified. Comply with governing codes and regulations.

B. Thermal Conductivity: The thickness shown for each material is for the thermal conductivity, k-value at 75 degrees Fahrenheit (°F), specified for each material. Provide adjusted thickness as directed for the equivalent use of material having a different thermal conductivity.

1.04 SUBMITTALS

A. Manufacturer's Data: Submit manufacturer's specifications and installation instructions for each type of insulation required. Include data substantiating that materials comply with specified requirements.

1.05 PRODUCT HANDLING

A. Protection from Deterioration: Do not allow insulation materials to become wet or soiled. Comply with manufacturer's recommendations for handling, storage and protection during installation. Protect plastic insulation from exposure to sunlight.

B. Deliver insulation materials in their original unopened packages and store in an enclosed shelter providing protection from damage and exposure to the elements. Damaged or deteriorated materials shall be removed from the premises.

C. Mineral fiber blankets shall be delivered in their original unopened packages and stored in an enclosed shelter providing protection from damage and exposure to the elements. Damaged or deteriorated materials shall be removed from the premises.

1.06 JOB CONDITIONS

A. Examination of Substrate: Examine the substrate and the conditions under which the insulation work is to be performed. Do not proceed with the insulation work until unsatisfactory conditions have been corrected.

PART 2: PRODUCTS

2.01 MATERIALS

A. Glass-Fiber Board Insulation: Unfaced, Flexible Glass-Fiber Board Insulation: ASTM C 612, Type IA; ASTM C 553, Types I, II, and III; or ASTM C 665, Type I; with maximum flame-spread and smoke-developed indices of 25 and 50, respectively; and of the following properties

1. Thickness as indicated or as required to yield the "R" values as indicated or required by the Florida Building Code, latest Edition including all amendments. Provide in manufacturer's standard lengths and widths as needed to coordinate with structural elements of spaces to be insulated

2. Nominal density of 1.0 lb./cu. ft., thermal resistivity of 3.7 °F x h x sq. ft./Btu x in. at 75 °F.

3. Nominal density of not less than 1.5 lb./cu. ft. nor more than 1.7 lb./cu. ft thermal resistivity of 4 °F x h x sq. ft./Btu x in. at 75 °F.

4. Combustion Characteristics: Passes ASTM E 136.

B. Extruded-Polystyrene Board Insulation: ASTM C 578, Type as required to achieve a minimum insulating value of R-11 for thickness indicated, with maximum flame-spread and smoke-developed indices of 75 and 450, respectively.

C. Sound Insulation: Mineral fiber blanket, surfaced, equal to U.S. Gypsum "Thermafiber Sound Attenuation Blanket", or Manville "Sound Attenuation Blankets". Provide in thickness as indicated on the Drawings.

D. Mechanical Anchors: Where required, type and size shown or, if not shown, as recommended by the insulation manufacturer for the type of application shown and condition of substrate.

PART 3: EXECUTION

3.01 INSTALLATION

A. General: Comply with manufacturer's instructions for the particular conditions of installation in each case including method of support or anchorage to the substrate as appropriate for each application indicated. If printed instructions are not available, or do not apply to the project conditions, consult the manufacturer's technical representative for specific recommendations before proceeding with the work.

B. Extend insulation full thickness as shown over entire surface to be insulated. Cut and fit tightly around obstructions and fill voids with insulation.

C. Apply a single layer of insulation of the thickness indicated, or the required thickness for the thermal value indicated, unless otherwise shown or required to make-up the total thickness.

D. Sound Insulation: Install prior to gypsum board application in accordance with manufacturer's printed installation instructions.

END OF SECTION

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SECTION 07620

SHEET METAL FLASHING AND TRIM

PART 1: GENERAL

1.01 WORK INCLUDED

A. Work of this section includes, but is not limited to, parapet cap flashings, two-piece spring-lock counter flashing; miscellaneous sheet metal accessories, trim and associated fasteners.

B. All fabrications shall be of stainless steel unless indicated otherwise on the Drawings.

C. Related Work:

1. Rough carpentry is specified in Section 06100.
2. Metal roofing is specified in on drawings.
3. Roof penetration seals are specified in Section 07700.
4. Joint sealers are specified in Section 07920.
5. Plumbing work associated with flashing for roof drains is specified on drawings.

1.02 SUBMITTALS

A. Submit shop drawings showing assembly, erection, and installation methods for all flashing items indicated on the Drawings.

B. Submit fabricators standard details, and installation manuals.

1.03 QUALITY ASSURANCE

A. All flashing and sheet metal shall be fabricated and installed in accordance with SMACNA latest standard.

1.04 WARRANTY

A. Furnish Owner a five (5) year warranty covering materials and workmanship for all flashing work in conjunction with warranty of roofing system.

B. Warranty shall cover watertight integrity of flashing work including repair and replacement of components or systems that are deemed faulty or in disrepair by the Owner during warranty period. Items deemed faulty or in disrepair shall be repaired or replaced at no cost to the Owner.

C. Definition of faulty components or system in disrepair includes, but is not limited to the following:

1. Defects in manufacture and installation
2. Defects in materials

3. Leaks of any kind

PART 2: PRODUCTS

2.01 MATERIALS

A. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304, No. 2D finish.

B. Lead: ASTM B 749, Type L51121, copper-bearing sheet lead, minimum 4 pounds per square foot (0.0625-inch thick), except not less than 6 pounds per square foot (0.0937-inch thick) for welding.

C. Solder: ASTM B32, Sn 50

2.02 MISCELLANEOUS MATERIALS AND ACCESSORIES:

A. General: Provide materials and types of fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation.

B. Felt Underlayment: ASTM D 226, Type II (No. 30), asphalt-saturated organic felt, non-perforated. Slip Sheet: Rosin-sized paper, minimum 3-lb/100 sq. ft.

C. Sealing Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealing tape with release-paper backing. Provide permanently elastic, non-sag, nontoxic, non-staining tape.

D. Elastomeric Sealant: ASTM C 920, silicone polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.

E. Fasteners: Same metal as flashing and sheet metal or, other non-corrosive metal as recommended by sheet manufacturer. Match finish of exposed heads with material being fastened. Types: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads.

1. Exposed Fasteners: Heads matching color of sheet metal by means of plastic caps or factory-applied coating.

2. Fasteners for Flashing and Trim: Blind fasteners or self-drilling screws, gasketed, with hex washer head.

3. Blind Fasteners: High-strength aluminum or stainless-steel rivets.

F. Bituminous Coating: FS TT-C-494 or SSPC – Paint 12, solvent type bituminous mastic, nominally free of sulfur, compounded for 15-mil dry film thickness per coat.

G. Mastic Sealant: Polyisobutylene; non-hardening, non-skinning, non-drying, non-migrating sealant.

H. Epoxy Seam Sealer: 2-part non-corrosive metal seam cementing compound recommended by metal manufacturer for exterior non-moving joints.

I. Adhesives: Type recommended by flashing sheet manufacturer for waterproof/ weather-resistant seaming.

J. Metal Accessories: Provide sheet metal clips, straps, anchoring devices and similar accessory units as required for installation of work, matching or compatible with material being installed, non-corrosive, size and gauge required for performance.

K. Elastic Flashing Filler: Closed-cell polyethylene or other soft closed-cell material recommended by flashing manufacturer as filler for expansion joints to ensure movement with minimum stress on flashing sheet.

L. Roofing Cement: ASTM D 2822, asphaltic.

2.03 REGLETS, COUTERFLASHING AND COPINGS

A. General: Provide units of type, metal and profile indicated, compatible with flashing.

1. Form reglets to securely interlock with counter flashings

2. Copings shall have shop-fabricated corners. Include anchor plates formed from at least 0.028-inch thick, stainless steel sheet; cleats or other attachment devices; concealed splice plates; and trim and other accessories required for complete installation with no exposed fasteners.

B. Reglets: Units of type, material, and profile indicated, non-corrosive, with factory-mitered and welded corners and junctions, and formed to provide secure interlocking of separate reglet, wind-resistant clips, and spring-lock counter flashing pieces.

1. Provide reglets as manufactured by Cheney Flashing Company, Hickman, or Fry Reglet

2. Material: Stainless steel, 0.0187 thick

C. Copings: Formed-stainless steel copings, minimum 0.063-inch thick, unless otherwise indicated as manufactured by Cheney Flashing Company, Hickman, Architectural Products, Co., or equivalent manufacturer that can meet specified requirements.

2.04 FABRICATED UNITS

A. General Metal Fabrication: Shop-fabricate work to greatest extent possible. Comply with details shown, and with applicable requirements of SMACNA "Architectural Sheet Metal Manual" and other recognized industry practices.

1. Fabricate for waterproof and weather-resistant performance; with expansion provisions for running work, sufficient to permanently prevent leakage, damage or deterioration of the work. Form work to fit substrates.

2. Comply with material manufacturer instructions and recommendations for forming material.

3. Form exposed sheet metal work without excessive oil-canning, buckling and tool marks, true to line and levels indicated with exposed edges folded back to form hems.

B. Seams: Fabricate non-moving seams in sheet metal with flat-lock seams. Tin edges to be seamed, form seams, and solder.

C. Expansion Provisions: Where lapped or bayonet-type expansion provisions in work cannot be used, or would not be sufficiently water/weatherproof, form expansion joints of intermeshing hooked flanges, not less than 1" deep, filled with mastic sealant (concealed within joints).

D. Sealant Joints: Where movable, non-expansion type joints are indicated or required for proper performance of work, form metal to provide for proper installation of elastomeric sealant, in compliant with SMACNA standards.

E. Separations: Provide for separation of metal from non-compatible metal or corrosive substrates by coating concealed surfaces at locations of contact, with bituminous coating or other permanent separation as recommended by manufacturer/fabricator.

PART 3: EXECUTION

3.01 INSPECTION

A. Examine substrates adjoining construction and conditions under which Work is to be installed.

B. Do not proceed with the Work until unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. General: Comply with SMACNA requirements unless indicated otherwise.

1. Refer to Section 07920, Joint Sealers, for sealant installation.

2. Do not proceed with Work until curb and substrate construction is completed.

B. Forming:

1. Accurately reproduce profiles and bends.

2. Make intersections sharp, even, and true.

3. Make plain surfaces free from buckles and waves with minimal joints.

4. Reinforce Work as required for strength and appearance.

5. Bend to minimum radius recommended by manufacturer with radius not less than metal thickness.

C. Application:

1. Make joints tight.

2. Conceal nails and fasteners where possible.

3. Do not use face nailing on exposed surfaces.
4. Secure exposed edges to underlying materials using clips or tab-edge strips.
5. Make seams in direction of water flow.
6. Hem exposed edges 1/2 inch.
7. Perform cutting, fitting, punching for related work and provide necessary accessories.

D. Flashing:

1. Install to provide watertight protection as detailed.
2. Use cap, and two-piece snap-in counter type flashing where indicated.
3. Extend minimum 4 inches around corners.
4. Solder watertight three-way angles at corners.
5. Nail maximum 3 inch on centers unless clips or cleats are used.
6. Make continuous straight runs in maximum 24-foot lengths except where manufacturer has more stringent requirements.

E. Vent Pipe Flashing:

1. Flash and make watertight at roof with sheet lead flashing.
2. Extend minimum 8 inches from pipes in all directions and to top of vent pipe turning down into pipes.
3. Exercise extreme care to prevent rupturing flashing when turning into pipe and form to lay flat against interior of pipe to prevent blockage.

F. Separate dissimilar metals by painting with SSPC Paint 12 bituminous mastic or by using bitumen saturated and coated felt.

G. Specific Items: Refer to SMACNA Architectural Sheet Metal Specifications and comply with details indicated on Drawings.

H. Install reglets to receive counter-flashing in manner and by methods indicated. Where shown in concrete, furnish reglets to trades of concrete work for installation. Where shown in masonry, furnish reglets to trades of masonry work, for installation as work of Division-4 sections or as specified on the Drawings.

I. Install counter-flashing in reglets, by spring-loaded, snap-in seal arrangement.

J. Install copings in accordance with manufacturer’s published instructions.

K. Pipe Flashing: Install flashing at all vent stack penetrations. Set in roofing cement and extend a minimum of 4" over roofing. Nail and cover with two plies of felt stripping.

3.03 CLEANING AND PROTECTION

A. Clean exposed metal surfaces, removing substances that might cause corrosion of metal or deterioration of finishes.

B. Protection: Protect flashing and sheet metal work during construction, to ensure that work will be without damage or deterioration, other than natural weathering, at time of Substantial Completion.

END OF SECTION

SECTION 07700

ROOF ACCESSORIES

PART 1: GENERAL

1.01 WORK INCLUDED

A. Work of this Section includes, but is not limited to, the following:

1. Equipment supports.
2. Roof penetration seals.

B. Related Work:

1. Rough carpentry is specified in Section 06100.
2. Joint sealers are specified in Section 07920.
3. Mechanical equipment and penetrations per drawings.

1.02 SUBMITTALS

A. Product Data: For each product indicated.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other Work.

C. Coordination Drawings: Roof plans drawn to scale and coordinating penetrations and roof-mounted items.

D. Samples: For each exposed finish.

1.03 QUALITY ASSURANCE

A. Standards: Comply with the following:

1. SMACNA's "Architectural Sheet Metal Manual" details for fabrication of units, including flanges and cap flashing to coordinate with type of roofing indicated.
2. NRCA's "Roofing and Waterproofing Manual" details for installing units.

PART 2: PRODUCTS

2.01 MATERIALS

A. Aluminum:

1. Sheet, ASTM B 209 for alclad alloy 3005H25 or alloy and temper required to suit forming operations, with mill finish, unless otherwise indicated.
2. Extrusions: ASTM B 221 alloy 6063-T52 or alloy and temper required to suit structural and finish requirements, with mill finish, unless otherwise indicated.

B. Wood Nailers: Softwood lumber, pressure treated with waterborne preservatives for aboveground use, complying with AWPA C2, not less than 1-1/2 inches thick.

C. Fasteners: Same metal as metals being fastened, or nonmagnetic stainless steel or other non-corrosive metal as recommended by manufacturer. Match finish of exposed fasteners with finish of material being fastened.

D. Gaskets: Manufacturer's standard tubular or fingered design of neoprene, EPDM, or PVC; or flat design of foam rubber, sponge neoprene, or cork.

E. Bituminous Coating: SSPC-Paint 12, solvent-type bituminous mastic, nominally free of sulfur and containing no asbestos fibers, compounded for 15-mil dry film thickness per coating.

F. Mastic Sealant: Polyisobutylene, non-hardening, non-skinning, nondrying, non-migrating sealant.

G. Elastomeric Sealant: Recommended by unit manufacturer that is compatible with joint surfaces; ASTM C 920, Type S, Grade NS, Class 25.

H. Roofing Cement: ASTM D 4586, non-asbestos, fibrated asphalt cement designed for trowel application or other adhesive compatible with roofing system.

2.02 EQUIPMENT SUPPORTS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Custom Curb, Inc.

2. ThyCurb, Inc.

3. Uni-Curb, Inc.

B. General: Units capable of supporting superimposed live and dead loads, including equipment loads and other construction to be supported. Coordinate dimensions with equipment to be supported.

C. Provide preservative-treated wood nailers at tops of units and formed flange at perimeter bottom for mounting to roof.

D. Fabricate units to minimum height of 8 inches unless otherwise indicated. Where slope of roof deck exceeds 1/4 inch per foot fabricate support units with height tapered to match slope to level tops of units.

E. Equipment Supports: Capable of supporting superimposed live and dead loads including equipment loads and other construction to be supported. Coordinate dimensions with equipment to be supported. Unless otherwise indicated or required for strength, fabricate units from minimum 0.063-inch-thick, sheet aluminum with welded corner joints.

2.03 PENETRATION SEALS

A. Provide penetration seals composed of either black structural urethane or polymer-modified cement.

B. Penetration seal components shall have the capability of forming round, oval, square, or rectangular shaped seals.

C. Accessory Materials:

1. Two-component urethane pourable, self-leveling sealant.

2. Manufacturer's structural grade sealant, self-fixturing, moisture-curing mastic.

D. Acceptable Manufacturer: ChemCurb System as manufactured by Chem Link, or equivalent.

PART 3: EXECUTION

3.01 INSTALLATION

A. General: Coordinate installation of roof accessories with installation of roof deck, roof insulation, flashing, roofing membranes, penetrations, equipment, and other construction to ensure that combined elements are waterproof and weather-tight. Anchor roof accessories securely to supporting structural substrates so they are capable of withstanding lateral and thermal stresses, and inward and outward loading pressures.

B. Install roof accessory items according to construction details in NRCA's "Roofing and Waterproofing Manual", unless otherwise indicated,

C. Separation: Separate metal from incompatible metal or corrosive substrates, including wood, by coating concealed surfaces, at locations of contact, with bituminous coating or providing other permanent separation.

D. Flange Seals: Set flanges of accessory units in a thick bed of roofing cement to form seal, unless indicated otherwise.

E. Cap Flashing: Where required as component of accessory, install cap flashing to provide waterproof overlap with roofing or roof flashing (as counterflashing). Seal overlap with thick bead of mastic sealant.

F. Penetration Seals: Install in accordance with manufacturer's published instructions.

1. Bond the penetration seal components firmly in place around the roof penetration and seal with structural sealant.

2. Seal the interior of the penetration seal curb with 2-inches of pourable, self-leveling urethane sealant.

G. Clean exposed surfaces according to manufacturer's written instructions. Touch up damaged metal coatings.

END OF SECTION

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SECTION 07840

FIRESTOPPING

PART 1: GENERAL

1.01 WORK INCLUDED

A. Work of this Section includes through-penetration firestopping systems as indicated on the drawings for the following types of fire-resistance-rated assemblies:

1. Roofs
2. Walls and partitions
3. Smoke barriers

B. Related Work: Joint sealants are specified in Section 07920.

1.02 PERFORMANCE REQUIREMENTS

A. F-Ratings: Provide firestopping systems with F-ratings equaling or exceeding fire-resistance rating of constructions penetrated as determined per ASTM E 814.

B. T-Ratings: Provide firestopping systems with T-ratings required, as well as F-ratings, determined per ASTM E 814, where systems protect penetrating items with potential to contact adjacent materials in occupied floor areas including, but not limited, to the following:

1. Penetrations located outside wall cavities.
2. Penetrations located outside fire-resistive shaft enclosures.
3. Penetrations located in construction containing fire-protection-rated openings.
4. Penetrating items larger than 4-inch-diameter nominal pipe or 16-sq. in. in overall cross-sectional area.

C. For firestopping systems exposed to view, traffic, moisture, and physical damage, provide products that after curing do not deteriorate when exposed to these conditions both during and after construction.

D. For piping penetrations for plumbing and wet-pipe sprinkler systems, provide moisture-resistant firestopping systems.

E. For penetrations involving insulated piping, provide firestopping systems not requiring removal of insulation.

F. For through-penetration firestopping systems exposed to view, provide products with flame-spread indices of less than 25 and smoke-developed indices of less than 450, when tested per ASTM E 84.

1.03 SUBMITTALS

A. Product Data: For each product indicated.

B. Shop Drawings: Include details of installation and design designation of testing and inspecting agency acceptable to authorities having jurisdiction that evidences compliance with requirements for each condition indicated.

C. Product test reports.

1.04 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: Provide rated systems identical to those tested per ASTM E 814 and with products bearing the classification marking of a qualified testing and inspecting agency acceptable to authorities having jurisdiction.

B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate firestopping systems.

PART 2: PRODUCTS

2.01 MANUFACTURERS

A. Subject to compliance with requirements, provide the named product or a comparable product by one of the following:

1. A/D Fire Protection Systems Inc.
2. Grace Construction Products
3. Hilti Construction Chemicals, Inc.
4. Specified Technologies Inc.
5. 3M Fire Protection Products
6. United States Gypsum Company

2.02 FIRESTOPPING SYSTEMS

A. Compatibility: Provide firestopping systems that are compatible with the substrates forming openings, and with the items, if any, penetrating firestopping systems, under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.

B. Accessories: Provide accessories required to install fill materials that comply with requirements of tested assemblies, are approved by qualified testing and inspecting agency that performed testing, and are specified by manufacturer of tested assemblies.

C. Accessories include, but are not limited to, the following:

1. Permanent forming/damming/ backing materials
2. Sealants used in combination with other forming/damming/backing materials to prevent leakage of fill materials in liquid state
3. Fire-rated form board
4. Fillers for sealants

5. Temporary forming materials
6. Substrate primers
7. Collars
8. Steel sleeves

PART 3: EXECUTION

3.01 INSTALLATION

A. General: Install through-penetration firestopping systems to comply with "Performance Requirements" Article and firestopping system manufacturer's written installation instructions and published drawings for products and applications indicated.

B. Clean openings immediately before installing firestopping systems.

C. Remove foreign materials that could interfere with adhesion of firestopping systems.

D. Remove laitance and form-release agents from concrete.

E. Produce clean, sound surfaces capable of developing optimum bond with firestopping systems. Remove loose particles remaining from cleaning operation.

F. Priming: Prime substrates when recommended in writing by firestopping system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not spill primers or allow them to migrate onto adjoining surfaces.

G. Masking Tape: Use masking tape where required to prevent contact of firestopping with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove firestopping smears. Remove tape immediately after installation without disturbing firestopping seal.

H. Accessories: Install accessories of types required to support fill materials during their application and in the position necessary to produce cross-sectional shapes and depths required to achieve fire ratings indicated.

I. After installing fill materials, remove combustible forming materials and other accessories that are not permanent components of firestopping systems.

J. Install fill materials for firestopping systems by proven techniques.

K. Fill voids and cavities formed by openings, forming materials, accessories, and penetrating items as required to achieve fire-resistance ratings indicated.

L. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.

M. For fill materials that will remain exposed after completing Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

N. Identification: Identify firestopping systems with pressure-sensitive, self-adhesive, preprinted vinyl labels. Attach labels permanently to surfaces of penetrated

construction on both sides of each firestopping system installation where labels will be visible. Include the following information on labels:

1. The words: "Warning--Through-Penetration Firestopping System--Do Not Disturb. Notify Maintenance Department of Any Damage."
2. Contractor's name, address, and phone number.
3. Through-penetration firestopping system designation of applicable testing and inspecting agency.
4. Date of installation.
5. Firestopping system manufacturer's name.
6. Installer's name.

O. Clean excess fill materials adjacent to openings as installation progresses by methods and with cleaning materials that are approved in writing by manufacturers and that do not damage materials in which openings occur.

3.02 FIELD QUALITY CONTROL

A. Notify the Code inspection agency having jurisdiction at least seven days in advance of firestopping system installations; confirm dates and times on days preceding each series of installations.

B. Do not cover up firestopping system installations that will become concealed behind other construction until inspecting agency and building inspector, if required by authorities having jurisdiction, have examined each installation.

C. Enclose firestopping systems with other construction only after inspection reports are issued.

D. Where deficiencies are found, repair or replace firestopping systems to comply with requirements.

END OF SECTION

SECTION 07920

JOINT SEALANTS

PART 1: GENERAL

1.01 WORK INCLUDED

A. Scope: Furnish and install caulking and sealant required for joints between dissimilar materials and to close other joints unless they are specified to be done under another section.

B. Related work in other sections:

1. Compressible filler for concrete work is specified in Division 3.
2. Joints in sheet metal flashing are specified in Section 07620.
3. Firestopping sealants are specified in Section 07840.
4. Joints between gypsum board and dissimilar materials are specified in Section 09260.

1.02 DEFINITIONS

A. Substrates:

1. M-type substrates: Concrete, concrete masonry units, mortar, stucco, natural stone. The term "masonry" means stone, and concrete masonry work.
2. G-type substrates: Glass and transparent plastic glazing sheets.
3. A-type substrates: Metals, porcelain, glazed tile, and smooth plastics.
4. O-type substrates: Wood, unglazed tile; substrates not included under other categories.

1.03 QUALITY ASSURANCE

A. Installer Qualification: Engage installer who is experienced in at least three (3) joint sealer applications similar in type and size to that of this project.

B. Single Source Responsibility: Obtain like materials from a single manufacturer.

1.04 SUBMITTALS

A. Product data from manufacturers for each joint sealer product required including manufacturers recommendation for preparation and application.

B. Submit samples of sealant colors.

1.05 WARRANTY

A. Provide warranties covering sealant materials for a ten (10) year period from date of project acceptance covering joint failure. Joint failure is defined as "leaks of air or water, evidence of loss of cohesion, fading of sealant material, migration of sealant and evidence of loss of adhesion between sealant and joint edge.

PART 2: PRODUCTS

2.01 MATERIALS

A. General: Manufacturers and products named for specific materials in this paragraph are believed to conform to the criteria stated for that material and to the intended standards of quality, function and appearance.

B. Sealants and caulks used in roofing components shall be compatible and in accordance with roofing material manufacturer's recommendations.

C. Primer: As required or recommended by sealant manufacturer for subsurface materials involved.

D. Joint Fillers:

1. For caulking compound, use oakum.

2. For sealant use round rod or closed-cell polyethylene sponge, acceptable to sealant manufacturer as compatible with sealant. Use joint filler that is at least 25% larger than width of joint.

E. Joint Backing: Heavy polyethylene tape with adhesive backing.

2.02 ELASTOMERIC SEALANTS

A. General: Chemically curing elastomeric sealants of types indicated, complying with ASTM C 920, including specific Type, Grade, Class, and Uses indicated, as well as all other requirements specified.

1. Where movement capability exceeding that measured by ASTM C 920 is specified, sealant shall withstand the total movement indicated while remaining in compliance with the other requirements specified, when tested in accord with ASTM C 719, with base joint width measured at the time of application.

B. One-Part Non-sag Low-Modulus Urethane Sealant: Type S, Grade NS, Class 25, Use NT, plus movement capability of 50 percent in both extension and compression.

1. Acceptable Manufacturers:

a. Tremco, Inc.

b. Sika Corporation

c. Sonneborn

d. Pecora Corp.

C. One-Part, Non-sag Polysulfide Synthetic Rubber Sealant: FS TT-S-00230C, Type II, Class A.

1. Joint Movement Range: 25 - 40 percent.

2. Service Life: 10 - 20 years.

3. Ultimate Tensile Strength: 85 - 120 psi.

4. Shore-A Hardness: 30 - 34 at 75 degree F, and 50 percent relative humidity.
5. Color: As selected by Architect/Engineer.
6. Acceptable Manufacturers:
    a. Pecora Corp.
    b. Tremco, Inc.
    c. Sonneborn

D. Two-Part, Non-sag Polysulfide Synthetic Rubber Sealant: FS TT-S-00227 EOC, Type I, Class B.

1. Joint Movement Range: 25 - 50 percent.
2. Service Life: 10 - 20 years.
3. Ultimate Tensile Strength: 120 - 770 psi.
4. Shore-A Hardness: 15 - 50 at 75 degree F, and 50 percent relative humidity.
5. Color: As selected by Architect/Engineer.
6. Acceptable Manufacturers:
    a. Pecora Corp.
    b. Grace Construction Products
    c. Sonneborn
    d. Tremco, Inc.
    e. W.R. Meadows

2.03 LATEX SEALANTS

A. Acrylic-Latex Emulsion Sealant: One-part, non-sag, mildew-resistant, colored, paintable; complying with ASTM C 834.

PART 3: EXECUTION

3.01 GENERAL

A. Manufacturer's representative: At the start of Sealant work a representative of the Sealant manufacturer shall be present at the job to determine that proper preparations and methods are being used to satisfactorily install his product and to assist as necessary by instructing workmen in the proper application of his product. Submit immediate notification of unsatisfactory conditions.

B. Where shown but material type is not defined:

1. Use same type as shown elsewhere for same condition of use.
2. Use Caulk in interior or backup work not exposed directly to weather or wear.
3. Use Sealant for exterior work and for conditions not otherwise shown or specified.

C. Location: In addition to that which is shown, the following minimum work is required:

1. Perimeter joints: Close exposed exterior and visible interior perimeter joints between dissimilar materials.

2. Exterior Joints for Which No Other Sealer Is Indicated: One-part, non-sag low-modulus urethane sealant.

3. Interior Joints for Which No Other Sealer Is Indicated: Acrylic-emulsion latex sealant, color as selected.

4. Masonry: Coordinate with requirements of Division 4 and Drawings for extent of additional Caulk and Sealant required for open joints in masonry. Close exposed exterior and visible interior open joints. Sealant color shall be approved to match mortar color.

5. Joints around Pipes, Ducts, and Conduit Penetrating Exterior Walls and Roofs: Use same sealant used for adjacent substrates.

6. Wide Joints: Use Polyurethane, Non-Sag to fill joints over 1/2 inch wide.

7. Clear Sealant: Use where Sealant is required in a joint between glass and metal.

8. Concealed Joints in Acoustical Assemblies: Acrylic-emulsion latex sealant.

3.02 PREPARATION

A. Cleaning: Remove oil, grease, and foreign or loose material from joint surfaces. Clean non-porous surfaces with oil-free solvents such as Toluol, methyl ethyl ketone, or a mixture of equal parts of xylol and acetone. Remove lacquer from aluminum surfaces in contact with Sealant if necessary to achieve adhesion. Do not use soap, detergent, or any water-base cleaner.

B. Joint Filler: Provide under sealant, and if necessary to control its depth, also under caulk. Position material to provide for specified depth of compound.

C. Joint Backing: Required under sealant where depth of joint will not accept joint filler. Cover surface at back of joint with joint backing to form a continuous bond breaker between sealant and the back surface of the joint.

D. Protection: Cover adjacent finished surfaces with a continuous strip of masking tape 2 inches wide. Apply tape prior to priming.

E. Primer: Comply with compound manufacturer's recommendations for type of primer and its application for the substrate materials involved.

3.03 APPLICATION

A. Depth of Sealant Compound: Half the joint width, but not less than 1/8 inch or greater than 3/8 inch. Caulk equal to joint width but not greater than 1/2 inch.

B. Sealant: Apply with cartridge-type gun, keeping nozzle tip deep in joint to force compound to fill it, except where compound manufacturer recommends knife application or other techniques. Use non-sag type for joints and self-leveling type for joints in horizontal surfaces.

C. Caulk: Apply with cartridge-type gun, keeping nozzle tip deep in joint to force compound to fill it, except where compound manufacturer recommends knife application or other techniques.

3.04 FINISHING

A. Caulk: Smooth, in neat bead or bevel.

B. Sealant: Tool surface to force it into the joint cavity and as necessary to assure wetting of entire bonding surface. Tool surface of flat joints slightly concave. Smooth bevels and beads.

C. Tape: Remove making tape within 10 minutes after joint has been filled and finished.

END OF SECTION

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SECTION 08100

DOORS AND FRAMES

PART 1: GENERAL

1.01 SECTION INCLUDES

A. Requirement for providing fiberglass reinforced polyester doors and aluminum frames as indicated and in accordance with the Contract Documents

B. Finish Hardware for Doors: See Section – 08710 Finish Hardware.

1.02 QUALITY ASSURANCE

A. All components shall be the standard product of a manufacturer regularly engaged in the production of the required materials and equipment.

B. All doors, frames, and associated appurtenances shall be furnished by a single supplier who shall have overall responsibility for the design and coordination of the entire system.

C. All materials shall be designed and constructed in accordance with applicable standards, including ASTM B209, ASTM B221, ASTM D256, ASTM E84, and NAAMM Metal Finishes Manual.

D. All materials shall be of a quality to withstand the corrosion, abrasion, and stresses to which the door and frame will be subjected during fabrication, erection, and operation.

1.03 SUBMITTALS

A. Submit in accordance with Section 01300 – Submittals. Submit Shop Drawings, Product Data and Samples.

1. Product Data:
    a. Catalog data showing details of door and frame construction, dimensions, gages of metal, hardware markings, anchors, setting diagrams, shop finish, and details of glass and louver openings.
2. Shop Drawings:
    a. Where information required for Product Data above is not available as catalog data, submit missing information in Contractor’s shop drawings.
    b. Door schedule.
3. Quality Assurance/Control Submittals:
    a. Manufacturer's instructions and recommendations for installation.
    b. Certified laboratory test report for sound transmission classification requirements shown on drawings and stated herein.
4. Color selection for doors and frames. The selection of colors for the products specified may be dependent on the coordinated selection of other products specified elsewhere. As directed by the Engineer, submit color selection data.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Deliver, handle and store the material in accordance with Section 01600 – Delivery Storage and Handling.

B. Deliver material in original unopened cartons or wrappings clearly labeled with manufacturer's names, brand designation, door schedule number, type, class, and ratings, as applicable. Doors shall be floated within cartons with no portion of the door having contact with the outer shell of the container.

C. Store doors covered with vented tarpaulins or plastic sheets in upright position in dry space not less than 6 inches above ground.

D. Protect exposed surfaces of prefinished items with polyethylene sheets and masking tape.

E. Handle doors and frames to prevent damage and breakage to cartons and materials.

1.05 WARRANTY

A. Provide a written warranty agreeing to replace, at no cost to the Owner, door(s) that fail in materials or workmanship for a period of four years after the Contractor’s one-year warranty expires.

B. Failure of materials or workmanship includes excessive deflection, faulty operation, deterioration of finish more than normal weathering and defects in weatherstripping.

PART 2: PRODUCTS

2.01 MANUFACTURERS

A. Special-Lite, Inc.

B. “Or equal” product.

2.02 FRAMES

A. Free of warps, buckles, and fractures.

B. Aluminum extrusions complying with ASTM B221, Alloy 6063 TS.

C. Sheets and strips: ASTM B209, alloy and temper best suited for the purpose.

D. Size, shape, and of sufficient wall thickness to support required loads, but not less than 0.107 inch.

E. Frame Construction:

1. Joints: Jamb, header, and mullion joints accurately milled to hairline crack.

2. Corners: Mechanically joined with interlocking aluminum channel clips minimum of 3/16-inch wall and flathead stainless-steel screws, minimum of 18-8.

3. Frame Reinforcement for Hardware: Minimum 6061, T6 aluminum 1/4-inch thick.

F. Fasteners: Type 304 or 316 stainless steel.

G. Finish

1. Dark Duranodic Bronze meeting finish designation AA-M10622 A41 of the NAAMM Metal Finishes Manual.

H. Anchors

1. Stainless steel, Type 304, size and shape required for securing fames to adjacent construction.

2. Plant anchors near top and bottom of each jamb and at intermediate points not more than 25-inches apart. Weld stainless steel angle clips to the bottom of each jamb to permit anchoring bottom of frame to floor.

I. Edge Clearances:

1. Between doors and frames at head and jamb: 1/8 inch.

2. Sills without threshold: Maximum 3/4 inch.

3. Sills with threshold: Maximum 1/4 inch.

2.03 DOORS, GENERAL

A. Exterior door weather-strip: Felt or neoprene gasketing at frame contacts with door.

B. Door Sizes, Thickness, Types, Fire Rating, and Sound Retardant Classification: Follow Door Schedule on Drawing.

2.04 FIBERGLASS DOORS

A. Material.

1. Aluminum rails and stiles: ASTM B221, 6063-T6 aluminum, minimum thickness 0.125 inch.

2. Face sheet of doors:

a. Fiberglass reinforced polyester

b. 0.120-inch thickness.

c. Pebble-like embossed finish.

d. Color: Owner selection.

e. Flame spread not greater than 10 with smoke developed not more than 340, in accordance with ASTM E84.

3. Fasteners: Aluminum or non-magnetic steel fasteners, compatible with doors and items being fastened.

B. Construction.

1. 1-3/4 inch thick constructed of aluminum alloy rails and stiles, joined with steel tie rods, inner core of foamed-in-place urethane with fiberglass reinforced polyester face sheets locked in with extruded interlocking edges.

2. Stiles: Tubular shape with top and bottom rails extruded with Iegs for inter-locking rigidity weather bar.

3. Joinery: 3/8-inch galvanized tie rods, top and bottom bolted through an extruded spline and 3/16-inch riveted reinforcing angles secured with aircraft type nuts.

4. Core: Urethane foam, 3 pounds per cubic foot density. Properly reinforce door for hardware prior to urethane core foaming.

5. Finish for exposed aluminum surface: match finish for frames.

C. Reinforcement.

1. Locations: At hardware locations and perimeters of cutouts for lights and louvers.

2. Hardware Reinforcement: Top, bottom, and center with 3 standard sections of not less than 5-5/8 inches for hardware.

D. Lights.

1. Glass molding for areas to be glazed.

2. Mitered and coped corner joints with integral beveled glazing stop fabricated with minimum 18-gauge steel on 1 side and screwless snap-in type glazing beads on other.

3. Glazing Pocket: 1/2 inch by 1/2 inch high.

2.05 DOUBLE DOORS

A. General: Follow for single doors.

B. Astragals: Two-piece overlapping astragals fabricated from material compatible with doors.

1. Astragal assembly may be attached to doors for shipment or packaged separately for attachment to doors during installation.

2.06 PREPARATION FOR FINISH HARDWARE

A. Ensure that hardware schedule, templates, and samples of hardware are coordinated for correct fitting and installation with doors and frames.

B. Prepare cutouts and coring for mortise and concealed hardware.

PART 3: EXECUTION

3.01 PREPARATION

A. Visually inspect surfaces to receive frames and doors, and repair defects and damaged areas prior to installation of doors and frames.

3.02 INSTALLATION

A. Frames

1. Protect frames in contact with masonry with one of the following:

a. Paint: Solvent clean aluminum surfaces contacting masonry and coat with zinc-chromate primer and one coat of aluminum paint.

b. Non-absorptive tape or gasket – place between adjoining surfaces and cement to aluminum surface using a cement compatible with aluminum.

2. Set accurately in plumb position, hold head level, and maintain schedule dimensions.

3. Secure anchorages and connections to adjacent construction with expansion bolts, power fasteners, or as indicated on Drawings.

4. Anchor metal frames to slab with angle clips and minimum 2 expansion bolts in each clip.

5. Remove all stains and blemishes from frames. Removal agents shall not cause discoloration in frames. Do not use agents with abrasives.

B. Doors

1. Hang doors to achieve intended functional operation and appearance with smooth and easy operation, free of binds, warps, and squeaks.

2. Apply hardware following manufacturer's templates and instructions.

3.03 CLEANING

A. Upon completion, clean surfaces of doors and frames following manufacturer’s recommended procedures.

3.04 FIELD QUALITY CONTROL

A. Visually inspect door for uniform fit and appearance.

B. Fully open and close door for smooth operation without binding and for proper closing.

END OF SECTION

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SECTION 08110

HOLLOW METAL WORK

PART 1: GENERAL

1.01 WORK INCLUDED

A. Provide hollow metal work including doors, door frames and necessary accessories as indicated on Drawings and specified herein.

B. Provide fire-rated picture windows, doorframes and doors at locations indicated.

1.02 SUBMITTALS

A. Submit properly identified product data including manufacturer's specifications and installation directions.

B. Submit shop drawings indicating sizes, elevations, locations, fire labels, construction details, gages, finishes, reinforcement, anchors, louvers, light openings, glazing stops and hardware locations.

1.03 QUALITY ASSURANCE

A. Provide hollow metal doors and frames fabricated and installed in accordance with the following standards except as otherwise indicated:

1. Steel Door Institute's (SDI) Recommended Specifications for Standard Steel Doors and Frames, SDI 100.

2. For Fire-Rated Assemblies: Either National Fire Protection Association's (NFPA) Standard No. 80 or Underwriter's Laboratories, Inc. (UL) Building Materials Directory. Provide UL label on each fire-rated door and frame.

3. For Exterior Doors, Calculations: Signed and sealed by a Georgia registered Professional Engineer, establishing wind velocity pressure values according to American Society of Civil Engineers (ASCE) 7-98.

4. For Exterior Doors, Certification: Accepted independent laboratory test results demonstrating resistance to missile impact.

1.04 PRODUCT DELIVERY AND STORAGE

A. Protect doors and frames during transit, storage, and handling to prevent damage, soiling, and deterioration.

B. Ship welded frames in bundles securely strapped or in packages.

C. At the building site, store doors and frames under cover. Avoid the use of nonvented plastic or canvas shelters which create a humidity chamber. Store frames in an upright position on at least 4" wood sills or on floors in a manner that will prevent rust or damage. Provide a 1/4" air space between the doors to promote air circulation.

PART 2: PRODUCTS

2.01 ACCEPTED MANUFACTURERS

A. Provide doors and frames from same manufacturer. Subject to the requirements of this Section, provide doors and frames as manufactured by Ceco Entry Systems, Republic Builders Products, Curries Co., or equal.

B. Provide fire rated doors and frames, bearing appropriate UL labels, where indicated.

2.02 HOLLOW METAL FRAMES

A. Exterior door frames (16 gage) and interior doorframes (18 gage) subject to moisture shall be fabricated of bonderized hot-dip zinc coated sheet steel according to ASTM A525 G60 or ASTM A526, 1.25 oz. zinc per sq. ft.

B. Interior door frames not subject to moisture shall be of 18 gage, fabricated of bonderized electrolytic zinc-coated sheet steel according to ASTM A1008 and ASTM A591, Class C.

C. Fabricate both exterior and interior frames to profiles indicated.

D. Frames for Masonry Walls: Fully welded, custom type, with mitered or butted head and jamb members with integral stops and with combination buck and trim as shown, and corners having continuous welds ground flush and smooth without dishing.

E. Frames for gypsum wallboard shall be fully welded frames.

F. Hardware Reinforcements and Preparations:

1. Mortise, reinforce and drill/tap the frames for mortised hardware in accordance with approved finish hardware schedule and templates by hardware supplier.

2. Drill and tap for surface applied hardware in the field.

3. Locate finish hardware in accordance with Recommended Locations for Builder's Hardware, published by National Builder's Hardware Association or as otherwise directed by the Engineer.

4. Butt (Hinge) Reinforcing: Steel plate 3/16" thick by 1-1/4" minimum to 1-1/2" maximum wide by 10" long, offset where required so faces of butts are flush with door frame edge, secured by not less than six spot welds.

5. Strike Reinforcement: Offset clips of 12 gage steel, 1-1/2" x 3" long.

6. Closer Shoe Reinforcing: 10 gage steel plates, minimum 14" long x 1" wide, in both rabbets (each side of stop) and top of head section near corner of hinge jamb. Provide styrofoam or treated wood over plates to allow closer foot screws to seat without interference from grout fill.

G. Silencer (Mute) Provisions: Punch frames to receive silencers on strike jamb as scheduled in Section 08710.

H. Center Mullions, Not used.

I. Grout Guards: Provide 26 gage sheet metal covers welded to the back of frames at hinges, locks, bolts, tapped reinforcements at hardware and silencer locations.

J. Jamb Anchors: Provide in accordance with frame manufacturer's recommendations for attachment to masonry walls, concrete columns and metal stud system as shown on Drawings.

K. Floor Anchors: Provide 14 gauge galvanized sheet steel angle shaped anchors on each jamb which extends to the floor, punched for not less than two ¼" diameter bolts.

L. Spreaders: Provide frames with temporary steel spreader bars tack welded to jambs to maintain full rigidity and proper alignment during installation.

M. Grout solid all hollow metal door frames.

1. Provide sheet metal covers (grout guards) welded in back of frames at hinges, locks, bolts and tapped reinforcements at hardware.

2. At silencer locations furnish suitable removable plugs in holes to keep free of grout.

2.03 HOLLOW METAL DOORS

A. Fabricate interior doors from 18 gage bonderized electrolytic zinc-coated cold-rolled stretcher leveled sheet steel in accordance to ASTM A1008 and ASTM A 591, Class C. Steel shall be of commercial quality, stretcher leveled flatness, galvanized to G60 minimum coating weight standard.

B. Fabricate exterior doors (16 gage) and interior doors (18 gage) subject to moisture from bonderized hot-dipped zinc-coated sheet steel in accordance with ASTM A 525, G60 or ASTM A 526, 1.25 oz. zinc per sq. ft.

C. Types: Flush, seamless hollow construction with louvers or vision cutouts as shown or specified.

D. Sizes and Thicknesses: Size shall be as indicated and thickness 1-3/4" unless otherwise specified or shown. Provide undercuts where indicated for ventilation, ¾" maximum undercut allowed for fire labeled doors.

E. Bottom Clearance: Doors which close against thresholds shall have a bottom clearance of 1/8" to 3/8" above finish floor. Doors which do not close against thresholds shall have a bottom clearance of ¼" to ½" above finish floor, except for undercutting of door.

F. Door Perimeters:

1. Stile Edges:

a. Reinforce stile edges full height with 16 gage bonderized zinc coated steel channels.

b. Bevel for Single Acting Doors: 1/8" in 2".

2. Door Tops:

a. Reinforce door tops with full width 16 gage bonderized zinc coated steel channels.

b. Provide exterior door tops with flush surface.

3. Door Bottoms:

a. Reinforce door bottoms with full width 16 gage bonderized zinc coated steel channels.

b. Provide weep holes in bottom of exterior doors on each side.

4. Weatherstrips:

a. Coated aluminum body with closed cell sponge neoprene gasket strips, with coating on aluminum strips and screw heads to match that on door frames. Ship weatherstrips with doors, fully aliphatic urethane coated, disassembled, for attachment at site.

b. Provide head and jamb strips at exterior door heads and jambs, and at interior door heads and jambs for which gasketing, weatherstrips is indicated. Provide profile equal to 950N by Accurate Metal Weatherstrip Company Incorporated, 130N by National Guard Products Incorporated, 315AR by Pemko Manufacturing Company, or DS78 by Reese Enterprises Incorporated.

G. Stiffeners: Provide vertical members spaced not more than 6"o.c. with shape standard to manufacturer.

H. Core Fill: Provide manufacturer's standard mineral core filler.

I. Hardware Reinforcements and Preparation:

1. Unless otherwise directed, mortise and reinforce as follows:

a. Drill/tap for mortised hardware in accordance with accepted finish hardware schedule and templates furnished by hardware supplier.

b. Perform drilling and tapping for surface applied hardware in the field.

c. Locate finish hardware per Recommended Locations for Builder's Hardware, published by National Builder's Hardware Association.

2. Butt (Hinge) Reinforcing: Steel plate, 7 gauge, 1-1/4" min. to 1-1/2" max. wide x 10" long. Offset where required and secure by not less than six spot welds.

J. Fire-Rated Assemblies:

1. Fabricate fire-rated assemblies, including doors, frames, hardware, and picture windows to the test and rating requirements of Underwriter's Laboratories Building Materials Director or NFPA Standard No. 80.

2. Label doors and frames of fire-rated assemblies either UL or FM (Factory Mutual). Labels shall be factory installed and not removed at any time.

K. Light Opening in Doors:

1. Provide light openings of sizes indicated.

2. At light opening cut outs, provide 16 gage zinc coated steel channel closures welded into opening perimeter.

3. Glass Light Frames: 18 gage (min) galvanized steel with attachment screws allowed only on the non-secure side, not visible when viewing door lite frame face.

2.04 BORROWED LIGHTS

A. Fabricate of 16 gage bonderized electrolytic zinc-coated sheet steel according to ASTM A1008 and ASTM A591 with removable steel stops on the secure size of the room. Frame shall be fully welded with mitered corners.

2.05 STEEL STILE AND RAIL DOORS WITH AND TRANSOM/SIDELIGHT SYSTEM

A. Fabricate of 16 gage bonderized electrolytic zinc-coated sheet steel according to ASTM A1008 and ASTM A591 with removable steel stops on the secure size of the room. Frame shall be fully welded with mitered corners. Fire rated construction to meet rating indicated in the Finish Door Schedule.

B. Fire-rate glass per Section 08800

2.06 PICTURE WINDOWS FIRE-RATED

A. Fabricate of 16 gage bonderized electrolytic zinc-coated sheet steel according to ASTM A1008 and ASTM A591 with removable steel stops on the secure size of the room or as otherwise detailed. Frame shall be fully welded with mitered corners. Fire rated construction to meet rating indicated.

2.07 FINISHING AND SHOP PAINT

A. After fabrication, grind exposed weld marks smooth and flush, clean and degrease surfaces, apply metallic filler, sand smooth and shop prime with a primer compatible with the finish coating specified in Section 09900.

PART 3: EXECUTION

3.01 INSPECTION

A. Do not proceed with the work until conditions detrimental to the proper and timely completion of the work have been corrected in an acceptable manner.

3.02 INSTALLATION

A. Frames

1. Install plumb, level and true to line, secured in openings in compliance with the provisions of SDI-105, Recommended Erection Instructions for Steel Frames, unless otherwise indicated.

2. Install frames in accordance per shop drawings and manufacturer's instruction.

B. Doors:

1. Install plumb, level and true to line with clearances as specified in SDI-100.

2. Install fire rated doors with clearances as specified in NFPA No. 80.

3. Apply hardware and adjust to achieve smooth and quiet operation.

4. Install weatherstrips and thresholds at all exterior doors.

C. Final Adjustments: Make final adjustments as follows:

1. Door Contact with Silencers: Doors shall strike a minimum of two silencers without binding lock or latch bolts in the strike plate.

2. Head, Strike and Hinge Jamb Margin: 1/8".

3. Meeting Edge Clearance, Pairs of Doors: □1/16".

4. Bolts and Screws: Leave tight and firmly seated.

3.03 PAINTING

A. Prior to applying finish coat, touch up any scratches or abrasions in prime coat as necessary to restore quality of original prime coat.

END OF SECTION

SECTION 08211

FLUSH WOOD DOORS

PART 1: GENERAL

1.01 SUMMARY

A. Provide solid core doors as follows:

1. Doors with wood-veneer faces and factory finishing.
2. Doors with medium-density overlay faces.
3. Doors shall be installed in hollow metal frames per section 08110

1.02 SUBMITTALS

A. Product Data for each type of door. Include factory-finishing specifications**.**

B. Shop Drawings indicating location, size, and hand of each door; elevation of each kind of door; construction details; location and extent of hardware blocking; mortises, holes, and cutouts; requirements for veneer matching; factory finishing; fire ratings; and other pertinent data.

C. Samples for each face material and finish.

1.03 QUALITY ASSURANCE

A. Quality Standard: Comply with NWWDA I.S.1-A, "Architectural Wood Flush Doors."

B. Fire-Rated Wood Doors: Doors that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated. PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following, or equivalent:

1. Algoma Hardwoods Inc.
2. Ampco Products, Inc.
3. Eggers Industries; Architectural Door Division.
4. Mohawk Flush Doors, Inc.
5. Weyerhaeuser Company.

2.02 DOOR CONSTRUCTION

A. Doors for Transparent Finish:

1. Grade: Premium, with Grade A faces
2. Species and Cut: White birch, rotary cut.

3. Match between Veneer Leaves: Book match.

4. Assembly of Veneer Leaves on Door Faces: Balance match.

5. Pair and Set Match: Provide for doors hung in same opening or separated only by mullions.

B. Doors for Opaque Finish:

1. Grade: Custom.

2. Faces for Interior Doors: Medium-density overlay.

C. Interior Veneer-Faced Solid-Core Doors: Glued block core.

D. Fire-Rated Doors:

1. Construction: Construction and core specified above for type of face indicated or manufacturer's standard mineral-core construction as needed to provide fire rating indicated.Edge Construction: Intumescent seals concealed by outer stile matching face veneer, and laminated backing for improved screw-holding capability and split resistance.

3. Pairs: Provide fire-rated pairs with fire-retardant stiles matching face veneer that are labeled and listed for kinds of applications indicated without formed-steel edges and astragals. Provide stiles with concealed intumescent seals.

E. Provide doors with glued-block at locations where exit devices are indicated.

F. Wood-Veneered Beads for Light Openings in Fire Doors: Manufacturer's standard wood-veneered noncombustible beads matching veneer species of door faces and approved for use in doors of fire rating indicated.

2.03 FABRICATION

A. Fabricate doors in sizes indicated for site fitting.

B. Factory fit doors to suit frame-opening sizes indicated. Comply with clearance requirements of referenced quality standard for fitting. Comply with requirements in NFPA 80 for fire-rated doors.

C. Factory machine doors for hardware that is not surface applied. Premachine metal astragals and formed-steel edges for hardware for pairs of fire-rated doors.

D. Openings: Cut and trim openings through doors to comply with applicable requirements of referenced standards for kind(s) of door(s) required.

1. Light Openings: Trim openings with moldings of material and profile indicated.

2. Louvers: Factory install louvers in prepared openings.

2.04 SHOP PRIMING

A. Doors for Opaque Finish: Shop prime faces and edges of doors, including cutouts, with one coat of wood primer compatible with finish coats specified in Section 09900.

2.05 FACTORY FINISHING

A. General: Finish doors at factory that are indicated to receive transparent finish. Field finish doors indicated to receive opaque finish.

B. Grade: Custom.

C. Finish: NWWDA I.S.1-A System TR-6 catalyzed polyurethane.

D. Staining: As selected from manufacturer's full range.

E. Effect: Semi filled finish.

F. Sheen: Semigloss.

PART 3: EXECUTION

3.01 INSTALLATION

A. Install doors to comply with manufacturer's written instructions, referenced quality standard, and as indicated. Install fire-rated doors in corresponding fire-rated frames according to NFPA 80

B. Job-Fitted Doors: Align and fit doors in frames with uniform clearances and bevels; do not trim stiles and rails in excess of limits set by manufacturer or permitted for fire-rated doors. Machine doors for hardware. Seal cut surfaces after fitting and machining. Comply with NFPA 80 for fire-rated doors.

C. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.

D. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

END OF SECTION

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SECTION 08332

OVERHEAD COILING DOORS

PART 1: GENERAL

1.01 SECTION INCLUDES

A. Requirements for the provision and installation of:

1. Service doors.

1.02 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for both installation and maintenance of units required for this Project.

B. Source Limitations: Obtain overhead coiling doors from single source from single manufacturer.

1. Obtain operators and controls from overhead coiling door manufacturer.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.03 SUBMITTALS

A. Comply with Section 01300 – Submittals. Submit Shop Drawings, Product Data and Samples. Provide the following:

1. Product Data: For each type and size of overhead coiling door and accessory. Include the following:

a. Construction details, material descriptions, dimensions of individual components, profiles for slats, and finishes.

b. Rated capacities, operating characteristics, electrical characteristics, and furnished accessories.

2. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data. Include plans, elevations, sections, details, and attachments to other work.

a. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

b. Wiring Diagrams: For power, signal, and control wiring.

3. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below.

a. Curtain Slats: 12 inches long.

4. Qualification Data: For qualified Installer.

5. Seismic Qualification Certificates: For overhead coiling doors, accessories, and components, from manufacturer.

6. Maintenance Data: For overhead coiling doors to include in maintenance manuals.

1.04 PERFORMANCE REQUIREMENTS

A. Structural Performance, Exterior Doors: Exterior overhead coiling doors shall withstand the wind loads, the effects of gravity loads, and loads and stresses within limits and under conditions indicated according to SEI/ASCE 7.

1. Wind Loads: As indicated on Drawings.

2. Deflection Limits: Design overhead coiling doors to withstand design wind load without evidencing permanent deformation or disengagement of door components.

B. Operability under Wind Load: Design overhead coiling doors to remain operable under design wind load, acting inward and outward.

C. Seismic Performance: Overhead coiling doors shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

2. Seismic Component Importance Factor: 1.5.

D. Operation Cycles: Provide overhead coiling door components and operators capable of operating for not less than number of cycles indicated for each door. One operation cycle is complete when a door is opened from the closed position to the fully open position and returned to the closed position.

PART 2: PRODUCTS

2.01 DOOR CURTAIN MATERIALS AND CONSTRUCTION

A. Door Curtains: Fabricate overhead coiling-door curtain of interlocking metal slats, designed to withstand wind loading indicated, in a continuous length for width of door without splices. Unless otherwise indicated, provide slats of thickness and mechanical properties recommended by door manufacturer for performance, size, and type of door indicated, and as follows:

1. Aluminum Door Curtain Slats: ASTM B 209 sheet or ASTM B 221 extrusions, alloy and temper standard with manufacturer for type of use and finish indicated; thickness of 0.050 inch and as required to meet requirements.

2. Metal Interior Curtain-Slat Facing: Match metal of exterior curtain-slat face.

B. End-locks and Wind-locks for Service Doors: Malleable-iron castings galvanized after fabrication, secured to curtain slats with galvanized rivets or high-strength nylon. Provide locks on not less than alternate curtain slats for curtain alignment and resistance against lateral movement.

C. Bottom Bar for Service Doors: Consisting of two angles, each not less than 1½ by 1½ by 1/8-inch thick; fabricated from manufacturer's standard hot-dip galvanized steel, stainless steel, or aluminum extrusions to match curtain slats and finish.

D. Curtain Jamb Guides: Manufacturer's standard angles or channels and angles of same material and finish as curtain slats unless otherwise indicated, with sufficient depth and strength to retain curtain, to allow curtain to operate smoothly, and to withstand loading. Slot bolt holes for guide adjustment. Provide removable stops on guides to prevent overtravel of curtain, and a continuous bar for holding wind-locks.

2.02 HOOD

A. General: Form sheet metal hood to entirely enclose coiled curtain and operating mechanism at opening head. Contour to fit end brackets to which hood is attached. Roll and reinforce top and bottom edges for stiffness. Form closed ends for surface-mounted hoods and fascia for any portion of between-jamb mounting that projects beyond wall face. Equip hood with intermediate support brackets as required to prevent sagging.

1. Aluminum: 0.040-inch-thick aluminum sheet complying with ASTM B 209, of alloy and temper recommended by manufacturer and finishes for type of use and finish indicated.

2.03 LOCKING DEVICES

A. Slide Bolt: Fabricate with side-locking bolts to engage through slots in tracks for locking by padlock, located on both left and right jamb sides, operable from coil side.

B. Chain Lock Keeper: Suitable for padlock.

C. Safety Interlock Switch: Equip power-operated doors with safety interlock switch to disengage power supply when door is locked.

2.04 CURTAIN ACCESSORIES

A. Weather-seals: Equip each exterior door with weather-stripping gaskets fitted to entire perimeter of door for a weathertight installation, unless otherwise indicated.

1. At door head, use 1/8-inch-thick, replaceable, continuous sheet secured to inside of hood.

2. At door jambs, use replaceable, adjustable, continuous, flexible, 1/8-inch-thick seals of flexible vinyl, rubber, or neoprene.

2.05 DOOR OPERATORS

A. Door Operator: Manual

2.06 DOOR ASSEMBLY

A. Service Door: Overhead coiling door formed with curtain of interlocking metal slats.

1. Basis of Design: Provide overhead coiling doors by Overhead Door Corporation or equivalent doors by one of the following:
    a. Cookson Company.
    b. Cornell Iron Works, Inc.
    c. Raynor.
    d. Wayne-Dalton Corp.
    e. Windsor Door.

B. Operation Cycles: Not less than 50,000.
    1. Include tamperproof cycle counter.

C. Door Curtain Material: Galvanized steel.

D. Door Curtain Slats: Flat profile slats of 2-5/8-inch center-to-center height.

E. Curtain Jamb Guides: Galvanized steel with exposed finish matching curtain slats.

F. Hood: Match curtain material and finish.
    1. Shape: As shown on Drawings.
    2. Mounting: As shown on Drawings.

G. Locking Devices: Equip door with slide bolt for padlock.

H. Door Operator:
    1. Manual Operation: Chain type.

I. Door Finish:
    1. Baked-Enamel or Powder-Coated Finish: Color as selected by Owner from manufacturer's full range.
    2. Interior Curtain-Slat Facing: Match finish of exterior curtain-slat face.

2.07 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.08 STEEL AND GALVANIZED-STEEL FINISHES

A. Baked-Enamel or Powder-Coat Finish: Manufacturer's standard baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for cleaning, pretreatment, application, and minimum dry film thickness.

PART 3: EXECUTION

3.01 EXAMINATION

A. Examine substrates areas and conditions, with Installer present, for compliance with requirements for substrate construction and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Install overhead coiling doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; according to manufacturer's written instructions and as specified.

B. Install overhead coiling doors, hoods, and operators at the mounting locations indicated for each door.

C. Accessibility: Install overhead coiling doors, switches, and controls along accessible routes in compliance with regulatory requirements for accessibility.

3.03 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Perform installation and startup checks according to manufacturer's written instructions.

2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.04 ADJUSTING

A. Adjust hardware and moving parts to function smoothly so that doors operate easily, free of warp, twist, or distortion.

B. Lubricate bearings and sliding parts as recommended by manufacturer.

C. Adjust seals to provide weathertight fit around entire perimeter.

3.05 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain overhead coiling doors.

END OF SECTION

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SECTION 08410

ALUMINUM ENTRANCES AND STOREFRONTS

PART 1: GENERAL

1.01 WORK INCLUDED

A. This Section includes the following types of aluminum entrance and storefront work:

1. Exterior entrance doors
2. Frames for entrances
3. Small missile impact-resistant framing side lites for entrance doors.

B. Related Sections: The following sections contain requirements that relate to this Section:

1. Glazing requirements are specified in Section 08810
2. Hardware is specified in Section 08710
3. Door & Storefront opening elevations and schedules on drawings.

1.02 SYSTEM PERFORMANCE REQUIREMENTS

A. General: Provide aluminum entrance and storefront assemblies that comply with performance characteristics specified herein.

B. Thermal Movement: Design the aluminum entrance and storefront framing systems to provide for expansion and contraction of the component materials. Entrance doors shall function normally over the specified temperature range.

1. The system shall be capable of withstanding a metal surface temperature range of 180 degrees Fahrenheit without buckling, failure of joint seals, undue stress on structural elements, damaging loads on fasteners, reduction of performance, stress on glass, or other detrimental effects.

C. Design Requirements: Provide aluminum entrance and storefront systems that comply with structural performance, air infiltration, and water penetration requirements indicated.

1. Wind Loads: Provide aluminum entrance and storefront assemblies capable of withstanding 110 wind loads in accordance with ASCE 7-99.
2. Provide systems having small air-borne and missile impact from storm force winds.

D. Structural Performance: Systems shall be designed to meet the structural requirements of the International Building Code, latest edition. Structural compliance shall be demonstrated by means of ASTM test results or certification by a Georgia licensed Structural Engineer.

1. Deflection Normal to the Plane of the Wall: Test pressure required to measure deflection of framing members normal to the plane of the wall shall be equivalent to the wind load requirements of the Code specified above. Deflection shall not exceed 1/180 of the clear span, when subjected to uniform load deflection test.

2. Deflection Parallel to the Plane of the Wall: Test pressures required to measure deflection parallel to the plane of the wall shall be equal to 1.5 times the wind pressures required in the Code specified above. Deflection of any member carrying its full dead load shall not exceed an amount that will reduce glass bite below 75 percent of the design dimension and shall not reduce the edge clearance between the member and the fixed panel, glass or other fixed member above to less than 1/8 inch. The clearance between the member and an operable door or window shall be at least 1/16 inch.

E. Air Infiltration: Provide aluminum entrance and storefront framing system with an air infiltration rate of not more than 0.06 CFM per sq. ft. of fixed area (excluding operable door edges) when tested in accordance with ASTM E 283 at an inward test pressure differential of 1.57 psf.

F. Water Penetration: Provide framing systems with no uncontrolled water penetration (excluding operable door edges) as defined in the test method when tested in accordance with ASTM E 331 at an inward test pressure differential of 6.24 psf.

1.03 SUBMITTALS

A. Product data for each aluminum entrance and storefront system required, including:

1. Manufacturer's standard details and fabrication methods

2. Data on finishing, hardware and accessories

3. Recommendations for maintenance and cleaning of exterior surfaces

B. Shop drawings for each aluminum entrance and storefront system required, including:

1. Layout and installation details, including relationship to adjacent work

2. Elevations at 1/4-inch scale

3. Detail sections of typical composite members

4. Anchors and reinforcement

5. Hardware mounting heights

6. Provisions for expansion and contraction

7. Glazing details

C. Hardware Schedule: Indicate on the detailed shop drawings a list and description of all hardware as required by the Contract Documents.

D. Samples for Initial Color Selection: Submit pairs of samples of each specified color and finish on 12-inch-long sections of extrusions or formed shapes. Where normal color variations are anticipated, include 2 or more units in each set of samples indicating extreme limits of color variations.

E. Test Reports: Provide certified test reports from a qualified independent testing laboratory showing that impact resistant glazing systems have complied with the impact and cyclic testing as required for the area of application.

1.04 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced Installer who has completed installations of aluminum storefront and entrances similar in design and extent to those required for the project and whose work has resulted in construction with a record of successful in-service performance.

B. Fabricator Qualifications: Provide aluminum entrances and storefront systems fabricated by a firm experienced in producing systems that are similar to those indicated for this Project, and that have a record of successful in-service performance. The fabricator shall have sufficient production capacity to produce components required without causing delay in progress of the Work.

C. Single Source Responsibility: Obtain aluminum entrance and storefront systems from one source and from a single manufacturer.

D. Design Criteria: The drawings indicate the size, profile, and dimensional requirements of aluminum entrance and storefront work required and are based on the specific types and models indicated. Aluminum entrance and storefront by other manufacturers may be considered, provided deviations in dimensions and profiles are minor and do not change the design concept as judged solely by the Architect/Engineer.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver aluminum entrance and storefront components in the manufacturer's original protective packaging.

B. Store aluminum components in a clean dry location away from uncured masonry or concrete. Cover components with waterproof paper, tarpaulin or polyethylene sheeting in a manner to permit circulation of air. Stack framing components in a manner that will prevent bending and avoid significant or permanent damage.

1.06 PROJECT CONDITIONS

A. Field Measurements: Check openings by accurate field measurement before fabrication. Show recorded measurements on shop drawings. Coordinate fabrication schedule with construction progress to avoid delay of the work.

B. Maintain openings to receive aluminum entrances and storefronts to the field dimensions (plumb and level) recorded on shop drawings.

1.07 WARRANTY

A. Warranty: Submit a written warranty, executed by the manufacturer, agreeing to repair or replace units that fail in materials or workmanship within the specified warranty period. Failures include, but are not necessarily limited to:

1. Structural failures including excessive deflection, excessive leakage or air infiltration
2. Faulty operation
3. Deterioration of metals, metal finishes and other materials beyond normal weathering

B. Warranty Period: 2 years after the date of Substantial Completion.

C. The warranty shall not deprive the Owner of other rights or remedies the Owner may have under other provisions of the Contract Documents, and is in addition to and runs concurrent with other warranties made by the Contractor under requirements of the Contract Documents.

1. Exit Devices shall have a 5-year warranty against defects in material and workmanship from date of Project acceptance, and shall have N.O.A. for Dade County Hurricane Code Component Approval +/-80 PSF component testing.

PART 2: PRODUCTS

2.01 MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide entrance and storefront systems, fixed multi-lite and single unit conventional and impact resistive systems as manufactured by one of the following:

1. Kawneer Company, Inc.
2. United States Aluminum
3. YKK AP America, Inc.
4. Arch Aluminum & Glass (Basis of Design)

2.02 MATERIALS

A. Aluminum Members: Alloy and temper recommended by the manufacturer for strength, corrosion resistance, and application of required finish; comply with ASTM B 221 for aluminum extrusions, ASTM B 209 for aluminum sheet or plate, and ASTM B 211 for aluminum bars, rods and wire.

B. Carbon steel reinforcement of aluminum framing members shall comply with ASTM A 36 for structural shapes, plates and bars, ASTM A 611 for cold rolled sheet and strip, or ASTM A 570 for hot rolled sheet and strip.

C. Glass and Glazing Materials: Comply with requirements of "Glass" section of these specifications.

D. Fasteners: Provide fasteners of aluminum or other material warranted by the manufacturer to be non-corrosive and compatible with aluminum components, hardware, anchors and other components.

1. Reinforcement: Where fasteners screw-anchor into aluminum members less than 0.125 inch thick, reinforce the interior with aluminum or nonmagnetic

stainless steel to receive screw threads, or provide standard non-corrosive pressed-in splined grommet nuts.

2. Exposed Fasteners: Do not use exposed fasteners except for application of hardware. For application of hardware, use Phillips flat-head machine screws that match the finish of member or hardware being fastened.

E. Concealed Flashing: 0.0179-inch (26 gage) minimum dead-soft stainless steel, or 0.026-inch thick minimum extruded aluminum of alloy and type selected by manufacturer for compatibility with other components.

F. Brackets and Reinforcements: Provide high-strength aluminum brackets and reinforcements; where use of aluminum is not feasible provide nonmagnetic stainless steel or hot-dip galvanized steel complying with ASTM A 123.

G. Concrete and Masonry Inserts: Provide hot-dip galvanized steel embeds or concrete inserts for placement into masonry complying with ASTM A 123.

H. Compression Weatherstripping: Manufacturer's standard replaceable compressible Weatherstripping gaskets of molded PVC complying with ASTM D 2287.

2.03 HARDWARE

A. General: Aluminum and glass swing doors shall be supplied complete with hardware to include, but not be limited to, the following:

1. Hinges
2. Closers
3. Thresholds
4. Panic Exit Devices
5. Door Pulls
6. Push Bars

B. Refer to Division 8 Section "Door Hardware" for requirements of hardware items that are to be provided by the aluminum entrance manufacturer, including, but not limited to, lock cylinders.

C. Provide manufacturer’s heavy-duty, non-corrosive hardware units as indicated, scheduled, or required for operation of each door, including, but not limited to, hinges, closers, thresholds, exit devices, door pulls, and push bars, finish to match door. Cylinders are supplied under another Division-8 section for keying into the building system.

2.04 COMPONENTS

A. Storefront Framing System: Provide storefront and entrance framing systems fabricated from extruded aluminum members of size and profile indicated. Include sub-frames and other reinforcing members of the type indicated. Provide for flush glazing storefront from the exterior on all sides without projecting stops. Shop-fabricate and pre-assemble frame components where possible. Provide storefront frame sections without exposed seams.

B. Mullion Configurations: Provide pockets at the inside glazing face to receive resilient elastomeric glazing. Make provisions to drain moisture accumulation to the exterior.

C. Entrance Door Frames: Provide tubular and channel frame entrance door frame assemblies, as indicated, with welded or mechanical joints in accordance with manufacturer's standards. Reinforce as necessary to support required loads.

D. Glazed Entrance Doors: Provide tubular frame members, fabricated with mechanical joints using heavy inserted reinforcing plates and concealed tie-rods or j-bolts.

1. Glazing: Fabricate doors to facilitate replacement of glass or panels, without disassembly of stiles and rails. Provide snap-on extruded aluminum glazing stops, with exterior stops anchored for non-removal.

2. Design: Provide 1-3/4-inch-thick doors of medium style design (3-1/2 inch nominal width).

2.05 FABRICATION

A. General: Fabricate aluminum entrance and storefront components to designs, sizes and thicknesses indicated and to comply with indicated standards. Sizes and profile requirements are indicated on the drawings. Variable dimensions are indicated, with maximum and minimum dimensions required, to achieve design requirements and coordination with other work.

B. Prefabrication: Complete fabrication, assembly, finishing, hardware application, and other work to the greatest extent possible before shipment to the Project site. Disassemble components only as necessary for shipment and installation.

1. Perform fabrication operations, including cutting, fitting, forming, drilling and grinding of metal work to prevent damage to exposed finish surfaces. Complete these operations for hardware prior to application of finishes.

2. Do not drill and tap for surface-mounted hardware items until time of installation at project site.

3. Pre-glaze door and frame units to greatest extent possible.

C. Welding: Comply with AWS recommendations. Grind exposed welds smooth to remove weld spatter and welding oxides. Restore mechanical finish. Welding behind finished surfaces shall be performed in such a manner as to minimize distortion and discoloration on the finished surface.

D. Reinforcing: Install reinforcing as required for hardware and as necessary for performance requirements, sag resistance and rigidity.

E. Dissimilar Metals: Separate dissimilar metals with bituminous paint, or a suitable sealant, or a non-absorptive plastic or elastomeric tape, or a gasket between the surfaces. Do not use coatings containing lead.

F. Continuity: Maintain accurate relation of planes and angles with hairline fit of contacting members. Uniformity of Metal Finish: Abutting extruded aluminum members shall not have an integral color or texture variation greater than half the range indicated in the sample pair submittal.

G. Fasteners: Conceal fasteners wherever possible.

H. Weatherstripping: For exterior doors, provide compression weatherstripping against fixed stops. At other edges, provide sliding weatherstripping retained in adjustable strip mortised into door edge.

1. Provide EPDM or vinyl-blade gasket weatherstripping in bottom door rail, adjustable for contact with threshold.

2. At interior doors and other locations without weatherstripping, provide neoprene silencers on stops to prevent metal-to-metal contact.

2.06 FINISHES

A. General: Comply with NAAMM "Metal Finishes Manual" for recommendations relative to application and designations of finishes.

B. Provide manufacturer's color anodized finish, complying with NAAMM "Metal Finishes Manual" for recommendations relative to application and designations of finishes. Color shall be as selected by the Architect/Engineer.

PART 3: EXECUTION

3.01 EXAMINATION

A. Examine substrates and supports, with the Installer present, for compliance with requirements indicated, installation tolerances, and other conditions that affect installation of aluminum entrances and storefronts. Correct unsatisfactory conditions before proceeding with the installation. Do not proceed with installation until unsatisfactory conditions are corrected.

3.02 INSTALLATION

A. Comply with manufacturer's instructions and recommendations for installation.

B. Set units plumb, level, and true to line, without warp or rack of framing members, doors, or panels. Install components in proper alignment and relation to established lines and grades indicated. Provide proper support and anchor securely in place.

C. Construction Tolerances: Install aluminum entrance and storefront to comply with the following tolerances:

1. Variation from Plane: Do not exceed 1/8 inch in 12 feet of length or 1/4 inch in any total length.

2. Offset from Alignment: The maximum offset from true alignment between two identical members abutting end to end in line shall not exceed 1/16 inch.

3. Diagonal Measurements: The maximum difference in diagonal measurements shall not exceed 1/8 inch.

4. Offset at Corners: The maximum out-of-plane offset of framing at corners shall not exceed 1/32 inch.

D. Separate aluminum and other corrodible metal surfaces from sources of corrosion or electrolytic action at points of contact with other materials.

1. Zinc or cadmium plate steel anchors and other unexposed fasteners after fabrication.

2. Paint dissimilar metals where drainage from them passes over aluminum.

3. Paint aluminum surfaces in contact with mortar, concrete or other masonry with alkali resistant coating.

4. Paint wood and similar absorptive material in contact with aluminum and exposed to the elements or otherwise subject to wetting, with two coats of aluminum house paint. Seal joints between the materials with sealant.

E. Drill and tap frames and doors and apply surface-mounted hardware items. Comply with hardware manufacturer's instructions and template requirements. Use concealed fasteners wherever possible.

F. Set sill members and other members in bed of sealant as indicated, or with joint fillers or gaskets as indicated to provide weather-tight construction. Comply with requirements of Division 7 for sealants, fillers, and gaskets.

G. Refer to "Glass" Section of Division 8 for installation of glass and other panels indicated to be glazed into doors and framing, and not pre-glazed by manufacturer.

3.03 ADJUSTING

A. Adjust operating hardware to function properly, for smooth operation without binding, and for weather-tight closure.

3.04 CLEANING

A. Clean the completed system, inside and out, promptly after installation, exercising care to avoid damage to coatings.

B. Clean glass surfaces after installation, complying with requirements contained in the "Glass" Section for cleaning and maintenance. Remove excess glazing and sealant compounds, dirt and other substances from aluminum surfaces.

3.05 PROTECTION

A. Institute protective measures required throughout the remainder of the construction period to ensure that aluminum entrances and storefronts will be without damage or deterioration, other than normal weathering, at time of acceptance.

END OF SECTION

SECTION 08520

ALUMINUM WINDOWS

PART 1: GENERAL

1.01 WORK INCLUDED

A. Applications of aluminum windows on the project include pre-glazed fixed units and as otherwise indicated on the Drawings.

B. Pre-finished extruded aluminum frames and perimeter seals.

1.02 RELATED WORK

A. Preparation of adjacent work to receive work of this section

B. Wood perimeter shims are specified in Section 06100

C. Joint Sealants are specified in Section 07920

D. Glass and glazing requirements are specified in Section 08810

E. Window opening elevations and schedules on drawings.

1.03 QUALITY ASSURANCE

A. Standards: Requirements for aluminum widows, terminology and standards of performance, and fabricated workmanship are those specified and recommended in AAMA 101-88 and applicable general recommendation published by AAMA and AA, including ANSI A58.1, "Minimum Design Loads for Buildings and Other Structures".

B. Design Criteria: Fabricate units to comply with the following requirements and performance criteria.

1. Design Wind Velocity: As required by applicable provisions of the International Building Code including large and small missile impact resistance.

2. High Performance Requirements of AAMA 101-88, Section 3.

3. Condensation Resistance Factor: 45 in accordance with AAMA 1502.6.

4. Structural Performance: Provide units with no failure or permanent deflection for a positive (inward) and negative (outward) test pressure of 52.5 lbs. per square foot.

a. Air Infiltration: Provide units with an air infiltration rate of not more than 0.09 cubic foot per minute per foot of operable sash joint for an inward test pressure of 1.57 lbs. per square foot.

b. Water Penetration: Provide units with no water penetration as defined in the test method at an inward test pressure of 10 lbs. per square foot.

c. Testing: Test each type and size of required window unit through a recognized testing laboratory or agency for structural performance in accordance with ASTM E 300, and with ASTM E 547 for water penetration. Provide certified test results or Miami-Dade Product Approvals.

C. Single Source Responsibility: Provide aluminum widows produced by a single manufacturer capable of showing prior production of units similar to those required.

1.04 SUBMITTALS

A. Shop Drawings: Submit shop drawings including information not fully detailed in the manufacturer's standard product data and elevations of continuous work at 1/4" scale, typical unit elevations at 3/4" scale, full size section details of every typical composite member, anchors, hardware, accessories, and glazing details.

B. Product Data: Submit manufacturer's product specifications, technical product data, recommendations, and standard details for aluminum window units required. Include fabrication methods, finishing, and accessories.

C. Samples: Submit samples of the specified finish on 12" lengths of window members. The Architect/Engineer reserves the right to require additional samples, which show fabrication techniques and workmanship, and design of hardware and accessories.

D. Certification: Provide certification by the manufacturer showing that each type, grade and size of window unit complies with requirements where the manufacturer's standard window units have been tested in accordance with specified tests and meet performance requirements specified. Where such testing has not been accomplished, perform required tests through a recognized testing laboratory or agency and provide certified test results.

1.05 WARRANTY

A. Submit written warranty signed jointly by manufacturer, installer and Contractor, agreeing to replace units that fail in materials or installations within two (2) years of date of acceptance.

B. Failure of materials or installation shall include, but not be limited to, anchorage, fastening, excessive leakage or air infiltration, excessive deflections, and deterioration of finish or metal in excess of normal weathering.

PART 2: PRODUCTS

2.01 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the work include, but are not limited to, the following:

1. Arch Aluminum & Glass Co.

2. United States Aluminum Corporation.

3. Kawneer

4. Peerless Products, Inc.

2.02 MATERIALS

A. Aluminum Extrusions: 6063-T5 alloy, minimum 22,000 psi ultimate tensile strength and minimum 0.078 inch thickness at any location for main frame and sash members.

B. Anchors, Clips and Window Accessories: Depending on strength of corrosion-inhibiting requirements, fabricate units of aluminum, or non-magnetic stainless steel.

C. Compression Glazing Strips: At manufacturer's option, provide molded neoprene gaskets complying with ASTM D2000 Designation 2BC415 to 3VC620, molded PVC gaskets complying with ASTM D 2287, or molded expanded neoprene gaskets complying with ASTM C 509, Grade 4.

D. Sealant: Type recommended by window manufacturer for joint size and movement, to remain permanently elastic, non-shrinking and non-migrating. Comply with Section, "Joint Sealants" for materials and installation.

2.03 WINDOW PERFORMANCE CLASSIFICATION

A. Commercial Windows: Provide window units complying with the requirements of AAMA Grade and Performance Class HC-40, Heavy Commercial, type designation as specified.

2.04 FIXED WINDOWS

A. Provide fixed window units consisting of a glazed frame installed into one opening. Units are not operable.

B. Include a complete system for assembly of components and anchorage of window units.

C. Sizes and Profiles: Required sizes for window units and profile requirements are indicated on the drawings. Variable dimensions are indicated along with maximum and minimum dimensions as required to achieve design requirements and coordination with other work.

1. Details shown are based upon standard details by one or more manufacturers. Similar details by other manufacturers will be acceptable, provided they comply with size requirements, minimum/maximum profile requirements, and performance standards as indicated or specified.

D. Provide subframes with anchors for window units where shown, of profile and dimensions indicated but not less than 0.062" thick extruded aluminum. Miter or cope corners, and weld and dress smooth with concealed mechanical joint fasteners. Finish shall match window units.

E. Provide weep holes and internal water passages to conduct infiltrating water to the exterior.

F. Provide mullions and cover plats as shown, matching window units, complete with anchors for support to structure and installation of window units. Allow for

erection tolerances and provide for movement of window units due to thermal expansion and building deflections, in the manner indicated.

G. Glazing Stops: Provide extruded screw-applied or snap-on glazing stops, coordinated with glass selection and glazing system indicated. Finish glazing stops to match window units.

H. Pre-glazed Fabrication: Pre-glazed window units at the factory where possible and practical for applications indicated. Comply with glass and glazing requirements of the "Glass" section of these specifications, and AAMA 101-88.

2.05 FINISHES

A. General: Comply with NAAMM "Metal Finishes Manual" for recommendations relative to application and designations of finishes.

B. Provide windows with manufacturer's color anodized finish. Color shall be as selected by the Architect/Engineer.

PART 3: EXECUTION

3.01 INSTALLATION

A. Comply with manufacturer's specification and recommendations for installation of window units and other components of the work. Verify wall openings.

B. Set units plumb, level, and true to line, without warp or rack of frames. Provide proper support and anchor securely in place.

1. Separate aluminum and other corrodible surfaces from sources of corrosion or electrolytic action at points of contact with other materials by complying with the requirements specified under paragraph "Dissimilar Materials" in the Appendix to AAMA 101-88.

C. Set sill members and other members in bed of compound or with joint fillers or gaskets as shown, to provide weather-tight construction. Refer to the "Joint Sealants" section of Division 7 for compounds, fillers and gaskets to be installed concurrently with window units. Coordinate installation with wall flashings and other components of the work.

1. Compounds, joint fillers and gaskets to be installed after installation of window units are specified as work in another section in Division-7.

3.02 CLEANING

A. Clean aluminum surfaces promptly after installation of windows. Exercise care to avoid damage to protective coatings and finishes. Remove excess glazing and sealant compounds, dirt and other substances.

B. Clean glass of pre-glazed units promptly after installation of windows; comply with requirements of the "Glass" section for cleaning and maintenance.

3.03 PROTECTION

A. Initiate and maintain protections and other precautions required through the remainder of the construction period, to ensure that, except for normal weathering, window units will be free of damage or deterioration at time of acceptance.

END OF SECTION

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SECTION 08710

FINISH HARDWARE

PART 1: GENERAL

1.01 WORK INCLUDED (ADMINISTRATION BUILDING)

A. Consists of securing and furnishing to the administration building, all Finish Hardware in accordance with this section and applicable drawings. It is intended that the following list of hardware cover all items required to complete the building and supplement doors with electronic components (where required). Omissions and/or discrepancies shall be brought to the Architects attention during the bidding period and, as needed, be corrected by addendum.

B. Items covered include, but are not necessarily limited to:

Hinges	Overhead Stops and Holders
Pivots	Pulls, Pushplates, Pull Plates
Lock Cylinders and Keys	Protection Plates
Locks and Latches	Flush and Surface Bolts
Deadbolts	Wall and Floor Stops
Closers	Thresholds
Exit Devices	Weatherstripping

1.02 RELATED SECTIONS AND DRAWINGS

A. Finish Carpentry are specified in section 06410

B. Hollow Metal Work are specified in section 08110

C. Wood Doors are specified in section 08211

D. Aluminum Entrances and Storefronts are specified in section 08410

E. Architectural Drawings

1.03 SPECIFIC OMISSIONS

A. Hardware for the following is specified elsewhere.

1. Windows
2. Cabinets and casework including open wall shelving
3. Signs
4. Toilet Partitions and Rest Room accessories
5. Aluminum Entrance Doors (except keyed cylinders)

1.04 REFERENCES

A. State and Local Codes including Authority having jurisdiction.

B. Building Code

C. ANSI 156.18 - Materials and Finishes.

D. ANSI 117.1 - Specifications for making Buildings and Facilities usable by Physically Handicapped People.

E. Georgia Accessibility Standards for Building Construction.

F. ADA - Americans with Disabilities Act of 1990.

G. BHMA - Builders Hardware Manufacturers Assoc.

H. NFPA - National fire Protection Assoc.

1. NFPA80 - Fire Doors and Windows

2. NFPA101 - Life Safety Code

I. SDI - Steel Door Institute

J. WDI - Wood Door Institute

1.05 SUBMITTALS

A. Submit copies of vertically formatted Hardware Schedule in accordance with the General Conditions.

B. Format Hardware Schedule into Hardware Groups to clearly identify each door and frame with the following.

C. Unique number; Descriptive location; Size; Hand; Degree of swing.

D. List within Hardware Groups all items required for each door or pair of doors, including the following.

E. Quantity; Item description; Manufacturers name and catalog number; Size: BHMA finish.

F. Furnish numerically sorted cross reference of door numbers to Hardware Groups.

G. Furnish 4 copies of catalog cuts for each item of hardware.

H. Furnish index and explanation of abbreviations, symbols and/or codes contained in Hardware Schedule.

I. Furnish chart of mounting heights and locations.

J. Approval of Hardware Schedule will not relieve the supplier’s responsibility of furnishing all hardware to complete the project.

1.06 COORDINATION

A. Furnish templates and approved Hardware Schedule in a timely manner to respective material suppliers and trades to ensure accurate reinforcing and fitting of finish hardware.

1.07 QUALITY ASSURANCE

A. Supplier to be a directly franchised distributor of the products to be furnished, with warehousing facilities within 50 miles of the project. An AHC, Architectural

Hardware Consultant, or person of equivalent experience shall be in their employ and available for consultation to the Architect, Owner and General Contractor at reasonable times during the course of work.

B. Single Source Responsibility: Obtain each category of hardware; (lockset, latchset, deadbolt, cylinder); (hinges); (closers), etc: from a single manufacturer.

C. Hardware for fire rated openings shall comply with NFPA80, State and Local Fire Safety Codes.

1. Hardware shall comply with requirements of the Americans with Disabilities Act, ADA, A117.1.

1.08 DELIVERY, STORAGE AND IDENTIFICATION

A. Package hardware items individually in manufacturer's original cartons, clearly marked to indicate contents and cross referenced to Hardware Schedule.

B. Deliver, Store and protect all items under provisions of the General Conditions.

C. Provide locked storage area protected from moisture, sunlight, paint, chemicals, etc.

1.09 MAINTENANCE

A. Furnish any specialized tools and maintenance instruction manuals to Owner's Representative.

1.10 WARRANTY

A. Provide a one (1) year warranty against defects in materials and workmanship, commencing with substantial completion of the project. Extended warranties are specifically mentioned in each product category.

PART 2: PRODUCTS

2.01 MANUFACTURERS

A. Unless specifically noted otherwise in Hardware Groups the following requirements shall apply. Manufacturer's and product types have been uniquely selected for this project. Acceptable alternates are noted at the end of each section.

2.02 FINISHES

A. Satin Chromium: US26D, BHMA 626: Lock, Latch, Deadbolt trim; Cylinders; Floor Stops.

B. Satin Chromium: US26D, BHMA 652: Interior Hinges, Overhead Stops, Surface Bolts.

C. Satin Stainless Steel: US32D, BHMA 630: Exterior Hinges; Exit Device trim; Push, Pull and Kickplates, Wall Stops.

D. Powder Coat, Aluminum: BHMA 689: Closers.

E. Aluminum: US27, BHMA 719: Thresholds, Door Shoes, Weatherstripping, Astragals.

2.03 HINGES

A. As manufactured by Hager, five knuckle, flat button tip design.

B. Provide three hinges on all doors up to and including 90 inches in height.

C. Add one hinge for each additional 30 inches in height.

D. All exterior doors to have non-removable pins.

E. Types and Sizes:

1. Doors up to and including 36” in width: 1279 / 1191; w/ closer

2. BB1279 / BB1191, 4.5 x 4.5

3. Doors exceeding 36” in width: BB1168 / BB1199, 5 X 4.

F. Provide shims and instructions for proper door adjustment.

G. Stanley and Monthard are acceptable alternates in this product category.

2.04 LOCKSETS, LATCHSETS, DEADBOLTS, RIM AND MORTISE CYLINDERS

A. As manufactured by the Schlage Lock Company, B, D and D90 “Vandlgard” series in Rhodes design. Vandlgard functions to have clutching outside lever when mechanism is in the locked position.

B. All lock cylinders to be interchangeable core.

C. Functions as noted in Hardware Groups.

D. Sargent and Emhart are acceptable alternates in this product category.

2.05 KEYING

A. All pin tumbler cylinders shall be keyed, Masterkeyed and Grand

B. Masterkeyed as per the Owners instructions.

C. Provide patented keys, i.e.: Schlage EVEREST, to protect against unauthorized key duplication.

D. Furnish two, (2) keys each pin tumbler cylinder; four, (4) keys maximum for keyed alike groups; five (5) Masterkeys each masterkey set; five, (5) Grand masterkeys.

E. Provide temporary construction cores with twenty (20) construction keys.

F. Permanent cylinders to be shipped directly to the Owner’s representative.

G. As specific areas of the project are completed, the General Contractor, in concert with the Owner’s representative, shall replace the construction cyores with permanent ones provided by the Owner.

2.06 EXIT DEVICES

A. 99 series as manufactured by Von Duprin.

B. Functions as noted in Hardware Groups.

C. Thru bolt to door with sex bolts.

D. Sargent is an acceptable alternate in this product category.

2.07 CLOSERS

A. As manufactured by LCN, 4041 series utilizing hydraulic fluid in compliance with UBC 7.2 and UL 10C.

B. Install on inside of exterior doors and on non public side of interior doors.

C. Thru bolt to door with sex bolts.

D. Provide 5-year warranty written against defects in material and workmanship.

E. Sargent is an acceptable alternate in this product category.

2.08 PULL PLATES, PUSHPLATES, KICKPLATES;

A. As manufactured by Rockwood.

B. Types as noted in Hardware Groups. Reduce size accordingly to accommodate stile width.

C. Kickplates:

1. Provide on push side of all wood and hollow metal doors with door

2. closers.

3. Single door: 10 X 2” LDW .050 B3E

4. Pairs of doors: 10 X 1” LDW .050 B3E

5. Where louvers are present provide plates 1” less in height than remaining bottom rail.

D. Trimco and Quality are acceptable alternates in this product category.

2.09 OVERHEAD, WALL AND FLOOR STOPS

A. As manufactured by Glynn Johnson.

B. Overhead Stops:

1. Types as noted in Hardware Groups.

2. Thru bolt to door with sex bolts.

C. Wall and Floor Types:

1. Where doors parallel a wall or other obstruction in the open position and are not provided with an Overhead Stop or Cushion Closer, provide Wall type 50W / 60W.

a. General Contractor to provide solid blocking within stud space to receive wall attachment.

2. All other doors, Floor type F13 / F17.

D. Rockwood and Trimco are acceptable alternates in this product category.

2.10 FLUSH AND SURFACE BOLTS

A. As manufactured by Glynn Johnson.

B. Types as noted in Hardware Groups.

C. Ives is an acceptable alternate in this product category.

2.11 THRESHOLDS, WEATHERSTRIPPING, ASTRAGALS

A. As manufactured by Pemko.

B. Types as noted in Hardware Groups.

C. Zero and National Guard are acceptable alternates in this product category.

2.12 SILENCERS

A. Type GJ64 as manufactured by Glynn Johnson.

B. Furnish on all doors without weather stripping.

C. Provide 3 on each single and 2 on each pair of doors.

PART 3: EXECUTION

3.01 INSPECTION

A. Verify that doors and frames are ready to receive work and dimensions are as indicated on shop drawings.

B. Beginning of installation means acceptance of existing conditions.

3.02 INSTALLATION

A. Utilize instructions and templates provided with each item of hardware.

B. Set all thresholds in a full bed of butyl-rubber.

C. Mounting heights from finished floor to centerline of hardware item.

1. Locks, Latches: 38”
2. Deadbolts: 46”
3. Exit devices: 38”
4. Push, Pulls: 45”

3.03 ADJUST AND CLEAN

A. Check and adjust the operation of each door and item of hardware to ensure their proper function.

B. Final adjustments are to be made after all ventilating systems are in operation.

C. Clean all hardware and adjacent surfaces after installation.

D. Instruct Owners personnel in adjustment and maintenance of hardware and hardware finishes.

END OF SECTION

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SECTION 08810

GLASS AND GLAZING

PART 1: GENERAL

1.01 WORK INCLUDED

A. This Section includes glazing for the following products, including those specified in other Sections where glazing requirements are specified by reference to this Section:

1. Fixed storefront and window units
2. Aluminum and glass entrances
3. Vision Lites

B. Glazing locations shall be as indicated on the Drawings.

C. Related Sections: The following sections contain requirements that relate to this Section.

1. Aluminum Entrances and Storefronts are specified in Section 08410
2. Aluminum Windows are specified in Section 08520

1.02 DEFINITIONS

A. Manufacturer is used in this Section to refer to a firm that produces primary glass or fabricated glass as defined in the referenced glazing standard.

B. Deterioration of Laminated Glass: Defects developed from normal use that are attributed to the manufacturing process and not to glass breakage and practices for maintaining and cleaning laminated glass contrary to manufacturer's directions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated glass standard.

1.03 SYSTEM PERFORMANCE REQUIREMENTS

A. General: Provide glazing systems that are produced, fabricated, and installed to withstand normal thermal movement, wind loading, and impact loading (where applicable), without failure including loss or glass breakage attributable to the following: defective manufacture, fabrication, and installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; and other defects in construction.

1. Provide glass units for exterior openings that have Miami-Dade Products Control Approval for hurricane wind resistance and air-borne missile impact from hurricane force winds.

B. Glass Design: Glass thicknesses indicated on Drawings are for detailing only. Confirm glass thicknesses by analyzing Project loads and in-service conditions. Provide glass lites for the various size openings in the thicknesses and strengths (annealed or heat-treated) to meet or exceed the following criteria:

1. Minimum glass thickness, nominally, of lites in exterior walls is 9/16 inch unless otherwise indicated.

2. Minimum glass thicknesses of lites, whether composed of annealed or heat-treated glass, are selected so the worst-case probability of failure does not exceed 8 lites per 1,000 for lites set vertically or not over 15 degrees off vertical and under wind action. Determine minimum thickness of monolithic annealed glass according to ASTM E 1300. For other than monolithic annealed glass, determine thickness per glass manufacturer's standard method of analysis including applying adjustment factors to ASTM E 1300 based on type of glass.

C. Normal thermal movement results from the following maximum change (range) in ambient and surface temperatures acting on glass-framing members and glazing components. Base engineering calculation on materials' actual surface temperatures due to both solar heat gain and nighttime sky heat loss. Temperature Change (Range): 120 degrees F ambient; 180 degrees F, material surfaces.

1.04 SUBMITTALS

A. Product data for each glass product and glazing material indicated.

B. Samples for verification purposes of 12-inch-square samples of each type of glass indicated except for clear monolithic glass products, and 12-inch-long samples of each color required (except black) for each type of sealant or gasket exposed to view. Install sealant or gasket sample between two strips of material representative in color of the adjoining framing system.

C. Product certificates signed by glazing materials manufacturers certifying that their products comply with specified requirements. Separate certifications are not required for glazing materials bearing manufacturer's permanent labels designating type and thickness of glass, provided labels represent a quality control program of a recognized certification agency or independent testing agency acceptable to authorities having jurisdiction.

D. Compatibility and adhesion test reports from sealant manufacturer indicating that glazing materials were tested for compatibility and adhesion with glazing sealants. Include sealant manufacturer's interpretation of test results relative to sealant performance and recommendations for primers and substrate preparation needed for adhesion.

E. Product test reports for each type of glazing sealant and gasket indicated, evidencing compliance with requirements specified.

F. Maintenance data for glass and other glazing materials to be included in Operating and Maintenance Manual specified in Division 1.

1.05 QUALITY ASSURANCE

A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below, except where more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.

1. FGMA Publications: "FGMA Glazing Manual."

2. LSGA Publications: "LSGA Design Guide."

3. SIGMA Publications: TM-3000 "Vertical Glazing Guidelines".

B. Safety Glass: Products complying with ANSI Z97.1 and testing requirements of 16 CFR Part 1201 for Category II materials.

C. Glazier Qualifications: Engage an experienced glazier who has completed glazing similar in material, design, and extent to that indicated for Project with a record of successful in-service performance.

D. Single-Source Responsibility for Glass: Obtain glass from one source for each product indicated below:

1. Primary glass of each (ASTM C 1036) type and class indicated.

2. Heat-treated glass of each (ASTM C 1048) condition indicated.

3. Laminated glass of each (ASTM C 1172) kind indicated.

E. Single-Source Responsibility for Glazing Accessories: Obtain glazing accessories from one source for each product and installation method indicated.

F. Preconstruction Compatibility and Adhesion Testing: Submit to sealant manufacturers, samples of each glass, gasket, glazing accessory, and glass-framing member that will contact or affect glazing sealants for compatibility and adhesion testing as indicated below:

1. Use test methods standard with sealant manufacturer to determine if priming and other specific preparation techniques are required for rapid, optimum glazing sealants adhesion to glass and glazing channel substrates. Perform tests under normal environmental conditions during installation.

2. Submit not less than nine pieces of each type and finish of glass-framing members and each type, class, kind, condition, and form of glass (monolithic, laminated, insulating units) for adhesion testing, as well as one sample of each glazing accessory (gaskets, setting blocks and spacers) for compatibility testing.

3. Schedule sufficient time to test and analyze results to prevent delay in the Work.

4. Investigate materials failing compatibility or adhesion tests. Obtain sealant /manufacturer's written recommendations for corrective measures, including using special primers.

5. Testing is not required when glazing sealant manufacturer can submit required preparation data that is acceptable to Architect/Engineer and is based on previous testing of current sealant products for adhesion to and compatibility with submitted glazing materials.

G. Pre-Installation Conference: Conduct conference at Project site to comply with requirements of Division-1.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Protect glazing materials to comply with manufacturer's directions and as needed to prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

1.07 PROJECT CONDITIONS

A. Environmental Conditions: Do not proceed with glazing when ambient and substrate temperature conditions are outside the limits permitted by glazing materials manufacturer or when glazing channel substrates are wet from rain, frost, condensation, or other causes.

PART 2: PRODUCTS

2.01 PRIMARY FLOAT GLASS PRODUCTS

A. Uncoated Clear Fully Tempered Float Glass: ASTM C 1036, Type I (transparent glass, flat), Class I (clear), Kind FT (fully tempered) and Quality q3 (glazing select).

B. Uncoated Tinted Fully Tempered Float Glass: ASTM C 1036, Type I (transparent glass, flat), Class 2 (tinted, heat-absorbing, and light-reducing), Kind FT (fully tempered), Condition A (uncoated surfaces), Quality q3 (glazing select); manufacturer’s cool grey tint.

C. Refer to requirements for sealed insulating glass units for performance characteristics of assembled units composed of tinted glass, coated or uncoated, relative to visible light transmittance, U-values, shading coefficient, and visible reflectance.

2.02 HEAT-TREATED FLOAT GLASS PRODUCTS, GENERAL

A. Fabrication Process: By vertical (tong-held) or horizontal (roller-hearth) process, at manufacturer's option, except provide horizontal process where indicated as tongless or free of tong marks.

2.03 HEAT-TREATED FLOAT GLASS

A. Coated, Clear, Heat-Treated Float Glass: Glass shall be 3/16-inch tempered as manufactured by Viracon, Inc. or equivalent. Reflective coating shall be installed on the #2 surface.

B. Coated, Tinted, Heat-Treated Float Glass: Glass shall be 3/16-inch tempered as manufactured by Viracon, Inc. or equivalent. Tint shall be manufacturer’s standard light gray.

2.04 LAMINATED GLASS PRODUCTS

A. Laminated Glass Products: Comply with ASTM C 1172 for kinds of laminated glass indicated and other requirements specified. Refer to primary and heat-treated glass requirements relating to properties of glass products comprising laminated glass products.

B. Interlayer: Polyvinyl butyral sheet interlayer material, clear, and of thickness and composition to comply with testing and product approvals, but in no case less than 0.090 inch. Manufacturer: “Saflex Keepsafe” by Solutia or equivalent.

C. Laminating Process: Fabricate laminated glass to produce glass free of foreign substances and air or glass pockets as follows: Laminate lites in autoclave with heat plus pressure.

2.05 ELASTOMERIC GLAZING SEALANTS

A. General: Provide products of type indicated, complying with the following requirements:

1. Compatibility: Select glazing sealants and tapes of proven compatibility with other materials they will contact, including glass products, seals of insulating glass units, and glazing channel substrates, under conditions of installation and service, as demonstrated by testing and field experience.

2. Suitability: Comply with sealant and glass manufacturer's recommendations for selecting glazing sealants and tapes that are suitable for applications indicated and conditions existing at time of installation.

3. Colors: Provide selections made by Architect/Engineer from manufacturer's full range of standard colors for products of type indicated.

B. Elastomeric Glazing Sealant Standard: Provide manufacturer's standard chemically curing, elastomeric sealants of base polymer indicated that comply with ASTM C 920 requirements indicated on each Elastomeric Glazing Sealant Product Data Sheet at the end of this Section, including those referencing ASTM classifications for Type, Grade, Class and Uses.

1. Additional Movement Capability: Provide products, when tested for adhesion and cohesion under maximum cyclic movement per ASTM C 719, with the capability to withstand the specified percentage change in the joint width existing at time of installation and remain in compliance with other requirements of ASTM C 920 for uses indicated.

2.06 GLAZING GASKETS

A. Soft Compression Gaskets: Extruded or molded closed-cell, integral-skinned gaskets of material indicated below, complying with ASTM C 509, Type II, black, and of profile and hardness required to maintain watertight seal:

1. EPDM

2. Silicone

3. Thermoplastic polyolefin rubber

4. Any material indicated above

B. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the work include, but are not limited to, the following companies.

1. Advanced Elastomer Systems, L.P.

2. Schnee-Morehead, Inc.

3. Tremco, Inc.

2.07 MISCELLANEOUS GLAZING MATERIALS

A. General: Provide products of material, size, and shape complying with referenced glazing standard, requirements of manufacturers of glass and other glazing materials involved for glazing application indicated, and with a proven record of compatibility with surfaces contacted in installation.

B. Cleaners, Primers and Sealers: Type recommended by sealant or gasket manufacturer.

C. Setting Blocks: Elastomeric material with a Shore A durometer hardness of 85 +/- 5.

D. Spacers: Elastomeric blocks or continuous extrusions with a Shore A durometer hardness required by glass manufacturer to maintain glass lites in place for installation indicated.

E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side-walking).

2.08 FABRICATION OF GLASS AND OTHER GLAZING PRODUCTS

A. Fabricate glass and other glazing products in sizes required to glaze openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with recommendations of product manufacturer and referenced glazing standard as required to comply with system performance requirements.

PART 3: EXECUTION

3.01 EXAMINATION

A. Examine glass framing, with glazier present, for compliance with the following:

1. Manufacturing and installation tolerances, including those for size, squareness, offsets at corners.

2. Presence and functioning of weep system.

3. Minimum required face or edge clearances.

4. Effective sealing between joints of glass-framing members.

B. Do not proceed with glazing until unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings that are not firmly bonded to substrates.

3.03 GLAZING, GENERAL

A. Comply with combined recommendations of manufacturers of glass, sealants, gaskets, and other glazing materials, except where more stringent requirements are indicated, including those in referenced glazing publications.

B. Glazing channel dimensions as indicated on Drawings provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances. Adjust as required by Project conditions during installation.

C. Protect glass from edge damage during handling and installation as follows:

1. Use a rolling block in rotating glass units to prevent damage to glass corners. Do not impact glass with metal framing. Use suction cups to shift glass units within openings; do not raise or drift glass with a pry bar. Rotate glass lites with flares or bevels on bottom horizontal edges so edges are located at top of opening, unless otherwise indicated by manufacturer's label.

2. Remove damaged glass from Project site and legally disposed of off site. Damaged glass is glass with edge damage or other imperfections that, when installed, weaken glass and impair performance and appearance.

D. Apply primers to joint surfaces where required for adhesion of sealants, as determined by pre-construction sealant-substrate testing.

E. Install elastomeric setting blocks in sill rabbets, sized and located to comply with referenced glazing standard, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.

F. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.

G. Provide spacers for glass sizes larger than 50 united inches (length plus height) as follows:

1. Locate spacers inside, outside, and directly opposite each other. Install correct size and spacing to preserve required face clearances, except where gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and comply with system performance requirements.

2. Provide 1/8-inch minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.

H. Provide edge blocking to comply with requirements of referenced glazing publications, unless otherwise required by glass manufacturer.

I. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.

3.04 GASKET GLAZING (DRY)

A. Fabricate compression gaskets in lengths recommended by gasket manufacturer to fit openings exactly, with stretch allowance during installation.

B. Secure compression gaskets in place with joints located at corners to compress gaskets producing a weather-tight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

C. Install gaskets so they protrude past face of glazing stops.

3.05 SEALANT GLAZING (WET)

A. Install continuous spacers between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel weep systems until sealants cure. Secure spacers in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.

B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.

C. Tool exposed surfaces of sealants to provide a substantial wash away from glass. Install pressurized gaskets to protrude slightly out of channel to eliminate dirt and moisture pockets.

3.06 PROTECTION AND CLEANING

A. Protect exterior glass from breakage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels, and clean surfaces.

B. Protect glass from contact with contaminating substances resulting from construction operations including weld splatter. If, despite such protection, contaminating substances do come into contact with glass, remove them immediately as recommended by glass manufacturer.

C. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for build-up of dirt, scum, alkali deposits, or stains, and remove as recommended by glass manufacturer.

D. Remove and replace glass that is broken, chipped, cracked, abraded, or damaged in any way, including natural causes, accidents and vandalism, during construction period.

E. Wash glass on both faces in each area of Project not more than 4 days prior to date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended by glass manufacturer.

END OF SECTION

SECTION 09125

METAL FRAMING AND LATH

PART 1: GENERAL

1.01 WORK INCLUDED

A. Extent of metal framing and lath is indicated on the Drawings.

B. Work includes, but is not limited to, the following:

1. Expanded metal lath and metal framing associated with Portland cement plaster (stucco) work
2. Stainless steel framing support systems and connections
3. Plaster accessories and trim
4. Molded Expanded Polystyrene Board Insulation for decorative stucco moldings, trim and elements

C. Related Work:

1. Portland cement plaster (stucco) work is specified in Section 09220
2. Metal Fabrications are specified in Section 05500
3. Rough Carpentry is specified in Section 06100
4. Joint Sealants are specified in Section 07920
5. Framing for Gypsum Board is specified in Section 09260.

1.02 QUALITY ASSURANCE

A. Comply with latest specification of Metal Lath Manufacturer's Association and ANSI Standards, ANSI A42.3 and ANSI A42.4 except where more stringent or more detailed requirements are indicated.

B. Comply with ML/SFA "Guidelines for Metal Lathing and Furring" and "Technical Bulletin 10l" for selection of metal lath for each application indicated.

1.03 SUBMITTALS

Product Data: Submit two copies of manufacturer's product guidelines and Installation instructions for each item and each system required in the work. Include reports and other data as may be required to show compliance with these guidelines.

1.04 DELIVERY, STORAGE AND HANDLING

A. Protect lath and metal support materials from exposure to weather. Deliver in manufacturer's unopened containers or bundles, identified with name, brand, type and grade.

B. Store inside in a dry, ventilated space.

PART 2: PRODUCTS

2.01 MANUFACTURER

A. Acceptable Manufacturers: Provide products and systems from one of the following:

1. Manufacturers of Stainless Steel Metal Supports:

a. Alabama Metal Industries.

b. Dale Industries, Inc.

c. Gold Bond Building Products Division, National Gypsum Co.

d. United States Gypsum Co.

2. Manufacturers of Expanded Metal Lath:

a. Dale Industries.

b. Alabama Metal Industries.

c. K-Lath Division, Tree Island Steel.

3. Manufacturers of Accessories:

a. Fry Reglet Corp.

b. Gold Bond Building Products Division, National Gypsum Co.

c. Dale Industries.

d. Alabama Metal Industries.

e. MM Systems Corp.

f. United States Gypsum Co.

B. Manufacturer's Recommendations: Except where otherwise indicated or specified, provide the type, weight, grade and finish of materials, and include for each system the clips, fasteners, ties, reinforcing, stiffeners, shoes, tracks, hangers, brackets, anchors, accessories, and trim as recommended by the manufacturer for the application indicated.

2.02 MATERIALS

A. Metal and Finishes: Manufacturer's standard stainless steel products unless indicated otherwise.

1. Exterior Components: Stainless steel; ASTM A 276, Type 316L

2. Exterior Exposed Plastering Accessories: Provide zinc alloy accessories for exterior work.

2.03 HORIZONTAL METAL FRAMING

A. General: Size metal ceiling supports to comply with the following, unless otherwise indicated.

B. Lathing and Furring for Portland Cement and Portland Cement-Lime Plastering, Exterior (Stucco) and interior: ANSI A42.3-1971 including May 1976 Addendum.

C. Wire for Hangers and Ties: Stainless steel.

D. Load Bearing (Transverse and Axial) Studs and Runners: ASTM A 276, Type 316L complying with the following requirements:

1. Minimum 33,000 psi yield point for design thicknesses of 0.0478" (18 gage) or less.

2. Minimum 50,000 psi yield point for design thicknesses of 0.0598" (16 gage) or more.

E. Channels: Cold-rolled stainless steel, 0.0598" min, thickness of base metal (uncoated), allowable bending stress of 18,000 psi.

1. Carrying Channels: See studs and runners article above.

2. Furring Channels: 3/4" deep x 7/16" wide flanges, 316 lbs. per 1000' galvanized.

F. Anchorage Devices: Provide screws, cast-in-place concrete inserts or other devices of stainless steel or other non-corrosive metal appropriate for anchorage to the form of structural framing indicated and whose suitability for use intended has been proven through standard construction practices or certified test data.

Size devices to develop full strength of hanger but not less than 3 times calculated hanger loading, except size direct pull-out concrete inserts for 5 x calculated hanger loading.

2.04 VERTICAL METAL FURRING

Channel Furring and Braces: Stainless steel, 0.0598" min. thickness of base (uncoated) metal, allowable bending stress of 18,000 psi, 3/4" deep x 7/16" wide flanges, 316 lbs. per 1000 feet.

2.05 METAL LATH

A. Expanded Metal Lath: Fabricate expanded metal lath from zinc-coated (galvanized) steel sheet to produce lath complying with ASTM C 847 for type, configuration and other characteristics indicated below.

B. Diamond Mesh Lath: Comply with the following requirements:

1. Configuration: Flat; Weight: 3.4 lbs. per square yard.

2. Configuration: Self-furring; Weight: 3.4 lbs. per square yard.

C. Paper Backing: Where paper-backed diamond mesh lath is indicated, provide asphalt-impregnated paper factory-bonded to back and complying with FS UU-B-790, for Type I, Grade D (vapor permeable), Style 2.

D. Lath Attachment Devices: Devices of material and type required by referenced standards and recommended by lath manufacturer for secure attachment of lath to framing members and of lath to lath.

2.06 PLASTER ACCESSORIES

A. General: Comply with material provisions of Lathing and Furring for Portland Cement and Portland Cement-Lime Plastering Exterior (Stucco) and Interior, ANSI A42.3-1971 including May 1976 Addendum.

1. Coordinate depth of accessories with thicknesses and number of coats required.

2. All accessories to be non-corrosive types; zinc alloy wherever possible and hot dip galvanized (G90) elsewhere.

B. Metal Corner Reinforcement: Expanded large mesh diamond metal lath fabricated from zinc-alloy or welded wire mesh fabricated from 0.0475" diameter zinc-coated (galvanized) wire, and specially formed to reinforce external corners of Portland cement plaster on exterior exposures while allowing full plaster encasement.

C. Corner Beads: Small nose corner beads fabricated from zinc alloy, with perforated flanges of expanded large mesh diamond lath to allow full encasement by plaster.

D. Casing Beads: Square-edged style, with expanded flanges and removable protective tape, of Zinc alloy.

E. Control Joints: Prefabricate, of material and type indicated below:

1. Material: Zinc alloy.

2. One-Piece Type: Folded pair of non-perforated screeds in M-shaped configuration, with expanded flanges.

2.07 MOLDED EXPANDED POLYSTYRENE BOARD INSULATION

A. Rigid, cellular thermal insulation meeting the system manufacturer's current published specifications for material qualities including corner squareness and other dimensional tolerances; in manufacturer's standard lengths and widths; thickness 3/4 inch unless otherwise indicated; R-value: 3.85 per 1-inch thickness.

PART 3: EXECUTION

3.01 INSTALLATION OF LATHING AND FURRING, GENERAL

A. Portland Cement Plaster Lathing and Furring Installation Standard: Install lathing and furring materials indicated for Portland cement plaster to comply with ANSI A42.3, including May 1976 Addendum.

B. Install supplementary framing, blocking, and bracing at terminations in the work and for support of fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, and similar work to comply with details indicated or if not otherwise indicated, to comply with applicable published recommendations of gypsum plaster manufacturer, or if not available, of "Gypsum Construction Handbook" published by United States Gypsum Co.

C. Isolation: Where lathing and metal support system abuts building structure horizontally, and where partition/wall work abuts overhead structure, isolate the

work from structural movement sufficiently to prevent transfer of loading into work from the building structure. Install slip or cushion type joints to absorb deflections but maintain lateral support.

D. Frame both sides of control and expansion joints independently, and do not bridge joints with furring and lathing or accessories.

3.02 INSTALLATION OF CEILING SUSPENSION SYSTEMS

A. Preparation and Coordination: Coordinate installation of ceiling suspension system with installation of overhead structural systems to ensure that inserts and other structural anchorage provisions have been installed to receive ceiling hangers in a manner that will develop their full strength and at spacing required to support ceiling.

Furnish concrete inserts, and other devices indicated, to other trades for installations well in advance of time needed for coordination with other work.

B. Hanger Installation: Attach hangers to structure above ceiling to comply with ML/SFA "Specifications for Metal Lathing and Furring" and with referenced standards.

C. Install ceiling suspension system components of sizes and spacing indicated but not in smaller sizes or greater spacing than that required by referenced lathing and furring installation standards.

D. Carrying Channels: Space cold formed carrying channels (studs/joists and runners) as indicated on drawings.

E. Furring Channels to Receive Metal Lath: Space furring channels not over 16" on center for ¾ lb diamond mesh lath.

3.03 INSTALLATION OF METAL FURRING

A. Metal Furring to Receive Metal Lath: Comply with requirements of ML/SFA "Specification for Metal Lathing and Furring" applicable to each installation condition indicated.

B. Space furring members 16" on center, except space ceiling/soffit furring 13-1/2" on center.

3.04 METAL LATHING

A. Install expanded metal lath for the following applications where plaster base coats are required. Provide appropriate type, configuration and weight of metal lath selected from materials indicated which comply with Referenced lathing installation standards.

B. Vertical metal framing and furring: Nail self-furring diamond mesh lath directly to monolithic surfaces not complying with requirements of referenced plaster application standards for characteristics that permit direct bond with plaster.

3.05 INSTALLATION OF PLASTERING ACCESSORIES

A. General: Comply with referenced lathing and furring installation standards for provision and location of plaster accessories of type indicated. Miter or cope

accessories at corners; install with tight joints and in alignment. Attach accessories securely to plaster bases to hold accessories in place and alignment during plastering.

B. Accessories for Portland Cement Plaster: Install accessories of type indicated at following locations:

1. External Corners: Install corner beads at external corners

2. Casing Beads: Install at terminations of plaster work

C. Control Joints: Install control joints at locations indicated, or if not indicated, at locations complying with the following criteria and approved by Architect.

1. Where an expansion or control joint occurs in surface of construction directly behind plaster membrane.

2. Where, in plastered surfaces of ceilings and walls, distances between, and areas within, control joints exceed, respectively, the following measurements: 10' in either direction and 100 square feet; and where length to width ration exceeds 2-1/2 to 1.

3. Extend joints full width or height of plaster membrane where Portland cement plaster panel sizes or dimensions change.

D. Install prefabricated expansion joints of 2-piece design where shown as "Expansion Joint"; 3/8" joint width for exterior.

E. Install channel screeds (reveals) where indicated. Where ends of channel sections meet, set in bead of sealant; set all splice plates in mastic.

3.06 TOLERANCES

A. Install members to provide surface plane with maximum variation of l/8 inch in 10 feet in any direction.

END OF SECTION

SECTION 09220

PORTLAND CEMENT PLASTER (STUCCO)

PART 1: GENERAL

1.01 WORK INCLUDED

A. Extent of Portland cement stucco is shown on drawings and in schedules.

B. Types of Portland cement stucco required include, but are not limited to, interior and exterior work.

C. Metal Framing and Lath is specified in Section 09125.

1.02 QUALITY ASSURANCE

A. Coordination of Work: Coordinate layout and installation of suspension system components for suspended soffits with other work supported by, or penetrating through, soffits.

B. Single Source Responsibility: Obtain materials for Portland cement plaster from a single source for each type of material required to ensure consistency in quality of performance and appearance.

1.03 SUBMITTALS

A. Product Data: Submit manufacturer's product specifications and installation instructions for each product, including data showing compliance with the requirements.

B. Material Certificates: Submit producer's certificate for each kind of plaster aggregate indicated, evidencing that materials comply with requirements.

1.04 DELIVERY, STORAGE AND HANDLING

A. Deliver Cementitous materials in original packages, containers or bundles bearing brand name and identification of manufacturer.

B. Store materials inside, under cover and in manner to keep them dry, protected from weather, direct sunlight, surface contamination, aging, corrosion, and damage from construction traffic and other causes.

1.05 PROJECT CONDITIONS

A. Environmental Requirements, General: Comply with requirements of referenced plaster application standards and recommendations of plaster manufacturer for environmental conditions before, during and after application of plaster.

B. Protect contiguous work from moisture deterioration and soiling which might result from plastering operations. Provide temporary covering and whatever other provisions may be necessary to minimize harmful spattering of plaster on other work.

C. Warm Weather Requirements: Protect plaster against uneven and excessive evaporation and from strong flows of dry air, both natural and artificial. Apply and cure

plaster as required by climatic and job conditions to prevent drying out during cure period. Provide suitable coverings, moist curing, barriers to deflect sunlight and wind, or combinations of these, as required.

PART 2: PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide products of one of the following:

1. Manufacturers of Portland Cement Stucco:

a. WR Bonsal Co.

b. Thoro

c. Rinker Materials Corp.

d. Florida Stucco Corp.

2.02 PORTLAND CEMENT PLASTER MATERIALS

A. Base Coat Cements: Type as indicated below.

B. Portland cement, ASTM C 150, Type I or III.

C. Masonry cement, ASTM C 91, Type N

D. Finish Coat Cement: Material and color as indicated below:

E. Portland cement, ASTM C 150, type as follows: Type I.

F. Cement Color: Gray.

G. Lime: Special hydrated lime for finishing purposes, ASTM C 206, Type S, or special hydrated lime for masonry purposes, ASTM C 207, Type S.

H. Sand Aggregates for Base Coats: ASTM C 897.

I. Aggregate for Finish Coats: ASTM C 897, natural sand, white in color.

2.03 MISCELLANEOUS MATERIALS

A. Stucco Water Repellent: Master Builder's "Stearox" or other as approved by Architect/Engineer.

B. Bonding Agent: ASTM C 932. Color different from substrate.

C. Water for Mixing and Finishing Plaster: Potable, free of substances capable of affecting plaster set or of damaging plaster, lath or accessories.

2.04 PORTLAND CEMENT PLASTER MIXES AND COMPOSITIONS

A. General: Comply with ASTM C 926 for base and finish coat mixes as applicable to plaster bases, materials and other requirements as indicated, except that plastic cement not permitted.

B. Base Coat Mixes and Compositions: Proportion materials for respective base coats in parts by volume for Cementitous materials and in parts by volume per sum of Cementitous materials for aggregates to comply with the following requirements for each method of application and plaster base indicated. Adjust mix proportions below within limits specified to attain workability.

C. Three-Coat Work on Metal Lath: Base coats as indicated below are at Contractor's option:

1. Option #1: Scratch Coat: 1 part Portland cement, 0 to 3/4 parts lime, 2-1/2 to 4 parts sand; Brown Coat: 1 part Portland cement, 0 to 3/4 parts lime, 3 to 5 parts sand.

2. Option #2: Scratch Coat: 1 part Portland cement, 1 to 2 parts masonry cement, 2-1/2 to 4 parts sand; Brown Coat: 1 part Portland cement, 1 to 2 parts masonry cement, 3 to 5 parts sand.

3. Option #3: 1 part masonry cement, 2-1/2 to 4 parts sand; Brown Coat: 1 part masonry cement, 3 to 5 parts sand.

D. Two-Coat Work on Concrete Unit Masonry: Base coats as indicated below are at Contractor's option:

1. Base Coat: 1 part Portland cement, 3/4 to 1-1/2 parts lime, 3 to 4 parts sand.

2. Base Coat: 1 part masonry cement, 3 to 4 parts sand.

E. Job-Mixed Finish Coats: Proportion materials for finish coats in parts by volume for Cementitous materials and parts by volume of aggregates per sum of Cementitous materials to comply with the following requirements: Mixes are at Contractor's option.

1. 1 part Portland cement, 3/4 to 1-1/2 parts lime, 3 parts sand.

2. 1 part Portland cement, 1 part masonry cement, 3 parts sand.

3. 1 part masonry cement, 1-1/2 parts sand.

2.05 MIXING

Mechanically mix Cementitous and aggregate materials for plasters to comply with applicable referenced application standard and with recommendations of plaster manufacturer.

PART 3: EXECUTION

3.01 PREPARATIONS FOR PLASTERING

A. Clean plaster bases and substrates for direct application of Portland cement plaster, removing loose material and substances that might impair the work.

B. Apply bonding agent on concrete and masonry surfaces indicated for direct Portland cement plaster application; comply with manufacturer's instructions for application.

C. Install temporary grounds and screeds as necessary to ensure accurate rodding of plaster to true surfaces; coordinate with scratch-coat work.

D. Surface Conditioning: Immediately before plastering, dampen the surfaces of concrete and masonry that are indicated for direct application of plaster, except where a bonding agent has been applied. Experiment with moisture application to determine degree of saturation that will result in optimum suction for plastering.

3.02 PROVISIONS FOR DRAINAGE BEHIND EXTERIOR PLASTER

A. At the bottom of exterior walls where the wall is supported by a floor or foundation, a drip screed and through-wall flashing or weep holes or other effective means to drain away any water that may get behind the plaster shall be provided.

B. Where vertical and horizontal exterior plaster surfaces meet, terminate both surfaces with casing beads with the vertical surface protruding at least 1/4 inch below the intersecting horizontal plastered surface, thus providing a drip edge. Terminate the casing bead for the horizontal surface at least 1/4 inch from the back of the vertical surface to provide drainage.

C. Extend cotton rope weeps installed in block work or other backup so that ropes project at a slight downward angle out through the stucco. Leave excess rope length for trimming by painter.

3.03 RELIEF FROM STRESS

A. Where plaster and metal plaster base continues across the face of a concrete column, or other structural member, place water-resistive building paper or felt between the metal plaster base and the structural member (or use paper or plastic-backed metal plaster base). Where the width of the structural member exceeds the approved span capability of the metal plaster base, use self-furring metal plaster base and scatter nail sparingly to bring paper and metal base to general plane.

B. Where dissimilar base materials abut and are to receive a continuous edge of plaster, provide one of the following:

1. Install a suitable metal accessory, such as casing beads back-to-back or a control joint member at the juncture of such bases (verify design appropriateness with Architect).

2. Cover the juncture with an 8" wide strip of galvanized, self-furring metal plaster base extending 4" on either side of the juncture.

3. Extend self-furring metal plaster base 4" onto the abutting base where one of the bases is metal plaster base.

3.04 PLASTER APPLICATION

A. Portland Cement Application Standard: Apply Portland cement plaster materials, compositions, and mixes to comply with ASTM C926.

B. Sequence plaster application with the installation and protection of other work, so that neither will be damaged by the installation of the other.

C. Do not use materials which are caked or lumpy or which are dirty or contaminated by foreign materials.

D. Do not use excessive water in the mixing and application of plaster materials.

E. Tolerances: Do not deviate more than 1/8" in 10'-0" from a true plane in finished plaster surfaces, as measured by a 10'-0" straightedge placed at any location on surface.

F. Plaster flush with metal frames and other built-in metal items or accessories that act as a plaster ground, unless otherwise indicated. Where plaster is not terminated at metal by casing beads, cut base coat free from metal before plaster sets and groove finish coat at the junctures with metal.

G. Corners: Make internal corners and angles square; finish external corners flush with corner beads.

H. Number of Coats: Apply Portland cement plaster, of composition indicated, to comply with the following requirements:

1. Provide 3-coat work on metal lath bases as follows:

	At vertical Surfaces	At horizontal surfaces
1st (scratch) coat	3/8"	1/4"
2nd (brown) coat	3/8"	1/4"
3rd (finish) coat	1/8"	1/8"
Total (minimum)	7/8"	5/8"

2. Provide 2-coat work on solid masonry/concrete bases as follows:

	At vertical unit masonry	At vertical concrete	At horizontal surfaces
1st (scratch) coat	3/8"	1/4"	varies
2nd (finish) coat	1/4"	1/8"	varies
Total	5/8"	3/8"*	3/8" max.

*Provide 5/8" total where unit masonry and concrete are in same plane on same wall.

I. Finish Coats: Apply finish coats to comply with the following requirements:

1. Float Finish: Apply finish coat to a uniform thickness of 1/8" to completely cover base coat, uniformly floated to a true even plane with a fine-textured (sand) finish matching Architect's sample.

2. Moist cure plaster base and finish coats to comply with ASTM C926, including recommendations for time between coats and curing in "Annex A2 Design Considerations".

3.05 CUTTING AND PATCHING

A. Cut, patch, repair and point-up Portland cement plaster as necessary to accommodate other work in accordance with Section 01730. Repair cracks and indented surfaces. Point-up finish plaster surfaces around items which are built

into or penetrate plaster surfaces. Repair or replace the work to eliminate blisters, buckles, check cracking, dry-outs, efflorescence, excessive pinholes, and similar imperfections. Repair or replace the work as necessary to comply with required visual effects.

3.06 CLEANING AND PROTECTION

A. Remove temporary covering and whatever other provisions were made to minimize spattering of plaster on other work. Promptly remove plaster from door frames, windows, and other surfaces that are not to be plastered. Repair surfaces that have been stained, marred or otherwise damaged during the plastering work. When plastering work is completed, remove unused materials, containers, equipment, and plaster debris.

B. Provide final protection and maintain conditions, in a manner suitable to Installer, which ensures plaster work being without damage or deterioration at time of Substantial Completion.

END OF SECTION

SECTION 09260

GYPSUM BOARD ASSEMBLIES

PART 1: GENERAL

1.01 WORK INCLUDED

A. Scope: Furnish and install gypsum board surfaces complete including, but not limited to, the following:

1. Metal suspension, metal framing, metal furring, and metal support systems for these surfaces unless specified in another section.

2. Drywall framing members required to support the application of other work.

3. Tile Backing Panels

1.02 RELATED WORK

A. Rough Carpentry is specified in Section 06100.

B. Firestopping caulks and puttys are specified in Section 07840.

C. Aluminum Doors and Frames are specified in Section 08120

D. Metal framing for exterior work is specified in Section 09125

E. Portland cement plaster (stucco) is specified in Section 09220

F. Ceramic Tile is specified in Section 09310

G. Priming of Surfaces and Finish Painting is specified in Sections 09900.

1.03 QUALITY ASSURANCE

A. Fire Resistance Rating: Where indicated, provide materials and construction which are identical to those of assemblies whose fire resistance rating has been determined per ASTM E 119 by a testing and inspecting organization acceptable to authorities having jurisdiction:

1. By reference to Gypsum Association file number in GA-600 "Fire Resistance Design Manual" or to design designations in UL "Fire Resistance Directory" as testing agencies acceptable to jurisdictional authorities.

B. Single Source Responsibility: Obtain each type of gypsum board and related joint treatment materials from a single manufacturer.

1.04 SUBMITTALS

A. Submit manufacturer's product data for each type of product specified.

PART 2: PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Gypsum Board: Subject to compliance with specified requirements, provide products and materials by one of the following manufacturers:

1. American Gypsum
2. USG Corp.
3. G-P Gypsum Corp.
4. National Gypsum Company

2.02 MATERIALS

A. Fire-rated Gypsum Board: 5/8-inch thick, Type "C", or Type "X", with tapered edges.

1. Type "X" board shall carry the UL classification mark for 15, 15, 0 surface burning characteristics.

B. Regular Gypsum Board: ASTM C 36, tapered edge, 5/8-inch thick x 48 inches wide x longest stock length to fit available dimensions.

C. Paperless Gypsum Board Panels: 5/8-inch thick, DensArmor Plus as manufactured by Georgia-Pacific, or equivalent.

D. Drywall Framing Members: Studs, furring channels, floor and ceiling tracks, connecting accessories and clips as required for a complete framing system. Members designed for screw-on application of board, fabricated by one manufacturer, and meeting or exceeding the following requirements.

1. Stud: ASTM C 645; approximately 20 gauge minimum roll formed, electro-galvanized or hot-dip galvanized steel channels in required widths, having not less than 1-1/4 inch wide flanges, pierced webs and section properties equal to or exceeding USG Corp. metal studs.

a. If stud height exceeds manufacturer's recommendations for indicated size, spacing or surface material, provide heavier gauge studs in conformance with his recommendations.

b. Members for rough framing for door openings 2 feet 8 inches wide or more in interior partitions and for partitions to receive ceramic wall tile shall be 20-gauge minimum thickness.

2. Track for Metal Studs: U-shaped approximately 20 gauge minimum electro-galvanized or hot-dip galvanized steel, sized to receive the studs, in not less than 10 foot lengths. Provide heavier gauge when recommended by manufacturer for condition involved.

3. Furring Channels: 20 gauge electro-galvanized or hot-dip galvanized "Z" channels in 12-foot lengths, 7/8 inch deep.

4. Spacing: All stud walls shall be 16" on center maximum.

E. Fasteners: No.6 self-drilling, cross-slot, countersunk head, stainless steel 1-1/4 inch long screws.

1. For web or runner tracks or studs: Non-corrosive fasteners as required by conditions.

2. For drywall furring channels: Non-corrosive fasteners or stainless steel wire clips as required by conditions.

3. For furring brackets: Non-corrosive fasteners as required by conditions.

4. For resilient channels: Non-corrosive fasteners as required by conditions.

F. Adhesive: Embedding type joint compound or laminating adhesive as recommended by gypsum board manufacturer.

G. Joint Treatment Material:

1. General: Materials complying with ASTM C-475, ASTM C-840 and recommendations of manufacturer.

2. Joint Tape: Paper reinforcing tape; use pressure sensitive with compatible joint compound.

3. Setting-type joint compound, factory pre-packaged, job-mixed, chemical-hardening powder products formulated for uses indicated:

a. Where setting - type joint compounds are indicated for use as taping compounds, use formulation that develops greatest bond strength and crack resistance and is compatible with other joint compounds applied over it.

b. For pre-filling gypsum board joints, use formulation recommended by gypsum board manufacturer for this purpose.

c. For filling joints and treating fasteners of water-resistant gypsum backing board behind base for ceramic tile, use formulation recommended by manufacturer.

4. Drying-type joint: factory-prepackaged vinyl - based products complying with the following requirements for formulation and intended use:

a. Ready-mix formulation: factory per-mix product.

b. Topping compound formulated for finish (or third) coats.

H. Gypsum Board Ceiling Components:

1. Runner channels: 1-1/2 inch web, cold rolled stainless steel weighing 475 lbs. minimum per 1,000 lineal feet, having rust-inhibitive coating.

2. Furring channels: 3/4-inch web, cold rolled stainless steel weighing 300 lbs. minimum per 1,000 lineal feet, rust-inhibitive coating.

3. Wire: Stainless Steel meeting Federal Specification QQ-W-461.

I. Tile Backing Board:

1. Glass-Mat, Water-Resistant Backing Board: ASTM C 1178, G-P Gypsum Corp.; Dens-Shield Tile Backer, or equivalent; thickness as indicated on the Drawings

2. Cementitious Backer Units: ANSI A118.9; thickness as indicated on Drawings

J. Wall plugs: Wood filled metal type of 24 gauge or heavier galvanized metal, 2 inches or more in depth. Wood plugs will not be permitted.

K. Drywall Accessories: Provide the following items fabricated completely of heavy gauge galvanized sheet steel and distributed by the gypsum board manufacturer.

1. Corner Bead: Gypsum Association Type CB 114 X 114 having 1-1/4 inch or wider flanges

2. Casing: Gypsum Association Type LC in size necessary to receive board and designed for finishing with joint treatment

3. Casing with vinyl gasket having 1/4 inch vinyl foam tape: National Gypsum Gold Bond No. 500 VB or equivalent.

4. Reveal casing: Extruded aluminum accessory. Designed to form a 3/4-inch wide reveal. 1/2 or 5/8 inch size as required by gypsum board thickness. Provide Fry Reglet Corp. - Type "F" FDM-50-75 or 625-75 Type "W" WDM-625-75 as required by conditions, or equivalent.

5. Control joint: "V" shaped with 7/8-inch flanges.

6. Corner guards: provide a 2” x 2” x 48 inch high vinyl color matched with partitions.

L. Mastic: An asphaltic solvent base damp-proofing product formulated for brush on application; Gulf States Asphalt Co. "Gulf-Seal 210", or equivalent.

M. Glass Fiber Tape: Federal Specification HH-C-00466 having 20 x 10 thread count, coated so as to be compatible with mastic used.

PART 3: EXECUTION

3.01 GENERAL REQUIREMENTS

A. Standards: Unless they are modified or exceeded by the requirements of this Specification, conform to framing system manufacturer's recommendations and then to the following specifications of the Gypsum Association:

1. For Framing: "Installation of Screw-Type Steel Framing Members to Receive Gypsum board".

2. For gypsum board application and finishing: GA-216 "Recommended Specification for the Application and Finishing of Gypsum Board".

B. Coordination with other trades:

1. Reinforcing: Reinforce partitions as necessary to accommodate work of other trades which will be attached to, or bear on drywall construction. Reinforcing shall conform to drywall component manufacturer's recommendations. Provide back-up members to reinforce framing and provide support at surface mounted items. Verify requirements in Sections where surface mounted work is specified. In the absence of specific requirements, provide 2x wood blocking in sufficient width to accommodate the required fastenings. Fasten the blocking rigidly to the drywall framing and close against the drywall facing.

2. Building in other work: Cut, frame and fit this work around recessed, built into or penetrating work such as fixtures, outlet boxes, fittings, pipes, conduit, etc., and supports.

3. Finishes: Leave surfaces of this work in acceptable condition to receive applied finishes as scheduled. Review applicable Specification Sections and coordinate with appropriate other trades to determine requirements. Unless specifically scheduled or specified, no texture coat will be used on painted surfaces, therefore the quality of drywall workmanship must be acceptable for application of smooth finishes of the required sheen without evidence of joints, unevenness and surface defects.

4. Mechanical and Electrical: Cooperate with these trades for location requirements for other work to be installed or located on surfaces provided under this Section. Fit gypsum wallboard work close around penetrating work.

C. Temperature: Maintain continuous controlled interior temperature of at least 55 degrees F. 24 hours before and during application of this work and until building is occupied. Provide adequate ventilation to eliminate excessive moisture.

D. Workmanship: Vertical framing shall be tested with a straight edge both ways to establish that planes are true, plumb and level. If so directed, the plane of ceiling suspension shall be checked with a water level, and unacceptable areas adjusted until they are satisfactory. Do not cover framing or suspension until it is approved.

3.02 FRAMING FOR FURRED CEILINGS, SOFFITS

A. Provide Runner Channels to support furred ceilings and soffits. Unless otherwise required by time-design of referenced authority for fire-rated assemblies, space runners at 4 feet on centers and within 6 inches of abutting vertical surfaces or other interruption of runners. Tie runners to bar joists or beams with 10 gauge Wire.

3.03 PARTITION FRAMING

A. General: Where Drywall Studs are required, provide system of type, width and spacing necessary to form partition of required construction and thickness.

1. Special requirement - Where one side of a partition is drywall, provide metal framing required for the partition regardless of the material required on the opposite side.

B. Tracks: Accurately align tracks according to the partition layout. Fasten tracks at 24 inches on center but not less than 2 fasteners per section. Conform to details for sound seal where partitions abut each other and dissimilar surfaces.

C. Studs: Screw studs to tracks through both flanges at jambs of openings, partition intersections and corners. Provide an additional stud within 2 inches of end stud where partition abuts a dissimilar surface. At Control Joints provide double studs spaced 1/2 inch between. Provide horizontal members behind for work of other trades. Place the studs web-to-web. Locate the short stud over the head member of the opening. Where Control Joint is required above opening and aligned with jamb, space studs with 1/2 inch between them. Provide a Track across head of opening to receive the short studs. Fasten jamb stud to each opening frame anchor with 2 fasteners. In addition, provide a full-length 20-gauge stud with 2 inches of each jamb stud. Construct framing above opening as directed by gypsum board manufacturer.

D. Blocking: Where top track is located more than 1 foot above the finish ceiling line, block the space between studs at the ceiling line to provide backing for gypsum board facing. Use length of track cut and coped tight between stud webs. Fasten track to each stud. Provide similar blocking behind horizontal joints in the first layer of gypsum board applied to the studs vertically.

E. Bracing: Where partitions are not braced from both sides by abutting or continuous completed ceiling systems, brace partition framing as necessary to align and hold it for application of the finish, and to provide rigidity. Completed ceilings that do not provide bracing for partitions include direct suspension acoustic systems, and any other system that is discontinuous, ceiling to ceiling across the partition or discontinuous from ceiling to wall at the partition. Conform to the following minimum requirements:

1. Partition that extends above ceiling - Provide bracing where partition is not tied to framing of abutting ceilings.

2. Partition between ceilings of 2 different heights - When the distance to the lower abutting ceiling measured from the top of the partition is more than 1/3 the maximum partition height, provide bracing.

3. Method: For braces use lengths of tracks or studs, single or boxed as required by their length. Locate braces 4 feet on centers. For partitions short of structure height, fasten braces to the top track. For structure high partitions, fasten braces to a track fastened across the face of the studs over the facing material and close above abutting ceiling. Extend braces diagonally and fasten them to the structure above. Unless continuous obstructions interfere, braces for partitions having ceilings on both sides shall extend alternately from opposite sides of the partition. Other methods of bracing may be submitted for approval prior to use.

3.04 VERTICAL FURRING

A. General: Vertical furring shall consist of galvanized "Z" furring channels, 7/8-inch deep at locations shown on the drawings and details. Furring shall be installed at 16" on centers unless noted otherwise.

3.05 GYPSUM BOARD APPLICATION

A. Installation: Use wallboards of maximum practical length to reduce end joints. Edges and ends of boards shall be in contact but not forced into place. End joints shall be staggered. Joints on opposite sides of a partition shall not occur on the same stud.

B. Erect single-layer standard and fire rated gypsum boards vertically with edges and ends occurring over firm bearing.

C. For double layer application, use gypsum backing board for first layer, placed parallel to framing or furring members. Place second layer perpendicular to first layer. Ensure that joints of first layer do not occur over joints of first.

D. Screws: Shall be spaced not less than 3/8" from ends and edges of wallboard. Screws shall be spaced not over 12" apart on sidewalls. The wallboard shall be held in from contact with the member while the screws are being driven. The heads shall be recessed slightly below the surface of the wallboard with the final drive. Care must be taken not to break the paper face.

3.06 DRYWALL ACCESSORIES

A. Corner beads: Required at external corners of face board, continuous in one piece from floor to ceiling.

B. Casings: Required at visible edges of boards and where face board abuts a dissimilar material. Use casing in long lengths with tight butt joints and mitered corners.

C. Control joints: Locate at approximately 30 feet on centers in continuous walls. Behind control joints provide double supports spaced 1/2 inch apart and fasten board on each side of joint to a separate support.

D. Edge Trim: Shapes as required per ASTM C-1047.

E. Material: Formed metal complying with sheet steel zinc-coated by hot-dipped process.

3.07 GYPSUM BOARD FINISHING

A. Standards: Finish visible drywall work smooth, flush and even so as to provide a suitable base for the required applied finishes as they are specified, without additional procedures to mask defects in the drywall work. Any work not conforming to this standard shall be made acceptable as directed.

B. General:

1. Face board: Treat joints and fastener heads in visible surfaces. Where face board is required to extend above finish ceiling or is concealed by permanent construction or equipment, treat the joints only using full number of compound coats. Sanding may be omitted.

2. Pre-fill open joints.

C. Taping: Apply a uniformly thin 4-inch wide layer of Joint Compound over each joint. Center Joint Tape over the joint and embed it into the compound leaving

sufficient material under the tape to provide a proper bond. Reinforce inside corner angles with the tape folded to conform to the angle and embed it into the compound.

D. Floating: Cover the tape with a coat of Joint Compound extending approximately 3 inches on each side of the tape and feathered out at the edges. After this coat is dry, apply a second coat of compound with a smooth, uniform, slight crown over the joint and the edge feathered slightly beyond the preceding coat. Allow joints to dry for a minimum of 24 hours between each application of compound.

E. Use water-resistant tile backing board for ceramic tile. Comply with ASTM C-840.

F. Sand exposed joints, edges and corners to produce surface ready to receive final wall finish.

END OF SECTION

SECTION 09310

CERAMIC TILE

PART 1: GENERAL

1.01 WORK INCLUDED

A. Definition: Tile includes ceramic surfacing units made from clay or other ceramic materials.

B. Extent of tile work is indicated on drawings and schedules.

C. Types of tile work in this section include, but are not limited to, the following:

1. Porcelain ceramic floor tile

2. Glazed ceramic wall tile

3. Trim units and special shapes

4. Marble thresholds

5. Setting materials and grout

D. Portland cement plaster scratch coat on wall surfaces indicated to receive tile is work of this section.

E. Sealing expansion and other joints in tile work with elastomeric joint sealers is work of this section.

F. Backing board for ceramic wall tile application is specified in Section "Gypsum Board Assemblies".

1.02 QUALITY ASSURANCE

A. Source of Materials: Provide materials obtained from one source for each type and color of tile, grout, and setting materials.

B. Tile shall conform to requirements of TCA 137.1-1980, standard grade.

C. Manufacturers: 10 year's minimum satisfactory experience.

D. Installer: 5 year's minimum satisfactory experience.

1.03 SUBMITTALS

A. Product Data: Submit manufacturer's technical information and installation instructions for materials required, except bulk materials. Include complete maintenance recommendations.

B. Samples for Initial Selection Purposes: Submit manufacturer's color charts consisting of actual tiles or sections of tile showing full range of colors, textures and patterns available for each type of tile indicated. Include samples of grout and accessories involving color selection.

C. Samples for verification purposes: Submit the following:

1. Samples for each type of tile and for each color and texture required on plywood or hardboard backing and grouted.

a. For Porcelain Ceramic Tile, not less than 36” square

b. For all other tile, not less than 12" square

2. Full size samples for each type of trim, accessory and for each color.

3. 6" long samples of marble stone thresholds.

D. Certification: Furnish Master Grade Certificates for each shipment and type of tile, signed by manufacturer and Installer.

1.04 PRODUCT HANDLING

A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Prevent damage or contamination to materials by water, freezing, foreign matter or other causes.

1.05 PROJECT CONDITIONS

A. Maintain environmental conditions and protect work during and after installation to comply with referenced standards and manufacturer's printed recommendations.

B. Maintain temperatures at not less than 50^{o} F (10^{o} C) in tiled areas during installation and for 7 days after completion, unless higher temperatures required by referenced installation standard or manufacturer's instructions.

1.06 EXTRA STOCK

A. Deliver minimum of 1/2 of 1 percent of total square feet not less than one unopened carton of each color, pattern and shape of ceramic floor and wall tile material required for project for maintenance use.

B. Deliver minimum of 1/2 of 1 percent of total square feet not less than one unopened carton of each color, pattern and shape of porcelain tile material required for project for maintenance use.

C. Clearly identify each carton.

1.07 WARRANTY

A. Provide a two year written labor and material warranty.

B. Should defects develop, including any loss of adhesion to the subfloor or wall surfaces, completely replace tile to the satisfaction of the Owner.

PART 2: PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide products of one of the following manufacturers:

1. Glazed Ceramic Tile for Walls Only:
    a. American Olean
    b. DALTILE
    c. Florida Tile Industries Inc.
    d. Summitville Tiles, Inc.
2. Porcelain Ceramic Tile for Floors Only:
    a. Crossville
    b. American Olean
    c. DALTILE
    d. Florida Tile Industries Inc.
    e. Summitville Tiles, Inc.
3. Latex Portland Cement Grout:
    a. American Olean
    b. LATRICRETE Intl, Inc.
    c. WR Bonsal Co.
    d. Bostik
4. Chemical-Resistant Joint Sealants:
    a. Tremco, Inc.
    b. HB Fuller Co.
5. Tile Cleaners:
    a. Hillyard Chemical Co.
    b. L & M Surco Mfg. Co., Inc.

2.02 GENERAL

A. ANSI Standard for Ceramic Tile: Comply with ANSI A137.1 "American National Standard Specifications for Ceramic Tile" for types and grades of tile indicated.

1. Furnish tile complying with "Standard Grade" requirements unless otherwise indicated.

B. ANSI Standard for Tile Installation Materials: Comply with ANSI standard referenced with installation products and materials indicated.

C. Colors, Textures and Patterns: For tile and other products requiring selection of colors, surface textures or other appearance characteristics, provide products to match characteristics indicated or, if not otherwise indicated, as selected by Architect/Engineer from manufacturer's standards. Provide tile trim and accessories that match color and finish of adjoining flat tile.

D. Mounting: Where factory-mounted tile is required, provide back or edge-mounted tile assemblies as standard with manufacturer unless another mounting method is indicated.

2.03 TILE PRODUCTS

A. Slip-Resistant Porcelain Ceramic Floor Tile: 12” x 12” x 3/8” thick, having a minimum of 0.5 Wet Coefficient of Friction attained without use of abrasive impregnation. Color as selected by the Architect/Engineer from manufacturer’s standard color palette.

B. Glazed Ceramic Wall Tile: 12" x 12" x 3/8" thick, plain face, cushion edges, factory-back mounted; colors as selected by the Architect/Engineer from full range of manufacturer's standard and design colors.

C. Trim Units and Special Shapes: Provide tile trim units and special shapes to match characteristics of adjoining flat tile and to comply with following requirements:

1. Size: As indicated, coordinated with sizes and coursing of adjoining flat tile, where applicable.

2. Base: Straight edge base units, width and height to match wall tile, unless otherwise indicated on the Drawings.

3. External Corners: Bullnose shapes with round out base and top trim special shapes.

4. Internal Corners: Field-butted square with square in-corner base and top trim special shapes.

2.04 MARBLE THRESHOLDS

A. General: Provide marble which is uniform in color and finish, fabricated to sizes and profiles indicated or for thresholds, required to provide transition between tile surfaces and adjoining finished floor surfaces.

B. Provide marble thresholds complying with ASTM C 503 requirements for exterior use and abrasion resistance for uses subject to heavy foot traffic. Provide white, honed marble complying with MIA Group "A" requirements for soundness.

2.05 SETTING MATERIALS

A. Thin-Set Portland Cement Mortar: Where thin-set Portland cement mortar applications are indicated, use the following unless otherwise required.

1. Latex-Portland cement mortar, ANSI A118.4, latex modified 1:1 sand and Portland cement.

2. Latex liquid to be Laticrete 4237 or other as approved by Architect/Engineer.

3. Portland cement mortar: ANSI A108.1.

4. Dry Set Mortar, Factory sanded Portland cement and additives: ANSI A118.1.

B. Organic Adhesive: ANSI A136.1; Type II. Provide primer-sealer where recommended by manufacturer.

2.06 GROUTING MATERIALS

A. Latex-Portland Cement Grout: ANSI A118, pre-blended compound of Portland cement, selected and graded aggregates, color pigments and chemical additives gauged with latex additive to comply with manufacturer's directions.

1. Use latex additive in grout that is compatible with latex additive in latex-Portland cement mortar.

2. Latex liquid to be Laticrete 3701 or equivalent product as approved by Architect/Engineer.

B. Portland Cement Grout: ANSI A108.1.

2.07 MISCELLANEOUS MATERIALS

A. Single-component Sealants: ASTM C 920, Type S, Grade NS, use NT (for use in joints in non-traffic areas).

B. Two-Component Sealants: ASTM C 920, Type M, Grade P, Class 25, use T (for use in joints subject to pedestrian traffic).

C. Tile Cleaner: Product specifically acceptable to manufacturer of tile and grout manufacturer for application indicated as recommended by National Tile Promotion Federation, 112 North Alfred St., Alexandria, VA 22134 or Ceramic Tile Institute, 700 N. Virgil Ave., Los Angeles, CA 90029.

PART 3: EXECUTION

3.01 INSPECTION

A. Examine surfaces to receive tile work and conditions under which tile will be installed. Do not proceed with tile work until surfaces and conditions comply with requirements indicated in referenced tile installation standard.

3.02 INSTALLATION, GENERAL

A. ANSI Tile Installation Standard: Comply with applicable parts of ANSI 108 series of tile installation standards included under "American National Standard Specifications for the Installation of Ceramic Tile".

B. TCA Installation Guidelines: TCA "Handbook for Ceramic Tile Installation"; comply with TCA installation methods indicated or, if not otherwise indicated, as applicable to installation conditions shown.

C. Extend tile work into recesses and under or behind equipment and fixtures, to form a complete covering without interruptions, except as otherwise shown. Terminate work neatly at obstructions, edges and corners without disrupting pattern or joint alignment.

D. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim,

finish or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures and other penetrations so that plates, collars, or covers overlap tile.

E. Jointing Pattern: Unless otherwise shown, lay tile in grid pattern. Align joints when adjoining tiles on floor, base, walls and trim are same size. Layout tile work and center tile fields in both directions in each space or on each wall area. Adjust to minimize tile cutting. Provide uniform joint widths, unless otherwise shown. For tile mounted in sheets make joints between tile sheets same width as joints within tile sheets so that extent of each sheet is not apparent in finished work.

F. Lay out tile wainscots to next full tile beyond dimensions indicated.

G. Expansion Joints: Locate expansion joints and other sealant filled joints, including control, contraction and isolation joints, where indicated, or if not indicated, at spacing and locations recommended in TCA "Handbook for Ceramic Tile Installation," and approved by Architect/Engineer. Prepare joints and apply sealants to comply with requirements of referenced standards and sealant manufacturer.

H. Grout tile to comply with referenced installation standards, using grout materials indicated.

I. Mix and install proprietary components to comply with grout manufacturer's directions.

3.03 FLOOR INSTALLATION METHODS

A. Porcelain Ceramic Tile: Install tile to comply with requirements indicated below for setting bed methods, TCA installation methods related to types of subfloor construction, and grout types.

1. Thin-set Portland Cement Mortar: ANSI A108.5

2. Concrete Subfloors, Interior: TCA F113.

3. Grout: Latex-Portland cement.

B. Marble Thresholds: Install at locations indicated. Set thresholds in same type of setting bed as abutting field tile unless otherwise indicated. Set in thin-set mortar for locations, where mortar bed would otherwise be exposed above adjacent non-tile floor finish.

3.04 WALL TILE INSTALLATION METHODS

A. Install types of tile designated for wall application to comply with requirements indicated below for setting bed methods, TCA installation methods related to subsurface wall conditions, and grout types:

1. Latex Portland Cement Mortar: ANSI A118.4.

2. Solid Backing, Interior: TCA W221 (membrane, lath and scratch coat).

3. Metal Studs, Interior: TCA W241.

4. Grout: Latex-Portland cement.

3.05 CLEANING AND PROTECTION

A. Cleaning: Upon completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter. Unglazed tile may be cleaned with acid solutions only when permitted by tile and grout manufacturer's printed instructions, but no sooner than 14 days after installation. Protect metal surfaces, cast iron and vitreous plumbing fixtures from effects of acid cleaning. Flush surface with clean water before and after cleaning.

B. Finished Tile Work: Leave finished installation clean and free of cracked, chipped, broken, unbonded, or otherwise defective tile work.

C. Protection: When recommended by tile manufacturer, apply a protective coat of neutral protective cleaner to completed tile walls and floors. Protect installed tile work with Kraft paper or other heavy covering during construction period to prevent staining, damage and wear.

1. Prohibit foot and wheel traffic from using tiled floors for at least 7 days after grouting is completed.

2. Before final inspection, remove protective coverings and rinse neutral cleaner from tile surfaces.

END OF SECTION

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SECTION 09510

ACOUSTICAL CEILINGS

PART 1: GENERAL

1.01 WORK INCLUDED

A. Work of this section includes, but is not limited to, the following:

1. Acoustical tile in exposed suspension systems
2. Suspension grid systems for acoustical tile ceilings
3. Perimeter trim

B. Furnish special anchors or inserts for placement of suspension systems.

1.02 RELATED WORK

A. Gypsum board ceilings are specified in Section 09260.

B. Suspension framing for gypsum board and plaster ceilings is specified in Section 09125.

C. Items of mechanical and electrical work to be installed in acoustical ceiling grids are specified in Divisions 15 and 16, respectively, and drawings.

1.03 QUALITY ASSURANCE

A. Installer: Company with five (5) years minimum documented experience.

B. Fire Performance Characteristics: Provide acoustical ceiling components that are identical to those tested for the following fire performance characteristics, according to ASTM test method indicated, by UL or other testing and inspecting agency acceptable to authorities having jurisdiction. Identify acoustical ceiling components with appropriate marking of applicable testing and inspecting agency.

C. Surface Burning Characteristics: As follows, tested per ASTM E 84.

1. Flame Spread: 25 or less.
2. Smoke Developed: 50 or less.

D. Tolerances:

1. Free of irregularities and level to within 1/8" in 12 feet.
2. Maximum deflection: 1/360 of span.

E. Installation of Acoustical Ceiling Suspension Systems: ASTM C635 – Metal Suspension Systems for Acoustical Tile and Lay-In Panel Ceilings.

1.04 SUBMITTALS

A. Submit shop drawings indicating grid layout and related dimensions, junctions with other work or ceiling finishes, interrelation of mechanical and electrical items related to system: prepare coordinated reflected ceiling plan relating mechanical and electrical work by level/elevation above finish floor and their penetrations to acoustical ceiling.

B. Provide product data on each type of metal suspension grid system components and each type of acoustical ceiling tile.

C. Samples: Submit two samples each, twelve inches long, of suspension system main runner, cross runner, edge trim. Submit two samples full size of acoustical tiles.

D. Submit manufacturer's published installation instructions.

1.05 ENVIRONMENTAL REQUIREMENTS

A. Continuously maintain temperature and humidity at a value near those indicated for final occupancy.

1.06 SEQUENCING AND SCHEDULING

A. Do not install acoustical ceilings until building is enclosed, dust-generating activities have terminated, and overhead work is completed, tested, and approved.

B. Schedule installation of acoustic units after interior wet work is dry.

1.07 EXTRA STOCK

A. Provide extra quantity of acoustical units equal to two (2) panels for each 100 panels of each type of ceiling panel installed. Obtain receipt from Architect/Engineer or Owner's representative.

PART 2: PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS – SUSPENSION SYSTEM

A. Subject to compliance with specified requirements, provide suspension grid systems as manufactured by one of the following:

1. Armstrong

2. Chicago Metallic Corp.

3. USG Interiors, Inc.

2.02 SUSPENSION SYSTEM MATERIALS

A. Grid: ASTM C635, heavy-duty, and non-fire rated exposed Tee system for ceiling tiles as specified in Article 2.04. Grid Finish: White factory applied baked enamel finish.

B. Accessories: Non-corrosive, heavy-duty stabilizer bars, clips, splices, and edge moldings.

C. Support Channels and Hangers: Stainless steel; size and type of suit application, to rigidly secure acoustic ceiling system including integral mechanical and electrical components with maximum deflection of 1/360.

2.03 ACCEPTABLE MANUFACTURERS – ACOUSTICAL TILE

A. Subject to compliance with specified requirements, provide acoustical ceiling tiles as manufactured by one of the following:

1. Armstrong World Industries, Inc.

2. Celotex Building Products

3. USG Corporation

2.04 ACOUSTICAL TILE

A. Type-1: Mineral-Tiles, Water Felted, with Standard Washable Painted Finish: Provide Type III, Class A, Form 2 units in accordance with ASTM E 1264 and complying with the following requirements:

1. Pattern: Manufacturer's Standard Fissured Tile, Non-Directional Pattern

2. Light Reflectance: White/LR 1 (75% and over)

3. Color: White

4. Grade: NRC 0.50

5. STC Range: 35-39

6. Edge Detail: Beveled Tegular edge lay-in tiles for exposed "T" System where indicated on the Drawings

7. Thickness: 5/8"

8. Sizes: 24" x 24" as indicated on Drawings

B. Basis of Design: Lay-in acoustical ceiling tiles as manufactured by Armstrong World Industries, Inc.

PART 3: EXECUTION

3.01 INSPECTION

A. Verify that existing conditions are ready to receive work.

B. Verify that layout of hangers will not interfere with other work.

C. Beginning of installation means acceptance of existing conditions.

3.02 INSTALLATION

A. General: Install materials in accordance with manufacturer's printed instructions, and to comply with governing regulations, fire-resistance rating requirements as indicated, and CISCA standards applicable to work.

B. Arrange acoustical units and orient directionally patterned units (if any) in manner shown by reflected ceiling plans. Install panels with pattern running in one direction.

C. Install suspension systems to comply with ASTM C 636, with hangers supported only from building structural members. Locate hangers not less than 6" from each end and spaced 4'-0" along each carrying channel or direct-hung runner, unless otherwise indicated, leveling to tolerance of 1/8" in 12'-0".

1. Secure wire hangers by looping and wire-tying, either directly to structures or to inserts, eye-screws, or other devices which are secure and appropriate for substrate, and which will not deteriorate or fail with age or elevated temperatures. Spliced hanger wires are not allowed.

2. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum which are not part of supporting structural or ceiling suspension system. Splay hangers only where required to miss obstructions and offset resulting horizontal force by bracing, or other equally effective means.

3. Install edge moldings of type indicated at perimeter of acoustical ceiling area and at locations where necessary to conceal edges of acoustical units.

4. Screw-attach moldings to substrate at intervals not over 16" o.c. and not more than 3" from ends, leveling with ceiling suspension system to tolerance of 1/8" in 12"-0". Miter corners accurately and connect securely.

D. Install acoustical panels in coordination with suspension system, with edges concealed by support of suspension members. Scribe and cut panels to fit accurately at borders and at penetrations.

E. Install acoustical units in coordination with suspension system and exposed runner moldings. Scribe and cut units for accurate fit at borders and penetrations. Stiffen edges of cut units as required to eliminate evidence of oil-canning or buckling.

3.03 CLEANING

A. Clean exposed surfaces of acoustical ceilings, including trim, edge moldings, and suspension members. Comply with manufacturer's instructions for cleaning and touch-up of minor finish damage. Remove and replace work that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION

SECTION 09650

RESILIENT TILE FLOORING

PART 1: GENERAL

1.01 WORK INCLUDED

A. This Section includes vinyl composition floor tile.

1.02 SUBMITTALS

A. Product Data: For each product indicated.

B. Samples: For each product and for each color and pattern indicated.

1.03 PROJECT CONDITIONS

A. Maintain a temperature of not more than 95 deg F in spaces to receive floor tile for at least 48 hours before installation, during installation, and for at least 48 hours after installation, unless manufacturer's written recommendations specify longer time periods.

1. After post-installation period, maintain a temperature of not more than 95 deg F

B. Install floor tile after other finishing operations, including painting, have been completed.

1.04 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents. Furnish one box for each 50 boxes or fraction thereof of each type, color, and pattern of floor tile.

PART 2: PRODUCTS

2.01 VINYL COMPOSITION FLOOR TILE

A. Products: Armstrong World Industries, Inc.; Standard Excellon.

B. Vinyl Composition Floor Tile, VCT-1: ASTM F 1066.

1. Class: 2 (through-pattern tile**)**.

2. Color and Pattern: as indicated in the schedule.

3. Wearing Surface: Smooth

4. Thickness: 1/8 inch

5. Size: 12 by 12 inches

6. Critical Radiant Flux Classification: Class I, not less than 0.45 w/sq cm per ASTM E 648.

2.02 INSTALLATION ACCESSORIES

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement-based or blended hydraulic cement-based formulation provided or approved by flooring manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by manufacturer to suit resilient products and substrate conditions indicated.

C. Metal saddles: smooth top saddle threshold, ½" x 4 inch x opening length, by Pemko or equivalent.

PART 3: EXECUTION

3.01 INSTALLATION

A. Concrete Subfloors: Verify that concrete slabs comply with ASTM F 710 and are dry and free of curing compounds, sealers, hardeners, and other materials that may interfere with adhesive bond. Determine adhesion and dryness characteristics by performing bond and moisture tests recommended by flooring manufacturer.

B. Before installing floor tile:

1. Remove coatings, including curing compounds, and other substances that are incompatible with flooring adhesives and that contain soap, wax, oil, or silicone, using mechanical methods. Do not use solvents.

2. Use trowelable leveling and patching compounds to fill cracks, holes, and depressions in substrates.

3. Move resilient floor tile and installation accessories into spaces where they will be installed at least 48 hours before installation, unless longer conditioning periods are recommended in writing by manufacturer. Install products only after they are at the same temperature as the space where they are to be installed.

4. Broom and vacuum clean substrates to be covered immediately before product installation. After cleaning, examine substrates for moisture, alkaline salts, carbonation, or dust. Proceed with installation only after unsatisfactory conditions have been corrected.

C. Lay out tiles from center marks established with principal walls, discounting minor offsets, so tile widths at opposite edges of room are equal to one another and are at least one-half of a tile.

1. Lay tiles at a 45-degree angle with room axis, unless otherwise indicated.

D. Match tiles for color and pattern by selecting tiles from cartons in same sequence as manufactured and packaged.

E. Scribe, cut, and fit tiles to butt neatly and tightly to vertical surfaces and permanent fixtures, including built-in furniture, cabinets, pipes, outlets, edgings, door frames, thresholds, and nosings.

F. Extend tiles into toe spaces, door reveals, closets, and similar openings.

G. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on finish flooring as marked on subfloor. Use chalk or other nonpermanent, nonstaining marking device.

H. Install tiles on covers for telephone and electrical ducts, and similar items in finished floor areas. Maintain overall continuity of color and pattern with pieces of flooring installed on covers. Tightly adhere edges to perimeter of floor around covers and to covers.

I. Adhere tiles to flooring substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

J. Immediately after installing resilient floor tile, remove adhesive and other surface blemishes using cleaner recommended by resilient product manufacturers.

END OF SECTION

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SECTION 09660

RESILIENT WALL BASE

PART 1: GENERAL

1.01 WORK INCLUDED

A. The Work includes, but is not limited to, rubber wall base.

B. Extent of resilient wall base is indicated on the Drawings.

1.02 QUALITY ASSURANCE

A. Manufacturers: Provide resilient wall base as produced by a single manufacturer, including recommended primers, adhesives, sealants, and leveling compounds.

B. Fire Test Performance: Provide wall base that complies with the following fire test performance criteria as determined by an independent testing laboratory acceptable to authorities having jurisdiction.

C. Critical Radiant Flux (CRF): Not less than 0.45 watts per square cm per ASTM E 648.

D. Flame Spread: Not more than 75 per ASTM E 84.

E. Smoke Density: Not more than 450 per ASTM E 662.

1.03 SUBMITTALS

A. Product Data: Submit manufacturer's technical data.

B. Samples for Initial Selection Purposes: Submit manufacturer's standard color charts in form of actual sections of resilient wall base showing full range of colors and patterns available for selection by the Architect/Engineer.

C. Certification for Fire Test Performance: Submit certification from an independent testing laboratory acceptable to authorities having jurisdiction that resilient wall base complies with fire test performance requirements.

D. Maintenance Instructions: Submit 2 copies of manufacturer's recommended maintenance practices for resilient wall base.

1.04 PROJECT CONDITIONS

A. Maintain minimum temperature of 65^{o} F in spaces to receive resilient base for at least 48 hours prior to installation, during installation, and for not less than 48 hours after installation. Store resilient wall base in spaces where they will be installed for at least 48 hours before beginning installation. Subsequently, maintain minimum temperature of 55^{o} F in areas where work is completed.

B. Install resilient wall base after other finishing operations, including painting, have been completed.

PART 2: PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the work include, but are not limited to, the following:

1. Manufacturers of Vinyl Wall Base:
    a. Armstrong World Industries, Inc.
    b. Kentile Floors, Inc.
    c. Roppe Corporation.

2.02 WALL BASE MATERIALS

A. Rubber Wall Base: Provide rubber straight base 1/8-inch thick, 4-inches high and 6-inches high as indicated on the Drawings, standard toe, matte finish, complying with FS SS-W-40a, Type II, with matching end stops and preformed or molded corner units.

B. Adhesives (Cements): Waterproof, stabilized, low VOC type as recommended by flooring manufacturer to suit material and substrate conditions. Asphalt emulsions and other non-waterproof types are not acceptable.

C. Leveling and Patching Compounds: Latex type as recommended by flooring manufacturer.

PART 3: EXECUTION

3.01 INSPECTION

A. Require Installer to inspect surfaces to determine that they are satisfactory. A satisfactory surface is defined as one that is smooth and free from cracks, holes, ridges, coatings preventing adhesive bond, and other defects impairing performance or appearance.

3.02 PREPARATION

A. Use patching compounds as recommended by vinyl wall base manufacturer for filling small cracks, holes and depressions in surfaces to receive resilient wall base.

B. Remove coatings from surfaces that would prevent adhesive bond, including oils, waxes and sealers.

C. Clean surfaces to be covered.

3.03 INSTALLATION OF WALL BASE

A. Install resilient wall base in strict compliance with manufacturer's published instructions.

B. Scribe, cut and fit resilient wall base to permanent fixtures, built-in furniture and cabinets, outlets and permanent columns, walls, and partitions.

C. Apply wall base to walls, columns, pilasters, casework and other permanent fixtures in rooms or areas where base is required.

1. Install base in lengths as long as practicable, with preformed corner units, or fabricated from base materials with mitered or coped inside corners.

2. Tightly bond base to substrate throughout length of each piece, with continuous contact at horizontal and vertical surfaces.

D. On masonry surfaces, or other similar irregular substrates, fill voids along top edge of resilient wall base with manufacturer's recommended adhesive filler material.

3.04 CLEANING AND PROTECTION

A. Clean wall base thoroughly immediately upon completion in accordance with manufacturer’s published instructions.

B. Protect installed wall base from damage through substantial completion of the Work.

3.05 EXTRA STOCK

A. Deliver stock of maintenance materials to Owner equal to 10 percent of the length of resilient base installed. Furnish maintenance materials from same manufactured lot as materials installed and enclosed in protective packaging with appropriate identifying labels.

END OF SECTION

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SECTION 09900

PAINTS AND COATINGS

PART 1: GENERAL

1.01 RELATED DOCUMENTS

A. All applicable provisions of the Bidding and Contract Requirements shall govern the work under this Section.

B. See Section 15200 Piping - General for Pipe Schedule and associated pipe colors.

1.02 WORK INCLUDED

A. Scope: Surface preparation, painting, and finishing of new exposed exterior items and surfaces and interior surfaces as indicated on plan documents. Also included:

1. Surface preparation, priming, and finish coats specified in this section are in addition to shop priming and surface treatment specified under other sections.

B. Paint exposed surfaces whether or not colors are designated in "schedules", except where a surface or material is specifically indicated not to be painted or is to remain natural. Where an item or surface is not specifically mentioned, paint the same as similar adjacent materials or surfaces. Color or finish not designated will be selected from available approved colors or finishes by the Owner.

C. Painting is not required on pre-finished items, finished metal surfaces, concealed surfaces, operating parts, and labels.

1. Pre-finished items not to be painted include, but are not limited to, the following factory-finished components:

a. Finished mechanical and electrical equipment

b. Exterior light fixtures

c. Distribution and control cabinets

2. Finished metal surfaces not to be painted include, but are not limited to, the following:

a. Anodized aluminum

b. Stainless steel

c. Galvanized items

3. Concrete tanks and basins, unless otherwise specified herein.

4. Prefinished electrical items such as conduit, motor control centers, switchboards, switchgear, panel boards, transformers, and disconnect switches.

1.03 SUBMITTALS

A. Make all submittals 90 days prior to any work requiring final color or material selection.

B. Product Data: Manufacturer's technical information, label analysis and application instructions for each material proposed for use. List each material and cross-reference the specific coating and finish system and application. Identify each material by the manufacturer's catalog number and general classification.

C. Samples for initial color selection in the form of manufacturer's color charts. After review of color charts, color chips will be selected for surfaces to be coated.

D. Samples for verification purposes: Provide samples of each color and material to be applied, with texture to simulate actual conditions, on representative samples of the actual substrate. Define each separate coat, including block fillers and primers. Use representative colors when preparing samples for review. Resubmit until required sheen, color, and texture are achieved.

1. Submit samples on the following substrates for review of color and texture only:

a. Exterior Cement Plaster on Concrete Masonry: Provide two 4-inch by 8-inch samples of masonry for finish and color.

b. Ferrous and Non-Ferrous Metal: Provide two 4-inch square samples of flat metal and two 8-inch long samples of solid metal for each color and finish.

1.04 QUALITY ASSURANCE

A. Single Source Responsibility: Provide primers and undercoat paint produced by the same manufacturer as the finish coats.

B. Coordination of Work: Review other sections in which primers are provided to ensure compatibility of the total systems for various substrates. On request, furnish information on characteristics of finish materials to ensure use of compatible primers. Notify the Architect of problems anticipated using the materials specified.

C. Field Samples: On wall surfaces and other exterior components, duplicate finishes of prepared samples. Provide full-coat finish samples on at least 100 square feet of surface until required sheen, color and texture are obtained. Simulate finished lighting conditions for review of in-place work. Final acceptance of colors will be from job-applied samples.

D. Material Quality: Provide the manufacturer's best quality trade sale paint material of the various coating types specified. Paint material containers not displaying manufacturer's product identification will not be acceptable.

1. Proprietary names used to designate colors or materials re not intended to imply that products named are required or to exclude equal products of other manufacturers.

2. Federal Specifications (FS) establish a minimum quality level of paint materials, except where other product identification is used. Provide written certification from the manufacturer that materials provided meet or exceed these criteria.

3. Products that comply with qualitative requirements of applicable Federal Specifications, yet differ in quantitative requirements, may be considered for use when acceptable to the Architect. Furnish material data and

manufacturer's certificate of performance to Architect for proposed substitutions.

E. Regulatory Requirements

1. Meet federal, state, and local requirements limiting the emission of volatile organic compounds.

2. Perform surface preparation and painting in accordance with recommendations of the following:

a. Paint manufacturer’s instructions.

b. SSPC PA 3, Guide to Safety in Paint Applications.

c. Federal, state, and local agencies having jurisdiction.

1.05 DELIVERY, STORAGE AND HANDLING

A. Deliver materials to the job site in the manufacturer's original, unopened packages and containers bearing manufacturer's name and label and the following information:

1. Product name or title of material

2. Product description (generic classification or binder type)

3. Federal Specification number, if applicable

4. Manufacturer's stock number and date of manufacture

5. Contents by volume, for pigment and vehicle constituents

6. Thinning instructions

7. Application instructions

8. Color name and number

B. Store materials not in use in tightly covered containers in a well-ventilated area at a minimum ambient temperature of 45 degrees F. Maintain containers used in storage in a clean condition, free of foreign materials and residue. Keep storage area neat and orderly. Remove oily rags and waste daily. Take necessary measures to ensure that workers and work areas are protected from fire and health hazards resulting from handling, mixing, and application.

1.06 JOB CONDITIONS

A. Apply water-based paints only when the temperature of surfaces to be painted and surrounding air temperatures are between 50 degrees and 90 degrees F.

B. Apply solvent-thinned paints only when the temperature of surfaces to be painted and surrounding air temperatures are between 45 degrees F and 95 degrees F.

C. Do not apply paint in rain, fog or mist, when the relative humidity exceeds 85 percent, at temperatures less than 5 degrees F above the dew point, or to damp or wet surfaces. Painting may continue during inclement weather if surfaces and areas to be painted are enclosed and heated within temperature limits specified by the manufacturer during application and drying periods.

PART 2: PRODUCTS

2.01 PAINT MATERIALS

A. Provide paints as manufactured by Sherwin Williams, Tnemec, Benjamin Moore, or Porter Paints.

B. Primers, Undercoats, Split and Finish Coats: Use materials from same manufacturer when such materials are applied on same surface.

C. Color Selection: As selected by the Owner from Manufacturer's standard color palette.

1. Tint primers and undercoats to approximate shade of selected finish coat color.

2. For deep tone finish colors, use Deep Base Primers recommended by manufacturer for surface.

3. Dry Mil Thickness:

a. Comply with manufacturer's specifications.

b. If thinning of materials is performed, apply additional coats to achieve full film thickness of coats specified.

4. Color Selections:

a. If color is not listed on the Drawings for any specific area or item, it does not relieve Contractor of responsibility for providing colors to be selected.

b. Color selection made by Owner is to determine basic color required for surface.

c. Colors with same designation but produced from two or more sources shall match when viewed from distance of 24 inches or more.

d. Final application of colors shall match prepared samples approved by the Owner.

2.02 MIXING

A. Multiple-Compound Coatings:

1. Prepare using each component as packaged by paint manufacturer.

2. No partial batches will be permitted.

3. Do not use multiple-component coatings that have been mixed beyond their pot life.

4. Furnish small quantity kits for touchup painting and for painting other small areas.

5. Mix only components specified and furnished by paint manufacturer.

6. Do not intermix additional components for reasons of color or otherwise, even within the same generic type of coating.

B. Colors: Formulate paints with colorants free of lead, lead compounds, or other material that might be affected by the presence of hydrogen sulfide or other gases likely be present at the Site.

2.03 SHOP FINISHES

A. When required by equipment specifications, equipment shall be primed and finish coated in shop by manufacturer.

B. Ductile Iron Pipe:

1. Use SSPC standards as a guide for desired prepared surface. Follow recommendations of pipe and coating manufacturers for means and methods to achieve SSPC-equivalent surface.

2. The surface preparation and application of the primer shall be performed by pipe manufacturer.

3. For high performance (epoxy) coatings, follow additional recommendations of pipe and coating manufacturers.

4. Prior to blast cleaning, grind smooth surface imperfections, including, but not limited to delaminating metal or oxide layers.

PART 3: EXECUTION

3.01 GENERAL

A. Schedule inspection of cleaned surfaces and all coats prior to succeeding coat in advance with Engineer.

3.02 EXAMINATION

A. Examine substrates and conditions under which painting will be performed for compliance with requirements for application of paint. Do not begin paint application until unsatisfactory conditions have been corrected.

B. Start of painting will be construed as the Applicator's acceptance of surfaces and conditions within a particular area.

C. Surface Preparation Verification: Inspect and provide substrate surfaces prepared in accordance with these Specifications and printed directions and recommendations of paint manufacturer whose product is to be applied. The more stringent requirements shall apply.

3.03 PROTECTION OF ITEMS NOT TO BE PAINTED

A. Remove, mask, or otherwise protect hardware, lighting fixtures, switchplates, aluminum surfaces, machined surfaces, couplings, shafts, bearings, nameplates on machinery, and other surfaces not specified elsewhere to be painted.

B. Provide drop cloths to prevent paint materials from falling on or marring adjacent surfaces.

C. Protect working parts of mechanical and electrical equipment from damage during surface preparation and painting process.

D. Mask openings in motors to prevent paint and other materials from entering.

E. Protect surfaces adjacent to or downwind of Work area from overspray.

3.04 PREPARATION

A. General Procedures: Remove existing items in place that are not to be painted, or provide surface-applied protection prior to surface preparation and painting.

1. Remove these items if necessary for complete painting of the items and adjacent surfaces. Following completion of painting operations in each space or area, have items reinstalled by workers skilled in the trades involved.

2. Pressure clean surfaces before applying paint or surface treatments. Remove oil and grease prior to cleaning. Schedule cleaning and painting so that dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.

B. Surface Preparation: Clean and prepare surfaces to be painted in accordance with the manufacturer's instructions for each particular substrate condition and as specified.

1. Provide barrier coats over incompatible primers or remove and re-prime. Notify Architect in writing of problems anticipated with using the specified finish coat material with substrates primed by others.

2. Cementitous Materials: Prepare concrete, concrete masonry block and cement plaster panel surfaces to be painted. Remove efflorescence, chalk, dust, dirt, grease, oils, and release agents using pressure-cleaning methods. Roughen as required to remove glaze. If hardeners or sealers have been used to improve curing, use mechanical methods of surface preparation.

a. Use abrasive blast-cleaning methods if recommended by the paint manufacturer.

b. Determine alkalinity and moisture content of surfaces by performing appropriate tests. If surfaces are sufficiently alkaline to cause blistering and burning of finish paint, correct this condition before application. Do not paint surfaces where moisture content exceeds that permitted in manufacturer's printed directions.

3. Ferrous Metals: Clean non-galvanized ferrous metal surfaces that have not been shop coated; remove oil, grease, dirt, loose mill scale, and other foreign substances. Use solvent or mechanical cleaning methods that comply with recommendations of the Steel Structures Painting Council. Touch up bare areas and shop-applied prime coats that have been damaged. Wire brush, clean with solvents recommended by the paint manufacturer, and touch up with the same primer as the shop coat.

4. Galvanized Surfaces: Clean galvanized surfaces with non-petroleum based solvents so that the surface is free of oil and surface contaminants. Remove pretreatment from galvanized sheet metal fabricated from coil stock by mechanical methods.

5. Plastic Surface Preparation: Hand sand plastic surfaces to be coated with medium grit sandpaper to provide tooth for coating system. Large areas may

be power sanded or brush-off blasted, provided sufficient controls are employed so surface is roughened without removing excess material.

C. Field Abrasive Blasting:

1. Perform blasting for items and equipment where specified and as required to restore damaged surfaces previously shop or field blasted and primed or coated.

2. Refer to coating systems for degree of abrasive blasting required.

3. Where the specified degree of surface preparation differs from manufacturer's recommendations, the more stringent shall apply.

D. Metal Surface Preparation:

1. The Society for Protective Coatings (SSPC) SP 5, White Metal Blast Cleaning: Removal of visible oil, grease, dust, dirt, mill scale, rust, coatings, oxides, corrosion products, and other foreign matter by blast cleaning.

2. SSPC SP 6, Commercial Blast Cleaning: Removal of visible oil, grease, dust, dirt, mill scale, rust, coatings, oxides, corrosion products, and other foreign matter, except for random staining limited to no more than 33 percent of each unit area of surface which may consist of light shadows, slight streaks, or minor discolorations caused by stains of rust, stains of mill scale, or stains of previously applied coatings.

3. SSPC SP 7, Brush-Off Blast Cleaning: Removal of visible rust, oil, grease, soil, dust, loose mill scale, loose rust, and loose coatings. Tightly adherent mill scale, rust, and coating may remain on surface.

4. SSPC SP 10, Near-White Blast Cleaning: Removal of visible oil, grease, dust, dirt, mill scale, rust, coatings, oxides, corrosion products, and other foreign matter, except for random staining limited to no more than 5 percent of each unit area of surface which may consist of light shadows, slight streaks, or minor discolorations caused by stains of rust, stains of mill scale, or stains of previously applied coatings.

E. Materials Preparation: Carefully mix and prepare paint materials in accordance with manufacturer's directions.

1. Maintain containers used in mixing and application of paint in a clean condition, free of foreign materials and residue.

2. Stir material before application to produce a mixture of uniform density; stir as required during application. Do not stir surface film into materials. Remove film and if necessary strain material before using.

3. Use only thinners approved by the paint manufacturer, and only within recommended limits.

3.05 SURFACE CLEANING

A. Brush-off Blast Cleaning:

1. Equipment, procedure, and degree of cleaning shall meet requirements of SSPC SP 7.

2. Abrasive: Either wet or dry blasting sand, grit, or nutshell.

3. Select various surface preparation parameters, such as size and hardness of abrasive, nozzle size, air pressure, and nozzle distance from surface such that surface is cleaned without pitting, chipping, or other damage.

4. Verify parameter selection by blast cleaning a trial area that will not be exposed to view.

5. Engineer will review acceptable trial blast cleaned area and use area as a representative sample of surface preparation.

6. Repair or replace surface damaged by blast cleaning.

3.06 APPLICATION

A. Apply paint in accordance with manufacturer's directions. Use applicators and techniques best suited for substrate and type of material being applied.

B. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film.

1. Paint types, surface treatments, and finishes are indicated in "Schedules".

2. Provide finish coats that are compatible with primers used.

3. The number of coats and film thickness required is the same regardless of the application method. Do not apply succeeding coats until the previous coat has cured as recommended by the manufacturer.

4. Apply additional coats when undercoats, stains, or other conditions show through final coat of paint until paint film is of uniform finish, color, and appearance. Give special attention to ensure that surfaces, including edges, corners, crevices, welds, and exposed fasteners, receive a dry film thickness equivalent to that of flat surfaces.

5. The term "exposed surfaces: includes areas visible when permanent or covers, grilles, and similar components are in place. Extend coatings in these areas as required to maintain the system integrity and provide desired protection.

6. Omit primer on metal surfaces that have been shop-primed and touch-up painted.

C. Scheduling Painting: Apply first coat to surfaces that have been cleaned, pretreated, or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.

1. Allow sufficient time between successive coats to permit proper drying.

2. Do not re-coat until paint has dried to where it feels firm, and does not deform or feel sticky under moderate thumb pressure and where application of another coat of paint does not cause lifting or loss of adhesion of the undercoat.

D. Minimum Coating Thickness: Apply materials at not less than the manufacturer's recommended spreading rate. Provide a total dry film thickness of the entire system as recommended by the manufacturer.

E. Prime Coats: Before application of finish coats, apply a prime coat of material as recommended by the manufacturer to material that is required to be painted or finished and has not been prime coated by others. Re-coat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to assure a finish coat with no burn through or other defects due to insufficient sealing.

F. Pigmented (Opaque) Finishes: Completely cover to provide an opaque, smooth surface of uniform finish, color, appearance, and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections will not be acceptable.

G. Complete Work: Match approved samples for color, texture, and overage. Remove, refinish, or repaint work not in compliance with specified requirements.

3.07 CLEANING

A. Cleanup: At the end of each workday, remove empty cans, rags, rubbish, and other discarded paint materials from the site.

B. Upon completion of painting, clean paint-spattered surfaces. Remove spattered paint by washing and scraping, using care not to scratch or damage adjacent finished surfaces.

3.08 PROTECTION

A. Protect work of other trades, whether to be painted or not, against damage by painting. Correct damage by cleaning, repairing or replacing, and repainting, as acceptable to the Architect.

B. Provide "wet paint" signs to protect newly painted finishes. Remove temporary protective wrappings provided by others for protection of their work after completion of painting operations. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.09 EXTERIOR PAINT SCHEDULE (ADMINISTRATION BUILDING)

A. General: Provide the following paint systems for the various substrates indicated. Color by the Owner.

B. Concrete, Stucco, and Cement Plaster:

1. Elastomeric Epoxy Coating: 2 coats over 1 coat of sealer, minimum dry film thickness 8-10 mils per coat.

C. Ferrous Metal (including, but not limited to, exterior steel frames): Primer is not required on shop-primed items.

1. Full-Gloss Alkyd Enamel: 2 finish coats over primer.

a. Primer: Synthetic Rust-Inhibiting Primer

b. First Coat: Alkyd Gloss Enamel

c. Second Coat: Alkyd Gloss Enamel

D. Zinc-Coated Metal:

1. High-Gloss Alkyd Enamel: 2 finish coats over primer.
   a. Primer: Galvanized Metal Primer
   b. First Coat: Alkyd Gloss Enamel
   c. Second Coat: Alkyd Gloss Enamel

E. Wood: High-Gloss Alkyd Enamel: 2 finish coats over primer.

3.10 INTERIOR PAINT SCHEDULE (Administration Building)

A. Plaster, Gypsum Board - Paint

1. Two coats of Interior Alkyd Eggshell Enamel or equal.
   a. General Color: Color by the Owner.
   b. Accent Color: Color by the Owner.

3.11 PLANT SITE PAINT SCHEDULE

A. Pipe and equipment requiring insulation and jackets require priming only.

B. Submerged Metal

1. Surface Prep: SP 5
2. Primer: Per manufacturer's recommendations
3. Paint: Coal Tar Epoxy for immersion service, 2 coats, 16 mils
4. All metal surfaces below the maximum liquid surface, including submerged pipe, pumps, supports, manholes, sluice and slide gates, valves, and steel surfaces.

C. Exposed Metal

1. Surface Prep: SP 10
2. Primer: Epoxy Primer with rust inhibitor, 1 coat, 2.5 mills
3. Paint: Two-component high gloss polyurethane, 1 coat, 3 mils
4. All exposed metal surfaces, interior and exterior, including ductile iron pipe, beams and girders, metal columns, metal doors, frames, pumps and bases, doors, sluice and slide gates, valves, pipe and equipment supports, and metal trim and surfaces.

D. Concrete Encased Metal

1. Surface Prep: SP 6
2. Paint: Coal Tar Epoxy for immersion service, 2 coats, 16 mils
3. Concrete encased metals such as wall pipes, pipe sleeves, gate guides, concrete encased piping, and access manholes

E. Non-Skid Concrete

1. Surface Prep: Concrete Prep

2. Primer: Per manufacturer's recommendations

3. Paint: Aggregated polyamidoamine or amine converted epoxy, 160 square feet per gallon

4. Polymer areas in the Solids Handling Facility

F. CMU Buildings - Exterior

1. Surface Prep: Concrete Prep

2. Primer: Per manufacturer's recommendations

3. Paint: Water repellant sealer with siloxane as manufactured by Chemical Products Industries or equal, 70 – 175 square feet per gallon depending on absorbency.

4. Exterior of new CMU buildings on plant site.

G. CMU and Concrete Buildings - Interior

1. Surface Prep: Concrete Prep

2. Primer: 100% acrylic emulsion primer-sealer for CMU walls, 1 coat, 75 square feet per gallon

3. Paint: Two-component, polyamide epoxy emulsion, 2 coats, 300 square feet per gallon

4. Interior of new Solids Handling Facility and interior BNR/MBR Electrical Building.

3.12 EXTRA STOCK

A. Provide five (5) gallons of each finish paint product specified for the Administration Building in unopened, correctly labeled containers from original batch utilized on the Project.

3.13 FIELD QUALITY CONTROL

A. Thickness and Continuity Testing:

1. Measure coating thickness specified in mils with a magnetic type, dry film thickness gauge, in accordance with SSPC PA 2. Check each coat for correct millage. Do not make measurement before a minimum of 8 hours after application of coating.

2. Holiday detect coatings 20 mils thick or less, except zinc primer and galvanizing, with low voltage wet sponge electrical holiday detector in accordance with NACE RP0188.

3. Holiday detect coatings in excess of 20 mils dry with high voltage spark tester as recommended by coating manufacturer and in accordance with NACE RP0188.

4. After repaired and recoated areas have dried sufficiently, retest each repaired area. Final tests may also be conducted by Engineer.

B. Inspection: Leave staging and lighting in place until Engineer has inspected surface or coating. Replace staging removed prior to approval by Engineer. Provide additional staging and lighting as requested by Engineer.

C. Unsatisfactory Application:

1. If item has an improper finish color or insufficient film thickness, clean surface and topcoat with specified paint material to obtain specified color and coverage. Obtain specific surface preparation information from coating manufacturer.

2. Evidence of runs, bridges, shiners, laps, or other imperfections is cause for rejection.

3. Repair defects in accordance with written recommendations of coating manufacturer.

D. Damaged Coatings, Pinholes, and Holidays:

1. Feather edges and repair in accordance with recommendations of paint manufacturer.

2. Hand or power sand visible areas of chipped, peeled, or abraded paint, and feather the edges. Follow with primer and finish coat. Depending on extent of repair and appearance, a finish sanding and topcoat may be required.

3. Apply finish coats, including touchup and damage-repair coats in a manner that will present a uniform texture and color-matched appearance.

3.14 MANUFACTURER'S SERVICES

A. In accordance with Section 01640, Manufacturers' Field Services, coating manufacturer's representative shall be present at Site as follows:

1. On first day of application of any coating system, excluding painting associated with the Administration Building.

2. A minimum of four additional Site inspection visits, each for a minimum of 4 hours, in order to provide Manufacturer's Certificate of Proper Installation.

3. As required to resolve field problems attributable to or associated with manufacturer's product.

4. To verify full cure of coating prior to coated surfaces being placed into immersion service.

END OF SECTION

SECTION 10200

COMBINATION STATIONARY BLADE WALL LOUVERS WITH BACKDRAFT DAMPER

PART 1: GENERAL

1.01 SECTION INCLUDES

A. Extruded aluminum dual combination louver with gravity backdraft damper. Provide stationary drainable style front blades and automatic intake backdraft damper blades. Insect Screen is required.

B. Refer to the Contract Documents for the Louver locations.

1.02 REFERENCES

A. AMCA 500 - Test Methods for Louvers, Dampers and Shutters.

B. AMCA 511 - Certified Ratings Program for Air Control Devices.

C. ASCE 7 - Minimum Design Loads for Buildings and Other Structures.

1.03 DEFINITIONS

A. Horizontal Louver: Louver with horizontal blades; i.e., the axes of the blades are horizontal.

B. Drainable-Blade Louver: Louver with blades having gutters that collect water and drain it to channels in jambs and mullions, which carry it to bottom of unit and away from opening.

1.04 SUBMITTALS

A. Submit under provisions of Section 01300 – Submittals. Submit Shop Drawings, Product Data and Samples.

B. Product Data: For each product to be used, including:

1. Manufacturer's product data including performance data.

2. Preparation instructions and recommendations.

3. Storage and handling requirements and recommendations.

4. Installation methods.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications:

1. The manufacturer shall have implemented the management of quality objectives, continual improvement, and monitoring of customer satisfaction to assure that customer needs and expectations are met.

2. Manufacturer shall be International Organization for Standardization (ISO) 9001 accredited.

3. Louver Ratings based on tests and procedures performed in accordance with AMCA 511 and comply with AMCA Certified Ratings Program.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

B. Store materials in a dry area indoors, protected from damage and in accordance with manufacturer's instructions.

C. Handling: Protect materials and finishes during handling and installation to prevent damage.

D. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.07 PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.08 WARRANTY

A. Manufacturer shall provide standard limited warranty for louver systems for a period of five years (60 months) from date of installation, no more than 60 months after shipment from manufacturing plant. When notified in writing from the Owner of a manufacturing defect, manufacturer shall promptly correct deficiencies without direct financial cost to the Owner.

PART 2: PRODUCTS

2.01 MANUFACTURERS

A. Acceptable Manufacturer: Ruskin Company Or approved equal.

2.02 STATIONARY BLADE LOUVER

A. Basis of Design Model: ELBD375I as manufactured by Ruskin Company.

B. Fabrication:

1. Design: Combination intake louver backdraft damper type with all welded construction of stationary blades and frame.

2. Frame:

a. Frame Depth: 9” inches (224 mm).

b. Wall Thickness: .081 inch (2.1 mm), nominal.

c. Material: Extruded aluminum, Alloy 6063-T6.

3. Louver Blades:

a. Style: drainable. 37.5 degrees at 4 inches.

b. Wall Thickness: .081-inch nominal.

c. Material: Extruded aluminum, Alloy 6063-T6.

4. Backdraft Damper Blades:

a. Style: Gravity.

b. Material: .025 formed aluminum 6063 T6 with blade edge seals.

C. Performance Data:

1. Size: 48 -inch x 54 -inch size unit in accordance with AMCA 500.

2. Quantity: 2

3. Free Area Size/ louver: 7.41 square feet

4. Maximum Recommended free area intake velocity through louver: 550 fpm

5. Static pressure drop at maximum intake velocity: 0.20 inches w.g.

D. Design Wind load: Incorporate structural supports required to withstand wind load of 20 pounds per square foot.

2.03 ACCESSORIES

A. Insect Screens:

1. Aluminum: 18-16 mesh, mill finish, .011-inch wire.

2. Frame: Aluminum.

3. Removable

4. Rewireable

B. Extended Sills:

1. Formed aluminum, Alloy 3003. Minimum nominal thickness 0.081 inch (2.1 mm).

C. Visible Mullions: Manufacturer's standard horizontal or vertical visible mullions for architectural accent as indicated on drawings.

2.04 FINISHES

A. Finish: Prime Coat:

1. Primer preparation for field painting.

PART 3: EXECUTION

3.01 EXAMINATION

A. Inspect areas to receive louvers. Do not proceed with installation until unsatisfactory conditions are corrected.

3.02 PREPARATION

A. Clean opening thoroughly prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.03 INSTALLATION

A. Install louvers at locations indicated on the drawings and in accordance with manufacturer's instructions.

B. Install louvers plumb, level, in plane of wall, and in alignment with adjacent work.

C. The supporting structure shall be designed to accommodate the point loads transferred by the louvers when subject to the design wind loads.

D. Install joint sealants.

E. Apply field topcoat within 2 months of application of shop prime coat. Apply field topcoat as specified in Section 09900 Painting.

3.04 CLEANING

A. Clean louver surfaces in accordance with manufacturer's instructions.

B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

SECTION 10400

IDENTIFICATION DEVICES

PART 1: GENERAL

1.01 WORK INCLUDED

A. Work of this Section includes, but is not limited to, the following:

1. Interior Space Number and Name Signs

2. Fire Extinguisher and Fire Pull Station Signage

1.02 QUALITY ASSURANCE

A. Comply with Department of Community Affairs, Americans with Disabilities Guidelines.

1.03 SUBMITTALS

A. Submit manufacturer's technical data and installation instructions for each type of identifying device required.

B. Submit shop drawings showing sign dimensions, letterform and letter heights.

C. Submit one (1) full size sample for an interior space number and name sign identifying devices showing style, specified color, and method of attachment. If approved, sample shall be incorporated in the Work.

D. Submit a schedule of all space names and numbers as well as quantities and locations of all other signs specified.

1.04 DELIVERY, STORAGE AND HANDLING

A. Package signs in labeled name groups.

B. Store and protect products from soiling, damage, and degradation from exposure to excessive heat, moisture, and humidity.

1.05 ENVIRONMENTAL REQUIREMENTS

A. Do not install signs when ambient temperature is below 70 degrees F. Maintain minimum temperature during and after installation of signs.

PART 2: PRODUCTS

2.01 MANUFACTURERS

A. Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:

1. Desk & Door Name Plate, Inc.

2. Art in Bronze, Inc.

3. Best Mfg. Co.

4. Mohawk Sign Systems

B. Products of other manufacturers will be considered providing their products equal or exceed the quality specified, as well as the type, size, finish, letter style and arrangement specified.

2.02 SPACE SIGNS

A. Provide signs at all spaces using a sand-carved process, and as follows:

1. Tactile characters/symbols shall be raised the required 1/32-inch from sign face. Glue-on letters will not be accepted.

2. All text shall be accompanied by Grade 2 Braille.

3. Perimeter Borders: 3/8-inch.

4. All letters, numbers and symbols shall contrast with their background, either light characters on a dark background, or dark characters on a light background. Characters and background shall have a non-glare finish.

B. Plaque material shall be laminated colored plastic, 1/8-inch thick with contrasting core color. The plastic laminate shall be non-static, fire-retardant and self-extinguishing. The plastic laminate shall be impervious to most acids, alkalis, alcohol, solvents, abrasives and boiling water.

C. Letter form shall upper case Helvetica.

D. Size of letters and numbers shall be as follows:

1. Space Numbers: 1/4-inch minimum

2. Space Name: 1-1/2-inch minimum

E. Standard Grade 2 Braille shall be below copy.

2.03 SPACE NAME AND NUMBER SIGNS

A. Provide one sign at each door leading into each space.

1. Size: 6-inches by 6-inches. Size for spaces accessed from the exterior shall be 6-inches by 4-inches.

B. Fabricate signs in accordance with requirements specified in Article 2.2.

C. Mounting: Signs shall be installed on the wall adjacent to the latch side of the door. If there is no space on the latch side of the door, including double leaf doors, signs shall be placed on the nearest adjacent wall.

1. Mounting Height: 3'-6" above the finished floor to the centerline of the sign.

2. Mounting location shall be so that a person may approach within three inches of signage without encountering protruding objects or standing within the swing of a door.

2.04 PLANT SIGNS

A. Metal Signs (Type M):

1. Material: Baked enamel finished 20-gauge (minimum) steel or 18 gauge

2. Aluminum signs.

3. Manufacturers:

a. Seton Identification Products.

b. Nutheme Illustrated Safety Co.

B. Fiberglass Signs-Nameplates or Pictorial Symbols (Type FR[]):

1. Material: Three-ply laminated fiberglass, minimum 1/8 inch thick, with contrasting color core message layer between two clear weather-resistant surface layers.

2. Manufacturers:

a. Best Manufacturing Co.

b. Brady Signmark.

C. Hazardous Material Signals (Type Haz):

1. Conform to NFPA 704 and NFPA HAZ-01.

2. Material: Fiberglass 1/8-inch thick.

3. Background, Letters, and Numbers: Die-cut vinyl with pressure sensitive adhesive.

4. Manufacturers:

a. Brady Signmark.

b. Emed Co., Inc.

2.05 FIRE EXTINGUISHER AND PULL STATION SIGNS

A. Copy to Read: "FIRE PULL STATION"
"FIRE EXTINGUISHER"

B. Fabricate signs in accordance with requirements specified in Article 2.2 with red background and white raised letters, 1-1/2 inches high by width needed for copy. Braille lettering is not required.

C. Mount on wall surfaces with non-removable oval head screws 5'-0" above finish floor to centerline of sign.

PART 3: EXECUTION

3.01 EXAMINATION

A. Verify that surfaces are ready to receive work.

B. Verify location, placement and alignment of signage prior to installation.

3.02 SIGNS

A. Fasten to walls or posts or hang as scheduled. Anchor in-place for easy removal and reinstallation with ordinary hand tools.

B. Information and Safety Signs:

1. Install facing traffic. Locate for high visibility with minimum restriction of working area around walkways and equipment.

2. Removable with ordinary hand tools without leaving scars on structure or equipment.

3.03 INSTALLATION

A. Install in accordance with manufacturer's published instructions.

B. Install signs after receiving surfaces are finished in locations as indicated or directed. Install signs on receiving surface plumb and level.

C. Clean and polish each sign following installation.

3.04 SUPPLEMENTS

A. The supplement listed below, following “End of Section,” is a part of this Specification.

B. Sign Schedule: A tabulation of characteristics and mounting information for each sign on the Project. Provide items as scheduled. Meet requirements of Occupational Safety and Health Act (OSHA).

END OF SECTION

Canton WPCP Expansion to 6 MGD
Plant Signage Table

Sign Types	
M	Metal
FRP	Fiberglass
HAZ	Hazardous Materials

Chemical	Health (Blue)	Flammability (Red)	Instability (Yellow)	Special (White)
Polymer	1	1	0	0
Aluminum Sulfate	2	0	0	0
12.5% Sodium Hypochlorite	3	0	1	0
Citric Acid	1	0	0	0
Magnesium Hydroxide	0	0	0	0

				MAX. SIZE (in.)		MOUNTING			LETTERING			
LOCATION	QUANTITY	SIGN TYPE	COLOR	WIDTH	HEIGHT	LOCATION	METHOD	HEIGHT TO CENTER LINE	HEIGHT (in)	COLOR	MESSAGE	SIDES OF SIGN
ODOR CONTROL SYSTEM - HEADWORKS	1	FRP	Yellow/ White	20	14	Pipe Post	Bolts	5'-0"	1	Black	CAUTION Equipment Starts Automatically	1
FINE SCREENINGS	1	M	White	20	14	Pipe Post	Bolts	5'-0"	1	Black	FINE SCREENINGS FACILITY	1
	1	FRP	Yellow/ White	20	14	Pipe Post	Bolts	5'-0"	1	Black	CAUTION Equipment Starts Automatically	1
BNR BASINS 1 - 3	1	M	White	20	14	Pipe Post	Bolts	5'-0"	1	Black	BNR BASIN 1	1
	1	M	White	20	14	Pipe Post	Bolts	5'-0"	1	Black	BNR BASIN 2	1
	1	M	White	20	14	Pipe Post	Bolts	5'-0"	1	Black	BNR BASIN 3	1
	4	FRP	Yellow/ White	20	14	Pipe Post	Bolts	5'-0"	1	Black	CAUTION Equipment Starts Automatically	1
BNR BASIN 4	1	M	White	20	14	Pipe Post	Bolts	5'-0"	1	Black	BNR BASIN 4	
	2	FRP	Yellow/ White	20	14	Pipe Post	Bolts	5'-0"	1	Black	CAUTION Equipment Starts Automatically	1
MEMBRANE FACILITY	1	M	White	20	14	Pipe Post	Bolts	5'-0"	1	Black	MBR TRAIN 1	1
	1	M	White	20	14	Pipe Post	Bolts	5'-0"	1	Black	MBR TRAIN 2	
	1	M	White	20	14	Pipe Post	Bolts	5'-0"	1	Black	MBR TRAIN 3	
	1	M	White	20	14	Pipe Post	Bolts	5'-0"	1	Black	MBR TRAIN 4	1
	1	M	White	20	14	Pipe Post	Bolts	5'-0"	1	Black	MBR BLOWER ROOM	1
	1	M	White	20	14	Pipe Post	Bolts	5'-0"	1	Black	MBR CHEMICAL ROOM	1
	1	H	-	14	14	Pipe Post	Bolts	5'-6"	1	HAZ	CITRIC ACID	1
	1	H	-	14	14	Pipe Post	Bolts	5'-6"	1	HAZ	SODIUM HYPOCHLORITE	1
	1	FRP	Yellow/ White	20	14	Pipe Post	Bolts	Below Hazard Signage	1	Black	CITRIC ACID FILL STATION	1
	1	FRP	Yellow/ White	20	14	Pipe Post	Bolts	Below Hazard Signage	1	Black	SODIUM HYPOCHLORITE FILL STATION	1

Canton WPCP Expansion to 6 MGD
Plant Signage Table

Sign Types	
M	Metal
FRP	Fiberglass
HAZ	Hazardous Materials

Chemical	Health (Blue)	Flammability (Red)	Instability (Yellow)	Special (White)
Polymer	1	1	0	0
Aluminum Sulfate	2	0	0	0
12.5% Sodium Hypochlorite	3	0	1	0
Citric Acid	1	0	0	0
Magnesium Hydroxide	0	0	0	0

				MAX. SIZE (in.)		MOUNTING			LETTERING			
LOCATION	QUANTITY	SIGN TYPE	COLOR	WIDTH	HEIGHT	LOCATION	METHOD	HEIGHT TO CENTER LINE	HEIGHT (in)	COLOR	MESSAGE	SIDES OF SIGN
	2	M	White	20	14	Wall	Bolts	5'-0"	1	Red	EMERGENCY EYE WASH	1
BNR AND MBR ELECTRICAL BUILDING	2	M	Gray	8	8	Door	Permanent Tape	5'-0"	1	Black	ELECTRICAL ROOM	1
	2	FRP	Red/ White	8	8	Door	Permanent Tape	5'-0"	1	Black	DANGER High Voltage	1
UVPA FACILITY	1	M	Gray	8	8	Door	Permanent Tape	5'-0"	1	Black	UVPA ELECTRICAL ROOM	1
	1	FRP	Red/ White	8	8	Door	Permanent Tape	5'-0"	1	Black	DANGER High Voltage	1
WAS STORAGE, REUSE WETWELL	2	FRP	Yellow/ White	20	14	Pipe Post	Bolts	5'-0"	1	Black	CAUTION Equipment Starts Automatically	1
	1	M	White	20	14	Wall	Bolts	5'-0"	1	Black	WAS STORAGE TANK	1
	1	M	White	20	14	Wall	Bolts	5'-0"	1	Black	RECLAIMED WATER TANK	1
AEROBIC DIGESTERS	1	M	White	20	14	Pipe Post	Bolts	5'-0"	1	Black	AEROBIC DIGESTER 1	1
	1	M	White	20	14	Pipe Post	Bolts	5'-0"	1	Black	AEROBIC DIGESTER 2	1
SOLIDS HANDLING FACILITY	2	FRP	Gray	8	8	Door	Permanent Tape	5'-0"	1	Black	ELECTRICAL ROOM	1
	2	FRP	Red/ White	8	8	Door	Permanent Tape	5'-0"	1	Black	DANGER High Voltage	1
	2	FRP	Gray	8	8	Door	Permanent Tape	5'-0"	1	Black	THERMAL OIL ROOM	1
	6	FRP	Yellow/ White	20	14	Pipe Post	Bolts	5'-0"	1	Black	CAUTION Equipment Starts Automatically	1
	4	M	White	20	14	Pipe Post	Bolts	5'-0"	1	Red	EMERGENCY EYE WASH	1

Canton WPCP Expansion to 6 MGD
Plant Signage Table

Sign Types	
M	Metal
FRP	Fiberglass
HAZ	Hazardous Materials

Chemical	Health (Blue)	Flammability (Red)	Instability (Yellow)	Special (White)
Polymer	1	1	0	0
Aluminum Sulfate	2	0	0	0
12.5% Sodium Hypochlorite	3	0	1	0
Citric Acid	1	0	0	0
Magnesium Hydroxide	0	0	0	0

				MAX. SIZE (in.)		MOUNTING			LETTERING			
LOCATION	QUANTITY	SIGN TYPE	COLOR	WIDTH	HEIGHT	LOCATION	METHOD	HEIGHT TO CENTER LINE	HEIGHT (in)	COLOR	MESSAGE	SIDES OF SIGN
	1	M	White	20	14	Wall	Bolts	5'-0"	1	Black	BFP POLYMER	1
	1	H	-	14	14	Wall	Bolts	5'-6"	1	HAZ	BFP POLYMER FILL STATION	1
	1	M	White	20	14	Wall	Bolts	5'-0"	1	Black	RDT POLYMER	1
	1	H	-	14	14	Wall	Bolts	5'-6"	1	HAZ	RDT POLYMER FILL STATION	1
ALUM FEED SYSTEM	1	M	White	20	14	Pipe Post	Bolts	5'-0"	1	Black	ALUM FEED FACILITY	1
	1	H	-	14	14	Pipe Post	Bolts	5'-6"	1	HAZ	ALUMINUM SULFATE	1
	1	FRP	Yellow/ White	20	14	Pipe Post	Bolts	Below Hazard Signage	1	Black	ALUMINUM SULFATE FILL STATION	1
	2	M	White	20	14	Wall	Bolts	5'-0"	1	Red	EMERGENCY EYE WASH	1
MgOH FEED SYSTEM	1	M	White	20	14	Pipe Post	Bolts	5'-0"	1	Black	MAGNESIUM HYDROXIDE FEED FACILITY	1
	1	H	-	14	14	Pipe Post	Bolts	5'-6"	1	HAZ	MAGNESIUM HYDROXIDE	1
	1	FRP	Yellow/ White	20	14	Pipe Post	Bolts	Below Hazard Signage	1	Black	ALUMINUM SULFATE FILL STATION	1
COMPRESSED AIR MIXING SYSTEM	1	M	White	20	14	Pipe Post	Bolts	5'-0"	1	Black	COMPRESSED AIR MIXING SYSTEM	1
	1	FRP	Yellow/ White	20	14	Pipe Post	Bolts	5'-0"	1	Black	CAUTION Equipment Starts Automatically	1

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SECTION 10520

FIRE PROTECTION SPECIALTIES

PART 1: GENERAL

1.01 WORK INCLUDED

A. Extent of fire protection specialties is indicated on the Drawings and includes, but is not limited to, the following:

1. ABC-type portable fire extinguishers and brackets.

2. Attachment hardware

1.02 SUBMITTALS

A. Product Data: Submit manufacturer's technical data and installation instructions for all portable fire extinguishers required.

1.03 QUALITY ASSURANCE

A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, “Portable Fire Extinguishers”.

B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction over the Project.

PART 2: PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the work include, but are not limited to, the following:

1. Larsen's Manufacturing Co.

2. J.L. Industries

3. Potter-Roemer

B. Equivalent products of other manufacturers may be proposed, but in no case shall extinguishers have a plastic valve and handle assembly.

2.02 FIRE EXTINGUISHERS

A. General: Provide fire extinguishers for each extinguisher cabinet and other locations indicated, in colors and finishes selected by the Architect/Engineer from manufacturer's standard.

B. Abbreviations indicated below to identify extinguisher types related to UL classification and rating system and not necessarily to type and amount of extinguishing material contained in extinguisher.

1. Multi-purpose Dry Chemical Type (4A-80B:C) UL-rated, 10-pound nominal capacity.

2. Carbon Dioxide Type (10-B:C) UL-rated, 10-pound nominal capacity

2.03 FIRE EXTINGUISHER CABINETS

A. Fire Extinguisher Cabinets: Semi-recessed with break glass door equipped with cylinder lock, single extinguisher units, baked enamel on 18 gauge steel except exposed trim and doors stainless steel. Doors: Continuous hinges, 5/8-inch thick, frame molding glass 1 inch wide minimum. Stainless steel die cut, one piece construction with no welding and grinding.

2.04 FIRE EXTINGUISHER BRACKETS

A. Provide brackets as manufactured by the fire extinguisher manufacturer, sized to accommodate fire extinguishers required for this Project.

PART 3: EXECUTION

3.01 INSTALLATION

A. Install items included in this section in locations and at heights to comply with applicable regulations.

B. Securely fasten mounting brackets and fire extinguisher cabinets to structure, square and plumb, to comply with manufacturer's instructions.

C. All extinguishing equipment shall have annual maintenance performed and be certified according to requirements of NFPA 10 no more than one (1) month prior to occupancy.

3.02 IDENTIFICATION

A. Identify all fire extinguishers with permanent marking (non-removable label, engraving, silk-screen process) as follows:

B. Identify bracket mounted extinguishers with red, letter decals spelling "FIRE EXTINGUISHER" applied to wall surface. Letter size, style, and location shall be as selected by the Architect/Engineer.

END OF SECTION

SECTION 10810

TOILET ACCESSORIES

PART 1: GENERAL

1.01 WORK INCLUDES

A. Extent of each type of toilet accessory is indicated on drawings or is specified herein.

B. Types of toilet accessories required include, but are not limited to, the following:

1. Surface-Mounted Paper towel Dispenser/Waste Receptacle units
2. Recessed Paper Towel Dispenser/Waste Receptacle units
3. Grab bars
4. Sanitary Napkin/Tampon Vendor units
5. Framed Mirror units
6. Wall Mounted Soap Dispensers
7. Lavatory-Mounted Soap Dispensers
8. Combination Toilet Seat Cover Dispenser, Sanitary Napkin Disposal and Toilet Tissue Dispenser units
9. Combination Toilet Seat Cover Dispenser and Toilet Tissue Dispenser units
10. Curtain Rods
11. Mop and Broom Holders

C. Related Work:

1. Wood blocking is specified in Section 06100
2. Glass Mirrors are specified in Section 08810

1.02 DESIGN REQUIREMENTS

A. Provide surface-mounted toilet accessories unless indicated otherwise. Attach to walls with heavy duty, tamper-proof fasteners.

B. Provide stainless steel finish for all toilet accessories.

C. Provide barrier-free accessory items as specified.

1.03 QUALITY ASSURANCE

A. Inserts and Anchorages: Furnish inserts and anchoring devices that must be set in concrete or built into masonry. Coordinate delivery with other work to avoid

delay. Provide wood blocking and bracing requirements for units installed in gypsum board partition systems.

B. Products: Provide products of same manufacturer for each type of accessory unit and for units exposed in same areas, unless otherwise specified.

1.04 SUBMITTALS

A. Product Data: Submit manufacturer's technical data and installation instructions for each toilet accessory.

B. Samples: If requested by Architect/Engineer, submit full-size samples of specific units to Architect/Engineer for review of design and operation. Acceptable samples will be returned and may be used in work.

C. Setting Drawings: Provide setting drawings, templates, instructions, and directions for installation of anchorage devices and cutout requirements in other work.

PART 2: PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering toilet accessories that may be incorporated in the work include, but are not limited to, the following:

1. Bobrick Washroom Equipment, Inc.

2. Bradley Corporation.

3. American Specialties, Inc.

B. Products manufactured by Bobrick Washroom Equipment, Inc. have been used as a basis of design for this Project.

2.02 ACCESSORY ITEMS

A. General: The following list of Manufacturers and Model Numbers identify the unit quality. Equivalent models from the above list of manufacturers will be considered.

B. Paper Towel Dispenser/Waste Receptacle Units:

1. Recessed Units: Satin-finish stainless steel with seamless beveled flange; dispenses 600 C-fold or 800 multifold towels; removable, 12-gallon waste receptacle is locked into cabinet; Bobrick Model No. B-3944 or equivalent

2. Surface-Mounted Units: Satin-finish stainless steel with seamless beveled flange and stainless-steel skirt for surface mounting; dispenses 350 C-fold or 475 multifold towels; knob latch retains door; removable 2-gallon capacity container; Bobrick Model No. B-3699 or equivalent

C. Grab Bars: Wall-mounted types as indicated on the Drawings with theft-proof exposed fasteners; heavy duty, 1-1/2 inches diameter, with satin stainless-steel

finish; Bobrick B-5806 Series, Model Nos. B-5806x42 and B-5806x36, or equivalent

D. Sanitary Napkin/Tampon Vendor Units: Recessed units, satin-finish stainless steel; door has 90-degree return that conceals flange; dispenses 31 napkins and 22 tampons; single-coin mechanisms convertible for 25 cent operation (free-operation option); two-tumbler locks with separate lock and key for coin box; Bobrick Model No. B-3500 or equivalent

E. Framed Mirror Units: Surface-mounted, one piece channel framed units 1/2-inch by 1/2-inch, mitered corners, all stainless steel finish; provide No.1 quality, 1/4-inch glass mirrors warranted against silver spoilage for 10 years; theft-resistant mounting; Bobrick Model No. B-165-1836 or equivalent

F. Soap Dispensers:

1. Wall-Mounted Units; satin-finish stainless steel; with corrosion-resistant valve that dispenses commercially marketed all-purpose hand soaps; soap refill window; Bobrick Model No. B-2112 or equivalent

2. Lavatory-Mounted Units: Vandal-resistant locking cover and free-turning spout; corrosion-resistant; bright polished spout, cover and escutcheon; high-impact ABS body and shank; shatter-resistant polyethylene container; Bobrick Model No. B-822 or equivalent

G. Combination Toilet Seat Cover Dispenser, Sanitary Napkin Disposal and Toilet Tissue Dispenser Units: Side wall recessed units; 8-gllon capacity; holds 1000 toilet seat covers and four (4) rolls of toilet tissue; theft-resistant spindles; barrier-free design; Bobrick Model No. B-3574 or equivalent

H. Combination Toilet Seat Cover Dispenser and Toilet Tissue Dispenser Units: Side wall recessed units; holds 1000 toilet seat covers and four (4) rolls of toilet tissue; theft-resistant spindles; barrier-free design; Bobrick Model No. B-3474 or equivalent

I. Curtain Rods: 1-inch diameter rod, 20 gage, with concealed mounting; type 304 stainless steel with satin finish; flanges are chrome-plated plastic with bright polished finish; concealed bracket mounts; Bobrick Model No. B-207 or equivalent

J. Mop and Broom Holders: Type 304 stainless steel with satin finish; anti-slip mop holders have spring-loaded rubber cam that grips handles; Bobrick Model No. B-223 or equivalent

2.03 FASTENERS

A. Fabricate concealed mounting devices and fasteners from same material as particular accessory or galvanized steel.

B. Finish exposed mounting devices and fasteners to match particular accessory.

C. Fasteners: Theft-resistant type. Use sex-bolts in lieu of anchored screws wherever feasible.

PART 3: EXECUTION

3.01 INSTALLATION

A. Install toilet accessories in accordance with manufacturer's printed instructions.

B. Secure toilet accessories to supporting substrate with fasteners and anchors of types necessary for rigid anchorage to substrate construction. Provide back-up plates as required.

C. Conceal evidence of drilling and fitting in adjacent surfaces.

3.02 KEYS AND SPECIAL TOOLS

A. Deliver properly identified special tool of each type for theft-proof fasteners to the Owner.

B. Deliver three keys for each keyed alike accessory group to the Owner at completion of work.

3.03 CLEANING

A. After installation, clean toilet accessories in a manner not to damage finish and leave in condition satisfactory to the Architect/Engineer.

END OF SECTION

SECTION 11000

MISCELLANEOUS MECHANICAL ITEMS

PART 1: GENERAL

1.01 WORK INCLUDED

A. This Section covers the Work necessary to furnish and install, complete, the miscellaneous mechanical and/or specialty items specified herein.

1.02 GENERAL

A. Like items provided hereunder shall be the end products of one manufacturer in order to achieve standardization for appearance, maintenance, and replacement.

B. See Division 1, General Requirements, which contain information and requirements that apply to the work specified herein and are mandatory for this project.

1.03 SUBMITTALS

A. Shop Drawings:

1. Make, model, and weight of each equipment assembly/item.

2. Complete catalog information, descriptive literature, specifications, and identification of materials of construction with reference to ASTM material designation test.

3. Detailed Mechanical Drawings showing the equipment dimensions, size, locations of connections, and weight of associated equipment.

4. Factory finish for each component shall be in conformance with painting system specified.

5. Power and control wiring diagrams, including terminals and numbers.

6. List of materials, list of equipment, including a complete list of parts and supplies with current unit prices and source of supply. List of special tools for each type of equipment furnished including special tools necessary for adjustment, operation, maintenance, and disassembly.

B. Informational Submittals:

1. Special shipping, storage and protection, and handling instructions.

2. Manufacturer’s printed installation instructions.

3. Operation and Maintenance Data: Six complete copies of maintenance instructions listing routine maintenance procedure, possible breakdown and repairs, and trouble-shooting guides.

1.04 NAMEPLATES

A. Each major item of equipment shall have the manufacturer's name, address, type of style, model or serial number, and catalog number on a plate secured to the item of equipment.

B. Nameplates shall be 16-gauge stainless steel with 1/4-inch die stamped lettering.

1.05 DELIVERY AND STORAGE

A. Material and equipment delivered and placed in storage shall be stored with protection from the weather, excessive humidity and excessive temperature variation, dirt, dust, or other contaminants.

1.06 EXTRA MATERIALS

A. Concurrent with delivery and installation of the specified equipment, auxiliary equipment and spare parts shall be furnished as follows:

1. Spare parts of each different item of material and equipment specified including all of the parts recommended by the manufacturer to be replaced after 1 year service.

2. One set of special tools for the air compressor including calibration devices, and instruments required for adjustment, calibration, disassembly, operation, and maintenance of the equipment.

1.07 QUALITY ASSURANCE

A. Provide manufacturer's standard warranty for equipment to be furnished in accordance with this specification.

1. Warranty for workmanship and materials shall be manufacturer's standard for 1 year from startup, not to exceed 18 months from factory shipment.

PART 2: PRODUCTS

2.01 SUMP PUMPS

A. Provide two sump pumps:

1. Solids Handling Facility: 20 gpm at 32 ft TDH, ¾ hp, 230V, 3-phase

2. MBR Facility: 20 gpm at 32 ft TDH, ¾ hp, 230V, 3-phase

B. Sump pumps shall consist of pumps complete with motor, control system including level switches, and power cable.

C. Pumps shall be cast iron with an oil filled motor. Oil chamber between seals shall be equipped with drain and inspection plug. Plug shall have positive anti-leak seal and shall be easily accessible from outside.

D. Motor name plate horsepower shall not be exceeded at any head – capacity point on the pump curve.

E. Pump motor and sensor cables shall be suitable for submersible pump application and cable sizing shall conform to NEC specifications for pump motors.

Cable shall be of sufficient length to reach junction boxes without strain or splicing.

F. Pump shall be equipped with an integral level float. Float shall be wide angle, polypropylene, mechanical arm with a normally open contact. ON and OFF set points shall be adjustable. Float shall be suitable for installation in a Class 1, Division 2 area.

G. Pump shall be Goulds Model LSP07, Hydromax SHEF, or equal.

2.02 SOLIDS HANDLING FACILITY AIR COMPRESSOR SYSTEM

A. The compressor system shall include duplex 5 horsepower, 460-volt ac, 3-phase, pressure lubricated, two-stage, reciprocating type air compressors, each with a capacity of 17.3 acfm at 175 psig. Each compressor must be sized to recover from each use in 15 minutes.

B. The receiver shall be 80-gallon capacity receiver, complete with safety valve, pressure gauge, float-type auto drain and one 3-inch flanged air discharge port. The receiver tank shall be welded steel bearing ASME code stamp with required inspection openings and meeting the requirements of ASME Section VIII code for Unfired Pressure Vessels.

C. Furnish air receiver with inlet check valve, pressure gauge, safety valve, filter/ regulator with gauge, and manual drain valve.

D. Furnish an internal control panel whose enclosure shall be rated either NEMA 4X.

E. All components shall be mounted, piped, and wired on 80-gallon horizontal air receiver.

F. Compressor shall be Quincy, Ingersoll Rand, or equal.

2.03 BACKFLOW PREVENTION ASSEMBLY ENCLOSURE

A. The BFP enclosure shall be fabricated of 5052-H32 marine grade aluminum (.050/18 gauge), mill finish and shall meet ASTM B209. Enclosure shall be suitable for mounting on a concrete pad and come equipped with SST epoxy anchors.

B. Access shall be provided through completely removable panels or hinged lid.

C. Insulation shall be 1.5 inches minimum thickness with an R value equal to or greater than 9.0.

D. Heating equipment shall be furnished and designed by the manufacturer of the enclosure to maintain an interior temperature of +40º F with an outside temperature of -30º F. Quantity of electrical resistance elements shall be as recommended by the manufacturer. Heating equipment shall require one 120V/single phase service to the enclosure.

E. Manufacturers shall be Safe-T-Covers, Hubbell Power Systems, or equal.

PART 3: EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's printed instructions.

3.02 FIELD PAINTING

A. Factory painted items requiring touching up in the field shall be thoroughly cleaned of all foreign material and shall be primed and coated in accordance with Section 09900, Painting.

END OF SECTION

SECTION 11200

SUBMERSIBLE PUMPS

PART 1: GENERAL

1.01 GENERAL

A. Provide submersible pumps for the Dewatering Drain Pump Station and the WAS Pump Station as specified herein. Dewatering Drain Pumps shall be capable of handling fluids with temperatures of 140 degrees Fahrenheit associated with the drain from the condenser associated with the sludge dryer.

1.02 REFERENCES

A. The following is a list of standards that may be referenced in this Section:

1. American National Standards Institute (ANSI).
2. ASTM International (ASTM):
   a. A48, Standard Specification for Gray Iron Castings.
   b. A576, Standard Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality.
3. Hydraulic Institute Standards (HIS).
4. National Electric Code.
5. National Electrical Manufactures Association (NEMA).
6. National Fire Protection Association (NFPA): 70, National Electric Code.
7. Underwriters Laboratories (UL).

1.03 RELATED WORK SPECIFIED ELSEWHERE

A. Terminology pertaining to pumping unit performance and construction shall conform to ratings and nomenclature of Hydraulic Institute Standards.

1.04 SUBMITTALS

A. General: Provide Shop Drawings, samples, administrative, quality controls, and contract closeout submittals in accordance with the requirements of Section 01300 Submittals, Section 01640 Manufacturer’s Services, Section 01730, Operation and Maintenance Manual, and as listed below.

B. Action Submittals: Shop Drawings:

1. Make, model, weight, and horsepower of each equipment assembly.
2. Complete catalog information, descriptive literature, specifications, and identification of materials of construction.
3. Performance data curves showing head, capacity, horsepower demand, and pump efficiency over the entire operating range of the pump, from

shutoff to maximum capacity. Indicate separately head, capacity, horsepower demand, overall efficiency, and minimum submergence required at guarantee point.

4. Power and control wiring diagrams, including terminals and numbers.

5. See Section 13400 Process Instrumentation and Control Systems, for electrical and instrumentation submittal requirements.

6. Complete motor nameplate data, as defined by NEMA, from motor manufacturer.

7. Bearing life calculations.

C. Quality Control Submittals:

1. Factory and Field Performance Test Reports and Log for:

a. Flow, gpm

b. Total Dynamic Head (TDH), feet

c. NPSHr, feet

d. Input Power and Shaft Power, horsepower

e. Overall Efficiency and Pump Efficiency, %

2. Manufacturer's Certification of Compliance that finish system meets requirements specified herein.

3. Special shipping, storage and protection, and handling instructions

4. Manufacture's printed installation instructions.

5. Manufacturer's Certificate of Proper Installation.

6. Suggested spare parts list to maintain equipment in service for period of 1 year. Include list of special tools required for checking, testing, parts replacement, and maintenance with current price information.

7. List special tools, materials, and supplies furnished with equipment for use prior to and during startup and for future maintenance.

8. Operation and Maintenance Data as specified in Section 01730, Operation and Maintenance Manual.

1.05 PRODUCT DELIVERY STORAGE AND HANDLING

A. All equipment shall be delivered in suitable packages, cases or crates, and stored or placed as directed by the manufacturer. Each package shall have an identifying mark and a complete list showing contents. Equipment shall not be stored directly upon the ground.

B. All equipment shall be lifted and handled in a manner so as not to damage or deform the equipment in any way and in any special way as instructed by the manufacturer.

C. All parts and equipment shall be properly protected so that no damage or deterioration will occur during a prolonged delay from the time of shipment until installation is completed and the units and equipment are ready for operation. Finished surfaces of all exposed pump openings shall be protected by securely bolted wood planks. Finished iron or steel surfaces not painted shall be properly protected to prevent rust and corrosion during periods of storage and installation and shall be satisfactory to the County up to the time of the final acceptance test.

1.06 WARRANTY

A. Warranty: The pump manufacturer shall warrant the pumps being supplied to the County against defects in workmanship and materials for a period of 5-years or 10,000-hours under normal use, operation and service. The warranty shall apply to 100% parts and labor for the time specified and shall not be prorated.

PART 2: PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Where a manufacturer's standard equipment name and/or model number is listed the equipment system shall be provided as modified to conform to the performance, functions, features, and materials of construction as specified herein.

B. Materials, equipment, components and accessories specified in this Section shall be products of Flygt (Xylem), or Homa.

2.02 PUMP PERFORMANCE CRITERIA

A. Dewatering Drain Pump Station

Item	Criteria
Number of Pumps	2
Equipment Tag Number(s)	15-DP2-P-1 15-DP2-P-2
Primary Design Flow (gpm)	1775
Primary Design TDH (ft)	78
Secondary Design Flow (gpm)	2000
Secondary Design TDH (ft)	65
Pump Model Number	Flygt NP 3202
Impeller Diameter, mm	294
Impeller Type	Semi-open channel Semi-permanent, Wet
Solids Passing, Min (in)	3
Fluids Temperature (F)	140
Mixing Valve (per pump)	1

Pump Motor (hp/V/phase)	60/480/3
Pump Speed (rpm)	1720
Drive	VFD

B. Waste Activated Sludge (WAS) Pumps

Item	Criteria
Number of Pumps	3
Equipment Tag Number(s)	11-SF-P-1 11-SF-P-2 11-SF-P-3
Primary Design Flow (gpm)	400
Primary Design TDH (ft)	55
Secondary Design Flow (gpm)	800
Secondary Design TDH (ft)	28
Pump Model Number	Flygt NP 3127
Impeller Diameter, mm	215
Impeller Type	Semi-open channel Semi-permanent, Wet
Solids Passing, Min (in)	3
Mixing Valve (per pump)	0
Pump Motor (hp/V/phase)	10/480/3
Pump Speed (rpm)	1720
Drive	VFD

2.03 COMPONENTS

A. Brass or stainless steel nameplates identifying the name of the manufacturer, voltage, phase, rated horsepower, speed and any other pertinent data shall be attached to each pump.

B. Anchors and Fastener: All necessary foundation bolts, plates, nuts, and washers shall be furnished by the equipment manufacturer shall be Type 316 stainless steel.

C. Pump equipment shall consist of pump(s) complete with motor(s), guide rail and anchoring brackets, base elbow, power cable(s), and pump lifting cable(s). Pump equipment shall also include control systems for all pumps.

1. Pump metal parts that come into contact with guide rail of cable system shall be made of nonsparking materials.

D. Lifting Arrangement: 2 feet minimum, stainless steel chain, and one “grip eye”. Attach chain permanently to pump and access platform with stainless steel wire rope. “Grip-eye” will be capable of being threaded over the engaging links of stainless steel chain so pump and motor may be lifted with “grip-eye” and independent hoist.

E. Sliding guide bracket shall be integral part of pump unit. Pump unit shall be guided by no less than two guide bars and pressed tightly against discharge connection elbow with metal-to-metal contact. Guide rail assemblies and all support brackets shall be Type 304 stainless steel.

F. Oil Chamber between seals shall be equipped with drain and inspection plug. Plug shall have positive anti-leak seal and shall b easily accessible from outside.

G. Motor nameplate horsepower shall not be exceeded at any head-capacity prior on pump curve.

H. Pump motor and sensor cables shall be suitable for submersible pump application and cable sizing shall conform to NEC specifications for pump motors. Cable shall be of sufficient length to reach junction boxes without strain or splicing.

I. Mix-Flush System for the Dewatering Drain Pump Station:

1. Each pump in the Dewatering Drain Pump Station shall be equipped with an automatically operating valve that will provide a mixing action within the sump at the start-up of the pumping cycle.

2. This valve shall be mounted directly on the pump volute and shall direct a portion of the pumpage into the sump to flush and re-suspend solids and grease by the turbulent action of its-discharge. The turbulent action caused by

3. the flow shall also provide some sump aeration benefits. The valve shall be mounted on the pump volute so that it can be removed from the sump along with the pump during normal and routine maintenance checks and shall be positioned on the volute to provide for non-clogging operation. The valve shall be equipped with an adjustable, wear-resistant discharge nozzle which shall be used to direct flow from the valve to optimize mixing action within the sump.

4. The valve shall not require any external power source or control to operate, neither electric nor pneumatic. The use of the external power source is not acceptable. The valve shall be suitable for use in Class I, Division 1 hazardous locations.

5. The valve shall open at the beginning of each pumping cycle and shall automatically close during pump operation after a pre-selected time of operation. The valve shall operate automatically by differential pressure across the valve and shall be actuated through a self-contained hydraulic system which uses an environmentally safe fluid. A method of adjusting the valve operating time shall be provided.

J. Cable Entry System:

1. Junction chamber and motor shall be separated by terminal board that shall prevent foreign material entering through pump top.

2. O-ring compression seal between sealing gland and cable entry point shall be acceptable.

K. Special Tools and Spare Parts:

1. Special Tools: Provide special tools for normal operation and maintenance.

2. Spare Parts: The pump supplier will include at least one set of spare parts with a toolbox.

L. Pump Access Hatch and Frame

1. Provide access hatch and frame in accordance with Section 08310, Access Doors and Panels.

2.04 ELECTRICAL AND INSTRUMENTATION

A. General: Provide field panels, instrumentation, electrical components, and wiring for a complete functional system. These components shall comply with Division 16 for electrical and instrument and control equipment, including submittal requirements. Even though not specifically indicated, provide all items that are required for proper system operations.

B. Motors: Provide squirrel-cage ac induction motors in accordance with Section 16220, Motors.

C. Wiring: The Drawings and Specifications indicate the anticipated wiring for the equipment provided under this Section. If additional wiring is required, or if required wiring does not match what is indicated the Contractor shall make the necessary modifications to the electrical wiring and documentation as part of the lump sum price. All wiring shall meet the requirements of Section 16120 Wires and Cables and NFPA 70. All insulation shall be rated 600 volts, minimum.

D. Field Panels and Instrumentation: Provide field panel(s) and instruments with power supply, external interfaces and operator controls and indicators as shown on the P&IDs with descriptors as defined on the Instrumentation and Control Legend sheets. Field panels and instrumentation that are provided under this Section are identified on the P&IDs either with an asterisk, note as such, or are shown with Package Equipment boundaries. Construct field panels in accordance with Package Equipment boundaries. Construct field panels in accordance with Section Division 16 Electrical and instrumentation and control, its supplementary figures and as follow:

1. Field Panel(s):

Tag Number	Name	NEMA Rating	Enclosure Materials	Power Supply
15-DP-P-1 15-DP-P-2	Dewatering Facility Drain Pump Station	4X	Type 316 SST	460V, 3 Phase

11-SF-P-1 11-SF-P-2 11-SF-P-3	Waste Activated Sludge (WAS) Pumps	4X	Type 316 SST	480V, 3 Phase

2. Instrumentation: As shown on the P&ID Drawings, including, but not limited to, level floats. Instrumentation shall be rated for its environment and electrically hazardous location. Specific manufacturer and model are the vendor's choice unless noted below or if noted in 13400, Process Instrumentation and Control Systems.

3. Functional Requirements (15-DP-P-1 & 15-DP-P-2):

   a. Start Lag Pump on rising High Level.

   b. Start Lead Pump on rising Middle Level.

   c. Stop both pumps on falling Low Level.

   d. (Redundant) stop both pumps on falling Low Low Level.

   e. In either ON or AUTO mode, disable each pump on rising high motor temperature. To re-enable pump operation, press the Reset pushbutton.

   f. Assign pumps by means of the 1/2/ALT hand switch in conjunction with an alternator. In "1" the Lead and Lag pumps shall be assigned as "1" and "2" respectively. In "2" the Lead and Lag pumps shall be assigned "2" and "1" respectively. In "ALT" alternate pumps on falling Low Level with both pumps confirmed OFF.

4. Functional Requirements (11-SF-P-1, 11-SF-P-2 & 11-SF-P-3):

   a. Run the pump when the ON/OFF hand switch is in the ON position

   b. Disable the pump on falling Low Low Level. Once the condition clears, re-enable the pump by pressing RESET.

   c. Alarm lights shall remain actuated until the RESET pushbutton is pressed.

2.05 ACCESSORIES

A. Equipment Identification Plate: 16-guae stainless steel with ¼-inch die-stamped equipment tag number securely mounted in readily visible location.

B. Lifting Lugs: Equipment weighing over 100 pounds.

2.06 FACTORY FINISHING

A. Prepare, prime, and finish coat in accordance with Section 09900 Painting.

2.07 SOURCE QUALITY CONTROL

A. Factory Test: Perform manufacturer's standard test on equipment.

B. Motor Test: See Section 16220, Motors.

C. Hydrostatic Tests: Test all pump casing(s) at 150 percent of shutoff head. Test pressure maintained for not less than 5 minutes.

D. Pump:

1. Factory Performance Test:

a. In accordance with ANSI/HIS 11.6, Level A for submersible pump tests.

b. Include performance test logs.

2. Conduct on each pump.

3. Perform under actual or approved simulated operating conditions.

a. Throttle discharge valve to obtain pump data points on curve at 2/3, 1/3, and shutoff conditions.

E. Submersible Motor Functional Test: In accordance with ANSI/HIS/ 11.6.

PART 3: EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's printed instructions.

B. Connect suction and discharge piping without imposing strain to pump flanges.

C. No portion of pump shall bear directly on floor of sump.

3.02 FIELD QUALITY CONTROL

A. Provided field quality control tests in accordance with Section 01650 Equipment Testing and Facility Startup and as follows:

1. Alignment: Test complete assemblies for correct rotation, proper alignment and connection, and quiet operation.

2. Flow Output: Measured by plant instrumentation and storage volumes.

3. Operating Temperatures: Monitor bearing areas on pump and motor for abnormally high temperatures.

4. Test for continuous 3-hour period.

5. Test Report Requirements: In accordance with Hydraulic Institute Standards for submersible pump tests ANSI/HIS 1/6 and 11/6.

B. Vibration Test:

1. Test with units installed an in normal operation and discharging to connected piping systems at rates between low discharge head and high discharge head conditions specified, shall not develop vibration exceeding limits specified in ANSI.HIS 11.6.

2. If units exhibit vibration in excess of limits, adjust or modify as necessary. Units that cannot be adjusted or modified to conform as specified shall be replaced.

3. Flow Output: Measured by plant instrumentation and storage volumes.

C. Performance Test:

1. Test that all panel lights are functional.

2. Test that both manual and automatic modes of operation are functional.

3. Test pump alternation.

3.03 MANUFACTURER'S SERVICES PER SET OF PUMPS

A. Manufacturer's Representative: Present at site or classroom designated by Owner, for the minimum person-days listed below for each set of pumps, travel time excluded:

1. 1 person-day for installation and inspection for each set of pumps.

2. 1 person-day for functional performance testing and completion of Manufacturer's Certificate of Proper Installation for each set of pumps.

3. 1 person-day for facility startup for each set of pumps.

4. 1/2 person-day for post-startup training of Owner's personnel. Training shall not commence until accepted detailed lesson plan for each training activity has been.

END OF SECTION

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SECTION 11202

SLIDE GATES

PART 1: GENERAL

1.01 SCOPE

A. Work covered by this Section includes furnishing all labor, equipment, and materials required to install and test fabricated aluminum slide gates and complete with slides and frames and appurtenances, as shown on the Drawings and/or specified herein.

B. The equipment provided under this section shall be fabricated, assembled, erected, and placed in proper operating condition in full conformity with the drawings, specifications, engineering data, instructions, and recommendations of the equipment manufacturer unless exceptions are noted by the engineer.

1.02 RELATED WORK

A. Installation of anchor bolts is included in Division 3, but anchor bolts shall be furnished under this Section.

B. Field painting is included in Section 09900 Painting.

1.03 SUBMITTALS

A. Submit in accordance with Section 01300 Submittals. Submittals shall include at least the following:

1. Certified drawings showing details of construction and dimensions
2. Descriptive literature bulletins and/or catalogs of each product.
3. The total weight of each item, with design calculations demonstrating lift load and deflection
4. A complete bill of materials
5. Additional submittal data, where noted with individual pieces of equipment.

B. Manufacturer's Installation and Application Data

C. Complete operating and maintenance instructions shall be furnished for all equipment specified herein accordance with the Specification Section 01730 Operation and Maintenance Manual.

D. In the event that it is impossible to conform to certain details of the specifications due to different manufacturing techniques, describe completely all non-conforming aspects.

1.04 REFERENCE STANDARDS

A. Design, manufacturing and assembly of elements of the products herein specified shall be in accordance with the standards of the below listed organizations.

1. American Society for Testing and Materials (ASTM)

2. Aluminum Association, Inc. (AA)

3. Underwriters Laboratories (UL)

4. Factory Mutual (FM)

5. AWWA C561 Fabricated Stainless Steel Slide Gates

B. Where reference is made to a standard of one of the above, or other organizations, the version of the standard in effect at the time of bid opening shall apply.

1.05 QUALITY ASSURANCE

A. Qualifications

1. All products specified under this Section shall be standard products of proven ability as manufactured by competent organizations that are fully experienced, reputable and qualified in the manufacture of the products to be furnished. The products shall be designed, constructed and installed in accordance with the best practice and methods, and shall operate satisfactorily when installed.

2. All products furnished under this Section shall be new and unused and shall be the standard products of manufacturers having a successful record of manufacturing and servicing the equipment and systems specified herein for a minimum of five (5) years.

1.06 DELIVERY, STORAGE AND HANDLING

A. Reference is made to Section 01600 Delivery, Storage and Handling for additional information.

B. Packing and Shipping

1. Care shall be taken in loading, transporting and unloading to prevent injury to the gates, appurtenances, or coatings. Equipment shall not be dropped. All gates and appurtenances shall be examined before installation. Any piece of equipment that is found to be defective shall not be installed. Any damage to the coatings shall be repaired as acceptable to the Engineer.

2. Exposed stems shall be coated with a protective oil film that shall be maintained until the unit is installed and placed into service.

3. Any corrosion in evidence at the time of acceptance by the Owner shall be removed, or the valve shall be removed and replaced.

1.07 MAINTENANCE

A. Spare Parts

1. Manufacturer's recommended spare parts sufficient for the initial year of operation shall be provided.

2. Spare parts shall be properly bound and labeled for easy identification without opening the packaging and suitably protected for long term storage in a humid environment.

B. Special Tools

1. One set of all special tools required for normal operation and maintenance of the equipment shall be furnished by the manufacturer.

2. Tools shall be furnished in a suitable steel case, clearly and indelibly marked on the exterior to indicate the equipment for which the tools are intended.

1.08 GUARANTEE

A. The equipment and installation shall be fully guaranteed by the Contractor for a period of one year from the date of final acceptance by the Owner. The guarantee shall cover any and all defects in workmanship or materials that may develop in this specified time. Refer to the General Conditions of these specifications for additional information.

PART 2: PRODUCTS

2.01 DESIGN CRITERIA

A. Slide gates shall be sized Gate Schedule included as a Supplement to this specification.

B. Slide gates shall be reinforced as required for a deflection under the maximum design head of not more than 1/720 of the span of the gate.

C. The following is the allowable gate leakage when subjected to the specified head conditions included in the gate schedule.

1. Under a seating head condition, the leakage shall not exceed 0.1 gallon per minute per foot of perimeter.

2. For unseating head conditions up to a maximum of 20 feet, the leakage shall not exceed 0.2 gallon per minute per foot of seating perimeter.

D. Manufacturers

1. Rodney Hunt

2. Waterman

3. WACO

4. Or approved equal.

2.02 FABRICATED SLIDE GATES

A. Fabricated slide gate disc shall be a flat plate suitably reinforced to withstand the required head conditions. If flush-bottom closure is required, a resilient seal shall be attached to the lower edge of the disc to seat against a stop bar attached to the frame along the invert of the gate.

B. Gates shall be constructed from Stainless Steel, Type 304, ASTM A240.

C. The frame shall consist of a standard guide extending down both sides of the gate and across the invert. The frame shall be suitable for embedding in concrete unless otherwise shown on the plans.

D. If the gate is to be self-contained, guides shall extend above the opening to support a structural yoke. The operating bench stand or floor stand shall be mounted on the yoke.

E. The operating stem shall be the rising-stem type and shall be attached to the gate disc.

F. The gate disc and frame shall be constructed from Type 304L stainless steel.

G. Wall brackets to support stem shall be fabricated from Type 304 stainless steel. Distances from wall to centerline of stem are as shown on drawings.

2.03 STEMS

A. Operating stems shall be of a size to safely withstand, without buckling or distortion, the stresses induced by normal operating forces. Stems shall be designed to transmit in compression at least 2 times the rated output of the floor stand or bench stand with a 50-pound effort on the crank or handwheel.

B. Stem shall be of minimum 1½” diameter 304 stainless steel rod with accurately machined Acme threads. .

C. Stems of more than 1 section shall be joined by bronze or stainless steel couplings threaded and keyed or bored and pinned to the stems. All threaded and keyed couplings of the same size shall be interchangeable.

D. Manually operated rising stem gates shall be provided with an adjustable bronze stop collar on the stem above the floor stand lift nut.

E. Provide stem covers manufactured of clear polycarbonate to provide visual indication of gate position. Stem covers shall be provided with vent holes to limit the condensation build up.

F. Stem guides will be supplied to support the stem as required to meet the stem design criteria and shall be fabricated of the same alloy material as the gate and frame. Stem guides shall have bronze or UHMW bushings to reduce stem friction and wear as required by the installation. Stem guides shall be adjustable in multiple dimensions to allow for alignment with operator and gate stem nut. Guides will be mounted on the gate frame or installation wall as required to support and align the stem(s) properly.

2.04 SEALS

A. The seals shall be self-adjusting. Seals requiring periodic maintenance and adjustments to maintain specified leakage rates will not be permitted.

B. The top seal design on upward opening gates consisting of four side seals shall incorporate a self-cleaning wiping function that prevents debris from building-up above the top seal and causing premature wear of the seats, seals, and gate face.

C. The UHMW seats shall impinge on the slide (disc) by way of a continuous loop cord seal. Seal designs incorporating resilient seals such as “J-bulb” or “P” seals that come in direct contact with the friction surface of the slide will not be considered.

D. The cord seal shall function as a seal between the frame and the UHMW, and as a spring force to maintain contact between the UHMW and the slide (disc).

E. The resilient bottom seal shall be set into the invert member of the frame which shall be formed in a manner to protect 3 sides of the seal only exposing the side that will come in contact with the slide. Disc-mounted invert seals exposing additional surface area will not be permitted.

2.05 MANUAL OPERATOR FLOOR STANDS

A. Manual operation shall be by handwheel or crank-operated floor stands or bench stands as shown on the plans. Handwheel operated type shall be without gear reduction and crank-operated type shall have either a single- or double-gear reduction depending upon the lifting capacity required. Each type shall be provided with a threaded cast bronze lift nut to engage the operating stem.

B. Tapered ball or roller bearings shall be provided above and below a flange on the operating nut to support both opening and closing thrusts.

C. Floor stands shall operate the gates with not greater than 40-lb. pull on the crank or handwheel. The pinion shafts on crank-operated floor stands, either single or double, shall be supported on tapered roller bearings or needle bearings. All components shall be totally enclosed in a cast iron or cast aluminum case and cover. Positive mechanical seals shall be provided on the operating nut and the pinion shafts where they extend from the case or gear box to retain lubricant and to exclude moisture and dirt. Lubricating fittings shall be provided for lubrication of all gears and bearings.

D. The removable crank shall be cast iron or cast aluminum with a revolving brass or nylon grip. Floor stands shall include a cast iron pedestal design to position the input shaft approximately 36 inches above the operating floor.

2.06 ELECTRIC ACTUATED GATE OPERATORS

A. Non-Intrusive Type

1. The electric actuators for the motor operated gates shall be of Non-Intrusive design with the capability for remote two-wire digital control interface. No substitution or exception to the following specification will be accepted. The

actuators shall be suitable for use on a nominal 460 Volt, 3 Phase, and 60-Hertz power supply.

2. The actuators shall be self contained unit consisting of electric motor, 15-bit, optical, absolute position encoder, electronic torque sensor, integral reversing starter, electronic control, protection, and monitoring package, manual override hand wheel, valve interface bushing, 32-character LCD display, and local control switches all contained in a sealed watertight enclosure suitable for NEMA 4, 4X, 6, IP68 and explosion proof as required.

3. All calibration shall be possible without removing any covers and without the use of any special tools. Answering simple “YES” or “NO” questions displayed on the 32-character LCD display shall perform all calibration. All local displays shall be expressed in multilingual text, no symbols on the LCD will be allowed!

4. The actuator shall include a device to ensure that the motor runs with the correct rotation for the required direction of valve travel with either phase sequence of the three-phase power supply connected to the actuator.

B. Actuator Sizing

1. The actuator shall be sized to guarantee valve closure and opening at the specified differential pressure and valve opening. The safety margin of motor power available for seating and unseating the valve shall be sufficient to ensure torque switch trip at maximum valve torque with the supply voltage 10% below nominal. The operating speed shall be such as to give valve closing and opening at approximately 10-12 inches per minute unless otherwise specifically stated in the valve specification and/or valve data sheets.

C. Ambient Temperature

1. The actuator shall be capable of functioning in an ambient temperature ranging from -22° F to +158°F. Actual operating environment for specific valve application is as shown in the associated valve specification and/or data sheets.

D. Motor

1. The motor shall be 3-phase, 60-cycle, 460 volt with class F insulation, and a thermistor embedded within the motor windings to prevent damage due to overload. The motor shall be easily removed through the use of a plug-in connector and shaft coupling. Motor shall have the capability of removal without the need of draining oil from the actuator gearbox.

E. Power Transmission

1. The power transmission shall be completely bearing – supported, and consist of a hardened alloy steel worm and bronze worm gear, oil-bath lubricated using synthetic oil designed specifically for extreme pressure gear transmission service. Where the actuator operates gate valves or large diameter ball or plug valves, the drive shall incorporate a lost-motion hammer-blow feature. For rising spindle valves, the output shaft shall be

hollow to accept a rising stem and incorporate thrust bearings of the ball or roller type at the base of the actuator, and the design should be such as to permit the gear case to be opened for inspection or disassembled without releasing the stem thrust or taking the valve out of service.

F. Hand Operation

1. A hand wheel and a declutch (hand/auto selection) lever shall be provided for manual operation. The hand wheel drive must be mechanically independent of the motor drive, and any gearing should be such as to permit emergency manual operation in a reasonable time. The hand wheel shall not rotate during electric operation nor can a seized motor prevent manual operation. Hand wheel is engaged when the motor is declutched by a lever or similar means. Energizing the motor shall restore the actuator automatically to motor operation. The declutch (hand/auto selection) lever shall be padlockable. Lost motion “hammer blow” effect shall be provided with both direct and independently geared hand wheels.

2. Clockwise operation of the hand wheel shall give closing movement of the valve unless otherwise stated in the job specification.

G. Drive Bushing

1. The actuator shall be furnished with a drive bushing easily detachable for machining to suit the valve stem or gearbox input shaft. Normally the drive bushing shall be positioned in a detachable base of the actuator. Thrust bearings, when housed in a separate thrust base, should be of the sealed-for-life type.

2.07 POSITION & TORQUE SENSING

A. A position and torque sensing system shall be provided for both electrically actuated slide gates and manually operated slide gates.

B. A 15 – bit optical absolute position encoder, shall sense valve position. Position setting range shall be: 2 to 100,000 turns, with a maximum angular resolution of 7.5° degrees of actuator drive sleeve output position at the valve stem. Open and closed positions shall be stored in permanent, non-volatile memory. The encoder shall measure valve position at all times, including both motor and hand wheel operation, with or without 3 – phase power, and without use of a battery. Use of batteries in the actuators shall not be acceptable.

C. An electronic torque sensor shall be included. The torque limit may be adjusted from 40% to 100% of rating in 1% increments. The motor shall be de-energized if the torque limit is exceeded. A boost function shall be included to prevent torque trip during initial valve unseating, and a “Jammed Valve” protection feature, with automatic retry sequence shall be incorporated to de-energize the motor if no movement occurs.

D. No mechanical torque sensing system using springs, or washers will be accepted.

PART 3: EXECUTION

3.01 INSTALLATION

A. Installation shall be in strict accordance with the manufacturer's written instructions and recommendations in the locations shown on the Drawings.

B. Slide gate frames and plates shall be checked prior to installation for projections or warpage that would promote excessive leakage. Defective gates shall be removed and replaced.

C. Slide gate frames shall be installed true to the lines and elevations shown and accurately aligned. Frames shall be internally braced and adequately supported during concrete placement and/or installation.

D. The ability of each slide gate to operate easily without binding or excessive leakage or wear shall be demonstrated to the satisfaction of the Engineer.

3.02 TESTING

A. All gates shall be field tested to ensure all items are in compliance with this Section. Each gate shall be cycled through a minimum of three full open/close cycles.

B. Gates shall operate without binding, scraping, or distorting. The effort to open and close the gate shall be measured and shall not exceed the maximum torque specified.

C. The leakage rate shall not exceed leakage requirements as defined in PART 2 of this specification. Additional seals shall be provided as required to ensure the leakage requirement is met.

3.03 SERVICES OF MANUFACTURER'S REPRESENTATIVES

A. Manufacturer's Representative: Present at site or classroom designated by Owner, for the minimum person-days listed below, travel time excluded:

1. 1 person-day for installation and inspection per site visit for two (2) site visits.

2. 1 person-day for functional performance testing and completion of Manufacturer's Certificate of Proper Installation per site visit for two (2) site visits.

3. 1 person-day for facility startup.

4. ¼ person-day for post-startup training of Owner's personnel.

B. The instruction period shall be scheduled at least ten days in advance with the Owner and shall take place prior to plant start-up and acceptance by the Owner. The final approved copies of operation and maintenance manuals must have been delivered to the Engineer prior to scheduling the instruction period with the Owner.

END OF SECTION

SECTION 11212

VERTICAL TURBINE PUMPS

PART 1: GENERAL

1.01 SECTION INCLUDES

A. Provide two vertical, mixed flow or turbine pumps with appurtenances to convey plant reuse water as needed.

1. Install pumps in the Reuse Water Pump Station as shown on the Drawings.
2. Comply with the Contract Documents.

B. Each pump assembly to include, but not be limited to:

1. Bowl.
2. Column Assembly.
3. Discharge Head with Sole Plate.
4. Motor Including Couplings and Guards.

1.02 QUALITY ASSURANCE

A. Provide standard components of a manufacturer who has built vertical, mixed flow and turbine pumps of an equal or larger capacity for at least five years.

B. Provide proof of experience when requested by the County's project manager or designee. Provide all pumps from a single manufacturer who shall be responsible for the following:

1. Design.
2. Coordination.
3. Proper operation of the Pumps and Motors.

C. Comply with applicable standards including, but not limited to the most recent edition of the following:

1. Hydraulic Institute (HI).
2. American National Standards Institute (ANSI).
3. American Society of Testing and Materials (ASTM).
4. Anti-friction Bearing Manufacturers Association (AFBMA).

D. Design to provide satisfactory performance under the specified operating conditions.

1.03 SUBMITTALS

A. Comply with Section 01300 - Submittals. Include the following additional information:

1. Make, model, and weight of each equipment assembly.
2. Manufacturer's catalog information, descriptive literature, specifications, and a complete bill of materials including identification of materials of construction.
3. Certified structural, mechanical, electrical, and erection drawings showing important details of construction, equipment dimensions, size, anchor bolt locations, and locations of connections to other work.
4. Provide an installation list identifying at least five operating pumping stations that are equal to or larger than the proposed facility. Include the following information for each installation cited:
    a. Name of contact familiar with the equipment.
    b. Current mailing address.
    c. Current telephone number.
5. Certified pump performance curves showing flow, head, efficiency, and BHP over the manufacturer's recommended operating range for each required pump speed.
    a. Indicate limits of stable operation where pumps will operate without cavitation, surging or excessive vibration.
    b. Pump performance curves shall clearly indicate the minimum continuous flow rating of the pump
6. Certified NPSH curve based on previous shop test data from similar pumps or actual test data of project pumps.
7. Certification that motors and pumps have been dynamically balanced to the tolerances specified herein.
8. Provide complete Bill of Materials, parts list and assembly drawings for the pumps.
9. Motor data. Identify:
    a. Nominal rated horsepower.
    b. Rated ambient temperature.
    c. Service factor.
    d. Power requirements.
    e. Required full load current at rated horsepower.
    f. Starting code letter.
    g. Locked rotor KVA and current.
    h. Motor performance curves
10. Report documenting dynamic analysis of pump, motor, and structure.
11. Impact test results on each pump and motor assembly to establish its actual Reed critical frequency value.

12. Special shipping, storage and protection, and handling instructions.

13. A list of manufacturer's recommended parts required to maintain the equipment for a period of one year, with current price information.

14. A list of special tools, materials, and supplies furnished with the equipment for use prior to and during startup, and for future maintenance.

15. Manufacturer's installation instructions.

B. Submit O&M Manuals in accordance with Section 01730 – Operation and Maintenance Manual. Include the following additional information:

1. A list of manufacturer's recommended parts required to maintain the equipment for a period of one year, with current price information.

2. A list of special tools, materials, and supplies furnished with the equipment for use prior to and during startup, and for future maintenance.

C. Submit manufacturer's certificates. Include:

1. Equipment warranty and certification form in accordance with 01300, Submittals.

2. Manufacturer's certificate of proper installation.

1.04 SPECIAL TOOLS AND SPARE PARTS

A. Provide spare parts recommended by the manufacturer. At a minimum, provide one (1) complete set of the following:

1. Gaskets and O-rings – 1 complete set for each type of pump.

2. Bowl bearings – 1 complete set for each type of pump.

3. Lineshaft bearings – 1 complete set for each type of pump.

4. Mechanical Seals – 1 complete set for each pump provided.

5. Headshaft sleeve – 1 for each type of pump.

1.05 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver, handle and store the equipment in accordance with the manufacturer's recommendations.

B. Comply with ANSI/HI 2.4

1. Covered, dry, and ventilated storage may be used if stored on site for less than 60 calendar days.

2. Storage on site for longer than 60 days shall require the manufacturer to prepare the equipment for long-term storage prior to shipment.

a. Rotate pump and driver shaft for the duration of long-term storage.

b. Frequency of rotation shall be as recommended by the manufacturer.

c. Maintain log indicating time of rotation. The Owner's project manager or designee shall initial log.

C. Furnish one complete set of special tools required to disassemble, service, repair and adjust the equipment. Special tools are those that are not readily available through a commercial tool supplier. Include:

1. Tools that are unique to the equipment provided.

2. Tools that are not readily available from an industrial tool supplier such as “Snap-On” or Mac Tools.

1.06 DYNAMIC ANALYSIS

A. Analyze the line-shafting, pump and motor assembly for harmful natural frequencies in both the lateral and torsional directions prior to fabrication.

1. Comply with Hydraulic Institute recommendations.

2. A natural frequency 25 percent above or 33 percent below the normal range of pump operating speeds is considered harmful.

3. Submit results of analyses for approval.

1.07 WARRANTY

A. All equipment supplied under this Section shall be warranted by the manufacturer from the date that Startup Testing is complete in accordance with Section 01650 to at least one (1) year following issuance of Conditional Acceptance.

PART 2: PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. ITT-Goulds Pump Company; Size: 12CHC (6 stages), basis of design

B. Fairbanks Morse Pump Company

C. or Equal.

2.02 GENERAL

A. Service Conditions

1. Liquid Pumped – Treated and disinfected wastewater effluent with pH between 7.0 and 8.0.

2. Liquid Temperature

a. Summer – 70 degrees F average.

b. Winter – 55 degrees F average.

3. Controls

a. Reuse water pumps will start and stop automatically in response to either level control signals received from remote reuse water customer or manually by the operator.

b. Refer to Section 16155 and 16157 for motor controls and variable frequency drives.

B. Design the discharge head and sole plate to carry the entire weight of the bowl, column assembly, driver, and similar components.

1. Size sole plates for the concrete floor openings shown on the drawings.

2. Size all components to minimize vibration and noise. Vibration requirements are given in the Special Provisions.

C. Design and construct all pumps:

1. To be of premium quality and provide the maximum mechanical run time before failure.

a. Use precision manufacturing for both the pump and motor to minimize vibration.

b. Do not exceed a field installed vibration level of 0.21 inches per second (unfiltered) measured at the motor's lower bearing housing. Test vibration in accordance with Hydraulic Institute recommendations.

2. Operate continuously at any point within the specified flow rates without cavitation, overheating or excessive vibration.

3. Do not exceed the motor nameplate horsepower rating when operating as specified.

4. Make each pump's natural frequency either less than 65% of the operating speed or more that 125% of the operating speed.

D. Provide lifting lugs or eyebolts on all major pump components to facilitate safe handling.

E. Provide a stainless steel nameplate on each pump with the following information:

1. Manufacturers name, address, and telephone number.

2. Pump model number.

3. Pump serial number.

4. Head, capacity and rpm for each specified operating condition.

5. Motor horsepower, rpm, full load amperes, and frame size.

2.03 DESIGN CONDITIONS

A. Reuse Water Pump Station Pumps

<table>
<tr><th colspan="4">Pump Duty Points & Data</th></tr>
<tr><th>Flow</th><th>Total
Dynamic Head</th><th>Pump Efficiency
@ 1100 gpm</th><th>Maximum
Operating Speed</th></tr>
<tr><td>1. 1320 gpm</td><td>352 ft</td><td rowspan="3">86.2 %</td><td rowspan="3">1770 rpm</td></tr>
<tr><td>2. 1100 gpm</td><td>410 ft</td></tr>
<tr><td>3. 660 gpm</td><td>474 ft</td></tr>
<tr><td>4. Shutoff Head</td><td colspan="3">498 ft</td></tr>
<tr><td>5. Motor Horsepower</td><td colspan="3">150 hp – 3PH, 60Hz</td></tr>
</table>

6. Column	8-inch flanged
7. Discharge	8-inch flanged – 250lb
8. Number of Stages	6
9. Minimum Submergence	25.4 inches

2.04 CONSTRUCTION DETAILS

A. Bowl Assembly

1. Generally, consists of suction bell, impeller housing, impeller, and discharge bowl.
   a. Flange each section.
   b. Provide registered fit and join using 316 SS bolts.
2. Suction Bell
   a. Effluent Pump Station Pumps: 28-inch diameter suction bell to provide conservative entrance velocities and direct flow to the impeller.
   b. Fabricate smooth and free of sharp projections that could cause turbulence or cavitation.
   c. Construct of ASTM A48, minimum Class 30 Cast iron.
   d. Provide streamlined guide vanes to direct flow to the impeller eye and support the lower pump shaft bearing.

(1) Make bearing from ASTM B584 C90500 Bronze.

3. Impeller Housing
   a. Construct of ASTM A48, minimum Class 30 Cast iron.
   b. Impeller
      1) Construct from either bronze conforming to ASTM B-145 CDA 836 or Alum Bronze conforming to ASTM B148 C95200.
      2) Dynamically balance each impeller prior to assembly. Complete assembled pump rotor unbalance shall not exceed ANSI S2.19 Grade G2.5
      3) Certify that impeller meets specified ASTM and ANSI requirements.
      4) Provide keyed connection to the bowl shaft.
      5) Size to transmit maximum torque that can occur under any of the specified operating conditions.
      6) 316 stainless steel keys.
4. Discharge Bowl
   a. Construct of ASTM A48, minimum Class 30 Cast iron.
   b. Casting shall be free from blow holes or other imperfections.
   c. Provide streamlined vanes to properly direct flow into the discharge column.

d. Size bowl shaft to operate without distortion and have a first critical speed at least 50% greater than the maximum operating speed.

1) Construct from ASTM - A276 stainless steel.

2) Size based on a maximum combined stress of 7,000 psi.

3) Rifle drill to provide for bearing lubrication.

B. Column Assembly

1. Column

a. Fabricate from ASTM A53 and A36 steel.

b. Use flanged connection between sections.

c. Minimum wall thickness: Schedule 30.

d. Maximum bearing spacing of 5 feet or as determined by the critical frequency analysis

e. Provide welded steel retainers.

1) Make integral to column.

2) Bore during column machining process.

f. Fabricate such that the interior is free from offsets, burrs, discontinuities, and irregularities.

2. Lineshaft

a. Construct lineshafts, keys, and couplings from 416 stainless steel conforming to ASTM A276 S41600.

b. Size to transmit full power of the pump without slip, vibration, or excessive elongation.

c. Use keyed connections to join lineshaft sections.

1) Design connections to take rotation in either direction.

2) Sections shall not exceed 5 feet in length.

3. Guide Bearings

a. Replaceable fluted rubber type with bronze backing.

b. Provide sleeve at each bearing.

c. Design for pumped liquid lubrication.

C. Discharge Head Assembly

1. Fabricate from ASTM A53 and A36 steel.

2. Design discharge elbow for above-grade discharge as shown on the drawings.

a. Smooth radius type.

b. Flanged discharge connection.

1) Drill per ANSI B16.1

2) Class 125.

3. Design discharge head and sole plate to carry the entire weight of the complete pump and driver in operation.
   a. No distortion.
   b. Span concrete floor opening shown on the drawings.
   c. Comply with Hydraulic Institute vibration limits.
   d. Provide 300 series, corrosion-resistant coupling guard.
   e. Provide lifting lugs.
4. Stuffing Box.
   a. Drive shaft shall be coupled above a mechanical seal in the discharge head to facilitate easy removal and replacement of the driver
   b. Sealing of the pump liquid cavity shall be with a face-type mechanical seal with Ni-resist stationary seat, carbon sealing washer, Buna rubber flexible members, stainless steel metal parts and spring. The seal shall be rated for 225 °F. Seal shall be mounted over a bronze shaft sleeve and lubricated with non-potable water.
   c. Drain seal leakage to the sump, as shown on the drawings.
5. Provide a precision manufactured, flanged, adjustable coupling to make impeller adjustments.

2.05 MOTOR

A. General

1. The motor rotor shall be statically and dynamically balanced to a Special Balance tolerance to give a vibration amplitude of no more than 0.8 mils measured on the bearing housings at operating RPM an no load when tested at the factory. If the motor manufacturer's standard tolerances are more stringent, then they shall apply.
2. Provide vertical TEFC design.
3. Comply with the most recent NEMA, IEEE, ANSI, and AFBMA Standards where applicable, and meet the requirements of Section 16.

B. Performance Requirements

1. Operate on a 480-volt, three-phase, 60-Hertz power supply with a service factor of 1.15.
2. Efficiency type: premium
3. Free of objectionable noise and vibration. Maximum sound level not to exceed 90 dBA as measured 5 feet from any surface.
4. Maximum temperature of motor windings not to exceed 176 degrees F, as measured by resistance, when the motor is operating continuously at service factor horsepower, rated voltage, and frequency in ambient air temperature of 104 degrees F.

5. Operate within nameplate horsepower of the motor at any point on characteristic curve for impeller furnished.

C. Construction

1. Provide ductile iron motor frames and end shields strong enough to hold all motor components rigidly in proper position.
2. Provide adequate protection for the enclosure.
3. Provide motor suitable for outdoor installation with Class F non-hygroscopic epoxy sealed insulation but limited to Class B temperature rise.
4. Provide insulated windings securely braced to resist failure due to electrical stresses and vibration.
5. Provide high-grade machine steel or steel forging adequate size and design to withstand the load stresses normally encountered in motors of the particular rating.
6. Provide epoxy-coated stator and rotor cores made of low-loss, non-aging electrical sheet steel with insulated laminations.
   a. Stator coils to be random wound and of size, shape, insulation, and number of turns required.
   b. Epoxy seal coils after fabrication.
7. Motor Bearings
   a. Made to AFBMA standards.
   b. Have ample capacity of the motor rating.
   c. Grease lubricated bearings with a minimum B10 bearing life of 100,000 hours.
8. Provide stainless steel nameplate.
9. Provide lifting lugs or “O” type of bolts on all motors.
10. Provide stainless steel screen enclosures.
11. Use all stainless steel fittings, bolts, nuts, and screws.
12. Provide gaskets on conduit boxes and lead wires between motor frame and conduit box.
13. Prevent condensation on the core and winding by providing a space heater sized to prevent condensation on the core and winding.
    a. Isolate space heaters from adjacent painted surfaces.
    b. Space heater shall operate on 120-volt, 60-Hertz, single-phase power supply.

2.06 VARIABLE FREQUENCY DRIVES (VFD)

A. Use VFD to control the speed of EPS pumps to maintain a predetermined wet well level in the Effluent Pump Station.

B. VFD shall be provided by the pump manufacturer and shall comply with Section 16157 – Variable Frequency Drives.

2.07 SHOP PAINTING

A. Clean and shop prime the following surfaces.

1. Exterior of bowl assembly.
2. Interior of suction bell.
3. Exterior of column and discharge head.

B. Surface preparation shall comply with Section 09900.

C. Select the primer to be compatible with the specified finish coat.

PART 3: PART 3 - EXECUTION

3.01 SHOP TESTING

A. Test each pump and driver in a test facility in accordance with the latest edition of ANSI/HI 2.6:

1. Hydrostatic Test
   a. Maintain hydrostatic test pressure for 5 minutes.
   b. Test all liquid containing components.
2. Performance Test
   a. Conduct test on fully assembled pump and motor.
   b. Evaluate mechanical operation of each pump and motor.
      1) Overheating
      2) Cavitation
      3) Excessive Vibration
      4) Leakage
   c. May be witnessed by the Owner.
      1) Provide Owner with 10 calendar days written notice.
      2) Owner will pay his or her own expenses to observe testing.
   d. Test at four operating speeds between the specified minimum and maximum values. Demonstrate compliance with the specified performance.
   e. Provide certified performance curve for each tested operating speed.

B. Conduct each test in accordance with Hydraulic Institute Standards.

C. Submit all test results to the Engineer. Engineer must approve test results prior to shipping a pump and driver to the project site.

3.02 INSTALLATION

A. Install all pumps and appurtenances in accordance with the manufacturer instructions, ANSI/HI 2.4, and the Contract Documents.

B. The manufacturer shall supervise installation of all pumps and appurtenances.

3.03 FIELD PAINTING

A. Field prepare and paint all shop primed pump surfaces as specified in Section 09900.

3.04 FIELD QUALITY CONTROL AND TESTING

A. Perform field inspection and testing in accordance with Section 01650.

B. Demonstrate compliance with all requirements of these specifications.

3.05 MANUFACTURER'S FIELD SERVICES

A. Provide manufacturer's field services in accordance with the following:

1. Supervise the installation of each pump.

2. Inspect equipment after installation.

a. Provide Engineer with a written inspection report.

b. Verify proper operation and correct equipment deficiencies are required during testing in accordance with Section 01650.

c. Submit Manufacturer's Certificate in accordance with Section 01650.

B. Training

1. Conduct training in accordance with Section 01640 – Manufacturers Services. Provide two separate four (4) hour training sessions.

C. Testing and Startup.

1. Test and startup in accordance with 01650 – Facility Start-up and Testing.

END OF SECTION

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SECTION 11220

COMPRESSED AIR MIXING SYSTEM

PART 1: GENERAL

1.01 SCOPE

A. Furnish all labor, materials, equipment and incidentals required for the installation of a compressed air mixing system for the anaerobic and anoxic zones of BNR Basins 1–4 and for Aerobic Digesters 1 and 2 as shown on the Contract Drawings and specified herein.

B. The compressed air mixing system shall include compressors, receiver tank, master control panel, valve modules, header supply piping, nozzle headers, nozzles, above ground piping between the air compressors and the receiving tank, pipe supports, auxiliary equipment and all accessories required for a complete system.

C. The Contractor is shall coordinate construction sequencing with the installation, startup and testing support of the Compressed Air Mixing System Manufacturer.

D. Contractor shall coordinate the layout of the compressed air mixing system and the walkway support columns in BNR Basins 1, 2, and 3.

E. Contractor shall coordinate the layout of the fine bubble diffusers with the layout of the compressed air mixing system in Aerobic Digesters 1 and 2.

F. The specifications and drawings for this project are based on the Enviromix Compressed Air Mixing System.

1.02 RELATED WORK

A. Anchor bolts shall be provided by the Contractor and shall meet the requirements as listed in Section 05530 Anchor Bolts and Expansion Anchors.

1.03 SUBMITTALS

A. Submit complete Shop Drawings and product data per Section of Section 01300, Submittals.

B. Submit operations and maintenance manuals per Section 01730, Operating and Maintenance Data.

C. Submit manufacturer’s qualifications as described in Paragraph 1.04 Quality Assurance,

D. Submittals shall include the following information.

1. Complete catalog information, descriptive literature, and materials of construction.

2. Detailed Mechanical, and Electrical Drawings showing the equipment dimensions, size, and locations of connections and weights of associated equipment.

3. Power and control wiring diagrams, including terminals and numbers.
4. Complete motor nameplate data, as defined by NEMA, motor manufacturer, and including any motor modifications.
5. Information, including technical catalog literature and specifications, on factory prime and finish coating systems.
6. Test or performance data verifying that the system does not contribute measurable oxygen into the process stream.
7. Compressor support locations and loads transmitted to bases and foundations.
8. List of recommended spare parts.
9. Recommendations for short and long-term storage.
10. Special tool requirements.
11. Testing procedures and plan.

1.04 INFORMATION SUBMITTAL

A. Special shipping, storage and protection, and handling instructions.

B. Manufacturer's printed installations instructions.

C. Manufacturer's Certificate of Proper Installation.

D. Suggested spare parts list to maintain the equipment in service for a period of 5 years. Include a list of special tools required for checking, testing, parts replacement, and maintenance with current price information.

E. List special tools, materials, and supplies furnished with equipment for use prior to and during startup and for the future maintenance.

F. Operation and Maintenance Data: Operation and Maintenance Manual as specified in Section 01730 OPERATING AND MAINTENANCE DATA.

1.05 QUALITY ASSURANCE

A. Qualifications

1. The compressed air mixing system shall be furnished by a single manufacturer who has a minimum of ten (10) separate North American installations of compressed air mixing systems similar in scope and quantity to that required for this project.

1.06 DELIVERY, STORAGE AND HANDLING

A. All equipment shall be crated and delivered to protect against damage during shipment.

B. Factory assembled parts and components shall not be dismantled for shipment unless permission is received in writing from the Contractor.

1.07 WARRANTY

A. The compressed air mixing manufacturer shall guarantee the equipment against defects in materials and workmanship under normal use and service for a period of twelve (12) months from date of equipment startup, not to exceed eighteen (18) months from date of equipment shipment.

PART 2: PRODUCTS

2.01 MANUFACTURERS

A. Enviromix

B. Pulsair

2.02 PERFORMANCE AND DESIGN REQUIREMENTS

A. Provide a compressed air mixing system for the anaerobic and anoxic zones in BNR Basins 1 – 4 and Aerobic Digesters 1 and 2 as defined here.

	BNR 1–3 Anaerobic	BNR 1–3 Anoxic	BNR 4 Anaerobic	BNR 4 Anoxic	Aerobic Digesters
Basin Length (ft)	50	50	67.5	67.5	160.67
Basin Width (ft)	13.5	19	14	20	45.75
Basin Side Water Depth (ft)	21	21	17	17	15
Number of Basins	3	3	1	1	2
Service	Mixed Liquor	Mixed Liquor	Mixed Liquor	Mixed Liquor	TWAS*
Total Suspended Solids (%)	1	1	1	1	5

* Thickened Waste Activated Sludge

B. The system shall intermittently and sequentially inject compressed air through fixed nozzles located on the basin floors to create large bubbles which mix the basin contents using no moving parts located within the basin and with negligible oxygen transfer from the mixing system to the bulk liquid.

C. Basin mixing shall be uniform throughout the basin with effective mixing confirmed through a Field Performance Test as specified herein.

D. Mixing intensity and balancing shall be sufficient to maintain suspended solids in a state of suspension over entire basin. Basin mixing shall be achieved through control of firing parameters (sequence, duration, and frequency).

E. Firing air flow rate shall be adjustable via the throttling valve.

F. The compressed air mixing system equipment and piping shall be sized to thoroughly mix the contents of the basins for which the systems are designed.

G. The compressed air mixing system manufacturer shall be responsible for sizing and selecting all system components to meet the requirements of the field mixing performance test specified herein.

2.03 MATERIALS.

A. Piping shall be 304 stainless steel per ASTM A312. All couplings and fittings shall be press fittings with o-rings seals of molded synthetic rubber. Pipe shall have a working pressure rating of 150 psi.

B. Nozzles

1. Top plate shall be fabricated from 1/8” stainless steel plate, ASTM A240/A240M, Type 304/304L with a 2D finish.

2. Bottom plate shall be fabricated from HDPE and gasketed to prevent air from leaking between the top plate and the bottom plate.

3. Top and bottom nozzle plates shall be joined together using Type 304/304L stainless steel hardware. Nozzles shall come pre-assembled.

4. Nozzles shall be designed with adequate strength to withstand vertical thrust of mixing air.

C. Appurtenances

1. Miscellaneous: Nuts, bolts, washers, threaded rod, and other non-welded parts shall be stainless steel, ASTM A240/A240M, Type 304. Threaded assemblies shall be chemically treated or lubricated prior to assembling to prevent galling.

D. Fabrication

1. The piping used for the air mixing system shall be Type 304/304L stainless steel unless otherwise noted.

2. Shop fabricate welded metal parts and assemblies from stainless steel, ASTM A240/A240M, Type 304/304L with a 2D finish.

3. Shop fabricate non-welded parts and pieces from sheets and plates of stainless steel, ASTM A240/A240M, Type 304 or from bars of stainless steel ASTM A276, Type 304, unless specified otherwise.

4. Welds and Welding Procedure

a. Shop weld with filler wire using MIG, TIG or shield-arc, or plasma-arc welding inert gas processes. Provide a cross-section equal to or greater than parent metal.

b. Provide full penetration welds to interior surface with gas shielding to interior and exterior of joint.

c. Provide smooth, evenly distributed interior weld beads with an interior projection not exceeding 1/16 inch beyond inner diameter of nozzle header or fittings.

d. Field welding of the compressed air mixing system is not permitted.

e. Clean all welded stainless steel surfaces and welds after fabrication to remove weld splatter and finish clean all exterior welds, carbon deposits and contaminants by passivation per ASTM A380 Section 6.2.11.

2.04 MASTER CONTROL PANEL (MCP)

A. MCP shall have UL-rated NEMA 4X 316 SST, be suitable for outdoor environment, and be rated for a maximum ambient temperature of 104°F.

B. MCP shall accept a single source 120 VAC power connection. Lightning and surge protection shall be provided on the incoming line power.

C. The MCP shall have an Operator Interface Terminal (OIT) to make operating parameter changes and acknowledge alarms. The OIT shall be an Allen Bradley 10” Panelview Plus 7 color touch screen. The OIT shall have flash memory capacity, USB port, and Ethernet communication.

D. MCP shall be equipped with an Allen Bradley CompactLogix 5069-L306ER controller which controls the mixing system including sequence, duration, and frequency of the air control valve (ACV) openings in each valve module (VM). The controller shall also provide network communication capabilities via Ethernet IP protocol.

E. A stainless steel nameplate shall be provided on the control panel. The nameplate shall be securely fastened in a conspicuous place and clearly inscribed with the Manufacturer’s name, year of manufacture, and serial number.

2.05 CONTROL AND OPERATION.

A. All control features shall be adjustable from the OIT provided by the mixing system Manufacturer. Control features shall be adjustable at any time during the operation of the system. Control features shall be initially set according to Manufacturer recommendations.

B. The operator shall be able to enable/disable mixing operation, select the firing sequence, the firing duration and the frequency of firing. Minimum control features selected through the OIT shall include the following:

1. ACV firing can be started and stopped at any point during operation without powering down the system.

2. Individual ACVs or specific groups of ACVs may be added and/or removed from the firing sequence at any point during operation.

3. The control system shall be equipped with an intermittent mode that mixes at a higher intensity for a short duration and cycles through each VM. This cycle can be enabled and the frequency and duration can be adjusted through the OIT.

C. The control system shall be equipped with a special cycle that pulses the system during an extended mixing disabled period.

D. VMs distributed across multiple tanks or zones shall be grouped into separately controlled zones that can be enabled independently.

E. VMs shall come equipped with a pressure transducer plumbed to the valve manifold. The pressure transducer shall transmit pressure anomalies to the controller. The controller shall interpret the pressure to provide a low system pressure alarm and monitor ACV position.

F. When either the low system pressure or Valve Fail to Open alarms occur, a red general alarm light shall be illuminated on the MCP. The specific alarm shall be indicated on the OIT and shall remain until the fault is corrected or the system is turned off.

G. The controller shall have a register with a bit that toggles at a regular interval to act as a heartbeat for confirmation of continued controller operation and network communication.

H. The controller shall enable/disable compressors in a lead/lag sequence to maintain optimum system pressure based on the compressor discharge pressure transducer signal. The controller shall automatically rotate compressors for balanced runtime.

I. The controller shall open and close the condensate drain(s) based on operator adjustable frequency and duration settings.

J. Remote Communication with the Compressors and Compressor Line Pressure Transducer.

1. The controller shall communicate using the following I/O via hardwired conductors.
    a. Run discrete input
    b. No Fault discrete input
    c. Load discrete input
    d. Enable discrete output
    e. Pressure analog input

K. Remote Communication with the Condensate Drain Valve(s).

1. The controller shall communicate using the following I/O via hardwired conductors.
    a. Open discrete output
    b. Open discrete input
    c. VM reset
    d. Closed discrete input

L. Remote Communication with the Valve Modules.

1. The controller shall communicate using the following I/O via hardwired conductors.
    a. Valve Open discrete output
    b. Pressure analog input
    c. Controller heartbeat discrete output
    d. In Remote discrete input

M. Remote Communication with Plant Control System.

1. An RJ45 Ethernet port shall be provided for connection to the Plant Control Network.

2. The controller shall communicate via Ethernet/IP

a. System Low Pressure

b. Compressor(#) Running

c. Compressor(#) Fault

d. VM(#) Running

e. VM(#) Fault

f. VM(#) Not In Remote

2.06 VALVE MODULE (VM).

A. The VM enclosure shall be 304 stainless steel and all components shall be rated for a maximum ambient temperature of 115°F. The VM shall be built in accordance with UL standards and rated NEMA 4X for outdoor duty.

B. The air control valves shall be mounted to a common manifold. The valves shall be rated for a minimum of 15,000,000 cycles.

C. The VM shall be provided with an aluminum support stand unless wall mounted.

D. The VM located outdoors shall be provided with a 120 VAC heater designed to maintain 40° F in an ambient outside temperature of 20° F. The heater shall be equipped with a thermostat to turn the heater off at temperatures above 55° F.

E. The VM shall accept a single source 120 VAC power connection. Lightning and surge protection shall be provided on the incoming line power.

F. The VM shall have a Local-Off-Remote (LOR) selector switch, a Frequency dial, and a Duration dial. In Local control the ‘Duration’ dial and the ‘Frequency’ dial inside the VM shall allow the operator to adjust mixing intensity locally. In Remote control, the MCP controller shall control the mixing intensity. If there is not a master control panel, the remote position will function the same as the off position

G. A stainless steel nameplate shall be provided on the VM. The nameplate shall be securely fastened in a conspicuous place and clearly inscribed with the Manufacturer’s name, year of manufacture, and serial number.

H. Alarm Light. A red stack light shall be mounted on the top of the VM and indicate an alarm condition specific to the VM.

I. The VM controller shall be rated for a -40°F to 176°F temperature range, Class I, Division 2 Hazardous Areas, and be submersible in up to 3 feet of water.

1. The controller shall be programmed to operate according to the dial settings for valve open frequency and duration when the LOR is in Local mode.

2. The controller shall automatically take control of the ACVs based on the local settings if the discrete heartbeat signal from the MCP controller is lost and

shall automatically relinquish control when the MCP controller heartbeat is restored.

3. The controller shall be a Zombie™ controller or equal.

2.07 AIR COMPRESSOR SYSTEM

A. The air compressor system shall include two air compressors, one receiving tank, an air dryer and other ancillary equipment as defined herein and as required to make the system whole. The system shall be capable of being located outdoors with ambient conditions as listed below.

Ambient Conditions	
Max Air temperature, °F	105
Min Air temperature, °F	20
Relative humidity, percent	80
Site Elevation, FASL	870

B. Air Compressor Modules

1. Two (2) air compressor modules shall be as noted in the Design Table below. Each shall include an inlet air filter, compressor with an AC motor, air/oil separator reservoir, air cooled oil cooler, cooling fan, separator pressure relief valve, discharge check valve, moisture separator, controls, control panel, base, and unloading system.

Air Compressors	
Number required	2
Maximum discharge pressure, psig	104
Capacity at operating target pressure, acfm	481
Motor size, hp	100
Max motor shaft speed, rpm	3,600
Max free field noise ±3 dB(A) when measured in free field conditions at a distance of 1 meter according to ISO1217	75

2. Each compressor module shall be completely factory assembled requiring only field connection of electrical power, air piping, and condensate drain tubing.

3. Each compressor shall be of the single stage, positive displacement, oil-flooded, rotary screw type. The compressor shall be provided with an integral skid or lifting lugs for unloading and placement.

4. Compressor rotors shall be asymmetrical, steel or high strength ductile iron integral shafts, and dynamically balanced. Housings shall be cast iron. Rotors and housings shall be precision machined for accurate bearing positioning and running clearances.

5. The drive arrangement shall be a gear driven design.

6. Positive pressure lubrication shall be provided by an inherent pressure differential system. Lubricant shall be provided as recommended by the Manufacturer. A lubricant filter shall have a high-capacity 10 micron rating.

7. An air/oil separator reservoir shall be provided for each compressor. The reservoir shall be designed and constructed in accordance with the ASME Code for Unfired Pressure Vessels and shall bear the code stamp. The reservoir shall include two-stage filtration to remove oil from air stream. Oil carry-over downstream of compressor modules shall not exceed 3 mg/m3.

8. Each air compressor module shall have automatic controls integral to the unit which open (loaded condition) and close (unloaded condition) the inlet valve to the air end to deliver appropriate volume to meet demand and maintain system target pressure. On sensing a low demand, the motor will keep running but the air end inlet valve will close, resulting in a decreased “idling” power draw on the motor. The valve shall reopen when system pressure drops below the set point.

9. Each baseplate shall be constructed of one-piece folded mild-steel with structural members and shall be designed for no measurable deflection with the equipment mounted thereon and the baseplate supported around its perimeter. Each base shall be designed so that all equipment bolted to it can be removed without access to the underside of the plate and with a flat top surface for ease of cleaning. Structural stiffeners shall be located under the compressors at the compressor anchor points.

10. Valves and piping within the enclosure shall be the compressor manufacturer's standard. Relief valves shall be provided for equipment protection on the air and coolant systems as required.

11. Each compressor shall be provided with an integral, dry-type intake filter. Intake filters shall have replaceable filter element(s). Particle capture shall be not less than 99.9% efficient at 10 microns and above.

12. Each compressor shall be supplied in a sound attenuated enclosure. The enclosure shall reduce the measured sound to a maximum of 85 decibels, as measured by ISO 8571, while the compressor is operating, and the sound level is measured a distance of three feet from the enclosure.

13. A high air/fluid temperature shutdown system shall be provided. The unit must have safety devices mounted and wired. Safety devices shall include motor thermal overload and high compressor discharge temperature shut-down. These systems must be designed to prevent the compressor from running in an over-temperature situation or motor from running in an overload condition.

14. Each compressor shall feature controls capable of operating at two pressure settings, set up and selected in the controller. The controller shall allow one of two different pressure control settings to be chosen so that if the demand is greater than one unit’s capacity (the lead compressor), a second compressor (the lag compressor) will automatically turn itself on until the excess demand has been satisfied. The lag compressor’s motor will shut down after a set period in which it is not loaded as described in paragraph above. The lead/lag pressure settings shall be fully incorporated inside the compressor’s control panel. No additional separate control sequence panels shall be required.

15. The compressors shall be as manufactured by Atlas Copco, Model GA 75, or equal.

C. Air Dryers

1. The air dryers shall be as noted in the Design Table below. Each air dryer shall be a cycling refrigerated air type. The dryer shall produce 37-39°F pressure dew point at the dryer exit when operating continuously at 100 psi and 100°F inlet air ambient temperature.

Refrigerated Air Dryer	
Type	Cycling
Number required	2
Target Pressure Dew Point, °F	35 - 39

2. The dryer shall be capable of continuously drying the maximum discharge capacity of the air compressor.

3. The dryer shall be integral or separately mounted to the compressor module.

D. Free Standing Air Receiver Tank

1. One (1) air receiver shall be provided as described herein and as summarized in the Design Table below. The receiver shall be designed and constructed in accordance with the ASME Code of Unfired Pressure Vessels and shall bear the code stamp.

Receivers	
Number required	1
Design pressure (psig)	200
Nominal volume (gal)	1,060

2. Receiver shall be factory powder coated. One quart touch-up paint shall be provided.

3. The receiver shall be provided with mounting feet valve and pressure gauge.

4. Condensate Drain Valve

a. The receiver shall be provided with a 24 VDC motor-operated ½" FNPT stainless steel ball valve with deutsche connector powered, controlled, and monitored out of an adjacent MCP. A Deutsche pigtail connector shall be provided.

E. Compressor System Particulate and Coalescing Oil Filters.

1. Replaceable-cartridge primary particulate and secondary high-efficiency oil-removal filters shall be provided for each compressor. Following both filters, the maximum particulate size removal shall be to 1 micron and coolant removal shall be to 0.1 mg/m3 at 21oC.

2. The filters shall be rated for the maximum discharge capacity of the air compressor.

F. Compressor System Electrical.

1. All electrical and control equipment for the air compressor module shall be furnished as required for a complete installation, requiring only field connection of a 480 VAC, three phase power supply

2. The compressor electric motor shall be rated 480 volts, 60 Hz, three phase.

G. Compressor System Control Panel

1. An enclosure-integrated control panel shall be mounted on the compressor module.

2. Each compressor electrical control cabinet shall be a NEMA 4X 316 SST rated enclosure.

3. Reduced voltage motor starters shall be provided and sized by the Manufacturer

   a. Starters shall include auxiliary contacts as required.

   b. Magnetic motor circuit protectors shall be 3 phase, 480 volts, molded-case circuit breakers with instantaneous trip elements.

   c. One thermal overload relay shall be provided in each phase lead. Each starter shall be provided with an external manual reset push button for reset of the thermal overload relays. Overloads shall be bimetallic ambient compensated type, matched to motor current, and shall be provided with a manual reset pushbutton.

4. Control power transformers shall have both primary leads fused, one secondary lead fused, and one secondary lead grounded.

5. Terminal blocks shall be utilized for all system wiring. Internal panel wiring shall be neatly bundled and tied and shall be identified with suitable wire markers

6. Controller shall indicate the following conditions; discharge pressure, compressor element discharge temperature, power on, hours of operation, operating mode.

7. Remote mounted fusible disconnects with time delay fuses shall be provided by Contractor.

8. The following I/O shall be provided at the compressor control panel and hardwired to the MCP.

   a. RUN status discrete output

   b. NO FAULT discrete output

   c. ENABLE command discrete input

   d. LOAD discrete output

H. Pressure Transducer

1. The compressors shall be equipped with a pressure transducer plumbed to the discharge piping or receiver to monitor the common discharge pressure from the compressors.

2. The transducer range shall be 0-150 psi (minimum) with ¼" NPT male threaded connection, stainless steel housing, and M12x1 flange connector. Transducer shall be NEMA 4, minimum ambient -10°F, and maximum ambient 150°F.

3. The transducer shall be 4-20 mA, loop-powered from the MCP. An M12 x pigtail adaptor shall also be provided for termination in a junction box adjacent to the device.

4. The transducer shall be as manufactured by Schneider or equal.

I. Compressor Shop Painting

1. All components of the compressed air equipment system shall be shop primed and finish painted with the Manufacturer's standard paint system prior to shipment to the site. Touch up paint shall be provided by the manufacturer and delivered with the compressor system.

2.08 PAINTING

A. All ferrous surfaces shall be cleaned and shop primed in accordance with SSPC-SP-10 and given one (1) coat of manufacturer's epoxy primer.

B. All equipment shall be field painted by the Contractor in accordance with Division 9.

2.09 SPARE PARTS

A. Provide spare parts that are identical to and interchangeable with similar parts installed.

1. One (1) Air Control Valves (ACVs) rebuild kit

2. One (1) solenoid

3. One (1) valve plug and cable assembly

4. One (1) relay

5. One (1) compressor intake air filter element per compressor provided

6. One (1) compressor oil filter element per compressor provided

7. One (1) each compressor separator element per compressor provided

8. Any other standard parts recommended by the Manufacturer.

PART 3: EXECUTION

3.01 INSTALLATION

A. All equipment shall be installed in accordance with the manufacturer's requirements. The controls shall be easily accessible and walking areas unobstructed.

B. Install items in accordance with approved shop drawings, Manufacturer's printed instructions and as indicated.

C. All nozzles on respective nozzle header shall be level within ½-inch of a common horizontal plane.

D. The equipment supplier shall provide two site visits of two (2) days each of field supervision to assist the Contractor. The field supervision shall be performed by a factor service representative familiar with the product line and installation of the air compressor system and mixing system.

E. Contractor shall provide all lubricants required to allow initial start-up of the equipment.

F. The factory representative shall fully inspect and certify in writing to the Engineer that the equipment installation is acceptable to the equipment manufacturer prior to acceptance by the Owner.

G. Coordinate all electrical wiring and conductors with the Contractor for a complete system as defined above for hardwire IO and power connections. Contractor is responsible to review submittals and provide all wiring, conduit, and connections as required for a complete system.

3.02 FIELD PERFORMANCE TESTING AND GUARANTEE

A. The Compressed Air Mixing System Manufacturer shall submit a testing plan for three different phases of construction.

1. Phase 1: Startup of BNR Basins 1, 2 and 3.

2. Phase 2: Startup of BNR Basin 4

3. Phase 3: Startup of Aerobic Digesters 1 and 2.

B. All mixer components shall be field tested with the respective basins full to the maximum water surface elevation.

C. Exposed air piping shall be tested by Contractor for leaks using soapy water on all joints and applying 100 psi test pressure. Buried air piping shall be tested using this method before the trench is filled. Air piping in the tanks may be tested by submersing the piping in non-potable water and pressurizing the piping to 100 psi, in lieu of using soapy water on all joints. Pressure testing requirement shall not apply to supply piping downstream from VM or pre-manufactured nozzle headers.

D. The Contractor shall operate each mixing system at the maximum water surface elevation in the basins for a continuous period of not less than 72 hours. The Contractor shall correct and resolve all operating problems, deficiencies, etc., determined as a result of the tests.

E. After the above testing is complete, field mixing performance testing of the installed compressed air mixing system shall be performed by the Manufacturer as described below.

1. Mixing performance testing shall be conducted in all basins. Contractor shall provide 14 days written notice of testing to the Manufacturer for each testing instance.

2. All personnel and equipment necessary to conduct and supervise testing shall be provided by the compressed air mixing system Manufacturer. Engineer/Owner shall be notified of the test to witness at their option and expense.

3. The TSS shall be in typical operating ranges of 8,000-10,000 mg/L for the BNR Basins and 30,000 – 50,000 for the Aerobic Digesters. No flow shall enter or exit the respective basins for two hours prior to and during the test.

4. The compressed air mixing system Manufacturer shall conduct total suspended solids (TSS) testing using a Cerlic TSS probe, or equal, suspended solids analyzer.

F. Testing Procedure

1. In the mixing test, the compressed air mixing system shall have been in normal operating mode for at least two days prior to testing and must have TSS in the typical operating range indicated above.

2. Four horizontal-plane sample sites for each basin to be tested shall be selected by the Engineer. At each sample site, three vertical samples shall be collected as follows: 24-inches from the surface, tank sidewall mid-point and 24-inches above the tank sidewall bottom. Each sample site must be a minimum of 4 ft away from any structure within the tank. The samples for each location shall be analyzed as described above.

3. The Coefficient of Variation (Cv) shall be determined for the sample set, excluding the maximum and minimum samples. The Cv shall be calculated by taking the resultant set of ten (10) samples as follows: Cv = (100 x Standard Deviation of Ten Samples)/(Mean Value of Ten Samples).“

a. If the Cv is less than or equal to 10%, then the mixer performance shall be acceptable for that location.

b. If the Cv is greater than 10%, then the mixer performance shall be unacceptable for that location and the Contractor and/or Manufacturer shall make all necessary improvements (at no additional cost to the Owner) and repeat the testing procedure at no additional cost to the Owner until the Cv is less than or equal to 10% for that location.

3.03 MANUFACTURER’S FIELD SERVICES

A. Manufacturer shall meet the requirements of Section 01640 MANUFACTURER’S SERVICES and Section 01650 FACILITY STARTUP AND TESTING.

1. Manufacturer’s Representative shall be present at the site or classroom designated by OWNER, for minimum person-days listed below, travel time excluded.

a. 6 person-days for installation assistance and inspection over three (3) separate site visits.

b. 6 person-days for functional and performance testing over three (3) separate site visits.

c. 1 person-day for prestart up classroom or site training.

d. 1 person-day for post-startup training of OWNER's personnel.

B. The Equipment Manufacturer shall furnish operating and maintenance instruction for the equipment for the Contractor per Section 01730 Operating and Maintenance Manual of these Specifications.

C. Prior to shipment one (1) unit of each size shall be completely assembled and subjected to a full-scale test.

D. Provide complete testing and verification for monitoring operation of the compressor system with the plant control system. Coordinate database and IO points with the system integrator prior to testing and startup.

END OF SECTION

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SECTION 11231

CHEMICAL METERING PUMPS

PART 1: GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials and equipment required to install, test, and place into operation prefabricated skid mounted chemical metering pumps, controls and accessories as shown on the Drawings and specified herein. Appurtenances shall include but not be limited to the following items:

1. Polypropylene/polyethylene skid with drip lip.
2. Metering pumps.
3. Pump motors.
4. Calibration columns.
5. Basket Strainers.
6. Ball valves.
7. Pressure relief valves.
8. All piping, valves, gaskets, supports, hardware, wiring, junction boxes, and accessories necessary for a fully functioning skid.

1.02 RELATED WORK

A. Coatings per Section 09900 Painting.

B. Citric Acid and Sodium Hypochlorite Systems per Section 11380 Membrane Systems

C. Chemical Storage Tanks are included in Section 13205 FRP Tanks.

D. Piping, valves, specialties, and supports are included in Division 15.

E. Electrical work in included in Division 16.

F. Instrumentation - Division 16

1.03 SUBMITTALS

A. Submit in accordance with the Section 01300 Submittals, copies of all materials required to establish compliance with this Section.

B. Submit operation and maintenance manuals in accordance with Section 01730 Operation and Maintenance Manual.

1.04 SHOP DRAWINGS

A. Provide make, model, weight, and horsepower of each equipment assembly.

B. Complete catalog information, descriptive literature, specifications, identification of materials of construction and associated compatibility data.

C. Performance data curves showing head, capacity, horsepower demand, and pump efficiency and rpm over the entire operating range of the pump, from shutoff to maximum capacity.

D. Detailed Mechanical and Electrical Drawings showing the equipment dimensions, size, locations of connections, and weights of associated equipment.

E. Power and control wiring diagrams, including terminals and numbers.

F. Complete motor nameplate data, as defined by NEMA, motor manufacturer, and including any motor modifications.

G. Shop and Field Painting Systems Proposed: Include manufacturer's descriptive technical catalog literature and specifications, hazardous communication data sheets, and written certification that the factory-applied coating system(s) is identical to the requirements specified.

1.05 REFERENCE STANDARDS

A. Design, manufacturing and assembly of elements of the products herein specified shall be in accordance with the standards of the below listed organizations.

1. American Society for Testing and Materials (ASTM)

2. American National Standards Institute (ANSI)

3. National Electrical Manufacturers Association (NEMA)

B. Where reference is made to a standard of one of the above, or other organizations, the version of the standard in effect at the time of bid opening shall apply.

1.06 QUALITY ASSURANCE

A. All equipment furnished under this Section shall be new and be the standard products of manufacturers having a successful record of manufacturing and servicing the equipment and systems specified herein for a minimum of five (5) years. The equipment shall be designed, constructed and installed in accordance with the best practice and methods, and shall operate satisfactorily when installed.

B. These Specifications are intended to give a general description of what is required, but do not cover all details which may vary in accordance with the exact requirements of the equipment as offered. They are, however, intended to cover the furnishing, delivery, installation, field testing and field calibration of all materials and apparatus as required. Any additional equipment necessary for the proper operation of the proposed installation not specifically mentioned in these Specifications or shown on the Drawings shall be furnished and installed at no change in Contract Price or Time.

1.07 DELIVERY STORAGE AND HANDELING

A. Provide in accordance with Section 01600 Delivery Storage and Handling.

B. All parts shall be properly protected so that no damage or deterioration will occur during shipment or during a prolonged delay from the time of shipment until installation is completed and the unit and equipment are ready for operation. The Contractor shall store equipment in accordance with the manufacturer's instructions.

1.08 WARRANTY

A. The Contractor and the Manufacturer shall warrant all equipment supplied under this Section for a period of one (1) year. Warranty period shall commence as outlined in the General Conditions and Division 1.

B. The equipment shall be warranted to be free from defects in workmanship, design and materials. If any part of the equipment should fail during the warranty period, it shall be replaced in the machine(s) and the unit(s) restored to service at no expense to the Owner.

C. The manufacturer's warranty period shall run concurrently with the Contractor's warranty period. No exception to this provision shall be allowed.

D. Refer to the General Conditions and Division 1 for additional warranty requirements.

1.09 MANUFACTURERS

A. Approved manufacturer for prefabricated skid mounted chemical metering pumps:

1. Guardian Equipment

2. Watson Marlow

PART 2: PRODUCTS

2.01 GENERAL

A. The chemical pump manufacturer/supplier shall submit compatibility data to confirm the materials of construction.

B. Design Criteria:

	Aluminum Sulfate (48%)
Number of Skids	2
Pumps per Skid	3
Flow Range (gpm)	0.4–1.2
Pressure Required (psi)	25
Pump Type	Diaphragm Pump
Pump Motor (hp/V/ph)	.75/120/1

2.02 MECHANICAL ACTUATED DIAPHRAGM PUMPS

A. Mechanical Actuated Diaphragm Pumps shall be simplex positive displacement mechanically actuated diaphragm pump with ±2 accuracy within 10%-100% stroke setting.

B. The gearbox shall be cast aluminum, black anodized with external powder coating.

C. Gearbox shall have an easy to service oil lubrication system including a fill port with removable cap on top of the pump, oil level site glass on the side of the pump and oil drain with removable cap on the bottom of the pump

D. Pump hardware shall be stainless steel.

E. Mechanism

1. Pump gearing and bearings shall be submersed in an oil bath ensuring proper lubrication.

2. All internal gearing, bearings and components other than seals shall be metal. Plastic gearing will not be acceptable. Metal components in contact with other metal parts shall be temperature heat treated to achieve a minimum HRC 60.

3. Metering pump shall have an external, manual adjustment stroke length positioner with a 10:1 turndown.

F. Diaphragm

1. Pumps shall be spring return, positive displacement.

2. The diaphragm shall be completely flat without any protrusions into the process chemical and shall be removed and replaced in the pump for service by hand on a threaded connection to the actuation slide piston. The diaphragm shall be a multi-layered, Teflon coated, nylon reinforced rubber with PTFE backing. Diaphragm shall be bonded to a metallic disc surrounded by a PVC support ring covering 80% of diaphragm backing.

G. Liquid End

H. Pump shall not require any degassing system in order to operate properly.

I. Metering pump shall have a PVC liquid end with borosilicate glass check balls and FKM valve seals.

J. Suction and discharge ball valves shall be removable without disconnecting process piping.

K. Metering pump shall be self-priming and capable of indefinite operation without process fluid.

L. Pump shall be capable of operating under a maximum of 150 psi and minimum 10 psi back pressure.

M. Motors shall be AC squirrel cage induction motors in accordance with Division 16 requirements.

2.03 PUMP SKID MOUNTED SYSTEM AND ACCESSORIES

A. All pumps are to be skid mounted, as shown on the Drawings, with pipes and valves according to the P&IDs and shall be constructed using the materials listed in Section 15200, Process Piping-General and Section 15202, Valves and Operators.

B. Skid mounted chemical metering pump systems shall be complete with the skid assembly containing chemical metering pumps, all necessary piping, valves, fittings, supports, electrical controls, and accessories as specified herein. The metering pump skid shall contain the following items:

1. Polypropylene/polyethylene skid with drip lip
2. Metering pumps and motors.
3. Pump controllers
4. Calibration column
5. Pulsation Dampener
6. Isolation valves
7. Pressure relief valves
8. Backpressure valves
9. Pressure gauge

C. Skid shall be specially designed, constructed, and installed for the service intended and shall comply with the design criteria listed in Paragraph 2.01.

D. The skid mounting of the metering pumps shall conform to the following requirements:

1. Each chemical feed system shall be completely assembled, mounted, calibrated, tested, and delivered to the Site on a single skid. Components to be mounted on the skid are as indicated on the Drawings and shall include the metering pumps, calibration column, piping valves, piping accessories (pulsation dampeners, etc.), and wiring integral to the skid. The chemical feed system supplier shall be responsible for providing all equipment, valves, and piping within the skid boundary.
2. The skids shall be constructed of fusion welded polypropylene sheets with adequate supports for all equipment and piping. Fork lift truck cut outs and anchor bolt holes shall also be provided.
3. All components of the skid mounted system (pumps, piping, and controls) shall be tested prior to shipment as described below.

E. Piping, Valves, and Appurtenances:

1. Unless otherwise noted, materials of construction shall be suitable for respective chemical service. Skid supplier shall submit compatibility data to confirm the materials of construction

2. Skid pipe shall be Schedule 80 CPVC with socket or flanged ends. Cement shall be as recommended by the pipe manufacturer for the service outlined in this Section.

3. Adjustable external pressure relief type valve and backpressure valve shall be installed on pump discharge header set as recommended by pump manufacturer. Relief shall discharge to suction. Materials shall be suitable for respective chemical service.

4. Anchor bolts: All anchor bolts and anchor rods shall be of Type 316 stainless steel as specified in Section 05530 Anchor Bolts and Expansion Anchors.

5. An equipment identification plate shall be mounted in a visible location. The tag shall be 316 Stainless Steel with ¼" die-stamped equipment tag numbers.

2.04 SCADA CONTROL INTERFACE BOXES

A. All metering pumps shall be provided with a SCADA interface box. The control interface box shall be compatible with the pump. The SCADA control interface box shall convert standard input/output control signals of the pumps to provide the following:

B. Input Signals

1. Remote Start/Stop (pump enable) dry contact signal to be functional when the pump is in either the Manual or Automatic speed control mode.

2. Analog 4-20 mA signal to control pump speed when in the Auto mode.

3. Leak detector input to stop rotation of the hose pump when a tube leak has been detected.

C. Output Signals

1. Dry Contact NO or NC to remotely indicate pump running status. Rated 8A at 250VAC

2. Dry Contact NO or NC to remotely indicate tube fail status. Rated 8A at 250VAC

3. Analog 4-20mA signal to remotely indicate pump running speed.

D. Leak Detection

1. Factory mount a capacitance directly under the pumphead which shall shut the pump down in the event of a detected leak. Capacitance sensor shall be equipped with a sensitivity adjustment, reset pushbutton, and fault indicator LED.

E. Control Interface Box shall be footed to sit either atop or next to the pump. Provide five (5) glanded ports to accept field signal cable. Internal terminal strip shall accommodate 20-16 AWG signal wire.

1. Control Interface Box shall be powered off of 120 vAC, 60Hz 1 phase power with pass through power to the pump drive.

2. Supply Interface box with 6' standard power input cord, pump-to-interface box power cord, and pump-to-interface box signal cable.

3. Interface box shall be constructed of ABS plastic.

PART 3: EXECUTION

3.01 INSTALLATION

A. Installation shall be in strict accordance with the manufacturer's instructions and recommendations in the locations shown on the Drawings.

B. Contractor to supply hose barb-to-process line adapters for connection of peristaltic hose pump tubing to process lines. Hose barbs to be secured to the pump tubing via a stainless steel clamp tightened around the OD of the tubing.

C. All electrical conduits shall be connected to the motors with flexible liquid tight conduits.

D. Contractor shall provide all lubricants required to allow initial start-up of the equipment.

E. All field painting shall be in accordance with Section 09900 Painting of these specifications.

3.02 FIELD TESTING

A. The skid manufacturer shall fully inspect and certify in writing to the Engineer that the equipment installation is acceptable to the equipment manufacturer prior to acceptance by the Owner.

B. All pumping systems shall be pressure tested for leaks. All systems shall be flushed prior to start-up.

C. Provide testing of pumps in automatic and manual modes via inputs and outputs from the plant control system. Coordinate with the system integrator for operation.

3.03 PERFORMANCE TESTING

A. The equipment manufacturer shall provide the services of a field representative for the testing and startup of pump skids, including all accessories.

B. Flow measurements shall be made at the following conditions:

1. 25, 50, 75, and 100 percent speed

2. Final pump curves shall be provided to the PICS supplier for integration into the control programming.

C. Contractor and manufacturer shall correct any failures during testing and startup. Units failing to meet the specifications to the satisfaction of the Engineer and Owner shall be replaced at no cost to the Owner.

3.04 MANUFACTURER'S FIELD SERVICES

A. All manufacturers' field services shall be provided and performed in accordance with Sections 01640 Manufacturer's Services.

B. Manufacturer's representative: Present at site or classroom designated by Owner, for minimum person-days listed below, travel time excluded:

1. ½ person day for installation assistance and inspection of the skids for each chemical system (1½ days total).

2. 1 person-day for functional and performance testing and completion of Manufacturer's Certificate of Proper Installation for each chemical system (3 days total, over 2 site visits).

3. 1 person-day for post start up training of Owners personnel. Training shall not commence until an accepted detailed lesson plan for each training activity has been reviewed by Engineer.

SECTION 11237

ULTRAVIOLET DISINFECTION EQUIPMENT

PART 1: GENERAL

1.01 SCOPE

A. This work described under this section shall cover the furnishing of a complete and operational open channel, gravity flow, ultraviolet (UV) disinfection system. The Contractor shall provide and install UV modules, integral module lifting mechanisms, electrical cabinets, UV detection system, automatic mechanical wiping system and water level control devices and other necessary appurtenances for a complete and operating installation.

1.02 RELATED WORK

A. Electrical work, except as specified herein, is included in Division 16.

B. Section 01300 SUBMITTALS

C. Section 01400 QUALITY CONTROL

D. Section 01600 DELIVERY, STORAGE AND HANDLING

E. Section 01650 FACILITY START-UP AND TESTING

1.03 SUBMITTALS

A. Submit in accordance with Section 01300 SUBMITTALS, copies of all materials required to establish compliance with this Section. Submit Drawings to include interconnections and interface requirements, dimensions and locations of all major elements of the UV system and critical clearance requirements. Include the following information:

1. Major component dimensions and installation requirements.

2. Descriptive summary of the UV system provided.

3. Electrical and major component layouts.

4. Headloss calculations demonstrating compliance with the specified hydraulic characteristics.

5. UV dosage calculations that demonstrate the ability for the UV manufacturer to deliver the required UV dose at the peak flow and minimum UV Transmittance (UVT).

6. Manufacturer certification that system design and dose calculations are based on a third party bioassay in accordance with the criteria specified herein.

B. Submit three (3) hard copies of the Operation and Maintenance Manuals, and one electronic pdf copy (written in English) in accordance with General Conditions and Division 1. Include the following information:

1. Instructions on equipment storage, installation, start-up, and operation and maintenance.

2. Troubleshooting Guide.

C. Submit Manufacturer's Certificate of Proper Installation per Section 01400.

D. If it is impossible to conform to certain details of the specifications due to different manufacturing techniques, describe completely all non-conforming aspects.

1.04 DELIVERY, STORAGE AND HANDLING

A. Provide in accordance manufacturers recommendations and with Section 01600 DELIVERY, STORAGE AND HANDLING.

1.05 MAINTENANCE

A. Spare Parts

1. Provide spare parts recommended by the manufacturer. At a minimum, provide the following spare parts:

a. One (1) UV Intensity Sensor.

b. An additional 10% set (above what is initially installed) of UV lamps.

c. An additional 10% set (above what is initially installed) of Quartz Sleeves.

d. An additional 5% set (above what is initially installed) of UV Ballasts.

e. An additional 10% set (above what is initially installed) of Wiper Rings.

2. Package spare parts and safety equipment separately. All packages are to be marked with quantity, item description and part number.

B. Furnish one complete set of special tools required to disassemble, service, repair and adjust the equipment. Special tools are those that are not readily available through a commercial tool supplier.

1.06 WARRANTIES AND BONDS

A. The Contractor shall provide a warranty against defective or deficient materials and workmanship in accordance with the requirements of Section 01740 WARRANTIES AND BONDS.

B. The equipment manufacturer shall provide a warranty against defective or deficient equipment, workmanship and materials under normal use, operation and service. The warranty shall end one (1) year from the date of substantial completion. The warranty shall be in printed form and apply to all similar units.

PART 2: PRODUCTS

2.01 MANUFACTURERS

A. Wedeco Duron UV system from Xylem

B. Or approved equal.

2.02 DESIGN CONDITIONS

A. Provide equipment capable of disinfecting a tertiary effluent with the following characteristics:

1. Peak Design Flow: 14 MGD
2. Total Suspended Solids (maximum): 5 mg/L
3. Annual Effluent Temperature Range: 41 to 86 °F
4. Ultraviolet Transmittance (UVT) @ 253.7 nm: 70% minimum
5. Quartz Sleeve Fouling Factor (FF): 0.958
6. End of Lamp Life Factor (EOL): 0.89
7. Effluent disinfection target (30 day geometric mean): 200 fecal coliform / 100 mL
8. Maximum Headloss through UV channel and weir: 24.9 in

B. Install the system in an open channel as shown on the Drawings.

1. Number of channels: 1
2. Channel Width: 3’-3”
3. Overall Channel height: 6.27’
4. Channel length, Approx.: 30’

C. Provide two banks in the channel, with one module per bank and sixteen UV lamps per module, for a total of thirty-two (32) lamps.

2.03 PERFORMANCE REQUIREMENTS

A. System Performance

1. The ultraviolet disinfection system shall produce an effluent conforming to the microbiological discharge limit as specified in paragraph 2.02 A.
2. Deliver a minimum RED (Reduction Equivalent Dose) of 12 mJ/cm² based on the T1 bioassay, at peak flow and UVT conditions, after reductions for sleeve fouling and end of lamp life.
3. Conduct validation testing with the T1 organism to match dose response characteristics of fecal coliforms and E.Coli.
4. Provide validation testing conducted by a recognized independent third party expert according to the procedures described in the US EPA UV Disinfection Guidance Manual (2006) and IUVA (International Ultraviolet Association) Uniform Protocol.
5. At a minimum the following parameters shall have been considered during validation testing: UVT, Measured UV intensity, Flow rate per lamp, Power consumption, UV sensitivity of challenge organism, and Head loss across UV banks. Validation testing that does not utilize all of the above parameters is

considered inadequate as it does not allow for appropriate system sizing. To be acceptable, UV sensor data must be collected during the biodosimetry validation testing.

B. Energy and Lamp Conservation (Automatic Flow Pacing)

1. The UV system shall be capable of dose pacing to reduce electrical energy consumption in response to the disinfection demand based on a minimum of channel flow signal (Influent flow values will be transferred through Ethernet to UV system PLC), the UV sensor signals and the measured, real-time, UV transmittance.

2. For determining UV dose during operation and for dose pacing, the UV intensity signal shall be incorporated into the UV control system's validated operating equation to provide the most reliable method of monitoring and controlling the UV disinfection process during operation.

3. The UV system must utilize True Dose Pacing Control as defined in this specification and control based on the following dose parameters: sensor intensity, flow rate, and UV transmittance. Based on these parameters, the system shall automatically vary the UV lamp power within a range of 50% to 100% proportionally to the dose requirement.

2.04 MATERIALS

A. General

1. The system shall be designed for immersion of the UV lamps in the effluent within their protective quartz sleeve.

2. The UV lamp connectors shall be located above the effluent water level and shall be accessible without removing the UV module from the disinfection channel.

3. The UV lamps and sleeves shall be removable while the module is in the disinfection channel.

4. The UV lamps shall be arranged in an angle of 45° in staggered rows to assure best mixing and minimal channel depth.

5. All metal in contact with effluent shall be Type 304 or 316 stainless steel.

6. All materials exposed to UV light shall be 316 stainless steel, quartz glass, PTFE, FKM, or other suitable long-term UV resistant materials.

7. The UV system must be equipped with it own integral lifting system to eliminate the need for an external lifting unit.

8. The UV system must be equipped with a motor driven automatic wiping system and shall use Teflon/Viton sandwich wipers to clean the quartz sleeves.

B. Ultraviolet Lamps

1. Lamps shall be low-pressure mercury amalgam doped, high intensity type. Lamps containing liquid mercury will not be allowed.

2. The lamp filaments shall be pre-heated prior to striking of the arc in order to promote lamp longevity.

3. Lamp types with a polychromatic UV output or UVC output efficiency of less than 30% at 254nm are not acceptable.

4. Each lamp shall be tested in UV-output, lamp current and lamp voltage from supplier. All results shall be stored in a database referencing to the individual batch number. The lamp batch number shall be printed on the lamp surface.

5. UV output energy of the lamp shall be variable from 50 -100% of UV-C ballast power input.

6. Useful lamp life shall be guaranteed at 14,000 operating hours for each lamp under normal operation conditions. Normal operation conditions include a maximum of four on/off cycles per 24 operating hours.

7. UV lamps shall not require a long cool down period (>10 minutes) prior to re-start should the power to the UV system fail or be interrupted for a short period of time.

8. Each lamp base shall incorporate a dielectric barrier or pin isolator. The pin isolator shall consist of a non-conductive divider placed between the lamp pins to prevent direct arcing across the pins in moist conditions. The barrier shall be dielectrically tested for 2500 volts.

9. The UV manufacturer shall ensure disposal of returned lamps (old/used) at no cost to the owner upon receipt of the returned lamps at the manufacturing headquarters.

10. Lamps longer than 60 inches will not be allowed to avoid handling risks and breakage during maintenance.

C. UV Modules

1. The UV modules shall be designed for submergence without causing failures or damage to the system or components. Ballasts for powering UV lamps shall be located in electrical enclosures located away from the channel. Manufacturer shall provide evidence of components being submergence rated as part of the bid. Certification for lamp sleeve assemblies only will not be accepted.

2. All electrical connectors and motors located on the module and above nominal channel water level shall either rated at IP67 or located within IP67 enclosures suitable for temporary submersion.

3. Each UV module shall be equipped with an interlock switch, which will automatically disconnect power to its associated UV bank if the module is raised from the UV channel or the quick disconnect plug is removed.

4. The UV module design and mounting shall provide plug and socket quick disconnect facilities enabling maintenance personnel to carry out maintenance tasks such as lamp replacement and wiper insert replacement, without the need for any tools or special isolation procedures.

5. Lamps shall be removable with the quartz sleeve and wiper system remaining in place.

6. The UV lamp sleeve shall be a single piece of clear fused quartz circular tubing, which shall not be subject to degradation over the life of the system.

7. The lamp socket shall be centered against the inside of the quartz sleeve and shall be retained by a cap nut with a ribbed exterior surface providing a positive handgrip for tightening / loosening without the need for any tools. This connection includes a self-contained o-ring, sealing the lamp and socket module (independently from the quartz sleeve).

8. Each module be designed to allow lifting from the operating position in the channel to a maintenance / storage position above the channel using a integral lifting mechanism.

9. Actuation mechanisms for lifting the module from that channel shall be driven by an electric motor. Mechanisms that utilize pressurized hydraulic fluid in the vicinity of the UV channel will not be allowed due to risk of fluid leakage and additional maintenance.

D. Wiping System

1. Each UV module shall be equipped with an automatic wiping system with selectable wiping frequency and number of strokes.

2. Systems requiring removal of the module from the channel as the only means of cleaning will not be allowed.

3. Systems that require the addition of chemical cleaning substances will not be allowed.

4. The wiping system shall be controlled by the UV system controller and provide a fully automatic, unattended operation.

5. The number of wiping strokes per interval shall be factory preset for optimum effect and shall be easily reset by the owner from 1 to 5 strokes per time interval, with time intervals being user adjustable.

6. Actuation mechanisms for the automatic wiping system shall be driven by an integral electric motor within the module. Mechanisms that utilize pressurized hydraulic fluid in the vicinity of the UV channel will not be allowed due to risk of oil leakage and additional maintenance.

7. When in the raised position, all module wetted components shall be accessible.

E. UV Monitoring System

1. A submersible UV sensor shall continuously sense the UV intensity produced in each bank of UV lamp modules.

2. The UV sensor shall measure only the germicidal portion of the light emitted by the UV lamps as measured at 254 nm.

3. The UV intensity monitoring system shall be field calibrated. Regular UV sensor field calibration shall be possible via a separate UV reference radiometer to ensure reliable monitoring of UV dose delivery.

4. The measured UV intensity signal shall be fed into the UV System Controller and used for continuous monitoring and control of UV dose. In automatic mode the UV Control System shall automatically adjust to draw the minimum electrical power while maintaining the prescribed minimum dose required for disinfection. The UV dose shall be displayed on the operator interface as an absolute value in mW/cm^2.

5. Systems that use theoretical data or data from laboratories to determine lamp aging or fouling in the control logic are not allowed. Only measured intensity and flow rate should be used to determine the actual disinfection performance / dose applied according to the validation protocol or design calculation method.

6. The UV sensor shall be automatically cleaned at the same frequency as the lamp sleeves to prevent fouling of the sensor and resulting false alarms for low intensity.

7. The UV sensor design shall allow sensor removal without complete removal of the module from the channel.

8. Provide at least one (1) UV sensor for every bank of UV lamp.

2.05 ELECTRICAL

A. General

1. Install sensitive electronic components such as electronic ballast cards out of the wastewater.

2. All heat sensitive components shall be adequately cooled with dry air utilizing forced or natural ventilation.

3. Systems or designs that expose sensitive electrical or electronic components to excess humidity or poor air quality for cooling are not acceptable.

4. The electrical enclosure for the UV system shall be Type 12/ IP54 painted steel.

B. Electronic Ballasts

1. The electronic ballasts shall comply with the requirements for harmonic control, specifically the IEEE519 and the IEC 61000-3-2.

2. The ballasts shall be electronic microprocessor controlled, designed as slot cards fitting into a rack system with a plug connector for ease of maintenance.

3. Each ballast shall drive a pair of lamps with independent control and monitoring circuits, and providing individual lamp status information to the system control.

4. The ballast shall detect lamp failure and initiate a re-strike sequence, independently from any external influence. The ballast shall attempt three re-starts before shutting off.

5. The ballast shall incorporate a galvanic separation of the input and output circuits. In case of the output circuit operating in abnormal conditions regarding voltage and/or amperage, the ballast shall shut off the lamp concerned. Ballasts without this feature shall be equipped with one GFC per ballast.

6. The ballast shall incorporate a pre-heat circuit to heat lamp filaments prior to striking the lamp arc in order to promote lamp longevity.

7. The operating power factor for the ballasts shall be minimum 0.99 over the entire power range of the ballast.

8. One power factor correction circuit shall power a maximum of 2 UV lamps in order to increase system reliability.

9. The ballast efficiency shall be a minimum of 95% at maximum power and >94% across the entire range.

10. The ballast shall be capable of varying power between 50 – 100%.

11. The lamps shall be square wave driven by the ballasts for optimum UVC output efficiency and lamp life.

12. The ballast THD (Total Harmonic Distortion) shall be less than 5%. Ballast enclosures exceeding this THD value shall be equipped with an active harmonic filter.

13. The ballasts shall be tested on line disturbances up to 4000 V.

14. The ballasts shall be capable of operating down to 208 V to increase system reliability with regards to voltage fluctuations.

15. Ballasts requiring liquid closed loop re-circulating heat exchanger systems, e.g., propylene glycol, for cooling will not be allowed.

16. Ballasts that require a watertight seal to be broken for replacement will not be allowed.

17. Ballasts that require removal of the module for replacement will not be allowed.

2.06 INSTRUMENTATION AND CONTROLS

A. Requirements

1. A UV Disinfection Management System shall control the ON/ OFF cycling and lamp power of the UV banks based upon Dose pacing.

2. The Management System shall utilize a UV sensor located within the UV banks to accurately sense any change in UV intensity. The sensor signal together with the flow rate signal (and UVT for validated systems) shall be fed into the PLC as input parameters to accurately control and adjust UV lamp output to the required level under all operating conditions.

B. UV System Control

1. Provide one (1) System Enclosure to house the UV system Controller, operator interface, control and instrumentation equipment and plant interface termination points.

2. Electrical power supply 22.2 kW (by others) to each ballast cabinet shall be for 480/277 volts / 60 Hz (3) three phase 5 wire (WYE) including round. Allowable voltage tolerance is +/- 10%

3. Provide full application software from the UV equipment manufacturer to operate the UV system.

4. Low UV intensity alarms shall be provided to detect possible water quality problems or fouling of the system. Alarm set point shall be field adjustable.

5. The System Enclosure shall monitor individual lamp status, and provide specific location of any faulted lamps.

6. The System Enclosure shall monitor hardwired protection circuits, for faults such as Module lifted, Module unplugged, Module over current, Bank isolation, etc., to shut off the appropriate circuit, and to allow Owner maintenance personnel to readily locate faults.

C. On-line Transmittance Monitor

1. Provide an on-line transmittance measurement device, specifically designed for continuous monitoring of the effluent UV transmittance.

2. The measurement device shall consist of a stainless steel housing designed to be installed in the UV channel for monitoring of the effluent transmittance in the channel.

3. Transmittance monitors requiring pumping (and straining) of the effluent out of the channel to the monitor will not be allowed due to their fouling tendency and maintenance requirement.

4. Manual systems, which require the operator to take samples or perform lab work, are not acceptable.

5. The UVT monitor shall be the YSI DIQ/S 282 Controller with IQ UVT-254 Probe or approved equal.

2.07 LEVEL CONTROL DEVICE

A. Downward opening weir gate

1. Weir gate shall be constructed from Stainless Steel, Type 304, ASTM A240.

2. The frame shall consist of a standard guide extending down both sides of the gate and across the invert. The frame shall be suitable for embedding in concrete unless otherwise shown on the plans.

3. If the gate is to be self-contained, guides shall extend above the opening to support a structural yoke. The operating bench stand or floor stand shall be mounted on the yoke.

4. The operating stem shall be the rising-stem type and shall be attached to the gate disc.

5. The gate disc and frame shall be constructed from Type 304L stainless steel.

6. Wall brackets to support stem shall be fabricated from Type 304 stainless steel. Distance from wall to centerline of stem are as shown on drawings.

7. Water level control inside the UV channel shall be provided with an electric motor actuated downward opening gate weir.

8. The maximum water crest over the downward opening gate weir shall be no greater than 18.8 inches at the Peak Flow rate, The maximum headloss through UV channel and weir shall not exceed 24.9 inches as specified in 2.02 A.

9. The outlet weir shall prevent leakage of water at no flow conditions.

10. Systems that use mechanical flap gates are not allowed.

B. Weir control

1. Control of the weir position by the UV System Controller shall maintain a constant water level downstream of the UV modules under all flow conditions in the channel to ensure optimum disinfection conditions.

2. An ultrasonic level sensor mounted onto a fixed structure above the channel shall measure the channel level continuously. The channel level shall be used by the UV System Controller to provide modulating control of the downward opening gate utilizing a PID control algorithm.

3. The PID parameters and actuator run /dwell time setting shall be adjusted at commissioning of the system to suit the hydraulic characteristics of the works and minimize system hunting.

PART 3: EXECUTION

3.01 INSTALLATION

A. Install the UV equipment in accordance with manufacturer instructions and approved drawings.

B. All components shall be fully tested and verified for service by the UV System Supplier or an authorized representative.

C. Provide all required installation hardware, such as, but not limited to, support braces and saddles, bolts, washers, and nuts.

3.02 ELECTRICAL CONNECTIONS AND WIRING

A. The UV manufacturer shall coordinate with the contractor for installation of all conduit, wire, terminations, mounting hardware, and equipment not provided as part of the UV system. All additional material and work required for a complete system shall be performed by the contractor. Refer to Division 16 in the contract documents.

3.03 MANUFACTURER'S SERVICES

A. Provide the services of a representative of the UV System Supplier for the commissioning of the UV equipment.

B. Allow six (6) man-days and two (2) trips for the representative for the inspection of installation, start-up/system commissioning, and training.

C. Provide certification from the representative that all equipment is properly installed and that the Owner’s employees have been trained on proper operation and maintenance procedures.

END OF SECTION

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SECTION 11270

PARSHALL FLUMES

PART 1: GENERAL

1.01 SCOPE

A. The Contractor shall provide one (1) Parshall flume in the UV Disinfection/ Post Aeration Facility (UVPA Facility) as specified herein and shown on the Drawings.

1.02 RELATED WORK

A. Concrete work is included in Division 3.

B. UV Disinfection is included in Division 11.

C. Instrumentation, except as specified herein, is included in Division 16.

D. Electrical work, except as specified herein is included in Division 16.

1.03 REFERENCES

A. ASTM D 638 – Standard Test Method for Tensile Properties of Plastics.

B. ASTM D 790 – Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.

C. ASTM D 1941-91(2001) – Standard Test Method for Open Channel Flow Measurement of Water with the Parshall Flume

D. ASTM D 2583 – Test Method for Indentation Hardness of Rigid Plastics by Means of a Barcol Impressor.

E. ISO 9826-92 – Measurement of Liquid Flow in Open Channel – Parshall and SANIIRI Flumes.

F. United States Department of the Interior, Bureau of Reclamation, Water Measurement Manual.

1.04 SUBMITTALS

A. Submit in accordance with the Section 01300 Submittals, copies of all materials required to establish compliance with this Section.

B. Product Data: Test results of representative fiberglass reinforced plastic laminate.

C. Shop Drawings:

1. Critical dimensions, jointing and connections, fasteners and anchors.

2. Materials of construction.

3. Sizes, spacing, and location of structural members, connections, attachments, openings, and fasteners.

D. Samples: 8-inch square sample of representative fiberglass reinforced plastic laminate.

E. Manufacturer's installation instructions.

F. Complete operating and maintenance instructions shall be submitted in accordance with the requirements of Section 01730 Operating and Maintenance Manual.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Provide in accordance manufacturers recommendations and with Section 01600 DELIVERY, STORAGE AND HANDLING.

B. Store products indoors or in weather protected area until installation. Protect from construction traffic and damage.

1.06 WARRANTIES AND BONDS

A. The Contractor shall provide a warranty against defective or deficient materials and workmanship in accordance with the requirements of Section 01740 WARRANTIES AND BONDS.

B. The equipment manufacturer shall provide a warranty against defective or deficient equipment, workmanship and materials under normal use, operation and service. The warranty shall end one (1) year from the date of substantial completion.

PART 2: PRODUCTS

2.01 MANUFACTURERS

A. TRACOM, Inc. or approved equal.

2.02 PARSHALL FLUMES

A. Provide flume with dimensions based on a Throat Width of 18 inches.

B. Construction: Provide flume molded in one seamless piece.

C. Materials:

1. Fiberglass reinforced plastic.

2. Gloss inside surfaces, free of irregularities.

3. Minimum 3/16-inch wall thickness.

4. Minimum 30% glass by weight.

5. Isophthalic polyester resin.

6. Removable pultruded fiberglass bracing at top of flume with T-304 stainless steel hardware.

7. 2-inch (minimum) top and end stiffening flanges.

8. Molded-in stiffening ribs, maximum 12- inch center to center spacing.

9. 15 mil Isophthalic U.V. resistant gel coat on all surfaces, white interior, grey exterior.
10. Anchor clips, pre-drilled with a ¾- inch hole, pultruded fiberglass construction.
11. Tensile strength (ASTM D 638): 14,000 PSI
12. Flexural strength (ASTM D 790): 27,000 PSI
13. Flexural modulus (ASTM D 790): 1,000,000 PSI
14. Barcol hardness (ASTM D 2583): 50

2.03 APPURTENANCES

A. Laminated, high visibility staff gauge:
   1. Graduated in 1/10 foot and MGD increments
B. Ultrasonic mounting bracket:
   1. Horizontally and vertically adjustable stainless steel.
   2. 2-inch NPT coupling for ultrasonic mounting bracket (bracket by others).
   3. Refer to Section 16920 Instrumentation.

PART 3: EXECUTION

3.01 EXAMINATION

A. Verify that the flume dimensions are correct and project conditions are suitable for installation. Do not proceed with installation until condition deficiencies have been corrected.

3.02 INSTALLATION

A. Installation shall be in strict accordance with the manufacturer's instructions and recommendations in the locations shown on the Drawings.
B. Ensure that the product is installed plumb and that the upstream floor is level.
C. Set the flume at the elevations indicated on the Drawings.
D. Embed the flume in concrete; pour concrete in maximum 6- inch lifts; internally line and brace the flume as necessary to ensure bowing or distortion does not occur.
E. Submit a certificate from the manufacturer stating that the installed equipment has been examined and found to be in complete accordance with the manufacturer's requirements, that the equipment is ready for operation and that the operating personnel have been suitably instructed in the operation, maintenance, and care of the equipment.

3.03 ADJUST AND CLEAN

A. Clean surfaces in accordance with the manufacturer’s instructions.

B. Remove trash and debris and leave the site in a clean condition.

END OF SECTION

SECTION 11307

CENTRIFUGAL CHOPPER PUMPS

PART 1: GENERAL

1.01 DESCRIPTION

A. This section includes requirements for providing two centrifugal chopper pumps for use as scum pumps at the BNR Basins, as indicated and in accordance with the Contract Documents.

B. Pumps will be located outdoors. Manufacturer shall provide all accessories required to operate the equipment in the environmental conditions associated with the location of the pumps as shown on the construction drawings.

1.02 REFERENCES

A. The following is a list of standards which may be referenced in this Section:

1. American Bearing Manufacturer's Association (ABMA).
2. American Iron and Steel Institute (AISI):
    a. Type 416 Stainless Steel.
    b. Type 1035 Steel.
    c. Type 1045 Carbon Steel.
    d. Type 4140 Alloy Steel.
3. ASTM International (ASTM):
    a. A48, Standard Specification for Gray Iron Castings.
    b. A53/A53M, Standard specification for pipe, steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
    c. A276, Standard Specification for Stainless Steel Bars and Shapes.
    d. A576, Standard Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality.
    e. B62, Standard Specification for composition Bronze or Ounce Metal Castings.
    f. B148, Standard Specification for Aluminum-Bronze Sand Castings.
    g. B548, Standard Specification for Copper Alloy Sand Castings for General Applications.
4. Hydraulic Institute Standards.
5. Institute of Electrical and Electronics Engineers (IEEE): 112, Standard Test Procedure for Polyphase Induction Motors and Generators.
6. National Electrical Manufacturer's Association (NEMA): MG 1, Motors and Generators.

7. Occupational Safety and Health Administration (OSHA).

1.03 DEFINITIONS

A. Terminology pertaining to pumping unit performance and construction shall conform to the ratings and nomenclature of the Hydraulic Institute Standards.

1.04 QUALITY ASSURANCE

A. All components shall be the standard product of a manufacturer regularly engaged in the production of required materials and equipment.

B. The horizontal end suction centrifugal pumps specified in this section shall be furnished, coordinated, serviced, and guaranteed by one supplier.

C. All equipment and material shall be designed and constructed in accordance with applicable standards.

D. The centrifugal pumps shall be suitably constructed of materials to withstand the designated operating conditions.

E. Balancing: The pump units shall be statically and dynamically balanced. The vibration allowance in the units shall not exceed the upper limits as established by the Hydraulic Institute Standards.

1.05 WARRANTY AND GUARANTEES

A. All equipment supplied under this section shall be warranted for a period of one (1) year by the manufacturer. Warranty period shall commence upon the date of the Owner final acceptance as specified in the General Conditions.

1.06 SUBMITTALS

A. Submit Contractor's Drawings and Shop Drawings in accordance with Section 01300 Submittals. In addition, provide the following:

1. Make, model, weight, and motor size (horsepower) of each pump assembly.

2. Comments and exceptions paragraph by specification paragraph. Provide detailed information on structural, mechanical, electrical or other changes or modifications necessary to adapt non-specified materials to the arrangement or details shown.

3. Complete manufacturer's information and illustrations, descriptive literature, and list of materials of construction.

4. Performance data curves showing head, capacity, horsepower demand, and pump efficiency over the entire operating range of the pump, from shutoff to maximum capacity. Indicate separately the head, capacity, horsepower demand, and overall efficiency, at the duty points specified herein.

5. Detailed structural, mechanical, and electrical drawings showing the equipment dimensions, size, and locations of connections and weights of associated equipment. Power and control wiring diagrams, including terminals and numbers.

6. Complete motor data including the materials of construction, dimensions, rpm at full load, frequency, voltage, full load current, code and design letter, efficiency, horsepower, number of phases, time rating, temperature rise, service factor, and bearing life rating. Also provide motor manufacturer's recommended lubrication requirements.

7. Factory finish system, including specifications to indicate compliance with the Contract Documents.

8. Special shipping, storage and protection, and handling instructions.

9. A list of manufacturer's recommended spare parts required to maintain the equipment in service for a period of one (1) year. Include a list of special tools required for checking, testing, parts replacement, and maintenance with current price information. Factory-finish system data sheets. Bearing life calculations.

B. Submit Certified Test Reports.

1. After acceptance of pump shop drawings, factory performance test data shall be submitted for review on each size pump and motor combination furnished. Factory performance tests shall be performed as specified herein.

2. The shop tests shall include certified copies of the pump curves illustrating pump characteristics of head, discharge flow, efficiency, impeller size, motor speed, and horsepower for the full range of the head capacity curve. The curves shall also include the NSPH required for heads from shutoff to the maximum acceptable run-out capacity at maximum pump speed.

C. Submit Operation and Maintenance Manuals and instructions in accordance with Section 01730 Operation and Maintenance Manual. Submit certified performance curves and test results of the pump efficiencies.

D. Provide Quality Control Submittals as Follows:

1. Operation and Maintenance Data.

2. Manufacture's Certificate of Proper Installation.

3. Manufacturer's Training Program.

4. Equipment Testing and Field Startup Report.

1.07 PRODUCT DELIVERY, HANDLING, AND STORAGE

A. The equipment shall be delivered, handled, and stored in accordance with Section 01600, Delivery, Storage and Handling.

1.08 SPECIAL TOOLS AND SPARE PARTS

A. Furnish for each set of pumps:

1. Complete set of gaskets and O-ring seals.

2. Complete set keys, dowels, pins, etc.

3. Complete mechanical seal.

4. One complete set of any special tools required to dismantle pump.

PART 2: PRODUCT

2.01 GENERAL

A. Coordinate pump requirements with drive manufacturer and be responsible for pump and drive requirements.

B. Where adjustable speed drives are required, furnish a coordinated operating system complete with pump, drive, and speed controller.

2.02 MANUFACTURER

A. The pumps shall be as manufactured by:

1. Vaughan

2. Hayward Gordon

2.03 DESIGN CRITERIA

SCUM COLLECTION PUMPS

Number of Pumps	2
Liquid Pumped	Scum
Pumping Temperature	70
Specific Gravity at 60°F	1
pH	6.5–8
Primary Capacity (gpm)	400
Primary Total Dynamic Head (ft):	30
Secondary Capacity (gpm)	200
Secondary Total Dynamic Head (ft):	36
Min. Hydraulic Efficiency at Primary Capacity	50%
Maximum Pump Speed (rpm)	1750
Power (hp/V/ph)	7.5/480/3
Drive	Constant Speed

2.04 MATERIALS

A. General

1. Equipment shall be designed and built for 24-hour continuous service at any and all points within the specified range of operation, without overheating, without cavitation, and without excessive vibration or strain.

2. Provide lifting lugs or eyebolts for equipment components weighing over 100 pounds.

3. Anchor bolts, nuts, and washers shall be Type 316 stainless steel. Anchor bolts shall be ½ inch minimum diameter and as specified in Section 05500, Metal Fabrications.

4. Stainless steel nameplate giving the name of the manufacturer, the rated capacity, head, speed, and all other pertinent data shall be attached to the pump.

5. Stainless steel nameplate giving the name of the manufacturer, serial number, model number, horsepower, speed, voltage, amperes, and all other pertinent data shall be attached to the motor.

6. OSHA-approved coupling guard for direct coupled or belt driven pumps.

B. Pumps

1. General

a. The pumps shall be of the horizontal volute centrifugal, end suction, solids handling type for outdoor installation.

b. The pumps shall be standard dimensions, built to limit gauges or formed templates, such that parts will be interchangeable between like units.

C. Pump Construction

1. Pump Casings:

a. The pump casing shall be constructed of close-grained cast iron, of sufficient thickness to withstand all stresses and strains of service at full operating pressure. The pump casings shall be equipped with replaceable stainless-steel wear rings.

b. Suction and discharge connections shall be 125 lb. ANSI Standard flat face flanges positioned as indicated on the Contract Documents.

2. Shaft Seal: Shaft seal shall be constructed of silicone carbide and lubricated as per manufacturer's recommendation.

3. Pump Shaft: Each pump shaft shall be SAE 1045 steel or better, accurately machined and ground to size.

4. Bearings:

a. The pump bearing frame shall be equipped with a bearing system as described below. All bearings shall be designed for a 20-year average life for any point within the pump operating conditions as defined in Table 11312-A.

b. All bearing grease fittings shall be accessible while the pump is in operation. The bearings shall be grease lubricated, and a relief shall be provided so that excessive grease pressure will not damage the bearings.

c. For protection of bearings during shipment and installation, the bearings shall be properly processed with a high-quality rust preventative. Each bearing frame shall be designed so that the complete rotating element can be removed from the casing without disconnecting the suction and discharge piping.

d. The bearing support frame shall be of cast-iron construction and shall be designed to provide a self-centering and self-indexing fit with the wetted end of the pump to ensure proper alignment of the bearings and stuffing

box. A large opening shall be provided adjacent to the stuffing box to facilitate packing adjustment and replacement.

5. Impeller:
    a. Shall be semi-open type with pump out vanes to reduce seal area pressure.
    b. Chopping/maceration of materials must be accomplished by action of the curved, cupped, and sharpened leading edges at the bottom of impeller blades as they move across cutter bar. Impeller will be keyed to the shaft and shall have no axial adjustments or screws required.

D. Cutter Bar:
    1. Shall be single cast component recessed into pump bowl with a funnel shaped inlet opening.

E. Upper Cutter Assembly:
    1. Impeller pump-out vanes shall be specially modified to shear against upper cutter assembly mounted into back side casing, in order to eliminate buildup of rags, hair, or other stringy material in seal area or between impeller and pump casing.
    2. Shall consist of no more than 2 cutting anvils to minimize potential for binding.

F. Cutter Nut:
    1. Use to affix impeller to shaft and to eliminate binding or wrapping of stringy materials at pump inlet.
    2. Shall consist of hex head sufficiently sized for ease of removal and shall include integral cast anvil with shears against adjacent surface of segment bars on cutter bar.
    3. Pump Support:
        a. Each pump shall be mounted on a fabricated steel pump support base of sufficient size and strength to support all loads to which it may be subjected. Each base shall be designed to mount on the concrete pads as shown on the Contract Documents. Provide a minimum 3/4-inch tapped NPT threaded connection at the low point of the back head so that drainage of box leakage from the pump can be piped to the floor drains. Bases shall be reinforced and shall have large grout holes under the coupling area.
        b. Pump shall be designed for connection to the motor and shall be furnished complete with coupling guards.

G. Motors
    1. General:
        a. The motors for the pumps shall be of the horizontal TEFC design.

b. All motors shall be built in accordance with the latest NEMA, IEEE, ANSI, and AFBMA Standards where applicable. All motors shall also meet the requirements of Section 16220 Motors.

2. Performance Requirements:

   a. The motors shall be rated for operation on a 480 volt, three-phase, 60 Hz power supply.

   b. Each motor shall have a 1.0 service factor.

   c. Motors shall be premium efficiency type.

   d. Motors shall be free of objectionable noise and vibration. Units shall operate with a maximum sound level not to exceed 90 dBA as measured 5 feet from any surface.

   e. Maximum temperature of motor windings shall not exceed 80°C, as measured by resistance, when the motor is operating continuously at service factor horsepower, rated voltage, and frequency in ambient air temperature of 40°C.

   f. Nameplate horsepower shall not be exceeded during operation at any point on characteristic curve for impeller furnished.

3. Construction:

   a. Motor frames and end shields shall be cast iron construction of such design and proportions as to hold all motor components rigidly in proper position and provide adequate protection for the type of enclosure employed.

   b. The motors shall be of totally enclosed fan cooled construction. Motors shall have Class F non-hygroscopic epoxy sealed insulation but shall be limited to Class B temperature rise. The motor shall be suitable for indoor or outdoor weather conditions.

   c. Windings shall be adequately insulated and securely braced to resist failure due to electrical stresses and vibration.

   d. Motors shall be equipped with a minimum of two (2) thermal sensors in series, to monitor motor temperature and shall be wired into the pump controls as shown on the Contract Documents.

   e. shaft shall be made of high-grade machine steel or steel forging of size and design adequate to withstand the load stresses normally encountered in motors of the particular rating.

   f. Stator and rotor cores shall be made of low loss, non-aging electrical sheet steel with insulated laminations. Stator coils shall be random wound and of size, shape, insulation, and number of turns required. Coils shall be epoxy sealed after fabrication.

   g. Motors shall be equipped with bearings made of AFBMA Standards, and be of ample capacity of the motor rating. Bearings shall be grease lubricated and shall have a minimum B10 bearing life of 100,000 hours.

   h. Nameplates shall be stainless steel. Lifting lugs or “O” type of bolts shall be supplied on all motors. Enclosures shall have stainless steel screen and shall be protected from corrosion, fungus, and insects.

i. All fittings, bolts, nuts, and screws shall be plated to resist corrosion. Conduit boxes shall be gasketed. Lead wires between motor frame and conduit box shall be gasketed.

H. Controls

1. The pumps will be constant speed pumps with timer or manually initiated on-off control.

2. Controls for each of the pumping systems are specified in Division 16.

I. Shop Painting

1. Surface preparation and application of the shop paint coating shall be as specified in Section 09900, Painting.

2.05 SOURCE QUALITY CONTROL

A. Factory Inspections: Inspect for required construction, electrical connection, and intended function.

B. Factory Test Report: include test data sheets and curve test results.

C. Functional Test: Perform manufacturer's standard test on equipment.

D. Performance test:

1. In accordance with Hydraulic Institute Standards.

2. Adjust, realign, or modify units and retest in accordance with hydraulic Institute Standards if necessary.

E. Hydrostatic Test: Pump casings tested at 150 percent of shut off head. Test pressure maintained for not less than 5 minutes.

PART 3: EXECUTION

3.01 INSTALLATION

A. The centrifugal pumps and appurtenances shall be installed in accordance with the instructions of the manufacturer and in accordance with the Contract Documents.

B. Install piping, fittings, valves, and other appurtenances to the pump installation in accordance with the manufacturer's installation instructions, the requirements of the specifications, and as shown on the Contract Documents.

C. After pump and motor have been set in position, aligned, and shimmed to proper elevation, grout the space between the bottom of the baseplate and the concrete foundation with a poured, non-shrink grout.

3.02 FIELD PAINTING

A. Field surface preparation and painting shall be as specified in Section 09900, Painting.

3.03 FIELD QUALITY CONTROL

A. Functional Tests: Conduct on each pump.

1. Alignment: test complete assemblies for correct rotation, proper alignment and connection, and quite operation.

2. Flow Output: Measured by plant instrumentation and storage volumes.

B. Operating Temperatures: Monitor bearing areas on pump and motor for abnormally high temperatures.

C. Facility start up and testing shall be performed in accordance with Section 01650 Facility Start-Up and Testing.

3.04 MANUFACTURER'S FIELD SERVICES

A. All manufacturers' field services shall be provided and performed in accordance with Sections 01400 Quality Control and 01640 Manufacturer Services.

B. Manufacturer's representative: Present at site or classroom designated by Owner, for minimum person-days listed below, travel time excluded:

1. ½ person day for installation assistance and inspection of each pump.

2. ½ person-day for functional and performance testing and completion of Manufacturer's Certificate of proper installation.

3. 1 person-day for post start up training of Owners personnel. Training shall not commence until an accepted detailed lesson plan for each training activity has been reviewed by Engineer.

END OF SECTION

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SECTION 11311

HORIZONTAL SELF-PRIMING PUMPS

PART 1: GENERAL

1.01 DESCRIPTIONS

A. This section includes requirements for providing eight horizontal self-priming centrifugal pumps for use as internal recirculation pumps at the BNR Basins, as indicated and in accordance with the Contract Documents.

B. Horizontal self-priming pumping unit(s) shall be specifically designed to handle raw, unscreened, domestic sanitary sewage.

C. Pumps will be located outdoors. Manufacturer shall provide all accessories required to operate the equipment in the environmental conditions associated with the location of the pumps as shown on the construction drawings.

D. The Contractor shall coordinate with Manufacturer to furnish and install for each pump, tapped holes in the suction and discharge piping complete with pipe nipples and isolation valves for use in connecting pressure gauges. Nipples shall be of such length and provided with elbows, if necessary, so that a pressure gauge may be easily installed and read.

1.02 QUALITY ASSURANCE

A. All components shall be the standard product of a manufacturer regularly engaged in the production of required materials and equipment.

B. The self-priming centrifugal pumps specified in this section shall be furnished, coordinated, serviced, and guaranteed by one supplier.

C. All equipment and material shall be designed and constructed in accordance with applicable standards.

D. The centrifugal pumps shall be suitably constructed of materials to withstand the designated operating conditions.

E. Balancing: The pump units shall be statically and dynamically balanced. The vibration allowance in the units shall not exceed the upper limits as established by the Hydraulic Institute Standards.

F. Unit responsibility: Pump(s), complete with motor, coupling, baseplate, necessary guards, and all other specified accessories and appurtenances shall be furnished by the pump manufacturer to insure compatibility and integrity of the individual components.

1.03 SUBMITTALS

A. Submit Contractor’s Drawings and Shop Drawings in accordance with Section 01300. In addition, provide the following:

1. Make, model, weight, and motor size (horsepower) of each pump assembly.

2. Provide comments and exceptions paragraph by specification paragraph. Provide detailed information on structural, mechanical, electrical or other changes or modifications necessary to adapt non-specified materials to the arrangement or details shown.

    a. Complete manufacturer's information and illustrations, descriptive literature, and list of materials of construction.

    b. Performance data curves showing head, capacity, horsepower demand, and pump efficiency over the entire operating range of the pump, from shutoff to maximum capacity. Indicate separately the head, capacity, horsepower demand, and overall efficiency, at the duty points specified herein.

    c. Detailed structural, mechanical, and electrical drawings showing the equipment dimensions, size, and locations of connections and weights of associated equipment.

    d. Complete motor data including the materials of construction, dimensions, rpm at full load, frequency, voltage, full load current, code and design letter, efficiency, horsepower, number of phases, time rating, temperature rise, service factor, and bearing life rating. Also provide motor manufacturer's recommended lubrication requirements.

    e. Factory finish system, including specifications to indicate compliance with the Contract Documents.

    f. Special shipping, storage and protection, and handling instructions.

B. Submit Operation and Maintenance Manuals and instructions in accordance with Section 01730 Operation and Maintenance Manuals. Submit certified performance curves and test results of the pump efficiencies. Include installation instructions, assembly views, lubrication instructions, and replacement parts lists.

1.04 DELIVERY, STORAGE AND HANDLING

A. The equipment shall be delivered, handled, and stored in accordance with Section 01600 Delivery, Storage and Handling.

1.05 MAINTENANCE

A. Spare Parts

1. The pump manufacturer shall furnish one set of all special tools required to disassemble, service, repair, and adjust the pump.

2. Spare parts recommended by the pump manufacturer shall be provided. At a minimum, the following spare parts shall be furnished:

    a. Two (2) complete sets of gaskets for each individual pump supplied.

    b. Two (2) complete sets of mechanical seals for each individual pump supplied.

3. Furnish one year supply of lubricants including oil and greases, as recommended by the product manufacturer. The lubricants shall include summer and winter grades along with alternative references to equal products

of other manufacturers including specifications such as AGMA numbers, viscosity.

1.06 WARRANTY AND GUARANTEES

A. All equipment supplied under this section shall be warranted for a period of 1 year by the manufacturer. Warranty period shall commence upon the date of the Commission final acceptance as specified in the General Conditions.

B. The equipment shall be under warranty to be free from defects in workmanship, design, and materials. If any part of this equipment should fail during the warranty period, it shall be replaced at no expense to the Commission.

C. The replacement or repair (including cost of parts and labor) of those items normally consumed in service, such as pump packing, oil, grease, and the like, shall be considered as part of routine preventive maintenance by the Commission, and are not included in the Warranty and Guarantees.

PART 2: PRODUCTS

2.01 GENERAL

A. The equipment covered by these specifications is intended to be standard pumping equipment of proven ability as manufactured by reputable concerns having long experience in the production of such equipment. The equipment furnished shall be designed, constructed, and installed in accordance with the best practice and methods and shall operate satisfactorily when installed as shown on the Contract Documents.

B. Equipment shall be designed and built for 24-hour continuous service at any and all points within the specified range of operation, without overheating, without cavitation, and without excessive vibration or strain.

C. All parts shall be so designed and proportioned as to have liberal strength, stability, and stiffness and to be especially adapted for the work to be done. Ample room and facilities shall be provided for inspection, repairs, and adjustments. Provide lifting lugs or eyebolts for equipment components weighing over 100 pounds.

D. The pump base shall be rigidly and accurately anchored into position, precisely leveled and aligned, so that the completed installation is free from stress or distortion. All necessary foundation bolts, plates, nuts and washers shall be furnished and installed by the Contractor to conform to the recommendations and instructions of the pump manufacturer. Anchor bolts, nuts, and washers shall be Type 316 stainless steel. Grouting under the bases after the equipment is set is included under this section.

E. Stainless steel nameplate giving the name of the manufacturer, the rated capacity, head, speed, and all other pertinent data shall be attached to the pump.

F. Stainless steel nameplate giving the name of the manufacturer, serial number, model number, horsepower, speed, voltage, amperes, and all other pertinent data shall be attached to the motor.

G. The nameplate ratings of the motor shall not be exceeded, nor shall the design factor be reduced when the pump is operating at any point on its characteristic curve at maximum speed.

2.02 PUMPS

A. General

1. The pumps shall be of the horizontal volute centrifugal, self-priming, solids handling type for outdoor installation.

2. The pumps shall be standard dimensions, built to limit gauges or formed templates, such that parts will be interchangeable between like units.

3. The pumps shall conform to the following Design Criteria:

	Primary Design Conditions	Secondary Design Conditions
Capacity (gpm)	2,300	1,200
Total Dynamic Head (ft)	23	42
Dynamic Discharge Head (ft)	5	5
Static Discharge Head (ft)	0	0
Dynamic Suction Lift (ft)	8	8
Static Suction Lift (ft)	5.5	5.5
Maximum Repriming Lift (ft)	14	14
Maximum Sphere Capacity (in)	3	3
Minimum Discharge Size (in)	10	10
Minimum Suction Size (in)	10	10
Maximum Motor (hp)	30	30
Power Requirements (V/phase)	480/3	480/3
Maximum Motor (rpm)	900	900
Drive Type	VFD	VFD
Motor Enclosure	TEFC	TEFC

4. The pumps shall be as manufactured by:

a. Trillium Wemco

b. Gorman-Rupp

5. The pumps shall be designed for continuous operation and will be operated continuously under normal service.

6. All internal passages, impeller vanes, and recirculation ports shall pass a 3” spherical solid. Smaller internal passages that create a maintenance nuisance or interfere with priming and pump performance shall not be permitted. Upon request from the engineer, manufacturer’s certified drawings showing size and location of the recirculation port shall be submitted for approval along with the

manufacturer's certification of solids handling size certified by an officer of the company.

2.03 PUMP CASINGS

A. Casing shall be 65-45-12 ductile iron with a minimum brinell hardness of 150 and shall incorporate an integral volute scroll. The pump casing shall be constructed of close-grained cast iron, of sufficient thickness to withstand all stresses and strains of service at full operating pressure. The pump casings shall be equipped with replaceable stainless steel wear rings.

B. The casing shall incorporate following features:

1. Pumps shall incorporate two case fill/inspection ports. The ports shall be opened after loosening a hand nut/clamp bar assembly. A Teflon encapsulated Viton o-ring shall be utilized to prevent leakage and adhesion of the fill port cover to the casing.

2. Casing drain plug shall be at least 1 inch NPT on 3 inch and larger pumps to insure complete and rapid draining of the pump volute.

C. Suction and discharge connections shall be 125 lb. ANSI Standard flat face flanges positioned as indicated on the Contract Documents.

D. The coverplate shall be 65-45-12 ductile iron with a minimum Brinell hardness of 150. The design must incorporate the following maintenance features:

1. The coverplate must be retained by hand nuts for complete access to pump interior. Coverplate removal must provide ample clearance for removal of stoppages and allow service to the impeller, seal, wearplate, or check valve without removing the suction or discharge piping.

2. A replaceable wearplate made of A36 steel with a minimum hardness of 130 Brinell must be secured to the coverplate by 316 SS studs and hardware.

3. A pressure relief valve shall be supplied in the volute. The pressure relief valve shall open at 150 PSI.

4. Buna-N O-rings shall seal the coverplate to the pump casing.

5. Cover plate shall include 304 stainless steel hand adjustment knobs to assist in removal of the coverplate.

E. Rotating Assembly

1. A rotating assembly, which includes impeller, shaft, mechanical shaft seal, 316 stainless steel shaft sleeve and seal hardware, lip seals, bearings, seal plate and bearing housing, must be removable as a single unit without disturbing the pump casing or piping. The design shall incorporate following features:

2. The seal plate and bearing housing shall be 65-45-12 ductile iron with a minimum Brinell hardness of 150.

3. Separate oil-filled bearing and seal cavities shall be vented to the atmosphere. Cavities must be cooled by the liquid pumped. Three lip seals will maintain the

integrity of the atmospheric barrier and isolate the two oil cavities, preventing oil leakage.

4. The bearing cavity shall have an oil level sight gauge and fill/one way vent plug. The clear sight gauge shall provide easy monitoring of the bearing cavity oil level and condition, without removal of the fill plug check valve. The check valve shall vent the cavity but prevent introduction of moist air to the bearings.

5. The seal cavity shall have an oil level sight gauge and fill/one way vent plug. The clear sight gauge shall provide easy monitoring of the seal cavity oil level and condition without removal of the fill/one way vent plug. The check valve shall vent the cavity but prevent introduction of moist air to the mechanical seal chamber.

6. Double lip seal shall provide an atmospheric path to provide positive protection of the bearings and the capability for either external visual monitoring of drainage or with an optional seal leakage probe.

7. The impeller shall be 1020 cast steel with a minimum hardness of 130 Brinell, two-vane, semi-open, non-clog, with integral pump-out vanes on the back shroud. The impeller shall thread onto the pump shaft and be secured by an impeller locking bolt made of Nitronic 60 with locking threads.

8. The shaft shall be 17-4 PH stainless steel with rolled threads for installation of the impeller. Machining of threads which weaken the structural integrity of the shaft will not be accepted.

9. The bearings shall be anti-friction ball type of proper size and design to withstand all radial and thrust loads expected during normal operation. Bearings shall be oil lubricated from a dedicated reservoir. Pump designs which use the same oil to lubricate the bearings and shaft seal shall not be acceptable.

10. The mechanical shaft seal shall be of the oil lubricated type. The stationary and rotating seal faces shall be silicon carbide alloy. Elastomers shall be Viton; cage, spring and shaft sleeve are to be 316 stainless steel. The seal shall be oil lubricated from a dedicated reservoir.

11. The removal of stainless steel shims from the rotating assembly side of the pump shall allow for further adjustment to assist in obtaining optimal efficiency while extending the life of the impeller and wearplate.

F. Volute Casing Heater

The pump shall be provided with a thermostat mounted to the exterior of the volute casing, and 15/230 volt electric heater inserted into the interior of the volute by means of a dedicated port. The heater shall be energized at 40-46 F to provide heat to the casing and eliminate the possibility of freezing. Heater probes that must be installed through a pump drain port shall not be acceptable.

G. Pump Support

1. Each pump shall be mounted on a fabricated steel pump support base of sufficient size and strength to support all loads to which it may be subjected. Each base shall be designed to mount on the concrete pads as shown on the

Contract Documents. Provide a minimum 3/4-inch tapped NPT threaded connection at the low point of the back head so that drainage of box leakage from the pump can be piped to the floor drains. Bases shall be reinforced and shall have large grout holes under the coupling area.

2. Pump shall be designed for connection to the motor and shall be furnished complete with coupling guards.

H. Pump Suction and Discharge Gauges

1. The Contractor shall furnish and install for each pump, tapped holes in the suction and discharge piping complete with pipe nipples and isolation valves for use in connecting pressure gauges. Nipples shall be of such length and provided with elbows, if necessary, so that a pressure gauge may be easily installed and read.

2.04 MOTORS

A. General

1. The motors for the pumps shall be of the horizontal TEFC design.

2. All motors shall be built in accordance with the latest NEMA, IEEE, ANSI, and AFBMA Standards where applicable. All motors shall also meet the requirements of Section 16220 Motors.

B. Performance Requirements

1. The motors shall be rated for operation on a 480 volt, three-phase, 60 Hz power supply.

2. Each motor shall have a 1.0 service factor.

3. Motors shall be premium efficiency type.

4. Motors shall be free of objectionable noise and vibration. Units shall operate with a maximum sound level not to exceed 90 dBA as measured 5 feet from any surface.

5. Maximum temperature of motor windings shall not exceed 80°C, as measured by resistance, when the motor is operating continuously at service factor horsepower, rated voltage, and frequency in ambient air temperature of 40°C.

6. Nameplate horsepower shall not be exceeded during operation at any point on characteristic curve for impeller furnished.

C. Construction

1. Motors for the pumps shall be Corro-Duty suitable for operation in moist air with hydrogen sulfide gas present.

2. Motor frames and end shields shall be cast iron construction of such design and proportions as to hold all motor components rigidly in proper position and provide adequate protection for the type of enclosure employed.

3. The motors shall be of totally enclosed fan cooled construction. Motors shall have Class F non-hygroscopic epoxy sealed insulation but shall be limited to

Class B temperature rise. The motor shall be suitable for outdoor weather conditions.

4. Windings shall be adequately insulated and securely braced to resist failure due to electrical stresses and vibration.

5. Motors shall be equipped with a minimum of two (2) thermal sensors in series, to monitor motor temperature and shall be wired into the pump controls as shown on the Contract Documents.

6. The shaft shall be made of high-grade machine steel or steel forging of size and design adequate to withstand the load stresses normally encountered in motors of the particular rating.

7. Stator and rotor cores shall be made of low loss, non-aging electrical sheet steel with insulated laminations. Stator coils shall be random wound and of size, shape, insulation, and number of turns required. Coils shall be epoxy sealed after fabrication.

8. Motors shall be equipped with bearings made of AFBMA Standards and be of ample capacity of the motor rating. Bearings shall be grease lubricated and shall have a minimum B10 bearing life of 100,000 hours.

9. Nameplates shall be stainless steel. Lifting lugs or “O” type of bolts shall be supplied on all motors. Enclosures shall have stainless steel screen and shall be protected from corrosion, fungus, and insects.

10. All fittings, bolts, nuts, and screws shall be plated to resist corrosion. Conduit boxes shall be gasketed. Lead wires between motor frame and conduit box shall be gasketed.

2.05 CONTROLS

A. The speed of the pumps will be controlled through a variable frequency drive (VFD) to maintain the flowrate at a manually adjustable setpoint.

2.06 SHOP PAINTING

A. Surface preparation and application of the shop paint coating shall be as specified in Section 09900 Painting.

PART 3: EXECUTION

3.01 INSTALLATION

A. The centrifugal pumps and appurtenances shall be installed in accordance with the instructions of the manufacturer and in accordance with the Contract Documents.

B. All necessary piping, fittings, valves, pipe supports and hangers, anchor bolts, concrete pump pads, grouting, etc., shall be provided by the Contractor to insure a complete and satisfactory installation of the pumping unit.

C. Level base by means of steel plates and stainless steel shims. Accomplish shimming so that there is no change of level or springing of the baseplates when the anchor bolts are tightened.

D. Install piping, fittings, valves, and other appurtenances to the pump installation in accordance with the manufacturer's installation instructions, the requirements of the specifications, and as shown on the Contract Documents. Equipment shall be installed in a workmanlike manner so that individual equipment will function properly and freely and no individual parts shall be strained.

E. Noise and Vibration: All equipment containing moving parts shall be installed level and plumb, unless otherwise indicated, and shall be anchored securely in order that noise be suppressed to a minimum and that vibrations do not cause damage while in operation. Alignment of the pump's components shall be accomplished by utilizing either a dial or laser indicator.

F. Connect suction and discharge piping without imposing strain to pump flanges.

G. Hardware: All anchor bolts, nuts, and washers shall be Type 316 stainless steel. All brackets and the hardware items shall be Type 316 stainless steel.

H. Install pressure gauges on the pump suction and discharge piping, including an isolation valve, diaphragm seal, and pressure gauge at each location.

3.02 FIELD PAINTING

A. Field surface preparation and painting shall be as specified in Section 09900, Painting.

3.03 FIELD QUALITY CONTROL

A. Field inspection and testing shall be performed in accordance with Section 01650.

3.04 MANUFACTURER'S FIELD SERVICES

A. All manufacturers' field services shall be provided and performed in accordance with Sections 01400 Quality Control and 01640 Manufacturer's Services.

B. Manufacturer's Representative: Present at site or classroom designated by Owner, for minimum person-days listed below, travel time excluded:

1. 2 person-days for installation assistance and inspection, (1 day for Basins 1-3, 1 day for Basin 4, 2 site visits).

2. 3 person-days for functional and performance testing, including, but not limited to, verification of correct rotation, verification of proper alignment, and vibration testing, (2 days for Basins 1-3, 1 day for Basin 4, 2 site visits).

3. 2 person-days for facility startup, (1 day for Basins 1-3, 1 day for Basin 4, 2 site visits).

4. 1 person-day for training of Owner's personnel, (1 site visit).

END OF SECTION

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SECTION 11312

HORIZONTAL END SUCTION CENTRIFUGAL PUMPS

PART 1: GENERAL

1.01 DESCRIPTION

A. This section includes requirements for providing horizontal end suction centrifugal pumps, as indicated and in accordance with the Contract Documents.

1.02 REFERENCES

A. The following is a list of standards which may be referenced in this Section:

1. American Bearing Manufacturer's Association (ABMA).
    a. ABMA 9 - Load Ratings and Fatigue Life for Ball Bearings.
    b. ABMA 11 - Load Ratings and Fatigue Life for Roller Bearings.
2. American Iron and Steel Institute (AISI):
    a. Type 416 Stainless Steel.
    b. Type 1035 Steel.
    c. Type 1045 Carbon Steel.
    d. Type 4140 Alloy Steel.
3. ASTM International (ASTM):
    a. A48, Standard Specification for Gray Iron Castings.
    b. A53/A53M, Standard specification for pipe, steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
    c. A276, Standard Specification for Stainless Steel Bars and Shapes.
    d. A576, Standard Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality.
    e. B62, Standard Specification for composition Bronze or Ounce Metal Castings.
    f. B148, Standard Specification for Aluminum-Bronze Sand Castings.
    g. B548, Standard Specification for Copper Alloy Sand Castings for General Applications.
4. Hydraulic Institute Standards.
5. Institute of Electrical and Electronics Engineers (IEEE): 112, Standard Test Procedure for Polyphase Induction Motors and Generators.
6. National Electrical Manufacturer's Association (NEMA): MG 1, Motors and Generators.
7. Occupational Safety and Health Administration (OSHA).

1.03 DEFINITIONS

A. Terminology pertaining to pumping unit performance and construction shall conform to the ratings and nomenclature of the Hydraulic Institute Standards.

1.04 QUALITY ASSURANCE

A. All components shall be the standard product of a manufacturer regularly engaged in the production of required materials and equipment.

B. The horizontal end suction centrifugal pumps specified in this section shall be furnished, coordinated, serviced, and guaranteed by one supplier.

C. All equipment and material shall be designed and constructed in accordance with applicable standards.

D. The centrifugal pumps shall be suitably constructed of materials to withstand the designated operating conditions.

E. Balancing: The pump units shall be statically and dynamically balanced. The vibration allowance in the units shall not exceed the upper limits as established by the Hydraulic Institute Standards.

1.05 WARRANTY AND GUARANTEES

A. All equipment supplied under this section shall be warranted for a period of one (1) year by the manufacturer. Warranty period shall commence upon the date of the Owner final acceptance as specified in the General Conditions.

B. The equipment shall be under warranty to be free from defects in workmanship, design, and materials. If any part of this equipment should fail during the warranty period, it shall be replaced at no expense to the Owner.

C. The replacement or repair (including cost of parts and labor) of those items normally consumed in service, such as pump packing, oil, grease, and the like, shall be considered as part of routine preventive maintenance by the Owner, and are not included in the Warranty and Guarantees.

1.06 SUBMITTALS

A. Submit Contractor’s Drawings and Shop Drawings in accordance with Section 01300. In addition, provide the following:

1. Make, model, weight, and motor size (horsepower) of each pump assembly.

2. Comments and exceptions paragraph by specification paragraph. Provide detailed information on structural, mechanical, electrical or other changes or modifications necessary to adapt non-specified materials to the arrangement or details shown.

3. Complete manufacturer’s information and illustrations, descriptive literature, and list of materials of construction.

4. Performance data curves showing head, capacity, horsepower demand, and pump efficiency over the entire operating range of the pump, from shutoff to

maximum capacity. Indicate separately the head, capacity, horsepower demand, and overall efficiency, at the duty points specified herein.

5. Detailed structural, mechanical, and electrical drawings showing the equipment dimensions, size, and locations of connections and weights of associated equipment.

6. Power and control wiring diagrams, including terminals and numbers.

7. Complete motor data including the materials of construction, dimensions, rpm at full load, frequency, voltage, full load current, code and design letter, efficiency, horsepower, number of phases, time rating, temperature rise, service factor, and bearing life rating. Also provide motor manufacturer's recommended lubrication requirements.

8. Factory finish system, including specifications to indicate compliance with the Contract Documents.

9. Special shipping, storage and protection, and handling instructions.

10. A list of manufacturer's recommended spare parts required to maintain the equipment in service for a period of one (1) year. Include a list of special tools required for checking, testing, parts replacement, and maintenance with current price information.

11. Factory-finish system data sheets.

B. Submit Certified Test Reports.

1. After acceptance of pump shop drawings, factory performance test data shall be submitted for review on each size pump and motor combination furnished. Factory performance tests shall be performed as specified herein.

2. The shop tests shall include certified copies of the pump curves illustrating pump characteristics of head, discharge flow, efficiency, impeller size, motor speed, and horsepower for the full range of the head capacity curve. The curves shall also include the NSPH required for heads from shutoff to the maximum acceptable run-out capacity at maximum pump speed. For variable speed pumping units, the curves shall illustrate characteristics of head and discharge capacity at reduced and minimum speeds. The tests shall be performed with the jobsite motor.

3. Curves shall be submitted on 8 1/2-inch by 11-inch sheets, at as large a scale as practical. Curves shall be plotted from no flow at shut-off head to maximum pump runout head and capacity allowed by the manufacturer.

4. Points of operation which cause bearing stress or shaft deflection in excess of the manufacturer's tolerances for continuous operation shall be indicated on the submitted curves.

C. Submit Operation and Maintenance Manuals and instructions in accordance with Section 01730. Submit certified performance curves and test results of the pump efficiencies.

1.07 PRODUCT DELIVERY, HANDLING, AND STORAGE

A. Follow manufacturer's recommendations for handling and storage of equipment.

B. Contractor shall inspect all delivered equipment for any damage and shall note any damage.

C. Contactor shall receive recommendations from Manufacturer for correcting damaged equipment.

D. Any damaged equipment shall be repaired or replaced prior to installation

PART 2: PRODUCT

2.01 GENERAL

A. Coordinate pump requirements with drive manufacturer and be responsible for pump and drive requirements.

B. Where adjustable speed drives are required, furnish a coordinated operating system complete with pump, drive, and speed controller.

2.02 SUPPLEMENTS

A. Some specific requirements are attached to this section as supplements.

2.03 MATERIALS

A. General

1. The equipment covered by these specifications is intended to be standard pumping equipment of proven ability as manufactured by reputable concerns having long experience in the production of such equipment. The equipment furnished shall be designed, constructed, and installed in accordance with the best practice and methods and shall operate satisfactorily when installed as shown on the Contract Documents.

2. Equipment shall be designed and built for 24-hour continuous service at any and all points within the specified range of operation, without overheating, without cavitation, and without excessive vibration or strain.

3. All parts shall be so designed and proportioned as to have liberal strength, stability, and stiffness and to be especially adapted for the work to be done. Ample room and facilities shall be provided for inspection, repairs, and adjustments. Provide lifting lugs or eyebolts for equipment components weighing over 100 pounds.

4. The pump base shall be rigidly and accurately anchored into position, precisely leveled and aligned, so that the completed installation is free from stress or distortion. All necessary foundation bolts, plates, nuts and washers shall be furnished and installed by the Contractor to conform to the recommendations and instructions of the pump manufacturer. Anchor bolts, nuts, and washers shall be Type 316 stainless steel. Anchor bolts shall be ½ inch minimum diameter and as specified in Section 05500, Metal

Fabrications. Grouting under the bases after the equipment is set is included under this section.

5. Stainless steel nameplate giving the name of the manufacturer, the rated capacity, head, speed, and all other pertinent data shall be attached to the pump.

6. Stainless steel nameplate giving the name of the manufacturer, serial number, model number, horsepower, speed, voltage, amperes, and all other pertinent data shall be attached to the motor.

7. The nameplate ratings of the motor shall not be exceeded, nor shall the design factor be reduced when the pump is operating at any point on its characteristic curve at maximum speed.

8. Equipment Identification Plate: 16-gauge stainless steel with ¼ inch die-stamped equipment tag number securely mounted in a readily visible location.

9. OSHA-approved coupling guard for direct coupled or belt driven pumps.

B. Pumps

1. General

a. The pumps shall be of the horizontal volute centrifugal, end suction type for outdoor installation.

b. The pumps shall conform to all requirements stipulated in Table 11321-A.

c. The pumps shall be as manufactured by:

1) Goulds; Model 3656/3756 S-Group

2) Gorman-Rupp

3) or Equal

C. Pump Performance

TABLE 11312-A

Parameter	BFP Wash Water Booster Pump	Fine Screen Spray Wash Booster Pumps
No. of Units	3	2
Maximum motor speed at full load, (rpm)	3500	3500
Motor Size, (hp)	10	7.5
Maximum pump design speed, (rpm)	3600	3600
Environmental temperature, °F	68	68
Maximum liquid temperature, °F	212	212
Suction size, max., (inches)	2.0	2.0
Discharge size, max. (inches)	1.5	1.5

Parameter	BFP Wash Water Booster Pump	Fine Screen Spray Wash Booster Pumps
Pump duty point head, (ft)	209	151
Pump duty point, (gpm)	92	125
Minimum pump efficiency, (%)	60.3	67

D. Pump Construction

1. Casing:

   a. The pump casing shall be spiral volute type, back pull-out design with NPT threaded suction and discharge connections up to 2½" size and shall be constructed of, (Cast Iron, ASTM A48 CL20 or Bronze ASTM B584). The pump discharge nozzle shall be tangentially oriented. A pump casing drain shall be provided with a steel or brass pipe plug.

2. Wear Ring:

   a. A replaceable suction wear ring of (Cast Iron ASTM A48 CL20 or Bronze ASTMB584) shall be provided and held securely by means of an interference fit in the casing suction.

3. Impeller:

   a. The pump impeller shall be of enclosed design, constructed of (Cast Iron ASTM A48 CL20 or Bronze ASTMB584) material and key driven. A stainless steel cap screw and washer shall provide positive attachment of the impeller to the motor shaft.

4. Seal Housing:

   a. The seal housing shall be constructed of (Cast Iron ASTM A48 CL20 or Bronze ASTM B584) material and shall hold the stationary seat of the mechanical shaft seal. The seal housing shall be held in place in a machined fit on the pump casing to maintain component alignment and O-ring sealed to insure against leakage.

5. Mechanical Seal:

   a. Pump shaft seal shall be a John Crane Type 21 mechanical seal or equal constructed of the following materials.

Seal Type	Stationary Face	Rotating Face	Elastomers	Metal Components
Standard	Ceramic	Carbon	Buna-N	18-8 SS

6. Shaft Sleeve:

a. Shaft sleeve shall be constructed of AISI Type 303 stainless steel and shall be of the hook type design, locked in place by the impeller without necessity of other mechanical locking devices.

7. Motor Mounting Adapter:

a. A rigid motor adapter of ASTM A48 CL20 cast iron construction shall support the pump liquid end and maintain pump to motor alignment. A bottom port shall be provided to allow condensation or seal leakage to drain and not be retained within the adapter. The power frame adapter shall be an integral 1-piece design with the seal housing when all cast iron or bronze fitted construction is specified.

E. Motors

1. General:

a. The motors for the pumps shall be of the horizontal TEFC design.

b. All motors shall be built in accordance with the latest NEMA, IEEE, ANSI, and AFBMA Standards where applicable. All motors shall also meet the requirements of Section 16220 – Electric Motors.

c. The drive motor shall be non-overloading of NEMA standard design with JM shaft extension and C-Face mounting suitable for close-coupled pump mounting. Totally enclosed, fan cooled or open drip-proof. Motor shall be rated for hazardous duty.

2. Performance Requirements:

a. The motors shall be rated for operation on a 480 volt, three-phase, 60 Hz power supply.

b. Each motor shall have a 1.0 service factor.

c. Motors shall be premium efficiency type.

d. Motors shall be free of objectionable noise and vibration. Units shall operate with a maximum sound level not to exceed 90 dBA as measured 5 feet from any surface.

e. Maximum temperature of motor windings shall not exceed 80°C, as measured by resistance, when the motor is operating continuously at service factor horsepower, rated voltage, and frequency in ambient air temperature of 40°C.

f. Nameplate horsepower shall not be exceeded during operation at any point on characteristic curve for impeller furnished.

3. Construction:

a. Motor frames and end shields shall be of cast iron construction and of such design and proportions as to hold all motor components rigidly in their proper position and provide adequate protection for the type of enclosure employed.

b. The motors shall be of totally enclosed fan cooled construction or open drip-proof construction. Motors shall have Class F non-hygroscopic

epoxy sealed insulation but shall be limited to Class B temperature rise. The motor shall be suitable for indoor or outdoor weather conditions.

c. Windings shall be adequately insulated and securely braced to resist failure due to electrical stresses and vibration.

d. Motors shall be equipped with a minimum of two (2) thermal sensors in series, to monitor motor temperature and shall be wired into the pump controls as shown on the Contract Documents.

e. The shaft shall be made of high-grade machine steel or steel forging of size and design adequate to withstand the load stresses normally encountered in motors of their particular rating.

f. Stator and rotor cores shall be made of low loss, non-aging electrical sheet steel with insulated laminations. Stator coils shall be random wound and of size, shape, insulation, and number of turns required. Coils shall be epoxy sealed after fabrication.

g. Motors shall be equipped with bearings made of AFBMA Standards and be of ample capacity of the motor rating. Bearings shall be grease lubricated and shall have a minimum B_{10} bearing life of 100,000 hours.

h. Nameplates shall be stainless steel. Lifting lugs or “O” type of bolts shall be supplied on all motors. Enclosures shall have stainless steel screen and shall be protected from corrosion, fungus, and insects.

i. All fittings, bolts, nuts, and screws shall be plated to resist corrosion. Conduit boxes shall be gasketed. Lead wires between motor frame and conduit box shall be gasketed.

F. Controls

1. The pumps will be constant speed pumps controlled from process control panel(s) or manually initiated on-off control.

G. Shop Painting

1. Surface preparation and application of the shop paint coating shall be as specified in Section 09900, Painting.

2.04 SOURCE QUALITY CONTROL

A. Factory Inspections: Inspect for required construction, electrical connection, and intended function.

B. Factory Test Report: include test data sheets and curve test results.

C. Functional Test: Perform manufacturer’s standard test on equipment.

D. Hydrostatic Test: Pump casings tested at 150 percent of shut off head. Test pressure maintained for not less than 5 minutes.

PART 3: EXECUTION

A. Installation

1. The centrifugal pumps and appurtenances shall be installed in accordance with the instructions of the manufacturer and in accordance with the Contract Documents.

2. All necessary piping, fittings, valves, pipe supports and hangers, anchor bolts, concrete pump pads, grouting, etc., shall be provided by the Contractor to ensure a complete and satisfactory installation of the pumping unit. Install piping, fittings, valves, and other appurtenances to the pump installation in accordance with the manufacturer's installation instructions, the requirements of the specifications, and as shown on the Contract Documents. Equipment shall be installed in a workmanlike manner so that individual equipment will function properly and freely and no individual parts shall be strained. Installation shall include furnishing the required oil and grease for initial operation. The grades of oil and grease shall be in accordance with the manufacturer's recommendations.

3. Hardware: All anchor bolts, nuts, and washers shall be Type 316 stainless steel. All brackets and the hardware items shall be Type 316 stainless steel. Anchor Bolts shall accurately place using equipment templates and as specified in Section 05500, Metal Fabrications.

B. Field Painting

1. Field surface preparation and painting shall be as specified in Section 09900, Painting.

C. Field Quality Control

1. Facility start up and testing shall be performed in accordance with Section 01650.

D. Manufacturer's Field Services

1. All manufacturers' field services shall be provided and performed in accordance with Sections 01400 and 01640.

END OF SECTION

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SECTION 11315

PROGRESSIVE CAVITY PUMPS

PART 1: GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals required and install complete and ready for operation and field test progressive cavity pumps as shown on the Drawings and specified herein.

B. Each pump shall be furnished and installed complete with a drive motor, variable frequency drive, absence/presence detector for suction side of pump, and gauge/switch assembly for discharge side of pump and all other appurtenances needed to meet the designed pumping conditions.

C. Contractor shall coordinate Dryer Feed Pump location and connections with the sludge hopper per Specification Section 11600 Biosolids Storage Hopper.

D. Contractor shall fabricate 304 SST chute between belt filter press discharge and inlet to the Dewatered Sludge Pumps as shown on the Drawings and per Specification Section 05500 Metal Fabrications.

E. All motors and drives shall be high torque type with a startup torque of at least 150 percent of normal operating torque.

F. All motors, controls, boxes, conduit, wiring, etc. shall be rated and approved for Class I, Division 2 hazardous locations.

1.02 RELATED WORK

A. Painting, except as specified herein, is included in Division 9.

B. Instrumentation, except as specified herein, is included in Division 13.

C. Variable frequency drive controllers are included in Division 16.

D. Electrical work, except as specified herein is included in Division 16.

1.03 SUBMITTALS

A. Submit in accordance with the Section 01300 Submittals, copies of all materials required to establish compliance with this Section. Submittals shall include at least the following:

1. Certified shop and erection drawings showing all details of construction, dimensions and anchor bolt locations.

2. Descriptive literature, bulletins, and/or catalogs of the equipment.

3. The total operational weight of the equipment including the single largest component.

4. Complete bill of materials of all equipment.

5. A list of the Manufacturer's recommended spare parts.

6. Complete motor data.

7. Complete control panel component and wiring schematics.

B. Test Reports to be Submitted:

1. Description of test procedures and equipment.

2. Copies of all test results, as specified in Parts 2 and 3 of this Section.

C. Complete operating and maintenance instructions shall be submitted in accordance with the requirements of Section 01730 Operating And Maintenance Manual.

1.04 REFERENCE STANDARDS

A. Design, manufacturing and assembly of elements of the products herein specified shall be in accordance with the standards of the below listed organizations.

1. American National Standards Institute (ANSI)

2. American Bearing Manufacturers Association (ABMA)

3. National Electrical Manufacturers Association (NEMA)

4. American Gear manufacturers Association (AGMA)

B. Where reference is made to a standard of one of the above, or other organizations, the version of the standard in effect at the time of bid opening shall apply.

1.05 QUALITY ASSURANCE

A. A single manufacturer shall furnish all the equipment specified under this Section and shall be standard units of proven ability as manufactured by a competent organization that is fully experienced, reputable and qualified in the manufacture of the equipment to be furnished. The equipment shall be designed, constructed and installed in accordance with the best practice and methods, and shall operate satisfactorily when installed.

B. All equipment furnished under this Section shall be new and unused and shall be the standard products of manufacturers having a successful record of manufacturing and servicing the equipment and systems specified herein for a minimum of five (5) years.

C. These Specifications are intended to give a general description of what is required, but do not cover all details which may vary in accordance with the exact requirements of the equipment as offered. They are, however, intended to cover the furnishing, delivery, installation, field testing and field calibration of all materials and apparatus as required. Any additional equipment necessary for the proper operation of the proposed installation not specifically mentioned in these Specifications or shown on the Drawings shall be furnished and installed at no change in Contract Price or Time.

D. To assure unity of responsibility, the pump, pump accessories, motor, and variable frequency drive shall be furnished and coordinated by the pump manufacturer. The Contractor and manufacturer shall assume responsibility for the satisfactory installation and operation of the entire pumping system.

1.06 DELIVERY STORAGE AND HANDLING

A. Provide in accordance manufacturers recommendations and with Section 01600 Delivery, Storage and Handling.

B. All parts shall be properly protected so that no damage or deterioration will occur during a prolonged delay from the time of shipment until installation is completed and the units and equipment are ready for operation.

C. Factory assembled parts and components shall not be dismantled for shipment unless permission is received in writing.

D. Finished iron or steel surfaces not requiring painting, such as flange faces, shall be properly protected to prevent rust, corrosion and damage.

E. Each box or package shall be properly marked to show its net weight in addition to its contents.

1.07 WARRANTY

A. The Contractor and the Manufacturer shall warrant all equipment supplied under this Section for a period of one (1) year. Warranty period shall commence as outlined in the General Conditions and Division 1. Provide a 3-year extended warranty on rotor and stator for both sets of pumps.

B. Provide manufacturer’s 3-year warranty on nonbridging of sludge hopper associated with the Dewatered Sludge Pumps under normal operating conditions. In the event that bridging does occur, Contractor, at his own expense, shall provide additional equipment or modify the existing equipment to eliminate the bridging problem.

C. The equipment shall be warranted to be free from defects in workmanship, design and materials. If any part of the equipment should fail during the warranty period, it shall be replaced in the machine(s) and the unit(s) restored to service at no expense to the Owner.

D. The manufacturer's warranty period shall run concurrently with the Contractor's warranty period. No exception to this provision shall be allowed.

E. Refer to the General Conditions and Division 1 for additional warranty requirements.

PART 2: EQUIPMENT

2.01 MATERIALS AND EQUIPMENT

A. The pumps shall be a heavy duty, positive displacement, single-stage, progressive cavity pump. The pumps shall be cradle mounted to allow the normally vertical suction port to be rotated to any angle perpendicular to the centerline to facilitate piping connections.

B. The bearing and suction housings of the pump shall be thick walled cast iron. All cast parts will be free of sand holes, blowholes and other defects. The suction housing shall incorporate two inspection ports, 180° apart, to permit access to the suction housing interior without disconnecting piping.

C. The suction and discharge piping connections shall be 125-lb. flat face flanges with bolt hole dimensions and spacing conforming to ANSI standards.

D. The pump rotor shall be machined and polished single helix of ANSI 4150 alloy steel, hardened to Rockwell “C” value of 57 – 60, and must be covered with a nominal chrome plate thickness of 0.10 inches for maximum abrasion resistance.

E. The stator must be of double helix configuration with the molded Nitrile elastomer chemically bonded to a steel tube. The stator shall be fastened to the suction housing and discharge flange with removable clamp rings to facilitate stator removal. The stator seals shall be designed to prevent the material being pumped from contacting the stator bonding tube.

F. The gear joints must be of grease lubricated crown gear type, totally enclosed and protected by a wire reinforcing elastomeric seal. Mechanical components of the gear joints shall be designed to operate for 10,000 hours at the manufactures published maximum speeds and pressures. Pin joints will not be accepted.

G. A rigid, splined connecting rod shall connect the gear joints of the drive shaft and eccentrically moving rotor. The connecting rod shall pass through the shaft seal area inside the hollow drive shaft quill so that no eccentric loads are imparted on the shaft seal area.

H. The drive shaft shall be of one-piece construction through the bearings and shaft seal area. This design shall permit disassembly of the universal joints without affecting the alignment of the shaft in the shaft sealing area. Flexishaft design will not be accepted. The quill portion of the shaft shall be hard chrome plated.

I. The bearings will be grease lubricated, tapered roller bearing type with diverging pressure angles for maximum shaft stability. Bearings shall be designed for a minimum B-10 life of 30,000 hours under maximum operating conditions and will not require periodic relubrication. The bearings shall be protected from contaminants by means of a bearing cover plate bolted to the bearing housing.

J. The stuffing box shall be equipped with a split packing gland and split Teflon lantern ring to permit repacking of the pump without removing the bearings or drive shaft components. Fittings will be provided for grease lubrication of the packing.

K. Each pump shall be equipped with a presence/absence fluid detector located immediately prior to the suction flange. The detector shall cause the pump to shut down (via two sets of normally open and normally closed contacts) when fluid is not present in the sensor flange. The detector shall be equipped with an adjustable delay circuit (0 – 90 seconds) to facilitate start up and prevent accidental shut down for momentary voids in the process flow. The detector shall be in a NEMA 4 housing and include status lights. Operational voltage shall be 120V.

L. A Type 304 Stainless Steel hopper with a bridge breaker shall be provided by the manufacturer of the Dewatered Sludge Pumps.

2.02 GENERAL

A. Dewatered Sludge Pumps

1. Number of Pumps: 2
2. Service: Dewatered Sludge
3. Solids Concentration: 16-21%
4. Maximum Flow: 30 gpm
5. Minimum Flow: 20 gpm
6. Total Dynamic Head: 405 FT
7. Maximum Pump Speed: 85 RPM
8. Motor: 20 HP/480V/3ph
9. Acceptable Manufacturers
    a. Seepex Nord SK52FAL-132SP/4
    b. Netzsch

B. Dryer Feed Pumps

1. Number of Pumps: 2
2. Service: Dewatered Sludge
3. Solids Concentration: 16-21%
4. Maximum Flow: 10 gpm
5. Minimum Flow: 4 gpm
6. Total Dynamic Head: 580 FT
7. Maximum Pump Speed: 85 RPM
8. Motor: 30 HP/480V/3ph
9. Acceptable Manufacturers
    a. Seepex Nord SK52FAL-132SP/4
    b. Netzsch

2.03 ELECTRICAL CONTROLS

A. Absence/Presence Detector

1. Each pump shall be equipped with a sensor flange mounted absence/ presence detector to ensure the pump of running dry. This absence/presence detector and its associated panel shall be supplied by the pump manufacturer for installation by the Contractor. See Paragraph 2.01 K of this section for additional requirements.

2. Refer to Control Drawings included in the Contract Drawings for components within the absence/presence detector panel.

B. The Dryer Feed Pumps shall be interlocked with the Dryer Control Panel.

C. Provide NEMA 4X rated 316 SST panels for the Dewatered Sludge Pumps.

1. At a minimum, provide the following operator controls on the panel front at each panel provided:
    a. Handswitch, Hand/Off/Auto
    b. Handswitch, Emergency Stop/Alarm Rest
    c. Potentiometer, Speed Adjust
2. Provide the following indicators on the panel front of each panel:
    a. Cake level high indicating light, amber lens.
    b. Pump discharge pressure high indicating light, amber lens.
    c. Pump temperature high indicating light, amber lens.
    d. Pump speed indicator, which shall be digital and rated NEMA 4X.
    e. Level indicator, which shall be digital and rated NEMA 4X.
3. For each motor, furnish an elapsed time meter on the panel front at each panel. Elapsed time meter shall be digital and rated NEMA 4X.

D. The Variable Frequency Drive (VFD) for the pumps shall be supplied and installed by the Contractor.

E. Power Requirement: 460 volts, 3-phase.

F. External Interfaces:

1. Accept the following discrete inputs at each panel; (can’t read this) and Emergency Stop Alarm.
2. Provide the following discrete outputs from each panel:
    a. In Automatic mode status, two signals per panel.
    b. Pump ON status, two signals per panel.
    c. High discharge pressure alarm, two signals per panel.
    d. Cake high level alarm, two signals per panel.
    e. High motor temperature alarm, two signals per panel.

G. Functional Requirements:

1. The Dewatered Sludge Pump motor shall respond to an AC adjustable frequency controller located in each panel.
2. Provide Hand/Off/Auto control of the pump:
    a. In Hand:
        1) Normally run the pump continuously

2) Adjust speed using the potentiometer on the panel front

b. In Auto:

1) Pump responds to a controller to maintain hopper level within normal operating range. Controller both starts and stops the pump and adjusts its speed to maintain hopper level.

2) Disable the pump on the following conditions. Provide manual reset:

a) Rising high cake level.

b) BFP Emergency Stop.

c. In either Hand or Auto: Disable the pump on either rising high temperature or high discharge pressure. Provide manual reset.

3. Provide logic to maintain all alarm and fail condition indication and (can't read) outputs as well as common FAIL contact output(s) until they are manually reset by pressing the RESET pushbutton.

H. Special requirements:

1. UL Listing Mark for Enclosures: Mark stating "Listed Enclosed Industrial Control Panel" per UL508A.

2. Within each panel, provide surge suppressors on the income power 480-volt 3-phase power. Also provide surge suppressors on the stepped-down 120-volt ac power.

3. Panel stainless steel enclosures shall be finished to a No. 7 polished finish(?), not brushed.

4. Furnish each NEMA 4X panel with an internal 3-point latch and Type (?) stainless steel handle able to be padlocked.

5. Furnish vendor's standard level controller and temperature sensor.

6. Furnish an Adjustable Frequency Drive (AFD) with each panel. AFD shall be the high torque start type, with a startup torque or at least 150 percent of normal operating torque. Program AFD to start at 150 percent torque and then reduce to required torque.

7. The vendor shall coordinate with the Process Instrumentation and Control (PICS) Supplier so that the belt filter press and its support equipment, specifically the Dewatered Solids pumps, are seamlessly monitored and controlled by the plant control system. At a minimum, such coordination includes, but is not limited to:

a. Joint functional testing and performance testing with the PICS Supplier as described under Part 3, Execution.

PART 3: EXECUTION

3.01 INSTALLATION

A. Installation shall be in strict accordance with the Manufacturer's instructions and recommendations and the approved shop drawings in the locations shown on the Drawings.

B. Level by means of steel wedges (steel plates and steel shims). Wedge taper not greater than 1/ inch per foot. Use double wedges to provide a level bearing surface for the pump and driver base. Accomplish wedging so that there is no change of level or springing of the baseplate when the anchor bolts are tightened.

C. The Contractor shall furnish all required oil and grease for initial operation, if required, in accordance with the Manufacturer's recommendations. Anchor bolts shall be set in accordance with the Manufacturer's recommendations.

D. Upon completion of each pump application, the Manufacturer shall inspect the installation and submit a certificate stating that the installation of the equipment is satisfactory, that the equipment is ready for operation, and that the operating personnel have been suitably instructed in the operation, lubrication and care of each unit.

3.02 INSPECTION AND TESTING

A. General

1. The Engineer shall have the right to inspect, test or witness tests of all materials or equipment to be furnished under these Specifications, prior to their shipment from the point of assembly.

2. The Engineer shall be notified in writing prior to initial shipment or testing, in ample time so that the Engineer can make arrangements for inspection.

3. The pump Manufacturer shall perform the following test on each pump prior to shipment from factory:

   a. Megger motor and pump for insulation breaks or moisture.

   b. The pump shall be removed from test tank, meggered immediately for moisture and upper and lower seal unit shall be checked for water intrusion.

   c. A written certification test report regarding the above tests shall be supplied with each pump at the time of shipment.

4. The manufacturer shall furnish the services of a factory Service Technician who shall have complete knowledge of proper operation and maintenance to inspect the final installation and supervise the test run of the equipment. The Manufacturer shall include in his price, a minimum of eight (8) hours of a Service Technician’s time per pump.

5. Field tests shall not be conducted until such time that the entire installation is complete and ready for testing.

6. In the event that the equipment does not meet the Final Acceptance Test, the Contractor shall, at his own expense, make such changes and adjustments in

the equipment that he deems necessary and shall conduct further tests until the Engineer indicates full satisfaction and written certification is received thereof.

B. Pumps

1. After all pumps have been completely installed, and working under the direction of the Contractor, conduct in the presence of the Engineer such tests as are necessary to indicate that pumps conform to the Specifications. Field tests shall include all pumps included under this Section. The Contractor shall supply all electric power, water or wastewater, labor, equipment and incidentals required to complete the field tests.

2. Performance Test:

   a. In accordance with the Hydraulic Institute Standards.

   b. Field Test: Test and demonstrate that the pump systems perform as intended. Test the control system. Demonstrate each function. Participate in a witnessed joint performance test with the PICS supplier.

3. The Final Acceptance Test shall demonstrate that all items of these Specifications have been met by the equipment as installed and shall include, but not be limited to, the following tests:

   a. That all units have been properly installed and are in correct alignment.

   b. That the units operate without overheating or overloading any parts and without objectionable vibration.

   c. That there are no mechanical defects in any of the parts.

   d. That the pumps can deliver the specified pressure and flow.

   e. That the pump sensors and controls perform satisfactorily as to sequence control, correct start and stop elevations, and proper level alarm functions.

   f. The plant control system and variable frequency drive operates the pumps in manual and automatic mode including all interlocks. The pump speed shall be verified throughout the range of the pump to verify operation. All minimum and maximum speed parameters for the pump shall be coordinated and implemented with the VFD, control system, and system integrator prior to acceptance.

4. If the pump performance does not meet the Specifications, corrective measures shall be taken or pumps shall be removed and replaced with pumps that satisfy the conditions specified. A 24-hour-operating period of the pumps will be required before acceptance.

C. Motors

1. The Contractor shall check all motors for correct clearance and alignment and for correct lubrication in accordance with Manufacturer's instructions. The Contractor shall check direction of rotation of all motors and reverse connections if necessary.

3.03 MANUFACTURER'S FIELD SERVICES

A. All manufacturers' field services shall be provided and performed in accordance with Sections 01400 Quality Control and 01640 Manufacturer's Services.

B. Manufacturer's Representative: Present at site or classroom designated by Owner, for minimum person-days listed below, travel time excluded:

1. 2 person-days for installation assistance and inspection
2. 2 person-days for functional and performance testing, including, but not limited to, verification of correct rotation, verification of proper alignment, and vibration testing
3. 2 person-days for facility startup
4. 1 person-day for training of Owner's personnel

END OF SECTION

SECTION 11316

ROTARY LOBE PUMPS

PART 1: GENERAL

1.01 DESCRIPTION

A. Provide rotary lobe pumps with motors, controls, and appurtenances as specified and as shown on the Contract Documents for pumping thickened solids from the Aerobic Digesters to the belt filter presses.

B. Each pumping unit shall be furnished complete with all accessories and appurtenances specified or otherwise required for proper operation. Each pump and drive unit shall be mounted on a common base plate.

1.02 QUALITY ASSURANCE

A. Provide components that are the standard product of a manufacturer regularly engaged in the production of the required materials and equipment.

1. A single manufacturer shall provide all components.

2. The manufacturer shall be responsible for the design, construction and proper operation of all components.

a. Manufacture parts to standard sizes and gauges.

b. Design components for the stresses that may occur during fabrication, shipping, erection, and maintenance.

c. Test the complete unit, including controls, prior to shipment.

1.03 SUBMITTALS

A. Comply with Section 01300 SUBMITTALS. Include the following information:

1. Make, model, and weight of each pump including motors and appurtenances.

2. Manufacturer’s catalog information that describes each type of pump provided. Include:

a. Specifications

b. A complete bill of materials that identifies all materials of construction.

c. Control schematics and wiring diagrams

3. Pump performance curves showing the following:

a. Head vs. capacity

b. Horsepower vs. capacity

c. Pump efficiency vs. capacity

4. Size each motor and indicate the following:

a. Full load and locked rotor current draw

b. Horsepower.

5. Certified structural, mechanical, electrical, and erection drawings, including the following.
   a. Important details of construction,
   b. Equipment dimensions including connections to other work.
   c. Size and location of anchor bolts, and
   d. Locations of connections to other work.
   e. Weight of components.
6. Special shipping, storage, protection, and handling instructions.
7. A list of manufacturer's recommended parts required to maintain the equipment for a period of one year, with current price information.
8. A list of special tools, materials, and supplies furnished with the equipment for use prior to and during startup, and for future maintenance.
9. Manufacturer's installation instructions.

B. Submit Operation and Maintenance Manuals in accordance with Section 01730 OPERATION AND MAINTENANCE MANUALS.

1.04 DELIVERY, STORAGE AND HANDLING

A. Deliver, handle, and store the equipment in accordance with Section 01600 DELIVERY, HANDLING, AND STORAGE.

B. Pack components for extended outside storage. Protect against damage.
   1. Ship as complete assembly where possible.
   2. Label container contents and identify each part with a written description and a part number.
   3. Conform to Contractor's delivery schedule.
   4. Deliver to location designated by the Contractor.

C. Inventory all items with Contractor upon delivery to the project site. Repair or replace damaged components at no cost to the Owner.

D. Coordinate spare parts delivery with the Owner.

1.05 SPARE PARTS AND SPECIAL TOOLS

A. Provide the following spare parts:
   1. One set of bearings
   2. One set of mechanical seals or packing including lantern rings and O-rings as applicable.
   3. One set of rotary lobes
   4. One set of rear wear plates

5. One set of radial wear plates

B. Furnish one year supply of lubricants including oil and greases, as recommended by the product manufacturer.

1. Include summer and winter grades.

2. Provide alternative references to equal products of other manufacturers including specifications such as AGMA numbers and viscosity.

C. Furnish one complete set of special tools required to disassemble, service, repair, and adjust the equipment. A special tool shall be any item that is not readily available through a commercial tool supplier such as Snap-On or Mac tools.

PART 2: PRODUCTS

2.01 MANUFACTURER

A. Börger; Model No. PL 200.

B. Vogelsang; Model No. VX136-105Q.

2.02 GENERAL

A. Provide positive displacement, rotary lobe pumps suitable for pumping solids with a consistency of up to 10% solids by weight and with a solids concentration up to 10,000 mg/L.

1. Provide a pair of counter rotating rotors encased in a ductile iron pumping chamber.

2. Do not exceed a rotor tip speed of 8.2 feet per second when operating at maximum speed.

3. Synchronize gears to ensure lobes rotate without any contact under maximum service conditions.

B. Design pump head to all wetted parts to be easily removed and cleaned in place.

C. Design pump to run dry up to 30 minutes in either direction.

D. Provide pumps, motors, and drives on a common steel baseplate. Include the necessary couplings, guards and mounting hardware.

E. Size the motor to provide 25% reserve horsepower when operating at maximum design conditions.

F. Suction and discharge connections from galvanized steel shall be ANSI 150-lb flanges.

2.03 SERVICE AND DESIGN CONDITIONS

A. BFP Feed Pumps

Number of Pumps	3
Tag Numbers	15-BFP-P-1, -2 and -3
Rated Capacity, each pump	160 gpm @ 35 psi
Solids Passing, inch	1.5
Control	VFD with minimum 10:1 turndown
Motor, hp/V/ph	5/480/3
Drive	Inline geared motor with flexible coupling

2.04 ROTOR CASING

A. Cast or ductile iron construction with Brinell hardness between 230 and 270.

B. Design front cover to allow rotors to be removed without disturbing piping, bearing, or mechanical seals

1. Make flush with no recesses or dead pockets where solids can accumulate.

2. Seal with “Buna-N” O-ring

3. Brinell hardness between 230 and 270

4. Machine to accept reversible front wear plate.

C. Provide a blocking chamber in the casing located behind the mechanical seal and in front of the bearing housing lip seal.

1. Fill the chamber with oil through the side of the pump.

2. Provide an external method to review the status of the mechanical seal operation.

3. If applicable, locate oil bottle on top of the pump in easy view of the operator.

D. Use ANSI Class 150 piping connections.

2.05 ROTORS

A. Provide two tri-lobe rotors constructed of gray cast iron that is covered with a layer of 65 to 72 Durometer hardness Buna-N.

1. Design vanes to provide pressure-pulse free operation.

2. Do not use rotor vanes parallel to the shaft centerline.

B. Drive lobes through positive timing gears running in oil.

C. Position rotors on the shaft using replaceable, hardened keyways.

1. Secure to shaft using internal/external expansion bolts and flush discs or single fastener.

2. Do not require recesses in the end cover.

2.06 SHAFTS

A. Construct of ASTM A293 carbon steel fitted with replaceable ceramic coated stainless steel sleeves where it passes through the seal area.

1. Support the shafts on suitably sized ball and roller bearings.

2. Design of shaft shall be of sufficient diameter to operate at all duty points on the pump curve.

B. Time the shafts through their rotation by straight cutting timing gears running in an oil chamber.

C. Seal the casing penetration using silicon mechanical seals.

2.07 MOTORS

A. General

1. Comply with Division 16 specifications.

2. Provide horizontal TEFC design.

3. Comply with the latest NEMA, IEEE, ANSI, and AFBMA Standards where applicable.

4. Motors to be inverter duty rated, suitable for use with variable speed drives.

5. Provide VFD and controls for each of the pumping systems as specified in Division 16.

B. Performance Requirements:

1. Each unit shall consist of a pump with a gear reducer and 1800 rpm electric motor. Motor shall operate on a 480 volt, three-phase, 60 Hz power supply with a service factor of 1.15.

2. Efficiency type – premium.

3. Free of objectionable noise and vibration. Maximum sound level not to exceed 80 dBA as measured 3 feet from any surface.

4. Maximum temperature of motor windings not to exceed 80°C, as measured by resistance, when the motor is operating continuously at service factor horsepower, rated voltage, and frequency in ambient air temperature of 40°C.

5. Operate within nameplate horsepower of the motor at any point on characteristic curve for impeller furnished.

C. Construction

1. Provide cast iron motor frames and end shields strong enough to hold all motor components rigidly in proper position.

2. Provide motors suitable for indoor or outdoor installation with Class F non-hygroscopic epoxy sealed insulation but limited to Class B temperature rise.

3. Provide insulated windings securely braced to resist failure due to electrical stresses and vibration.

4. Equip motors with a minimum of one (1) temperature switch for each phase connected in series, to monitor motor temperature. Wire into the pump controls as shown on the Contract Documents.

5. Provide epoxy coated stator and rotor cores made of low loss, non-aging electrical sheet steel with insulated laminations.

   a. Stator coils to be random wound and of size, shape, insulation, and number of turns required.

   b. Epoxy seal coils after fabrication.

6. Motor Bearings

   a. Made of AFBMA Standards.

   b. Have ample capacity of the motor rating.

   c. Grease lubricated bearings with a minimum B_{10} bearing life of 100,000 hours.

7. Provide stainless steel Nameplates.

8. Provide lifting lugs or “O” type of bolts on all motors.

9. Provide stainless steel screen enclosures.

10. Use all plated fittings, bolts, nuts, and screws.

11. Provide gaskets on Conduit boxes and lead wires between motor frame and conduit box.

12. Prevent condensation on the core and winding by providing a space heater sized to prevent condensation on the core and winding.

    a. Isolate space heaters from adjacent painted surfaces.

    b. Space heater shall operate on 120 volt, 60 Hz, single phase power supply.

    c. Supply switches as recommended by the manufacturer.

2.08 SHOP PAINTING

A. Clean and shop prime all non-galvanized, non-stainless steel metal surfaces in accordance with Section 09900 PAINTING.

PART 3: EXECUTION

3.01 INSTALLATION

A. Install the pumps and appurtenances in accordance with the instructions of the manufacturer and in accordance with the Contract Documents.

B. Pipe all pump drainage to the nearest floor drain.

3.02 FIELD PAINTING

A. Field prepare and paint required surfaces as specified in Section 09900 PAINTING.

3.03 TESTING

A. Factory test each pump for proper alignment, quiet operation, proper connection, pumping capacity, and satisfactory performance.

B. Provide certified shop test reports before shipping to the project site.

C. Inspect and field test each unit as specified in Section 01640 MANUFACTURER'S SERVICES.

3.04 MANUFACTURER'S FIELD SERVICES

A. Manufacturer's Representative: Present at site or classroom designated by Owner, for minimum person-days listed below, travel time excluded:

1. 1 person-day for installation assistance and inspection.

2. 1 person-day for functional and performance testing, including, but not limited to, verification of correct rotation, verification of proper alignment, and vibration testing.

3. 1 person-day for facility startup.

4. 1 person-day for training of Owner's personnel.

END OF SECTION

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SECTION 11318

GRINDER PUMP STATION

PART 1: GENERAL

1.01 SCOPE

A. The contractor shall furnish and install, complete factory-built and tested E/One DH152-93 Wetwell/Drywell Grinder Pump Station, consisting of grinder pumps suitably mounted in a basin constructed of polyethylene (HDPE) with dimensions and capacities as shown in this specification and on the Contract Drawings, NEMA 6P electrical quick disconnect (EQD), pump removal system, stainless steel discharge assembly/shut-off valve, anti-siphon valve/check valve, each assembled in the basin, electrical alarm panel and all necessary internal wiring and controls.

1.02 SUBMITTALS

A. Submit shop drawings and product data under provisions of Section 1300 Submittals. The contract shall furnish shop drawings detailing the equipment to be furnished including dimensional data and materials of construction.

1.03 QUALITY ASSURANCE

A. The equipment furnished hereunder shall be the product of a company experienced in the design and manufacture of grinder pumps specifically designed for use in low pressure systems. The manufacturer of the equipment shall have at least 10 years of experience in the design and manufacture of units of identical size(s) and performance to the specified units. The manufacturer must also have not less than 500 successful installations of low pressure sewer systems utilizing grinder pumps of like type to the grinder pumps specified herein.

1.04 DELIVERY, STORAGE AND HANDLING

A. Deliver equipment to site under provisions of Section 01600 Delivery, Storage and Handling.

B. Store all equipment off the ground in enclosed shelter.

1.05 WARRANTIES AND BONDS

A. The Contractor shall provide a warranty against defective or deficient materials and workmanship in accordance with the requirements of Section 01740 WARRANTIES AND BONDS.

B. The equipment manufacturer shall provide a warranty against defective or deficient equipment, workmanship and materials under normal use, operation and service. The warranty shall end one (1) year from the date of substantial completion.

PART 2: PRODUCTS

2.01 GENERAL

A. Furnish and install grinder pump station, complete with all appurtenances, form an integral system, and as such, shall be supplied by one grinder pump station manufacturer.

B. The pump station model shall be E/One Model DH152-93 150 Gallon Duplex manufactured by Environment One Corporation (E/One).

2.02 OPERATING CONDITIONS

A. The grinder pump station shall be rated for 3,500 gallons per day. The pumps shall be capable of delivering 15 GPM against a rated total dynamic head of 0 feet (0 PSIG), 11 GPM against a rated total dynamic head of 92 feet (40 PSIG), and 7.8 GPM against a rated total dynamic head of 185 feet (80 PSIG). The pump(s) must also be capable of operating at negative total dynamic head without overloading the motor(s).

2.03 PUMP

A. The pumps shall be a custom designed, integral, vertical rotor, motor driven, solids handling pump of the progressing cavity type with a single mechanical seal. Double radial O-ring seals are required at all casting joints to minimize corrosion and create a protective barrier. All pump castings shall be cast iron, fully epoxy coated to 8-10 mil Nominal dry thickness, wet applied. The rotor shall be through-hardened, highly polished, precipitation hardened stainless steel. The stator shall be of a specifically compounded ethylene propylene synthetic elastomer. This material shall be suitable for domestic wastewater service. Its physical properties shall include high tear and abrasion resistance, grease resistance, water and detergent resistance, temperature stability, excellent aging properties, and outstanding wear resistance. Buna-N is not acceptable as a stator material because it does not exhibit the properties as outlined above and required for wastewater service.

2.04 GRINDER

A. The grinder shall be placed immediately below the pumping elements and shall be direct driven by a single, one-piece motor shaft. The grinder impeller (cutter wheel) assembly shall be securely fastened to the pump motor shaft by means of a threaded connection attaching the grinder impeller to the motor shaft. Attachment by means of pins or keys will not be acceptable. The grinder impeller shall be a one-piece, 4140 cutter wheels of the rotating type with inductively hardened cutter teeth. The cutter teeth shall be inductively hardened to Rockwell 50 – 60c for abrasion resistance. The shredder ring shall be of the stationary type and the material shall be white cast iron. The teeth shall be ground into the material to achieve effective grinding. The shredder ring shall have a staggered tooth pattern with only one edge engaged at a time, maximizing the cutting torque. These materials have been chosen for their capacity to perform in the intended environment as they are materials with wear and corrosive resistant properties.

B. This assembly shall be dynamically balanced and operate without objectionable noise or vibration over the entire range of recommended operating pressures. The grinder shall be constructed so as to minimize clogging and jamming under all

normal operating conditions including starting. Sufficient vortex action shall be created to scour the tank free of deposits or sludge banks which would impair the operation of the pump. These requirements shall be accomplished by the following, in conjunction with the pump:

1. The grinder shall be positioned in such a way that solids are fed in an upward flow direction.

2. The maximum flow rate through the cutting mechanism must not exceed 4 feet per second. This is a critical design element to minimize jamming and as such must be adhered to.

3. The inlet shroud shall have a diameter of no less than 5 inches. Inlet shrouds that are less than 5 inches in diameter will not be accepted due to their inability to maintain the specified 4 feet per second maximum inlet velocity which by design prevents unnecessary jamming of the cutter mechanism and minimizes blinding of the pump by large objects that block the inlet shroud.

4. The impeller mechanism must rotate at a nominal speed of no greater than 1800 rpm.

C. The grinder shall be capable of reducing all components in normal domestic sewage, including a reasonable amount of “foreign objects,” such as paper, wood, plastic, glass, wipes, rubber and the like, to finely-divided particles which will pass freely through the passages of the pump and the 1-1/4" diameter stainless steel discharge piping.

2.05 ELECTRIC MOTOR

A. As a maximum, the motor shall be a 1 HP, 1725 RPM, 240 Volt 60 Hertz, 1 Phase, capacitor start, ball bearing, air-cooled induction type with Class F installation, low starting current not to exceed 30 amperes and high starting torque of 8.4 foot pounds. The motor shall be press-fit into the casting for better heat transfer and longer winding life. Inherent protection against running overloads or locked rotor conditions for the pump motor shall be provided by the use of an automatic-reset, integral thermal overload protector incorporated into the motor. This motor protector combination shall have been specifically investigated and listed by Underwriters Laboratories, Inc., for the application. Non-capacitor start motors or permanent split capacitor motors will not be accepted because of their reduced starting torque and consequent diminished grinding capability. The wet portion of the motor armature must be 300 Series stainless. To reduce the potential of environmental concerns, the expense of handling and disposing of oil, and the associated maintenance costs, oil-filled motors will not be accepted.

2.06 MECHANICAL SEAL

A. The pump/core shall be provided with a mechanical shaft seal to prevent leakage between the motor and pump. The seal shall have a stationary ceramic seat and carbon rotating surface with faces precision lapped and held in position by a stainless-steel spring.

2.07 TANK & INTEGRAL ACCESSWAY

A. The tank shall be a Wetwell/Drywell design made of polyethylene, with a grade selected to provide the necessary environmental stress cracking resistance. The

tank model shall be E/One Model DH152-93 150 Gallon Duplex Polyethylene Construction. The tank model Corrugated sections are to be made of a double wall construction with the internal wall being generally smooth to promote scouring. The corrugations of the outside wall are to be a minimum amplitude of 1-1/2" to provide necessary transverse stiffness. Any incidental sections of a single wall construction are to be 0.250” thick (minimum). All seams created during tank construction are to be thermally welded and factory tested for leak tightness. The tank wall and bottom must withstand the pressure exerted by saturated soil loading at maximum burial depth. All station components must function normally when exposed to 150 percent of the maximum external soil and hydrostatic pressure.

B. The tank shall be furnished with one EPDM grommet fitting to accept a 4” PVC Schedule 40 pipe.

C. The Drywell accessway shall be an integral extension of the Wetwell assembly and shall include a lockable cover assembly providing low profile mounting and watertight capability. The cover shall be high density polyethylene, green in color, with a load rating of 150 lbs per square foot. The accessway design and construction shall enable field adjustment of the station height in increments of 3" or less without the use of any adhesives or sealants requiring cure time before installation can be completed. The finish grade line shall be 1" to 4" below the bottom of the lid, and final grade shall slope away from the grinder pump station.

D. The station shall have all necessary penetrations molded in and factory sealed. To ensure a leak free installation no field penetrations will be acceptable.

E. All discharge piping shall be constructed of 304 stainless steel. The discharge shall terminate outside the accessway bulkhead with a stainless steel, 1-1/4” Female NPT fitting. The discharge piping shall include a stainless-steel ball valve rated for 235 psi WOG; PVC ball valves or brass ball/gate will not be accepted. The bulkhead penetration shall be factory installed and warranted by the manufacturer to be watertight.

F. The accessway shall include a single NEMA 6P Electrical Quick Disconnect (EQD) for all power and control functions, factory installed with accessway penetrations warranted by the manufacturer to be watertight. The EQD will be supplied with 32’, 25’ of useable Electrical Supply Cable (ESC) outside the station, to connect to the alarm panel. The ESC shall be installed in the basin by the manufacturer. Field assembly of the ESC into the basin is not acceptable because of potential workmanship issues. The EQD shall require no tools for connecting, seal against water before the electrical connection is made, and include radial seals to assure a watertight seal regardless of tightening torque. Plug-type connections of the power cable onto the pump housing will not be acceptable due to the potential for leaks and electrical shorts. A junction box shall not be permitted in the accessway due to the large number of potential leak points. The EQD shall be so designed to be conducive to field wiring as required. The accessway shall also include an integral 2-inch vent to prevent sewage gases from accumulating in the tank.

2.08 CHECK VALVE

A. The pump discharge shall be equipped with a factory installed, gravity operated, flapper-type integral check valve built into the stainless-steel discharge piping. The check valve will provide a full-ported passageway when open and shall introduce a friction loss of less than 6 inches of water at maximum rated flow. Moving parts

will be made of a 300 Series stainless steel and fabric reinforced synthetic elastomer to ensure corrosion resistance, dimensional stability, and fatigue strength. A nonmetallic hinge shall be an integral part of the flapper assembly providing a maximum degree of freedom to assure seating even at a very low backpressure. The valve body shall be an injection molded part made of an engineered thermoplastic resin. The valve shall be rated for continuous operating pressure of 235 psi. Ball-type check valves are unacceptable due to their limited sealing capacity in slurry applications.

2.09 ANTI-SIPHON VALVE

A. The pump discharge shall be equipped with a factory-installed, gravity-operated, flapper-type integral anti-siphon valve built into the stainless-steel discharge piping. Moving parts will be made of 300 Series stainless steel and fabric-reinforced synthetic elastomer to ensure corrosion resistance, dimensional stability, and fatigue strength. A nonmetallic hinge shall be an integral part of the flapper assembly, providing a maximum degree of freedom to ensure proper operation even at a very low pressure. The valve body shall be injection-molded from an engineered thermoplastic resin. Holes or ports in the discharge piping are not acceptable anti-siphon devices due to their tendency to clog from the solids in the slurry being pumped. The anti-siphon port diameter shall be no less than 60% of the inside diameter of the pump discharge piping.

2.10 CORE UNIT

A. The grinder pump station shall have a cartridge type, easily removable core assembly consisting of pump, motor, grinder, all motor controls, check valve, anti-siphon valve, level controls, electrical quick disconnect and wiring. The core unit shall be installed in the basin by the manufacturer. Field assembly of the pump and controls into the basin is not acceptable because of potential workmanship issues and increased installation time. In some cases, stations taller than 96” may be shipped on their side without the cores assembled in the basin for freight purposes but this is the only exception. The core unit shall seal to the tank deck with a stainless-steel latch assembly. The latch assembly must be actuated utilizing a single quick release mechanism requiring no more than a half turn of a wrench. The watertight integrity of each core unit shall be established by a 100 percent factory test at a minimum of 5 PSIG.

2.11 CONTROLS

A. All necessary motor starting controls shall be located in the cast iron enclosure of the core unit secured by stainless steel fasteners. Locating the motor starting controls in a plastic enclosure is not acceptable. The wastewater level sensing controls shall be housed in a separate enclosure from motor starting controls. The level sensor housing must be sealed via a radial type seal; solvents or glues are not acceptable. The level sensing control housing must be integrally attached to pump assembly so that it may be removed from the station with the pump and in such a way as to minimize the potential for the accumulation of grease and debris accumulation, etc. The level sensing housing must be a high-impact thermoplastic copolymer over-molded with a thermo plastic elastomer. The use of PVC for the level sensing housing is not acceptable.

B. Non-fouling wastewater level controls for controlling pump operation shall be accomplished by monitoring the pressure changes in an integral air column

connected to a pressure switch. The air column shall be integrally molded from a thermoplastic elastomer suitable for use in wastewater and with excellent impact resistance. The air column shall have only a single connection between the water level being monitored and the pressure switch. Any connections are to be sealed radially with redundant O-rings. The level detection device shall have no moving parts in direct contact with the wastewater and shall be integral to the pump core assembly in a single, readily exchanged unit. Depressing the push to run button must operate the pump even with the level sensor housing removed from the pump.

C. All fasteners throughout the assembly shall be 300 Series stainless steel. High-level sensing will be accomplished in the manner detailed above by a separate air column sensor and pressure switch of the same type. Closure of the high-level sensing device will energize an alarm circuit as well as a redundant pump-on circuit. For increased reliability, pump ON/OFF and high-level alarm functions shall not be controlled by the same switch. Float switches of any kind, including float trees, will not be accepted due to the periodic need to maintain (rinsing, cleaning) such devices and their tendency to malfunction because of incorrect wiring, tangling, grease buildup, and mechanical cord fatigue. To assure reliable operation of the pressure switches, each core shall be equipped with a factory installed equalizer diaphragm that compensates for any atmospheric pressure or temperature changes. Tube or piping runs outside of the station tank or into tank-mounted junction boxes providing pressure switch equalization will not be permitted due to their susceptibility to condensation, kinking, pinching, and insect infestation. The grinder pump will be furnished with a 6 conductor 14-gauge, type SJOW cable, pre-wired and watertight to meet UL requirements with a **FACTORY INSTALLED** NEMA 6P EQD half attached to it.

2.12 STAINLESS STEEL CURB STOP/CHECK VALVE ASSEMBLY (UNI-LATERAL)

A. The curb stop shall be pressure-tight in both directions. The ball valve actuator shall include position stop features at the fully opened and closed positions. The curb stop/check valve assembly shall be designed to withstand a working pressure of 235 psi.

B. The stainless-steel check valve shall be integral with the curb stop valve. The check valve will provide a full-ported 1-1/4” passageway and shall introduce minimal friction loss at maximum rated flow. The flapper hinge design shall provide a maximum degree of freedom and ensure seating at low back pressure.

2.13 ENGINEERED THERMOPLASTIC FITTINGS

A. All plastic fitting components are to be in compliance with applicable ASTM standards.

B. All pipe connections shall be made using compression fitting connections including a Buna-N O-ring for sealing to the outside diameter of the pipe. A split-collet locking device shall be integrated into all pipe connection fittings to securely restrain the pipe from hydraulic pressure and external loading caused by shifting and settling.

2.14 CURB BOX

A. Curb box or meter box shall be constructed of ABS, conforming to ASTM-D 1788. Lid top casting shall be cast iron, conforming to ASTM A-48 Class 25, providing

magnetic detectability, and be painted black. All components shall be inherently corrosion-resistant to ensure durability in the ground. Curb boxes shall provide height adjustment downward (shorter) from their nominal height.

2.15 METER BOXES AND COVER LIDS WITH WORDS “SEWER”

A. Meter Boxes shall be NDS D1800 Meter Boxes, 14” x 19” x 18” size with boxes and cover lid injection molded of structural foam recycled polyolefin material with a melt index between 10-12. Color of meter box is black. Coloring and UV stabilizers are added along with processing lubricants when needed. The 14” x 19” body is tapered and has a minimum thickness of 0.250”. The body has a double wall at the top cover seat area with minimum thickness of 0.22”. The cover seat has 26 structural support ribs on the underside of the seat, each with a minimum thickness of 0.12”. The bottom of the body has a 0.50” flange. The green drop in cover lid has an average thickness of 0.20” and contains the words “sewer” embossed in the top.

2.16 FACTORY TEST

A. The stainless steel, combination curb stop/check valve component shall be 100 percent hydrostatically tested to 150 psi in the factory.

2.17 DUPLEX PROTECT PLUS

A. Each grinder pump station shall include a NEMA 4X, UL-listed alarm panel suitable for wall or pole mounting. The NEMA 4X enclosure shall be manufactured of thermoplastic to ensure corrosion resistance. The enclosure shall include a hinged, lockable cover with padlock, preventing access to electrical components, and creating a secured safety front to allow access only to authorized personnel. The standard enclosure shall not exceed 12.5" W x 16" H x 7.5" D.

B. The panel shall contain one 15-amp single pole circuit breaker for the alarm circuit and one 15-amp double pole circuit breaker per core for the power circuit. The panel shall contain a push-to-run feature, an internal run indicator, and a complete alarm circuit. All circuit boards in the alarm panel are to be protected with a conformal coating on both sides and the AC power circuit shall include an auto resetting fuse.

C. The visual alarm lamp shall be inside a red, oblong lens at least 3.75" L x 2.38" W x 1.5" H. Visual alarm shall be mounted to the top of the enclosure in such a manner as to maintain NEMA 4X rating. The audible alarm shall be externally mounted on the bottom of the enclosure, capable of 93 dB @ 2 feet. The audible alarm shall be capable of being deactivated by depressing a push-type switch that is encapsulated in a weatherproof silicone boot and mounted on the bottom of the enclosure (push-to-silence button).

D. The High-Level Alarm System Shall Operate as Follows:

1. The panel will go into alarm mode if either pump’s alarm switch closes. During the initial alarm mode both pumps will run and the alarm light and buzzer will be delayed for a period of time based on user settings (default is 3-1/2 minutes). If the station is still in high-level alarm after the delay, the light and buzzer will be activated.

2. The audible alarm may be silenced by means of the externally mounted push-to-silence button.

3. The visual alarm remains illuminated until the sewage level in the wet well drops below the “off” setting of the alarm switch for both pumps.

E. The entire alarm panel, as manufactured and including any of the following options shall be listed by Underwriters Laboratories, Inc. Contains the following features:

1. Alarm Activated Dry Contacts – Normally open relay contact closes upon alarm activation.

2. Alarm Activated Contacts for Remote Indoor Alarm Module – Will work with or without power to the alarm panel and is designed to work with E/One’s Remote Sentry.

3. Includes Inner Door Dead Front

4. Separate LED’s for each condition

F. Provides Protection from the Following Operating Conditions:

1. Low Voltage (Brownout) Protection – A lockout cycle will prevent the motor from operating and will illuminate the Trouble LED if:

a. the incoming AC Mains voltage drops below a predetermined minimum, typically 12% of nameplate (211 volts for a 240 volt system) for 2 to 3 seconds, regardless of whether the motor is running the lockout cycle will end if the incoming AC Mains voltage returns to a predetermined value, typically 10% of nameplate (216 volts for a 240 volt system).

b. The system continues to retest the voltage every second indefinitely. If the lockout cycle has been initiated and the voltage comes back above the predetermined starting voltage, the system will function normally. The Trouble LED remains illuminated during a Brownout condition and a corresponding Brownout message will be displayed on the LCD screen. The LED will turn off when the Brownout condition ends, and the LCD message remains latched until the panel is reset. The audible and visual alarm will not be activated unless there is a high wastewater level in the tank.

2. Run Dry Protection – A 20-minute lockout cycle will prevent the motor from operating and will illuminate the Trouble LED when the wastewater level in the tank is below the pump inlet shroud. A corresponding Run Dry message will be displayed on the LCD screen. The condition is rechecked every 20 minutes and the LCD message remain latched. If the condition is satisfied, the pump is allowed to cycle normally and the Trouble LED will go out, but the LCD message remains latched. The LCD message will remain latched until the panel is reset. If the condition is not satisfied after 3 consecutive attempts, the visual alarm will be activated until the panel is reset or until there is one cycle of normal operation. If a high level condition is presented at any time, a pump run cycle will be activated.

3. High System Pressure Protection – A 20-minute lockout cycle will prevent the motor from operating and will illuminate the Trouble LED when the pressure in the discharge line is atypically high (closed valve or abnormal line plug). A corresponding Overpressure message will be displayed on the LCD screen. The condition is rechecked every 20 minutes. If the condition is satisfied, the pump is allowed to cycle normally and the Trouble LED will turn off, but the

LCD message remains latched. The LCD message will remain latched until the panel is reset. If the condition is not satisfied after 3 consecutive attempts, the pump is locked out indefinitely and the audible and visual alarm will be activated. The LCD message and alarms will remain latched until the condition is removed, and the panel is reset.

4. In all of the above cases, if more than one error condition is presented, the LCD message depicting the most recent error condition will be displayed.

G. Protect Plus Features:

1. High/Low Voltage monitoring with Trouble indication
2. High/Low Wattage (wattage is used instead of current because it is a better indicator of pump performance) monitoring with Trouble indication
3. Extended Run Time monitoring with Trouble indication
4. Cycle/Event Counter
5. Run Time Counter (Hour Meter)
6. Run Time Limit — time adjustable, user-selected options: 10 minutes (default) to 120 minutes in 1-minute intervals
7. Power-up Delay — time adjustable, user-selected options: None (default), to 300 minutes in 1-minute intervals
8. Alarm Delay — time adjustable, user-selected options: zero to 10 minutes in 30-second increments; 4 minutes is default
9. System self-test diagnostic
10. User-selectable Alarm latch
11. User-selectable Protect Mode disable
12. User-selectable buzzer timer

H. Specific Duplex Protect PLUS Indicators and Programming Features Shall Include:

1. Ready LED to indicate AC power to the station is satisfactory
2. Pump Run LED to indicate pump is operating (LCD indicates which pump is running)
3. Trouble LED indicator and predictive Visual Alarm notification (“blinking” alarm lamp; clears on Normal cycle)
4. High Level Alarm LED indicator (LCD indicates which pump is in alarm)
5. Manual Run switch to manually activate pumps
6. Lead/Lag indication (LCD indicates which pump is lead)
7. Menu-driven programmable controller with navigation overlay-type buttons (Enter, Scroll, Up, Down)
8. Normal Operation LED and Mode button for Mode status

9. Pump Performance menu LED with LCD display of the following pump performance statistics:
    a. Real-time Voltage
    b. Real-time Amperage
    c. Real-time Wattage
    d. Minimum/Maximum/Average Voltage
    e. Minimum/Maximum/Average Amperage
    f. Minimum/Maximum/Average Wattage
    g. Minimum/Maximum Run-time
    h. Average Run-time
    i. Last Run-time
    j. Cycle/Event Counter
    k. Run Time Counter (Hour Meter)
10. Diagnostics Menu LED
11. Initialize System Menu LED
12. Run Limit Menu LED
13. Alarm Delay Menu LED
14. Power Delay Menu LED
15. Pump alternating options (no alternation, adjustable time based and test)
16. Pump alternating time options — 24 hours to 72 hours in 12-hour increments

I. The grinder pump station will be provided with 50 feet, 45 feet of useable, electrical supply cable to connect the station to the alarm panel.

2.18 SERVICEABILITY

A. The grinder pump core, including level sensor assembly, shall have two lifting hooks complete with lift-out harness connected to its top housing to facilitate easy core removal when necessary. The level sensor assembly must be easily removed from the pump assembly for service or replacement. All mechanical and electrical connections must provide easy disconnect capability for core unit removal and installation. Each EQD half must include a water-tight cover to protect the internal electrical pins while the EQD is unplugged. A pump push-to-run feature will be provided for field trouble shooting. The push-to-run feature must operate the pump even if the level sensor assembly has been removed from the pump assembly. All motor control components shall be mounted on a readily replaceable bracket for ease of field service.

2.19 SAFETY

A. The grinder pump shall be free from electrical and fire hazards as required in a residential environment. As evidence of compliance with this requirement, the completely assembled and wired grinder pump station shall be listed by

Underwriters Laboratories, Inc. to be safe and appropriate for the intended use. UL listing of components of the station, or third-party testing to UL standard are not acceptable. UL Listing as a complete station is mandatory.

B. The grinder pump shall meet accepted standards for plumbing equipment for use in or near residences, shall be free from noise, odor, or health hazards, and shall have been tested by an independent laboratory to certify its capability to perform as specified in either individual or low-pressure sewer system applications. As evidence of compliance with this requirement, the grinder pump shall bear the seal of NSF International. Third-party testing to NSF standard is not acceptable.

PART 3: EXECUTION

3.01 INSTALLATION

A. Installation of the equipment shall be in complete accordance with the manufacturer's instructions and recommendations, and the reviewed shop drawings.

3.02 FACTORY TEST

A. Each grinder pump shall be submerged and operated for 1.5 minutes (minimum). Included in this procedure will be the testing of all ancillary components such as, the anti-siphon valve, check valve, discharge assembly and each unit's dedicated level controls and motor controls. All factory tests shall incorporate each of the above listed items. Actual appurtenances and controls which will be installed in the field shall be particular to the tested pump only. A common set of appurtenances and controls for all pumps is not acceptable. Certified test results shall be available upon request showing the operation of each grinder pump at two different points on its curve. Additional validation tests include integral level control performance, continuity to ground and acoustic tests of the rotating components.

B. All completed stations shall be factory leak tested to assure the integrity of all joints, seams and penetrations. All necessary penetrations such as inlets, discharge fittings and cable connectors shall be included in this test along with their respective sealing means (grommets, gaskets etc.).

3.03 FIELD TESTING

A. Upon Completion of The Installation, Perform the Following Test:

1. Make certain the discharge shut-off valve in the station is fully open.

2. Turn ON the alarm power circuit and verify the alarm is functioning properly.

3. Turn ON the pump power circuit. Initiate the pump operation to verify automatic "on/off" controls are operative. The pump should immediately turn ON.

4. Upon completion of the start-up and testing, submit the start-up authorization form describing the results of the tests performed for the grinder pump station. Final acceptance of the system will not occur until authorization forms have been received for pump station installed and any installation deficiencies corrected.

3.04 MANUFACTURER'S SERVICES

A. Manufacturer's Representative: Present at site or classroom designated by Owner, for minimum person-days listed below, travel time excluded:

1. 1 person-day for installation assistance and inspections

2. 1 person-day for functional/performance/field testing and completion of Manufacturer's Certificate of Proper Installation.

3. ½ person-day for facility startup

4. ½ person-day for post-start-up training of Owner's personnel

B. See Section 01640 Manufacturer's Services and Section 01650 Facility Start-Up and Testing.

END OF SECTION

SECTION 11321

VORTEX GRIT CHAMBER

PART 1: GENERAL

1.01 WORK INCLUDED

A. This section covers the work necessary to furnish and install, complete, all necessary equipment and appurtenances for the new grit chamber equipment, cyclone grit separator, including paddle apparatus, drive, fluidizer vanes, grit well cover plate, flow control baffles, grit pump, grit concentrator, and controls.

B. To ensure compatibility and complete system integration, all pieces of equipment for the grit removal system (e.g., grit pump, grit concentrator) shall be manufactured to match existing grit system components.

C. The existing grit system control panel will be removed and replaced with a terminal cabinet to be provided by the grit manufacturer. All existing wiring will be extended to the new grit system control panel. The new panel shall provide operation, control and monitoring of both the existing grit system and the new grit system. The new PLC in the control panel shall communicate via Ethernet to the plant control system for monitoring and control.

1.02 REFERENCES

A. Reference Standards: Comply as a minimum with applicable provisions and recommendations of the following:

1. NEC, National Electric Code.
2. NEMA, Standards of National Electrical Manufacturers Association.
3. IEEE, Institute of Electrical and Electronic Engineers.
4. AFBMA, Anti-Friction Bearing Manufacturers Association.
5. ANSI, American National Standards Institute.
6. SSPC, Steel Structures Painting Council.
7. ASTM, American Society for Testing and Materials.

1.03 SUBMITTALS

A. Submit shop drawings and product data under provisions of Section 1300 SUBMITTALS. Shop drawings shall include but not be limited to the following components.

1. Make, model, weight, and horsepower of each equipment assembly.

B. Detailed Structural, Mechanical, and Electrical Drawings showing the equipment fabrication and interface with other items. Include dimensions, size, details of anchorages and of connections to other work, and weights of associated equipment.

C. External utility requirements such as air, water, power, drain, etc., for each component.

D. Motor nameplate data, in accordance with NEMA MGI, motor manufacturer, and any motor modifications.

E. Power and control wiring diagrams, including terminals and numbers.

F. Control panel layout drawings and control schematics.

G. Information on factory-applied coating system(s). See Section 09900, PAINTING for specified requirements.

H. Electrical and instrumentation submittals in accordance with Section 13400, PROCESS INSTRUMENTATION AND CONTROL SYSTEMS.

1.04 QUALITY ASSURANCE

A. All materials used shall be new, of high grade and of properties best suited to the Work required.

B. Contractor shall retain overall responsibility for equipment coordination, installation, testing and operation.

1. Manufacturer shall have operational grit chamber with minimum 4 MGD capacity at their facility and upon request from the engineer, the operational unit may be witnessed by the engineer and/or representative of their choice. Hands on demonstration and training with operational grit chamber shall be completed prior to delivery.

1.05 DELIVERY, STORAGE AND HANDLING

A. Deliver equipment to site under provisions of Section 01600 DELIVERY, STORAGE AND HANDLING.

B. Store all equipment off the ground in enclosed shelter.

1.06 GUARANTEE

A. Manufacturer shall furnish to the Owner a written warranty against workmanship and material for 1 year under normal use and service. Warranty shall be in printed form and previously published as the manufacturers' Standard Warranty for similar units.

PART 2: PRODUCTS

2.01 GENERAL

A. Furnish and install the vortex grit removal equipment and appurtenances in accordance with these specifications and as shown on the Drawings.

2.02 MANUFACTURER

A. Smith & Loveless, Inc.

B. Or Engineer approved equal.

2.03 OPERATIONAL CHARACTERISTICS

A. Design each grit chamber for following hydraulic conditions.

1. Maximum Flow While Maintaining Below Removal Efficiency: 12 MGD

B. Construct suitable for extremely humid installation and splash resistant.

C. Limit head loss through grit chamber to 19 in. or less at peak flow.

D. Grit removal from screened raw wastewater.

Grit Size	Removal % (by Weight)
Down to 140-mesh particle size	95

E. Wearing parts readily accessible for inspection, repairs, and replacement.

F. Replacement parts easily duplicated and attainable.

G. No moving parts subject to wear or stoppage below water surface.

H. No bends or elbows on underwater or inaccessible grit piping.

I. Provide drives, lubrication, and support equipment bearings accessible from operating floor level.

J. No loss of grit removal efficiency for flows with inlet velocity less than 3.5 ft/s.

K. Provide inlet ramp to enhance Coanda effect and direct grit downward to separation chamber.

L. Grit removal system to fit in grit tank shown on Drawings.

1. Inlet and outlet to be separated by flow control baffle and chamber travel path to be 360°.

2. Storage hopper to have 60° sloped bottom with a maximum diameter of 3’-0” and a minimum depth of 5’-6”.

3. Upper chamber floor to be flat. Units with sloped floor shall not be allowed.

2.04 GRIT CHAMBER EQUIPMENT

A. Paddles

1. Adjustable grit scouring intensity.

2. Four blades.

3. Material: 316 stainless steel.

4. Provide organic separation in main chamber.

B. Propeller Drive Tube:

1. Driven by large, totally enclosed spur gear and turntable bearing.

2. Dia: 10-3/4 in. minimum.

3. Material: 316 stainless steel.

C. Grit Fluidizer

1. Bolted to propeller drive tube.
2. Within 6" of pump suction inlet.
3. Helical configuration.
4. Material: 316 stainless steel.
5. Provides mechanical fluidization of lower hopper.
6. Units that require fluidizing water shall not be acceptable.

D. Propeller Drive Unit (Gear Motor and Gear Head):

1. Motor:
   a. Helical gear type.
   b. 0.75 hp, 230/460 v, 3-ph, 60 Hz. (explosion proof) (TEFC)
   c. Steel housing and frame.
   d. Service Factor: 2.0 or greater on reducer, 1.15 on motor.
2. Gears:
   a. Alloy steel, heat treated, and hardened.
   b. Teeth: Hobbed and flame hardened.
   c. Helical Gears: Oil lubricated.
   d. Spur Tooth Bull Gear: Large, driven by pinion mounted on output shaft of helical gear motor, enclosed in heavy cast iron case.
   e. Spur Gear Pinion: Cut from heat-treated steel.
   f. Bull Gear: Rotate with minimum 21-in. diameter turntable bearing.
   g. Service Factor for Pinion and Bull Gear: 5 or greater at standard operating speeds.
3. Bull Gear Box:
   a. Specifically designed for this service.
   b. Provide opening for propeller drive table.
   c. Seal with air bell at bottom opening around drive tube.
   d. Provide bolted flanged connection at top for grit pump suction.
4. General Requirements:
   a. Maximum Drive Output Speed: 21 rpm.
   b. Suitable for continuous (24 hrs/day year round) service.
   c. Bearings shall have minimum B-10 bearing life of 50,000 hrs., except 21” diameter turntable bearing which shall have minimum B-10 life of 20 years.

E. Grit well cover plates

1. Maximum 3" opening between cover plate and propeller drive tube.
2. Two-piece with lifting loops.
3. Stationary, not part of rotating assembly.
4. Material: 316 stainless steel.

F. Flow Control Baffle:

1. Fabricate to dimensions as shown on Drawings.
2. No additional downstream flow control device shall be allowed to keep inlet channel velocity between 3.5 ft/s and 1.6 ft/s at flows from peak flow down to 10% of peak flow.
3. Material: 316 stainless steel.

2.05 GRIT PUMP

A. Pump:

1. Centrifugal, vertical configuration.
2. Close-coupled.
3. Recessed Ni-Hard impeller.
4. Construction: Ni-hard especially designed for use of mechanical seals (and vacuum priming).
5. Size: 4” suction, 4” discharge.
6. Capable of passing 4” sphere.
7. Capacity: 250 GPM at 37.2 ft. TDH.
8. One piece motor adapter/backhead.
9. Self priming pump not allowed.

B. Motor:

1. 10 HP, 1800 RPM, 230/460 Volt, 3 phase, 60 hertz (explosion-proof) (TEFC).
2. Minimum 1-7/8" shaft diameter.
3. Solid stainless steel shaft through mechanical seal.
4. 6" maximum lower bearing to impeller distance.
5. Class F insulation, Class B temperature rise, 1.15, unless explosion-proof or VFD duty then 1.0 service factor.

C. Lifting Stanchion

1. A stanchion with lifting arm shall be provided to lift the Grit Pump for disassembly.

2. The lifting arm shall have a hook over the center of the motor to support a hoist provided by the Owner. Installation shall be as detailed in the contract drawings.

3. The lifter shall be designed for a 1,000 lbs. (454 kg) lifting load.

2.06 CENTRIFUGAL GRIT CONCENTRATOR

A. Mount grit concentrator on grit dewatering screw as recommended by manufacturer.

B. Size, capacity, and range of operation shall be compatible with total grit removal system as described herein.

C. Operates on same principle and flow patterns as grit chamber.

D. Purpose: Remove water and organics from mixture of grit, water, and organics (pumped by grit pump) prior to grit dewatering screw, thereby minimizing hydraulic load.

E. Flow Pattern:

1. Pumped flow enters tangentially through side.

2. Grit and small volume of water exit out bottom into hopper of dewatering screw.

3. Organic material and rest of water exit out top to drain.

4. Minimum 93% removal of influent water and 95% removal influent organics.

5. Less than 5% putrescible material in recovered grit from underflow.

F. Material: Minimum 1/2" Ni-Hard, high nickel iron coated with minimum 6 mil dry film thickness epoxy resin.

G. No moving parts; operates totally on hydraulic principles.

H. Mechanisms that require internal liners shall not be allowed.

2.07 ELECTRICAL CONTROLS FOR AUTOMATIC OPERATION

A. Panel

1. NEMA 4X Stainless steel.

2. Removable access cover.

B. Circuit Breakers

1. Thermal magnetic.

2. Include on following circuits:

a. Motor control.

b. Auxiliary circuits.

C. Starters

1. Magnetic across the line with overload coils.
2. Include for following motors:
    a. Paddle drive.
    b. Grit pump.
    c. Grit washer.

D. Control Devices

1. Dedicated PLC to provide control function to properly operate grit system.
    a. Control the operation of grit pump and priming system
    b. Control the operation of grit washer through various cycles (air infusion, wash water, drain solenoid, level detectors, screw operation).
    c. Control the operation of the existing grit system.
    d. Provide necessary output signals, interlock, timing functions.
    e. 20k-Hz high speed counter and 6K-word non-volatile memory
    f. Use RSLogix programming software.
    g. 14 inputs and 10 outputs and built in RS-232-C port for external interfacing.
    h. Real-time clock module shall control scheduling.
2. Human Machine Interface (HMI) to provide operator input to and visual output from the controller.
    a. NEMA 4 rated display mounted through front of panel.
    b. 5.7” graphic interface with DSTN 256-color Liquid Crystal Display
    c. Backlighting and resistive-type touch screen, with audible feedback on touch for data input and programming.
    d. “Sleep” feature to prolong screen life.
    e. Provide aluminum hood to shade HMI display from direct sunlight.
    f. Powered by 24v DC from dedicated 650ma regulated power supply.
3. Power supply:
    a. 120v AC supply powering 24v DC unit
    b. Filtered to reduce transient spikes and noise going to PLC and HMI.
    c. Single phase active tracking filter, series connected for high frequency noise and transient protection.
    d. Surge capacity of 45,000 amps, with transient protection in all modes (line to neutral, line to ground, and neutral to ground).
    e. Typically reduced to + or – 2.0 volts.

2.08 LOCAL CONTROL STATIONS

A. Panel

1. NEMA 7
2. Include Hand-Off-Automatic switch and E-stop push button
3. Include for the following:
    a. Paddle drive
    b. Grit pump
    c. Grit Washer

2.09 VACUUM PRIMING

A. Panel
    1. NEMA 4X Stainless steel.
    2. Mounted on paddle drive unit.
B. Panel Mounted Devices
    1. Vacuum Pump:
        a. Corrosion resistant internal components.
        b. Sized to prime pump and piping in less than 60 seconds.
    2. Air Compressor:
        a. Oil-less
C. Priming System
    1. Consists of vacuum pump, vacuum control solenoid valve, prime level sensing probe, and float operated check valve.
    2. Positive lubrication of mechanical seal.
    3. Minimum passageway equivalent to 2-1/2" opening.
    4. Prime from low-pressure area of pump.
D. Pinch Valve
    1. On pump discharge line.
    2. In vertical piping.
    3. 4" diameter.
    4. Pneumatically controlled.

2.10 SHOP PAINTING

A. Surface Preparation
    1. All structural steel surfaces shot blasted with steel grit.
    2. Weld splatter and surface roughness removed by grinding.
    3. Comply with SSPC-SP6 specifications.

B. Coating

1. Single 3-mil dry film thickness of red oxide primer, factory applied.

2. Stainless, aluminum, other corrosion resistant surfaces shall not be coated.

3. Auxiliary components (grit pump, gear motor, etc.) furnished with original Manufacturer's coating.

2.11 SPARES

A. Pump

1. Spare mechanical seal and volute gasket

2. Pinch valve sleeve

3. Solenoid valve and dome

PART 3: EXECUTION

3.01 INSTALLATION

A. Installation of the equipment shall be in complete accordance with the manufacturer's instructions and recommendations, and the reviewed shop drawings.

3.02 FIELD QUALITY CONTROL

A. Functional Test:

1. Alignment: Prior to facility startup, test complete assembly for proper rotation, proper alignment and connection.

B. Performance Test:

1. Perform under actual or approved simulated operating conditions.

2. Test for a continuous 3-hour period without malfunctions.

3. Perform with the ENGINEER present.

4. Upon completion of test, record information listed on sample test log.

5. Adjust, realign, or modify units and retest in accordance with the Hydraulic Institute Standards, if necessary.

6. Verify communications and system operation with the plant control system through the Ethernet communications. Coordinate the database with the system integrator for the project.

3.03 MANUFACTURER'S SERVICES

A. Manufacturer's Representative: Present at site or classroom designated by Owner, for minimum person-days listed below, travel time excluded:

1. 1 person-day for installation assistance and inspections

2. 1 person-day for functional and performance testing and completion of Manufacturer's Certificate of Proper Installation.

3. ½ person-day for facility startup

4. ½ person-day for post-start-up training of Owner's personnel

B. See Section 1640 MANUFACTURER'S SERVICES and Section 01650 FACILITY START-UP AND TESTING.

END OF SECTION

SECTION 11331

FINE SCREENS AND CONVEYOR

PART 1: GENERAL

1.01 SCOPE OF WORK

A. Work covered in this Section includes furnishing two (2) fully automatic, self-cleaning, channel mounted rotating drum screens for wastewater applications and associated controls. Equipment shall be installed as shown on the plans, as specified herein, as recommended by the supplier and in compliance with all local, state and federal codes and regulations.

1.02 MANUFACTURER

A. The equipment supplier shall be Enviro-Care Company or equal.

B. The entire in-channel, rotating drum screen shall be designed, coordinated and supplied by one manufacturer.

C. The in-channel, rotating drum screen manufacturer shall take sole responsibility for the screen supplied.

D. Conveyor shall be provided by screen manufacturer.

1.03 EXPERIENCE

A. One manufacturer shall be responsible for the supply of the equipment specified herein.

B. Equipment manufacturer shall have no less than 15 years' experience in the design and manufacturing of in-channel rotating drum screens and demonstrate this experience by providing a reference list with at least 50 installations.

1.04 RELATED WORK

A. Section: 01300 SUBMITTALS: General submission requirements included in Division 1.

B. Section: 09900 PAINTING, except as specified herein, is included in Division 9.

C. Section: 11314 HORIZONTAL CENTRIFUGAL PUMPS included in Division 11.

D. Section: 16900 General Control Requirements.

E. Electrical work, except as specified herein is included in Division 16.

1.05 SUBMITTALS

A. The Manufacturer shall furnish the required number of submittals (and an electronic version if required) within forty-five (45) days of receipt of the order to verify compliance with the specification. The submittals shall include:

B. Technical information:

1. Manufacturer's layout drawing and electrical schematic drawings.

2. Motor performance data and features.

3. Gear reducer data including service, efficiency, torque rating and materials of construction.

C. Equipment information:

1. Brochures and other descriptive literature.

2. Ancillary item(s) data sheets.

3. Manufacturer's Warranty.

D. Operation & Maintenance Manuals

1. Equipment Operating instructions

2. Equipment weights and lifting instructions.

3. Installation instructions

4. Maintenance schedules

5. Recommended lubricants

6. Recommended spare parts including wear items.

7. Long-term and short-term storage instructions.

1.06 REFERENCE STANDARDS

A. The rotating drum screen and motor controllers shall, as applicable, meet the requirements of the following industry standards:

1. AISI (American Iron and Steel Institute)

2. ABMA (American Bearing Manufacturers Association)

3. AGMA (American Gear Manufacturers Association)

4. NEMA (National Electrical Manufacturer's Association)

5. NFPA (National Fire Protection Association)

6. ASTM (American Society for Testing and Materials)

7. WSC (American Welding Society Code)

8. ASME (American Society of Mechanical Engineers)

9. NEC (National Electrical Code)

10. UL (Underwriters Laboratory Standards)

1.07 QUALITY ASSURANCE

A. A single manufacturer shall furnish all the equipment specified under this Section and shall be standard units of proven ability as manufactured by a competent organization that is fully experienced, reputable and qualified in the manufacture of the equipment to be furnished. The equipment shall be designed, constructed

and installed in accordance with the best practice and methods, and shall operate satisfactorily when installed.

B. All equipment furnished under this Section shall be new and unused.

C. The Rotating Drum Screen shall be shipped to the site fully assembled. Some ancillary components may be removed in order to prevent damage during shipment.

D. The manufacturer shall test-run the fully assembled Screen in the factory before shipment.

E. A certificate of the shop run test shall be supplied showing the result of screenings capture ratio (SCR) test.

F. The Contractor and manufacturer shall assume responsibility for the satisfactory installation and operation of the Fine Screens System.

1.08 DELIVERY STORAGE AND HANDLING

A. Provide in accordance manufacturers recommendations and with Section 01600 Delivery, Storage and Handling.

B. All parts shall be properly protected so that no damage or deterioration will occur during a prolonged delay from the time of shipment until installation is completed and the units and equipment are ready for operation.

C. Factory assembled parts and components shall not be dismantled for shipment unless permission is received in writing.

D. Finished iron or steel surfaces not requiring painting, such as flange faces, shall be properly protected to prevent rust, corrosion and damage.

E. Each box or package shall be properly marked to show its net weight in addition to its contents.

1.09 WARRANTY

A. All equipment shall be covered against manufacturing defects in materials and workmanship during normal use and service for a period of one (1) year from date of start up as long as periodic maintenance procedures are followed and performed. Items specifically not covered by the one year warranty are consumable wear parts as identified in the O&M manual.

PART 2: EQUIPMENT

2.01 ACCEPTABLE MANUFACTURERS

A. SAVI Flo-Drum Rotating Drum Screen, Model VSA 3000/1, shall be as supplied by Enviro-Care, Inc.

B. Huber.

2.02 PERFORMANCE REQUIREMENTS

Conditions	Unit
Number of screens	2
Influent Type	Raw Sewage
Influent Solids Concentration (mg/l)	450
Peak flow per screen (mgd)	14
Downstream Water Level (at peak flow) (in)	36
Max Headloss (at peak flow) (in)	25
Perforation Size (mm)	1
Channel recess width (ft)	10.0
Influent & Effluent channel width (ft)	5
Channel depth (ft)	10.5
Screenings discharge height from channel top (ft)	5
Minimum Screenings Capture Ratio (SCR) Certified	92%

2.03 UTILITY REQUIREMENTS/ENVIRONMENTAL CONDITIONS

Conditions	Unit
Spray Wash Water – Low Pressure (gpm/psi)	113/72
Power Supply (V/P/Hz)	460/3/60
Screen Installation Location	Outdoor
Control Panel Location	Outdoor

2.04 DESIGN REQUIREMENTS

A. General

1. Equipment provided shall be fully automatic, self-cleaning, perforated plate rotating drum screen(s). Screen(s) will be provided with an angle-of-inclination of 35° from horizontal.

2. Each rotating drum screen unit shall be provided with a rotating screen basket, basket cleaning spray bar(s), basket cleaning brush, concentric screw conveyor with integral screenings washing, dewatering and screenings compaction zone with single motor drive system.

3. Under any flow condition up to the maximum flow condition, the average maximum flow through velocity of 3.3 ft/sec shall not be exceeded. The drum screen shall be designed to minimize solid deposition in the channel.

4. The screen(s) shall be designed so that there are no metal on metal wearing surfaces in the screening, transport and compaction/dewatering zones of the screen. The spiral shall be supported between the gearbox and the bottom bearing and shall not rely on the anti-rotation bars for support. Units requiring wear liners or wear bars shall not be accepted.

5. The in-channel rotating drum screen equipment shall produce dewatered screenings capable of passing the EPA Paint Filter Test as described in method 9095 of EPA publication SW-486.

6. The rotating drum screen shall be capable of presenting a clean filtration surface to the oncoming liquid stream at all times during operation.

B. All moving wetted parts, all wetted parts on which moving parts ride, all perforated drum components shall be 304L stainless steel unless otherwise noted.

C. Drum Screen Basket

1. The Drum Screen Basket shall be designed and built to withstand the maximum possible static hydraulic forces exerted on the screen by the liquid flow. Structural and functional parts shall be sized to prevent deflections or vibrations that may impair the screening, conveying, washing and compacting operations.

2. The drum screen basket shall be of a cylindrical shape with perforations around the entire basket.

3. The drum screen basket shall be perforated plate with maximum openings of 1 mm. Bar screens, wire mesh or wedge wire will not be acceptable screen media.

4. The top end ring and the bottom drive ring inclusive of support arm(s) shall each be made from a single plate from stainless steel. Units which use multiple pieces for each end and that are welded or otherwise affixed shall not be accepted.

5. Units with a drum screen basket diameter of 3000 mm and above shall be provided with dual lower support arms.

6. A support arm hub shall be welded directly to the support arm(s). The hub shall be machined complete with keyway from a single piece of stainless steel. The hub shall be sized to support the drum screen basket without deflection or distortion.

7. The drum screen basket shall have shaped lifting vanes to retain loose solids during rotation and lift them up and into the screw auger trough. Helical shaped vanes which can tumble screenings rather than lift screenings shall not be accepted.

8. A one piece stainless steel seal plate shall be provided to direct water flow into the circular drum screen basket in the channel. The seal plate shall be sufficient to prevent bypassing of flow around the screen basket at the maximum screen hydraulic capacity.

9. The drum screen basket shall be provided with a triple face seal system, incorporating an internal brush in order to minimize bypassing of hair and other fine particles, one HDPE seal creating a labyrinth through a ring welded on the drum screen, and an external rubber seal pressing on the external part of the drum ring preventing laminar bypass. Any unit which does not incorporate this design will not be accepted.

10. The upper portion of the drum screen basket shall have a brush seal to prevent screenings from being carried into the channel from splashing inside the drum.

11. The drum screen basket and screw conveyor shall be fixed to the same shaft and driven by a common drive.

12. The drum screen basket shall be supported by the drive end with a reinforced support arm and by nylon rollers at the opposite end. Each of the rollers shall use two ball bearing assemblies mounted to the stainless steel shaft. The rollers and bearings shall require no lubrication. A preload adjustment system shall be included for the rollers. Screens using wear shoes or glides to guide or support the basket shall not be accepted.

D. Drum Screen Basket Cleaning Brush and Low-Pressure Spray Bar

1. The rotating drum screen basket assembly shall be cleaned by a stainless steel spray bar with stainless steel spray nozzles and a stainless steel backed polypropylene brush. The drum screen basket shall continuously rotate in one direction during the cleaning cycle and pass through the topmost portion where it is cleaned by the spray bar and brush.

2. The drum screen basket shall incorporate a brush and spray wash located above the basket to remove solids from the screening basket and direct them into the concentric screw conveyor trough as the basket rotates.

3. Under certain operating conditions a second spray bar may be added either in conjunction with the existing spray bar or offset to the side of the drum screen basket to minimize water entering the screw conveyor trough.

4. Units with a drum screen basket diameter of 3000 mm and above shall utilize a double spray bar with a staggered nozzle pattern.

5. The cleaning brush shall be mounted on a holding device which keeps the brush in constant contact with the screen basket and can be adjusted to compensate for brush wear.

6. The drum screen basket shall have a stainless steel backed brush attached to sweep materials from the edge of the screw conveyor trough.

E. Screenings Conveyor and Dewatering Zone

1. The transport tube shall be provided with anti-rotation bars bolted from the outside along the longitudinal axis. The screenings screw conveyor shall not be dependent on the anti-rotation bars for support during normal operation.

2. The screenings shafted transport/dewatering screw shall be constructed from type 304L stainless steel.

3. The screen basket rollers and screenings collection hopper shall be attached to the screenings transport tube by a basket support flange. The drive assembly shall be attached via a drive support flange welded to the upper end of the screenings transport tube. The basket shall be mounted to the unit with a solid support arm hub at the lower end of the basket. The support arm hub shall be bolted directly to the concentric screw shaft.

4. The screenings shafted transport screw shall have a brush mounted on it for the length of the screenings inlet/drainage hopper.

5. The concentric transport/dewatering screw shall be designed to transport and dewater the screened material. The unit shall be provided with screw flights of constant pitch approaching the compaction zone in order to prevent clogging in the compaction zone. Designs incorporating a decreasing pitch screw will not be accepted.

6. The screenings screw conveyor shall be supported by a sealed, self-lubricating lower bronze bushing. The shaft in contact with the bushing shall be protected by chrome a plated sleeve. The lower bushing shall be designed such that it does not take any thrust load from the screw conveyor. Designs requiring bearings of any type or externally lubricated bushing(s) or water injection into the housing shall not be accepted.

7. The lower bearing shall have a 10-year or 55,000 hours of bearing life. Bearings unable to meet this service life will not be accepted.

8. The stainless steel lower bearing shaft and arm(s) shall be designed to minimize material wrapping around the shaft. A stainless steel seal plate shall be provided to mate between the stationary lower bearing support and the rotating arm(s) to prevent material intrusion into the bearing seals.

9. The compaction zone shall be integral to the screenings screw conveyor and compaction tube. The compaction zone shall be designed to form a screenings plug and return water released from the screened material back to the channel through circular holes that are machined into the screenings compaction tube.

10. The screw conveyor shall transport the screenings to the compaction/ dewatering chamber. After compaction and dewatering, the screenings shall be discharged with the aid of a serrated blade.

11. The compaction zone housing shall be fabricated entirely of 304L stainless steel. The lower body shall be a welded construction with a minimum of 10mm end plates for maximum torsion resistance. The bottom of the compaction zone shall be curved to promote maximum cleaning and minimum depositing of materials. Units utilizing a fiberglass reinforced compaction zone housing will not be accepted.

12. The compaction zone shall be furnished with a latched, hinged access cover with a gasket. The access cover shall incorporate a safety interlock switch in order to prevent operation of the unit with the access cover open. Units which require the use of any tools to gain access to the compaction zone will not be accepted.

F. Spray Wash System

1. The spray wash system shall utilize a local spray wash water booster pump. The pump shall be horizontal centrifugal to provide 113 gpm @ 72 psi; reference Specification Section 11312 – Horizontal End Suction Pumps.

2. The low-pressure automatic spray wash systems for the screen shall be furnished with automatic controlled valves.

3. Spray wash systems shall be constructed of 304 stainless steel piping and fittings, flexible rubber reinforced hoses and 316 stainless steel spray nozzles. Spray wash system shall operate only when the screen basket is rotating.

4. The low-pressure lower wash system shall be located over the rotating basket which utilizes spray bars with adequate spray nozzles to ensure a consistent spray pattern over the entire length of the basket. For maximum wash water flow rate and pressure the spray bar will be controlled with an electric actuated full port stainless steel ball valve. Full port ball valve shall have a maximum Cv rating of 60.

5. A screenings spray wash system shall be located in the lower section of the transport tube to break up and return organic materials to the flow stream and to ensure maximum screenings washing.

6. A compaction zone wash system shall be provided which periodically cleans the compaction and dewatering zone via a stainless steel wash header located in the uppermost end of the compaction/dewatering chamber. The header shall be designed to completely wash the full surface of the transport tube drainage area. Wash water to the compaction zone will be controlled with a brass body solenoid valve.

7. The electric actuated full port stainless steel ball valve shall be 120V AC rated and operated via the programmable controller and/or manually.

8. The solenoid valve shall be 120V AC rated and operated via the programmable controller and/or manually.

G. Screen Drum Channel Covers.

1. The rotating drum screen units shall be provided with covers from Aluminum.

2. Covers shall be 3/16 inch thick with ¼-inch-thick supporting struts/angles.

3. Cover mounting flange shall be from a ¼-thick x 4-x-4-inch angle.

4. Covers shall be rectangular with sloped sides access cover panels.

5. A total of four (4) access cover panels shall be provided. Each access cover panel shall be provided with two (2) stainless steels hinges with a stainless-steel lifting handle.

6. Provide lifting eyes at the four corners of the cover to allow for complete removal of the channel cover.

7. Top of cover shall be provided with a 6-inch bolt hole pattern odor control vent connection.

H. Drive Unit

1. Drive unit shall be rigidly supported so that there is no visible “wobble” movement under any operating condition.

2. Basket and transport screw shall be driven by a shaft mounted geared motor.

3. The gear reducer shall be bolted to a machined flange welded to the upper end of the transport tube.

4. Gear reducer shall be a helical gear type as manufactured by NORD or approved equal. Provide a cast iron frame; design in accordance with AGMA recommendations for wastewater service.

5. Gear reducer shall be driven by a 5 HP, TEFC, 480v, 3ph, 60hz motors.

6. Chain drives, belt drives, hydraulic drives or designs incorporating a separate upper bearing for the transport screw will not be accepted.

2.05 ELECTRICAL CONTROLS AND DEVICES

A. Control Panel: A 480-volt primary control panel shall be provided with a type 316 stainless steel NEMA 4X enclosure. Panel shall be suitable for wall mounting.

B. All controls necessary for the fully automatic operation of the screen shall be provided by the manufacturer.

C. The electrical control system shall provide for automatic control of the screen via a high liquid level using ultrasonic level transducers in conjunction with an adjustable time clock. The screen shall operate at a high liquid level or a pre-determined time sequence to provide variable time between cleaning operations. The level sensing device shall be provided as part of the control system.

D. The rotating drum screen control system shall incorporate a programmable relay/(programmable logic controller and integral operator interface) which can change the cleaning characteristics of the screen and spray wash systems.

E. Each control panel shall include the following items:

F. One (1) NEMA 4X type 316 stainless steel wall mount main control panel suitable for 480/3/60 electrical supply. Control panel shall contain the following control devices for operation of the drum screen.

1. Main fused disconnect with through door interlock handle.

2. Control transformer 480/120.

3. Branch circuit protection.

4. Screen drive motor VFD.

5. Emergency stop pushbutton.

6. HOA switch for each motor.

7. Open – Close – Auto switch for screen wash water electric actuated ball valve.

8. Open – Close – Auto switch for compaction zone wash water solenoid valve.

9. Hour meter for each motor.

10. Run indicating lights.

11. Alarm lights indicating overcurrent and starter overload.

12. Alarm reset pushbutton.

13. Allen Bradley MicrolLogix 1400 programmable control relay for screen and compactor control logic functions.
14. Allen Bradley PanelView 800.
15. Ethernet switch – unmanaged.
16. Run and alarm auxiliary contacts.
17. Flashing alarm light and alarm horn with silencer-reset button.
18. UL Label.

G. Safety Microswitch: 120 volt safety interlock switch shall be factory mounted to the compaction/discharge zone access door. Interlock switch shall prevent operation of the screen while the doors is open. Switch housing shall be rated for NEMA4X.

H. Electric Actuated Ball Valve: Provide one (1) electric actuated full port 316 stainless steel ball valves to control flow to the low-pressure basket spray wash assembly. Each full port ball valve shall be 2-piece body, threaded ends, cast body from CF8M, 316 stainless steel, ball and stem from 316 stainless steel, and RTFE seats. Each valve shall be controlled by a NEMA 4x electric actuator with a housing from cast aluminum with thermally bonded polyester power coating, stainless steel output shaft, stainless steel fasteners, 115 volt, single phase, 60 Hz, two SPDT limit switches, and visual indication on valve position. Electric actuator shall be suitable for area classification.

I. Solenoid Valves: Provide one (1) solenoid valve to control flow to the compaction zone spray wash assembly. Each valve shall have a stainless steel body. Each valve shall be 120 volt, single phase, 60 Hz. Valves shall be suitable for area classification.

J. Each screen provided with one (1) Local control station complete with –

1. Local/Remote switch.
2. Screen drive Hand-Off-Auto selector switch.
3. Drum low pressure spray wash water control valve Open-Close-Auto selector switch.
4. Compaction zone spray wash water control valve Open-Close-Auto selector switch.
5. Emergency Stop pushbutton.

K. Ultrasonic Level Controller: A 120V dual point controller shall be provided in a windowed NEMA 4X polycarbonate enclosure suitable for wall mounting, to receive and interpret a 4-20mA scaled signal from an upstream and downstream transducer. The controller shall have 6 internal relays and provide an LCD display and handheld programmer for use interface.

L. Ultrasonic Level Transducer: Two (2) ultrasonic level transducers shall be provided with type 316 stainless steel mounting brackets and expansion anchors. Each sensor shall have an ETFE housing with an integral sensor to provide compensation for acoustic variations due to temperature. Each sensor shall have

a range of 1-33 ft and be supplied with a 16 ft integral cable. Sensor shall be suitable for installation in a Class 1, Division 1, Group D area.

M. Outdoor Weather Protection:

1. Screenings transport tube shall be insulated with thermal insulation of mineral wool, riveted stainless steel protective covers and a heat tracing system for outdoor weather protection of the: screenings transport tube, compaction, dewatering zone, and all spray wash piping and valves.

2. Heat tracing shall be suitable for operation to a minimum temperature of -13°F.

3. Bulkhead adapters allowing easy access shall be provided where wash water supply and electrical conduit penetrates the screen cover.

2.06 OPERATION, MONITORING, AND CONTROL

A. Screen Hand Operation: Screen to run continuously.

B. Screen Automatic Operation: Operation of the rotating drum screen basket and spray bar(s) shall be automatically initiated at a preset high liquid level. Screen to cycle based on the level sensor.

C. Basket Zone Low-Pressure Spray Wash/Screening Wash System Hand Operation: Spray wash shall run continuously.

D. Basket Zone Low-Pressure Spray Wash/Screening Wash System Automatic Operation: Spray wash shall run when the spiral assembly is rotating in forward operation and also have the capability to sequence on and off as conditions warrant.

E. Compaction Zone Spray Wash Hand Operation: Spray wash shall run continuously.

F. Compaction Zone Spray Wash Automatic Operation: An intermittent cleaning cycle of the drum screen basket shall be initiated by the upstream water level as required. All open spaces of the drum screen basket shall be positively cleaned via brush bristles and spray wash system.

G. Fault Conditions:

1. Momentary motor over current shall trip the current monitor, stop the drive motor, and illuminate the alarm indicating light. Reset shall be manual on the outside of the control panel.

2. Excessive motor current shall trip the starter overload relays, stop the drive motor, and illuminate the alarm indicating light. Overload relays shall be reset manually on the inside of the control panel.

3. Spray Wash Booster Pump failed to run.

PART 3: EXECUTION

3.01 PREPARATION

A. Each rotary perforated plate screen shall be supplied complete with supports suitable for mounting as shown on the contract drawings. Supports shall be shop fabricated from 304L stainless steel shapes and plates. Supports shall be assembled and fitted to the screen prior to shipment.

B. The contractor shall furnish all anchor bolts of ample size and strength required to securely anchor each item of equipment. Contractor shall place equipment on the foundations, ensure that it is leveled, shimmed, bolted down and grouted with a non-shrinking grout.

C. The mounting points of the channel shall be level and parallel and of proper size.

3.02 LIFTING AND MOVING EQUIPMENT

A. Lifting points shall be identified on all Enviro-Care equipment. A crane of sufficient capacity must be on site for unloading the equipment from the truck and placing in the channel for installation.

3.03 SPARE PARTS

A. One (1) Solenoid valve rebuild kit.

B. One (1) Ball valve rebuild kit for each size provided.

C. One (1) set of low-pressure spray nozzles

D. One (1) complete set of Drum Support Rollers

E. Three (3) Drum Seal Gaskets

F. Three (3) Spiral Brush segments.

G. Three (3) Drum Cleaner brushes.

3.04 INSTALLATION

A. Installation shall be in strict accordance with the Manufacturer's instructions and recommendations and the approved shop drawings in the locations shown on the Drawings.

B. The Contractor shall furnish all required oil and grease for initial operation, if required, in accordance with the Manufacturer's recommendations. Anchor bolts shall be set in accordance with the Manufacturer's recommendations.

C. The manufacturer shall coordinate with the contractor for installation of all conduit, wire, terminations, mounting hardware, and equipment not provided as part of the manufacturers equipment. The contractor is responsible to provide all material and work required for a complete system. Refer to Division 16 in the contract documents.

D. Upon completion of each pump application, the Manufacturer shall inspect the installation and submit a certificate stating that the installation of the equipment is satisfactory, that the equipment is ready for operation, and that the operating

personnel have been suitably instructed in the operation, lubrication and care of each unit.

E. Coordinate with the system integrator for communications through the Ethernet system. Provide database for monitoring and control of point in the plant control system.

3.05 START UP/TRAINING/FIELD QUALITY CONTROL

A. The initial start-up of Enviro-Care equipment will be performed by Enviro-Care personnel and/or an authorized Enviro-Care representative. The Enviro-Care authorized representative will verify the proper installation, operation, and provide training to the equipment operators. Three (3) trips for a total of six (6) days are allotted.

3.06 ADJUSTING AND CLEANING

A. Information on minor periodic adjustments and cleaning is contained in the Operating and Maintenance Manual.

END OF SECTION

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SECTION 11353

LIQUID POLYMER FEED SYSTEM

PART 1: GENERAL

1.01 SCOPE

A. The polymer feed system shall be a liquid system and shall be fed by the water pressure associated with the polymer mixing system.

B. Furnish six (6) polymer blending unit (PBU) with progressive cavity pump, motors and controls, including all integral piping, valves, fitting, pipe supports, special equipment and appurtenances in accordance with these specifications, including all incidental work necessary to make it complete, satisfactory and ready for operation.

C. Furnish two (2) polymer recirculation pumps, motors, and controls in accordance with these specifications, including all incidental work necessary to make it complete, satisfactory and ready for operation.

1.02 RELATED WORK

A. Belt Filter Presses are included in Section 11370 SLUDGE DEWATERING SYSTEM.

B. Rotary Drum Thickener are included in Section 11410 ROTARY DRUM THICKENERS.

C. Polymer Solution Tanks are included in Section 13204 POLYETHYLENE STORAGE TANKS

D. Electrical work, except as specified herein is included in Division 16.

1.03 SUBMITTALS

A. Submit in accordance with the Section 01300 SUBMITTALS, copies of all materials required to establish compliance with this Section. Submittals shall include at least the following:

1. Submit data completely describing product, including detailed scope of supply, detailed bill of materials and annotated specification sheets of all components.

2. Certified shop and erection drawings showing all details of construction, dimensions, and anchor bolt locations.

3. Submit detailed specifications and shop drawings with both shaded isometric and orthogonal views of the proposed system, including dimensions and weights.

4. Submit wiring, control schematics, and control logic diagrams for all electrical and control components furnished.

5. Descriptive literature, bulletins, and/or catalogs of the equipment.

6. Equipment schematic and control diagrams.

7. Complete electrical wiring diagrams, including terminals and numbers.

8. A complete description of the warranty to be provided.

9. Information, including technical catalog literature and specifications, on factory prime and finish coating systems in accordance with Section 09900 Painting.

10. Electrical and Instrumentation submittals in accordance with Section 13400 Process Instrumentation and Control Systems.

B. Complete operating and maintenance instructions shall be submitted in accordance with the requirements of Section 01730 Operation and Maintenance Manual. Operations and Maintenance Manuals must include storage, installation start-up, operating instructions, safety precautions, and warnings of all hazards operating equipment.

C. Complete Start-up testing forms in accordance with Section 01650 Facility Start-Up and Testing.

1.04 QUALITY ASSURANCE

A. A single manufacturer shall furnish all the equipment specified under this Section and shall be standard units of proven ability as manufactured by a competent organization that is fully experienced, reputable and qualified in the manufacture of the equipment to be furnished. The equipment shall be designed, constructed and installed in accordance with the best practice and methods, and shall operate satisfactorily when installed.

B. Prior to shipment the system shall be inspected for quality of construction verifying all fasteners and fittings are tight, all wires are secure and connections whisker-free.

1.05 DELIVERY STORAGE AND HANDLING

A. Provide in accordance manufacturers recommendations and with Section 01600 Delivery, Storage and Handling.

B. Equipment shall be protected against damage during delivery and storage at the site.

1.06 WARRANTY

A. The Contractor and the Manufacturer shall warrant all equipment supplied under this Section for a period of a one (1) year limited warranty against defects in materials and workmanship. The mixing chamber shall be warranted for the life of the system against failure for plugging for any reason. The warranty shall exclude failure due to over pressure or freezing. Warranty period shall commence as outlined in the General Conditions and Division 1.

B. The equipment shall be warranted to be free from defects in workmanship, design and materials. If any part of the equipment should fail during the warranty period, it shall be at no expense to the Owner.

1.07 EXTRA MATERIALS

A. Provide the following spare parts:

1. One (1) progressive cavity pump stator
2. One (1) progressive cavity pump packing seal type
3. One (1) banding clamp tool for replacement of the progressive cavity metering pump pin joint banding clamps.
4. One (1) neat polymer check valve, complete
5. Two dozen (24) absorbent pads sized for skid drip pad

PART 2: PRODUCTS

2.01 MANUFACTURERS

A. Where a manufacturer's standard equipment name and/or model number is listed, the equipment system shall be provided as modified to conform to the performance, functions, features, and materials of construction as specified herein.

B. Acceptable Manufacturers:

1. VeloDyne
2. Dynablend

C. The proposed system, whether named or not, shall be modified as necessary to meet these specifications in full.

D. Provide a name plate securely affixed to the unit providing Manufacturer with phone number, model number, and serial number.

2.02 DESIGN CRITERIA

A. The polymer dilution/feed unit shall be capable of automatically metering, diluting, activating and feeding liquid polymer with water.

B. Provide three (3) complete units, two duty and one standby, for the belt filter presses (BFP) and three (3) complete units, two duty and one standby, for the rotary drum thickeners (RDT) to meet the following design criteria.

Polymer System Requirements

	RDT	BFP
Number of Blend Units	3	3
Polymer Type	Emulsion	Emulsion
Active %	33–35	33–35
Polymer Dose, lbs/dry ton	8–12	10–20
Neat Polymer Concentration, %	0.25	0.25
Minimum Neat Polymer Dose, gph	2.03	2.52
Maximum Neat Polymer Dose, gph	3.05	5.04
Minimum Dilution Water, gph	527	1,008
Maximum Dilution Water, gph	791	2,017

C. Provide two polymer recirculation tanks sized to recirculate the polymer tanks at 50 gpm.

2.03 PERFORMANCE REQUIREMENTS

A. The liquid polymer blending unit shall automatically meter, mix and blend concentrated liquid polymers with dilution water.

2.04 SERVICE CONDITIONS

A. Dilution water supply pressure shall be a minimum of 35 psi greater than the mixing chamber discharge pressure.

B. Control Panel supply voltage shall be: 120 VAC.

2.05 LIQUID POLYMER FEED SYSTEM

A. Polymer Activation & Blending Chamber

1. A hydrodynamic blending device capable of maintaining high energy independent of plant supplied water pressure shall be provided. Systems dependent on plant water pressure will be considered if the system includes an integral water booster pump.

2. The system shall have a minimum of two mixing zones, a non-mechanical and mechanical mixing zone.

a. Non-Mechanical stage shall be capable of activating and blending polymer based on plant water pressure alone at 30 psi or greater. Polymer shall be injected directly into a water jet by means of an injection quill positioned such that the non-mechanical mixing energy is no way diminished prior to polymer and water contact. The non-mechanical zone shall be designed such that the velocity of the mixing energy-producing water jet is maintained or increases as flow decreases.

b. Hydro-Mechanical mixing zone shall be capable of producing its mixing energy independent of plant water pressure through a variable intensity, controllable stainless steel hydro-mechanical mixer. The mixing impeller shall be fully controllable and capable of inducing ultrahigh, non-damaging mixing energy at all flow rates.

3. In order to prevent polymer build-up, the mixing chamber shall maintain high velocity in the entire chamber - at no time shall there be low velocity within any portion of the mixing chamber.

4. The mixing impeller shall be controlled by an SCR motor controller and driven by a wash-down duty motor. The motor shall be mounted horizontally or above the mixing chamber. Motors mounted under the mixing chamber where seal failure or leaks can damage the motor shall not be acceptable.

5. The mixer drive shaft shall be sealed by a mechanical seal which shall have an integrally mounted and factory plumbed seal flush. A drain port behind the seal shall be provided in the mixing chamber to drain the polymer solution in case of a seal failure. The seal shall be easily accessible for replacement. Systems without a seal flushing system shall not be considered. All bearings shall be external from the mixing chamber. Internal bearings shall not be acceptable.

6. Both mechanical and non-mechanical mixing zones shall be clear polycarbonate to view the mixing action and blending effectiveness. Acrylic chambers prone to becoming brittle over time and cracking, or opaque pipe shall not be acceptable to meet this requirement. The clear cover shall have a stainless steel reinforced gusseted flange with a stainless steel discharge connection in order to handle maximum operating pressures.

7. The mixing chamber shall have a maximum rated pressure of 100 psi. Provide a pressure relief on the mixing chamber factory set at 75 psi.

8. Provide a neat polymer check valve specifically designed to isolate neat polymer from dilution water. The valve shall be designed with an open, unobstructed path to the valve seat. The valve body shall be constructed of Teflon with Viton seals. The valve poppet and spring shall be stainless steel. The valve shall be readily accessible for cleaning and shall not require tools for removal, cleaning or replacement. Conventional check valves, valves that rely on ball seals, and or check valves that are installed inside the mixing chamber, or which require mixing chamber disassembly for servicing will not be accepted.

B. Dilution Water Assembly

1. The dilution water flow rate shall be monitored by a Rotameter flow meter having a minimum range as specified under Paragraph 2.02 above. Unions or flanges shall be provided on the flow meter to allow easy removal for cleaning.

2. The unit shall have an electric motor operated ball valve for On/Off control of total dilution water flow.

3. A differential pressure type low water differential pressure alarm shall be provided. The switch shall be adjustable between 9 and 60 psi with a static working pressure of 500 psi. The pressure switch shall be as manufactured by Ashcroft.

4. Provide a 2-1/2” stainless steel liquid filled pressure gauge to monitor dilution water inlet pressure.

C. Progressive Cavity Neat Polymer Metering Pump

1. The unit shall have one (1) neat polymer metering pump integrally mounted on the system’s skid. The metering pump shall have a range as specified under Paragraph 2.02 above. The pump shall be a positive displacement, progressive cavity type constructed of stainless steel and Viton. The shaft seal shall be a packing type riding on a ceramic sleeve. Mechanical seals shall not be used. A 90 VDC wash-down duty motor shall drive the pump. A gear reducer shall be provided to produce a maximum pump shaft speed of not more than 545 RPM. The motor shall be controlled by an SCR motor controller located in the system control panel.

2. Provide a calibration column with two full port PVC ball valves having Viton O-rings. The column shall be calibrated for a one minute draw-down at maximum pump rate and read in GPH and milliliters. The calibration column shall be rigidly mounted to the systems frame with a minimum of two heavy duty brackets. Mounting the calibration to the neat polymer inlet piping shall not be acceptable. Provide a breather plug in the top of the calibration column

designed to allow adequate displacement of air during calibration while preventing water or other foreign material from entering the calibration column.

3. Provide a thermal type loss of polymer flow sensor.

D. Plumbing Connections

1. Dilution water inlet, 1" FNPT
2. Neat polymer inlet, 1” FNPT
3. Solution discharge, 1" FNPT
4. Drain/overpressure, ½” FNPT

E. Solution Discharge Assembly

1. Provide a 2-1/2” stainless steel liquid filled pressure gauge to monitor system discharge pressure.

F. System Skid

1. The system's frame shall be of rugged 304 stainless steel construction. No mild steel shall be used. All piping shall be rigidly supported.
2. Under no circumstance shall the pump suction exceed 5” from the bottom of the skid for progressive cavity pumps.
3. The skid shall have an integral stainless steel drip pan located under the neat polymer metering pump.
4. The overall system dimensions shall be as shown on the Construction Drawings.

2.06 POLYMER RECIRCULATION PUMP

A. Provide two (2) progressive cavity recirculation pump systems to recirculate neat emulsion polymer in the bulk polymer storage tanks to prevent stratification.

B. Each pump shall be rated for 50 GPM.

C. The pumps shall be constructed of stainless steel and Viton and have a packing seal.

D. The pumps shall be driven by a 480 VAC, 3 Ph, 60 Hz motor and gear reducer. Maximum speed shall not exceed 350 RPM.

E. Provide a thermal type in-stator loss of flow sensor to sense loss of polymer solution flow and protect the pump from running dry.

F. The recirculation pump system shall be mounted on a 304 stainless steel skid constructed of structural steel tubing frame and a minimum 10 ga stainless steel fabricated mounting spans.

2.07 CONTROLS

A. Liquid Polymer Blend System Control

1. A control panel integral to the systems skid shall be provided. The enclosure shall be rated NEMA 4X and constructed of 304 316 stainless steel. The control panel shall consist of all motor starters with overload, switches, lights, relays, time delays, and other control devices required for a complete operable system. The control panel and all components shall be industrial duty. All skid mounted electrical components interconnected to the control panel shall terminate at numbered and labeled terminal blocks. The terminal blocks shall be sized for 14 ga. wire. Wires shall be neatly run through wire race-way and numbered with shrink tubing type labels. Adhesive labels shall not be used. The control panel shall be positioned such that there are no obstructions in front of the control panel per related NFPA requirements. The panel shall operate off of 480 VAC, 3 Ph, 60 Hz. power and have a main power rotary style fused disconnect switch.
    a. Operator Interface – Discrete Selector Switch:
        1) Provide a MAN/OFF/AUTO selector switch. In MANUAL mode the pump shall start and stop by push-button switches. In AUTO mode the pumps shall operate based on an operator programmable on-delay / off-delay panel mounted digital timer.
        2) Provide a panel mounted programmable digital timer.
    b. Status / Alarm Indicators:
        1) Main Power ON
        2) High Stator Temperature Alarm
        3) Motor Overload Alarm
    c. Inputs (signals by others):
        1) Remote Start / Stop (discrete dry contact)
        2) Pacing Signal Based on Process Flow (4-20mA)
    d. Outputs:
        1) System Running (discrete dry contact)
        2) Remote Mode (discrete dry contact)
        3) Common Alarm (discrete dry contact)

B. Polymer Recirculation Pump

1. A control panel integral to the systems frame shall be provided. The enclosure shall be rated NEMA 4X and constructed of 304 stainless steel. The control panel shall consist of all controllers, digital displays, potentiometers, switches, lights, relays, and other control devices required for a complete operable system. The control panel and all components shall be industrial duty. All skid mounted electrical components interconnected to the control panel shall terminate at numbered and labeled terminal blocks. The terminal blocks shall be sized for 14 ga. wire. Wires shall be neatly run through wire race-way and numbered with shrink tubing type labels. Adhesive labels shall not be used. The control panel shall be positioned such that there are no obstructions in front of the control panel per related NFPA requirements. Control.

2. Power: 120 VAC, 1Ph, 60/50 Hz. with a 10’ power cord and receptacle.

3. A circuit breaker on the main control circuit and on each motor shall be provided as manufactured by Allen Bradley or equal. Fuses shall not be used for circuit protection.

4. Control Series

   a. Operator Interface – Discrete Selector Switch:

      1) System ON / OFF(reset) / REMOTE

      2) One-Turn Potentiometer – Mixer Speed

      3) Ten-Turn Potentiometer – Progressive Cavity Metering Pump Control

   b. Status / Alarm Indicators:

      1) Main Power ON

      2) Low Water Differential Pressure Alarm

      3) Low Polymer Flow Alarm

   c. Inputs (signals by others):

      1) Remote Start / Stop (discrete dry contact)

      2) Pacing Signal Based on Process Flow (4-20mA)

   d. Outputs:

      1) System Running (discrete dry contact)

      2) Remote Mode (discrete dry contact)

      3) Common Alarm (discrete dry contact)

      4) Polymer Pump Rate (4-20mA)

2.08 MAINTENANCE

A. Unit shall be open frame design to allow easy access to all components.

B. Mixing chamber shall be easily disassembled and reassembled to allow access to all parts exposed to neat polymer.

C. Polymer check valve shall be readily accessible. Check valves installed inside mixing chamber shall not be acceptable.

PART 3: EXECUTION

3.01 INSTALLATION

A. Installation shall be in strict accordance with the manufacturer's instructions and recommendations in the locations shown on the Drawings.

B. All field painting shall be in accordance with Section 09900 Painting of these specifications.

3.02 FIELD TESTING

A. The manufacturer shall fully inspect and certify in writing to the Engineer that the equipment installation is acceptable to the equipment manufacturer prior to acceptance by the Owner.

B. All pumping systems shall be pressure tested for leaks. All systems shall be flushed prior to start-up.

3.03 PERFORMANCE TESTING

A. The equipment manufacturer shall provide the services of a field representative for the testing and startup of the polymer systems, including all accessories.

B. Contractor and manufacturer shall correct any failures during testing and startup. Units failing to meet the specifications to the satisfaction of the Engineer and Owner shall be replaced at no cost to the Owner.

3.04 MANUFACTURER'S FIELD SERVICES

A. All manufacturers' field services shall be provided and performed in accordance with Sections 01640 Manufacturer's Services.

B. Manufacturer's representative: Present at site or classroom designated by Owner, for minimum person-days listed below, travel time excluded:

1. 1 person day for installation assistance and inspection of the polymer systems and recirculation pumps

2. 2 person-days for functional and performance testing and completion of Manufacturer's Certificate of Proper Installation for the polymer systems and recirculation pumps

3. 1 person-day for post start up training of Owners personnel. Training shall not commence until an accepted detailed lesson plan for each training activity has been reviewed by Engineer.

END OF SECTION

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SECTION 11370

SLUDGE DEWATERING SYSTEM

PART 1: GENERAL

1.01 SCOPE

A. The Contractor shall provide and install two (2) 2-meter belt filter presses, complete with polymer mixing system, control panels and spare parts as specified herein and shown on the Contract Drawings for the dewatering of aerobically digested sludge. The belt presses will discharge into the new conveyor system as specified in Section 14550 CONVEYOR SYSTEMS.

B. The Contractor shall provide and install all necessary valves, interconnecting piping and wiring, instrumentation, anchor bolts and other necessary appurtenances for a complete and operating installation.

C. Contractor shall fabricate 304 SST chute between belt filter press discharge and inlet to the Dewatered Sludge Pumps as shown on the Drawings and per Specification Section 05500 Metal Fabrications.

D. The specifications and drawings for this project are based on the BDP Model 3DP 2.0m Belt Filter Press.

1.02 RELATED WORK

A. Field and finish painting is included in Section 09900 PAINTING.

B. Section 11312 HORIZONTAL END SUCTION PUMPS

C. Electrical work, except as specified herein, is included in Division 16.

D. Section 11353 LIQUID POLYMER FEED SYSTEMS

E. Section 01650 FACILITY START-UP AND TESTING

F. Section 14550 CONVEYOR SYSTEMS

1.03 SUBMITTALS

A. Submit in accordance with Section 01300 SUBMITTALS, copies of all materials required to establish compliance with this Section. Submittals shall include at least the following:

1. Certified shop and erection drawings showing all details of construction, dimensions, control panel dimensions, and anchor bolt locations.

2. Descriptive literature, bulletins and/or catalogs of the equipment, including mounting requirements, weight of each piece of equipment, anchor patterns, and access requirements.

3. A complete total bill of materials for all equipment.

4. A detailed description of the instrumentation and control system proposed, including a list of all functions monitored, controlled and alarmed. Describe all

automatic shutdown features and interfaces with the plant instrumentation and control systems. The instrumentation and control system shall be described in both words and schematic form.

5. Provide elementary diagrams of prewired panels. Include in diagram of control devices and auxiliary devices; for example, relays, alarms, fuses, lights, fans, and heaters. Show number for each wire and terminal.

6. Power and utility requirements including motor wiring diagrams, motor sizes, motor control schematics, and any special requirements.

7. Calculations shall be furnished substantiating shaft sizing, drum and roll construction design, bearing life, fatigue failure safety factors and drum and roller deflection.

8. A list of the manufacturer's recommended spare parts with the manufacturer's current price for each item. Include gaskets, packing, etc., on the list.

9. Complete description of surface preparation and shop prime painting.

10. Performance Test plan and schedule.

B. Complete operating and maintenance instructions shall be furnished for all equipment specified herein in accordance with the General Conditions and Division 1.

C. If it is impossible to conform to certain details of the specifications due to different manufacturing techniques, describe completely all non-conforming aspects.

1.04 REFERENCE STANDARDS

A. Design, manufacturing and assembly of elements of the products herein specified shall be in accordance with the standards of the below listed organizations.

1. American Iron and Steel Institute (AISI)

2. American National Standards Institute (ANSI)

3. American Society for Testing Materials (ASTM)

4. American Welding Society (AWS)

5. National Electric Code (NEC)

6. National Electrical Manufacturer Association (NEMA)

7. Steel Structures Painting Council (SSPC)

8. Underwriters’ Laboratories, Inc. (UL)

B. Where reference is made to a standard of one of the above, or other organizations, the version of the standard in effect at the time of bid opening shall apply.

1.05 QUALITY ASSURANCE

A. A single manufacturer shall furnish all the equipment specified under this Section and shall be standard units of proven ability as manufactured by a competent organization that is fully experienced, reputable and qualified in the manufacture

of the equipment to be furnished. The equipment shall be designed, constructed and installed in accordance with the best practice and methods, and shall operate satisfactorily when installed. The units shall be tested as a complete assembly at the manufacturer's facility prior to shipment.

B. All equipment furnished under this Section shall be new and unused and shall be the standard products of manufacturers having a successful record of manufacturing and servicing the equipment and systems specified herein for a minimum of ten (10) years.

C. These Specifications are intended to give a general description of what is required but may not cover all details which may vary in accordance with the exact requirements of the equipment as offered. They are, however, intended to cover the furnishing, testing, delivery and field calibration of all materials and apparatus as required. Any additional equipment necessary for the proper operation of the proposed installation not specifically mentioned in these Specifications or shown on the Drawings shall be furnished and installed with no additional charge.

1.06 DELIVERY, STORAGE AND HANDLING

A. Provide in accordance with manufacturers recommendations and with Section 01600 DELIVERY, STORAGE AND HANDLING.

B. Units shall be assembled as much as possible and crated prior to shipment.

C. Equipment shall be protected against damage during storage at the site.

D. All units and components shall be handled in accordance with manufacturer’s instructions. Lifting rings and soft harnesses shall be used for lifting the unit to prevent scratching or abrading of finished surfaces.

E. Maintaining grease coating on all machined surfaces during on-site storage shall be the responsibility of the Contractor.

1.07 WARRANTIES AND BONDS

A. The Contractor shall provide a warranty against defective or deficient materials and workmanship in accordance with the requirements of Section 01740 WARRANTIES AND BONDS.

B. The equipment manufacturer shall provide a warranty against defective or deficient equipment, workmanship and materials under normal use, operation and service. The warranty shall end one (1) year from the date of substantial completion. The warranty shall be in printed form and apply to all similar units.

PART 2: PRODUCTS

2.01 MANUFACTURERS

A. BDP Model 3DP 2.0m Belt Filter Press

B. Klampress KPZ High solids 2.0 meter Belt Filter Press

C. Or approved equal

2.02 GENERAL

A. All equipment specified in this section shall be furnished by the manufacturer of the belt filter presses except as otherwise indicated. This does not require that all equipment be manufactured by a single manufacturer but does require that the manufacturer of the belt filter presses shall be responsible for the satisfactory operation of the belt presses and all the appurtenances and the associated equipment listed herein.

B. Each belt filter press shall be of the continuous belt design with three distinct dewatering zones including an extended length gravity dewatering zone, an adjustable wedge or low pressure zone and a vertical shear/pressure zone and shall consist of a structural frame, dewatering belts, an inlet distributor, belt support/wiper bars, drainage elements, drums, rollers, bearings, discharge blades, a belt drive unit, belt tracking and tensioning systems, a belt wash system and a filtrate/belt washwater drainage system. The belt filter press shall be factory assembled including all internal piping, valving, wiring and control devices and shall be shipped as a complete assembly except that the dewatering belts shall be shipped separately in suitable containers to prevent accidental damage.

C. Compliance with the performance requirements of the specifications will not relieve the Contractor of his responsibilities of supplying equipment having the specified structural, mechanical, corrosion resistant and operational features. Deviations from the requirements specified shall not be permitted.

2.03 PERFORMANCE REQUIREMENTS

A. Each belt filter press shall operate satisfactorily under the following performance conditions:

1. Type of sludge: Aerobically digested sludge

2. Sludge feed concentration: ≤ 5.0%, averaging 1.5% consistency by weight of dry solids.

3. Hydraulic throughput, solids throughput, cake solids concentration, solids capture (combined filtrate and washwater) and polymer use requirements:

a. Hydraulic Throughput: 145-400 gpm

b. Total Solids Throughput: 750 dry lbs./hr. per meter of press or 1,500 dry lbs./hr total per press

c. Cake Solids, minimum: 14 %

d. Solids Capture: 95% Capture @ ≥ 1.5 % feed solids

e. Polymer Use: The polymer dosage shall not exceed 25 pounds per dry ton of active ingredient.

2.04 GENERAL SYSTEM REQUIREMENTS

A. After proper flocculation of the sludge with polymer, initial dewatering shall occur by gravity drainage through a filter belt traveling horizontally along the press. Further dewatering shall occur by squeezing the sludge between two tensioned pressure belts, first through a wedge zone then over and under a minimum of eight drums forcing entrained water from the sludge through both pressure and shear

action. Dry cake discharge shall be assisted by doctor blades at each belt. Each belt shall be subsequently washed with high pressure, low volume water from spray headers before it returns to the head of its section of the press. Washwater and filtrate shall be collected in drain pans for direction to a curbed concrete drainage basin surrounding the press.

B. The equipment furnished shall be designed and constructed in accordance with the best practices and methods and for continuous service at maximum conditions. All parts shall be so designed and proportioned as to have liberal strength, stability and stiffness and to be fully suitable for the intended conditions of service. Provisions shall be made for easy lubrication, adjustment or replacement of all parts. Corresponding parts of multiple units shall be interchangeable. Except as otherwise specified, steel plates and shapes shall have a minimum thickness of 3/8-in., sheet metal shall be 14-gauge minimum and bolts shall be ½-in. diameter minimum. All welding shall be in accordance with the latest applicable codes of the American Welding Society. All materials used shall be of the best quality and fully suitable in every respect for the service intended. Unless otherwise specified, all materials in direct contact with sludge, polymer or filtrate shall be type 304l stainless steel or plastic. All fasteners shall be type 304l stainless steel.

2.05 POLYMER MIXING SYSTEM

A. Each belt filter press shall be provided with a sludge conditioning system designed to efficiently mix polymer with the sludge and to adequately condition the sludge for optimum dewatering. The vortex mixing valve, polymer injection ring, and manifold are to be installed by others. Reference Section 11353 – Liquid Polymer Feed System.

B. The sludge conditioning system shall be mounted upstream of the press and shall consist of an in-line vortex mixer with a variable orifice, polymer injection ring, and polymer solution distribution manifold.

C. The sludge conditioning shall meet the following mechanical specifications:

1. Vortex Mixer - The in-line mixer shall have a flanged housing, an adjustable orifice with a removable side plate for inspection and cleaning.

2. The open throat area shall be fully adjustable downward and shall open automatically to prevent clogging.

2.06 PRESS FRAME

A. The frame shall be fabricated from tubular structural members designed to adequately support all components and accessories. C-channel, or plate frames shall not be acceptable. Steel shall meet the requirements of ASTM A500; all welding shall be performed in accordance with ANSI/AWS D1.1. Where frame components are bolted, stainless steel fasteners shall be used. The frame moment of inertia shall be a minimum of 59.9 $in.^4$ in the x-x axis and 20.1 $in.^4$ in the y-y axis. At a minimum the main press structural members shall be constructed of 8”x4”x1/4” tubular steel. The load bearing frame member of the pressure section shall have a moment of inertia minimum of 180 $in.^4$ in the xx axis and 38 $in.^4$ in the yy axis. Due to the importance of structural integrity of the press, the above moments of inertia must be met or the unit will not be accepted.

B. The frame shall have minimum safety factors of nine times the allowable yield strength in bending and ten times the allowable shear stress at an applied belt tension of 70 pounds per linear inch of belt width. Maximum deflection of each structural member shall not exceed L/600, where L is span length. Maximum stress of each member shall not exceed L/5 at the members yield point. Belt press loads imposed on building floor shall be vertical. All horizontal loads shall be contained within the frame. Design calculations shall be submitted to substantiate the required frame safety factors and deflection limit.

C. After fabrication all frame members shall be sandblasted according to SSPC SP-10 standards to near white finish then hot dipped galvanized per ASTM A123 to a thickness of 5 to 7 mils to assure complete and thorough corrosion protection. Painted or flame sprayed coatings are not acceptable since adequate surface protection at bolt holes, slots and inaccessible areas is not assured. Stainless steel local side panels shall be provided where necessary to contain spray mist and provide operator protection from moving parts.

D. The framework shall be constructed in such a manner that it will insure absolute plane parallelism of all rolling elements by machined bearing pads.

E. The framework shall be of welded and/or bolted construction. No disassembled component, excluding the belt filter frame, shall weigh more than 3500 lbs.

F. Provide adjustable leakage seals to contain the sludge on the belt through the gravity drainage zone. Seals shall be 304 stainless steel with rubber skirts, designed to provide an effective seal without causing wear to the belt.

2.07 INDEPENDENT GRAVITY DRAINAGE SECTION

A. The press shall be furnished with an independent gravity drainage area consisting of a variable speed belt designed to contain and drain conditioned sludge. The inlet distributor shall be utilized to evenly distribute the conditioned sludge over the face of the moving filter belt. The inlet shall incorporate a variable speed, 6-blade paddle wheel distributor across the full width of the belt press. The feed distributor must form a uniform slurry depth over the full belt width immediately upon leaving the feed distributor of plus or minus 1/16 inch. The paddle wheel shall be driven by a 1/3 HP AC TEFC variable speed motor and gearbox. The belt system shall be sealed to prevent leakage and shall be easily accessible for operating, viewing, cleaning, and adjusting.

B. All materials in contact with the sludge in the distributor area shall be 316L stainless steel with adjustable angle furrowing plows of UHMW plastic.

C. Gravity dewatering shall occur on a horizontal traveling belt section with a minimum active dewatering area of 65 square feet through which free water drainage shall occur. The belt shall be supported in this section by full width stainless steel support/wiper bars 1/4” x 3” extending the full width of the belt. The framework shall be fully adjustable to allow extended life for the slide strips and seals with adjustable jack bolts. The strips be shall be spaced and designed to provide support and enhance gravity dewatering.

D. The gravity drainage zone shall be so designed that the filter belt does not have to be removed to rotate or replace support bars. Replaceable rubber side seals with type 316 stainless steel holders shall be provided to contain the sludge on the belt.

These seals shall not require bolted connections so that they may be easily and quickly replaced. A type 316 stainless steel discharge chute shall be provided at the discharge end of the gravity section to provide a gentle transition to the wedge zone to prevent floc shear of the thickened sludge at this point.

E. A minimum of six (6) rows of plows shall be furnished. To facilitate convenient operator cleaning and to provide flexibility of operation, the plows shall be mounted on crossbars with lifting handles to raise and lock each row in an upright, out of service position. The crossbars shall be type 316 stainless steel; associated mounting and lifting hardware shall be hot dipped galvanized malleable iron. Each plow shall be of ultra-high-density molecular weight polyethylene and shall be mounted on a type 316 stainless steel holder that in turn shall be mounted on the crossbar and spaced on 6-inch centers. The plows shall be individually adjustable on the crossbars to allow for more flexibility. Plows shall be in constant and uniform contact with the belt. They shall also be designed to be self-cleaning by being mounted to allow them to freely and independently rotate and/or rise to prevent solids build-up.

F. The independent gravity unit shall be equipped with a variable speed VFD drive, powered and controlled from the main press panel.

G. A 14-gauge type 316 stainless steel drain pan shall be provided beneath the gravity drainage section to collect the filtrate and to direct it to the collection sump beneath the press through rigid PVC pipes of sufficient size to handle the drainage from the combined sludge and polymer feed streams.

H. Elevated gravity zones above four feet shall be supplied with catwalks extending around both sides of the gravity zones. The catwalks shall be constructed of stainless steel structural support members with aluminum grating. All stairs and platforms shall meet all OSHA requirements. The platform height shall be such that the gravity deck of the belt filter press is easily visible and accessible. The platform shall be constructed such that its placement will not interfere with routine maintenance of the belt filter presses. All additional costs for foundation and anchor supports shall be at no extra cost to the customer. Handrails and vertical stairs shall be provided for the platform. Kick plates (toe plates) shall be provided which shall project a minimum of 4 inches above the walking surface. The platform and all supports shall be constructed of structural aluminum or Type 304 stainless steel and it shall be designed to carry a live load of 200 pounds per square foot not to exceed the working stresses for materials in 1990 BOCA Code. All walking surfaces shall be non-slip. Minimum platform width shall be 30 inches.

2.08 WEDGE SECTION

A. The belt filter press shall be furnished with a distribution chute to receive sludge from the primary gravity dewatering section for purposes of even distribution of the sludge to the curve wedge section.

B. The wedge section shall be of a curved belt path design, straight belt path designs will not be allowed. The initial radius of curvature shall be a minimum of 24-inch radius and transition to a final radius of curvature of 16.5 inches. The curved section must be a minimum of 56” in length. The wedge section design shall provide gradual cake pressure through the zone to enhance dewatering. This area shall be easily accessible for operating, viewing, cleaning, and adjusting.

C. Movement through the wedge section shall be designed to insure a uniform layer of sludge across the entire working width of the belt. It further shall be adjustable to allow operator determination of proper relationship between belt speed and cake height, in order to insure optimum dewatering.

D. The materials in contact with the sludge shall be fabricated from type 316l stainless steel. All fasteners, along with mounting and adjustment hardware shall be 316l stainless steel.

E. The wedge section shall be supported by construction equal to that of the gravity belt section, shall be a minimum of 2" wider than the width of the belt and so designed to reduce belt wear.

F. The wedge section shall have a minimum horizontal area of 40 ft^2. This calculation is based on only one belt.

2.09 VERTICAL SHEAR/PRESSURE SECTION

A. The press shall include a shear/pressure section containing a minimum of six dewatering drums, which shall apply compression, and shear reversals to the sludge by passing the sludge cake sandwiched between the two tensioned belts alternately over one drum and under the next completing a full S with each turn exceeding 200 degrees.

B. The shear/pressure section shall begin with a minimum of 24-inch diameter perforated drum, which shall be self-bailing to provide unimpeded filtrate drainage without rewetting of downstream cake and provide a gradual transition into the shear/pressure section.

C. The remainder of the dewatering drums shall be solid surface drums and shall vary from 20 to 10 inches in diameter to provide the proper combination of dewatering area, applied pressure profile and time under pressure. Inactive belt runs between dewatering drums shall be kept to a minimum.

D. The minimum area of the vertical pressure section shall be 128 ft^2.

2.10 BELTS

A. Each press shall be provided with two dewatering belts (1 set), which shall be seamed and shall be fabricated of wear-resistant monofilament polyester, wear resistant plastic material or a combination of monofilament polyester and stainless steel. Each belt and connecting splice shall be designed for a minimum tensile strength equal to five times the normal maximum dynamic tension to which the belt shall be subjected. The mesh design, porosity and tensile properties shall be selected for optimum dewatering of the specific sludge to be processed and for a minimum life of 2,000 hours of continuous failure-free operation.

B. Each belt shall be a minimum of 87-in. wide, providing an effective 2.0-meter operating belt width in contact with the sludge. Each belt shall have its own drive roll, tension roll and tracking roll as well as several carrying rolls. Each belt, both gravity and pressure, shall have its own drive motor and drive roll.

C. Belts shall be designed for ease of replacement with a minimum of press downtime. Belt replacement shall be such that disassembly of the equipment is not required.

2.11 BELT ALIGNING SYSTEM

A. The belt aligning devices shall be hydraulically operated to align each belt and locate it centrally on the rollers by means of a sensing arm, which detects the position of the belt edge. This arm shall operate a pilot valve, which in turn affects the position of the hydraulic actuator. The actuator shall be connected to a pivot belt-aligning roller, causing this roller to skew from its traverse position.

B. The alignment system shall function as a continuous automatic belt guidance system and shall be an integral part of the press. The alignment system shall operate with smooth and slow motions resulting in a minimum of belt travel from side to side. The use of electric servos shall not be acceptable.

C. Backup limit switches for the belt aligning system shall be provided on the machine with sufficient contacts to de-energize all drives and sound an alarm in case of a belt over travel.

D. A complete simplex hydraulic system shall be provided. This package shall include pump, 2 hp TEFC motor, valves, 20-gallon storage reservoir, all controls and piping as necessary to provide a complete and operating system. The pump shall be an adjustable flow and adjustable pressure vane pump. The unit shall include a low-pressure switch, system pressure gauge, temperature gauge, and tank level gauge. The system shall include a high-pressure line filter and low-pressure return filter. The hydraulic unit will be floor mounted away from the press to eliminate wash down spray. The manufacturer shall supply and install a minimum of ½" 316L stainless steel tubing from the hydraulic unit to the press. Hydraulic units mounted to the press frame will not be accepted. Hydraulic systems schematics and catalog cuts must be included in the equipment bid package.

E. The hydraulic tank shall also include a 304l stainless steel drain valve to allow for draining to the hydraulic oil.

F. All hydraulic lines shall be 316l stainless steel and be rigidly supported on the structural frame and be properly sized for the intended use with adequate factors of safety for the rated pressure.

G. All belt alignment control equipment shall be fabricated from corrosion resistant materials or effectively coated not to rust or stain.

2.12 BELT TENSIONING SYSTEM

A. Each belt shall be provided with a belt tensioning system. The belt tensioning system shall be hydraulically actuated. The design of the tensioning system shall be such that the dewatering pressure is directly proportional to belt tension and that adjustments in the tension shall result in immediate changes in dewatering pressure. Manual, pneumatic or electric servo tensioning systems are not acceptable.

B. Each belt tensioning shall be furnished with an individual control station such that independent adjustment for each belt is possible. The control stations shall incorporate an on/off selector, calibrated pressure regulating valve and a pressure gauge to indicate actual operating pressure on each system.

C. The design of the belt tensioning system shall insure parallel movement of the tensioning cylinders. The gravity belt tensioning roller shall be mounted on a

rugged yoke assembly, with hydraulic cylinders at each end. The pressure section tensioning section shall have a stainless steel rack and pinion tensioning system with hydraulic cylinders at each end. The rack and pinion must be constructed of stainless steel components. Plastic components will not be accepted. The belt tensioning system shall accommodate a minimum of 2.5% increase in belt length.

D. Sensing devices shall be furnished to determine belt travel beyond normal operating limits. The sensing devices shall be electrically connected within the alarm system to cause "an alarm shut down". Manual reset shall be required.

2.13 BELT DRIVE SYSTEM

A. The three belt drives shall be 3 HP for the gravity zone and dual 3 HP for the press section. Each shall be variable speed with a variable frequency AC drive unit. The feedbox paddle wheel shall be driven by 1/3 HP AC VFD drive. Speed indicator readout for each shall be installed in the main press control panel.

B. The gravity belt drive shall be capable of varying output speed from 8 to 75 feet per minute and the press section drive, 3 to 15 ft. per minute.

C. The nominal input horsepower rating of each gear or speed reducer shall be at least equal to the nameplate horsepower of the drive motor. Each drive unit shall be designed for 24 hour continuous service.

D. Each gear reducer shall be totally enclosed, water spray proof, oil lubricated with anti-friction bearings throughout. All motors shall be TEFC.

E. The drives shall be furnished with provisions for use on 460 volt, 60 hertz, 3-phase power supply.

F. The belt drive for the pressure section shall be driven by dual rollers. The gearbox shall be shaft mounted. Spur gears or chain driven rollers shall not be acceptable.

2.14 SAFETY GUARDS

A. All equipment having exposed moving parts such as fans, V-belts, gears, couplings, chains, and including the pressure roll section, shall be provided with safety guards as required by OSHA standards.

2.15 DISCHARGE BLADES

A. Discharge blades shall be provided to assist in removing dewatered sludge cake from the belts at the discharge end of the press. The lower blade shall also direct the sludge cake to the conveyor. The discharge blades shall be replaceable and shall be made from UHMW polyethylene, polyurethane, or similar material to prevent warping, bowing or distortion. The blades shall be secured in place with counterweights.

B. The minimum discharge height shall be 7’6” high. If necessary, the belt presses and catwalks shall be supplied with additional support legs by the press manufacture.

C. The belt press manufacturer shall supply a 304 stainless steel discharge hopper that will mount off the belt press frame. The hopper shall transition to the existing belt conveyors and shall include rubber skirting.

2.16 DRUMS AND ROLLERS

A. The press shall be furnished with the necessary drums and rollers to provide gravity dewatering, shear/pressure dewatering, belt drive, belt tension, belt tracking and general belt support.

B. Belt drive and tracking rollers shall have a minimum ¼-in thick 65 durometer vulcanized rubber covering for gripping the belts and for corrosion protection and shall have type 316 stainless steel end plates. All other solid surface drums and rollers shall have a 30-mil thick applied thermoplastic nylon coating for corrosion protection as well as proper belt tracking and drive.

C. All drums and rollers shall be designed to withstand the stress reversals inherent in rotating elements and shall be designed with a minimum factor of safety of 5 over fatigue failure for drum and roller bodies. Drum and roller design shall be based on operating at rated belt speed, a belt tension of 70 pounds per linear inch on each belt and rated drive horsepower. Deflection of all drums and rollers whether major load carrying or not, shall be limited to 0.05 inch over the full width of the drum or roll body when operating at a belt tension of 70 pounds per linear inch per belt at rated drive horsepower. Calculations shall be furnished substantiating shaft sizing, drum and roll construction design, fatigue failure safety factors and drum and roller deflection.

2.17 BEARINGS

A. The shafts of all rollers shall be equipped with heavy-duty grease-able type, roller bearings in sealed, split case bearing housings. All bearings in the press shall be spherical roller bearings. The housings shall allow the changing of the bearings without changes in the factory alignment of the roller. The housing shall be sealed to provide adequate sealing from moisture and grime with closed end housing. The outside of the housing on tracking roller bearings shall also incorporate a stainless steel sealed end cap. The bearing housing seal shall incorporate a triple lip, nitrile seal mechanism to eliminate contamination.

B. All bearings shall have a minimum B-10 bearing life of 1,000,000 hours based on ANSI-B13.6-1972. The B-10 bearing life of 1,000,000 hours shall be based on the maximum summation of all forces applied to the bearing. The forces shall include both belts at a belt tension of 70 PLI each, maximum belt speed of 15 ft/min and torque of the drive motor.

C. Bearings and housings shall be US manufactured and shall be manufactured by FMC Corporation, Link-Belt Division, Indianapolis, Indiana; Reliance Electric Company, Dodge Division, Greenville, South Carolina: or equal.

2.18 BELT FILTER PRESS (BFP) CONTROL PANEL

A. General Requirements

1. Each belt filter press shall have a local full operating NEMA 4X 304 stainless steel, UL508 control panels complete with all motor control and supervisory devices for press-mounted equipment. Each local panel shall include VFDs for the feedbox, gravity belt and pressure belts. The local panels shall also have motor starters for the wash water booster pump and hydraulic unit. Each local panel shall have an I/O module that will communicate to the master panel via Ethernet.

2. The Master Control Panel shall include an Allen Bradley 12” color Panel View Plus 7 touch screen for controls for each press and including the hydraulic unit, booster pump, tank mixers, polymer pumps, sludge pump, conveyor, feed box motor drive, gravity section drive, and pressure section drive. Each panel shall include motor starters for the tank mixers. The master panel shall include the VFDs for the sludge feed pumps, polymer pumps, and Conveyor system. The control panel shall include an Allen Bradley Compact Logix PLC with Ethernet communication. The panel shall also include such ancillary drives as hereafter specified.

3. Each control panels shall be a 304 stainless steel NEMA 4x enclosure with a white back panel.

4. Three phase, 460 volt, 60 Hertz power shall be supplied to the main control panel.

5. A control transformer shall be provided in the control panel to provide a 120-volt, single phase power source for motor starter coils, lights, relays, timers, controllers, local operating panel and other related items.

6. Each control panel shall be provided with terminal blocks for power wiring to and from the panel. The incoming terminal blocks shall be provided with a single magnetic circuit breaker disconnect switch. Fuse protected motor starters with thermal overloads shall be supplied for each motor including hydraulic unit, booster pump, polymer mixers and discharge conveyor furnished with the press.

7. All electrical equipment controls located on the belt filter press shall have NEMA 4X enclosures and wired, through PVC conduit, to a single common NEMA 4X terminal box.

8. All devices within the panel shall be permanently identified. Name plates shall be provided on the face of the panel or on the individual devices as required. Nameplates shall be made of laminated phenolic materials with a white face and a black core.

9. The panel shall be designed for manual starting and stopping of all drives. A master run-jog switch shall be supplied to override the alarm system and allow operation of any drive through a momentary contact push button.

10. All drive stations shall be equipped with a start/stop and run controls. The sludge pumps, polymer pumps, conveyors, feedbox, main press drive and gravity belt drive drives as herewith specified shall also incorporate a variable speed control and speed indicator. The press panels shall include start/stop controls, run indication and motor starters for the polymer mixers, booster pump and hydraulic unit. The panel shall also include start/stop controls, and speed controls for three sludge pumps and four polymer pumps.

11. Alarm lights, sensors, and related circuitry shall be provided for the following functions: belt misalignment, high and low belt tension, emergency trip cord on each side of the press, belt conveyor zero speed switch, polymer system fail, and low hydraulic pressure. In the event of any of the above malfunctions, the machine will shut down and an alarm will sound. The alarm system shall include an audible horn rated at 90 DBA at 10'. The system shall include

silencing provisions, but the function alarm indicating light shall remain lit until the alarm condition is satisfied. A separate set of alarm contacts shall be provided for remote alarm indication and for interruption of ancillary drives such as polymer and feed sludge pumping.

12. Arrange master panel to include the following controls for each belt press control panels to allow either manual or automatic control of belt press equipment. When “MANUAL” operation is selected, all equipment associated with the belt press shall be controlled by “START/STOP” pushbuttons. When “AUTOMATIC” operation is selected, control of equipment shall be “AUTOMATIC/START” and “AUTOMATIC/STOP” pushbuttons, and programmable controller:
    a. Local belt press control panels shall include OIT touchscreens with the following:
        1) One control mode selector switch marked “AUTOMATIC/MANUAL.” When “MANUAL” operation is selected, all equipment associated with belt press shall be controlled by “START/STOP” pushbuttons. Provide one “START” and one “STOP” pushbutton for each of the following:
            a) Feedbox Drive.
            b) GBT Drive.
            c) Press Press Drive.
            d) Hydraulic Unit.
            e) Wash Water Pump.
            f) Sludge Pump Drive.
            g) Polymer Pump Drives.
            h) Discharge Conveyor System
        2) One speed potentiometer for manual adjustment of each drive speed.
        3) Digital indicators for sludge feed flow rate. Indicators shall accept 4 to 20 mADC field input and shall be calibrated in GPM.
        4) Green indicating lights for “RUNNING” status for each unit operated from panel, including wash water solenoid valve energized indication.
        5) Red indicating lights for “OFF” status for each unit operated from panel, including wash water solenoid valve de energized indication.
        6) One each “AUTOMATIC/START” and one “AUTOMATIC/STOP” momentary pushbuttons, for automatically starting and stopping each belt press system. Sludge cake conveyor shall be manually controlled when belt press control mode selector switch is in either the “AUTOMATIC” or “MANUAL” position.
        7) One “EMERGENCY STOP” red mushroom pushbutton.
13. Automatic Controls and Sequencing:
    a. General:

1) Program the PLC for automatic control of belt press, system sequencing, and interlock functions as specified.

2) Configuration and programming of PLC system shall be responsibility of belt press manufacturer. System documentation including memory loading, I/O configuration and programming shall be provided.

3) Provide and install auxiliary relays and wiring for equipment and devices specified in this Section required for implementing functional requirements specified.

b. "AUTOMATIC START/AUTOMATIC STOP" Cycle (typical for all belt presses):

1) Automatic start cycle request to PLC shall be initiated by "AUTOMATIC/START" pushbutton.

2) Control logic for an "AUTOMATIC/START" cycle shall start belt press in the following order after "AUTOMATIC/START" command has been initiated and interlocks are complete.

a) Wash water pump.

b) Belt Shower "Pre-Wash"

c) Belt press drive.

d) GBT drum drive.

e) Press drive.

f) Polymer solution pump drive.

g) Sludge feed pump.

h) Discharge Conveyor System.

3) In "AUTOMATIC" mode the polymer system will automatically be called to dilute the neat emulsion polymer system. The polymer system will be controlled by the level sensor in the age tank. Each unit will start and stop based on preset levels in the tanks that can be viewed on the OIT.

4) Each drive shall not start until previous drive is running and necessary time delay has elapsed. The belt press manufacturer shall determine where time delays are required and shall program settings to provide smooth start-up of equipment.

5) Once all drives are confirmed running by motor run contacts from their respective starters, PLC shall cause the run indicating light to illuminate. Loss of run status contact for a drive once cycle logic is complete shall shut down belt press and associated equipment.

6) Upon "AUTOMATIC /STOP" command, system shall shut down in order that is reverse of specified start-up order with necessary time delays.

c. Interlocks: The following interlocks shall be satisfied when control mode selector switch is in either "AUTOMATIC" or "MANUAL" position. Failure of any one signal during start cycle or after cycle is complete shall shut down all associated belt press equipment.

1) Wash water pump must be on and sufficient wash water pressure must be sensed at a specified level.
2) Hydraulic pressure must be sensed at a specified level.
3) Control mode selector switch shall be in “AUTOMATIC” position.
4) “EMERGENCY STOP” pushbutton shall be in operating position.

14. Annunciation and Alarms:
    a. Provide audible alarm and detailed alarm history in belt press control panel for alarming of the following:
        1) GBT drive failure.
        2) Press drive failure.
        3) Feedbox failure.
        4) Local emergency stop initiated at either belt filter press control panel or pull cord switch.
        5) High discharge pressure at sludge feed pump.
        6) Low washwater pressure.
        7) Low hydraulic pressure.
        8) Polymer pump failure.
        9) Sludge pump failure.
        10) Conveyor zero speed.
        11) Low polymer tank level.
    b. Wire all alarms to PLC system for relaying to remote location.
15. Additional stations shall be included as hereinafter specified for other ancillary drives or systems.

B. Electric Motors furnished with this equipment shall meet the following requirements:

1. Rated for continuous duty at 40°C ambient and insulated with a minimum of Class F insulation, with Class B temperature rise. All motors shall be totally enclosed, fan cooled or non-ventilated. All motors supplied shall be rated at 150% name plate horsepower of the required horsepower maximum service condition.

2.19 2.21 SURFACE PROTECTION

A. Belt filter press materials of construction (stainless steel, fiberglass, plastic, etc.) and protective coatings and coverings (hot dipped galvanizing, fusion bonded nylon, rubber, etc.) shall be completely corrosion resistant such that shop, or field applied paint coating is not required.

B. Miscellaneous parts such as brackets, spacers, guards, etc. shall be fabricated from type 316 or 304 stainless steel, galvanized steel or plastic and shall not require shop or field applied paint coating.

C. Items such as motors, gear reducers, and the like shall receive finish painting in accordance with the Section 09900 of these specifications.

D. The control panel enclosure shall be Nema 4X constructed of type 304 stainless steel.

2.20 SPARE PARTS

A. Spare Parts

1. Furnish the following spare parts:

a. One complete set of dewatering belts.

b. One complete set of discharge blades.

c. One set of drive chains or belts of each size and type (if applicable).

d. One cleaning brush for nozzles.

e. One relay of each size and type.

f. One set of seals for each inlet distributor, belt wash station, and wedge section.

g. Ten spray wash nozzles.

h. Ten standardized grease fittings.

2. Spare parts shall be properly bound and labeled for easy identification without opening the packaging and suitably protected for long term storage in a humid environment.

B. Furnish a one-year supply of lubricants oils, grease and filters. Lubricants shall include summer and winter grades along with alternate references to equal products of other manufacturers including specifications such as AGMA numbers, viscosity, etc.

PART 3: EXECUTION

3.01 INSTALLATION

A. Installation shall be in strict accordance with the manufacturer's instructions and recommendations in the locations shown on the Drawings. Installation shall include furnishing the required oil and grease for initial operation. The grades of oil and grease shall be in accordance with the manufacturer's recommendations. Anchor bolts shall be furnished by the equipment manufacturer and set in accordance with the manufacturer's recommendations.

B. The Contractor shall be responsible for coordinating related items, not covered in this section of the specifications, such as piping, fittings, additional valves, and supports.

C. The equipment shall not, under any conditions be allowed to sit out-of-doors unprotected. During actual installation, each unit shall be covered with a waterproof material in the event of any precipitation and always that construction does not require exposure of the equipment. Covering shall be securely anchored.

D. Submit a certificate from the manufacturer stating that the installed equipment has been examined and found to be in complete accordance with the manufacturer's requirements, that the equipment is ready for operation and that the operating personnel have been suitably instructed in the operation, lubrication and care of the equipment.

E. The manufacturer shall coordinate with the contractor for installation of all conduit, wire, terminations, mounting hardware, and equipment not provided as part of the manufacturers equipment. The contractor is responsible to provide all material and work required for a complete system. Refer to Division 16 in the contract documents.

3.02 EQUIPMENT

A. The equipment shall be guaranteed against defects in material and workmanship under normal use and service for a period of one (1) year after start-up not to exceed eighteen months after delivery during which time repairs or replacements shall be made without charge. Further, an additional five-year warranty shall be provided for the belt press frame and its coating, the belt press rollers and their coatings and the belt press roll bearings.

3.03 FUNCTIONAL TESTING

A. Prior to startup, inspect all equipment to ensure proper alignment, noisy operation, proper connection, calibration of all instrumentation, and satisfactory operation of all equipment.

B. Functional Testing shall demonstrate that the belt filter presses and ancillary equipment are operating as specified.

C. Verification of electrical power and control panel operation, including data exchange with ancillary equipment and plant SCADA system, shall be included in Functional Testing.

D. If in the opinion of the Engineer, the system is operating as intended, Performance Testing may begin. If the system is determined to not be in compliance or is not operating as specified, the Contractor shall make all necessary improvements at no additional cost to the Owner.

E. While conducting Functional Testing, the Contractor shall perform, at his expense, such testing as is necessary to determine and recommend the type of belt, optimum polymer type, and the optimum point of polymer injection to or exceed the performance requirements.

3.04 MANUFACTURER'S SUPERVISORY SERVICES

A. Before the equipment is started, the manufacturer shall make a thorough inspection of the installation to make sure the press has been installed properly and that all equipment relating to it has been installed according to the needs of the press.

B. The manufacturer shall provide five (5) days of on-site services spread over two (2) trips of a qualified factory representative to place the units in operation. The owner shall assist the manufacturer by starting up and operating all support systems such as water, sludge pumping, polymer mixing and feed, electrical power and instrumentation, and other ancillary equipment as needed. This trip will be

separate from training and performance. The services provided by the manufacturer shall be as detailed in the O&M manuals and shall include at a minimum the following:

1. Check equipment alignment and assure that there are no unusual internal stresses.
2. Calibrate all instrumentation such as hydraulic systems.
3. Check hydraulic systems to insure proper operation.
4. Check lubrication in all drives.
5. Adjust all edge seals, discharge scraper blades, drive chains, etc.
6. Adjust spray wash, cloth tension, and belt aligning system.
7. Start the drives and assure they are operating properly with no binding and with correct rotation.
8. Ensure that all ancillary systems have been properly adjusted, including polymer and sludge feed.

C. Start-up services shall be considered completed when the manufacturer and manufacturer have demonstrated that the units are operating without mechanical problems.

3.05 TRAINING SUPERVISION

A. During the start up procedures, the equipment manufacturer shall provide two separate trips, five days of on-site training to the owner's employees for proper operation and maintenance of the sludge dewatering equipment.

B. Two (2) emergency service trips with one day of on-site service for each trip that shall be used anytime during the first five years of operation.

END OF SECTION

SECTION 11371

SLUDGE DRYING EQUIPMENT

PART 1: GENERAL

1.01 SCOPE AND RESPONSIBILITIES

A. On April 2, 2020, the City of Canton solicited sludge dryer proposals through *Sludge Dryer System Supplier Request for Proposals* (RFP). The RFP was awarded to Veolia Water Technologies, Inc. (Supplier) for the Kruger BioCon Thermal Drying System and Fulton Thermal Oil System. A copy of the RFP is included in the Supplements to this Specification Section.

B. The prenegotiated scope and price are defined in the attached Supplement: Supplement 1, Veolia Water Technologies Proposal (“Proposal”). CONTRACTOR’S responsibilities are defined herein.

C. The CONTRACTOR shall purchase the sludge drying system and thermal oil system at the pre-negotiated price. CONTRACTOR shall make every effort to issue a purchase order for the sludge drying system by May 1, 2021. In the event that a purchase order has not been issued by May 1, 2021, the pre-negotiated price of the system will be adjusted per Supplement 1, Veolia Water Technologies Proposal (“Proposal”). In the event that a purchase order has not been issued by May 29, 2022, the pre-negotiated price of the system will be adjusted per Paragraph 1.10 per the attached RFP.

D. OWNER’s preselection and prenegotiation shall in no way be construed to otherwise change, in any material way, CONTRACTOR’s responsibilities under the terms and conditions of this Contract.

E. The prenegotiated scope includes, but is not limited to, manufacturing and furnishing equipment and materials, delivering to the jobsite, providing various documentation, and providing services, as specified herein. The CONTRACTOR shall coordinate with the Supplier regarding details of Supplier’s scope.

F. A preliminary payment schedule was included in Paragraph 1.11 of the RFP. CONTRACTOR and Supplier may negotiate modifications to the payment schedule as noted in the RFP with written approval by the Owner.

G. Additional documentation concerning Supplier’s prenegotiated scope and price are included as Supplements to this Section.

H. CONTRACTOR’s responsibilities shall include, but are not limited to, procurement, unloading/receipt at the jobsite, storage, handling, installation, testing, coordination, and startup.

I. Supplier shall provide sludge dryer, thermal oil system, and directly related equipment as specified herein and provided in the attached Proposal. CONTRACTOR shall provide all piping, ductwork, and hardware not supplied by Supplier.

J. CONTRACTOR shall provide installation and startup services, including electrical and control systems.

1.02 WORK INCLUDED

A. The work in this Section includes the furnishing of all materials and equipment and the installation of the Sludge Drying Equipment and Thermal Oil System, as specified in the attached Proposal.

1.03 SUBMITTALS

A. General: Provide Shop Drawings, samples, administrative, quality controls, and contract closeout submittals in accordance with the requirements of Section 01300 Submittals, Section 01640 Manufacturer's Services, Section 01730, Operation And Maintenance Data, and as listed below.

B. Vendor shall provide submittals as specified in the attached Proposal.

1.04 DELIVERY, STORAGE AND HANDLING

A. Preparation for Shipment and Delivery: Refer to Section 01600 Delivery, Storage and Handling

B. The CONTRACTOR shall be responsible for unloading all equipment at the jobsite. Follow the Supplier's storage and handling instructions.

C. PURCHASE ORDERS AND PAYMENTS

D. The CONTRACTOR shall enter into a contract with the Vendor in accordance with Supplement 1, Veolia Water Technologies Proposal, and Supplement 2, Sludge Dryer System Supplier Request for Proposals.

E. FUNCTIONAL AND PERFORMANCE TESTING

F. As described in the attached Proposal.

PART 2: PRODUCTS

2.01 MANUFACTURERS

A. Manufacturer shall be Veolia Water Technologies, Inc. No substitute will be allowed.

2.02 SLUDGE DRYING AND THERMAL OIL EQUIPMENT AND MATERIALS

A. See attached Proposal.

PART 3: EXECUTION

3.01 INSTALLATION

A. Contractor's installation services include, but are not limited to, the following:

1. Unloading and storing equipment provided by the Supplier and according to the Supplier.

2. Installation of all equipment and materials provided by Supplier.

3. Coordination of the installation and timing of all interface points such as piping and electrical tie-ins with the Supplier.

4. Provide all labor, materials, supplies and utilities as required for startup, adjustment and performance testing including laboratory equipment, laboratory facilities, analytical work and chemicals. Such equipment includes a CEM solids analyzer, sample jars, and coolers.

5. Provide all chemicals, lubricants and other supplies required for equipment startup and adjustment, including two nitrogen cylinders for the thermal oil system.

6. Assist the Supplier with process startup activities.

7. Provide all support beams and/or slabs, grating, floor plate, handrails, hatches, ladders and platforms not included in Supplier's scope.

8. Supply and install Concrete Dryer Service Pad in compliance with Division 3.

9. Provide and install piping, pipe supports, expansion loops, valves, vents, and ductwork between equipment as shown in the Construction Documents and as required to connect to Supplier's equipment. Provide air release valves at all high points of piping.

10. Field verify ductwork dimensions and elevations in order to properly design and install ductwork and ductwork dampers. Provide condensate drains with P-traps at all low points on ductwork.

11. Provide and install exhaust stack for thermal oil system per Supplier's installation guidelines and as shown in the Construction Documents.

12. Provide and install insulation for Supplier's equipment as called for in Section 15250 Piping Insulation and as required by Supplier.

13. Provide and install anchor bolts as required by Supplier.

14. Pin together and install dryer belts per Supplier's instructions. Belt assembly will require field welding.

15. Install nitrogen blanket kit for Thermal Oil System, including piping to nitrogen cylinders per Supplier's instructions.

16. Furnish and install oil and grease for equipment in accordance with the Supplier's recommendations.

17. Unless otherwise stated, all equipment furnished by the SYSTEM SUPPLIER shall be shipped to the jobsite loose and installed by Contractor.

18. Supply and installation of all sample pumps and sample piping as required for instrumentation provided by the SYSTEM SUPPLIER.

19. All electrical and mechanical hardware with the exception of the equipment that is identified in this specification

20. All work associated with buildings or other structures used for housing any part of the system provided, including HVAC and electrical work.

21. All interconnecting ductwork between dryer, fans, and condenser shall be designed, supplied, and installed by Contractor. All ductwork dampers shall be installed in ductwork by Contractor. All ductwork shall be smoke tested for leaks.

22. Supply and installation of all insulation and heat tracing for all equipment and piping specified herein as specified in Section 15250 Pipe Insulation

23. Provide and install all piping and pipe supports required to connect to the SYSTEM SUPPLIER'S equipment. This includes sprinkler supply, drains, piping associated with thermal oil skid not provided by SUPPLIER.

24. Supply and installation of any embedded pipe sections or wall inserts, if applicable, for any penetrations including but not limited to those for drop pipes and instruments.

25. The interconnecting sludge piping between the wet cake pump and dosing pump manifold shall be supplied and installed by Contractor.

26. All external water connection piping, hard drain piping, and water supply shall be supplied and installed by Contractor per the instructions given by the SYSTEM SUPPLIER.

27. All interconnecting piping and insulation between the dryer and the thermal oil heater skid shall be supplied and installed by Contractor. Installation of the Thermal Fluid by Contractor.

28. All interconnecting piping supplied by Contractor shall be hydrostatically tested by Contractor.

29. All odor control and off-gas piping shall be supplied and installed by Contractor.

30. All natural gas piping to thermal oil system to be supplied and installed by Contractor.

31. Compressed air piping, isolation valves, and air filter regulators shall be provided by Contractor.

32. Supply and installation of all valves not supplied by SUPPLIER herein but indicated on P&ID's.

33. All loose valves provided by SYSTEM SUPPLIER to be installed in water piping shall be by Contractor.

34. Supply and install, in coordination with the SYSTEM SUPPLIER, all motor control centers, motor starters, panels, transformers, main disconnects, breakers, generators, power supply, and variable frequency drives (VFD's) in compliance with Division 16.

35. Installation of all control panels and instrumentation provided by the SYSTEM SUPPLIER in compliance with Division 16.

36. Supply and install all electrical power, control wiring and conduit to the Sludge Thermal Drying System, including wire, cable trays, cable, junction boxes, fittings, disconnects, conduit, etc. in compliance with Division 16.

37. The CONTRACTOR shall install and test all level floats, level transmitters, level alarms, and alarm communication devices prior to sending sludge to SYSTEM SUPPLIER'S equipment.

38. Field wiring, interconnecting wiring, conduit, wiring terminations at equipment, local equipment disconnects, local equipment control panels, junction boxes, and wiring terminations at control panels.

39. The following shall be supplied and/or installed by Contractor for Thermal Oil System:

    a. Stack (Supplied and Installed by Contractor)

        1) Refer to the Thermal Fluid Heater O&M manual for stack design requirements and guidelines. This includes information on draft requirements, stack cap design, stack diameter and arrangement, and any dampers required.

    b. Stack Temperature Switch to be installed by Contractor.

    c. Two (2) nitrogen cylinders (dimensions roughly 6” D x 5 ft H) supplied and installed by Contractor.

    d. Natural gas connection by Contractor. Allowable pressure for the 0600C system is 1.45 psi to 5 psi.

    e. DA Tank Includes two (2) Liquid Level Switches (installed and wired by Contractor).

    f. The Nitrogen kit is to be installed per Thermal Fluid Heater O&M manual by Contractor.

        1) The piping from the nitrogen cylinders to the nitrogen blanket kit are to be supplied and installed BY Contractor.

    g. Loose fill/drain pump

        1) The following shall be completed by Contractor:

            a) Provide an enclosed size 1 starter with start-stop pushbuttons connected to 480v female pin & sleeve receptacle permanently mounted near system fill/drain.

            b) Connect 10m of suitable cable to the SYSTEM SUPPLIER’s fill-drain pump. Terminate opposite end of cable to male 480v pin & sleeve plug which matches enclosed starter receptacle.

            c) Pump shall be utilized only for fill and drain operation and will shelf-store when not in use.

            d) Enclosed starter with local control supplied and installed by Contractor.

    h. Paratherm HE thermal fluid or equal shall be used (Oil Supply and Fill by Contractor). SYSTEM SUPPLIER will specify the quantity of oil.

    i. The catch tank interconnecting piping will be supplied and installed in the field by Contractor. Refer to vendor submittal and instructions. Piping from DA tank PSV, heater outlet PSV valves and from DA tank drains will be supplied and installed in the field by Contractor.

    j. Vent Piping from DA tank and Catch tank will be supplied and installed by Contractor.

1) Supply and installation of the interconnecting piping between the TO skid and dryer shall be by Contractor. Piping size will be determined by SYSTEM SUPPLIER.
2) Supply and installation of insulation and cladding of thermal oil skid piping and interconnecting piping (piping to and from the dryer unit) by Contractor. Refer to the insulation and cladding Section.
3) The thermal fluid system skid will be delivered without insulation. Insulation and cladding will be provided and installed onsite after assembly (BY Contractor). Refer to the insulation and cladding Section.
4) All power and instrument wiring to PLC and MCC by Contractor. Refer to vendor submittal and instructions.
5) The system shall be skid mounted. Assembly of the Thermal Fluid Heating System components by Contractor. Refer to submittal for detailed bill of material list and installation instructions.

40. The CONTRACTOR shall coordinate the installation and timing of all interface points such as piping and electrical tie-ins with the SYSTEM SUPPLIER.
41. Video recording of any training activities.
42. All necessary conveyance system(s) from dewatering to the wet sludge bins and after extraction screw of dryer not included in this specification.
43. All other work not included in the SYSTEM SUPPLIER SCOPE OF WORK.
44. Unless otherwise specified, all equipment shall be painted per manufacturer standard paint systems.
45. Installation shall include furnishing the required oil and grease for initial operation. The grades of oil and grease shall be in accordance with the SYSTEM SUPPLIER'S recommendations. It is the responsibility of Contractor to work with the plant operating personnel to furnish and install extended grease lines. Their location should be convenient to the operator's standard maintenance procedures.
46. All equipment, components, piping, and appurtenances shall be installed true to alignment and rigidly supported. Any damage caused by the negligence of Contractor to the above items shall be repaired or replaced by the party responsible for the damage, restoring the item to its original condition.
47. A non-potable or potable water supply of >50 PSI to be supplied by Contractor. Water is used for condenser, nozzle cleaning, and dosing manifold cleaning. Water should contain less than 20 mg/L TSS, 5 grains/gal total hardness, and 10 ppm Iron and Magnesium. pH to be between 6.5 and 7.5 and Alkalinity under 200 mg/L CaCO3.
48. Potable water supply of >50 PSI to be supplied by Contractor for the dryer sprinkler system.
49. All other work not included in Supplier's Scope of Supply and as otherwise noted in Supplement 1, *Veolia Water Technologies Proposal.*

B. All equipment, components, piping, and appurtenances shall be installed true to alignment and rigidly supported.

3.02 SUPPLIER'S SERVICES DURING CONSTRUCTION

A. Per the RFP, the Supplier agreed to a minimum of the following Services During Construction:

1. Preparation and delivery of equipment submittals and any subsequent resubmittals.

2. Support during installation of the drying system to identify issues or problems that require the GENERAL CONTRACTOR's attention and to assist the GENERAL CONTRACTOR in the resolution of conflicts associated with the drying system equipment and other solids handling equipment or controls (minimum of 20 working days, five site visits).

3. Performance testing (minimum of 5 working days, two site visits).

4. Training of City Staff (minimum of 2 working days, one site visit).

5. Additional details are provided in the attached Proposal.

A. CONTRACTOR is responsible for coordinating site visits and installation support with the Supplier.

3.03 SUPPLEMENTS

A. The supplements listed below are part of this Specification.

1. Supplement 1, Veolia Water Technologies Equipment Specifications and Proposal.

2. Supplement 2, Sludge Dryer System Supplier Request for Proposals.

END OF SECTION

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September 2020

To ALL Bidding Contractors:

Subject: Veolia Water Technologies Proposal (“Proposal”)

City of Canton, Georgia
Water Pollution Control Plant Expansion to 6 MGD

Bidding Contractors,

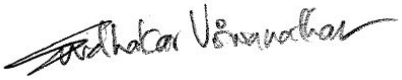
Kruger is pleased to provide you with a proposal for the Pre-selected Sludge Drying Equipment for the above mentioned project as provided in the following Sludge Drying Equipment Scope of Supply.

The lump sum price shall be $3,481,725 (U.S. Dollars) and valid until May 1st 2021. Should the Contractor, at their own discretion, choose to issue a purchase order after May 1st 2021, the Contractor shall bear the risk and expense of a price increase if said increase is justifiable by Kruger.

Questions regarding this proposal are to be addressed to:

Veolia Water Technologies, Inc.
dba Kruger
4001 Weston Parkway
Cary, NC 27513
Tel: (919) 653-4596
sudhakar.viswanathan@veolia.com

Thank you,



Sudhakar Viswanathan
National Sales Manager - Biosolids & Bioenergy, Kruger
VEOLIA WATER TECHNOLOGIES

SECTION 11371 SUPPLEMENT 1

SLUDGE THERMAL DRYING SYSTEM

PART 1 -- GENERAL

This section covers the work necessary to furnish the equipment associated with the thermal sludge drying system for the Canton WPCP Expansion to 6 MGD Project. All components of the system included herein shall be designed and furnished by Veolia Water Technologies with installation provided by the selected General Contractor.

The thermal sludge drying system shall be installed inside a weather protected building and shall include the dryer system, thermal fluid heating system, condenser and system control panel with PLC as described herein. The dryer system controls are intended to be integrated with other sludge handling equipment and the Plant SCADA system by the General Contractor in coordination with Veolia Water Technologies and as required by the Construction Documents.

1.1 RELATED DOCUMENTS

A. Section 01300 Submittals

B. Section 01600 Delivery, Storage and Handling

C. Section 01640 Manufacturer's Services

D. Section 03300 Cast In Place Concrete

E. Section 15250 Piping Insulation

F. Division 16: Electrical

G. Division 16: Instrumentation and Control

1.2 SYSTEM SUPPLIER SCOPE OF WORK

A. SYSTEM SUPPLIER is responsible for process design and equipment sizing, selection and procurement required for the thermal sludge drying system. The system will be designed and supplied in accordance with this section of the specification. SYSTEM SUPPLIER scope of work does not include any engineering, selection, procurement, installation, or operation of any equipment, materials or other services not specifically defined in this section of the specification.

B. Services, equipment, and materials required for system installation that is not provided by the SYSTEM SUPPLIER shall be provided by the Contractor.

C. SYSTEM SUPPLIER will provide all necessary design, installation instructions and operating information for equipment within its stated scope of supply. SYSTEM SUPPLIER is not responsible for the design, selection, installation, operation or maintenance of any materials, equipment or services supplied by OTHERS.

D. The System shall be comprised of the following and meet the specifications of this Section:

1. Wet Cake Handling
2. Sludge Dryer
3. Drying Air Treatment
4. Thermal Fluid Heater

E. SYSTEM SUPPLIER will provide process engineering and design support for the system as follows:

1. Process Flow Diagrams
2. Dimensional Layout Drawings
3. Installation Details
4. Start-Up and Operation Instructions
5. Electrical and Control Diagram(s)
6. Parts and Spare Parts List(s)
7. Operation and Maintenance Manuals

F. SYSTEM SUPPLIER will provide the field services necessary to start-up, test, and operate the system as follows:

1. Advice during installation
2. Equipment check-out and start-up assistance.
3. Operator training
4. In accordance with 11371, Section 3.02 SUPPLIER'S SERVICE DURING CONSTRUCTION.

G. Equipment furnished under this section shall be fabricated, assembled, erected and placed in proper operation condition in full conformity with the drawings, specifications, engineering data instructions, and recommendations of the SYSTEM SUPPLIER and equipment manufacturers.

1.3 SUBMITTALS

A. The SYSTEM SUPPLIER shall furnish for review, one electronic copy (pdf format) of each submittal. The term "submittal" as used herein shall be understood to include installation drawings, catalog sheets and data sheets. Unless otherwise required, these submittals shall be presented at a time sufficiently early to allow review.

B. Submittals shall include the following:

1. Drawings as required to provide the following details:
    a) Plan and Section Drawings of equipment
    b) Arrangement Drawings for shipped loose sub-assemblies.
    c) Details for Field Connections.
    d) Instrument Locations.

e) Piping and Instrumentation Diagrams.

2. Descriptive literature, bulletins, and/or catalogs of the equipment.

3. Data on the characteristics, features, and performance of the equipment.

4. Electrical Schematics, panel layouts, instrumentation sheets, and product data sheets for all electrical equipment being supplied by the SYSTEM SUPPLIER.

5. The weight of major equipment.

6. Equipment list (motors, instruments and valves).

1.4 QUALITY ASSURANCE

A. American National Standards Institute (ANSI)

B. National Electric Manufacturer's Association (NEMA)

C. American Society for Testing and Materials (ASTM)

D. American Welding Society (AWS)

E. National Electric Code (NEC)

F. Institute of Electrical and Electronics Engineers (IEEE)

G. International Society of Automation (ISA)

H. National Fire Protection Association (NFPA)

1.5 BASIS OF DESIGN & PERFORMANCE GUARANTEE

A. Basis of Design

1. OWNER/CONTRACTOR hereby agrees to the Basis of Design as defined herein, confirms its accuracy and completeness, and agrees that it shall serve as a basis for the Performance Guarantee.

2. The Performance Guarantee is predicated on receipt of feed sludge composition with conditions being in compliance with the Basis of Design and compliance with all other conditions and requirements specified in Supplement 1 (Veolia Water Technologies Proposal) to the Contract Documents.

3. The Performance Guarantee shall be conclusively demonstrated through the successful completion of one, 2-day Performance Test.

Table 1.6.A - Basis of Design

	Per System	Units
Annual Dry Solids	3,370	ton DS / yr
Sludge Cake Loading (wet)	4,821	lb cake / hr
Inlet Solids Composition	16	%

	Per System	Units
Outlet Solids Composition	92	%
Annual Operating Hours	8,760	hr / yr
Assumed Volatile Solids	60-80	%
Gross Dried Product	3,663	ton product / yr
Evaporative Load	3,983	lb evap / hr
Consumption: Fuel	5.89	MMBtu/hr
Installed Electric Load	143	kW
Consumption: Electric	99	kW
Consumption: Effluent (77°F)	145	gpm

1.6 OPERATION AND MAINTENANCE

A. SYSTEM SUPPLIER shall furnish operation and maintenance manuals. The manuals shall be prepared specifically for this installation and shall include all required cuts, drawings, equipment lists, descriptions, and other information that is required to instruct operation and maintenance personnel unfamiliar with such equipment.

B. A factory trained representative with knowledge of the proper system operation and maintenance shall be provided to instruct representatives of the OWNER on proper operation and maintenance of the system and equipment. The instruction shall be conducted in conjunction with the inspection of installation and start-up assistance as provided under Part 3: Execution. If there are difficulties in operation of equipment due to the work of OTHERS, additional services shall be provided by SYSTEM SUPPLIER at standard SYSTEM SUPPLIER rates. The SYSTEM SUPPLIER shall be provided with a minimum of 3-week notice prior to the date personnel are requested to be on site.

C. Mechanical ancillary equipment (including fans and pumps) shall be accessible without requiring temporary access (i.e. ladders, cranes, man lifts, etc.).

1.7 EQUIPMENT HANDLING

A. Equipment, including spares will be shipped by the SYSTEM SUPPLIER or the SYSTEM SUPPLIER'S vendor when the equipment is ready and available for shipment. OTHERs will be responsible for receiving, unloading and properly storing the equipment in accordance with SYSTEM SUPPLIER'S instructions. Promptly upon the arrival of any equipment components at the job site or first shipping destination, the onsite supervisor will prepare a SYSTEM SUPPLIER'S receiving report and submit a copy thereof to the SYSTEM SUPPLIER. The receiving report is to note equipment receipt and all evidence of damage in transit, if any. Confirmation of inspection will be no later than 10 days after receipt of delivery.

B. Finished iron or steel surfaces not required to be painted, such as flange faces, shall be properly protected to prevent rust, corrosion and damage.

C. Each box, crate, or package shall be properly marked to show its net weight in addition to its contents.

1.8 EQUIPMENT WARRANTY

A. SYSTEM SUPPLIER shall warrant to the OWNER that the Equipment shall materially conform to the description in SYSTEM SUPPLIER's Documentation and shall be free from defects in material and workmanship. The warranty shall not apply to any Equipment that is specified or otherwise demanded by OWNER and is not manufactured or selected by SYSTEM SUPPLIER, as to which (i) SYSTEM SUPPLIER hereby assigns to OWNER, to the extent assignable, any warranties made to SYSTEM SUPPLIER and (ii) SYSTEM SUPPLIER shall have no other liability to OWNER under warranty, tort or any other legal theory. If OWNER gives SYSTEM SUPPLIER prompt written notice of breach of this warranty within 18 months from delivery or 1 year from beneficial use, whichever occurs first (the "Warranty Period"), SYSTEM SUPPLIER shall, at its sole option and as OWNER's sole remedy, repair or replace the subject parts to the extent of the original scope of supply or refund the purchase price therefore. If SYSTEM SUPPLIER determines that any claimed breach is not, in fact, covered by this warranty, the OWNER shall pay SYSTEM SUPPLIER its then customary charges for any repair or replacement made by SYSTEM SUPPLIER. SYSTEM SUPPLIER's warranty is conditioned on OWNER's (a) storage (as applicable), operating and maintaining the Equipment in accordance with SYSTEM SUPPLIER's instructions, (b) not making any unauthorized repairs or alterations, and (c) not being in default of any payment obligation to SYSTEM SUPPLIER. SYSTEM SUPPLIER's warranty does not cover damage caused by chemical action or abrasive material, misuse or improper installation (unless installed by SYSTEM SUPPLIER). THE WARRANTIES SET FORTH IN THIS SECTION ARE SYSTEM SUPPLIER'S SOLE AND EXCLUSIVE WARRANTIES. SYSTEM SUPPLIER MAKES NO OTHER WARRANTIES OF ANY KIND, EXPRESS OR IMPLIED, INCLUDING WITHOUT LIMITATION, ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR PURPOSE.

1.9 MANUFACTURER

A. The dryer system shall be supplied by Veolia Water Technologies, Inc. (dba Kruger) as the pre-selected SYSTEM SUPPLIER for the Sludge Thermal Sludge Drying System (BioCon). The SYSTEM SUPPLIER's equipment, equipment warranty, and performance criteria have been incorporated into this specification.

B. The Contract entered into between SYSTEM SUPPLIER and successful Contractor shall be in strict accordance with SECTION 11371 Supplement 1 - SLUDGE THERMAL DRYING SYSTEM, herein, including technical scope and requirements, supply of equipment and associated services, and SYSTEM SUPPLIER'S Proposal in Supplement 1 (Veolia Water Technologies Proposal) to Contract Documents including the price, schedule, payment terms, and terms and conditions therein. SYSTEM SUPPLIER'S pricing is expressly conditioned on the terms and conditions contained in its Proposal. If successful Bidder fails to enter into a contract with SYSTEM SUPPLIER in strict accordance with this section

and SYSTEM SUPPLIER'S Proposal, SYSTEM SUPPLIER reserves the right to increase its price and Contractor shall bear the risk and expense of any such increase.

PART 2 -- EQUIPMENT

2.1 GENERAL

A. The equipment covered by these Specifications is intended to be standard process equipment of proven ability as manufactured by reputable companies having long experience in the production of such equipment. The equipment furnished shall be designed, constructed and installed in accordance with the best practices and methods and shall operate satisfactorily when installed as shown on SYSTEM SUPPLIER'S drawings.

B. All parts shall be so designed and proportioned as to have liberal strength and stiffness and to be especially adapted for the work to be done. Ample room and facilities shall be provided for inspection, repairs, and adjustment.

C. The nameplate rating for the motors shall not be exceeded, nor shall the design service factor be reduced when its piece of equipment is operating at any point on its characteristic curve.

D. All equipment furnished under this specification section shall be new and unused.

2.2 WET CAKE DOSING (WCD)

A. The following major components shall be supplied by SYSTEM SUPPLIER.

1. Dryer Access Platform
2. Dosing Platform
3. Dosing Manifold
4. Dosing Pumps (with lubricant dosing system when sludge DS greater than 25%)
5. Dosing Headers
6. Nozzle Assembly
7. Nozzle Cleaning Station

B. Dryer Access Platform

1. SYSTEM SUPPLIER shall furnish (1) Dryer Access Platform per dryer to provide access to the Dryer Assembly.
2. The design, fabrication, and installation shall be in compliance with the Occupational Safety and Health Administration (OSHA).
3. This Dryer Access Platform shall be four feet wide and will wrap around one side and one end of the dryer to provide access to Dryer hatches, instruments, and miscellaneous piping and equipment.

4. The Dryer Access Platform shall ship in 8-10 foot long sections, along with separately packaged support legs and stairs.

5. Dryer Access Platform shall also provide access to the Dosing Platform.

6. Handrails shall be 2 inch square tube.

7. Grating shall be 1 inch x 3/16 inch Bar Grating.

8. Structural Design

   a) PE stamped calculations shall be provided to ensure structure will be designed to support a 100 psf live load.

   b) The Maximum beam deflections as a fraction of span for walkways and platforms shall be L/240 for total load and L/360 for live load.

9. Material Specification

   a) The factory welded platform material of construction shall be carbon steel.

   b) All carbon steel plates, members, and miscellaneous parts shall be powder coated per manufacturer's standard specifications.

   c) All hardware shall be minimum ½ inch diameter and shall be stainless steel.

   d) The materials, design, and fabrication of the welded platform shall conform to the manufacturer's standard specifications.

C. Dosing Platform

1. SYSTEM SUPPLIER shall furnish (1) Dosing Platform per dryer for inspection and maintenance of the Wet Cake Dosing Equipment.

2. The design, fabrication, and installation shall be in compliance with the Occupational Safety and Health Administration (OSHA).

3. The Dosing platform shall consist of two main sub-assemblies to be joined in the field. The Dosing Platform Depositor Pumps and Depositor Gearbox shall be supplied with local disconnect suitable for Class II, Division 2 location.

4. The Dosing Platform will utilize ¼ inch thick diamond plate floor to prevent spills falling to the walkway and Dryer Enclosure below.

5. Structural Design

   a) PE stamped calculations shall be provided to ensure structure will be designed to support a 100 psf live load.

   b) The maximum beam deflections as a fraction of span for walkways and platforms shall be L/240 for total load and L/360 for live load.

6. Material Specification

a) The factory welded platform material of construction shall be carbon steel.

b) All carbon steel plates, members, and miscellaneous parts shall be powder coated per manufacturer's standard specifications.

c) All hardware shall be minimum ½ inch diameter and shall be stainless steel.

d) The materials, design, and fabrication of the welded platform shall conform to the manufacturer's standard specifications.

D. Dosing Manifold

1. The SYSTEM SUPPLIER shall furnish Dosing Manifold(s). The Dosing Manifold shall distribute wet sludge to the Dosing Pumps.

2. The Dosing Manifold shall be stainless steel.

3. Drain piping is required on both ends of each Dosing Manifold.

4. Pressure Equalizing Valves

a) The SYSTEM SUPPLIER shall provide (2) valves per manifold, (1) valve mounted at each end of each manifold.

b) The valves shall protect the Dosing Pump seals against over-pressure on the suction side.

c) The valves shall open when the pressure exceeds control set points and close when the pressure decreases to acceptable levels.

d) Valves shall be made of stainless steel.

e) The valves shall be pneumatically actuated full port ball type.

f) Direct Acting (FO on loss of power/signal), FL on loss of air

g) The valve actuator, solenoid, and limit switch shall be classified as Class II Division II, Group G.

5. Flushing Valves

a) The SYSTEM SUPPLIER shall provide (2) valves per manifold. The valves shall be connected to a non-potable water source of >45 psi.

b) The valves are used to flush sludge down the drain when the dosing pump reaches high pressure limit.

c) Valves shall be made of stainless steel.

d) The valves shall be pneumatically actuated standard port ball type.

e) Spring Return Fail Closed (loss of power/signal, air)

f) The valve actuator and solenoid shall be classified as Class II Division II, Group G.

6. Manual Ball Valves

   a) The SYSTEM SUPPLIER shall provide four (4) Manual Ball Valve per dosing manifold. These valves are used to flush the suction piping of the dosing pumps if required.

   b) The SYSTEM SUPPLIER shall provide one (1) Manual Ball Valve per dosing pump suction piping. These valves isolate the dosing pump during maintenance.

   c) The valves shall be of the full port ball type.

   d) The valves shall be made of stainless steel.

E. Dosing Pumps

1. The SYSTEM SUPPLIER shall furnish Dosing Pumps shop mounted to one of the main subassemblies of the Dosing Platform. An identical shelf spare pump shall also be provided.

2. The pumps shall receive dewatered sludge from the Wet Cake Pump(s) and transfer the dewatered sludge to the Dosing Header.

3. The pumps shall be cast iron body, progressive cavity type with suction and discharge pipe flanges. Each pump shall be provided with run dry protection in the stator. The pumps shall be installed on a platform and fed from bottom at a slight positive pressure.

4. The pumps shall be of the compact, close-coupled design. The gear reducer shall be sized for a minimum service factor of 1.5 and designed with a thrust load capability of 150 percent of the actual thrust load.

5. The pumps, along with associated drive appurtenances, shall be mounted on common fabricated steel baseplates.

6. The pumps shall have an inverter duty motor and be regulated via variable frequency drives.

7. C-face NEMA Gearbox and motors shall be provided. Motors shall be energy-efficient, TEFC motors. Motors shall be explosion proof design in accordance with Class II, Division II, Grp E standards. Gear motors or gear reducers shall be designed in accordance with AGMA 6019-E (Class II).

8. Variable Frequency Drives shall be constant torque type.

9. Each pump shall be a four stage design employing a convoluted rotor operating in a similarly convoluted stator. The convolutions shall be configured to form a cavity between the rotor and stator, which shall progress from the pump's inlet to discharge port with the operation of the rotor. The fit between the rotor and stator at the point of contact shall compress the stator material sufficiently to form a seal and to prevent leakage from the discharge back to the inlet end of the pumping chamber. The stator shall be molded with a seal integral to the stator

elastomer preventing the metal stator tube and the bonding agent from the elastomer from contacting the pumped liquid. Gaskets or O-rings may not be used to form this seal. Stators for sludge pumps shall have Perbunan elastomer. The sludge pump rotors shall be constructed of 316 SS. Additionally, the sludge pump rotors shall have a chromium nitride coating (Duktil) with a hardness of 1250 Vickers and a minimum thickness of 0.0108 inches. Hard chrome plating or ceramic coatings are not acceptable due to the ease at which this coating will crack and the lack of diffusion into the rotor base metal.

10. Each pump rotor shall be driven through a pin joint or gear joint connected to the input shaft

11. Each pump rotor shall be driven through a positively sealed and lubricated pin joint.

12. Pin joint shall have replaceable bushings, constructed of air-hardened tool steel of 57-60 HRc, in the rotor head and coupling rod. The pin shall be constructed of high speed steel, air hardened to 60-65 HRc. The joint shall be grease lubricated with a high temperature (450° F), PTFE filled synthetic grease, covered with Buna N sleeve and positively sealed with hose clamps constructed of 304 stainless steel. A stainless steel shell shall cover the rotor side universal joint assembly to protect the elastomer sleeve from being damaged by tramp metals or glass. The universal joints shall carry a separate warranty of 10,000 operating hours. This warranty shall be unconditional in regards to damage or wear.

13. A 150-pound (ANSI B16.5) flanged connection shall be provided at both the inlet and discharge ports. The suction and discharge casings shall each be provided with a 3/8-inch (or larger) tap to permit installation of pressure instruments.

14. Each pump shall be provided with oil lubricated thrust and radial bearings, located in the gearmotor, designed for all loads imposed by the specified service.

15. Shaft shall be sealed using a single internal mechanical seal (Burgmann MG1-45/G60 SiC/SiC FKM). The shaft shall be solid through the sealing area, but of a two-part design which allows the rotating unit to be removed from the pump without disassembly of the gearmotor bearings. Seal materials shall be solid silicon carbide faces with 316 stainless steel metal parts and Viton elastomers. A mechanical seal pot and pipe stand shall be provided for barrier fluid lubrication.

    The stator shall be fitted with a sensor sleeve and PT100 RTD.

F. Dosing Headers

1. The SYSTEM SUPPLIER shall furnish eight (8) sets of Dosing Headers to be field mounted to one of the main sub-assemblies of the Dosing Platform.

2. The Dosing Headers shall consist of wet sludge piping between the Dosing Pumps and the Nozzle Assemblies.

3. The Dosing Headers shall be 304 stainless steel.

4. The Dosing Headers shall be furnished with three (3) pipe stubs.

5. Each pipe stub shall be furnished with a three-way manual valve. The three-way valve shall serve as a means for shutting off sludge flow and venting pressure for the Nozzle Assembly.

6. Each Dosing Header shall be furnished with one Manual Ball valve for sampling/cleanout. All Manual Ball Valves shall be in accordance with the provisions of the Manual Ball Valve section of this specification.

G. Nozzle Assembly

1. The SYSTEM SUPPLIER shall furnish Twenty-Four (24) Nozzle Assemblies shipped loose to site for installation. Nozzle assemblies connect to the Dosing Header and are inserted into Depositor Guide Pipes. Components require field assembly per SYSTEM SUPPLIER installation instructions.

2. Nozzle Assemblies shall consist of:

   a) Flexible Hose

   b) Quick Disconnects

   c) Injection Pipe

   d) Dosing Nozzle

3. Injection Pipes shall be stainless steel.

4. Wet Cake shall be extruded through the Dosing Nozzles and onto the top belt located inside the Dryer Enclosure.

5. The Nozzle Assemblies shall be removable without tools.

6. The Nozzle Assemblies (including nozzles) shall be able to be cleaned and maintained as required without disrupting sludge feed to the belt.

7. The Nozzles shall be made of heat resistant silicone.

H. Nozzle Cleaning Station

1. The SYSTEM SUPPLIER shall furnish one (1) Nozzle Cleaning Station per dryer. The Nozzle Cleaning Station field mounts to one of the main sub-assemblies of the Dosing Platform per SYSTEM SUPPLIER. Installation instructions will be provided by SYSTEM SUPPLIER for the installation of the Nozzle Cleaning Station.

2. The Nozzle Cleaning Station contains a stainless steel pipe made of welded construction designed for placement of the Injection Pipe.

3. The Injection Pipe shall be fixed into the Nozzle Cleaning Station by means of a plate with a locator pin on the top end of the nozzle cleaning station pipe.

4. A drain pipe will be required to drain the Nozzle Cleaning station area.

5. Three (3) stainless steel manual valves will be provided as detailed:

a) One (1) water flush inlet valve – 1 inch ball valve.

b) One (1) drain flush valve – ½ inch ball valve.

c) One (1) pressure equalizing valve – ½ inch ball valve.

d) One (1) cleaning valve with hose connection – 1 inch ball valve

e) One (1) isolation valve for pressure gauge – ½ inch ball valve

6. A quick connect is provided of the same size to match the quick connect on the depositor hose.

2.3 DRYER ASSEMBLY

A. The Dryer shall be capable of drying dewatered sludge continuously and consistently at the rate required for the application. All Dryer components shall be anchored to the Dryer Service Pad using mechanical anchors as specified in the Construction Documents. The following major components shall be supplied by SYSTEM SUPPLIER:

1. Dryer Belt Frames and Supports
2. Dryer Belts
3. Recirculation Fan Modules
4. Warm Zone Heat Exchanger
5. End Zone Heat Exchanger
6. Internal Baffles
7. Dryer Enclosure
8. Sludge Depositors
9. Belt Drives
10. Sprinkler System
11. Extraction Screw
12. Rotary Airlock

B. Dryer Belt Frames and Supports

1. SYSTEM SUPPLIER shall furnish (2) stainless steel Dryer Belt Frames and Supports, one (1) Upper Belt Frame and (1) Lower Belt Frame.
2. The frames will incorporate brass guide rails for the Dryer Belt.
3. All components shall be manufactured in the United States.
4. Belt frames will arrive on site in large sections to be bolted together per SYSTEM SUPPLIER instructions.

C. Dryer Belts

1. SYSTEM SUPPLIER shall furnish Two (2) stainless steel Dryer Belts, one (1) Top Belt and one (1) Bottom Belt.

2. Sludge is introduced into the Dryer by being extruded onto the Top Belt.

3. The belts shall have a self-cleaning device without the use of water.

4. The belts must be able to handle a maximum temperature of 550 °F.

D. Recirculation Fan Modules

1. SYSTEM SUPPLIER shall provide four (4) Recirculation Fan Modules that will circulate drying air through the Dryer Enclosure. Each module will consist of the fan, fan support structure, baffles, shrouds, and plenums as required.

2. There shall be two (2) fan modules per zone

E. Warm Zone Fans

1. Warm Zone Fans shall be Type TCVA Vane axial, fixed pitch, steel wheel.

2. Fans shall be tested in accordance with ANSI/AMCA Standard 210 (air performance) and 300 (sound performance) in an AMCA accredited laboratory.

3. Fans shall bear a permanently attached nameplate displaying model and serial number of the unit for future identification.

4. The entire fan assembly, excluding the shaft, shall be thoroughly degreased and de-burred before application of a rust-preventative primer. After the fan is completely assembled, a finish coat of paint shall be applied to the entire assembly. The fan shaft shall be coated with a petroleum-based rust protectant. Aluminum components shall be unpainted.

5. All fans with motors and drives mounted in the factory shall be completely assembled and test run as a unit at the specified operating speed prior to shipment. Each wheel shall be statically and dynamically balanced in accordance with ANSI/AMCA 204-96 “Balance Quality and Vibration Levels for Fans” to Fan Application Category BV-3, Balance Quality Grade G6.3. Balance readings shall be taken by electronic type equipment in the axial, vertical, and horizontal directions on each of the bearings.

6. Fans shall be Type TCVA AXIFAN® Vaneaxial Fans as manufactured by Twin City Fan & Blower, Minneapolis, Minnesota. Fans shall be Arrangement 9, V-belt driven with the wheel mounted on a separate shaft and bearings supported completely within an enclosed tube isolated from the high velocity airstream or Arrangement 4, with the propeller mounted directly on the motor shaft and with the propeller and motor assembly enclosed entirely within the fan casing.

7. PERFORMANCE - Performance ratings shall conform to AMCA Standard 205 (fan efficiency grade) and 211 (air performance). Fans shall be tested in accordance with ANSI/AMCA Standard 210 (air performance) and 300 (sound performance) in an AMCA accredited laboratory. Fans shall be

licensed to bear the AMCA certified ratings seal for air and fan efficiency grade (FEG).

8. Model TCVA shall be available UL 705 listed. Fans shall bear a permanently attached nameplate displaying model and serial number of the unit for future identification.

9. HOUSING - Fan housings shall be welded of 14-gauge ASTM A-569 hot rolled steel on size 12, 12-gauge hot rolled steel on sizes 15 through 21, 10-gauge hot rolled steel on sizes 24 through 36, and 7-gauge hot rolled steel on sizes 42 through 60. Inlet and outlet flanges are standard.

10. GUIDE VANES - Fan housings shall be fitted with aerodynamically designed stationary straightening guide vanes on the air discharge side of the wheel. The guide vanes shall be welded to both the inner cylinder and the fan housing interior and function to aid in the elimination of swirl and turbulence downstream thereby recovering rotational energy losses, improving efficiency and static pressure capability, and reducing fan noise generation.

11. WHEEL - The fan wheel shall be a solid one-piece sand casting of A356 - T6 Aluminum and shall contain seven blades and an integral center hub. The wheel shall have blades of airfoil shape designed with a variable hub ratio system to allow the selected fan to operate at the highest efficiency possible. Wheels shall be machined to the proper diameter so that blade tip clearance shall be within tolerance necessary to insure certified fan performance. The wheel shall be secured to the fan/motor shaft with a Trantorque® or taperlock bushing.

12. SHAFT (ARR. 9) - Shafts shall be AISI 1040 or 1045 hot rolled steel, accurately turned, ground, polished, and ring gauged for accuracy. Shafts shall be sized for the first critical speed of at least 1.43 times the maximum speed.

13. BEARINGS (ARR. 9) - Bearings shall be heavy duty, grease lubricated, anti-friction ball or roller, self-aligning, pillow block type and selected for a minimum average bearing life (AFBMA L-50) in excess of 200,000 hours at the maximum fan RPM. All bearings are provided with pre-filled factory extended lubrication lines terminating at the housing exterior.

14. DRIVE (ARR. 9) - The fan shall be equipped with a (fixed/adjustable) pitch V-belt drive selected to operate the fan at the correct operational RPM. The V-belt drive shall consist of cast iron sheaves and anti-static conducting belts and shall be selected with a (1.2/1.5) safety factor based upon the required brake horsepower of the fan. The complete fan shaft and bearing assembly is mounted within a steel fabricated inner cylinder. The V-belt drive assembly is extended through a two-piece belt fairing. The belt fairing shall be an aerodynamically shaped tube designed to maximize fan efficiency. The belt fairing is welded continuously to both the inner cylinder that houses the fan shaft and bearings and the fan housing. The housing shall be fitted with aerodynamically designed stationary straightening guide vanes on the air discharge side of the

wheel. The guide vanes shall be welded to both the inner cylinder and the fan housing interior

15. All wheels are statically and dynamically balanced prior to assembly.

16. Shafts shall be AISI 1040 or 1045 hot rolled steel, accurately turned, ground, polished, and ring gauged for accuracy. Shafts shall be sized for the first critical speed of at least 1.43 times the maximum speed. Bearings shall be heavy duty, grease lubricated, anti-friction flange ball or roller, self-aligning, pillow block type and selected for a minimum average bearing life (AFBMA L-50) in excess of 200,000 hours at the maximum fan RPM.

17. All bearings shall be provided with pre-filled factory extended lubrication lines terminating at the housing exterior to facilitate bearing re-lubrication without gaining access inside the ductwork.

18. Fan motors shall be manufactured in accordance with current applicable standards of IEEE and NEMA and, where applicable, shall meet current EPACT standards. They shall be foot-mounted, NEMA standard, (ODP, TEFC, Explosion-Proof), continuous duty, ball bearing type with class (“B”,”F”) insulation and of cast iron construction when commercially available.

19. Motors for Arrangement 4 fans shall be foot-mounted, NEMA standard, totally enclosed fan cooled (TEFC), continuous duty, ball bearing type with class "F" insulation and of cast iron construction when commercially available. For ease in wiring the motor, wiring connections shall be extended to an exterior conduit box located on the exterior of the fan housing. A duplicate motor nameplate shall be mounted on the exterior of the fan adjacent to the fan nameplate. External grease fittings with pre-filled factory extended grease leads shall be supplied for lubrication of the motor bearings on all motors that provide grease fittings.

20. FINISH - The entire fan assembly, excluding the shaft, shall be thoroughly degreased and deburred before application of a rust-preventative primer. After the fan is completely assembled, a finish coat of paint shall be applied to the entire assembly. The fan shaft shall be coated with a petroleum-based rust protectant. Aluminum components shall be unpainted.

21. FACTORY RUN TEST - All fans with motors and drives mounted by Twin City Fan & Blower shall be completely assembled and test run as a unit at the specified operating speed prior to shipment. Each wheel shall be statically and dynamically balanced in accordance with ANSI/AMCA 204-96 "Balance Quality and Vibration Levels for Fans" to Fan Application Category BV-3, Balance Quality Grade G6.3. Balance readings shall be taken by electronic type equipment in the axial, vertical, and horizontal directions on each of the bearings. Records shall be maintained, and a written copy shall be available upon request.

F. End Zone Fans

1. End Zone Fans shall be Type TCTA Vane axial, fixed pitch, aluminum wheel

2. Fans shall be Type TCTA AXIFAN® Tubeaxial Fans as manufactured by Twin City Fan & Blower, Minneapolis, Minnesota.

3. Fans shall be Arrangement 9, V-belt driven with the wheel mounted on a separate shaft and bearings supported completely within an enclosed tube isolated from the high velocity airstream or Arrangement 4, with the propeller mounted directly on the motor shaft and with the propeller and motor assembly enclosed entirely within the fan casing.

4. PERFORMANCE - Fans shall be tested in accordance with ANSI/AMCA Standard 210 (air performance) and 300 (sound performance) in an AMCA accredited laboratory.

5. Model TCTA shall be available UL 705 listed. Fans shall bear a permanently attached nameplate displaying model and serial number of the unit for future identification.

6. HOUSING - Fan housings shall be welded of 14-gauge ASTM A-569 hot rolled steel on size 12, 12-gauge hot rolled steel on sizes 15 through 21, 10-gauge hot rolled steel on sizes 24 through 36, and 7-gauge hot rolled steel on sizes 42 through 60. Inlet and outlet flanges are standard.

7. WHEEL - The fan wheel shall be a solid one-piece sand casting of 319 alloy aluminum and shall contain seven blades and an integral center hub. The wheel shall have blades of airfoil shape designed with a variable hub ratio system to allow the selected fan to operate at the highest efficiency possible. Wheels shall be machined to the proper diameter so that blade tip clearance shall be within tolerance necessary to insure certified fan performance. The wheel shall be secured to the fan/motor shaft with a Trantorque® or taperlock bushing.

8. SHAFT (ARR. 9) - Shafts shall be AISI 1040 or 1045 hot rolled steel, accurately turned, ground, polished, and ring gauged for accuracy. Shafts shall be sized for the first critical speed of at least 1.43 times the maximum speed.

9. BEARINGS (ARR. 9) - Bearings shall be heavy duty, grease lubricated, anti-friction ball or roller, self-aligning, pillow block type and selected for a minimum average bearing life (AFBMA L-50) in excess of 200,000 hours at the maximum fan RPM. All bearings are provided with pre-filled factory extended lubrication lines terminating at the housing exterior.

10. DRIVE (ARR. 9) - The fan shall be equipped with a (fixed/adjustable) pitch V-belt drive selected to operate the fan at the correct operational RPM. The V-belt drive shall consist of cast iron sheaves and anti-static conducting belts and shall be selected with a (1.2/1.5) safety factor based upon the required brake horsepower of the fan.

11. The complete fan shaft and bearing assembly is mounted within a steel fabricated inner cylinder. The V-belt drive assembly is extended through

a two-piece belt fairing. The belt fairing shall be an aerodynamically shaped tube designed to maximize fan efficiency. The belt fairing is welded continuously to both the inner cylinder that houses the fan shaft and bearings and the fan housing.

12. Motors for Arrangement 4 fans shall be foot-mounted, NEMA standard, totally enclosed fan cooled (TEFC), continuous duty, ball bearing type with class "F" insulation and of cast iron construction when commercially available. For ease in wiring the motor, wiring connections shall be extended to an exterior conduit box located on the exterior of the fan housing. A duplicate motor nameplate shall be mounted on the exterior of the fan adjacent to the fan nameplate. External grease fittings with pre-filled factory extended grease leads shall be supplied for lubrication of the motor bearings on all motors that provide grease fittings.

13. FINISH - The entire fan assembly, excluding the shaft, shall be thoroughly degreased and deburred before application of a rust-preventative primer. After the fan is completely assembled, a finish coat of paint shall be applied to the entire assembly. The fan shaft shall be coated with a petroleum-based rust protectant. Aluminum components shall be unpainted.

14. FACTORY RUN TEST - All fans with motors and drives mounted by Twin City Fan & Blower shall be completely assembled and test run as a unit at the specified operating speed prior to shipment. Each wheel shall be statically and dynamically balanced in accordance with ANSI/AMCA 204-96 "Balance Quality and Vibration Levels for Fans" to Fan Application Category BV-3, Balance Quality Grade G6.3. Balance readings shall be taken by electronic type equipment in the axial, vertical, and horizontal directions on each of the bearings. Records shall be maintained and a written copy shall be available upon request

G. Warm Zone Heat Exchanger

1. SYSTEM SUPPLIER shall furnish one (1) Warm Zone Heat Exchanger that will exchange heat between thermal fluid and drying air.

2. The tube material shall be stainless steel.

3. The materials and coatings of the fins and tubes shall be suitable for the dryer environment.

4. The casing and frame material shall be stainless steel.

H. End Zone Heat Exchanger

1. The SYSTEM SUPPLIER shall provide one (1) dryer heat exchanger that will exchange heat between thermal fluid and drying air.

2. The tube material shall be stainless steel.

3. The materials and coatings of the fins and tubes shall be suitable for the dryer environment.

4. The casing and frame material shall be stainless steel.

5. Manufacturer

    1. Marlo,

    2. or approved equal.

I. Dryer Enclosure

1. SYSTEM SUPPLIER shall furnish One (1) Thermal Panel Enclosure per Dryer.

2. The Dryer Enclosure shall be manufactured in the United States.

3. Dryer Enclosure will consist of thermal panels packaged and skidded in bundles for easy, efficient offloading and assembly. Thermal panels are supported by an external I-Beam frame.

4. Thermal panels will be constructed of a 20-gauge aluminized steel Exterior, 20-gauge 304-2B stainless steel interior, and an 18-gauge G-90 Galvanized steel frame. Panels are 33 inches wide, 4 inches thick and incorporate an interlocking tongue and groove joint.

5. I-Beam support frame shall be of carbon steel construction and powder coated per manufacturer's standard specification.

6. Enclosure SYSTEM SUPPLIER shall furnish strategically placed Hatches on the Dryer Enclosure for visual inspection and internal maintenance purposes. These access hatches must be able to be opened during operation for inspection.

7. The sludge detention time in the dryer Enclosure should be no more than 120 minutes.

8. Dry product recycling shall not be allowed in order to prevent dust generation and associated risk of fire and explosion.

J. Sludge Depositors

1. SYSTEM SUPPLIER shall furnish Eight (8) Sludge Depositors to be positioned on top of the Dryer Enclosure. Sludge Depositors shall be accessible from the Dosing Platform.

2. The dryer shall have multiple depositors. The dryer shall be able to operate with one depositor out of service.

3. The Sludge Depositors provide support for Nozzle Assemblies while allowing oscillating motion for Wet Cake distribution onto the Top Belt.

4. Sludge Depositors shall consist of the following shipped loose components:

    a) Covers

    b) Depositor Shafts

c) Nozzle Guide Pipes

d) Depositor Linkage

e) Depositor Gearbox

f) Depositor Motor

5. Cover

a) Each Sludge Depositor shall include one (1) sheet metal cover of welded construction with a bolted connection to the Dryer Enclosure.

b) A fiberglass reinforced silicone seal shall be placed between the Cover and Depositor to prevent air loss from the Dryer Enclosure.

6. Depositor Shaft

a) A stainless steel Depositor Shaft is installed in each Sludge Depositor.

b) There shall be a total of Seven (7) 'Driven' Depositor Shafts and one One (1) 'Driving' Depositor Shaft.

7. Nozzle Guide Pipes

a) Stainless steel pipes welded to the Depositor Shaft guide the Nozzle Assemblies into place

b) There shall be a total of twenty four (24) Nozzle Guide Pipes per dryer.

8. Depositor Linkage

a) The Depositor Linkage shall link each depositor shaft, transferring oscillating motion to each depositor simultaneously.

b) The Depositor Linkage shall consist of a stainless steel pipe with a ball joint on each end. Depositor Gearbox.

K. Depositor Gearbox

1. A common Depositor Gearbox shall control the oscillating movement of the 'Driving' Depositor shaft.

2. The Depositor Gearbox, along with instrumentation housed in the switch box, shall initiate the movement of the 'Driving' Depositor Shaft by changing the direction of rotation.

3. The Depositor Gearbox shall have a torque arm and inverter duty motor and be regulated via a variable frequency drive.

L. Depositor Motor

1. Inverter Duty

2. Class II, Division II, Group G.

3. TEFC.

4. NEMA Class F

5. Installation of the Depositor Gearbox and torque arm shall be done by OTHERS once the Dryer Enclosure and the Dosing Platform are set in place. Depositor Gearbox shall be test fit before shipment. Switches for the gearbox will be shop wired to a local junction/switch box. Wiring shall be disconnected, bundled and labeled for shipment. Once the Depositor Gearbox is re-installed by OTHERS in the field, equipment shall be re-wired by OTHERS.

M. Belt Drives

1. SYSTEM SUPPLIER shall furnish One (1) belt drive for the Top Belt.

   a) The belt drive shall have a gearbox, torque arm, and inverter duty motor that is regulated via a variable frequency drive.

   b) SYSTEM SUPPLIER shall furnish One (1) zero speed switch for the Top Belt.

2. Top Belt Motor

   a) Inverter Duty

   b) Class II, Division II, Group G

   c) TEFC

   d) NEMA Class F

   e) Motor Coupling – Hollow Quill

3. SYSTEM SUPPLIER shall furnish One (1) belt drive for the Bottom Belt.

   a) The belt drive shall have a gearbox, torque arm, and inverter duty motor that is regulated via a variable frequency drive.

   b) SYSTEM SUPPLIER shall furnish One (1) zero speed switch for the Bottom Belt.

4. Bottom Belt Motor

   a) Inverter Duty

   b) Class II, Division II, Group G

   c) TEFC

   d) NEMA Class F

   e) Motor Coupling – Hollow Quill

N. Sprinkler System

   a) SYSTEM SUPPLIER shall furnish Insertion Mounts for one (1) 1-1/4 inch Male NPT and one (1) 2 inch Male NPT connections on the outside of the Dryer Enclosure to connect external Sprinkler Piping.

b) SYSTEM SUPPLIER shall furnish two (2) solenoid valves to initiate potable water flow to each dryer zone. The valve size for Warm Zone shall be 1.25". The valve size for End Zone shall be 2".

O. Extraction Screw

1. SYSTEM SUPPLIER shall furnish One (1) Extraction Screw to remove dried product from the Dryer Enclosure. All fabricated components are 304SS unless otherwise noted.

a) The Extraction Screw shall be equipped with Three (3) ¾ inch NPT temperature sensor ports, one (1) 10 inch square hinged overflow door with expanded metal safety screen and (1) rotary hinge actuated explosion proof limit switch, and one (1) 10 inch square clean out hatch with quick connect levers.

b) The unit shall be of notched flight design with progressive pitch to enable agitation and breaking up of the dried product.

c) The unit shall have a zero speed switch and controller. Controller mounted in separate box. Controller box shall be mounted outside of classified area.

d) The unit shall include a safety pull cord switch with mounting brackets, angle iron, eye bolts, and orange PVC coated cable.

e) Extraction Screw Motor.

1. Premium Efficient Severe Duty

2. Class II, Division I, Group F&G

3. TEFC

4. The unit shall be painted per manufacturer's standard specification and insulated with a removable pad.

P. Rotary Airlock

1. SYSTEM SUPPLIER shall furnish One (1) Rotary Airlock to provide an air trap to reduce the amount of intrusion air from conveying to enter the drying process.

2. The Rotary Airlock will be inclusive of the following:

a) Cast iron housing and endplates

b) Outboard bearings

c) Square inlet and outlet flanges

d) ACST 4 shaft seal assembly

e) 8-vane open end mild steel rotor assembly

f) Fixed edge mild steel rotor tips– beveled

g) Inlet flat style shear protector, mild steel construction

h) Quick Clean Feature

i) Premium Efficient Severe Duty Motor rated for Class II, Division I, Group F&G, TEFC.

2.4 DRYING AIR TREATMENT

A. The components of the drying air treatment system include a drying air treatment fan to transfer air through the condenser for dehumidification and return dried air to the Dryer Enclosure. The Condenser will be used to remove humidity from the dryer air. The vacuum fan maintains a negative pressure inside the Dryer Enclosure and its exhaust is sent to the odor control system. The maximum dryer exhaust flow (off-gas from the drying process should be no greater than 1,200 acfm. Exhaust flow rates of 1,200 acfm or less can be tied into the larger odor control system. Any dryer system with an exhaust flow greater than 1,200 acfm shall require a separate/dedicated odor control system. The following major components shall be supplied by SYSTEM SUPPLIER.

1. Vertical Packed Bed Condenser
2. Drying Air Treatment Fan
3. Vacuum Fan

B. Vertical Packed Bed Condenser

1. SYSTEM SUPPLIER shall furnish a Vertical Packed Bed Condenser delivered in three (3) sections. The Condenser will be used to remove humidity from the dryer air.
2. The following equipment shall be included:
   a) One (1) Vertical Condenser/Scrubber
   b) Media and a mist eliminator
   c) Upper and Lower Site Glasses
   d) Access Door and Hatch
   e) Four (4) differential pressure taps.
   f) Spray nozzles for main packed area
   g) Spray nozzles for mist eliminator section
   h) Level switch at bottom of condenser column to alert blocked drain line
3. The following valves are supplied by SYSTEM SUPPLIER:
   a) One (1) V-Port Flow Control Valve
   b) One (1) Mist Eliminator Control Valve (Solenoid)
4. A temperature indicating transmitter shall be supplied by SYSTEM SUPPLIER to be installed on the duct from the dryer (or air cooler if provided) to the condenser and from the condenser back to the dryer (or air pre-heater if provided).

C. Drying Air Treatment Fan

1. SYSTEM SUPPLIER shall furnish One (1) Drying Air Treatment Fan to transfer air through the condenser for dehumidification and return dried air to the Dryer Enclosure.

2. Performance ratings shall conform to AMCA Standard 205 (fan efficiency grade) and 211 (air performance). Fans shall be tested in accordance with ANSI/AMCA Standard 210 (air performance) and 300 (sound performance) in an AMCA accredited laboratory. Fans shall be licensed to bear the AMCA certified ratings seal for air and fan efficiency grade (FEG)

3. Housings shall be continuously welded heavy gauge steel, suitably braced to prevent pulsation. Housings with lock seams or partially welded construction are not acceptable. Class 22 housings shall be constructed of a minimum 12 gauge through 0.31 inch steel. Class 32 housings shall be constructed of at least 7 gauge through 0.31 inch steel. Class 45 housings shall be constructed of a minimum 7 gauge through 0.31 inch steel. Units having wheel diameters of 33 inches (size 919) and smaller shall be built with adjustable discharge housings which can be field rotated to any of the eight standard positions. Fans with wheel diameters larger than 33 inches shall be built with a fixed discharge housing and have a flanged type discharge to provide unit rigidity.

4. Class 22 fan wheels shall be constructed of a minimum 10 gauge through 0.75 inch thick steel. Class 32 fan wheels shall be constructed of a minimum 7 gauge through 0.75 inch steel. Class 45 fan wheels shall be constructed of a minimum 7 gauge through 0.75 inch steel. All industrial fan wheels shall be continuously welded.

5. Shafts shall be AISI 1040 or 1045 hot rolled steel, accurately turned, ground, polished, and ring gauged for accuracy. Shafts shall be sized for the first critical speed of at least 1.43 times the maximum speed.

6. Bearings shall be heavy duty, grease lubricated, anti-friction ball or roller, self-aligning, pillow block type and selected for a minimum average bearing life (AFBMA L-50) in excess of 200,000 hours at the maximum fan RPM.

7. Fan and motor sheaves shall be cast iron fixed pitched drives for service over 10 HP. Small drives may use variable pitch cast iron motor sheaves. The minimum belt service factor is 120% for drives.

8. The fan surfaces shall be coated per manufacturer’s standard specification.

9. When specified, accessories such as inlet vanes, outlet dampers, companion inlet and outlet flanges, inlet bells, inlet boxes, shaft guards, and wheel and scroll liners shall be provided by Twin City Fan & Blower to maintain one source responsibility.

10. All fans prior to shipment shall be completely assembled and test run as a unit at the specified operating speed or maximum RPM allowed for the particular construction type. Each wheel shall be statically and dynamically balanced in accordance with ANSI/AMCA 204-96 "Balance Quality and Vibration Levels for Fans" to Fan Application Category BV-3, Balance Quality Grade G6.3. Balance readings shall be taken by electronic type equipment in the axial, vertical, and horizontal directions on each of the bearings. Records shall be maintained and a written copy shall be available upon request.

11. Fan Includes inverter duty rated motor and a variable frequency drive. Class II. Div. II.

12. Fan will include a ¾ inch drain connection.

D. Vacuum Fan

1. SYSTEM SUPPLIER shall furnish One (1) Vacuum Fan to pull air from the air recirculation loop. This will serve the purpose of keeping negative pressure on the Dryer Enclosure. The discharge from this fan will be sent to the odor control system.

2. Housings are to be continuously welded heavy gauge steel suitably braced to prevent pulsation. Housings with lock seams or partially welded construction are not acceptable.

3. Fan wheels are constructed of a minimum 10 gauge through 0.75 inch steel. All industrial fan wheels shall be continuously welded. Wheels shall be statically and dynamically balanced and the complete fan assembly shall be test balanced at the operating speed prior to shipment.

4. Bearings shall be heavy duty, grease lubricated, anti-friction, cast iron, precision, self-aligning ball or roller pillow block type and selected for a minimum average bearing life (AFBMA L-50) in excess of 200,000 hours at the maximum class RPM. Bearings are equipped with zerk fittings.

5. Shafts are to be AISI C-1040 or 1045 hot rolled steel accurately turned, ground, polished, and ring gauged for accuracy.

6. The fan surfaces shall be coated per manufacturer’s standard specification.

7. Fan Includes inverter duty rated motor and a variable frequency drive. Class II. Div. II

2.5 THERMAL FLUID HEATER SYSTEM

A. One (1) thermal oil heater fueled by Natural Gas. The thermal fluid heating system will be used to heat thermal fluid to be used to heat the dryer. This thermal fluid system will be on a standalone skid and the heated thermal fluid will be pumped to the dryer enclosure. This configuration makes the dryer an indirect heater.

1. Thermal Fluid will be circulated by centrifugal pumps to the warm zone and end zone heat exchangers in the dryer. Two 3-way valves will

modulate and distribute the correct flow to each zone of the dryer by temperature set points.

2. NEMA 12 Control Panel

3. Two (2) (1 duty+1 shelf spare) centrifugal pump for circulation of thermal fluid to warm zone of dryer.

4. Two (2) (1 duty+1 shelf spare) centrifugal pump for circulation of thermal fluid in end zone, detailed as:

5. One (1) deaerator cold-seal expansion tank

6. One (1) three way valve for thermal fluid flow control in warm zone (primary loop), one (1) three way valve following by one (1) two-way valve for thermal fluid control in end zone (secondary loop). All valves mentioned are controlled by local control in conjunction with temperature sensors.

7. One (1) stack temperature switch

8. Loose fill/drain pump

    1. SYSTEM SUPPLIER provides Pump that is shipped loose. Pump motor is ¾ HP, 480V, 3 phase.

9. To reduce thermal oil breakdown over time, a nitrogen system will be used to blanket the headspace in the DA tank. The Nitrogen Blanket Kit is inclusive of a loose safety relief valve, loose spool piece with a 2 inch bubble tight ball valve, and a loose, assembled N2 kit (two (2) back pressure regulating valves, pressure gauge with isolation ball valve, and check valve).

10. NFPA 85 rated fuel train.

11. Thermal Fluid Piping Specification:

Carbon Steel Thermal Fluid Pipe Specification -20F to +650F, 100 psig		
Pipe	1/2" and under	Carbon steel pipe, sch. 80 SA106B.
	>1/2"	Carbon steel pipe, sch. 40, SA106B.
Fittings	2" and under	3000# socket weld forged steel SA105 or butt weld connections
	≥2 1/2"	Carbon steel butt weld SA234 WPB sch. 40.
Flanges	≤ 3"	300# raised face slip on or weld neck including blind flange ASTM A105/ANSI B16.5.
	≥ 4"	150# raised face slip on or weld neck including blind flange ASTM A105/ANSI B16.5.
Gaskets	≤ 3"	300# Corrugated Metal Core, Graphite Covered, Elastagraph or equal.
	≥ 4"	150#, Corrugated Metal Core, Graphite Covered, Elastagraph or equal.

2.6 DRYING AIR TREATMENT HEAT RECOVERY

A. The SYSTEM SUPPLIER shall furnish a drying air treatment heat recovery system. The system will consist of an air to air heat exchanger that shall 1) cool the dryer exhaust going to the condenser and 2) recover the heat from the dryer exhaust to preheat the condenser effluent air back to the dryer.

B. SYSTEM SUPPLIER shall furnish one (1) Air to Air Heat Exchanger inclusive of the following:

1. Thermo-Z welded plate heat exchanger: IU- Counterflow configuration
2. All welded 316L Stainless heat exchanger matrix (20Ga-.038in thick)
3. All welded 304 Stainless interior casing (12Ga-.105in thick)
4. Integral all welded thermal expansion joints:
    a) T1 - 304 Stainless bellows type
    b) T2 - 304 Stainless bellows type
    c) T3 - 304 Stainless slip joint type
    d) T4 - 304 Stainless bellows type
5. FOUR (4) inches of thermal insulation
6. All welded Carbon Steel exterior casing, sandblasted and painted (11Ga-.120in thick)
7. All welded Carbon Steel 2" X 2" X 11GA Exterior Case Supports - stitch welded (2in on 12in centers), sandblasted and painted
8. Unit Flanges (with pre-punched holes for installation unless otherwise stated):
9. T1 - 2" x 2" x 1/4" Carbon Steel, sandblasted and painted
10. T2 - 2" x 2" x 1/4" Carbon Steel, sandblasted and painted
11. T3 - 2" x 2" x 1/4" Carbon Steel, sandblasted and painted
12. T4 - 2" x 2" x 1/4" Carbon Steel, sandblasted and painted
13. Any items specified as painted, will have 2 coats of FC TemperKote 850 Standard Paint
14. Heat Exchanger is factory leak tested for 0.01% max leakage @ 14'' W.C. differential pressure
15. Rated for 275 °F max continuous hot inlet (T3) temperature, with max allowable spike temperature of 325 °F
16. Unit Nameplate Type: Standard Foil Adhesive Label
17. ONE (1) Insulated Plug Style access door(s) for inspection and cleaning - bolted on with gasket

C. Water Wash System Details

1. All welded 304 Stainless interior casing (12Ga-.105in thick)
2. FOUR (4) inches of thermal insulation

3. All welded Carbon Steel exterior casing, sandblasted and painted (11Ga-.120in thick)

4. All welded Carbon Steel 2" X 2" X 11GA Exterior Case Supports - stitch welded (2in on 12in centers), sandblasted and painted

5. Unit Flanges (with pre-punched holes for installation unless otherwise stated):

6. Inlet - 2" x 2" x 1/4" 304 Carbon Steel, sandblasted and painted

7. Outlet - 2" x 2" x 1/4" 4 Carbon Steel, sandblasted and painted

8. Gasketing and Hardware Included

9. Fully welded pipe and fittings material: 304 Stainless

10. Nozzle material: 303 Stainless

11. Nozzles selected for 90° spray angle

12. System designed for a water-supply pressure of 40psi, which is standard for municipal water systems. Max water pressure to system is 150psi, based on pipe fittings ratings

13. The SYSTEM SUPPLIER shall provide the following valves and instruments:

    a) Temperature Indicator and Transmitter (Dryer Outlet Duct to HTX)

    b) Temperature Indicator and Transmitter (HTX Outlet Duct to Dryer)

    c) Differential Pressure Indicator and Transmitter on Hot and Cold Air sides of HTX (2 total)

    d) One (1) one inch Solenoid valve for CIP spray station

2.7 CONTROL PANELS

A. SYSTEM SUPPLIER shall furnish One (1) PLC Based Control panel per dryer to control the dryer I/O based on operator set points. There will be one panel supplied for each drying system. All I/O will be wired to field terminations and include surge arrestors and isolation as required. The Control Panels will be completely assembled, tested, and programmed for the required functionality. The completed control panels shall be UL labeled.

B. The PLC Control Panels will include the necessary input/output, I/O, capabilities as listed in the attached I/O listing as well as 20% spare wired IO. All I/O will be wired to field terminations and include surge arresters and isolation as required.

C. The dryer PLC Control Panels shall be located in a non-classified climate controlled room, and shall be supplied in a NEMA 12 carbon steel enclosure suitable for inside use. The

front panel of each Enclosure shall contain push buttons, as detailed within this specification. The internal portion of the Enclosure shall contain all rack mounted PLC equipment, power supply, processor and interface cards. Relays, terminal strips and surge suppressors shall also be contained within the Enclosure. Terminal strips for all field wiring shall be furnished within the panel. The Panels shall be manufactured by Saginaw.

D. One surge suppression device on the 120 VAC main supply line shall be installed. The power surge suppressor shall be equivalent to part #2856702 by Phoenix Contact.

E. On all analog input signals, current isolators shall be installed to galvanically separate external and internal 4-20 mA current loops. Current Isolators shall be equivalent to Phoenix Contact part #2864406.

F. All analog inputs and outputs shall also be protected from surges. The surge-arresting module shall combine coarse, medium and fine protection elements such as gas filled arrestors, varistors and suppressor diodes. The surge arresting modules shall be plug-in style allowing replacement of arrestors without removing field or panel wires. The analog surge arrestors shall be equivalent to Phoenix Contact part # 2838228.

G. Isolated Input Cards shall be used.

H. Digital I/O will be wired from the PLC to field terminal blocks located inside the dryer PLC Control Panels. The terminal blocks shall be rated for 600 Volts, 30 Amps, 26-10 Gage Wire and shall be din rail mountable. Terminal blocks shall be Phoenix UTTB 4 Double Level Terminal Block part # 3044814.

I. All hazardous area wiring to the control panels shall connect to intrinsic safety barriers located in control panel(s). All field wiring BY OTHERS to intrinsic safety barriers shall meet NEC for intrinsic safety

2.8 PROGRAMMABLE LOGIC CONTROLLER

A. Programmable Logic Control System Submittals shall include

1. Block Diagram: A diagram showing all major PLC components. Identify components by manufacturer and model number.

2. Bill of materials: A list of all PLC components. Group components by type and include:

   a) Component manufacturer, model number and part number.

   b) Component description.

   c) Quantity supplied.

   d) Reference to component catalog information.

3. Descriptive Information: Catalog information, descriptive literature, performance specifications, internal wiring diagrams, power and grounding requirements, and power consumption for all elements of the PLCS. Clearly mark all options and features proposed for this project.

4. Control/Interconnection Loop Wiring Diagrams: Diagrams shall show all PLC elements, their interconnecting cables, wiring terminations, and

terminations to all interacting elements and subsystems. Terminations shall be numbered. Terminations for circuits extending outside PLC assemblies and/or having housing panels shall be labeled with circuit names corresponding to the Circuit and Raceway Schedule. The external circuit portion of this diagram shall be coordinated with the Electrical Subcontractor and shall bear his mark showing that this work has been done. Wiring diagrams are not to scale to reflect component details for ease of wiring.

5. Outline Drawings: Equipment envelope drawings showing: external dimensions, enclosure materials, conduit connections, and installation requirements.

6. Installation Details: Any modifications or further details as may be required to supplement the Contract Documents and adequately define the installation of the PLC elements.

7. Input/Output List: For each I/O point list point type, tag number of the source or final control element, equipment description, PLC number, PLC terminal identification, and PLC address.

B. Factory Testing

1. All non-loop specific functions shall be tested, including, but not limited to:

a) Failure mode and backup procedures: power failure, auto restart, and retentive outputs.

b) All IO (Analog Inputs, Analog Outputs, Digital Inputs, and Digital Outputs) will be confirmed for proper operation form the PLC to the terminals within the PLC Control Panels.

c) Programming and documentation methods and features.

C. Functional Requirements

1. The PLC system shall be used for monitor and control of the drying process. The operations described herein are intended to identify minimum acceptable performance.

a) PLC Processor (CPU): Allen Bradley Control Logix

b) PLC Power Supply: Allen Bradley Control Logix

c) PLC Chassis: Allen Bradley Control Logix

d) PLC Ethernet Communication Module: Allen Bradley Control Logix

e) PLC Digital Input Module: Allen Bradley Control Logix

f) PLC Digital Output Module: Allen Bradley Control Logix

g) PLC Analog Input Module: Allen Bradley Control Logix

h) PLC Analog Output Module: Allen Bradley Control Logix

2. The dryer system shall be designed and supplied and with a remote monitoring to allow for troubleshooting and maintenance assistance.

2.9 FIELD INSTRUMENTS

A. Field Instruments will be supplied as required to meet the functionality of the Sludge Thermal Drying System.

B. Field Instruments shall include:

1. Loop Powered Pressure Indicating Transmitter: Endress & Hauser PMC71
2.
3. Pressure Gauge w/Diaphragm Seal: Ashcroft 45-1279 w/50-201-SS Diaphragm Seal
4. Limit Switch (Over travel): Square D 9007ML02S0300
5. Proximity Sensor (travel limit): Turck BI10S-Q26-AD4X/S34
6. Inductive Sensor/Low Velocity Switch: Square D XS618B1MAL2
7. Infrared Temperature Transmitter with Type K Thermocouple: Exergen 10K-240F/120C
8. Differential Pressure Transmitter: Endress & Hauser PMD75
9. Loop Powered Temperature Indicating Transmitter w/ RTD: Endress & Hauser Transmitter TMT162 w/ RTD TH13/TH11
10. Photo Electric Sensor: Banner Engineering SMI30
11. Temperature Switch: Ashcroft LTS-N4-G-00
12. Loop Powered Magnetic Flowmeter w/transmitter: Endress & Hauser Promag 400W Polyurethane Liner 150 Pound ANSI Flange w/NEMA 4X Compact Housing Transmitter
13. Differential Pressure Gauge: Dwyer 200

PART 3 - EXECUTION

3.1 INSTALLATION

A. All equipment furnished under this section shall be fabricated, assembled, erected, and placed in proper operating condition in full conformity with detailed drawings, specifications, engineering data, instructions, and recommendations furnished by the SYSTEM SUPPLIER and equipment manufacturer.

3.2 SERVICES OF SYSTEM SUPPLIER

A. Preliminary field testing, inspection, and checkout of the entire dryer system following installation, shall be performed by a qualified representative of the SYSTEM SUPPLIER. Tests shall be conducted to demonstrate to the Engineer that all system components furnished by the SYSTEM SUPPLIER shall be fully operational, that all connecting piping is

leak-proof and properly anchored, and that the entire system furnished by the SYSTEM SUPPLIER is ready for continuous safe operation. The purpose of the checkout shall be to ensure that each individual system component had been correctly installed, shall operate fully in the manner intended, and is ready to perform its function as part of an integrated system when placed in continuous operation.

B. During the start-up period the process performance shall be evaluated on a per dryer basis. The OWNER shall provide for any necessary sampling and analysis during the testing period. Should the system meet satisfactory process performance requirements (or as required by the contract documents), the performance of the system shall be deemed successful and the SYSTEM SUPPLIER shall be relieved of any further process performance obligations. In the event that the system does not meet satisfactory process performance requirements, the performance test shall be repeated.

C. Instruction of OWNER'S Personnel: The SYSTEM SUPPLIER or an authorized service representative shall also provide instruction of the OWNER'S personnel in the operation and maintenance of the equipment including step-by-step troubleshooting procedures with necessary test equipment.

3.3 SUPPLEMENTS

A. The supplement listed below are part of this Specification.

1. Supplement 1-1, Veolia Water Technologies Proposal

**** END OF SECTION ****

Sludge Drying Equipment
Supplement 1, Veolia Water Technologies Proposal (“Proposal”)
Canton, Georgia

Submitted to:	Yvonne Picard, PE Atkins Global
Submitted by:	Ashley Waples Application Engineer
Date:	09/24/2020

Water Technologies

1. PRICING, TERMS AND SCHEDULE

1.1. DESCRIPTION OF WORK

Kruger, an equipment supplier, proposes and agrees to furnish all labor services, materials, equipment, and all other items necessary to supply and deliver the equipment items as specified in Kruger's RFP Response.

1.2. PROPOSAL PRICE

Price includes BioCon equipment, as well as instrumentation and controls as detailed herein. Kruger's Proposal is expressly conditioned upon the scope of supply, all terms and conditions, pricing, Comments to Bid Documents, and Kruger's Terms of Sale as provided herein.

The price excludes sales and/or use taxes. Buyer agrees to provide the necessary tax-exempt certification or Reseller documentation for sales taxes exemption within thirty (30) days after receipt of a purchase agreement executed by all parties. Furthermore, Buyer accepts responsibility for all applicable state and local sales taxes.

Kruger shall furnish and deliver (FOB Jobsite) Equipment, including submittals, start-up and other services, in conformance to the requirements set forth in this document for the Lump Sum price provided in the cover letter herein.

1.3. LIQUIDATED DAMAGES

Kruger shall not accept liquidated damages from Buyer, unless otherwise agreed to in writing between Buyer and Supplier. In any event, Kruger shall not be liable for liquidated damages imposed on an installing CONTRACTOR by the OWNER.

1.4. TERMS OF PAYMENT AND CONDITION OF SALE

In accordance with the RFP, CONTRACTOR and Supplier may negotiate modifications to the payment schedule with written approval by the Owner. Kruger proposes the following modifications:

The terms of payment are 10% upon receipt of fully executed contract, 15% upon delivery of Submittals of shop drawings, and 75% upon delivery of equipment to destination.

Payment shall not be contingent upon receipt of funds by the CONTRACTOR from the OWNER and there shall be no retention in payments due to Kruger. All payment terms are net 30 days from date of invoice. Final payment shall not exceed 120 days from delivery of equipment. All other payment terms are as defined in Kruger's Standard Terms of Sale.

1.5. BONDS

Pricing does not include bonds. If bonds are required, Kruger shall provide a quotation as an adder that will be based upon a quotation from our Surety.

1.6. DELIVERY SCHEDULE

Shop drawings will be submitted within 10 to 12 weeks of receipt of an executed Agreement signed by all parties.

All equipment will be delivered within 24 to 26 weeks of written notice to fabricate. Changes in scope resulting in cost impacts to Kruger after release of Kruger equipment will result in a change order to the contract. If Kruger is able to ship equipment sooner than the above schedule, the contractor must accept deliveries and provide adequate storage on-site for such equipment.

Operation and Maintenance Manuals will be submitted within 30 days prior to delivery of equipment.

1.7. CONTACT INFORMATION

This RFP Response is respectfully submitted by:

	Veolia Contact	Representative
Name	Sudhakar Viswanathan	Rory Russo
Company	Kruger / Veolia	Heyward Atlanta
Address	4001 Weston Parkway Cary, NC 27513	3590 Habersham at Northlake Rd, Tucker, GA 30084
Phone	919 653-4596	404-444-0026
Email	sudhakar.viswanathan@veolia.com	rory.russo@heywardatlanta.com

1.8. PROPRIETARY INFORMATION

The information or data contained in this proposal is proprietary to Kruger and should not be copied, reproduced, duplicated, or disclosed to any third party, in whole or part, without the prior written consent of Kruger. This restriction will not apply to any information or data that is available to the public generally.

1.9. STATEMENT REGARDING COVID-19

Veolia shall not be held liable in the event of a non-compliance with its obligations set forth herein to the extent such non-compliance is due to the consequences of the Covid-19 pandemic including without limitation (i) obligation to comply with the legislation enacted or measures taken by the authorities to address the Covid-19 pandemic (including mandatory closures, requisitions, transport limitations, social distancing requirements), (ii) observance of hygiene and security rules and recommendations resulting from the Covid-19 pandemic, (iii) inability to supply or distribute to relevant personnel appropriate personal protective equipment for the tasks to be performed, as a result of shortages of supply resulting from the Covid-19 pandemic, (iv) inability of a Veolia subcontractor or supplier to comply with its obligations for the reasons mentioned above; and to the extent the resulting impediments cannot be reasonably overcome.

In the event such consequences of the Covid-19 pandemic render Veolia's performance hereunder more onerous than could have been anticipated at the date hereof the parties shall negotiate alternative contractual terms, including for delivery/performance dates or service levels, which reasonably allow for the impact of the consequences of the Covid-19 pandemic referred to here above.

2. DESIGN SUMMARY

2.1. DESIGN CRITERIA

Design Criteria is as provided in SECTION 11371 SUPPLEMENT 1000 – SLUDGE THERMAL DRYING SYSTEM, Paragraph 1.6 - Basis of Design and Performance Guarantee.

2.2. PROCESS PERFORMANCE GUARANTEE

SYSTEM SUPPLIER's Process Performance Guarantee is as provided in Attachment 1 of this Proposal.

3. EQUIPMENT SCOPE OF SUPPLY

Kruger will provide the equipment and field services as described herein.

Kruger will supply the following equipment as described below:

- 8x Dosing pumps
- 1x SD-8312-IO Turbo dryer inclusive of internal HTX's and Fans
- Extraction screw
- Condenser
- Drying Air Treatment Fan
- Vacuum Fan
- Drying Air Treatment HTX
- Thermal Fluid Heating System
- Platform Assemblies (Noted in Scope Section)
- Controls & Instrumentation
- 1x Lot of Valves (non-AIS)
- Control Instruments
- Hardware & Software
- Electrical Control Panels
- Modem Connection to Kruger

Please note the equipment manufacturers listed below are based upon Kruger's current review of their offerings and our past experience. 'Or equal' equipment manufacturers may be reviewed and mutually agreed upon with the Owner and/or Contractor during final design.

Important Note: **No additional tools and/or spare parts other than listed herein will be provided as part of Kruger's scope of supply. Oil and lubricants are not included as part of Kruger's scope of supply. These are to be the responsibility of the contractor. Please review the scope of supply by others for additional details**.

3.1. PROCESS AND MECHANICAL EQUIPMENT

Process and Mechanical Equipment Items	Qty	Description
Thermal Belt Dryer	1	BioCon is a belt dryer that deposits sludge onto one of two belts and heats the sludge to remove moisture. The dryer works with two belts to convey the sludge through a warm zone then a cool zone before it exits the dryer. The BioCon thermal dryer is designed to operate at 350-375 °F and heats the air indirectly with a thermal fluid system. The following equipment is included as part of Kruger's dryer cabinet: ● BioCon Model SD8312-IO reinforced, 304 stainless steel BioCon Dryer, inclusive of: ○ Eight (8) sludge depositor stations ○ 304 stainless steel support legs ○ Two (2) 304 SS drying belts inclusive of drums and inverter duty motors ○ Four (4) internal drying air circulation fans; inclusive of inverter duty rated motor ○ Two (2) internal air to thermal fluid heat exchangers ○ One (1) extraction screw conveyor, (detailed below) ○ Inspection Hatches, mounted on the side of the dryer to inspect product drying on the belt. ○ Thermal Panel Enclosure supported by external I-Beam frame. ● The dryer will be manufactured in a fabrication shop and shipped to Canton. The dryer cabinet will be shipped in modules. The dryer will be assembled onsite by the installation contractor.
BioCon Platform Assemblies	1 Dosing Platform 1 Access Platform	Kruger shall supply two levels of platforms around the BioCon dryer unit, consisting of an upper and lower platform. Kruger will have these modular platforms fabricated to include frames, decking, rails, and piping associated with the dosing pumps, valves, and depositors. Stairs with handrail from the floor will lead to the lower platform. Stairs with handrail from the lower platform will lead to the upper platform. See drawings and P&IDs for details. The following platform shall be included as part of Kruger's Scope: ● Dosing (Upper) Platform ○ Upper Platform Approximately 26' W x 17' L x 20' H. ○ Main frame and Sub-frame will be powder coated / epoxy painted gray ○ Floor Frame will be shipped in (2) sections ○ Decking will be diamond plate and will be powder coated / epoxy painted gray ○ Handrails shall be 2 in sq tube, powder coated / epoxy painted gray ○ (1) Stair section will be provided from Lower Platform to Upper Platform ○ Grating shall be 1 inch x 3/16 inch Galv. Bar Grating ○ Legs will have pads to be bolted to the main frame for reassembly ○ Angle braces will be supplied as needed ○ Depositor wash down station is included ○ Dosing Manifolds (for inlet to dosing Pumps) shall be 304 SS ○ Dosing Headers (for outlet of dosing Pumps) shall be 304 SS ● Access (Lower) Platform ○ Lower Platform Approximately 30' W x 45' L x 10' H. (This Dryer Access Platform shall be four feet wide and will wrap around one side and one end of the dryer to provide access to Dryer hatches, instruments, and miscellaneous piping and equipment.) ○ Main frame and Sub-frame will be powder coated / epoxy painted gray ○ Frame will be shipped in multiple sections (6'-10' lengths) and require field assembly. ○ Handrails shall be 2 in sq tube, powder coated / epoxy painted gray ○ (1) Stair section will be provided from Floor level to Lower Platform ○ Grating shall be 1 inch x 3/16 inch Galv. Bar Grating ○ Legs will have pads to be bolted to the main frame for reassembly

		○ Angle braces will be supplied as needed ● Frames shall be CS HSS, I-Beam, C-Channel, and Angle sized as needed
Dosing Pump	8	The Dosing Pumps will be used to convey sludge to the depositors. These pumps will be used to convey equal and consistent sludge amounts to the sludge drying belts on the BioCon dryer. ○ Flow-rate (gpm): 1 – 2 ○ Sludge Percent Dry Solids (%): 16-20 ○ Design Discharge Pressure (psig) : 348 ○ Design Sludge Temperature (deg F): 60 – 90 ○ Maximum Pump Speed (rpm): 100 ○ Motor Horsepower (HP): 1 ○ Maximum Motor Speed (rpm): 1,800 ○ Pump Make and Model: Seepex BN 2-24 ○ Connections: 2.5 inch inlet ANSI Class 150 RF, 2” ANSI 300 flange RF discharge ○ Control box & temperature probes for dry run protection ○ Rotor – 1.4404 / AISI 316L with ductile chromium coating ○ Stator – NBR Perbunan ○ Pump body Cast iron ○ Single Acting Mechanical Seal ○ The pumping units are self-priming, progressing cavity type specifically designed for pumping wastewater treatment sludge in liquid or slurry form containing organic solids and small inorganic particles.
Condenser	1	Kruger shall supply a condenser that will be installed separately from the dryer cabinet. The Condenser will be used to remove humidity from the dryer air. The following equipment shall be included: ● Vertical Condenser detailed as: ○ Viron International Corp. ○ Stainless Steel Construction ○ Packed Bed includes 8’-0” depth of Lantec Q-Pac media ○ The mist eliminator will remove 99% of droplets of 5 microns or larger. ○ Static pressure through the scrubber will be approximately 1.6" w.g. when operating at 7,306 ACFM. ○ Upper and Lower Site Glasses ○ Access Door and Hatch ○ Upper and Lower Sight Glasses ○ Mist Eliminator Wash down ○ Mist Eliminator Access Door ○ Stainless Steel grating ○ Gore-Tex gaskets ○ Stainless steel mesh pad ○ Stainless steel hardware ○ Four (4) 1/8” differential pressure taps ○ 2 levels of spray nozzles for main packed area ○ 2 levels of spray nozzles for mist eliminator section ○ The condenser will be delivered without insulation.
Drying Air Treatment Fan	1	A drying air treatment fan will be supplied to pull air through the condenser unit and return the air to the BioCon dryer. The following equipment shall be included: ● Fan detailed as: ○ Volumetric Flow: 6,089 acfm @ 9.64 iwc, 176F ○ Motor: 20 HP 1800 RPM 460/60/3 EXPL Premium Eff. Motor (Class II, Div II, Groupfs F&G, inverter duty rated) ○ AMCA Spark C Construction ○ Fixed Pitch belt drive, 1.5 SF, OSHA Belt Guard ○ Welded mild steel housing and frame ○ Welded steel radial air handling wheel ○ Coating: Entire fan including wheel and accessories, Incilate 810 inorganic zinc (Two coats, air dry, 4 mils DFT, 350F) ○ Extended lube lines to fan bearings

		○ Isolation Base, 1” springs with seismic restraints, coated same as fan ○ Leak tight construction ○ Bolted access door and housing drains x 2
Vacuum Fan	1	A vacuum fan will be supplied to pull air from the air recirculation loop. This will serve the purpose of keeping negative pressure on the BioCon dryer, to eliminate odor coming from the dryer cabinet. The following equipment shall be included: ● Fan detailed as: ○ Volumetric Flow: 1,423 acfm @ 7.23 iwc, 176F ○ Motor: 5 HP 1800 RPM 460/60/3 EXPL Premium Eff. Motor (Class II, Div 1, Groups F&G, inverter duty rated) ○ AMCA Spark C Construction ○ Fixed Pitch belt drive, 1.5 SF, OSHA Belt Guard ○ Welded mild steel housing and frame ○ Welded steel radial air handling wheel ○ Coating: Entire fan including wheel and accessories, Incilate 810 inorganic zinc (Two coats, air dry, 4 mils DFT, 350F) ○ Extended lube lines to fan bearings ○ Isolation Base, 1” springs with seismic restraints, coated same as fan ○ Leak tight construction ○ Bolted access door and housing drains x 2
Drying Air Loop Heat Exchanger	1	This heat exchanger is to exchange heat from the warm air exiting the dryer with air entering the dryer from a condenser. This is an air to air type plate heat exchanger. ● Heat Exchanger detailed as: ○ Inlet Volumetric Flow (from dryer): 8,054 acfm ○ Inlet Volumetric Flow (from condenser): 4,752 acfm ○ Inlet/Outlet Temperature (from dryer / to condenser): 248F / 182F ○ Inlet/Outlet Temperature (from condenser / to dryer): 86F / 176F ○ Thermo-Z welded plate heat exchanger: IU- Counterflow configuration ○ All welded 316L Stainless heat exchanger matrix (20Ga-.038in thick) ○ All welded 304 Stainless interior casing (12Ga-.105in thick) ○ Integral all welded thermal expansion joints (304) ○ FOUR (4) inches of thermal insulation ○ All welded Carbon Steel exterior casing, sandblasted and painted (11Ga-.120in thick) ○ All welded Carbon Steel 2" X 2" X 11GA Exterior Case Supports - stitch welded (2in on 12in centers), sandblasted and painted ○ Any items specified as painted, will have 2 coats of FC TemperKote 850 Standard Paint ○ ONE (1) Insulated Plug Style access door(s) for inspection and cleaning - bolted on with gasket ○ Water Wash System Details ■ All welded 304 Stainless interior casing (12Ga-.105in thick) ■ FOUR (4) inches of thermal insulation ■ All welded Carbon Steel exterior casing, sandblasted and painted (11Ga-.120in thick) ■ All welded Carbon Steel 2" X 2" X 11GA Exterior Case Supports - stitch welded (2in on 12in centers), sandblasted and painted ■ Gasketing and Hardware Included ■ Fully welded pipe and fittings material: 304 Stainless ■ Nozzle material: 303 Stainless

Rotary Air Lock	1	A rotary airlock will be supplied to isolate the heated air in the dryer from the outside environment at the dryer extraction screw. The rotary airlock is detailed as follows: ● Detailed as: ○ 839 lb/hr, 15-21 pcf ○ Model CI-QC 10 x 10 ○ Cast iron housing and endplates ○ Outboard bearings ○ Square inlet/outlet flanges, 10” ○ ACST-4 shaft seal assembly c/w air purge connections (plugged) ○ 8-vane open end mild steel rotor assembly ○ Fixed edge mild steel rotor tips – beveled ○ Quick Take Apart CLAMP ENTRY SYSTEM, (4) vertical toggle pull action clamps hand operated, rotor and endplate removable without tools, for cleaning on slide rail system including slider bars with stainless steel linear bearings with alignment tab ○ 1 HP direct drive assembly including TEXP enclosure, 460 volt, 3 phase, 60 cycle c-face explosion proof Toshiba motor (Div 1, Class II, Groups F&G), SEW reducer, motor mount, completely factory assembled. Final drive RPM is 20. ○ Inlet flat style shear protector, mild steel construction ○ Paint ACS Blue
Valves	LOT	Automated Valves: ● Four (4) – Pressure Equalizing Valve, 4" full port ball valve ● Four (4) – Cleaning Valve, 1" standard port ball valve ● One (1) - Warm Zone Sprinkler Water Control Valve, 1.25” ● One (1) - End Zone Sprinkler Water Control Valve, 2” ● One (1) - Condenser Water Control Valve, 3” ● One (1) - Condenser Mist Eliminator Control Valve, 1.5” ● One (1) - Drying Air Treatment HTX CIP Valve, 1” Manual Valves: ● Eight (8) – 1" Manual Ball Valve for Dosing Pump Manifold flushing ● Eight (8) - 2.5” Manual Ball Valve for Dosing Pump Isolation (suction) ● Eight (8) – 1" Manual Ball Valve for Sludge Depositor Station ● Twenty-four (24) – 1.5" Manual 3-way valve ● Two (2) – nozzle cleaning station valve, 1" ● Three (3) – nozzle cleaning station valve, 0.5"
Extraction Screw	1	An extraction screw conveyor transports product from the dryer to the rotary air lock. The following equipment is included as part of the extraction screw conveyor: ● Extraction Screw Conveyor ○ 12” dia. shafted screw X 25’-10.3” long. ○ Trough, CEMA 13” Dia. T-304ss, 3/16” thick pl. ○ Three (3) 0.75 in. NPT half couplings for thermocouples ○ Inlet 19’-10.3” long, flanged for connection to dryer. ○ Flights T-304ss, full pitch, 0.25” thick, sectional. Notched flights for thermocouples ○ Shaft, 8” pipe sched. 40 T-304ss. ○ Discharges, two places, 12” square. This includes one (1) intermediate discharge clean out with shroud, blind flange, with quick connect hardware & handle ○ Covers, 12 ga. T-304 bolted. Hinged cover with limit switch, Class II. Div. I. ○ Fasteners & Hardware, T-304ss. ○ Supports to floor, one pair, T-304ss, plates and shapes. ○ Drive System: Nord or SEW Eurodrive AGMA Class II service FA shaft mounted ○ gearboxes, drive shaft, adapter, packing gland seal. ○ Motor, 1 Hp 230/460 v. 3 ph. 60 hz.TEFC 1800 rpm. Inverter Duty, Class II. Div. I

		○ Emergency stop switch and cables, RS-2, NEMA 4X ○ Zero speed switch, Milltronics, NEMA 4X

Thermal Fluid Heating System	1	The thermal fluid heating system will be used to heat thermal fluid to be used to heat the BioCon dryer. This thermal fluid system will be on a standalone skid and the heated thermal fluid will be pumped to the dryer cabinet. Thermal Fluid will be circulated by a centrifugal pump to the warm zone and end zone heat exchangers in the Biocon. Two 3-way valves will modulate and distribute the correct flow to each zone of the dryer by temperature setpoints. The following equipment is included as part of Kruger's Thermal Fluid Heating System: ● Each thermal fluid heater, detailed as: ○ Manufacturer: Fulton ○ Model: FT-C 0600 ○ Fuel source: Natural gas ○ Output: 6,000,000 BTU/hr ○ NEMA 12 Control Panel ● Primary Loop (Warm Zone) ○ Two (2) centrifugal pumps (1 duty, 1 shelf spare) for circulation of thermal fluid, detailed as: ○ Manufacturer: RA 3000 Centrifugal Pump, rated for 375 gpm ○ Flow Rate: 242 gpm ○ Motor: 40 HP, 460V / 3ph / 60 Hz, 3600 RPM, TEFC with motor starter. ● Two (2) centrifugal pumps (1 duty, 1 shelf spare) for circulation of thermal fluid in end zone, detailed as: ○ Manufacturer: Dean Centrifugal Pump ○ Flow: 221 gpm ○ Motor: 15 HP, 460V / 3ph / 60 Hz, 3600 RPM, TEFC with motor starter. ● One (1) deaerator cold-seal expansion tank (FT-1000-L), detailed as: ○ Includes Liquid Level Switch ○ Sight glass ○ 264 gal capacity ○ Suitable for total system fluid content of 1000 gal ● One (1) 200 gal catch tank (supplied loose) ● One (1) ¾ HP, 5 gpm drain/fill pump (supplied loose) ● Each zone will have two (2) three way valves for thermal fluid flow control, controlled by local control in conjunction with temperature sensors. ● One (1) stack temperature switch with alarm horn ● Fuel train built to the requirements of NFPA85 ● Nitrogen Blanket Kit (for code tanks, outdoor installations, etc.) – including a loose safety relief valve, a loose spool piece with a 2" bubble tight ball valve, and a loose, assembled N2 kit: 2-way nitrogen regulator, 2-way nitrogen back pressure regulator, check valve, and pressure gauge

3.2. INSTRUMENTATION AND CONTROLS

Allen-Bradley ControlLogix processor based control panels will be supplied as described herein to control the BioCon system based on operator set points. All I/O will be wired to field terminations as required.

Each PLC Control Panel will include the necessary input/output plus twenty percent (20%) “Live” spare wired signals for future or additional signal interface.

All PLC and Operator Interface programming are based on Kruger standards. Any requests or requirements that would deviate from this standard will result in additional costs. Kruger will be providing PLC/Operator Interface programming only for the Kruger supplied PLC Control Panel.

The PLC Program and Operator Interface Program and its associated Graphic screens developed by Kruger are for use on the Kruger supplied PLC and Operator Interface only. The Kruger supplied PLC Program and Operator Interface Program and its associated Graphic screens cannot be used, whole or any part for other uses.

Kruger will use Allen Bradley development software for PLC Programming and Operator Interface Programming; the development software is licensed to Kruger and will not be provided as part of this scope. Kruger will not be providing any PLC, Network, Operator Interface, SCADA, or Alarm Notification software.

Kruger will supply copies of the completed PLC and Operator Interface programs at job completion. Prior to supplying completed PLC and Operator Interface programs, Kruger requests that a non-disclosure agreement be signed and returned to Kruger.

Factory testing of the Kruger PLC Control Panel will be conducted by Kruger personnel at a Kruger selected Panel Facility. Kruger reserves the right to conduct this testing when it is deemed appropriate in regards to Kruger personnel. Kruger has an established Panel testing criteria and will conduct all Panel and Software testing per Kruger standards. When said Panel/Software testing is complete, a Test Report will be generated per Kruger standards. Other party’s are welcome to witness panel testing at no expense to Kruger. Testing can be witnessed at an agreed upon date that does not impact delivery or start-up schedules.

No other Instruments, Control Panel Components (PLC or other components) will be supplied unless they are explicitly listed in this Scope of Supply.

The control panel will be completely assembled, tested, and programmed for the required functionality. The U.L. labeled panel will be comprised of the following:

BioCon Control Panel

Qty	Description	Manufacturer
1	NEMA 12 Painted Carbon Steel 90”H x 72”W x 24”D Freestanding Panel (SCE-907224FSD) For use in an indoor, climate controlled, non-classified environment.	Saginaw
1	Back Panel for Control Panel 78”H x 68”W (SCE-90P72F1)	Saginaw
1	19” In-Panel Widescreen Touchscreen PC Computer (6200P-19WS3C1)	Versaview
1	Control Logix PLC Processor (1756-L72)	Allen Bradley
3	Control Logix PLC Ethernet Module (1756-EN2T)	Allen Bradley
2	Control Logix PLC 17 Slot Chassis (1756-A17)	Allen Bradley
2	Control Logix PLC Power Supply (1756-PA72)	Allen Bradley
11	Control Logix PLC Digital Input Module 16PT 24VDC (1756-IB16)	Allen Bradley
4	Control Logix PLC Digital Output Module 16PT 24VDC (1756-OB16I)	Allen Bradley
4	Control Logix PLC Analog Input Module 16PT 4-20mA (1756-IF16)	Allen Bradley
2	Control Logix PLC Analog Output Module 8PT 4-20mA (1756-OF8)	Allen Bradley
1	eWON Flexy Device for Remote Access	eWON
1	120 VAC Surge Protector (28 56 70 2)	Phoenix Contact
AR	Circuit Breakers	Square D
4	24VDC 5A Power Supply (QUINT-PS-100-240AC/24DC/5)	Phoenix Contact
64	4-20mA to 4-20mA Analog Isolator (28 64 40 6)	Phoenix Contact
40	4-20mA Analog Surge Arrestor (PT2x2 24DC ST)	Phoenix Contact
40	4-20mA Analog Surge Arrestor Base Element (PT2x2 24DC BE)	Phoenix Contact
240	Double Level Field Terminal Block (UTT B4)	Phoenix Contact
64	Interposing Relay w/Base for Digital Outputs	Allen Bradley
1	Uninterruptible Power Supply 1500VA	APC
1	Ethernet Switch 6 Port 10/100 Base T 2 SC Fiber Optic Port Industrial Ethernet Switch (708FX2-SC)	N-Tron
64	Intrinsic Safety Barriers (KFD2/KCD2)	Pepperl + Fuchs
1	Cabinet Light	Simkar
1	Convenience Outlet	Phoenix Contact
AR	Misc. Wire and Panduit	
1	Completed Panel Shop Tested and UL Labeled	Kruger
1	PLC /Operator Interface Programming for Kruger PLC	Kruger

NOTE: AR means As Required. The quantity of these items will be determined at the time of panel construction.

BioCon Motor Disconnect Switches

Qty	Description	Manufacturer
8	30A 480VAC Motor Disconnect, Lockable Rotary Handle, NEMA 4X Polycarbonate Enclosure 6”H x 4”W x 4.5”D (MD3304X)	Square D

BioCon Dosing Platform Junction Box

Qty	Description	Manufacturer
1	NEMA 4X 304 Stainless Steel Panel 16”H x 14”W x 8”D (SCE-16148ELJtiflo Termination Box16)	Saginaw
1	Back Panel for Control Panel 15”H x 13”W (SCE-16P14L)	Saginaw
32	Double Level Field Terminal Block (UT4)	Phoenix Contact
1	Ground Bar	Square D
AR	Misc. Wire and Wire Duct	
1	Completed Panel Shop Tested and UL Labeled	Kruger

Kruger shall supply the field instruments as described herein.

BioCon Field Instruments

Qty	Description	Manufacturer
15	24VDC Loop Powered Pressure Transmitter Cerabar S PMC71 PIT-1103 Wet Cake Pumps 1 Inlet PIT-1104 Wet Cake Pumps 2 Inlet PIT-1121 Wet Cake Pumps 1 Discharge PIT-11122 Wet Cake Pumps 2 Discharge PIT-2110 Dosing Header 1 PIT-2120 Dosing Header 2 PIT-2131 Dosing Pump 1 Discharge PIT-2132 Dosing Pump 2 Discharge PIT-2133 Dosing Pump 3 Discharge PIT-2134 Dosing Pump 4 Discharge PIT-2135 Dosing Pump 5 Discharge PIT-2136 Dosing Pump 6 Discharge PIT-2137 Dosing Pump 7 Discharge PIT-2138 Dosing Pump 8 Discharge PIT-3100 Dryer Inlet	Endress + Hauser
2	Limit Switch 9007ML02S0300 ZA-2139A Depositor Forward Over Travel Limit ZA-2139D Depositor Reverse Over Travel Limit	Square D
2	Proximity Sensor BI10S-Q26-AD4X/S34 ZS-2139B Depositor Forward Travel Limit ZS-2139C Depositor Reverse Travel Limit	Turck
2	24VDC Loop Powered Temperature Transmitter w/Thermowell iTemp TMT162, TH13 TIT-5100 Condenser Inlet Water TIT-5105 Condenser Water (Drain)	Endress + Hauser
11	24VDC Loop Powered Temperature Transmitter w/Thermowell iTemp TMT162, TH11 TIT-3128 Warm Zone Heat Exchanger Outlet TIT-3129 End Zone Heat Exchanger Outlet TIT-3118 Warm Zone Heat Exchanger Inlet TIT-3119 End Zone Heat Exchanger Inlet TIT-3116 Extraction Screw Temperature 1 TIT-3126 Extraction Screw Temperature 2 TIT-3136 Extraction Screw Temperature 3 TIT-5106 Condenser Inlet Air TIT-5107 Condenser Outlet Air TIT-5111 Drying Air HTX (Outlet to Dryer) TIT-5112 Drying Air HTX (Inlet from Dryer)	Endress + Hauser
8	Temperature Switch LTS-N4-G-00-120-XNH TSH-3150 Warm Zone High Temp 1 TSH 3160 Ware Zone High 2 TSH-3130 End Zone Top Belt High Temp 1 TSH-3140 End Zone Top Belt High Temp 2 TSH-3110 End Zone Bottom Belt High Temp 1 TSH-3120 End Zone Bottom Belt High Temp 2 TSH-3115 Extraction Screw Hopper High Temp 1 TSH-3125 Extraction Screw Hopper High Temp 2	Ashcroft
2	Inductive Sensor/Low Velocity Switch XS618B1MAL2	Square D

	SSL-3101 Top Belt Drive Low Speed SSL-3102 Bottom Belt Drive Low Speed	
3	Photo Electric Sensor 42GRL-9540/42GRR-9500 LSH-3111/3121 Warm Zone Top Belt High Level LSH-3112/3122 End Zone Top Belt High Level LSH-3115/3125 Extraction Screw Hopper High Level	Allen Bradley
4	Differential Pressure 2000 Red Gage PDI-3103 Warm Zone HTX PDI-3104 End Zone HTX PDI-5102 Fan Pressure PDI-5109 Fan Pressure	Dwyer
4	Differential Pressure Transmitter PMD75 PDIT-5102 Condenser Column PDIT-5103 Condenser Column PDIT-5110A Air Pre-Heater/Cooler PDIT-5110B Air Pre-Heater/Cooler	Endress + Hauser
1	3” Magnetic Flowmeter w/Transmitter 400W FE/FIT-5101 Condenser Inlet Water Flow	Endress + Hauser
2	Infrared Temperature Transmitter with Type K Thermocouple 10-K-240F/120C TIT-3112 Bottom Belt Temperature 1 TIT-3122 Bottom Belt Temperature 2	Exergen
16	Pressure Gauge 45-1279 w/Diaphragm Seal 50-201-SS PI-2112 Dosing Pump 1 Manifold 1 PI-2113 Dosing Pump 1 Manifold 2 PI-2122 Dosing Pump 2 Manifold 1 PI-2123 Dosing Pump 2 Manifold 2 PI-6100 Sprinkler Water PI-6001 Nozzle Cleaning Station PI-5111 Demister Pressure 1 PI-5121 Demister Pressure 2 PI-5131 Demister Pressure 3 PI-5112 Condenser Water Pressure 1 PI-5122 Condenser Water Pressure 2 PI-5132 Condenser Water Pressure 3 PI-3103A Air Plenum Warm Zone 1 PI-3103B Air Plenum Warm Zone 2 PI-3104A Air Plenum End Zone 1 PI-3104B Air Plenum End Zone 2	Ashcroft
2	Level Switch LS-7 Type 9 (164870) LSH-3107 Extraction Screw (Dry Product) LSH-5104 Condenser Water Drain	GEMS
1	Pressure Switch w/Diaphragm B424B100 PSL-6100 Sprinkler Water	Ashcroft
1	Instrument Start-Up and Calibration	Kruger

Kruger will calibrate and start-up instruments supplied by Kruger. Instruments supplied by others will require calibration and start-up by others.

3.3. SPARE PARTS

All spare parts for the BioCon dryer system can be available within three days.

There are no included spare parts in Kruger's Scope of Supply.

4. SCOPE OF WORK

Kruger is responsible for process design and equipment procurement required for the BioCon system. Kruger's scope of work does not include any equipment, materials or other services not specifically defined in Kruger's RFP Response.

4.1. PROCESS DESIGN AND ENGINEERING

Kruger shall perform engineering in accordance with the applicable national codes, standards, and/or regulations (except where otherwise noted) in effect at the time of this proposal. Additionally, Kruger shall provide all necessary design, installation, and operating information for equipment within its stated scope of supply. Kruger is not responsible for the design, selection, installation, operation, or maintenance of any material, equipment, or services provided by others.

Kruger shall provide installation instruction and onsite advice. Kruger shall not supervise or assist directly.

Kruger shall provide process engineering and design support for the system as follows:

- Equipment specification for all equipment supplied by Kruger
- Technical instruction for operation and start-up of the system
- Equipment layout drawings
- Equipment installation instructions O&M manuals

4.2. FIELD SERVICE

Kruger shall supply the following services of system trained representatives as detailed herein:

Purpose	Trips
Technical Representative to Guide Contractor Through Installation	Twenty (20) man-days in not more than four (4) trips
Field Testing & Performance Testing	Twenty (20) man-days in not more than four (4) trips
System Training	Twenty-five (25) man-days in not more than five (5) trips
Follow-Up Training	Five (5) man-days in not more than one (1) trip
Control System Training	Two (2) man-days in not more than one (1) trip

4.3. ONE YEAR SDSS SERVICE AGREEMENT

Kruger shall include support services required to implement the project and assist with operations during the first year of operation. Kruger shall supply the following:

- Four (4) site visits, One (1) 8-hour day on-site during each visit, including Instrumentation troubleshooting and PLC programming support.

NOTES:

- Man-days are eight hour days Monday through Friday that include travel time.
- Kruger will remain onsite generally 8-12 hours per day Monday through Friday to commission and optimize the dryer system.
- As we are ready to conduct the performance test, Kruger will bring additional staff to run the dryer during a series of trial performance tests over 24 hour periods.
- The plant staff and/or contractor shall perform maintenance such as replacement of rotors, seals and/or stators for PC pumps and replacement of fan belts during commissioning and performance test.
- Man-days and/or trips required beyond those indicated above will be billed at Kruger's published standard rates at time of service, plus travel and lodging costs. Such additional days could become necessary for correction of improperly installed equipment or instrumentation, prolonged construction time, or Contractor's failure to properly coordinate start-up and training.

4.4. SCOPE OF SUPPLY BY OTHERS

The following items are NOT included in the scope of supply for the BioCon™ system and should be provided for by the Installing Contractor/Purchaser of the system unless explicitly stated as included in the above scope of supply. These items include, but are not necessarily limited to, the following items:

- One, Skid-mounted natural gas fired thermal fluid heater as specified by Kruger.
- 2 Duty Main Feed pumps as specified by Kruger.
- Odor Control
- Concrete foundations, dryer service pad (per Kruger spec), equipment pads, tanks, structural components, vents / stacks, and covers.
- Walkways, stairs, platforms, handrail, and grating not specifically noted in Kruger scope of supply.
- Equipment installation.
- Wet Cake Bin.
- Thermal panels and support frames are erected on site by the installation contractor.
- Flashing to seal off the various zones of the dryer as well as to limit infiltration.
- Assembly of Dryer, Thermal Panel Enclosure, and I-Beam frame.
- Assembly of platforms in the field. Platforms, stairs, and legs will be shipped in 12 sections and any reconnection points will be labeled.
- Piping to and from the dryer system, including but not limited to interconnecting piping, sprinkler piping outside of the dryer cabinet, condenser drain and P-trap piping, condenser water supply

piping, P-trap and drain piping for drying air treatment fan and vacuum fans, P-trap and drain piping for ducting to and from drying air treatment HTX (4 total).

- Thermal Oil Skid System (please refer to Kruger Specification Section “Thermal Fluid System” regarding vent piping, interconnecting piping between pressure relief valves and catch tank, between DA tank and catch tank and between skid and dryer, pipe and skid insulation and cladding, equipment installation, loose/fill pump installation, nitrogen cylinder supply and installation and wiring.
- Paratherm HE thermal fluid or equal shall be used (Oil Supply and Fill by OTHERS). SYSTEM SUPPLIER will specify the quantity of oil.
- Manual or automatic modulating or isolation valves in interconnecting piping including but not limited to instrument air piping, wet cake piping, thermal fluid piping, water piping; fan, duct, and dryer drains.
- Condenser service water pumps are not included, the intent is to simply use existing plant water supply to the condenser.
- Flange gaskets, expansion joints and hardware for interconnecting piping and ductwork.
- Anchor bolts, epoxy/adhesive for anchors.
- Drain piping for Dosing Manifold, nozzle cleaning station, all condensation drain piping and valves for fans and/or ductwork.
- Influent sludge pumping, influent screening and grit removal facilities.
- Solids handling/disposal system.
- Motor control center, motor starters, adjustable frequency drives, main disconnects, breakers, generators, or power supply.
- Field wiring, interconnecting wiring, conduit, wiring terminations at equipment, local equipment disconnects, local equipment control panels, junction boxes, and wiring terminations at control panels.
- All electrical and mechanical hardware with the exception of the equipment that is identified above.
- All interconnecting ductwork (with insulation) and expansion joints between dryer cabinet, condenser and fans.
- All work associated with buildings or other structures used for housing any part of the system provided, including HVAC and electrical work.
- Insulation and cladding for ductwork, condenser, thermal fluid skid and interconnecting piping, dryer circulation fans, extraction screw.
- Supply and fill of thermal fluid into thermal fluid system.
- All lubrication for bearings, gearboxes, pumps and sealing fluids.
- All instrument air piping and associated isolation valves.
- Air Compressor system to actuate actuated valves.
- All PE stamps required for the project.

5. TERMS OF SALE

1. Applicable Terms. These terms govern the purchase and sale of the equipment and related services, if any (collectively, "Equipment"), referred to in Seller's purchase order, quotation, proposal or acknowledgment, as the case may be ("Seller's Documentation"). Whether these terms are included in an offer or an acceptance by Seller, such offer or acceptance is conditioned on Buyer's assent to these terms. Seller rejects all additional or different terms in any of Buyer's forms or documents.
2. Payment. Buyer shall pay Seller the full purchase price as set forth in Seller's Documentation. Unless Seller's Documentation provides otherwise, freight, storage, insurance and all taxes, duties or other governmental charges relating to the Equipment shall be paid by Buyer. If Seller is required to pay any such charges, Buyer shall immediately reimburse Seller. All payments are due within 30 days after receipt of invoice. Buyer shall be charged the lower of 1 ½% interest per month or the maximum legal rate on all amounts not received by the due date and shall pay all of Seller's reasonable costs (including attorneys' fees) of collecting amounts due but unpaid. All orders are subject to credit approval.
3. Delivery. Delivery of the Equipment shall be in material compliance with the schedule in Seller's Documentation. Unless Seller's Documentation provides otherwise, Delivery terms are F.O.B. Jobsite.
4. Ownership of Materials. All devices, designs (including drawings, plans and specifications), estimates, prices, notes, electronic data and other documents or information prepared or disclosed by Seller, and all related intellectual property rights, shall remain Seller's property. Seller grants Buyer a non-exclusive, non-transferable license to use any such material solely for Buyer's use of the Equipment. Buyer shall not disclose any such material to third parties without Seller's prior written consent.
5. Changes. Seller shall not implement any changes in the scope of work described in Seller's Documentation unless Buyer and Seller agree in writing to the details of the change and any resulting price, schedule or other contractual modifications. This includes any changes necessitated by a change in applicable law occurring after the effective date of any contract including these terms.
6. Warranty. Subject to the following sentence, Seller warrants to Buyer that the Equipment shall materially conform to the description in Seller's Documentation and shall be free from defects in material and workmanship. The foregoing warranty shall not apply to any Equipment that is specified or otherwise demanded by Buyer and is not manufactured or selected by Seller, as to which (i) Seller hereby assigns to Buyer, to the extent assignable, any warranties made to Seller and (ii) Seller shall have no other liability to Buyer under warranty, tort or any other legal theory. If Buyer gives Seller prompt written notice of breach of this warranty within 18 months from delivery or 1 year from beneficial use, whichever occurs first (the "Warranty Period"), Seller shall, at its sole option and as Buyer's sole remedy, repair or replace the subject parts or refund the purchase price therefore. If Seller determines that any claimed breach is not, in fact, covered by this warranty, Buyer shall pay Seller its then customary charges for any repair or replacement made by Seller. Seller's warranty is conditioned on Buyer's (a) operating and maintaining the Equipment in accordance with Seller's instructions, (b) not making any unauthorized repairs or alterations, and (c) not being in default of any payment obligation to Seller. Seller's warranty does not cover damage caused by chemical action or abrasive material, misuse or improper installation (unless installed by Seller). THE WARRANTIES SET FORTH IN THIS SECTION ARE SELLER'S SOLE AND EXCLUSIVE WARRANTIES AND ARE SUBJECT TO SECTION 10 BELOW. SELLER MAKES NO OTHER WARRANTIES OF ANY KIND, EXPRESS OR IMPLIED, INCLUDING WITHOUT LIMITATION, ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR PURPOSE.
7. Indemnity. Seller shall indemnify, defend and hold Buyer harmless from any claim, cause of action or liability incurred by Buyer as a result of third party claims for personal injury, death or damage to tangible property, to the extent caused by Seller's negligence. Seller shall have the sole authority to direct the defense of and settle any indemnified claim. Seller's indemnification is conditioned on Buyer (a) promptly, within the Warranty Period, notifying Seller of any claim, and (b) providing reasonable cooperation in the defense of any claim.
8. Force Majeure. Neither Seller nor Buyer shall have any liability for any breach (except for breach of payment obligations) caused by extreme weather or other act of God, strike or other labor shortage or disturbance, fire, accident, war or civil disturbance, delay of carriers, failure of normal sources of supply, act of government or any other cause beyond such party's reasonable control.
9. Cancellation. If Buyer cancels or suspends its order for any reason other than Seller's breach, Buyer shall promptly pay Seller for work performed prior to cancellation or suspension and any other direct costs incurred by Seller as a result of such cancellation or suspension.
10. LIMITATION OF LIABILITY. NOTWITHSTANDING ANYTHING ELSE TO THE CONTRARY, SELLER SHALL NOT BE LIABLE FOR ANY CONSEQUENTIAL, INCIDENTAL, SPECIAL, PUNITIVE OR OTHER INDIRECT DAMAGES, AND SELLER'S TOTAL LIABILITY ARISING AT ANY TIME FROM THE SALE OR USE OF THE EQUIPMENT SHALL NOT EXCEED THE PURCHASE PRICE PAID FOR THE EQUIPMENT. THESE LIMITATIONS APPLY WHETHER THE LIABILITY IS BASED ON CONTRACT, TORT, STRICT LIABILITY OR ANY OTHER THEORY.
11. Miscellaneous. If these terms are issued in connection with a government contract, they shall be deemed to include those federal acquisition regulations that are required by law to be included. These terms, together with any quotation, purchase order or acknowledgement issued or signed by the Seller, comprise the complete and exclusive statement of the agreement between the parties (the "Agreement") and supersede any terms contained in Buyer's documents, unless separately signed by Seller. No part of the Agreement may be changed or cancelled except by a written document signed by Seller and Buyer. No course of dealing or performance, usage of trade or failure to enforce any term shall be used to modify the Agreement. If any of these terms is unenforceable, such terms shall be limited only to the extent necessary to make it enforceable, and all other terms shall remain in full force and effect. Buyer may not assign or permit any other transfer of the Agreement without Seller's prior written consent. The Agreement shall be governed by the laws of the State of North Carolina without regard to its conflict of laws provision.

Attachment 1:

Process Performance Guarantee

PROCESS PERFORMANCE SPECIFICATION

I. Definitions

A. Supplier: Veolia Water Technologies, Inc. dba Kruger

B. Purchaser: Shall mean the party that has or will enter into a Contract or Purchase Order with Supplier for the purchase of the Equipment.

C. System Stability: Is achieved when the Basis of Design conditions being met, the system appears to be acclimated to the biosolids that it is intended to treat, the System's unit operations are treating the load being provided and appear to be functioning at acceptable operating conditions, and the System is being operated with proper pre-treatment, pre-conditioning, or chemical conditioning as instructed by Supplier.

D. System: The facility at which the Supplier's Equipment is to be installed inclusive of upstream and downstream Equipment and appurtenances.

E. Equipment: Equipment provided by the Supplier upon which the Process Guarantee applies.

II. Basis of Design

A. Purchaser hereby agrees to and certifies the Basis of Design is as provided in Annex A.

III. Process Guarantee

A. The Process Guarantee as defined in Annex B shall be conclusively and finally demonstrated through the successful completion of the Performance Test as described herein.

B. Supplier's obligation to comply with the Process Guarantee is strictly subject to and conditioned on the following criteria in effect during start up, operation and Performance Test periods:

1. The inlet solids are in compliance with the Basis of Design in accordance with Annex A ("Compliant Inlet Conditions").

2. The operation of the System is in accordance with Supplier's Operation and Maintenance manual and/or Supplier's direction.

3. Purchaser allowing Supplier access to the site and any and all data deemed relevant by Supplier and documentation for the facility and its operation.

4. Remote access monitoring at Supplier's discretion.

5. All existing equipment and facilities of Purchaser are in good condition and free of defects.

6. System Stability is achieved as deemed by Supplier.

C. A Performance Test Protocol shall be provided by Supplier at least 60 days before the start of feeding inlet solids to the Equipment.

IV. Performance Test:

A. Activities and responsibilities

1. During start-up, operation and Performance Test periods, the Purchaser shall be responsible to provide trained, competent operators who will operate the facility in accordance with Section III(B)(2) above.

2. Purchaser shall be responsible and bear all costs for collecting all samples, carrying out all laboratory analysis or other tests, and furnishing all necessary labor, laboratory equipment, and supplies.

3. The Performance Test shall commence no later than 7 days after Supplier's written notice to Purchaser that System Stability has been reached.

4. The Performance test shall consist of one, 48-hour continuous performance test.

5. If by one (1) month after the Equipment is ready to accept inlet solids, the design loading is not available, the Performance Test may be conducted on as much inlet solids as is available.

6. This Performance Guarantee will be considered fully satisfied upon completion of the Performance Test demonstrating that the Equipment meets the Outlet Objectives as defined in Annex B.

7. During the Performance Test, if operations are interrupted for the maintenance, repair or replacement of Equipment necessary to the Performance Test, the Equipment shall be repaired or replaced (at the cost of the party who is responsible for the damage) and only the remaining portion of the Performance Test will be completed.

8. Upon successful completion of the Performance Test, Supplier shall execute and submit a performance test report to the Purchaser. The effective date for acceptance shall be the date the Performance Test was completed and shall be confirmed in writing in accordance with the specifications.

B. Unavailability of compliant inlet conditions or other obstacles to the Performance Test

1. Non-Compliant Inlet Conditions. Any change in the Basis of Design conditions provided in Annex A may have a negative impact on the performance of Supplier's Equipment. It is therefore agreed by the Parties that: (i) the Purchaser shall inform Supplier of any such changes in a timely manner in order to allow the Parties to assess any impact on the Basis of Design and/or the performance of Supplier's Equipment; (ii) Supplier shall assess the consequences of such changes on the Performance Guarantee and/or Performance Test; and (iii) the parties shall meet to try to agree on any required revisions to the Performance Guarantee and/or Contract.

2. If, after the commencement of the Performance Test, the Purchaser is unable to deliver Compliant Inlet Conditions to the Equipment, the Supplier shall attempt to treat the Non-Compliant Inlet Conditions, while Purchaser makes every effort to bring the Inlet Conditions into compliance. Supplier shall assist Purchaser and use commercially reasonable efforts to adjust Equipment and/or operating and maintenance guidelines to optimize performance of the Equipment under the prevailing conditions.

3. Despite the efforts described above, if after the commencement of the Performance Test, any daily inlet Conditions composite samples taken during such Test are Non-Compliant Inlet Conditions, then that day's results and any following days impacted will be excluded from the Performance Test's final results and that day(s) will be considered passed.

4. Disagreement over Compliant Inlet Conditions. Should the Parties disagree on whether the Inlet Conditions is Compliant Inlet Conditions or not, Supplier may take additional Inlet Conditions and Dry Conditions samples and conduct laboratory testing at a mutually agreed upon 3rd party laboratory, and as applicable, either the Performance Test will be delayed (if not yet commenced) or the Performance Test will be rescheduled. The Contract Schedule and date of the Performance Test will be adjusted accordingly as provided in the applicable section of the Contract, until the results of such laboratory tests are issued. If the laboratory testing confirms the Inlet Conditions is Non-Compliant Inlet Conditions, Purchaser shall reimburse Supplier for its costs and expenses.

5. Should the Performance Test fail due to reasons not attributable to Supplier (other than non-compliant Inlet Conditions), at Purchaser's request, cost and expense, Supplier may agree to conduct a subsequent Performance Test.

6. Should the Purchaser be unable or unwilling to conduct the Performance Test within 12 months from delivery of Supplier's Equipment, the requirement to conduct a Performance Test and the Process Guarantee will be deemed met and Purchaser will execute the Certificate of Acceptance. At Purchaser's request, cost and expense, Supplier may agree to extend the time period to conduct the Performance Test.

C. Failure of the Performance Test due to Supplier

1. Should the Performance Test fail due to reasons attributable to Supplier, Supplier will be given the opportunity and a reasonable time to adjust or modify the System in accordance with Supplier's scope of supply, or to modify the operating protocols of the System, provided such operating protocols are in accordance with good engineering practices. Supplier shall be granted two (2) additional opportunities to successfully complete a Subsequent Performance Test. All such adjustments, modifications and additional testing shall be done at Supplier's expense.

2. In the event that the Equipment fails to meet the Process Guarantee following Supplier's efforts as described in the preceding paragraph, Supplier's sole obligation and Purchaser's sole remedy shall be to replace or modify the Equipment, as Supplier deems appropriate to enable the Equipment to meet the Process Guarantee, subject to the limitation of liability set forth in the Contract.

V. Test Methods and Sampling Requirements

A. The following Sampling and Analytical Parameters table provides the minimum parameters for sampling and analysis. Supplier reserves the right to witness the sampling and testing and to take portions of the samples for analysis in its own laboratories.

B. The publication, Standard Methods for Examination of Water and Wastewater, most recent edition, shall be used as the primary laboratory and analytical procedure source, unless otherwise agreed to by Supplier. All other analyses, data reduction or tests not specified in that publication or otherwise specified shall be carried out using procedures furnished or approved by Supplier.

Sampling and Analytical Parameters	
Parameter	Units
Sludge Cake Loading	lb cake/hr
Inlet Solids Composition	% (Method SM 2540G)
Outlet Solids Composition	% (Method SM 2540G)

VI. Extended Performance Warranty

A. Kruger has excluded the specified 5 year Process Performance Warranty required by the RFP from the scope and price provided herein due to the fact that Kruger will not be contracted by the Owner to operate or maintain the plant. Kruger can provide an extended Performance Warranty with the purchase of a service contract extending through the Performance Warranty Period as mutually agreed to between Kruger and Owner.

ANNEX A – BASIS OF DESIGN

Purchaser hereby agrees to the Basis of Design as defined herein, confirms its accuracy and completeness, and agrees that it shall serve as the basis for the Process Guarantee as provided in Annex B.

I. Compliant Inlet Conditions:

Parameter	Value	Units
Sludge Cake Loading	4,821	lb cake/hr
Inlet Solids Composition	16	%
Condenser Feed Water Consumption	145 @ 77	gpm @ °F

A. Conditions and Clarifications:

1. The average Inlet Solids Composition during the duration of the performance test shall not be less than 16%.

2. Purchaser shall provide enough sludge to conduct the performance test as defined herein.

3. Condenser Feed Water shall be fed continuously at a minimum of 50 psig. Supplied condenser water shall contain less than 20 mg/L TSS, 5 grains/gal total hardness and 10 ppm iron and magnesium, pH between 6.5 and 7.5, and alkalinity (CaCO3) under 200 mg/L.

4. The following sludge parameters must be met including being form stable on the belt (i.e. must not fall through the belt).

Parameter	Unit	Min	Max
Organic Content	%DS	50	80
Total Fiber Content	%DS	0	20
Particles	mm		6
pH		6.5	7.5
Fat and Grease	mg/kg DS	0	50,000
Chloride - total	mg/kg DS	0	2,500

ANNEX B – PROCESS GUARANTEE

Supplier warrants and represents that during the Performance Test, the Equipment will produce dry solids while meeting the objectives listed in the table below:

I. Compliant Outlet Composition:

Outlet Objectives	Avg	Units
Outlet Solids Composition	>90	%
Outlet Solids Quality	Class A	-

A. Conditions and Clarifications:

1. Kruger guarantees the BioCon Dryer will achieve Class A compliance in accordance with one of the two EPA 40 CFR Part 503 Alternatives:

   a. Alternative 5 (Biosolids Treated in a PFRP): Kruger guarantees that the drying process fully complies with these requirements. Specifically, the drying process dries sludge by direct contact with hot gases (air) to produce a product containing less than 10 percent moisture while exceeding a particle temperature of 80 °C (176 °F). The drying process control system shall continuously monitor particle temperature of the dried product via infrared temperature probes at the discharge end of the bottom belt.

   b. Alternative 1 (time/temperature): Kruger guarantees that the drying process fully complies with these requirements. Specifically, the drying process dries sludge by direct contact with hot gases (air) to produce a product containing less than 10 percent moisture while exceeding a particle temperature of 80 °C (176 °F) over 20 min. The drying process control system shall continuously monitor particle temperature of the dried product via two infrared temperature probes, one at the discharge end of the bottom belt and one upstream.

VEOLIA

Attachment 2:

Certificate of Insurance

ACORD

CERTIFICATE OF LIABILITY INSURANCE

DATE (MM/DD/YYYY): 12/12/2019

THIS CERTIFICATE IS ISSUED AS A MATTER OF INFORMATION ONLY AND CONFERS NO RIGHTS UPON THE CERTIFICATE HOLDER. THIS CERTIFICATE DOES NOT AFFIRMATIVELY OR NEGATIVELY AMEND, EXTEND OR ALTER THE COVERAGE AFFORDED BY THE POLICIES BELOW. THIS CERTIFICATE OF INSURANCE DOES NOT CONSTITUTE A CONTRACT BETWEEN THE ISSUING INSURER(S), AUTHORIZED REPRESENTATIVE OR PRODUCER, AND THE CERTIFICATE HOLDER.

IMPORTANT: If the certificate holder is an ADDITIONAL INSURED, the policy(ies) must have ADDITIONAL INSURED provisions or be endorsed. If SUBROGATION IS WAIVED, subject to the terms and conditions of the policy, certain policies may require an endorsement. A statement on this certificate does not confer rights to the certificate holder in lieu of such endorsement(s).

PRODUCER Marsh USA, Inc. 540 W. Madison Street Chicago, IL 60661 Attn: Veolia.CertRequest@marsh.com | Fax: 212-948-5053 5700	CONTACT NAME: PHONE (A/C, No, Ext): FAX (A/C, No): E-MAIL ADDRESS:	
	INSURER(S) AFFORDING COVERAGE	NAIC #
	INSURER A : National Union Fire Insurance Company Of Pittsburgh,	19445
INSURED Veolia Water Technologies, Inc. 4001 Weston Parkway Cary, NC 27513	INSURER B : New Hampshire Insurance	
	INSURER C : AIG Specialty Insurance Company	26883
	INSURER D : N/A	N/A
	INSURER E : Lexington Insurance Company	19437
	INSURER F : Illinois National Insurance Company	23817

COVERAGES **CERTIFICATE NUMBER:** CHI-008853924-14 **REVISION NUMBER:** 1

THIS IS TO CERTIFY THAT THE POLICIES OF INSURANCE LISTED BELOW HAVE BEEN ISSUED TO THE INSURED NAMED ABOVE FOR THE POLICY PERIOD INDICATED. NOTWITHSTANDING ANY REQUIREMENT, TERM OR CONDITION OF ANY CONTRACT OR OTHER DOCUMENT WITH RESPECT TO WHICH THIS CERTIFICATE MAY BE ISSUED OR MAY PERTAIN, THE INSURANCE AFFORDED BY THE POLICIES DESCRIBED HEREIN IS SUBJECT TO ALL THE TERMS, EXCLUSIONS AND CONDITIONS OF SUCH POLICIES. LIMITS SHOWN MAY HAVE BEEN REDUCED BY PAID CLAIMS.

INSR LTR	TYPE OF INSURANCE	ADDL INSD	SUBR WVD	POLICY NUMBER	POLICY EFF (MM/DD/YYYY)	POLICY EXP (MM/DD/YYYY)	LIMITS	
A	X COMMERCIAL GENERAL LIABILITY			GL5425835	01/01/2020	01/01/2021	EACH OCCURRENCE	$ 3,000,000
	CLAIMS-MADE X OCCUR						DAMAGE TO RENTED PREMISES (Ea occurrence)	$ 1,000,000
							MED EXP (Any one person)	$ 10,000
							PERSONAL & ADV INJURY	$ 3,000,000
	GEN'L AGGREGATE LIMIT APPLIES PER:						GENERAL AGGREGATE	$ 6,000,000
	X POLICY PRO-JECT LOC						PRODUCTS - COMP/OP AGG	$ 6,000,000
	OTHER:							$
A	AUTOMOBILE LIABILITY			CA9767418 (AOS)	01/01/2020	01/01/2021	COMBINED SINGLE LIMIT (Ea accident)	$ 3,000,000
A	X ANY AUTO			CA9767419 (MA)	01/01/2020	01/01/2021	BODILY INJURY (Per person)	$
A	OWNED AUTOS ONLY / SCHEDULED AUTOS			CA9767420 (VA)	01/01/2020	01/01/2021	BODILY INJURY (Per accident)	$
	HIRED AUTOS ONLY / NON-OWNED AUTOS ONLY						PROPERTY DAMAGE (Per accident)	$
								$
	UMBRELLA LIAB OCCUR						EACH OCCURRENCE	$
	EXCESS LIAB CLAIMS-MADE						AGGREGATE	$
	DED RETENTION $							$
B	WORKERS COMPENSATION AND EMPLOYERS' LIABILITY			WC 046-91-2802 (AOS)	01/01/2020	01/01/2021	X PER STATUTE OTH-ER	
B	ANY PROPRIETOR/PARTNER/EXECUTIVE OFFICER/MEMBER EXCLUDED? (Mandatory in NH) Y / N: N	N / A		WC 046-91-2803 (AZ, IL, KY, NC, NH, NJ, PA, UT, VA, VT)	01/01/2020	01/01/2021	E.L. EACH ACCIDENT	$ 1,000,000
	If yes, describe under DESCRIPTION OF OPERATIONS below						E.L. DISEASE - EA EMPLOYEE	$ 1,000,000
F				WC 046-91-2804 (FL)	01/01/2020	01/01/2021	E.L. DISEASE - POLICY LIMIT	$ 1,000,000
C	CPL - SIR: $500,000			CPO2932661	01/01/2020	01/01/2021	Per Occurrence/Aggregate	3,000,000
E	E&O -SIR: $2,000,000			065703643	01/01/2020	01/01/2021	Per Claim/Aggregate	3,000,000

DESCRIPTION OF OPERATIONS / LOCATIONS / VEHICLES (ACORD 101, Additional Remarks Schedule, may be attached if more space is required)

CERTIFICATE HOLDER	CANCELLATION
Veolia Water Technologies, Inc. 4001 Weston Parkway Cary, NC 27513	SHOULD ANY OF THE ABOVE DESCRIBED POLICIES BE CANCELLED BEFORE THE EXPIRATION DATE THEREOF, NOTICE WILL BE DELIVERED IN ACCORDANCE WITH THE POLICY PROVISIONS. AUTHORIZED REPRESENTATIVE of Marsh USA Inc. Manashi Mukherjee Manashi Mukherjee

ATKINS

Member of the SNC-Lavalin Group

Sludge Dryer System Supplier Request for Proposal

City of Canton, Georgia
Water Pollution Control Plant Expansion to 6 MGD

April 2, 2020

Proposal Due Date: April 24, 2020

Owner Contact:

Mr. David Hatabian, P.E.
Canton City Hall
110 Academy Street
Canton, Georgia 30114

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Acronyms and Abbreviations

CITY	City of Canton, Georgia
mgd	million gallons per day
WPCP	Water Pollution Control Plant
WAS	waste activated sludge
SDSS	sludge drying system supplier
RFP	Request for Proposal
NTP	Notice to Proceed
CPI	US Department of Labor Price Index
CPI-U	CPI for Urban Customers
CIP	clean-in-place
ADF	average daily flow
MMF	maximum monthly flow
PHF	peak hour flow
PDF	peak day flow
TSS	total suspended solids
VSS	volatile suspended solids
EPA	Environmental Protection Agency
PDF	Portable document format
gpm	gallons per minute

1. General Information

1.1. Introduction

City of Canton, Georgia (CITY), is expanding their wastewater treatment facility from 4 million gallons per day (mgd) to 6 mgd. As part of the expansion of the Canton Water Pollution Control Plant (WPCP), the sludge management processes will be modified to create Class B sludge through the use of aerobic digesters, then dried to 90 percent to create Class A sludge. The solids management design will include a waste activated sludge (WAS) holding tank followed by rotary drum thickeners and aerobic digestion. Sludge from the aerobic digesters will be pumped to two 2-meter belt filter presses, dewatered to a minimum of 16 percent solids, then sent to a sludge convection drying system.

The CITY is hereby publicly soliciting proposals for a sludge drying system supplier (SDSS) for the project. The sludge drying system shall utilize a convection drying process that will result in 90 percent solids by utilizing a belt conveyor system to treat sludge with ambient air that has been heated to a low to medium temperature by a burner or steam heat exchanger system. The selected drying system proposal and pricing will be incorporated into the Construction Bid Documents issued to GENERAL CONTRACTORs for soliciting construction bids. The project is a Design-Bid-Build Project.

This Request for Proposal (RFP) is open to sludge drying system suppliers that meet the minimum supplier requirements as described in Paragraph 1.2.

There is no guarantee that this project will be constructed. All costs associated with the preparation and submittal of the supplier's proposal will be borne by the PROPOSER.

1.2. Requirements of Sludge Drying System Suppliers

The minimum requirements for the SDSS are as specified below:

- Utilizes a convection drying system to reduce the volume of municipal wastewater sludge from 16 percent solids (and above) to 90 percent (or greater) solids.
- Provides a convection drying system consisting of belt conveyor and low to medium temperature air drying process.
- Has flexibility to produce a product that contains 50 percent solids or 90 percent solids through operational changes only (no equipment modifications required).
- Can meet the Design Criteria specified herein including frequency and duration of operation.
- Has been in business for a minimum of 10 years.
- Can, upon request, provide verification of a minimum of five (5) successful installations of municipal sludge drying systems that are currently in operation.
- Has factory certified technicians and/or engineers available to provide on-site technical support within 2 working days of request by the CITY.
- Has spare parts available for shipment to the Canton WPCP within 3 working days of request by the CITY.
- Understands and can meet the federal and state air quality requirements and can assist the CITY with the associated permitting.

- Understands and can assist the CONSULTANT (Atkins) in the coordination of the design of the multiple processes and equipment types required to provide a safe, high quality, and functional solids handling system at the Canton WPCP.

- Will assist Atkins in completing their design efforts associated with the sludge drying system. This includes but is not limited to attending meetings, workshops, providing design submittals, preparing AutoCAD files, sizing equipment, developing plan layouts, and preparing of specifications.

- Will provide Services During Construction including:
  - Preparation and delivery of equipment submittals and any subsequent resubmittals
  - Support during installation of the drying system to identify issues or problems that require the GENERAL CONTRACTOR's attention and to assist the GENERAL CONTRACTOR in the resolution of conflicts associated with the drying system equipment and other solids handling equipment or controls (minimum of 20 working days, five site visits)
  - Performance testing (minimum of 5 working days, two site visits)
  - Training of City Staff (minimum of 2 working days, one site visit)

1.3. Proposal Due Date

Details of the proposals will be public information. The proposal will be received at Canton City Hall, 110 Academy Street, Canton, Georgia. If mailing or using a courier service, please address the proposal to Mr. David Hatabian, P.E., City Engineer. The submittal will be time and date stamped with the clock at the Canton City Hall reception desk. No late proposals will be accepted.

E-mailed proposals will not be accepted.

Submission Date for Proposal: 2:00 pm EST, April 24, 2020

The CITY reserves the right to waive any informality or to reject any or all proposals. It shall be the sole responsibility of the PROPOSER to have his or her proposal delivered to Canton City Hall for receipt on or before the date and time above. If the proposal is sent via US Mail Service, the PROPOSER remains responsible for timely delivery.

1.4. Schedule

Anticipated schedule for procurement of services described herein is summarized in Table 1. The days are shown as calendar days. The CITY reserves the right to modify or amend any or all dates included in the schedule at its sole discretion.

The anticipated schedule to begin the construction of the dewatering facilities at the Canton WPCP, including the sludge dryer, is 18 to 30 months after the GENERAL CONTRACTOR has received Notice to Proceed on the Canton WPCP Expansion Project.

Table 1 Anticipated Schedule

Item	Target Date
RFP Phase	
Issue RFP	March 31, 2020
Last Date for Questions	April 9, 2020
Final Addendum	April 13, 2020
Proposal Due Date	April 24, 2020
Phone Interviews (if needed)	May 4, 2020

Item	Target Date
SDSS Selection	May 8, 2020
Design Phase	
Design Phase Notice to Proceed (NTP) for SDSS	Selection + 7 days
Design Meeting 1	7 days from Design NTP
Design Submittal 1 Due Date	2 weeks from Design NTP
Design Meeting 2	1 week after receipt of Submittal 1
Design Submittal 2 Due Date	2 weeks from date of Meeting 2
Design Meeting 3	1 week after receipt of Submittal 2
Construction Phase	
Construction NTP	TBD
Construction Purchase Order for Sludge Drying System	TBD
Submittals	Per Construction Schedule
Installation Services	Per Construction Schedule
System Programming and Start-Up	Per Construction Schedule
Operation Training	Per Construction Schedule
System Commissioning and Testing	Per Construction Schedule

1.5. Proposal Preparation Cost

The CITY and ENGINEER will not be liable in any way for costs incurred by the PROPOSER in the preparation of their bid proposal for the presentation of said proposal or for participation in any discussions or negotiations.

1.6. Withdrawal of Proposal before Closing

The PROPOSER may request in writing the withdrawal if their proposal at any time prior to the schedule proposal opening time and date (closing). Upon receiving request to withdrawal their proposal, the CITY will consider the PROPOSER's proposal null and void and will be returned unopened to the PROPOSER.

1.7. Confidential Information

If any proposal contains technical, financial, or other confidential information that the PROPOSER believes is exempt from disclosure, the PROPOSER must clearly label the specific portions sought to be kept confidential and specify on what the exemption is based. The CITY, at its sole discretion and subject to applicable law, will determine whether such exemption applies. The CITY has sole discretion to make such determination regarding the disclosure of information, and by responding to this request for proposal, PROPOSER's waive any challenge to the CITY'S decisions in this regard. Marking all or substantially all of a proposal as confidential may result in the PROPOSER being deemed non-responsive to this RFP.

Notwithstanding the foregoing, PROPOSERS recognize and agree that the CITY, its staff, and the ENGINEER will not be responsible or liable in any way for any losses that the PROPOSER may suffer from the disclosure of information or materials to third parties.

1.8. Indemnification

The SDSS agrees to defend, indemnify, and hold harmless the CITY and all of its officers, agents, employees, and elected officials and hold harmless against any claim and all claims for damages, costs, and expenses of persons or property that may arise out of, or be occasioned by, or from any negligent act or omission of the SDSS in the execution of the performance of this agreement. Any claims, interpretations, or litigation arising, regarding this agreement or performance of work contemplated under the terms of this agreement, shall be heard and determined by the presiding Judge of the Superior Court of Cherokee County, Georgia.

1.9. Termination of Project

No payment will be made to the SDSS or PROPOSER in advance of the construction project. All payments to the SDSS will be made through the GENERAL CONTRACTOR. The selected PROPOSER will assist the CONSULTANT (Atkins) in completing their design efforts associated with the sludge drying system. This includes but is not limited to meetings, workshops, preparation of AutoCAD files, equipment sizing, layouts, specifications, and training.

1.10. Proposal Price Adjustment

The GENERAL CONTRACTOR who is awarded the construction project will purchase the sludge drying system at the proposed/pre-negotiated price from the selected SDSS. The SDSS proposal will be included in the bidding Contract Documents for Construction of the treatment plant expansion that is distributed to the GENERAL CONTRACTORs. The SDSS proposal cost will be fixed for a period of twenty-four (24) months from receipt of proposals for this RFP.

If the GENERAL CONTRACTOR has not issued a purchase order for the sludge drying system by the end of the 24-month period, the proposed/pre-negotiated price of the system will be adjusted based on the US Department of Labor Price Index (CPI) for Urban Customers (CPI-U) U.S. City Average for all items (less food and energy) as of the 24th month and the month of purchase order is made as follows:

Escalated Cost = (Proposed or Pre-negotiated Price x CPI month of PO)/(CPI month 24)

1.11. Method of Payment

Partial payment of the total LUMP SUM PRICE shall be made through the GENERAL CONTRACTOR to the SELECTED PROPOSER in accordance with the following schedule:

1. Upon ENGINEER's approval of shop drawings: 10 percent
2. Upon delivery and acceptance by the GENERAL CONTRACTOR of the equipment at the plant site: 40 percent
3. Upon installation of equipment and submittal of Manufacturer's Certification of Proper Installation: 25 percent
4. Upon successful completion of the performance test: 10 percent (minus value of incomplete work)
5. Upon substantial completion: 10 percent
6. Upon training of personnel: 5 percent

Substantial completion shall be defined as beneficial use of the facility. Progress invoices shall be paid by the GENERAL CONTRACTOR in accordance with applicable state laws, including applicable retainage.

1.12. Equipment

The SDSS shall provide all equipment required for a complete and operable system including but not limited to blowers, burners, fans, ductwork, belt conveyors, cooling towers, drain piping, pumps, condensers, sludge receiving system, odor control and air quality system(s), all piping, any process valves and valve actuators, process analyzers, clean-in-place (CIP) systems equipment, motors and drives, and instrumentation and controls.

All equipment shall be new and unused and shall be standard products of the SDSS having used such equipment successfully in other projects. The equipment must be from a reputable supplier, operate satisfactorily and safely.

1.13. Warranty

1.13.1. Equipment Warranty

The PROPOSER shall guarantee all components of the sludge drying system supplied including appurtenances against material defect for a period of one (1) year after completion of performance testing and the system is certified as substantially complete. All replacement materials to be provided at no cost to the CITY during the warranty period. The GENERAL CONTRACTOR shall be responsible for providing all labor and equipment to make needed repairs to the sludge drying system.

1.13.2. Performance Warranty

The sludge drying system supplier must warrant the performance of the dryer equipment to meet or exceed the performance requirements included in this RFP and in their Proposal for a period of five (5) years upon completion of the Performance Testing. Failure to meet performance requirements during the 5-year warranty period will result in the sludge dryer supplier being responsible for undertaking modifications and/or providing technical assistance to incorporate operational changes and/or changes to the system as required and at no cost to the CITY to meet the Performance Requirements. Performance Warranty will not be prorated.

1.14. One Year SDSS Service Agreement

This proposal shall include support services required to implement the project and assist with operations during the first year of operation. Support services should include, but not be limited to, the following:

- A minimum of four site visits totaling one 8-hour day on-site during each visit. Visits may include staff operations, review of sludge drying operations, and visual inspection of the drying equipment.
- Instrumentation troubleshooting and PLC programming support

1.15. Proposal Process

Submit proposals in strict compliance with the requirements of this RFP. Failure to submit in accordance with the requirements of this RFP will result in rejection of the proposal. The CITY reserves the option of conducting phone interviews and making site visits with select PROPOSERS in order to clarify or verify specific components of their proposal.

The selected SDSS proposal will be used as the Basis of Design for final design of the new sludge drying facility and the SDSS will supply equipment and other services for the project, as agreed between the OWNER and the SDSS.

Based on the design criteria set forth by the SELECTED SDSS, Atkins will design the associated yard piping, electrical supply to the sludge drying system, system instrumentation interface to plant SCADA, civil site modifications, reinforced concrete structures, and other major structural and architectural facilities including the building to house the sludge drying system and support equipment.

Atkins will specify in the construction phase contract documents that the GENERAL CONTRACTOR will install the sludge drying system, including ancillary equipment furnished by the SELECTED SDSS. The GENERAL CONTRACTOR will supply and install required electrical connections, motor starters, power, and control wiring that is beyond the scope of this RFP.

The equipment selection, sizing, specifications, pricing data, and related contractual terms and conditions submitted by the SELECTED SDSS will be inserted into *the City of Canton Pollution Control Plant Expansion to 6 MGD* construction documents to establish and control the guaranteed scope, price, terms, and conditions for the subject equipment. This scope of supply and price shall be fixed in US Dollars.

1.16. Clarification and Addenda

PROPOSERS may submit requests for clarifications or interpretations regarding this RFP. PROPOSERS must prepare such requests in writing for the CITY's consideration as set forth in this section of this RFP. While the CITY has not placed an initial limitation on the number of requests which can be submitted, PROPOSERS are cautioned that if PROPOSERS do not request meaningful clarifications or interpretations in an organized manner (e.g., limited frequency of requests), the CITY will set restrictions on the frequency and number of requests permitted. The CITY/ENGINEER will not respond to requests, oral or written, received after April 9, 2020 at 5:00 PM, local prevailing time. PROPOSERS are advised that this section places no obligation on the part of the CITY/ENGINEER to respond to any or all requests for clarification or interpretation, and that the CITY/ENGINEERS' failure to respond to any such request will not relieve the PROPOSER of any obligations or conditions required by this RFP.

Requests for clarification or interpretation regarding this RFP shall only be submitted in writing (letter or email) to: Mr. Tyler Hewitt, ATKINS North America, tyler.hewitt@atkinsglobal.com for evaluation and/or response. Only questions answered by addenda will be binding. No oral interpretation, instruction, or information concerning this RFP given by any employee or agent of the CITY shall be binding on the CITY. PROPOSERS who submit a proposal in reliance on any such oral information risk having their response to this RFP deemed non-responsive by the CITY. Only written responses issued by addendum to this RFP should be considered by the PROPOSERS.

During the period provided for the preparation of proposals, the CITY may issue addenda to this RFP. These addenda will be numbered consecutively and will be posted on the CITY's website, www.cityofcanton.gov. These addenda will be issued by, or on behalf of, the CITY and will constitute a part of this RFP. Each PROPOSER is responsible for checking the CITY's website for addenda and shall acknowledge the number of addenda in their proposal as required in Paragraph 2.5 "Proposal Content Requirements". All responses to this RFP shall be prepared with full consideration of the addenda issued prior to the Proposal Submission Date.

1.17. Definitions

Average daily flow (ADF) – the average flow rate occurring over a 24-hour period based on annual flow rate information.

Maximum Monthly Flow (MMF) – the average flow rate occurring over a 24-hour period during the 30-day period with the highest flow based on annual flow rate data.

Peak Hour Flow (PHF) – maximum flow rate over a 1-hour period based on annual flow rate data.

Peak Day Flow (PDF) – the maximum flow rate over a 24-hour period, based on annual flow data.

Sludge Drying System – the complete functional sludge drying process consisting of belt dryers, blowers, condensers, ductwork, burners, insulation, cooling towers, cleaning systems, pipes, valves, odor control systems, pumps, instrumentation and control, and associated electrical equipment and wiring.

Total Suspended Solids (TSS) – the dry weight of undissolved, suspended particles in a water sample. TSS includes two components; inert suspended solids and volatile suspended solids.

Volatile Suspended Solids (VSS) – biological solids generated during the aerobic/anaerobic treatment process. VSS are organic in nature and by definition will ignite at 550 °C in a muffle furnace.

Class B Sludge – Per Environmental Protection Agency (EPA) 503, Class B sludge is defined as biological solids with detectable pathogens that have been reduced to levels that do not pose a threat to public health and the environment as long as actions are taken to prevent exposure to the biosolids after their use or disposal.

Class A Sludge – Per EPA 503, Class A sludge is defined as biological solids with no detectable pathogens.

2. Proposal Requirements

2.1. General

The CITY and ENGINEER will evaluate each proposal and select the proposal that is most advantageous to the CITY.

All PROPOSERS will be notified of the evaluation results. The CITY will not make an award or enter into a contract with the SELECTED SDSS, nor will the CITY guarantee the timing and/or the realization of this project. Information provided by the SELECTED SDSS will be used for facilitating the design of the sludge drying system. There shall be no separate payment to the PROPOSER for design services to assist the ENGINEER during the design phase of this project. There is no contract between the ENGINEER or CITY and PROPOSER during the design services phase of this project.

The construction phase of the solids handling system will be separate from the design phase. Construction is expected to begin the fourth quarter of year 2020 with completion at the end of the second quarter year 2024. Sequencing of construction to maintain treatment will result in the start of construction of the solids handling processes in 2022.

The GENERAL CONTRACTOR who is awarded the construction project will purchase the sludge drying system at the proposed/pre-negotiated price from the selected SDSS. The SDSS proposal will be included in the bidding Contract Documents for Construction of the treatment plant expansion that is distributed to the GENERAL CONTRACTORs. The SDSS proposal cost will be fixed for a period of twenty-four (24) months from receipt of proposals for this RFP.

Proposals that do not contain the required information will be considered incomplete and will not be reviewed.

2.2. Design Criteria

The solids handling process will include two 2-meter belt filter presses. The product of these presses will be fed to the sludge dryer. The anticipated quantity of sludge will be as shown in Table 2. The end product from the dryer system shall be a minimum of 90 percent solids.

Table 2. Design Criteria for Sludge Drying Equipment

Belt filter press operations	10 hours/day, 5 days/week
Wet tons per week at 16% cake	405
Wet tons per week at 18% cake	360
Dryer operations (max)	24 hours/day, 5 days/week
Dryer products (% solids)	90

The sludge drying equipment shall include all convection drying equipment, including blowers, condensers, burners, heat exchangers, pumps, motors, drives, safety systems/equipment, odor control systems, and cooling towers required to make the system whole. All instrumentation and control panels required for a fully functional system shall be provided by the SDSS. GENERAL CONTRACTOR shall provide electrical supply to the sludge drying system and system instrumentation interface to plant SCADA.

2.3. Labelling

Proposal for the selection of the SDSS will be sealed and clearly labelled on the outside of the package with the following:

> **"Request for Proposals – CITY OF CANTON, GEORGIA WATER POLLUTION CONTROL PLANT EXPANSION SLUDGE DRYING SYSTEM SUPPLIER SELECTION"**

2.4. Copies

Submit eight (8) copies of the proposal and one (1) electronic copy of the proposal. The electronic copy shall be in portable document format (PDF) and shall be submitted on a USB flash drive. The PDF shall be bookmarked.

The proposal shall be spiral-bound 8-½" x 11" with transparent cover and black back cover. The font type for the body text shall be Arial with a minimum size of 10 or Calibri with a minimum size of 11. All pages shall be single-sided. Tabs between sections are optional. The total number of pages shall not exceed 25 pages, not including drawings, blank pages, covers, or tabs. Number each page for ease of review and for convenience during phone interviews if requested. Drawings may be numbered in title blocks.

2.5. Proposal Content Requirements

- Cover Page
- Table of Contents
- Dryer System Supplier Information
  - Company name and type of organization (LLC, corporation, etc.)
  - Contact name, position in company, contact address, contact email, contact phone number
  - Location of main office, regional offices, and local sales offices
  - Number of years company has been in operation and number of municipal installations in the last five (5) years
  - Verify that the minimum requirements specified in Paragraph 1.2 "Requirements of Sludge Drying System Suppliers" can be met or provide exceptions to specific requirements
  - Acknowledge total number of addenda issued for this RFP

- Summary
  - A brief description of the approach to sizing and selecting the proposed equipment, understanding of the project goals and objectives, with identification of potential problems or concerns associated with the project
  - Any additional information regarding the ability of the PROPOSER to provide maintenance, repair, and/or technical support to the CITY
  - Avoid presenting duplicated information from other sections of the proposal.

- Equipment and Demands
  - List all major components for a fully functional system (blower, burner, cooling tower, odor control, safety equipment/systems, etc.). **Typical Table Headings:**

Equipment	Description

  - List all electrical and natural gas demands required for a fully functional system (average daily demand). **Typical Table Headings:**

Power Demand	Quantity	Units

  - List all motors and drives required for a fully functional system. **Typical Table Headings:**

Equipment	Motor Size (hp)	Drive Type (constant speed or variable speed)

  - List the average daily water demand and total water removal from the drying system.

Average Daily Water Demand (gallons per minute [gpm]):
Average Daily Water to Drain from System (gpm):
Average Temperature (°F) of Waste Water:

- Supplemental Information
  - Discuss sludge receiving and belt application process and the recommended method of transferring from a sludge hopper to the proposed dryer system
  - Provide photos and description of the anticipated end product from the proposed drying system
  - Provide a list of safety provisions and/or systems that are recommended for the safe operation of the sludge drying system that are not provided by the PROPOSER, e.g. building fire sprinkler system
  - Discuss anticipated temperature rise inside the room housing the proposed drying equipment
  - Provide the anticipated number of hours of operation per day and the number of days per week required for the proposed drying system, if different from Design Criteria
  - Provide the anticipated number of full-time employees required on a weekly basis to operate and maintain the proposed drying system
  - Provide the anticipated number of working days required to install the proposed drying system
  - Other information that may be consequential or provide value to the CITY

- References
  - Provide three example installations and include the following information for each example:
    - Location
    - Years in operation
    - The model and capacity at the site
    - Type of sludge processed (industrial, municipal, etc.)
    - Contact name, address, phone number, and email address

- Drawings (no limit, 11” x 17” sheets, tri-fold)
  - Provide typical layout and dimensional information for the proposed drying system. Identify any equipment that requires special protection or conditions (protection from elements, conditioned space, personal protection equipment, safety precautions, atypical pipe/ductwork routing, etc.)
  - Provide typical Process and Instrumentation Drawings showing the process piping, instrumentation, and mechanical equipment for the proposed drying system

- Contract Price and Warranty

Item No.	Description	Quantity	Unit	Price
1	Design Phase Services – including workshops and preparation of construction documents	1	LS	
2	Services During Construction – including submittals, installation support, and start-up services	1	LS	
3	Drying System Equipment – all equipment, piping, ductwork, valves, appurtenances, electrical and instrumentation required for a fully functional system	1	LS	
4	Warranties and One Year SDSS Service Agreement	1	LS	
			Total	

Lump Sum Total, Items 1 through 4, inclusive of, the amount of:

$_____ US Dollars

2.6. Selection Criteria

The following selection criteria including financial and non-financial criteria will be used to score the proposals. A total of 100 points will be allocated. The PROPOSER with the highest score will be selected as the SDSS.

Criteria	Points
Equipment Requirements and Configuration	35
Operational Requirements	25
Ability to Perform and Respond	15
Contract Price and Warranty	25

2.6.1. Contract Price and Warranty Scoring

A maximum of 25 points will be awarded for the sludge drying system with the overall lowest contract price and warranty cost. The SDSS with the lowest cost will be awarded the maximum number of points. All other suppliers will receive lesser points based on the percentage difference from the lowest cost, as shown in the example below in Table 3.

Table 3 Contract Price and Warranty Scoring Example

Sludge Drying System Supplier	Total Capital Cost	Points
A	$ 100,000	25.00
B	$ 125,000	18.75
C	$ 150,000	12.75
D	$ 170,000	7.50

Example Calculation for Points Distribution

Supplier A receives 25 points (lowest cost)

Supplier B receives points as follows:

25 – [25 x (125,000 – 100,000)/100,000] = 18.75 points

Supplier C receives points as follows:

25 – [25 x (150,000 – 100,000)/100,000] = 12.75 points

Supplier D receives points as follows:

25 – [25 x (170,000 – 100,000)/100,000] = 7.5 points

END

ATKINS
Member of the SNC-Lavalin Group

Addendum 1

Date:	16 April 2020
Ref:	Request for Proposals for Sludge Drying System Supplier for City of Canton, GA, Water Pollution Control Plant Expansion to 6 MGD
Subject:	Addendum Number 1

This Addendum forms part of the "Request for Proposals" (RFP) and modifies or clarifies the original RFP dated April 2, 2020. Prospective Proposers shall acknowledge receipt of the total number of Addenda issued for this Project on their Proposals. Failure to do so may subject the Proposer to disqualification. Items not referenced herein remain unchanged.

<table>
<tr><th>Section</th><th>Page</th><th>Comment</th></tr>
<tr><td>Title Page</td><td></td><td>Proposal Due Date

<u>DELETE:</u> "April 24, 2020" and <u>REPLACE</u> with: "May 1, 2020"</td></tr>
<tr><td>1.3</td><td>2</td><td>Proposal Due Date

<u>DELETE:</u> "April 24, 2020" and <u>REPLACE</u> with: "May 1, 2020"</td></tr>
<tr><td>1.4</td><td>2-3</td><td>Table 1

<u>DELETE</u> Table 1 in its entirety and <u>REPLACE</u> with the following:

<table>
<tr><th>Item</th><th>Target Date</th></tr>
<tr><td>RFP Phase</td><td></td></tr>
<tr><td>Issue RFP</td><td>March 31, 2020</td></tr>
<tr><td>Last Date for Questions</td><td>April 16, 2020</td></tr>
<tr><td>Final Addendum</td><td>April 21, 2020</td></tr>
<tr><td>Proposal Due Date</td><td>May 1, 2020</td></tr>
<tr><td>Phone Interviews (if needed)</td><td>May 12, 2020</td></tr>
<tr><td>SDSS Selection</td><td>May 15, 2020</td></tr>
<tr><td>Design Phase</td><td></td></tr>
<tr><td>Design Phase Notice to Proceed (NTP) for SDSS</td><td>Selection + 7 days</td></tr>
<tr><td>Design Meeting 1</td><td>7 days from Design NTP</td></tr>
<tr><td>Design Submittal 1 Due Date</td><td>2 weeks from Design NTP</td></tr>
<tr><td>Design Meeting 2</td><td>1 week after receipt of Submittal 1</td></tr>
</table>
</td></tr>
</table>

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<table>
<tr><th>Section</th><th>Page</th><th>Comment</th></tr>
<tr><td></td><td></td><td>
<table>
<tr><td>Design Submittal 2 Due Date</td><td>2 weeks from date of Meeting 2</td></tr>
<tr><td>Design Meeting 3</td><td>1 week after receipt of Submittal 2</td></tr>
<tr><td colspan="2">Construction Phase</td></tr>
<tr><td>Construction NTP</td><td>TBD</td></tr>
<tr><td>Construction Purchase Order for Sludge Drying System</td><td>TBD</td></tr>
<tr><td>Submittals</td><td>Per Construction Schedule</td></tr>
<tr><td>Installation Services</td><td>Per Construction Schedule</td></tr>
<tr><td>System Programming and Start-Up</td><td>Per Construction Schedule</td></tr>
<tr><td>Operation Training</td><td>Per Construction Schedule</td></tr>
<tr><td>System Commissioning and Testing</td><td>Per Construction Schedule</td></tr>
</table>
</td></tr>
<tr><td>1.16</td><td>6</td><td>Clarification and Addenda Section

<u>DELETE:</u> “April 24, 2020” and <u>REPLACE</u> with: “May 1, 2020”</td></tr>
<tr><td>2.4</td><td>8</td><td>Copies

<u>DELETE</u> both paragraphs in their entirety and <u>REPLACE</u> with the following:

“Each Proposal shall include two (2) electronic files in portable document format (PDF), both files to be submitted on one (1) USB flash drives.
• The first PDF file shall contain the general Proposal information. Title this PDF file with the Proposer’s Name followed by “Proposal w/o Costs”. The PDF file shall be bookmarked.
• The second PDF file shall contain the proposed costs. Title this PDF file with Proposers Name followed by “Contract Price and Warranty”.
The font type for the proposal body text shall be Arial with a minimum size of 10 or Calibri with a minimum size of 11. Tabs between sections are optional. The total number of pages associated with the general Proposal information shall not exceed 25 pages, not including drawings, blank pages, covers, or tabs. Number each page for ease of review and for convenience during phone interviews if requested. Drawings may be numbered in title blocks.”</td></tr>
<tr><td>2.5</td><td>8</td><td>Proposal Content Requirements

<u>ADD</u> the following:
“Submit the Proposal information as described and listed below in a separate file from the information required in Paragraph 2.5.A. Contract Price and Warranty. Title the PDF file with Proposers Name followed by “Proposal w/o Costs”.</td></tr>
<tr><td>2.5</td><td>8</td><td>Equipment and Demands

<u>DELETE</u>:
- “List all major components for a fully functional system (blower, burner, cooling tower, odor control, safety equipment/systems, etc.). Typical Table Headings:
Equipment | Description

and <u>REPLACE</u> with the following:</td></tr>
</table>

ATKINS
Member of the SNC-Lavalin Group

Section	Page	Comment
		- "List all major components for a fully functional system and if the components will be provided by the SDSS (blower, burner, cooling tower, odor control, safety equipment/systems, etc.). **Typical Table Headings:** **Equipment** **Description** Provided by SDSS (Y or N)
2.5	9	Supplemental Information **ADD** the following: "SDSS may provide additional information and/or cost breakdown data for each of the cost items listed in the Contract Price and Warranty table below."
2.5	10	Contract Price and Warranty **DELETE** "Contract Price and Warranty" and **REPLACE** with: "2.5.A. Contract Price and Warranty Submit completed table below in a separate file from all other documents associated with this Proposal. Title the PDF file with Proposers Name followed by "Contract Price and Warranty"."

Vendor Questions

These questions and responses are for information purposes only and do not form part of the Request for Proposal.

No.	Section	Page	Question	Response
1	Multiple		Please extend section 1.3 submission date for proposal by two (2) weeks to: 2:00 pm EST, May 8th, 2020	See Addendum 1 for a one week extension for questions and submittal.
2	2.4	8	Due to Stay at Home orders in our state, and in the interest of public safety, please change section 2.4 requirement for submission to include just one (1) electronic copy of the proposal.	See Addendum 1 for modifications to Section 2.4 Copies/
3	2.5	8	Please include in (future) addendum the attached scope checklist.	See Addendum 1 for an update of the requirements for the Table Headers associated with Equipment and Demands.
4	1.2	1	Please consider changing section 1.2, requirement of sludge drying system suppliers to include additional requirements regarding installations, years in business, product manufacturing source.	Requirements for Sludge Drying System Suppliers are listed in Paragraph 1.2.
5	2.6	10	Can you provide further details on the criteria for each scoring section (e.g., points assigned for each subcriteria, etc.)?	Proposal scoring will be as described in Paragraph 2.6 Selection Criteria.
6			Please confirm that the RFP document is the only document to use to base the bid.	This is Addendum 1 to the RFP. No other documents have been provided.
7			Have we missed any phase or preliminary selection, site visits or communications up to this point? If so which?	This is Addendum 1 to the RFP. No other communication has been provided.
8	2.5	9	Would it be acceptable that our proposal showed some of the items with firm prices (the dryer, its shipping and accessories other than piping, ducts and electrical cabling) and others with budgetary pricing, such as the on site installation partnering with a local contractor, and some of the accessories and connections?	Provide pricing as described in Paragraph 2.5 Proposal Content Requirements, Contract Pricing and Warranty.
9			Please provide the Federal tax id number (EIN number) for the City of Canton.	The City's Taxpayer Identification Number (TIN) is 58-6000532.

SECTION 11372

ROTARY POSITIVE DISPLACEMENT BLOWERS

PART 1: GENERAL

1.01 SCOPE

A. Furnish all labor, materials, equipment and incidentals required and install complete, ready for operation and field-test eleven (11) new rotary positive displacement blowers and appurtenances - five (5) for the BNR Basins 1 through 4, three (3) for the UV/ Post Aeration Facility, and three (3) for the Aerobic Digesters, as shown on the Drawings and as specified herein.

B. The entire blower package and its components shall comply with all applicable safety and environmental regulations.

C. Blowers will be located outdoors. Manufacturer shall provide all accessories required to operate the equipment in the environmental conditions associated with the location of the blowers as shown on the construction drawings.

1.02 RELATED WORK

A. Valves shall be as specified in Section 15100 Valves and Appurtenances.

B. Instrumentation work, except as otherwise specified herein, is included in Division 13.

C. Electrical work, except as otherwise specified herein, is included in Division 16.

1.03 SUBMITTALS

A. Submit in accordance with Section 01300 Submittals, copies of all materials required to establish compliance with this Section. Submittals shall include at least the following information:

1. Certified general arrangement drawings showing materials, details of construction, dimensions and connections.

2. Complete Blower Performance Data including:

   a. RPM

   b. Capacity – scfm (standard cubic feet per minute) and icfm (inlet cubic feet per minute)

   c. Discharge pressure

   d. dB(A) noise pressure level

   e. Maximum gear tip speed and rotor tip speed (fpm)

   f. HP required at rated capacity and pressure

   g. Rated maximum pressure rise of blowers

3. List of recommended spare parts broken down into regularly replaced parts and parts required for long term operation (more than 2 years).

4. Description data, including catalog cutsheets, for valves, flexible connectors, and pressure and temperature gauges.

5. Performance Curves

6. Motor drawings and operating characteristics

7. Declaration of Conformity, per Machinery Directive 2006/42/EC, Annex II, No.1 A.

8. All control panel drawings, wiring diagrams, motor controls, variable frequency drives, and other electrical related drawings.

B. Submit operation and maintenance manuals for all equipment included under this Section in accordance with Section 01730.

C. Submit Manufacturer's Certificate of Proper Installation per Section 01400.

1.04 QUALITY ASSURANCE

A. Qualifications

1. Each blower package will be produced by the manufacturer of the blower stage or a certified factory designated OEM to ensure single source responsibility for blower performance and compatibility of associated accessories.

2. The equipment shall be designed, constructed and installed in accordance with the best practices and methods and shall operate satisfactorily when installed as shown on the Drawings.

3. The blower(s) shall be covered by a warranty for 24 months from date of commissioning, or a maximum of 30 months from date of shipment.

4. The performance data and manufacturing methods shall achieve a Declaration of Conformity, per Machinery Directive 2006/42/EC, Annex II, No.1 A.

1.05 DELIVERY, STORAGE AND HANDLING

A. All equipment shall be completely factory assembled, skid mounted, crated and delivered to protect against damage during shipment.

B. All exposed flanges shall be covered and sealed with shrink-wrap to prevent the entrance of moisture. Finished iron or steel surfaces not painted shall be properly protected to prevent rust and corrosion.

C. Factory assembled parts and components shall not be dismantled for shipment unless permission is received in writing from the Contractor.

D. Finished surfaces of all exposed flanges shall be protected by wooden blank flanges, strongly built and securely bolted thereto.

E. Finished iron or steel surfaces not painted shall be properly protected to prevent rust and corrosion. No shipment shall be made until approved by the Contractor in writing.

F. All equipment delivered to the site shall be stored in accordance with Section 01600 Delivery, Storage and Handling and with the manufacturer's instructions.

1.06 MAINTENANCE

A. Spare Parts

1. Furnish the following spare parts for each blower package specified:
   a. Complete set of matched V-belts
   b. One filter element
   c. Volume of oil change for first service interval
2. Spare parts shall be properly bound and labeled for easy identification without opening the packaging and suitably protected for long term storage in a humid environment.

PART 2: PRODUCTS

2.01 DESIGN CRITERIA

A. Provide equipment meeting the following technical criteria:

1. Design Inlet Temperature: 100°F
2. Site elevation: 900 ft above sea level
3. Design Inlet Pressure: 14.22 psia.
4. Design Relative Humidity: 90%

	BNR Basins 1–3	BNR Basin 4	BNR Standby	Post Aeration	Aerobic Digesters
Number of Blowers	3	1	1	3	3
Design Flow (scfm/ icfm per blower)	3,432/3,969	4,043/4,676	4,043/4,676	185/214	4,520/5246
Minimum Turndown (scfm/ icfm per blower)	1,239/1,432	1,414/1,636	1,316/1,522	53/62	1,190/1,380
Design Discharge Pressure (psig)	10.8	9.02	10.8	7.55	7.30
Pressure at Minimum Turndown (psig)	10.18	8.04	10.8	7.55	7.30
Maximum Blower Speed (rpm)	1,597	1,815	1,827	3,852	1,822
At Percent maximum (for Max. Blower Speed)	77	88	88	80	96
Brake Horsepower (Max)	236	233.3	278.8	10.3	219
Max. Motor Size (hp)	300	300	350	15	250
Drive Type	Variable Speed	Variable Speed	Variable Speed	Variable Speed	Variable Speed
Free Field Noise Guarantee at 1 meter, at design point (dB(A))	85	82	83	73	77

5. Blower Package BHP to include pressure loss through a clean inlet filter / silencer, pressure loss of the exhaust silencer and check valve.

6. Blower Package Performance shall conform to ISO 1217 with a tolerance of +/- 5% on volume flow and +/- 5% on package horsepower. Manufacturer of blower must provide data for purchased machine.

7. Sound data shall be from an ISO 2151 method of measurement, in an ISO 3745 qualified test facility. Sound data shall be compliant with a Declaration of Conformity assessment standard.

8. Manufacturer:

   a. Aerzen: Provide Model GM 150S for BNR Basin blowers, Model GM 7L for the post aeration blowers, and Model GM 150S for the aerobic digester blowers.

2.02 GENERAL

A. Blower packages shall be designed to minimize the life-cycle costs and maximize plant reliability. The design and the selection of the components shall be based on a minimum useful life of 15 years and a Mean Time Between Overhauls of 5 years of continuous operation. Bearing life must be submitted by manufacturer of service life, based on specified conditions.

B. No special foundations shall be required. The blower packages will be installed directly on a concrete slab without grouting the base frame. There shall only be 4 easily accessible anchor points.

C. Manufacturer shall guarantee that the rotary lobe blower shall provide oil-free operation and be certified to ISO 8573-1 Class Zero.

D. Factory Testing:

   1. Each blower stage shall be factory tested in accordance with ISO 1217 performance test to verify flow and brake horsepower at blower maximum conditions.

   2. The acceptance criteria are +5% tolerance on power and –5% tolerance on flow regardless of the size of the machine.

2.03 BLOWER COMPONENTS

A. Blower Casing

   1. The blower casing shall be of one-piece construction, with separate sideplates that are bolted and pinned to the housing.

   2. Materials shall be close-grained cast iron ASTM A48 suitably ribbed to prevent distortion under the specified operating conditions.

   3. Minimum blower casing pressure rating shall be 36 psig.

   4. Inlet and outlet shall be flanged connections.

5. The casing shall incorporate a proven means of pulsation cancellation which achieves 90% of better reduction in vibration. Systems without a means of pulsation cancellation shall not be accepted.

6. The vibration level as measured at the blower casing, in the X/Y planes of the bearings, shall not exceed ½ "/ sec RMS (root mean square) when operating at the specified maximum operating pressure and speed in the actual blower package.

B. Rotors:

1. Each rotor shall be of the "stiff" design with first lateral critical speed at least 120% of the maximum allowable operating speed.

2. The rotors shall be of the straight, three-lobe type, and shall operate without rubbing or liquid seals or lubrication.

3. Rotor/shaft shall be drop forged in one single piece of AISI 1043 carbon steel or equivalent. Cast, hollow rotors shall be capped, dust tight. Open rotors are not acceptable.

4. The rotors shall be statically and dynamically balanced per ISO1940/ANSI S2.19 G6.3.

C. Bearings:

1. Each rotor/shaft shall be supported by anti-friction bearings, and fixed to control the axial location of the rotor/shaft in the unit.

2. Regardless of theoretical bearing life calculations, the bearings shall be sized for a minimum expected life of 5 years between overhauls. Calculated bearing life shall be submitted, based on specified operating conditions.

D. Timing Gears:

1. The rotors shall be timed by a pair of single helical AGMA 12 quality gears with hardened and ground teeth; minimum AGMA service factor of 1.70. Spur cut gears are unacceptable

2. Gears shall be mounted on the shafts with a tapered interference fit, and secured by a locknut. Pinned gears are unacceptable.

E. Seals:

1. Seal shall be designed to prevent lubricant from leaking into the air stream as well as to prevent oil from leaking out of the machine.

2. Four rotary piston ring shaft seals, an oil slinger and an O-ring seal shall be provided at the point where the shaft passes through the side plates.

3. Further provision shall be made to vent the rotor side of the oil seal to atmosphere to eliminate any possible carry-over of lubricant into the air stream.

F. Lubrication:

1. The timing gears and the bearings shall be splash lubricated. Grease lubrication shall be not acceptable.

2. Provide a recessed Oil Sight Glass on each oil sump.

G. Painting:

1. Painting shall be per supplier's standard meeting the following criteria:

   a. Except for machined sealing and machined mounting surfaces, the package shall be painted dark blue.

   b. Aluminum, stainless steel, and brass shall not be painted.

   c. The supplied motor shall not be over sprayed and will be supplied with the motor manufacturer's standard protection and paint color.

   d. Painted Cast Iron and Carbon Steel shall be Alkyd Resin Primer and Final coat with a total dry film thickness of 70μm. Surface preparation SSPC10 or better.

   e. Sound enclosure shall be powder-coated polyester base total dry film thickness 80μm.

   f. Galvanized components shall only be painted with appropriate surface preparation.

H. Inlet Filter / Silencer:

1. Each package shall be supplied with one combination inlet filter silencer.

2. The inlet filter silencer shall be mounted directly to the inlet flange of the blower.

3. The filter media efficiency must meet the requirements of ASHRAE 52.2 MERV7 50-70% @3-10 microns corresponding to EN779 G4.

4. The silencer portion shall be located upstream of the inlet filter.

5. Filter and silencer performance losses shall be included in the blower performance calculation.

6. The filter element shall be designed to trap dirt on the inside so that upon changing, dirt does not fall into the machinery. Filters where dirt accumulates on the external surface of the filter will not be permitted.

I. Base Frame / Discharge Silencer:

1. Each package shall be supplied with one combination base frame / discharge silencer.

2. The silencer shall be a chamber type design for maximum sound attenuation and shall not use fibrous or absorption materials of any kind. Internal absorption material has been shown to degrade and internally foul diffusers, and will not be permitted.

3. The silencer shall be fabricated of a single shell of pressure vessel quality steel with continuous welds.

4. The silencer shall be subject to a pressure test for tightness and strength at a minimum of 1.65 times the maximum blower operating pressure.

5. The silencer shall have a machined inlet connection where the discharge flange of the blower stage bolts directly to, with no intermediary pieces.

6. Discharge silencer performance losses shall be included by the blower vendor in the blower performance calculation. This is another reason why the blower accessories must be supplied by the manufacturer of the blower stage.

7. The base frame shall be constructed from welded carbon steel or cast iron that shall be designed to maintain alignment of the blower internal components and the drive during operation.

8. The base frame shall be designed to resist distortion while being installed on vibration isolating mounts.

9. The blower manufacturer shall supply a stainless steel grounding lug fully welded to the base.

J. Pressure Safety Valve:

1. Each package shall be supplied with a single pressure safety valve on the discharge side of the blower mounted downstream of the discharge silencer and upstream of the check valve.

2. The safety valve shall be set to protect the blower from exceeding its maximum pressure rating and shall be sized to pass 100% of the design flow.

3. The safety valve shall be field adjustable, spring loaded, and have a certificate of conformity to PED.

4. The pressure relief valve shall be housed by the sound enclosure and shall relieve into a segmented section of the sound enclosure. Weighted relief valves inside in the enclosure are not permitted.

K. Vibration Isolators

1. Each package shall be supplied with vibration isolating feet with a minimum efficiency of 80%.

2. Blower manufacturer shall be responsible for attenuating noise and vibration in the blower package such that no special installation base shall be required, nor shall any additional measures be required to reduce vibrations from the blower package being transmitted to the base or the piping.

L. Flexible Connectors:

1. Each package shall be connected to the plant piping via flexible connector(s) located downstream of the discharge silencer.

2. Flexible connectors shall prevent the transmission of noise and vibrations from the blower package into the piping.

3. Flexible discharge connectors shall be Proco Style 240, Type EE, EPDM, with a standard ANSI flange discharge connection, rated for 300 °F at 20 psig.

M. Acoustical Sound Enclosure:

1. Each package shall be supplied with a sound enclosure covering the entire blower package.

2. The enclosure shall provide suitable protection for outdoor installation under the specified site conditions (wind load and snow load).

3. The enclosure shall be designed so as to be able to install them side-by-side with all maintenance done from the front or back of the package.

4. Details shall be as follows:

a. Panels shall be made of galvanized steel sheet, powder coated in a light reflecting, blue color per RAL 5001. The skid shall be of the same color.

b. Sound enclosure acoustic material shall comply with UL 94 - HF1 for fire-retardant, self-extinguishing, non-dripping materials.

c. The enclosure and the blower package shall both be mounted on a skid / oil-drip pan designed for meeting environment protection standards and for easy transportation and installation.

d. A grounding strap shall be installed between the blower base and the package skid to bypass any vibration isolating mounts.

e. Quick release panels, each less than 50 lb (as mandated by MSHA) must provide easy and quick access for routine maintenance of the blower and the package components.

f. Enclosure Cooling Fan:

1) A high efficiency blower shaft driven or electric driven ventilation fan shall provide ventilation and cooling integral to the sound enclosure.

2) Cooling fan shall be sized for sufficient heat removal from the sound enclosure, even when the blower is operated with a VFD.

g. Electrical components, instrumentation and instrument connections shall not be mounted or interface with moving panels of the sound enclosure.

h. Both blower oil sumps shall be piped to a common fill and drain, located at the front of the package for easy maintenance. An oil level indicator shall be mounted on the outside of the enclosure, which gives an accurate oil level indication while the blower is in operation. All oil lines to be hydraulic hose with fittings. No plastic tubing with compression fittings are allowed.

2.04 ELECTRIC MOTOR

A. Each package shall be supplied with a WEG (or approved equal) manufactured TEFC motor that shall operate on 460 Volts, 3 Phase, 60 Hertz current, 1800 RPM. The packages for the post aeration blowers shall have 3600 RPM motors.

1. Torque NEMA B

2. Temperature Rise Class B

3. Dust tight enclosures (Severe Duty)
4. Class F inverter rated insulation with Class H applied varnish
5. 3:1 constant torque
6. All cast iron construction, including frame, end bells, conduit box and fan cover
7. NPT threaded and gasketed F3 top mounted conduit box
8. Copper windings
9. Re-greasable bearings, positive pressure lubrication system with automatic drawn plugs – pressure compensated (Frame sizes 254T and larger).
10. All frame sizes shall be NEMA standard, suitable for overhung belt drive and with the conduit box location on top of the motor. IEC frame motors shall not be allowed.
11. The motor shall be mounted on a pivoting base to provide automatic tensioning of the belts.
12. The motor nominal rating after any corrections for ambient conditions shall be 10% above the maximum operating bHp.
13. The motor shall have a 1.15 service factor.
14. Motor windings shall be supplied with a normally closed thermostat, one per phase, wired in series to form a fail-safe motor protection circuit for the external fault circuit of the motor controller.
15. Blower manufacturer shall be responsible for coordinating the starting torque requirement of the blower and the motor.

B. V-Belt Drive

1. Each package shall be supplied with a V-belt drive that shall be of the high capacity type, oil and heat resistant. Drive shall be designed for a minimum service factor of 1.4 times operating power (bHp), or 1.1 times the motor nameplate Hp, whichever is larger to allow a minimum of 1.4-service factor based on the maximum blower bHp.
2. Belt tensioning shall be automatic without the use of any devices or interaction on the part of the operator. Neither slide rails nor load-adjusting springs shall be used.
3. Sheaves shall be dynamically balanced regardless of the operating speed.

C. Belt Guard:

1. The belt drive shall be guarded in compliance with OSHA regulations.
2. Portions of the guard shall be easily removable allowing for belt inspection and replacement.
3. Guard material shall be perforated carbon steel.

D. Each blower shall receive its initial oil filling at the factory, the synthetic oil shall be rated for a minimum of 16,000 hrs.

E. Variable Frequency Drive (VFD)

1. Each blower package shall include a factory mounted, 6-pulse, constant torque, variable frequency drive.

2. Drive shall operate on 460 VAC, 3 phase, 60 hertz power and shall be integrated with the local blower permissive switches.

3. The drive shall include the following features and accessories:

a. VFD shall be mounted in the blower enclosure as one package suitable for outdoor installation.

b. Rotary fused disconnect

c. Method to minimize power line harmonics while providing a near unity power factor.

d. Input surge protection to withstand surges of 2.3 times line voltage for 1.5 msec.

e. Modbus TCP Ethernet communication over CAT5 cable

f. Minimum 100kA SCCR safety rating

g. Local control panel for start/stop, speed control, and auto/manual operation.

4. The VFD shall have the following local indicators with local reset:

a. E-Stop

b. Inlet Pressure High

c. Discharge Pressure High

d. Motor Over Temp

e. Blower Over Temp

f. Motor Speed

2.05 INSTRUMENTATION

A. Each package shall be supplied with the following instrumentation:

1. Inlet Vacuum Gauge (4” Gauges)

a. Aerzen or Wika standard gauge with 4” dial and scale from 0 to –40 inches of water column.

b. Gauge to function as a filter maintenance indicator.

2. Discharge Pressure Gauge (4” Gauges)

a. Aerzen model 32-0053-02 or Winters with 4” dial and scale from 0 to 20 psig.

b. The pressure gauge shall have a stainless steel case and be glycerin-filled for pulsation dampening.

c. A pulsation snubber shall be provided.

3. Discharge Temperature Gauge / Switch (4” Gauges)

a. Aerzen or Winters standard gauge with 4” dial and scale from 32°F to 572°F

b. NEMA 4 enclosure, 5A @ 250volt, SA 28 SPDT microswitch

c. UL & CSA approved.

PART 3: EXECUTION

3.01 INSTALLATION

A. Conduct a coordination conference call with the Manufacturer and the Engineer to review the integration and installation requirements of the equipment after the Submittal documentation has been approved and prior to installation of the equipment.

B. The Contractor shall install the blowers in accordance with the Manufacturer’s written instructions.

C. The Contractor shall make all electrical and process connections to the blower package prior to the arrival of the manufacturer’s representative.

D. The Contractor shall complete and return the Manufacturer’s installation check list prior to having a Manufacturer’s representative come onsite.

E. Representatives of the blower manufacturer shall verify and adjust blower and motor alignment.

3.02 FIELD TESTING

A. After installation of all equipment has been completed and as soon as conditions permit, the manufacturer shall provide the number of trips and hours as shown in the Required Field Testing Table below to verify the installation and conduct an acceptance test under actual operating conditions.

1. The Manufacturer shall perform a physical check of the blower installation, perform safety checks, power up the equipment and perform functional testing.

2. The functional test shall consist of operation of each blower with vibration, temperature, and pressure readings as well as motor amp readings taken and recorded at 60-minute intervals. Refer to the Required Field Testing Table below.

3. Installed noise measurements shall be taken to compare the installed noise values with the factory free field ISO 2151 measurements.

4. The Manufacturer shall provide operations and maintenance training to the plant personnel. The training shall consist of classroom training using the Operation and Maintenance Manual for reference and hands on training at the blower package. Refer to the Required Field Testing Table below.

Required Field Testing Table

Blowers	Number of Site Visits	Length of Acceptance Test (hours)	Length of Functional Test (hours)	Hours of Training (Total per Facility)
BNR Blowers in Basins 1 to 3	3	8 per Basin	4 per Basin	4
BNR Blower in Basin 4	1/2	4	2	4
BNR Standby Blower	1/2	4	2	-
Post Aeration Blowers	1	4	4	2
Aerobic Digester Blowers (including Standby)	2	4 per Digester	4 per Digester	2

B. If required, Contractor shall make any changes, at his own expense, to the installation that may be necessary to assure satisfactory operation. Contractor shall be held liable for changes needed in the installation.

C. Manufacturer shall provide a written field test / start up report after completion of testing.

D. Provide testing of VFD for local and remote operation. Verify communications with system integrator and plant control system for automatic control and monitoring via the plant control system. Provide all VFD parameters to system integrator.

END OF SECTION

SECTION 11380

MEMBRANE SYSTEM

PART 1: GENERAL

1.01 SCOPE AND RESPONSIBILITIES

A. OWNER has preselected and prenegotiated the scope and price specified herein with the Supplier, SUEZ Water Technologies & Solutions, for the ZeeWeed MBR System.

B. The prenegotiated scope includes, but is not limited to, manufacturing and furnishing equipment and materials, delivering to the jobsite, providing various documentation, and providing services, as specified herein. The CONTRACTOR shall coordinate with the Supplier regarding details of Supplier's scope.

C. Additional documentation concerning Supplier's prenegotiated scope and price are included as Supplements to this Section.

D. CONTRACTOR's responsibilities shall include, but are not limited to, procurement, unloading/receipt at the jobsite, storage, handling, installation, testing, coordination, and startup.

E. Supplier shall provide membranes and directly related equipment. CONTRACTOR shall provide all piping and hardware not supplied with the ZeeWeed MBR System.

F. CONTRACTOR shall provide installation and startup services, including electrical and control systems.

G. OWNER's preselection and prenegotiation shall in no way be construed to otherwise change, in any material way, CONTRACTOR's responsibilities under the terms and conditions of this Contract.

1.02 WORK INCLUDED

A. The work in this Section include the furnishing of all materials and equipment and the installation of the membrane bioreactor system, as specified in the attached Proposal.

1.03 SUBMITTALS

A. General: Provide Shop Drawings, samples, administrative, quality controls, and contract closeout submittals in accordance with the requirements of Section 01300 Submittals, Section 01640 Manufacturer's Services, Section 01730, Operation and Maintenance Data, and as listed below.

B. Vendor shall provide submittals as specified in the attached Proposal.

1.04 DELIVERY, STORAGE AND HANDLING

A. Preparation for Shipment and Delivery: Refer to Section 01600 Delivery, Storage and Handling

B. The CONTRACTOR shall be responsible for unloading all equipment at the jobsite. Follow the Supplier's storage and handling instructions.

1.05 FUNCTIONAL AND PERFORMANCE TESTING

A. As described in the attached Proposal.

PART 2: PRODUCTS

2.01 MANUFACTURERS

A. Manufacturer shall be SUEZ Water Technologies & Solutions. No substitute will be allowed.

2.02 SUEZ ZEEWEED MBR SYSTEM

A. See attached Proposal – Supplement 1.

PART 3: EXECUTION

3.01 INSTALLATION

A. The membrane system equipment will be installed by the CONTRACTOR.

B. CONTRACTOR shall be responsible for the installation of all instrumentation control panels and wire/cable provided by the Supplier.

C. CONTRACTOR shall be responsible for temporary pumping and piping of reject permeate flow during start-up and commissioning of the membrane process until the permeate flow from the membranes meet the plant permit discharge water quality requirements. Temporary pumping will be from the UVPA structure to either the head of the plant or the BNR basins.

D. The membrane process equipment bill of materials and cutsheet shop-drawings from Appendix B in the manufacturer's proposal for the membrane cassettes, associated piping, pumps, valves, instrumentation, etc. will be provided during the construction phase of the project.

E. The additional contractor information documents from Appendix E of the manufacture's proposal for operation and maintenance will be provided during the construction phase of the project.

3.02 SUPPLIER'S SERVICES DURING CONSTRUCTION

A. As specified in the attached Supplements 1 and Supplement 2.

3.03 SUPPLEMENTS

A. The supplements listed below, following "END OF SECTION," are part of this Specification.

END OF SECTION

SUPPLEMENTS

1. Supplement - 1, SUEZ Water Technologies & Solutions Proposal

   As-Sold Proposal for City of Canton, Georgia,
   Wastewater Treatment Plant Expansion

   SUEZ proposal number: 245805
   Date: September 2, 2020

   All documents contained in Appendices A through E of this proposal are provided as Supplements 1A through 1E.

   Pricing shall be as outlined on the Bid Forms in the Owner's Contract Documents.

2. Supplement – 1A, Appendix A of Supplement – 1
3. Supplement – 1B, Appendix C of Supplement – 1
4. Supplement – 1C, Appendix D of Supplement – 1
5. Supplement – 2, Membrane System Supplier Request for Proposal

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Water Technologies & Solutions

SUEZ WTS Systems USA, Inc.
3239 Dundas Street, West
Oakville, Ontario L6M 4B2
Canada

September 28, 2020

To All Bidding Contractors,

SUEZ WTS Systems USA, Inc. (SUEZ) is pleased to be the pre-selected MBR supplier for the City of Canton's wastewater treatment plant expansion. The following price for the SUEZ equipment and services is based on SUEZ's As-Sold Proposal 245805, dated September 2nd, 2020.

Lump Sum Price: $USD 2,695,080.82 (exclusive of taxes)

Please let us know if you have any questions.

Sincerely,

J Watt

Jennifer Watt, P. Eng.
Regional Director, Southeast USA and Caribbean
+ 1 905 464-3114 (cell)
Jenn.Watt@suez.com

cc. David Williams, Templeton & Associates
Jordan Longoria, Templeton & Associates

As-Sold Proposal for City of Canton, Georgia Wastewater Treatment Plant Expansion

SUEZ proposal number: 245805

submitted to:
City of Canton, Georgia
110 Academy Street
Canton, Georgia 30114
attn : Mr. David Hatabian, P.E

submitted by:

SUEZ WTS Systems USA, Inc.
3239 Dundas Street West
Oakville, Ontario L6M 4B2

Jennifer Watt
Regional Manager
tel: (905) 464 -3114
e-mail: jenn.watt@suez.com

local representation by:

Templeton & Associates
4324 Brodgdon Exchange Ste 100
Suwanee, Georgia 30024

David B Williams Jr.
Local Representative
tel: (404) 219-8469
e-mail: dave@templeton-associates.com

September 2nd, 2020

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appendix e – additional contractor information documents

1 technical approach

1.1 ultrafiltration system design

For the City of Canton WWTP membrane system, SUEZ has proposed four identical trains, in accordance with the Atkins RFP January 2020 Section 4.5. Each train will contain five full cassettes, each with 52 modules, and one partially-filled ZW500D cassette, with 32 installed modules. An additional spare cassette space in each train will accommodate a seventh cassette if required. In total, each train has 292 installed modules, providing 19.8% spare-space to flexibly adapt to future needs and exceeding the 10% minimum spare-space requirement per the Atkins RFP January 2020 Section 4.5.

parameter	value	unit
type of membrane	ZeeWeed 500D	n/a
type of aeration	LEAPmbr aeration	n/a
total number of membrane trains	4	no.
number of membrane cassettes installed per train	6	no.
number of membrane cassettes spaces per train	7	no.
number of fully populated membrane cassettes per train	5	no.
number of partially populated membrane cassettes per train	1	no.
maximum number of membrane modules per cassette	52	no.
number of membrane modules installed per train	292	no.
number of membrane cassettes installed per plant	24	no.
number of membrane modules installed per plant	1,168	no.
total membrane area per train	108,040	ft^2
total membrane area per plant	432,160	ft^2
spare space available	19.8	%
Q_{MMF} net flux	13.9	gfd
Q_{MDF} net flux	20.8	gfd

1.2 membrane cleaning

Below is a summary of the proposed cleaning regime when the plant is operating at design capacity. During initial operation, the cleaning regime may be optimized (less cleans) for less than design flow operation. The equipment supplied by SUEZ is capable of doing both MCs and RCs for both types of chemical. The use of acid MC and RCs typically depends on the amount of inorganic fouling which varies due to influent alkalinity and amount of coagulant dosed.

chemical		maintenance clean	recovery clean
sodium hypochlorite solution	frequency	1 per week	3 times per year
	concentration	200 mg/L	1,000 mg/L
citric acid solution	frequency	-	3 times per year
	concentration	-	2,000 mg/L

2 SUEZ scope of supply

Please refer to the BOM and Cutsheets in Appendix B. The BOM should be read in conjunction with the Process and Instrumentation Diagrams (P&ID) and GA Drawings in Appendix A. Where there is a conflict between P&ID's and BOM, the P&ID's shall take precedence.

The following table summarizes scope not outlined in the BOM.

2.1 membrane bioreactor system

general	
completed and approved	engineering submittals
	PLC and HMI programming
	operator training, per section 2.1.2.1
	operating & maintenance manuals
	design and field services to include, installation assistance, start-up and commissioning, performance testing and training per section 2.1.2.1
	24/7 telephone technical support service – 5 years, per section 2.1.3
	equipment mechanical warranty – 1 year, per section 3
	membrane warranty– 10 years, per section 3
	performance warranty – 5 years, per section 3
	InSight Pro – process consulting service – 5 years, section 2.1.3

note 1: all SUEZ supplied equipment is designed for installation in an unclassified area.

2.1.1 contractor bidding support services

SUEZ understands the importance of selecting the right team for any project and will be available during the contractor selection process to provide the following services according to section 5.2 of the Atkins RFP January 2020:

- provide responses to questions submitted by the general contractors related to the proposed scope of supply and services for the membrane system.
- prepare addenda material and design revisions associated with the scope of supply and services for the membrane system.

2.1.2 construction phase support services

SUEZ knows the importance and long-term implications involved in selecting a membrane supplier. We are committed to building our partnership with City of Canton, Contractor and operations team, and believe communication is the essential ingredient to achieve this.

Per section 5.3 of the Atkins RFP January 2020, SUEZ will be available for the Owner, Contractor and Engineer to assist in the following ways:

- development of all shop drawings;
- development of operation & maintenance manuals accordance with Atkins RFP January 2020 section 5.3.2
- development of a commissioning and start-up schedule and plan;
- provide guidance to questions related to SUEZ supplied equipment;
- discuss and review control system integration;
- identification of all SUEZ supplied equipment;
- ensuring all SUEZ supplied equipment has been delivered in good order and that no damage has occurred during delivery;
- identification of any discrepancies between the shipping lists and the equipment received;
- construction and installation assistance related to SUEZ supplied equipment;
- recommendations for SUEZ equipment off-loading and installation;
- supervision of SUEZ membrane installation;

2.1.2.1 commissioning and training services

Throughout commissioning, testing and start-up, we will assign an internal field service supervisor that will support our field service representative (FSR) to ensure rapid response to any on-site issues that may arise.

During the commissioning phase of the project, regular updates will be provided to document site progress. Potential delays, site issues and planning of future activities will be communicated within these reports.

The following is a summary of the on-site technical support services provided by trained SUEZ field service representatives or manufacturer's representatives.

- operator training in accordance with Atkins RFP January 2020 section 5.3.3.1
- inspection of all SUEZ supplied equipment,
- inspection of equipment supplied by others (provided it is necessary for the correct operation of the SUEZ system)
- assistance with commissioning and start-up of the membrane system;
    - pre-operational checkout and test
    - functional testing

- assistance with the acceptance testing of the system.
  - start-up testing
  - performance testing

The following table outlines commissioning and training services to be performed by SUEZ, and the number of days and visits involved as specified in section 5.3.3 of the Atkins RFP January 2020 and the addendum.

service	personnel	days	visits	Atkins RFP January 2020 section
operator training	1	5	1	5.3.3.1
pre-operational checkout, testing, start-up	1	50	1	5.3.3.2 addendum 1
performance testing	1	14	1	5.3.3.3
Total		**69**	**3**	

note 1: number of days based on a 10-hour work day, 6 days/week schedule.

If additional field services are requested, below are the current hourly field service rates.

skill category	price/hour
technician level field service technician, product support technician	$ 175
specialist level field service representative, membrane specialist, commissioning specialist, plant controls specialist	$ 175
engineer level project manager, electrical/controls engineer, process engineer, operator training specialist	$ 195

For multiple, scheduled site visits, please feel at liberty to request a firm service proposal from your regional lifecycle manager.

scheduling - Service requests should be directed to our service headquarters at 1-866-271-5425. Business hours for daytime technical support by telephone are 8:30am to 17:00pm eastern time GMT-5, from Monday to Friday.

conditions

1. Rates are inclusive of travel and living expenses in Canada and the lower US. Remote sites, or those requiring special or urgent travel or accommodations, may incur additional charges.
2. In times of special circumstances (i.e. pandemic/national emergencies) additional costs may be incurred.
3. A minimum booking of 40 hours (one working week) is required for commissioning, startup or training services on capital projects or additional charges may be applied.

4. Travel time is charged at the applicable service rate. Travel hours begin at the SUEZ representative's residence or airport and end at arrival to the hotel or work site, and vice versa.
5. Hours exceeding a 10-hour day or a 40-hour work week may be considered overtime. Holiday rates apply based on US/Canada holidays and/or holidays observed in the country where the work is performed.
6. For extended duration assignments, staff rotations are scheduled on a monthly basis. Site-specific training required by customer will be billed as time worked.
7. Supplies, materials, consumables or services purchased for direct use during service will be charged separately.
8. State/provincial taxes, use taxes, withholding taxes and all other taxes are extra where applicable. Buyer is responsible to provide any applicable tax exemption certificates with its purchase order or work order.
9. All services provided are governed by SUEZ Water Technologies & Solutions general term and conditions. Additional or conflicting terms contained in purchase orders which authorize work are prohibited and shall not apply except where agreed to in writing.
10. For multiple scheduled or recurring site visits, please request a firm service proposal.
11. These rates are valid through December 31, 2021.

2.1.3 five year service agreement

SUEZ is a proven leader in delivering tangible value to our clients over the life of their plant. Our measure of success is how well we deliver solutions that help our clients meet their critical business objectives in each year of operation.

Through long-acquired membrane experience, SUEZ has clearly distinguished itself from other membrane manufacturers. A mature service culture and deep technical expertise are at the ready to serve and support the City of Canton through this membrane lifecycle.

SUEZ has distinguished itself from other MBR membrane manufacturers with the quality and range of post-commissioning service support offered to our clients. After initial project start-up and commissioning is complete, SUEZ equipment system owners have access to comprehensive support through flexible, responsive, and professional service packages. SUEZ has developed the systems and technical expertise necessary to anticipate and resolve any process or equipment problem.

SUEZ will provide the Owner with the following services during the first year of operation as specified in section 5.3.3.4 of the Atkins RFP January 2020 and with two bonus additional services:

- InSight Pro process consulting service
- 4 site visits each lasting for two 8-hour days
- 1 additional site visit with 12 hours of on-site operator training following the first 4 months of operation
- 24/7 emergency telephone support and PLC programming support
- pre-paid conference fee to ZeeWeed Wastewater User's Group for 2 operators
- regional lifecycle manager to assist and respond to the City of Canton and their operations teams for any support and guidance

SUEZ will provide the Owner with the additional services for Years 2 to 5.

- InSight Pro process consulting service
- 24-7 Emergency Telephone Support and PLC programming support
- 1 site visit, 3 days onsite
- access to ZeeWeed Wastewater User's Group
- regional lifecycle manager to assist and respond to the City of Canton and their operations teams for any support and guidance

2.1.3.1 InSight Pro

InSight – knowledge management solution

InSight Pro puts a professional SUEZ process expert on your team, collaborating to empower your operating team to apply the power of InSight to continuously improve their treatment processes.

The process expert is specifically assigned to your plant and will monitor key parameters on a regular basis using the InSight platform. The process expert will be in contact with the key members of your operations team to discuss and resolve performance, process and operational issues. While supporting your operations team with day-to-day issues, the process expert will also use InSight to bring attention to long term trends and provide recommendations that will help increase membrane and equipment life and reduce costs.

As part of InSight Pro which is provided for the first five years of operation, the process expert provides quarterly process reports with analysis of key trends and recommendations to improve plant operation, membrane cleaning and overall performance. In addition, an annual summary performance report is provided.

A high speed Internet connection is required for our InSight service. If the need for troubleshooting does arise, your SUEZ process expert is accessible, familiar with your system and equipped with accurate information to assist.

2.1.3.2 telephone support 24/7

after-hours - 24/7 emergency telephone technical support

Our 15-person technical support team is always on call and is equipped with the system information for effective communication with a plant operator through an emergency, potentially averting loss of plant production and expensive call outs. The telephone technical support group maintains access to all plant drawings for rapid reference during 24/7 support calls and maintains remote connectivity to dial into a plant's control system in order to gain a better understanding of the situation, and to make any necessary adjustments to control set-points or software. Dial-in access requires a LAN modem or hi-speed internet connection at your facility and requires that permissions are setup in advance. If a situation requires more detailed investigation of control code, a SUEZ programmer is on call at all times. Our technical support specialists will manage the resources needed within SUEZ to assist you in resolving your plant issues.

telephone technical support

For the life of the system, plant operators have telephone access to a skilled SUEZ technical support specialist who will assist plant operators in troubleshooting of system problems such as electrical (PLC/HMI), mechanical and process control issues.

Plant operators call the telephone number provided below at any time during business hours and ask for technical support.

hours of operation:	8:00 am to 6:00 pm Monday to Friday, EST
telephone, toll free in North America:	1-866-271-5425; press 1 for technical support, press 2 for non-warranty parts quotations

2.1.3.3 annual ZeeWeed users group

As an on-going support to ZeeWeed plants, an annual, two-day ZeeWeed users group meeting is organized by SUEZ consisting of formal meetings and a tour of a hosting ZeeWeed plant. New technologies are introduced, current issues are tabled, and roundtable discussions ensue. The users group has become an excellent forum for experienced operators to keep current, to renew old acquaintances, to exchange the "tricks of the trade" with each other, and to impart their knowledge to newer ZeeWeed operators. Generous hospitality combines with informal experiences and exercises to enhance the camaraderie amongst domestic and international plant operators.

ZeeWeed users group meeting in Bonita springs, FL

All ZeeWeed owners are invited to send operators representing their plant. SUEZ covers the conference fee and food expenses (travel costs and hotel not included). SUEZ supports this forum to facilitate interaction between ZeeWeed plant operators and to provide real-world feedback to SUEZ's management, design and operations staff.

2.1.3.4 regional lifecycle manager

The regional lifecycle manager (RLM) will act as the SUEZ Services' "quarterback", engaging in frequent communication with plant staff and ensuring timely access to all the technical resources provided by SUEZ. The RLM will also design a schedule and package of services suited to your needs and budget, including:

- additional years of 24/7 telephone technical support coverage
- additional years of InSight
- greater frequency of site visits and or special provisions for emergency site visits
- plant optimization and plant upgrades
- membrane replacement planning/budgeting
- membrane cleaning studies

SUEZ's regional lifecycle manager is Craig Brown who is located in Dacula, GA. Craig has been with SUEZ for 17 years and supports all of the SUEZ facilities in the Southeast USA.

2.2 scope of supply by others

SUEZ has provided a detailed list of the equipment and services to be provided. All equipment or services not specified in the scope of supply by SUEZ and as designated on the P&IDs are to be provided by others. Supply by General Contractor or Others includes all indicated items in section 4.5 of the Atkins Request for Proposal January 2020 and includes but is not limited to:

mechanical

- overall plant and biological design.
- review of all submittals and equipment cutsheets.
- headworks and pretreatment equipment and facilities including but not limited to grit removal, coarse and fine screening and associated equipment (collection/disposal of screenings) and instrumentation
- influent flow measurement to the membrane filtration system (4-20 mA signal to be sent to SUEZ PLC).
- biological tanks and equipment including but not limited to: process chemical pumps, process blowers, diffusers, mixers, raw sewage feed pumps and associated instrumentation and valves.
- finished water disinfection, post-aeration tank, pumping equipment and associated instrumentation.
- design, supply and installation of anchor bolts and fasteners for SUEZ supplied equipment. Seismic structural analysis and anchor bolt sizing.
- design, supply and installation of bulk chemical storage facilities, containment, transfer pumps and associated controls.
- design, supply and installation of containment for chemical totes as required
- supply and install membrane tank deflector plates
- supply and install influent gates to membrane tanks
- any spacer rings that may be required for valves.
- all required energy/power and chemical usage measurement and equipment for performance testing (if required)
- all required permits and permissions including but not limited to civil works, mechanical and electrical works, environmental permits or other permits to allow operation.
- weather protection as required for all SUEZ supplied equipment. Electrical panels are designed for indoor operation and will need shelter from the elements. Includes heat tracing, insulation, etc., of equipment and instrumentation.

electrical

- supply and installation of panel boards, transformers, and other equipment as necessary to provide power distribution and control for all membrane system equipment.
- design, supply and installation of motor control centers complete with motor starters and variable frequency drives as required for SUEZ supplied equipment.
- integration of plant PLC or DCS, including SCADA configuration, testing and interfacing with the SUEZ supplied control system.
- design, supply and installation of all power distribution and instrumentation interconnecting wiring, optical fibers, conduit and appurtenances, as follows.
    - power connections as needed from the electrical power source to the SUEZ control panels, owner supplied MCC and from the MCC to SUEZ supplied equipment.
    - connections as needed between the various field-mounted instruments and valve actuators to the SUEZ control panels.

  the electrical installation should meet the requirements of best practice guidelines which include standards for facility grounding, lightning protection, transient control, single-point grounding, load-balancing and management of harmonics.
- control of equipment and systems not supplied by SUEZ.
- electrical support labor for commissioning activity

commissioning

- equipment installation, including;
    - all SUEZ supplied equipment and membranes
    - alignment of rotating equipment supplied by SUEZ by a qualified and certified millwright. Submission of an alignment report to SUEZ is required for equipment warranty validation purposes for each piece of equipment.
- unloading of delivered equipment and membranes at the defined point of destination including receiving, sign-off and safe storage of equipment at site until ready for installation.
- storage of membrane cassettes, if required and must meet SUEZ's storage requirements (refer to appendix e)
- provide trailers/offices and washroom facilities for the SUEZ site personnel and its representatives.
- installation & removal of suitable temporary screens (if required) on all process lines entering the membrane basins to prevent foreign construction related debris from coming in contact with the membranes.
- raw materials, seeding sludge and utilities during equipment start-up and operation including a supply of raw water feed that meets all design parameters for the successful commissioning of the membrane equipment.

- supply and installation of all required oil and lubricants for equipment start-up and initial operation per the manufacturer's specifications.
- replacement of lubricants in all drives and intermediate drives of mechanical equipment after initial break-in of the equipment
- flushing of all piping and membrane tanks and verification of removal of all residual debris from construction.
- laboratory services, operating and maintenance personnel during equipment checkout, start-up and operation.
- all required permits and approvals to run the plant.
- temporary piping/hosing may be required for the commissioning of the plant before effluent distribution is authorized.
- contractor checklists are required complete prior to commissioning (refer to appendix e)
- supply and installation of a suitable secure remote internet connection for 24/7 emergency telephone technical service; as well as for InSight
- mechanical support labor for commissioning activities
- disposal of initial start-up wastewater and associated chemicals

civil

- provision of main plant structures, existing tank modifications, buildings, equipment foundation pads, concrete work, etc.
- equipment access platforms, walkways, stairs, safety tie off points, handrails, grating, ladders, full floor coverage equipment contact pads, etc.
- membrane tank walkways, stairs, safety tie off points, handrails, grating, ladders, as required, etc.
- any on-site touch-up primer or painting of equipment supplied by SUEZ.
- overhead traveling beam crane above the membrane tanks for installation and removal of the membrane cassettes (10,000 lbs capacity)
- HVAC equipment design, specifications and installation (where applicable)

piping interfaces

- installation of supplied air header pipes that run the length of the membrane tanks, to the end of the membrane gallery. Supply and installation of pipe supports and hangers for this piping.
- installation of supplied permeate header pipes that run the length of the membrane tanks to the process pump and to the permeate collector. Supply and installation of pipe supports and hangers for this piping.
- design, supply and installation of process and utilities piping, pipe supports, hangers, valves, etc., to and from SUEZ supplied equipment including but not limited to:
  - piping from the blowers to the SUEZ supplied process air pipes at the membrane gallery.
  - piping from permeate collector to disinfection to discharge
  - temporary piping systems required for the start-up and commissioning of the SUEZ equipment. Typically, the provision of a re-circulation loop between the permeate header and the tank inlet channel/pipe is required for the start-up of the SUEZ system to allow for testing prior delivery of water the distribution system.
  - any heat tracing, insulation and cladding on any piping systems as required.
- piping, pipe supports and valves between SUEZ-supplied equipment and other plant process equipment

hazardous area classification

- unless stated otherwise, the equipment & instrumentation quoted is to be installed in a NFPA 820 non-classified area.

seismic zone consideration

- the system and equipment quoted is assumed to be installed in a location that has non-seismic zone.

miscellaneous

- stamping, signing or sealing of general drawings as per Federal, State or local regulations or codes, where required

2.3 proposed project schedule

The schedule presented below summarizes the key milestones and estimated time for each item.

anticipated schedule	
item	**duration**
membrane system equipment manufacturing and delivery to site	20-24 weeks after Notice to Proceed with manufacturing (partial shipments allowed)
install MBR equipment & construction assistance	~6 months
pre-operational checkout & system commissioning	10 weeks
operation training	1 week
performance testing	2 weeks

Below are brief descriptions of the services during each main stage of execution noted above.

membrane system equipment delivery

SUEZ will work with the General Contractor to ship equipment as they need it for the installation progress. For example, typically the hardware for the membrane tanks may be shipped earlier to site, as well as any key items that are required to be installed earlier in the process. SUEZ will create a delivery schedule with the General Contractor once they are selected for the project.

The General Contractor issues PO to SUEZ, typically 2-4 weeks after the General Contractor is awarded project. SUEZ will provide a final shop drawing submittal (mechanical and electrical) to the General Contractor for review prior to release for manufacturing. This is in essence a re-submittal of what has been supplied in the Contractor bid documents and previously approved.

The General Contractor will get approval for the submittals and provide a Notice to Proceed with manufacturing (NTP) to SUEZ for Procurement and Manufacture of Equipment. SUEZ will proceed with equipment manufacturing once the NTP is provided by the General Contractor. The NTP will be provided as soon as reviews are completed for the final shop drawing submittal and the General Contractor will review their schedule to ensure the NTP will provide delivery of equipment when required on site. This NTP may be provided as early as 2-4 weeks after SUEZ provides the submittal to the Contractor.

installation

The key items for the civil installation work to be completed in order to get the membrane system operational will be the new membrane tanks, equipment building, new headworks and new aeration basins. To install the MBR equipment for this size of facility, it will take approximately six months.

construction assistance

A SUEZ representative will meet with the owner and contractor to assist in the following ways:

- development of a commissioning and start-up schedule and plan;
- provide guidance with onsite questions related to SUEZ supplied equipment;
- review resources required during commissioning and start-up;
- discuss and review control system integration;
- identification of all SUEZ supplied equipment;
- ensuring all SUEZ supplied equipment has been delivered in good order and that no damage has occurred during delivery;
- identification of any discrepancies between the shipping lists and the equipment received;
- inspection of all SUEZ supplied equipment,
- inspection of equipment supplied by others (provided it is necessary for the correct operation of the SUEZ system)

pre-operational checkout and testing

After the contractor has completed the installation of the membrane filtration system equipment and provided a completed installation checklist to SUEZ, a commissioning representative will return to site. This visit is to ensure the installation work has been carried out correctly and has reached a degree of completion adequate to allow plant start-up to proceed smoothly and without delays. It will include:

- inspection of all wiring to SUEZ supplied equipment (I/O checks);
- rotation checks on all SUEZ supplied equipment;
- witness flushing of all influent permeate and backpulse piping using potable/clean water;
- witness correct operation of prescreening equipment;
- setup of SUEZ supplied instrumentation;
- stroking SUEZ supplied valves;
- verifying operation of SUEZ supplied pumps, blowers and air compressors;
- verifying ranges and calibration of SUEZ supplied instrumentation, and;
- establishing communication between SUEZ supplied control equipment and control equipment supplied by others.

Following the above, the SUEZ commissioning representative will be present to advise and provide direction to the installation contractor on the preparation and installation of the ZeeWeed membrane cassettes into the membrane tanks.

Once the membranes are installed, the SUEZ commissioning representative will perform testing to validate membrane integrity. Once completed, the membrane system is ready for wet commissioning.

commissioning

Once membrane installation is complete, the SUEZ representative will assist with further commissioning and start-up, which includes:

- confirming the performance of all SUEZ supplied rotational equipment;
- confirming the performance of chemical and cleaning systems;
- functional testing of membranes through bubble testing;
- tuning SUEZ system operation;
- functional testing of the entire system including instrumentation, and;
- clean water flux testing.

Once all the above tasks are completed, the membrane system can take feed from the seeded bioreactors and begin treating wastewater. This occurs once the biological process acclimation period is complete.

performance test

The buyer/owner will begin operating the plant for a 14 day performance test. SUEZ will be on site during the test and the 24/7 telephone support and remote online monitoring of the system will begin during this period. A performance test report will be provided after the completion of the test with supporting data that indicates that the plant has met all the requirements of the Atkins RFP January 2020.

operator training

Operator training will occur ideally during commissioning and will consist of a combination of classroom, shadowing and hands on operation. SUEZ has developed numerous operator training courses, each catered to the individual needs of its client. The training included by SUEZ will **empower the staff to operate the membrane system proficiently and confidently**.

Client training packages are developed, maintained, and delivered by the commissioning group. SUEZ has full-time training experts responsible for training methodologies and curriculum development.

shadowing: During the commissioning and start-up of the system and for membrane installation, SUEZ recommends that an operator representative shadows the field service representative. Shadowing provides superior operator understanding and confidence in all aspects of membrane system operation. Our partner-focused field service representatives will instruct a “shadow” operator over the course of start-up and commissioning.

classroom: SUEZ will conduct classroom training at the facility. It is recommended that this section of training is conducted prior to the completion of commissioning, but after the installation of membranes, so that the information learned is quickly put into practice and reinforced through actual application on the system.

One of our training specialists will deliver the classroom training, covering the theory and practice required to operate a SUEZ system. Group sizes of five to ten are optimal for classroom training, but up to twenty people can be accommodated in one session. Material to be covered includes:

- membrane application theory
- performance monitoring
- membrane cleaning theory
- system controls theory
- the reasoning method of troubleshooting

SUEZ requires that there be a suitable classroom with associated teaching materials such as blackboards, overhead projectors, pens, pencils, writing pads etc. be available for the duration of the course. It is preferred that, where possible, training be carried out at the plant where the equipment supplied is located.

hands-on: Immediately following the classroom training, the training specialist will further train the owner's personnel through hands-on operation of the membrane system. The material to be covered includes:

- use of the computer operator interface
- plant maintenance
- instrumentation and equipment maintenance
- membrane cleaning
- troubleshooting
- SUEZ's experience in training shows that groups for hands-on training should be kept to five (5) or less.

learning outcomes

Upon successful completion of this learning program the learner will be able to:

- membrane application and systems control theory;
- primary flows and equipment functions;
- navigate the P&IDs to locate components;
- performance monitoring and membrane cleaning;
- navigate the Operating Manual and controls documentation;
- the reasoning method of troubleshooting;
- use of the computer operator interface (HMI);
- plant maintenance and preventive steps, and;
- instrumentation and equipment maintenance.

3 warranties

3.1 introduction

As requested in Section 1.16 of the Atkins RFP January 2020, SUEZ has provided a comprehensive warranty for the City of Canton wastewater treatment plant expansion.

- equipment warranty
  - **mechanical equipment warranty:** Seller will repair or replace any device or part thereof that was supplied by the seller that proves to be defective. This warranty covers all seller's supplied membrane system general equipment and excludes the membrane modules.
  - **membrane warranty:** This warranty provides protection and assurances to the buyer/owner with respect to the membrane modules.
- **performance warranty:** This warranty provides protection and assurances to the buyer/owner with respect to the ability of the seller's system to meet the established performance criteria.

The Owner mentioned herein is defined as the City of Canton.
Per Addendum 1, substantial completion is defined as beneficial use of the facility.

3.2 mechanical warranty

material and workmanship warranty

The mechanical warranty is only applicable to equipment supplied by the seller. Seller's obligation under this warranty is to the repair or replace, at its factory, of any device or part thereof, which shall prove to have been thus defective. The mechanical warranty period on all equipment supplied is twelve (12) months from the date of completion of performance testing or eighteen (18) months from equipment shipment, whichever occurs first. Warranty repair, replacement or re-performance by seller shall not extend or renew the applicable warranty period.

Seller assumes no liability for any damage to equipment caused by inadequate storage or handling per manufacturer's recommendations in supplied technical literature, or by defective or sub-standard workmanship or materials provided by the Buyer/Owner or any other third party responsible for handling, storing or installing the equipment.

The buyer/owner undertakes to give immediate notice to seller if goods or performance appear defective and to provide seller with reasonable opportunity to make inspections and tests. If seller is not at fault, the buyer/owner shall pay seller the costs and expenses of the inspections and tests.

Goods shall not be returned to seller without seller's permission. Seller will provide Buyer/Owner with a "return goods authorization" (RGA) number to use for returned goods. All returns are F.C.A. – Oakville, Ontario, Canada.

All costs associated with the removal and shipment of the defective part from the owner's facility to the seller's factory and all costs related to return shipment to the owner's facility and installation of a repaired or replacement part shall be the buyer (General Contractor's) responsibility.

Implied warranties, including but not limited to warranties of fitness for particular purpose, use or application, and all other obligations or liabilities on the part of the Seller, unless such warranties, obligations or liabilities are expressly agreed to in writing by Seller, are null and void.

3.3 membrane warranty

A ten (10) year full replacement membrane warranty is offered in accordance to the criteria set forth in Section 1.16 of the Atkins RFP January 2020 and warranty provisions summarized below. This membrane warranty is for a period of ten (10) years and begins from the date of successful completion of the performance test, or three (3) months from delivery of the membranes to site, whichever occurs first.

Failure to meet performance requirements during the 10-year warranty period will result in the membrane supplier being responsible for undertaking modifications, and/or providing technical assistance to incorporate operational changes and/or changes to the system as required and at no cost to the City to meet the Performance Requirements.

3.3.1 warranty provisions

Warranty provisions are defined in the "Seller's warranty – ZeeWeed membrane modules" located at the end of this section, and the following provisions below:

- the equipment is operated and maintained at all times in accordance with the seller's operations and maintenance manual,
- the equipment is operated within the mixed liquor characteristics defined in table 1 of this section. Any value above or below the ranges stated may not automatically invalidate the membrane warranty but rather they could impact the system performance; for example, backwashing in lieu of relaxing may be implemented, or cleaning requirements may be affected. Should any excursion(s) to the parameters defined in table 1 occur, please consult with the seller to discuss appropriate follow-up actions.
- Seller has, until performance of its obligation herein is met, reasonable access to the equipment and the operational data relating thereto,
- the Buyer/Owner furnishes adequate and competent operating, supervisory and maintenance staff, and necessary laboratory facilities with test equipment and personnel,
- the Buyer/Owner utilizes the services of seller until its performance obligations are met,
- the buyer/owner supplies all necessary raw materials and services of a quantity and of a quality specified by the seller,

- an adequate and continuous power supply is available that will enable operation of all required equipment,
- the following pre-treatment guidelines are followed:
  - ***fats, oil and grease (FOG)*** – the seller's membrane treatment system is designed for FOG concentrations of ≤150 mg/L of emulsified FOG in the feed with no free oil and ≤10 mg/L of mineral or non-biodegradable oil, typical of municipal wastewater.

    Note that should an unexpected discharge to the wastewater collection system occur, e.g. industrial or institutional release of oily residue, there may be an impact on the membrane treatment system either directly on account of the FOG itself, and/or due to the deleterious impact of the FOG on the biological treatment process, e.g. development of poor-filterability sludge. Should elevated FOG levels be noted or a known discharge of FOG upstream of the treatment plant occur, please consult with the seller to discuss appropriate follow-up actions.
  - ***wastewater screening*** - A punched hole or woven wire mesh screen with a maximum size opening of no greater than 2 mm and without possibility of bypass of any particle larger than 2 mm in all directions must be included in the headworks and fully operational.
  - ***process chemical additives*** - The usage and presence of typical municipal wastewater treatment chemicals such as metal-based coagulants in the mixed liquor entering the biological treatment process and/or membrane tanks represents minimal risk to the long-term operation of ZeeWeed membranes. However, silicone-based agents such as antifoams generally have deleterious impacts on mixed liquor filterability and membrane performance and their use is strongly discouraged, including in processes outside of the seller's system that may be transferred to the Seller's system, such as in solids-handling facilities. The Seller can provide further information on the compatibility of specific process chemical additives on the ZeeWeed membranes; please consult the seller with any questions or concerns prior to changing existing or introducing new process chemicals.
  - ***debris*** - The presence of material greater than 2-mm in size in mixed liquor in membrane tanks should be avoided, and the Seller recommends periodically applying a standard sieve test procedure (available upon request) for monitoring purposes. The accumulation of debris in the membrane tanks may lead to reduced throughput, increased cleaning frequency, and/or manual intervention (e.g. manual desludging).

table 1: mixed liquor characteristics for warranty purposes

parameter	design value	accepted operating range	units
mixed liquor temperature	13	13-35	°C
MLSS concentration in membrane tanks [1]	10,000	10,000 – 12,000	mg/L
pH of mixed liquor in membrane tanks	7.0	6.0-9.0	SU
soluble $cBOD_5$ concentration in mixed liquor entering membrane tanks	5	≤ 5	mg/L
NH3-N concentration in mixed liquor entering membrane tanks [2]	0.5	≤ 1.0	mg/L
colloidal TOC (cTOC) concentration in mixed liquor entering membrane tanks (mg/L) [3]	7	≤ 10	mg/L
soluble alkalinity of mixed liquor entering membrane tanks	230 [4]	50 – 400	mg/L as $CaCO_3$
time to filter (TTF) of mixed liquor in membrane tanks [5]	100	≤ 200	seconds

note 1: Membrane tank MLSS concentration of 12,000 mg/L is permissible during MDF and PHF events; membrane tank MLSS concentration should be maintained between 8,000-10,000 mg/L during all other flow conditions. For temporary excursions >12,000 mg/L, please refer to the section entitled "MLSS Exceedances".

note 2: The seller is cognizant that the buyer/owner's plant has a seasonal monthly-average NH3-N limit >1 mg/L, but a Design Target Monthly Average of ≤1.0 mg/L; based on estimated bioprocess performance simulations performed and provided by the buyer/owner, ≤1.0 mg/L NH3-N entering the membrane tanks is reasonable.

note 3: Colloidal TOC (cTOC) is the difference between the TOC measured in the filtrate passing through a 1.5 µm filter paper and the TOC measured in the ZeeWeed membrane permeate.

note 4: Design value obtained by performing an alkalinity balance based on BioWin 5.3 modelling per the bioprocess parameters provided in the Atkins RFP January 2020

note 5: Per seller's standard time to filter (TTF) procedure (available upon request).

3.3.2 MLSS exceedances

The ZeeWeed 500 membrane is very robust and can handle high solids events and unexpected thickening situations. The same ZeeWeed 500 membrane is used in sludge thickening applications where the design MLSS concentration is ≥20,000 mg/L, and there is a wide toolkit of strategies to manage unforeseen temporary MLSS excursions in an MBR system. In the case of abnormal mixed liquor concentrations within the membrane tank(s) outside the baseline values, the Owner should contact SUEZ immediately for possible corrective actions. Should an upset occur such that the membrane tank MLSS concentration exceeds 12,000 mg/L – potentially exceeding 20,000 mg/L - for a period of up to 72 continuous hours, SUEZ will review the impact of the performance in these conditions and if necessary, will recommend operational changes (ie. aeration strategies, backpulsing, etc.) and a chemical cleaning strategy to be followed as soon as practical.

3.3.3 membrane filtration performance

Seller warrants, subject to the provisions set forth above, that after stable operation of the Seller's system has been attained and operators have acquired reasonable skills, the membrane modules supplied for this project will be capable of producing the results set forth in table 2.

table 2: guaranteed membrane filtration system performance

parameter	guaranteed values	units
membrane filtration system hydraulic capacity		
average day flow (ADF) with all trains in service [1]	≤ 5.0	mgd
maximum month average flow (MMF) with all trains in service [1]	≤ 6.0	mgd
maximum day flow (MDF) with all trains in service [1]	≤ 9.0	mgd
peak hourly flow (PHF) with all trains in service [1]	≤ 8,333	gpm
75% maximum month average flow (MMF) with one train out of service [1, 2]	≤4.5	mgd
membrane filtration system permeate quality		
TSS	≤ 5	mg/L
turbidity	≤ 1 average < 3 maximum	NTU

note 1: The flow conditions are defined as follows:

Average Day Flow (ADF) – The average flow rate occurring over a 24-hour period based on annual flow rate data.

Maximum Month Flow (MMF) – The average daily flow rate occurring during the 30-day period with the highest flow based on annual flow rate data.

Maximum Day Flow (MDF) – The maximum flow rate that occurs over a 24-hour period based on annual flow rate data.

Peak Hour Flow (PHF) – The maximum flow rate sustained over a 1-hour period based on annual flow rate data.

note 2: Class 1 reliability criteria per EPA -430-99-74001

3.3.4 membrane module replacement price (MMRP)

The price of replacement ZeeWeed 500 membrane modules for this project is stated in Appendix B. Guaranteed Membrane Replacement Cost Form which can be found at the end of this section. Seller will guarantee this price for twenty (20) years subject to adjustment for inflation according to the North American Consumer Price Index + 1.0% or a maximum equivalent price per gallon of treatment capacity in the event that the module area/permeability etc. changes such that the same amount of feed water can be treated with fewer modules of the next generation design.

The membrane replacement price quoted refers to replacement of installed membranes which are no longer under warranty per the original terms and conditions of sale.

Membrane modules purchased to replace a membrane module whose warranty has expired or purchased additional membrane modules, shall be provided with a standard two (2) year full replacement warranty.

Membrane module replacement price does not include bagging, boxing, crating, and will be shipped on the basis of INCOTERMS 2010 FCA SUEZ Manufacturing Facility. Membrane module replacement price is quoted without taxes.

3.4 performance warranty

The performance warranty will be provided per Section 1.16 of the Atkins RFP January 2020. This warranty provides protection and assurances to the buyer/owner with respect to the ability of the seller's membrane filtration system to meet the established performance criteria. Based on the influent wastewater and/or mixed liquor characteristics and system operating parameters specified in this document, the equipment offered herein will be capable of meeting the performance defined in table 2 listed above.

The performance warranty period is five (5) years and will commence from the date of successful completion of the Performance Testing. The Seller shall monitor the operation of the membrane system during the first twelve (12) months after completion of the performance test via a high-speed connection to the membrane master control panel provided by the buyer/owner. The performance warranty will run in conjunction with the mechanical and membrane warranty.

Per 1.16 of the Atkins RFP January 2020, failure to meet performance requirements during the 5-year warranty period will result in the Seller being responsible for undertaking modifications, and/or providing technical assistance to incorporate operational changes and/or changes to the system as required and at no cost to the Owner to meet the Performance Requirements.

3.5 performance testing

A fourteen (14) day performance test shall be performed per the Atkins RFP January 2020 Section 5.3.3.3. to demonstrate the ability of the seller's system to meet the performance warranty requirements. Upon completion of the performance test, the twelve (12) month Warranty Reporting period shall commence, per the Atkins RFP January 2020 Section 1.16.

Upon starting the performance test, the buyer/owner shall use its reasonable best efforts to maintain continuous and stable operation of the system until the Seller's obligation under this performance guarantee has been discharged. The Buyer/Owner shall notify the Seller that the system is ready for the test or notify why the system is not ready and the party responsible for the lack of readiness shall promptly take the appropriate remedial action.

The Buyer/Owner shall afford the seller full access to the system and to all operating data pertaining to system performance until discharge of the latter's obligations hereunder. The test shall be conducted by the Buyer/Owner in accordance with a mutually agreeable test protocol and applicable standard techniques and operating procedures specified by seller in the operations and maintenance manual.

The performance warranty values are based on a fourteen (14) day average of each parameter. 24-hour flow-proportional sequential composite samples from the influent and effluent of the membrane system shall be obtained by the Buyer/Owner for the measurement of BOD_5, TSS, TKN, ammonia-N, NO_2-N, NO_3-N, turbidity, and total P. Hourly influent and effluent pH measurement will be taken from both the influent and the effluent from the membrane system. Grab samples for mixed liquor concentrations will be performed once per day. On-line instrumentation provided and grab sample testing performed is included as indications of the performance of the plant and to assist in the proper operation and control of the system. These results may include values beyond the stated warranty values (during process upsets or if instrument poorly/not calibrated, etc.) and additional composite testing as above must be performed to establish that the plant is not meeting performance requirements. All analytical work shall be coordinated by and paid for by the Buyer/Owner.

During the test, the MBR system operation should be according to the Seller's operations and maintenance manual and the operating parameters specified in this section. In the event of an interruption during the test due to any of the following events, the test shall be extended by the period of the interruption plus the time required to re-attain operating conditions in effect at the time of the interruption and data recorded during that period shall not be included:

- power interruption in excess of sixty (60) minutes per day.
- mechanical failure of the system.
- any influent or operating parameter outside the accepted operating ranges defined in this section.

If during the execution of the test the wastewater flow and/or load into the plant are outside the specified acceptable operating ranges in this document, the Seller will modify the test protocol within reason to mimic the design condition.

The Seller is not responsible for any limitations on the performance test protocol or results due to wastewater flow and/or load that is outside of the specified acceptable operating ranges.

When Seller is of the opinion (based on the results obtained at the completion of the performance test), that the system has fulfilled the performance guarantees herein contained, it shall give written notice to the Buyer/Owner to that effect. Within two (2) weeks immediately following receipt of such notice, the Buyer/Owner shall notify the seller in writing that it accepts the system, or that it does not accept the system, in which latter case the buyer/owner shall state the specific reason for non-acceptance. In the absence of such reply from the Buyer/Owner within the two (2) week period, the system shall be deemed to have been accepted.

If, after the system has been operated pursuant to the conditions hereinabove set forth, it becomes reasonably apparent, based on the results obtained at the completion of the performance test, that the system performance is short of the guaranteed performance, then additional performance tests of the system shall be conducted by the Buyer/Owner whenever seller shall reasonably request. In such event, Seller shall be responsible to undertake all necessary reasonable corrective measures in an effort, consistent with commercial and technical reasonableness, to bring the system up to the guaranteed performance levels.

If for any reason outside of the Seller's control, the performance test cannot be completed within one hundred and eighty (180) days after installation of the membrane modules, or if any changes are made to the system without the Seller's written consent that would affect the Seller's ability to meet this performance warranty, then all obligations to the Buyer/Owner under this performance warranty will be deemed fulfilled.

Guaranteed Membrane Replacement Cost Form

The dollar amount shall constitute the guaranteed maximum membrane replacement cost for all modules.

Membrane Replacement Cost (Years 11 through 20) $ 992,800 USD

nine-hundred and ninety-two thousand eight-hundred
Dollars
(in words)

4 commercial terms

4.1 system price

Pricing shall be as outlined on the Bid Forms in the Contract documents.

4.2 price validity

SUEZ's price is fixed for 15 months from February 3rd, 2020.

If the GENERAL CONTRACTOR has not issued a purchase order for the membrane system by the end of the 15 months period, the proposed/pre-negotiated price of the membrane system will be adjusted based on the US Department of Labor Price Index (CPI) for Urban Customers (CPI-U) U.S. City Average for All Items Less Food and Energy. All items as of the 15 month and the month of purchase order is made as follows;

Escalated Cost = (Proposed or Pre-negotiated Price x $CPI_{month\ of\ PO}$) / ($CPI_{month\ 15}$)

If a formal NTP for Manufacturing/Equipment Procurement is not received and accepted within three (3) months of the Purchase Order date referenced above, Seller will be afford the right to review and adjust the scope of supply, pricing and delivery schedule offered herein.

Seller would like to note that under the current exceptional circumstances under the COVID 19 Pandemic situation, Seller may not be in a position to guarantee and comply with the planned schedule for project delivery or performance and that should there be any new measures taken by any governmental authority which may impede or delay the said schedule or performance, Seller reserves the right to modify the schedule / contract accordingly. Seller will promptly inform you of any changes which may impact the contract or the project.

4.3 taxes

Pricing provided herein does not include any taxes or duties, as specified in appendix A of the Atkins Request for Proposal January 2020.

Buyer shall be directly responsible, and reimburse Seller, for the gross amount of any present, for future sales, use, excise, value-added, environmental, or other similar tax or duty applicable to the price, sale or delivery of any equipment or services furnished under this proposal. Unless Buyer has furnished Seller with evidence of tax exemption or direct pay permit acceptable to taxing authorities prior to the execution of any Purchase Order / Agreement or Seller's acceptance of Buyer's Purchase Order (as applicable), Buyer shall pay all taxes as invoiced by Seller and Seller is relieved of any obligation to (i) apply any tax exemption or direct pay permit, and/or (ii) refund the Buyer any tax paid by the Seller.

Seller's price and schedule shall be based on applicable Federal and State laws, local ordinances, codes, and standards as well as duties, sales or use taxes in effect as of the date of Seller's proposal. Should such laws, codes, taxes and standards change and increase the cost of performing the work or impact the schedule, Seller shall, upon notice to Buyer of such, be entitled to an equitable adjustment of price and /or schedule. Similarly,

should such laws, codes, taxes and standards change and decrease the cost of performing the work, Buyer shall be entitled to an equitable adjustment of price.

4.4 order confirmation centre

In order to facilitate efficient order handling, Seller has instituted an Order Confirmation Centre (OCC). All Purchase Orders or Contracts being issued to Seller are to be directed to OCC following the methods indicated below:

❑	via email:	WTS.equipmentpo@suez.com
❑	via facsimile:	905-469-2236
❑	via courier:	**SUEZ WTS Systems USA, Inc** 3239 Dundas Street West Oakville, Ontario L6M 4B2 Attn: OCC

4.5 delivery

The following freight terms for delivery of equipment used are as defined by INCOTERMS 2010.

All pricing is FCA to designated Buyer jobsite per Appendix A of the Atkins Request for Proposal January 2020.

Upon acceptance of Buyer's Purchase Order or, alternatively, where specified in the Purchase Order, upon receipt of Buyer's Notification to Proceed with Manufacturing/Equipment Procurement that satisfies Seller's requirements for meeting the delivery schedule, Seller shall commence fabrication of equipment. The place of delivery specified therein shall be firm and fixed, provided that Buyer may notify Seller no later than forty-five (45) days prior to the scheduled shipment date of the equipment of an alternate point of delivery. Provided the parties agree to a change order to take into account any additional cost or delay incurred by Seller in implementing this change, the alternate place of delivery shall become the agreed place of delivery for all purposes under such Purchase Order. Failure by Buyer to take delivery of the equipment shall be a material breach of such Purchase Order.

4.6 shipment to storage

If any part of the equipment cannot be delivered when ready due to any cause not attributable to Seller, Buyer shall designate a climate-controlled storage location and Seller shall ship such equipment to storage. Upon shipment to the storage location then (i) title and risk of loss shall thereupon pass to the Buyer if it had not already passed; (ii) any amounts payable to the Seller upon delivery or shipment shall become payable upon presentation of Seller's invoice(s); (iii) any amounts otherwise payable to Seller, such as for preparation for storage, handling, inspection, preservation, insurance and any taxes shall be payable by Buyer upon submission of Seller's invoice(s); (iv) the Services provided herein shall subsequently charged at the rate prevailing at the time of actual use and Buyer shall pay the net increase; and (v) Buyer is responsible for direct payment of all costs for storage of the equipment and subsequent transportation from the storage facility to their place of installation.

4.7 bonds

Performance and/or Labor & Material Payment Bonds are not included in the system price. These bonds can be purchased on request at an additional cost.

4.8 payment terms

Upon approved credit for the Buyer, payment terms will be as outlined below:

1. Upon ENGINEER's Approval of Shop Drawing: 10%
2. Upon Delivery, Accpetance by the GENERAL CONTRACTOR of the Equipment at the plant site, and title transfer to the OWNER: 65%
3. Upon Substantial Completion, Startup and Commissioning: 10%
4. Upon Successful Completion of the Performance Test: 10% (minus value of incomplete work)
5. Upon Satisfactorily Completion of Operator Training: 5%

Seller shall only proceed with procurement and production of equipment and materials upon receipt of a formal Purchase Order and a written Notice to Proceed with Manufacturing/Equipment Procurement from the General Contractor.

appendix a P&ID and GA drawings

appendix b bill of materials and cutsheets

appendix c electrical documents (network architecture; load list and panel drawings)

appendix d control documents (control narrative; operation sequence chart and control logic chart)

appendix e additional contractor information documents

SUEZ Water Technologies & Solutions Proposal

Supplement – 1B

SUEZ WTS
CONTROLLED DOCUMENT

CUSTOMER INFORMATION
CITY OF CANTON, WATER POLLUTION CONTROL PLANT(WPCP)

I/O LIST

CUSTOMER DOCUMENT NUMBER
506357-WTS-EL-T02-8533-LI-001

SUEZ DOCUMENT NUMBER: **506357-WTS-EL-T02-8533-LI-001**

CONTRACT	ISSUER	DISCIPLINE	PRODUCT	PHASE	TYPE	CHRONO
506357	WTS	EL	T02	8533	LI	001

REV	DESCRIPTION	CREATED BY	CHECKED BY	APPROVED BY	DATE (DD-MMM-YY)
A	ISSUED FOR INFORMATION	RS	KR	SKH	28-Apr-20

ROW NO.	P&ID	DEVICE TAG	DESCRIPTION	SIGNAL TAG	I/O TYPE	PANEL TAG	RACK	SLOT	CHANNEL	ADDRESS	IO MODULE PART NUMBER	IO ENERGIZED ACTION	POWER SUPPLY	SIGNAL TYPE	NOTES / REMARKS
1	506357-WTS-PR-T02-8521-DS-102	20-TSH-201-A	MEMBRANE BLOWER-A DISCHARGE TEMPERATURE HIGH	20-TAH-201-A	DI	CP-01	1	00	00	I:1:00.00	1794-IB16	TEMPERATURE HIGH		24VDC	
2	506357-WTS-PR-T02-8521-DS-102	20-TSH-201-B	MEMBRANE BLOWER-B DISCHARGE TEMPERATURE HIGH	20-TAH-201-B	DI	CP-01	1	00	01	I:1:00.01	1794-IB16	TEMPERATURE HIGH		24 VDC	
3	506357-WTS-PR-T02-8521-DS-102	20-FSL-201-A	MEMBRANE BLOWER-A DISCHARGE LOW FLOW	20-FAL-201-A	DI	CP-01	1	00	02	I:1:00.02	1794-IB16	LOW FLOW	24VDC	24 VDC	
4	506357-WTS-PR-T02-8521-DS-102	20-FSL-201-B	MEMBRANE BLOWER-B DISCHARGE LOW FLOW	20-FAL-201-B	DI	CP-01	1	00	03	I:1:00.03	1794-IB16	LOW FLOW	24VDC	24 VDC	
5	506357-WTS-PR-T02-8521-DS-107	20-LSL-001	PERMEATE LEVEL LOW	20-LAL-001	DI	CP-01	1	00	04	I:1:00.04	1794-IB16	LEVEL LOW		24 VDC	
6	506357-WTS-PR-T02-8521-DS-112	90-PSL-001	AIR COMPRESSOR PRESSURE LOW	90-PAL-001	DI	CP-01	1	00	05	I:1:00.05	1794-IB16	PRESSURE LOW		24 VDC	
7	506357-WTS-PR-T02-8521-DS-102	20-B-201-A	MEMBRANE BLOWER-A RUNNING	20-YA-201-A	DI	CP-01	1	00	06	I:1:00.06	1794-IB16	RUNNING		24 VDC	
8	506357-WTS-PR-T02-8521-DS-102	20-B-201-B	MEMBRANE BLOWER-B RUNNING	20-YA-201-B	DI	CP-01	1	00	07	I:1:00.07	1794-IB16	RUNNING		24 VDC	
9	506357-WTS-PR-T02-8521-DS-111	23-P-301-A	CITRIC ACID PUMP-A RUNNING	23-YA-301-A	DI	CP-01	1	00	08	I:1:00.08	1794-IB16	RUNNING		24 VDC	
10	506357-WTS-PR-T02-8521-DS-111	23-P-101-A	SODIUM HYPOCHLORITE PUMP-A RUNNING	23-YA-101-A	DI	CP-01	1	00	09	I:1:00.09	1794-IB16	RUNNING		24 VDC	
11	506357-WTS-PR-T02-8521-DS-112	90-AC-001-A	AIR COMPRESSOR-A RUNNING	90-AC-001-A	DI	CP-01	1	00	10	I:1:00.10	1794-IB16	RUNNING		24 VDC	
12	506357-WTS-PR-T02-8521-DS-112	90-AC-001-A	AIR COMPRESSOR-A FAULT	90-AC-001-A	DI	CP-01	1	00	11	I:1:00.11	1794-IB16	ALARM		24 VDC	
13		-	SPARE		DI	CP-01	1	00	12	I:1:00.12	1794-IB16				
14		-	SPARE		DI	CP-01	1	00	13	I:1:00.13	1794-IB16				
15		-	SPARE		DI	CP-01	1	00	14	I:1:00.14	1794-IB16				
16		-	SPARE		DI	CP-01	1	00	15	I:1:00.15	1794-IB16				
17	506357-WTS-PR-T02-8521-DS-102	20-TSH-201-C	MEMBRANE BLOWER-C DISCHARGE TEMPERATURE HIGH	20-TAH-201-C	DI	CP-01	2	00	00	I:2:00.00	1794-IB16	TEMPERATURE HIGH		24 VDC	
18	506357-WTS-PR-T02-8521-DS-102	20-TSH-201-D	MEMBRANE BLOWER-D DISCHARGE TEMPERATURE HIGH	20-TAH-201-D	DI	CP-01	2	00	01	I:2:00.01	1794-IB16	TEMPERATURE HIGH		24 VDC	
19	506357-WTS-PR-T02-8521-DS-102	20-FSL-201-C	MEMBRANE BLOWER-C DISCHARGE LOW FLOW	20-FAL-201-C	DI	CP-01	2	00	02	I:2:00.02	1794-IB16	LOW FLOW	24VDC	24 VDC	
20	506357-WTS-PR-T02-8521-DS-102	20-FSL-201-D	MEMBRANE BLOWER-D DISCHARGE LOW FLOW	20-FAL-201-D	DI	CP-01	2	00	03	I:2:00.03	1794-IB16	LOW FLOW	24VDC	24 VDC	
21	506357-WTS-PR-T02-8521-DS-112	90-PSLL-002	AIR COMPRESSOR PRESSURE LOW LOW	90-PALL-002	DI	CP-01	2	00	04	I:2:00.04	1794-IB16	PRESSURE LOW LOW		24 VDC	
22	506357-WTS-PR-T02-8521-DS-102	20-B-201-C	MEMBRANE BLOWER-C RUNNING	20-YA-201-C	DI	CP-01	2	00	05	I:2:00.05	1794-IB16	RUNNING		24 VDC	
23	506357-WTS-PR-T02-8521-DS-102	20-B-201-D	MEMBRANE BLOWER-D RUNNING	20-YA-201-D	DI	CP-01	2	00	06	I:2:00.06	1794-IB16	RUNNING		24 VDC	
24	506357-WTS-PR-T02-8521-DS-111	23-P-301-B	CITRIC ACID PUMP-B RUNNING	23-YA-301-B	DI	CP-01	2	00	07	I:2:00.07	1794-IB16	RUNNING		24 VDC	
25	506357-WTS-PR-T02-8521-DS-111	23-P-101-B	SODIUM HYPOCHLORITE PUMP-B RUNNING	23-YA-101-B	DI	CP-01	2	00	08	I:2:00.08	1794-IB16	RUNNING		24 VDC	
26	506357-WTS-PR-T02-8521-DS-112	90-AC-001-B	AIR COMPRESSOR-B RUNNING	90-AC-001-B	DI	CP-01	2	00	09	I:2:00.09	1794-IB16	RUNNING		24 VDC	
27	506357-WTS-PR-T02-8521-DS-112	90-AC-001-B	AIR COMPRESSOR-B FAULT	90-AC-001-B	DI	CP-01	2	00	10	I:2:00.10	1794-IB16	ALARM		24 VDC	
28		-	SPARE		DI	CP-01	2	00	11	I:2:00.11	1794-IB16				
29		-	SPARE		DI	CP-01	2	00	12	I:2:00.12	1794-IB16				

CUSTOMER INFORMATION

CITY OF CANTON, WATER POLLUTION CONTROL PLANT(WPCP)

I/O LIST

CUSTOMER DOCUMENT NUMBER

506357-WTS-EL-T02-8533-LI-001

SUEZ DOCUMENT NUMBER: **506357-WTS-EL-T02-8533-LI-001**

CONTRACT	ISSUER	DISCIPLINE	PRODUCT	PHASE	TYPE	CHRONO
506357	WTS	EL	T02	8533	LI	001

REV	DESCRIPTION	CREATED BY	CHECKED BY	APPROVED BY	DATE (DD-MMM-YY)
A	ISSUED FOR INFORMATION	RS	KR	SKH	28-Apr-20

ROW NO.	P&ID	DEVICE TAG	DESCRIPTION	SIGNAL TAG	I/O TYPE	PANEL TAG	RACK	SLOT	CHANNEL	ADDRESS	IO MODULE PART NUMBER	IO ENERGIZED ACTION	POWER SUPPLY	SIGNAL TYPE	NOTES / REMARKS
30		-	SPARE		DI	CP-01	2	00	13	I:2:00.13	1794-IB16				
31		-	SPARE		DI	CP-01	2	00	14	I:2:00.14	1794-IB16				
32		-	SPARE		DI	CP-01	2	00	15	I:2:00.15	1794-IB16				
33	506357-WTS-PR-T02-8521-DS-102	20-TSH-201-E	MEMBRANE BLOWER-E DISCHARGE TEMPERATURE HIGH	20-TAH-201-E	DI	CP-01	1	01	00	I:1:01.00	1794-IB16	TEMPERATURE HIGH		24 VDC	
34	506357-WTS-PR-T02-8521-DS-102	20-FSL-201-E	MEMBRANE BLOWER-E DISCHARGE LOW FLOW	20-FAL-201-E	DI	CP-01	1	01	01	I:1:01.01	1794-IB16	LOW FLOW	24VDC	24 VDC	
35	506357-WTS-PR-T02-8521-DS-102	20-B-201-E	MEMBRANE BLOWER-E RUNNING	20-YA-201-E	DI	CP-01	1	01	02	I:1:01.02	1794-IB16	RUNNING		24 VDC	
36		-	SPARE		DI	CP-01	1	01	03	I:1:01.03	1794-IB16				
37		-	SPARE		DI	CP-01	1	01	04	I:1:01.04	1794-IB16				
38		-	SPARE		DI	CP-01	1	01	05	I:1:01.05	1794-IB16				
39		-	SPARE		DI	CP-01	1	01	06	I:1:01.06	1794-IB16				
40		-	SPARE		DI	CP-01	1	01	07	I:1:01.07	1794-IB16				
41		-	SPARE		DI	CP-01	1	01	08	I:1:01.08	1794-IB16				
42		-	SPARE		DI	CP-01	1	01	09	I:1:01.09	1794-IB16				
43		-	SPARE		DI	CP-01	1	01	10	I:1:01.10	1794-IB16				
44		-	SPARE		DI	CP-01	1	01	11	I:1:01.11	1794-IB16				
45		-	SPARE		DI	CP-01	1	01	12	I:1:01.12	1794-IB16				
46		-	SURGE PROTECTOR FAULT		DI	CP-01	1	01	13	I:1:01.13	1794-IB16	ALARM		24V DC	
47		-	AC POWER ON		DI	CP-01	1	01	14	I:1:01.14	1794-IB16	NORMAL		24V DC	
48		-	E-STOP PUSH BUTTON		DI	CP-01	1	01	15	I:1:01.15	1794-IB16	ALARM		24V DC	
49	506357-WTS-PR-T02-8521-DS-102	20-B-201-A	MEMBRANE BLOWER-A RUN COMMAND	20-KQI-201-A	DO	CP-01	1	02	00	O:1:02.00	1794-OB16	RUN COMMAND		RELAY	
50	506357-WTS-PR-T02-8521-DS-102	20-B-201-B	MEMBRANE BLOWER-B RUN COMMAND	20-KQI-201-B	DO	CP-01	1	02	01	O:1:02.01	1794-OB16	RUN COMMAND		RELAY	
51	506357-WTS-PR-T02-8521-DS-111	23-P-301-A	CITRIC ACID PUMP-A RUN COMMAND	23-KQI-301-A	DO	CP-01	1	02	02	O:1:02.02	1794-OB16	RUN COMMAND		RELAY	
52	506357-WTS-PR-T02-8521-DS-111	23-P-101-A	SODIUM HYPOCHLORITE PUMP-A RUN COMMAND	23-KQI-101-A	DO	CP-01	1	02	03	O:1:02.03	1794-OB16	RUN COMMAND		RELAY	
53	506357-WTS-PR-T02-8521-DS-112	90-AC-001-A	AIR COMPRESSOR-A RUN COMMAND	90-AC-001-A	DO	CP-01	1	02	04	O:1:02.04	1794-OB16	RUN COMMAND		RELAY	
54	506357-WTS-PR-T02-8521-DS-111	23-FV-301	CLEANING SOLUTION TO MEMBRANE VALVE OPEN COMMAND	23-FV-301	DO	CP-01	1	02	05	O:1:02.05	1794-OB16	OPEN COMMAND		24 VDC	
55		-			DO	CP-01	1	02	06	O:1:02.06	1794-OB16				
56		-			DO	CP-01	1	02	07	O:1:02.07	1794-OB16				
57		-			DO	CP-01	1	02	08	O:1:02.08	1794-OB16				
58		-			DO	CP-01	1	02	09	O:1:02.09	1794-OB16				

CUSTOMER INFORMATION

CITY OF CANTON, WATER POLLUTION CONTROL PLANT(WPCP)

I/O LIST

CUSTOMER DOCUMENT NUMBER

506357-WTS-EL-T02-8533-LI-001

SUEZ DOCUMENT NUMBER: **506357-WTS-EL-T02-8533-LI-001**

CONTRACT	ISSUER	DISCIPLINE	PRODUCT	PHASE	TYPE	CHRONO
506357	WTS	EL	T02	8533	LI	001

REV	DESCRIPTION	CREATED BY	CHECKED BY	APPROVED BY	DATE (DD-MMM-YY)
A	ISSUED FOR INFORMATION	RS	KR	SKH	28-Apr-20

ROW NO.	P&ID	DEVICE TAG	DESCRIPTION	SIGNAL TAG	I/O TYPE	PANEL TAG	RACK	SLOT	CHANNEL	ADDRESS	IO MODULE PART NUMBER	IO ENERGIZED ACTION	POWER SUPPLY	SIGNAL TYPE	NOTES / REMARKS
59		-			DO	CP-01	1	02	10	O:1:02.10	1794-OB16				
60		-			DO	CP-01	1	02	11	O:1:02.11	1794-OB16				
61		-			DO	CP-01	1	02	12	O:1:02.12	1794-OB16				
62		-			DO	CP-01	1	02	13	O:1:02.13	1794-OB16				
63		-			DO	CP-01	1	02	14	O:1:02.14	1794-OB16				
64		-			DO	CP-01	1	02	15	O:1:02.15	1794-OB16				
65	506357-WTS-PR-T02-8521-DS-102	20-B-201-C	MEMBRANE BLOWER-C RUN COMMAND	20-KQI-201-C	DO	CP-01	2	01	00	O:2:01.00	1794-OB16	RUN COMMAND		RELAY	
66	506357-WTS-PR-T02-8521-DS-102	20-B-201-D	MEMBRANE BLOWER-D RUN COMMAND	20-KQI-201-D	DO	CP-01	2	01	01	O:2:01.01	1794-OB16	RUN COMMAND		RELAY	
67	506357-WTS-PR-T02-8521-DS-102	20-B-201-E	MEMBRANE BLOWER-E RUN COMMAND	20-KQI-201-E	DO	CP-01	2	01	02	O:2:01.02	1794-OB16	RUN COMMAND		RELAY	
68	506357-WTS-PR-T02-8521-DS-111	23-P-301-B	CITRIC ACID PUMP-B RUN COMMAND	23-KQI-301-B	DO	CP-01	2	01	03	O:2:01.03	1794-OB16	RUN COMMAND		RELAY	
69	506357-WTS-PR-T02-8521-DS-111	23-P-101-B	SODIUM HYPOCHLORITE PUMP-B RUN COMMAND	23-KQI-101-B	DO	CP-01	2	01	04	O:2:01.04	1794-OB16	RUN COMMAND		RELAY	
70	506357-WTS-PR-T02-8521-DS-112	90-AC-001-B	AIR COMPRESSOR-B RUN COMMAND	90-AC-001-B	DO	CP-01	2	01	05	O:2:01.05	1794-OB16	RUN COMMAND		RELAY	
71	506357-WTS-PR-T02-8521-DS-111	23-FV-101	CLEANING SOLUTION TO MEMBRANE VALVE OPEN COMMAND	23-FV-101	DO	CP-01	2	01	06	O:2:01.06	1794-OB16	OPEN COMMAND		24 VDC	
72		-			DO	CP-01	2	01	07	O:2:01.07	1794-OB16				
73		-			DO	CP-01	2	01	08	O:2:01.08	1794-OB16				
74		-			DO	CP-01	2	01	09	O:2:01.09	1794-OB16				
75		-			DO	CP-01	2	01	10	O:2:01.10	1794-OB16				
76		-			DO	CP-01	2	01	11	O:2:01.11	1794-OB16				
77		-			DO	CP-01	2	01	12	O:2:01.12	1794-OB16				
78		-			DO	CP-01	2	01	13	O:2:01.13	1794-OB16				
79		-			DO	CP-01	2	01	14	O:2:01.14	1794-OB16				
80		-			DO	CP-01	2	01	15	O:2:01.15	1794-OB16				
81	506357-WTS-PR-T02-8521-DS-107	20-TIT-001	PERMEATE TEMPERATURE TRANSMITTER	20-TI-001	AI	CP-01	1	03	00	I:1:03.00	1794-IE8		LOOP-POWERED	4-20 mA	
82	506357-WTS-PR-T02-8521-DS-111	23-FIT-301	CLEANING SOLUTION PUMP DISCHARGE FLOW TRANSMITTER	23-FIT-301	AI	CP-01	1	03	01	I:1:03.01	1794-IE8		120VAC	4-20 mA	
83	506357-WTS-PR-T02-8521-DS-111	23-FIT-101	CLEANING SOLUTION PUMP DISCHARGE FLOW TRANSMITTER	23-FIT-101	AI	CP-01	1	03	02	I:1:03.02	1794-IE8		120VAC	4-20 mA	
84		-	SPARE		AI	CP-01	1	03	03	I:1:03.03	1794-IE8				
85		-	SPARE		AI	CP-01	1	03	04	I:1:03.04	1794-IE8				
86		-	SPARE		AI	CP-01	1	03	05	I:1:03.05	1794-IE8				
87		-	SPARE		AI	CP-01	1	03	06	I:1:03.06	1794-IE8				

CUSTOMER INFORMATION

CITY OF CANTON, WATER POLLUTION CONTROL PLANT(WPCP)

I/O LIST

CUSTOMER DOCUMENT NUMBER

506357-WTS-EL-T02-8533-LI-001

SUEZ DOCUMENT NUMBER: **506357-WTS-EL-T02-8533-LI-001**

CONTRACT	ISSUER	DISCIPLINE	PRODUCT	PHASE	TYPE	CHRONO
506357	WTS	EL	T02	8533	LI	001

REV	DESCRIPTION	CREATED BY	CHECKED BY	APPROVED BY	DATE (DD-MMM-YY)
A	ISSUED FOR INFORMATION	RS	KR	SKH	28-Apr-20

ROW NO.	P&ID	DEVICE TAG	DESCRIPTION	SIGNAL TAG	I/O TYPE	PANEL TAG	RACK	SLOT	CHANNEL	ADDRESS	IO MODULE PART NUMBER	IO ENERGIZED ACTION	POWER SUPPLY	SIGNAL TYPE	NOTES / REMARKS
88		-	SPARE		AI	CP-01	1	03	07	I:1:03.07	1794-IE8				
89	506357-WTS-PR-T02-8521-DS-102	20-B-201-A	MEMBRANE BLOWER-A SPEED CONTROL	20-B-201-A	AO	CP-01	1	04	00	O:1:04.00	1794-OE4			4-20 mA	
90	506357-WTS-PR-T02-8521-DS-102	20-B-201-B	MEMBRANE BLOWER-B SPEED CONTROL	20-B-201-B	AO	CP-01	1	04	01	O:1:04.01	1794-OE4			4-20 mA	
91	506357-WTS-PR-T02-8521-DS-111	23-P-301-A	CITRIC ACID PUMP-A SPEED CONTROL	23-P-301-A	AO	CP-01	1	04	02	O:1:04.02	1794-OE4			4-20 mA	
92	506357-WTS-PR-T02-8521-DS-111	23-P-101-A	SODIUM HYPOCHLORITE PUMP-A SPEED CONTROL	23-P-101-A	AO	CP-01	1	04	03	O:1:04.03	1794-OE4			4-20 mA	
93	506357-WTS-PR-T02-8521-DS-102	20-B-201-C	MEMBRANE BLOWER-C SPEED CONTROL	20-B-201-C	AO	CP-01	2	02	00	O:2:02.00	1794-OE4			4-20 mA	
94	506357-WTS-PR-T02-8521-DS-102	20-B-201-D	MEMBRANE BLOWER-D SPEED CONTROL	20-B-201-D	AO	CP-01	2	02	01	O:2:02.01	1794-OE4			4-20 mA	
95	506357-WTS-PR-T02-8521-DS-111	23-P-301-B	CITRIC ACID PUMP-B SPEED CONTROL	23-P-301-B	AO	CP-01	2	02	02	O:2:02.02	1794-OE4			4-20 mA	
96	506357-WTS-PR-T02-8521-DS-111	23-P-101-B	SODIUM HYPOCHLORITE PUMP-B SPEED CONTROL	23-P-101-B	AO	CP-01	2	02	03	O:2:02.03	1794-OE4			4-20 mA	
97	506357-WTS-PR-T02-8521-DS-102	20-B-201-E	MEMBRANE BLOWER-E SPEED CONTROL	20-B-201-E	AO	CP-01	2	03	00	O:2:03.00	1794-OE4			4-20 mA	
98		-	SPARE		AO	CP-01	2	03	01	O:2:03.01	1794-OE4				
99		-	SPARE		AO	CP-01	2	03	02	O:2:03.02	1794-OE4				
100		-	SPARE		AO	CP-01	2	03	03	O:2:03.03	1794-OE4				

CUSTOMER INFORMATION

CITY OF CANTON, WATER POLLUTION CONTROL PLANT(WPCP)

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CUSTOMER DOCUMENT NUMBER

506357-WTS-EL-T02-8533-LI-001

SUEZ DOCUMENT NUMBER: **506357-WTS-EL-T02-8533-LI-001**

CONTRACT	ISSUER	DISCIPLINE	PRODUCT	PHASE	TYPE	CHRONO
506357	WTS	EL	T02	8533	LI	001

REV	DESCRIPTION	CREATED BY	CHECKED BY	APPROVED BY	DATE (DD-MMM-YY)
A	ISSUED FOR INFORMATION	RS	KR	SKH	28-Apr-20

ROW NO.	P&ID	DEVICE TAG	DESCRIPTION	SIGNAL TAG	I/O TYPE	PANEL TAG	RACK	SLOT	CHANNEL	ADDRESS	IO MODULE PART NUMBER	IO ENERGIZED ACTION	POWER SUPPLY	SIGNAL TYPE	NOTES / REMARKS
101	506357-WTS-PR-T02-8521-DS-104	20-LSLL-201-X	MEMBRANE TANK LEVEL LOW LOW	20-LALL-201-X	DI	CP-1X	3	00	00	I:3:00.00	1794-IB16	LEVEL LOW LOW		24 VDC	
102	506357-WTS-PR-T02-8521-DS-104	20-LSHH-201-X	MEMBRANE TANK LEVEL HIGH HIGH	20-LAHH-201-X	DI	CP-1X	3	00	01	I:3:00.01	1794-IB16	LEVEL HIGH HIGH		24 VDC	
103	506357-WTS-PR-T02-8521-DS-104	20-ZAO-205-X	MEMBRANE AIR INLET VALVE OPEN	20-ZAO-205-X	DI	CP-1X	3	00	02	I:3:00.02	1794-IB16	OPEN		24 VDC	
104	506357-WTS-PR-T02-8521-DS-104	20-ZAC-205-X	MEMBRANE AIR INLET VALVE CLOSE	20-ZAC-205-X	DI	CP-1X	3	00	03	I:3:00.03	1794-IB16	CLOSE		24 VDC	
105	506357-WTS-PR-T02-8521-DS-104	20-ZAO-209-X	SLUICE GATE OPEN	20-ZAO-209-X	DI	CP-1X	3	00	04	I:3:00.04	1794-IB16	OPEN		24 VDC	
106	506357-WTS-PR-T02-8521-DS-104	20-ZAC-209-X	SLUICE GATE CLOSE	20-ZAC-209-X	DI	CP-1X	3	00	05	I:3:00.05	1794-IB16	CLOSE		24 VDC	
107	506357-WTS-PR-T02-8521-DS-105	20-ZAO-302-X	PROCESS PUMP DISCHARGE VALVE OPEN	20-ZAO-302-X	DI	CP-1X	3	00	06	I:3:00.06	1794-IB16	OPEN		24 VDC	
108	506357-WTS-PR-T02-8521-DS-105	20-ZAC-302-X	PROCESS PUMP DISCHARGE VALVE CLOSE	20-ZAC-302-X	DI	CP-1X	3	00	07	I:3:00.07	1794-IB16	CLOSE		24 VDC	
109		-	SPARE		DI	CP-1X	3	00	08	I:3:00.08	1794-IB16				
110		-	SPARE		DI	CP-1X	3	00	09	I:3:00.09	1794-IB16				
111		-	SPARE		DI	CP-1X	3	00	10	I:3:00.10	1794-IB16				
112		-	SPARE		DI	CP-1X	3	00	11	I:3:00.11	1794-IB16				
113		-	SPARE		DI	CP-1X	3	00	12	I:3:00.12	1794-IB16				
114		-	SPARE		DI	CP-1X	3	00	13	I:3:00.13	1794-IB16				
115		-	SPARE		DI	CP-1X	3	00	14	I:3:00.14	1794-IB16				
116		-	SPARE		DI	CP-1X	3	00	15	I:3:00.15	1794-IB16				
117	506357-WTS-PR-T02-8521-DS-105	20-P-301-X	PROCESS PUMP RUNNING	20-YA-301-X	DI	CP-1X	3	01	00	I:3:01.00	1794-IB16	RUNNING		24 VDC	
118	506357-WTS-PR-T02-8521-DS-110	20-P-501-X	RAS/DRAIN PUMP RUNNING	20-YA-501-X	DI	CP-1X	3	01	01	I:3:01.01	1794-IB16	RUNNING		24 VDC	
119		-	SPARE		DI	CP-1X	3	01	02	I:3:01.02	1794-IB16				
120		-	SPARE		DI	CP-1X	3	01	03	I:3:01.03	1794-IB16				
121		-	SPARE		DI	CP-1X	3	01	04	I:3:01.04	1794-IB16				
122		-	SPARE		DI	CP-1X	3	01	05	I:3:01.05	1794-IB16				
123		-	SPARE		DI	CP-1X	3	01	06	I:3:01.06	1794-IB16				
124		-	SPARE		DI	CP-1X	3	01	07	I:3:01.07	1794-IB16				
125		-	SPARE		DI	CP-1X	3	01	08	I:3:01.08	1794-IB16				
126		-	SPARE		DI	CP-1X	3	01	09	I:3:01.09	1794-IB16				
127		-	SPARE		DI	CP-1X	3	01	10	I:3:01.10	1794-IB16				
128		-	SPARE		DI	CP-1X	3	01	11	I:3:01.11	1794-IB16				
129		-	SPARE		DI	CP-1X	3	01	12	I:3:01.12	1794-IB16				

CUSTOMER INFORMATION

CITY OF CANTON, WATER POLLUTION CONTROL PLANT(WPCP)

I/O LIST

CUSTOMER DOCUMENT NUMBER

506357-WTS-EL-T02-8533-LI-001

SUEZ DOCUMENT NUMBER: **506357-WTS-EL-T02-8533-LI-001**

CONTRACT	ISSUER	DISCIPLINE	PRODUCT	PHASE	TYPE	CHRONO
506357	WTS	EL	T02	8533	LI	001

REV	DESCRIPTION	CREATED BY	CHECKED BY	APPROVED BY	DATE (DD-MMM-YY)
A	ISSUED FOR INFORMATION	RS	KR	SKH	28-Apr-20

ROW NO.	P&ID	DEVICE TAG	DESCRIPTION	SIGNAL TAG	I/O TYPE	PANEL TAG	RACK	SLOT	CHANNEL	ADDRESS	IO MODULE PART NUMBER	IO ENERGIZED ACTION	POWER SUPPLY	SIGNAL TYPE	NOTES / REMARKS
130		-	SURGE PROTECTOR FAULT		DI	CP-1X	3	01	13	I:3:01.13	1794-IB16	ALARM		24 VDC	
131		-	AC POWER ON		DI	CP-1X	3	01	14	I:3:01.14	1794-IB16	NORMAL		24 VDC	
132		-	ESTOP PUSHBUTTON		DI	CP-1X	3	01	15	I:3:01.15	1794-IB16	ALARM		24 VDC	
133	506357-WTS-PR-T02-8521-DS-104	20-FV-205-X	MEMBRANE AIR INLET VALVE OPEN COMMAND	20-FV-205-X	DO	CP-1X	3	02	00	O:3:02.00	1794-OB16	OPEN		24 VDC	
134	506357-WTS-PR-T02-8521-DS-104	20-FV-209-X	SLUICE GATE OPEN COMMAND	20-FV-209-X	DO	CP-1X	3	02	01	O:3:02.01	1794-OB16	OPEN		24 VDC	
135	506357-WTS-PR-T02-8521-DS-104	20-FV-209-X	SLUICE GATE CLOSE COMMAND	20-FV-209-X	DO	CP-1X	3	02	02	O:3:02.02	1794-OB16	CLOSE		24 VDC	
136	506357-WTS-PR-T02-8521-DS-104	20-FV-502-X	MIXED LIQUOR TO RAS/DRAIN VALVE OPEN COMMAND	20-FV-502-X	DO	CP-1X	3	02	03	O:3:02.03	1794-OB16	OPEN		24 VDC	
137	506357-WTS-PR-T02-8521-DS-104	20-SV-802-X	INSTRUMENT AIR INLET VALVE OPEN COMMAND	20-SV-802-X	DO	CP-1X	3	02	04	O:3:02.04	1794-OB16	OPEN		24 VDC	
138	506357-WTS-PR-T02-8521-DS-105	23-FV-102-X	SODIUM HYPOCHLORITE INJECTION VALVE OPEN COMMAND	23-FV-102-X	DO	CP-1X	3	02	05	O:3:02.05	1794-OB16	OPEN		24 VDC	
139	506357-WTS-PR-T02-8521-DS-105	23-FV-302-X	CITRIC ACID INJECTION VALVE OPEN COMMAND	23-FV-302-X	DO	CP-1X	3	02	06	O:3:02.06	1794-OB16	OPEN		24 VDC	
140	506357-WTS-PR-T02-8521-DS-105	20-FV-302-X	PROCESS PUMP DISCHARGE VALVE OPEN COMMAND	20-FV-302-X	DO	CP-1X	3	02	07	O:3:02.07	1794-OB16	OPEN		24 VDC	
141	506357-WTS-PR-T02-8521-DS-105	20-FV-320-X	TURBIDITY SAMPLE VALVE OPEN COMMAND	20-FV-320-X	DO	CP-1X	3	02	08	O:3:02.08	1794-OB16	OPEN		24 VDC	
142	506357-WTS-PR-T02-8521-DS-105	20-FV-321-X	TURBIDITY SAMPLE DRAIN VALVE OPEN COMMAND	20-FV-321-X	DO	CP-1X	3	02	09	O:3:02.09	1794-OB16	OPEN		24 VDC	
143		-	SPARE		DO	CP-1X	3	02	10	O:3:02.10	1794-OB16				
144		-	SPARE		DO	CP-1X	3	02	11	O:3:02.11	1794-OB16				
145		-	SPARE		DO	CP-1X	3	02	12	O:3:02.12	1794-OB16				
146		-	SPARE		DO	CP-1X	3	02	13	O:3:02.13	1794-OB16				
147		-	SPARE		DO	CP-1X	3	02	14	O:3:02.14	1794-OB16				
148		-	SPARE		DO	CP-1X	3	02	15	O:3:02.15	1794-OB16				
149	506357-WTS-PR-T02-8521-DS-105	20-P-301-X	PROCESS PUMP RUN FORWARD COMMAND	20-KQI-301-X	DO	CP-1X	3	03	00	O:3:03.00	1794-OB16	RUN COMMAND		RELAY	
150	506357-WTS-PR-T02-8521-DS-105	20-P-301-X	PROCESS PUMP RUN REVERSE COMMAND	20-KQI-301-X	DO	CP-1X	3	03	01	O:3:03.01	1794-OB16	RUN COMMAND		RALAY	
151	506357-WTS-PR-T02-8521-DS-110	20-P-501-X	RAS/DRAIN PUMP RUN COMMAND	20-KQI-501-X	DO	CP-1X	3	03	02	O:3:03.02	1794-OB16	RUN COMMAND		RELAY	
152		-	SPARE		DO	CP-1X	3	03	03	O:3:03.03	1794-OB16				
153		-	SPARE		DO	CP-1X	3	03	04	O:3:03.04	1794-OB16				
154		-	SPARE		DO	CP-1X	3	03	05	O:3:03.05	1794-OB16				
155		-	SPARE		DO	CP-1X	3	03	06	O:3:03.06	1794-OB16				
156		-	SPARE		DO	CP-1X	3	03	07	O:3:03.07	1794-OB16				
157		-	SPARE		DO	CP-1X	3	03	08	O:3:03.08	1794-OB16				
158		-	SPARE		DO	CP-1X	3	03	09	O:3:03.09	1794-OB16				

CUSTOMER INFORMATION

CITY OF CANTON, WATER POLLUTION CONTROL PLANT(WPCP)

I/O LIST

CUSTOMER DOCUMENT NUMBER

506357-WTS-EL-T02-8533-LI-001

SUEZ DOCUMENT NUMBER: **506357-WTS-EL-T02-8533-LI-001**

CONTRACT	ISSUER	DISCIPLINE	PRODUCT	PHASE	TYPE	CHRONO
506357	WTS	EL	T02	8533	LI	001

REV	DESCRIPTION	CREATED BY	CHECKED BY	APPROVED BY	DATE (DD-MMM-YY)
A	ISSUED FOR INFORMATION	RS	KR	SKH	28-Apr-20

ROW NO.	P&ID	DEVICE TAG	DESCRIPTION	SIGNAL TAG	I/O TYPE	PANEL TAG	RACK	SLOT	CHANNEL	ADDRESS	IO MODULE PART NUMBER	IO ENERGIZED ACTION	POWER SUPPLY	SIGNAL TYPE	NOTES / REMARKS
159		-	SPARE		DO	CP-1X	3	03	10	O:3:03.10	1794-OB16				
160		-	SPARE		DO	CP-1X	3	03	11	O:3:03.11	1794-OB16				
161		-	SPARE		DO	CP-1X	3	03	12	O:3:03.12	1794-OB16				
162		-	SPARE		DO	CP-1X	3	03	13	O:3:03.13	1794-OB16				
163		-	SPARE		DO	CP-1X	3	03	14	O:3:03.14	1794-OB16				
164		-	SPARE		DO	CP-1X	3	03	15	O:3:03.15	1794-OB16				
165	506357-WTS-PR-T02-8521-DS-104	20-LIT-203-X	MEMBRANE TANK LEVEL TRANSMITTER	20-LIT-203-X	AI	CP-1X	3	04	00	I:3:04.00	1794-IE8		LOOP-POWERED	4-20 mA	
166	506357-WTS-PR-T02-8521-DS-104	20-PIT-301-X	MEMBRANE PRESSURE TRANSMITTER	20-PIT-301-X	AI	CP-1X	3	04	01	I:3:04.01	1794-IE8		LOOP-POWERED	4-20 mA	
167	506357-WTS-PR-T02-8521-DS-105	20-FIT-307-X	PROCESS PUMP FLOW TRANSMITTER	20-FIT-307-X	AI	CP-1X	3	04	02	I:3:04.02	1794-IE8		120VAC	4-20 mA	
168	506357-WTS-PR-T02-8521-DS-105	20-AIT-320-X	PROCESS PUMP TURBIDITY ANALYZER	20-AIT-320-X	AI	CP-1X	3	04	03	I:3:04.03	1794-IE8		120VAC	4-20 mA	
169	506357-WTS-PR-T02-8521-DS-110	20-FIT-507-X	RAS/DRAIN PUMP DISCHARGE FLOW TRANSMITTER	20-FIT-507-X	AI	CP-1X	3	04	04	I:3:04.04	1794-IE8		120VAC	4-20 mA	
170		-	SPARE		AI	CP-1X	3	04	05	I:3:04.05	1794-IE8				
171		-	SPARE		AI	CP-1X	3	04	06	I:3:04.06	1794-IE8				
172		-	SPARE		AI	CP-1X	3	04	07	I:3:04.07	1794-IE8				
173	506357-WTS-PR-T02-8521-DS-105	20-P-301-X	PROCESS PUMP SPEED CONTROL	20-P-301-X	AO	CP-1X	3	05	00	O:3:05.00	1794-OE4			4-20 mA	
174	506357-WTS-PR-T02-8521-DS-110	20-P-501-X	RAS/DRAIN PUMP SPEED CONTROL	20-P-501-X	AO	CP-1X	3	05	01	O:3:05.01	1794-OE4			4-20 mA	
175		-	SPARE		AO	CP-1X	3	05	02	O:3:05.02	1794-OE4				
176		-	SPARE		AO	CP-1X	3	05	03	O:3:05.03	1794-OE4				

Notes:

1. CP-01=MAIN PANEL, CP-1X = TRAINS RIO PANEL WHERE X REPLACES WITH 1,2,3 &4 FOR TRAINS

CUSTOMER INFORMATION

CITY OF CANTON
WATER POLLUTION CONTROL PLANT (WPCP)

ELECTRICAL LOAD LIST

CLIENT DOCUMENT NUMBER

REV	DESCRIPTION	CHECKED BY	APPROVED BY	DATE (DD-MMM-YY)
A	Initial Release	HX	SKH	2-Apr-20

SUEZ DOCUMENT WTS #: **506357-WTS-EL-T02-8513-LI-001**

CONTRAT/CONTRACT	ÉMETTEUR / ISSUER	DISCIPLINE/DISCIPLINE	PRODUIT / PRODUCT	PHASE / PHASE	TYPE / TYPE	NR. SEQ./ CHRONO
506357	WTS	EL	T02	8513	LI	001

ROW NO.	REV	P&ID	EQUIPMENT TAG NUMBER(S)	EQUIPMENT NAME	SKID NAME / LOOSE SHIP	EQUIPMENT SCOPE	TOTAL CONNECTED	TOTAL DUTY	VOLTAGE (V)	PHASE (Φ)	LOAD RATING	UNITS (HP, kVA, kW)	UNIT CURRENT (A)	TOTAL CURRENT (A)	CONTROLLER TYPE	CONTROLLER SCOPE	SOURCE	POWER FACTOR	UTILITY CONNECTED LOAD (kW)	UTILITY CONNECTED LOAD (kVAR)	UTILITY CONNECTED LOAD (kVA)	NOTES / REMARKS
1	A	506357-WTS-PR-T02-8521-DS-102	20-B-201-A/B/C/D/E	MEMBRANE BLOWER	LOOSE SHIP	BY SUEZ WTS	5	4	460 VAC	3	60	HP	77.0	308.0	VFD CT	BY CLIENT	MCC	0.95	233.13	76.63	245.40	Temperature Switch to be interlocked with VFD for Safe Stop
2	A	506357-WTS-PR-T02-8521-DS-105	20-P-301-1/2/3/4	PROCESS PUMP	PROCESS SKID	BY SUEZ WTS	4	4	460 VAC	3	50	HP	65.0	260.0	VFD CT	BY CLIENT	MCC	0.95	196.80	64.69	207.16	Both Pressure Switches and Temperature Switch to be interlocked with VFD for Safe Stop
3	A	506357-WTS-PR-T02-8521-DS-110	20-P-501-1/2/3/4	RAS/DRAIN PUMP	LOOSE SHIP	BY SUEZ WTS	4	4	460 VAC	3	30	HP	40.0	160.0	VFD VT	BY CLIENT	MCC	0.95	121.10	39.80	127.47	Temperature Switch to be interlocked with VFD for Safe Stop
4	A	506357-WTS-PR-T02-8521-DS-111	23-P-301-A/B	CITRIC ACID CHEMICAL PUMP	CITRIC ACID CHEMICAL SKID	BY SUEZ WTS	2	1	460 VAC	3	1.0	HP	2.1	2.1	VFD VT	BY CLIENT	MCC	0.95	1.59	0.52	1.67	
5	A	506357-WTS-PR-T02-8521-DS-111	23-P-101-A/B	SODIUM HYPOCHLORITE CHEMICAL PUMP	SODIUM HYPOCHLORITE CHEMICAL SKID	BY SUEZ WTS	2	1	460 VAC	3	1.0	HP	2.1	2.1	VFD VT	BY CLIENT	MCC	0.95	1.59	0.52	1.67	
6	A	506357-WTS-PR-T02-8521-DS-112	90-AC-001-A/B	AIR COMPRESSOR	LOOSE SHIP	BY SUEZ WTS	2	1	460 VAC	3	7.5	HP	11.0	11.0	FVNR	BY CLIENT	MCC	0.679	5.95	6.43	8.76	Pressure Switch to be interlocked with Starter
7	A	506357-WTS-PR-T02-8521-DS-112	90-DR-001-A/B	AIR DRYERS	LOOSE SHIP	BY SUEZ WTS	2	2	115 VAC	1	0.69	kW	6.0	12.0	FDR	BY CLIENT	PNLBOARD	1	1.04	0.00	1.04	
8	A	506357-WTS-PR-T02-8521-DS-112	90-FV-001-A/B	AUTO DRAIN VALVE - COMPRESSOR	LOOSE SHIP	BY SUEZ WTS	2	2	115 VAC	1	0.01	kW	0.1	0.2	FDR	BY CLIENT	PNLBOARD	1	0.02	0.00	0.02	Plug into local 120 VAC receptacle
9	A	506357-WTS-PR-T02-8521-DS-112	90-FV-011	AUTO DRAIN VALVE - DRYER	LOOSE SHIP	BY SUEZ WTS	1	1	115 VAC	1	0.01	kW	0.1	0.1	FDR	BY CLIENT	PNLBOARD	1	0.01	0.00	0.01	Plug into local 120 VAC receptacle
													TOTAL CONNECTED CURRENT, AMP	743					560	188.59	592.14	
																			UTILITY CONNECTED LOAD (kW)	UTILITY CONNECTED LOAD (kVAR)	UTILITY CONNECTED LOAD (kVA)	

LEGEND	
VFD, VT	VFD, Variable Torque
VFD, CT	VFD, Constant Torque
SS	Soft Starter
FVNR	Full Voltage Non-Reversing Starter
FVR	Full Votlage Reversing
CON	Contactor
FDR	Feeder Circuit

OVERALL SYSTEM POWER FACTOR	0.95

DC

Notes:
1. FULL LOAD AMPS (FLA) IS BASED ON NEC TABLE 430.250.
2.
3.
4.

SUEZ WTS
CONTROLLED DOCUMENT

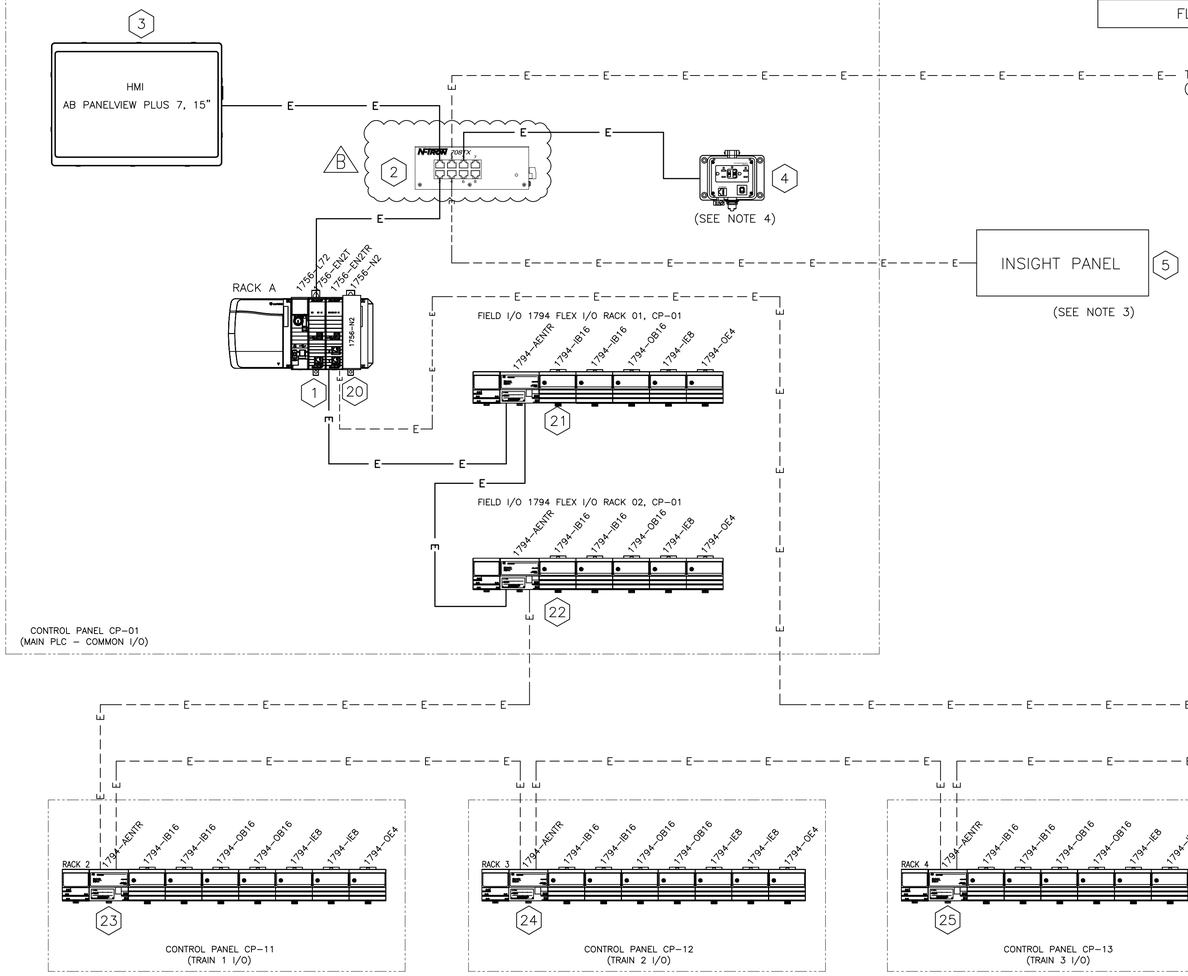
Printed on: 4/6/2020: 12:54 PM

COMMUNICATION	CABLE TYPE	RECOMMENDED MANUFACTURER PART #	LEGEND	
			BY SUEZ WTS	BY CONTRACTOR
ETHERNET	CATEGORY 6 UNSHIELDED TWISTED–PAIR (B)	BELDEN 1872A (B)	E	E

PLC COMPONENT	
MODULE	DESCRIPTION
PROCESSOR	1756–L72, 4MB PROCESSOR
HMI	A–B PANELVIEW PLUS 7, 15"
ETHERNET – PLANT NETWORK	1756–EN2T, ETHERNET/IP
ETHERNET – IO	1756–EN2TR, ETHERNET/IP, REDUNDANT
ETHERNET – IO	FLEX 1794–AENTR
FLEXLOGIX – DI	1794–IB16, 16–CH, ISOLATED DISCRETE INPUT
FLEXLOGIX – DO	1794–OB16, 16–CH, ISOLATED DISCRETE OUTPUT
FLEXLOGIX – AI	1794–IE8, 8–CH, ANALOG INPUT
FLEXLOGIX – AO	1794–OE4, 4–CH, ANALOG OUTPUT

NETWORK: ETHERNET – HMI/PLANT NETWORK		
SUBNET MASK: 255.255.255.0 GATEWAY: 192.168.169.9 IP ADDRESS: 192.168.169.2/69		
REF.	IP ADDRESS	DESCRIPTION
1	192.168.169.10	1756–EN2T, RACK A
2	N/A	N–TRON 708TX ETHERNET SWITCH (B)
3	192.168.169.20	AB PANELVIEW PLUS PERFORMANCE 7, 15" HMI
4	N/A	RJ45, GRACE PROGRAMMING PORT
5	192.168.169.9	INSIGHT PANEL

NETWORK: ETHERNET – I/O NETWORK		
SUBNET MASK: 255.255.255.0 GATEWAY: IP ADDRESS: 192.168.175.2/254		
REF.	IP ADDRESS	DESCRIPTION
20	192.168.175.10	1756–EN2TR, RACK A
21	192.168.175.30	FLEX 1794–AENTR, RACK 1
22	192.168.175.31	FLEX 1794–AENTR, RACK 2
23	192.168.175.32	FLEX 1794–AENTR, RACK 3
24	192.168.175.33	FLEX 1794–AENTR, RACK 4
25	192.168.175.34	FLEX 1794–AENTR, RACK 5
25	192.168.175.35	FLEX 1794–AENTR, RACK 6



SUEZ WTS
CONTROLLED DOCUMENT

NOTES

1. DASHED LINES DENOTES WIRING BY OTHERS/CONTRACTOR.
2. NETWORK COMMUNICATION CABLES SHOULD BE INSTALLED IN SEPARATE CONDUIT FROM POWER, CONTROL AND INSTRUMENTATION CIRCUITS.
3. ETHERNET NETWORKS CAN BE UPGRADED TO FIBER–OPTIC IF CABLE RUNS EXCEED 100M OR ENVIRONMENT IS ELECTRICALLY NOISY.
4. PROGRAMMING PORT MOUNTED ON ENCLOSURE DOOR.
5. SUEZ EXPECTS THE CUSTOMER PLANT ETHERNET NETWORK TO HAVE VPN–SECURED HIGH SPEED INTERNET CONNECTION FOR REMOTE DATA ACQUISITION AND PLC SUPPORT FROM SUEZ. ALTERNATIVELY, A VPN ROUTER CAN BE PROVIDED WITH THIS FUNCTIONALITY. FOR REMOTE DATA ACQUISITION ONLY, A CELLULAR DIGI "MODEM" CAN BE PROVIDED.
6. IP ADDRESSES TO BE UPDATED ONCE RECEIVED FROM CLIENT. (B) (DC)

REV	DESCRIPTION	ECO	DWN	APPR	APPR	DATE
B	REVISED AS NOTED	-	PM	MS	SKH	03-APR-20
A	INITIAL RELEASE	-	HJV	MS	SKH	13-MAR-20

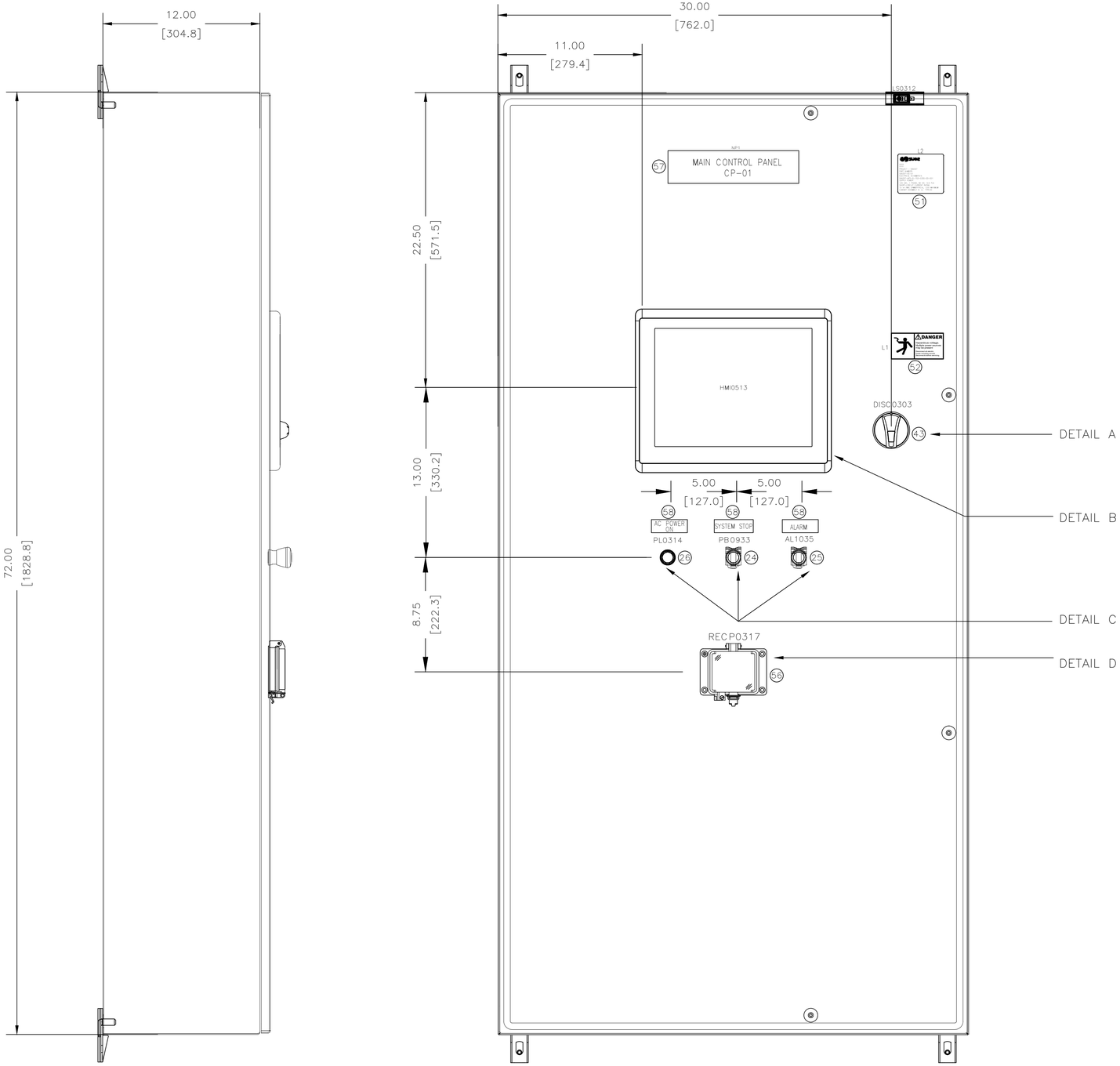
TOLERANCES UNLESS NOTED
DECIMALS: .X ±, .XX ±, .XXX ±
ANGLES ±
FRAC ±

CUSTOMER INFORMATION
CITY OF CANTON
WATER POLLUTION
CONTROL PLANT (WPCP)

NETWORK ARCHITECTURE
MAIN CONTROL PANEL
WASTEWATER TREATMENT SYSTEM

DRAWING NUMBER: 506357-WTS-EL-T02-8513-DN-001
REVISION: B
REF.: -
DOC. OWNER: -
PROJECT NO.: 506357
PART/MATERIAL NO.: -
SCALE: NONE
SIZE: D
SHEET: 1 OF 1
LAST SAVED: 03 April 2020 18:59:42

FILE LOCATION: C:_ADS\Vault MAIN\506357 - CITY OF CANTON\4 Electrical Drawings\506357-NETWORK ARCHITECTURE-506357-WTS-EL-T02-8513-DN-001-01.dwg



L2

XXXX
YYYY
PROJECT – 506357
PART NUMBER:
506357-EE-01
ELECTRICAL SCHEMATICS:
506357-WTS-EL-T03-0330-DD-001
SUPPLY POWER:
120 VAC, 1 PHASE, 60 HZ, 12.0 FLA
SHORT-CIRCUIT CURRENT RATING
10 kA RMS SYMMERTRICAL, 120V MAXIMUM
CABINET ASSEMBLY IS UL TYPE 4X

SEE NOTE 1

SUEZ WTS CONTROLLED DOCUMENT

NOTE:

1. MANUFACTURER'S PRODUCT DATA CONTAINED ON LABEL L1. YYYY = LOCATION OF SUEZ WTS MANUFACTURING FACILITY. (i.e. CITY. STATE/PROVINCE, COUNTRY) XXXX = CONTROL PANEL MANUFACTURING FACILITY (i.e. MANUFACTURED BY: PANEL SHOP NAME, CITY, STATE/PROVINCE, COUNTRY) IF DIFFERENT FROM SUEZ WTS MANUFACTURING FACILITY. OTHERWISE THIS LINE IS LEFT BLANK.
2. UL STICKER (L4) AND SUPPLY/FUSE TORQUE LABEL (L5) AFFIXED TO INSIDE OF FRONT DOOR.
3. HMI MEMORY SUPPLIED BY PANEL MANUFACTURER AND INSTALLED IN HMI.
4. REFERENCE DEVICE CUT-OUT INFORMATION ON PAGE 5.
5. DIMENSION IN INCHES [MM].

REV	DESCRIPTION	ECO	DWN	APPR	APPR	DATE
A	INITIAL RELEASE	-	VM	MS	SKH	26MAY2020

TOLERANCES UNLESS NOTED
DECIMALS ANGLES
.X - -
.XX - FRAC
.XXX - -

CUSTOMER INFORMATION
CITY OF CANTON
WATER POLLUTION
CONTROL PLANT (WPCP)

ENCL-ASSY,

MAIN CONTROL PANEL, CP-01

DRAWING NUMBER	REVISION
506357-WTS-EL-T03-0330-DA-001	A

REF.: -
DOC. OWNER: -

PROJECT NO.	PART/MATERIAL NO.	SCALE	SIZE	SHEET
506357	-	NONE	D	1 OF 8

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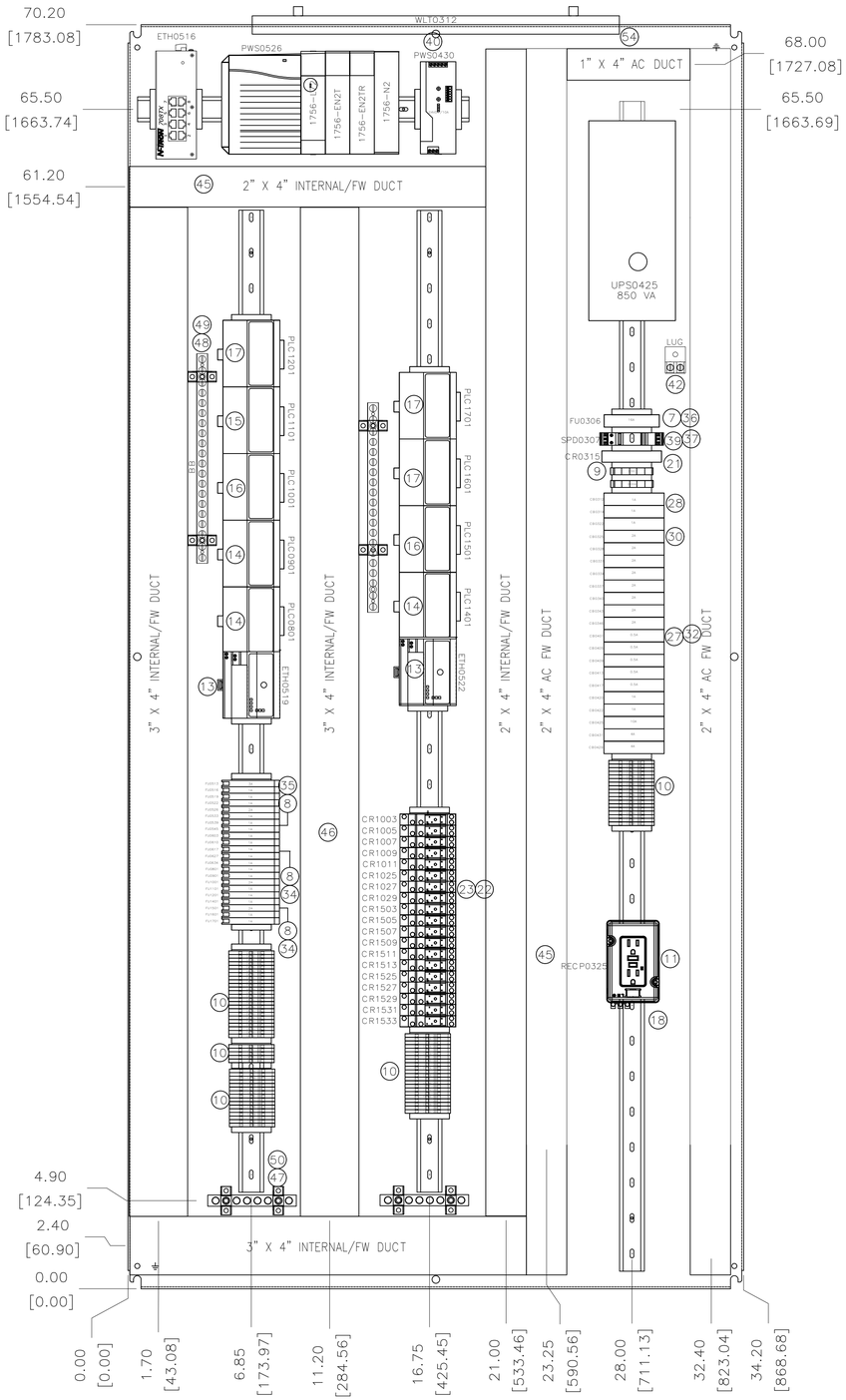

NOTE:
1. INSTALL A BONDING JUMPER THAT IS SIZED FOR THE RATING OF THE OVER CURRENT PROTECTION FOR THE CONTROL PANEL'S INCOMING SUPPLY BETWEEN RESPECTIVE BUSS BARS.
2. DIMENSIONS IN INCHES [MM].

REV	DESCRIPTION	ECO	DWN	APPR	APPR	DATE
A	INITIAL RELEASE	-	VM	MS	SKH	26MAY2020

TOLERANCES UNLESS NOTED
DECIMALS: .X - , .XX - , .XXX - ANGLES - FRAC -

CUSTOMER INFORMATION
CITY OF CANTON
WATER POLLUTION
CONTROL PLANT (WPCP)

PANEL-ASSY,

MAIN CONTROL PANEL, CP-01

DRAWING NUMBER: 506357-WTS-EL-T03-0330-DA-001
REVISION: A
REF.: -
DOC. OWNER: -
PROJECT NO.: 506357
PART/MATERIAL NO.: -
SCALE: NONE
SIZE: D
SHEET: 2 OF 8
LAST SAVED: Monday, June 1, 2020 5:06:03 PM

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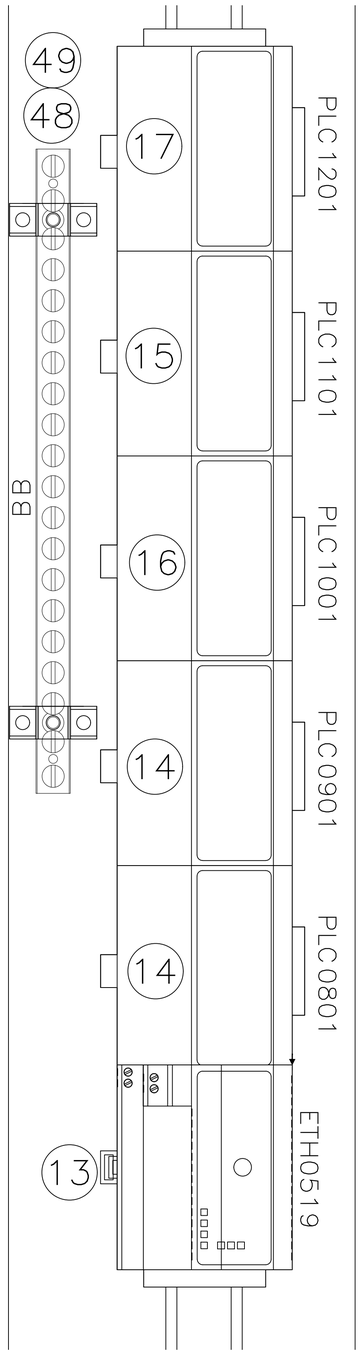
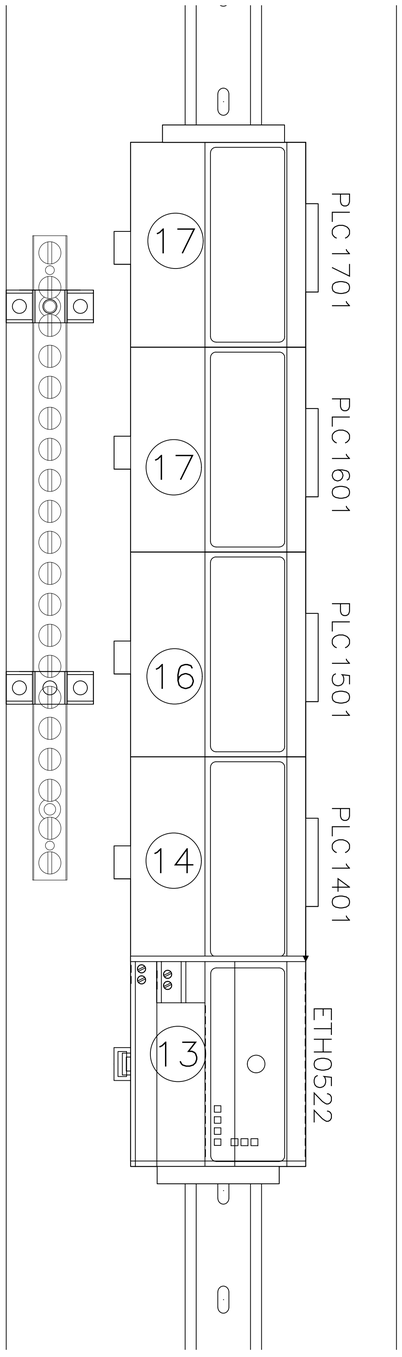
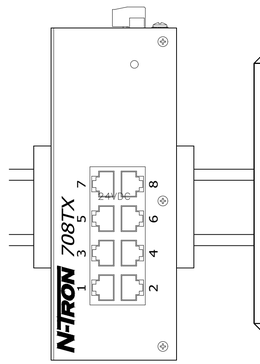


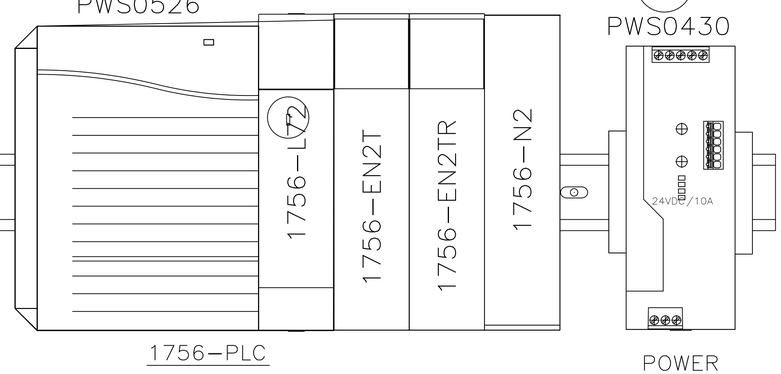
RACK(1)
FLEX IO
CARDS



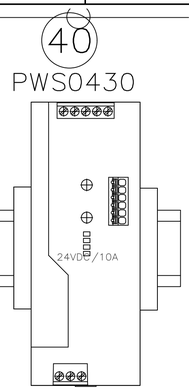
RACK(2)
FLEX IO
CARDS

ETHERNET
SWITCH

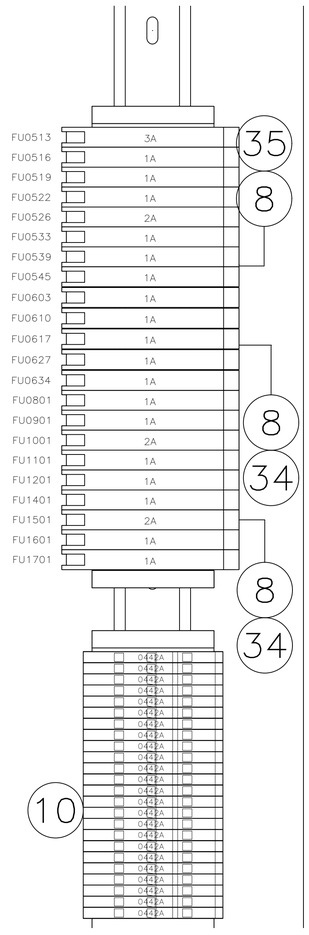




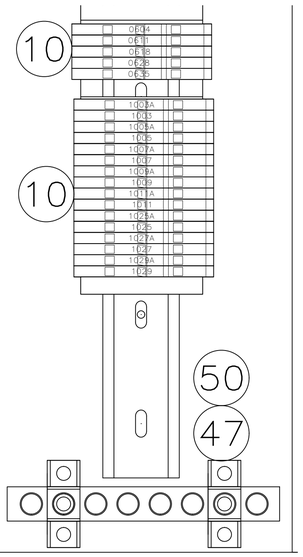
1756-PLC



POWER
SUPPLY



FUSE-VAC



TB-INT(1)

TB-FLD-DC

BUSS
BAR

TB-OVDC

REV	DESCRIPTION	ECO	DWN	APPR	APPR	DATE
A	INITIAL RELEASE	-	VM	MS	SKH	26MAY2020

TOLERANCES UNLESS NOTED
DECIMALS: .X -, .XX -, .XXX -
ANGLES: -
FRAC: -

CUSTOMER INFORMATION
CITY OF CANTON
WATER POLLUTION
CONTROL PLANT (WPCP)

TERMINAL BLOCK LAYOUTS

MAIN CONTROL PANEL, CP-01

DRAWING NUMBER	REVISION
506357-WTS-EL-T03-0330-DA-001	A

REF.: -
DOC. OWNER: -

PROJECT NO.	PART/MATERIAL NO.	SCALE	SIZE	SHEET
506357	-	NONE	D	3 OF 8

LAST SAVED: Monday, June 1, 2020 6:00:34 PM

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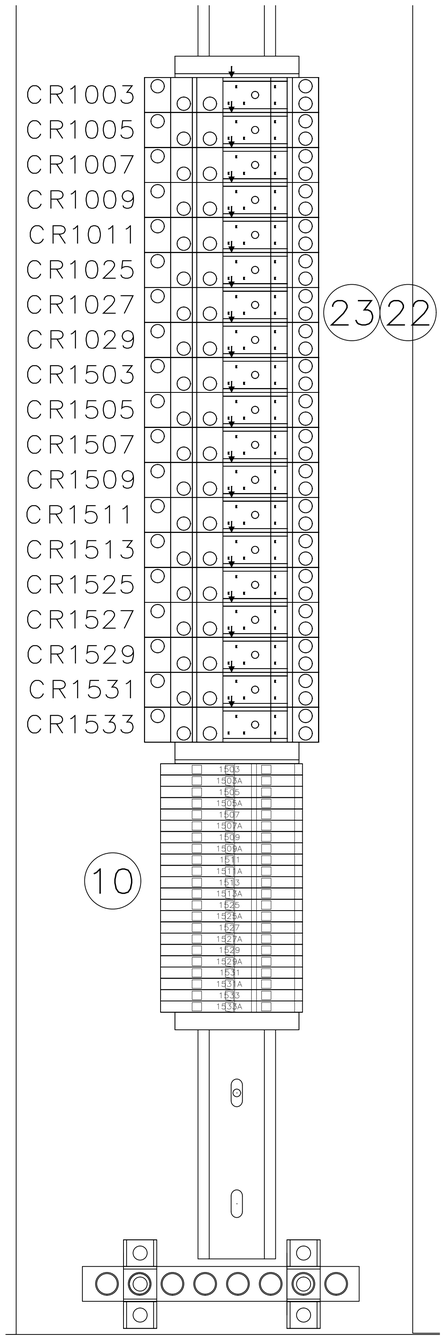
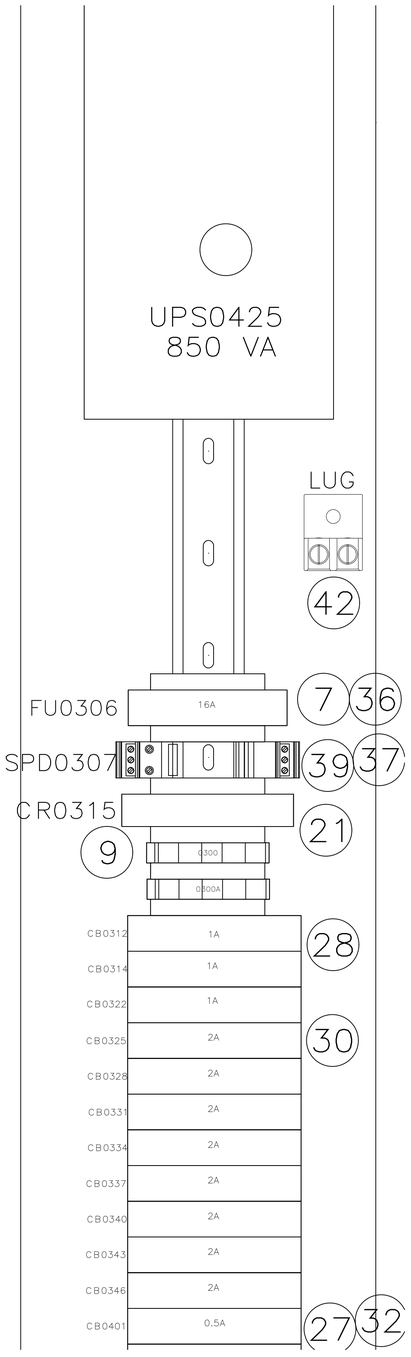


CONTROL RELAY

TB–FLD–DC

BUSS BAR



FUSE AC

SPD

RELAY AC

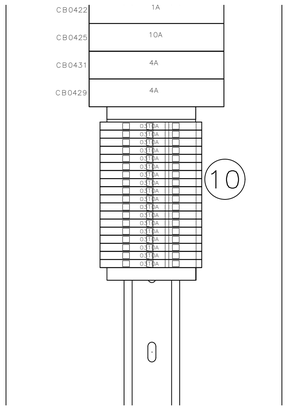
TB–VAC

TB–N(1)

CIRCUIT BREAKERS

TB–N

TB–FLD–AC



RECP

RECP

REV	DESCRIPTION	ECO	DWN	APPR	APPR	DATE
A	INITIAL RELEASE	-	VM	MS	SKH	26MAY2020

TOLERANCES UNLESS NOTED
DECIMALS: .X -, .XX -, .XXX -
ANGLES: - , FRAC -

CUSTOMER INFORMATION
CITY OF CANTON
WATER POLLUTION
CONTROL PLANT (WPCP)

TERMINAL BLOCK LAYOUTS

MAIN CONTROL PANEL, CP-01

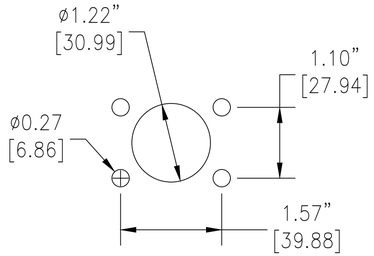
DRAWING NUMBER: 506357-WTS-EL-T03-0330-DA-001
REVISION: A
REF.: -
DOC. OWNER: -
PROJECT NO.: 506357
PART/MATERIAL NO.: -
SCALE: NONE
SIZE: D
SHEET: 4 OF 8

LAST SAVED: Monday, June 1, 2020 6:00:35 PM

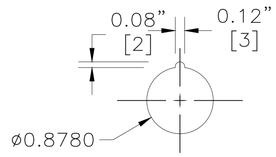
FILE LOCATION: C:_ADATA\Vault\NAM\506357 - CITY OF CANTON\4. Electrical Drawings\506357-MAIN CONTROL PANEL 506357-WTS-EL-T03-0330-DA-001-04.dwg

CUTOUT DIMENSIONS

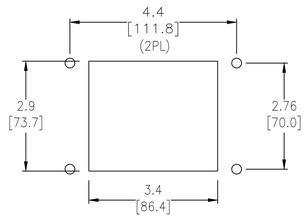
CUTOUT DETAILS FOR MANUFACTURING ONLY



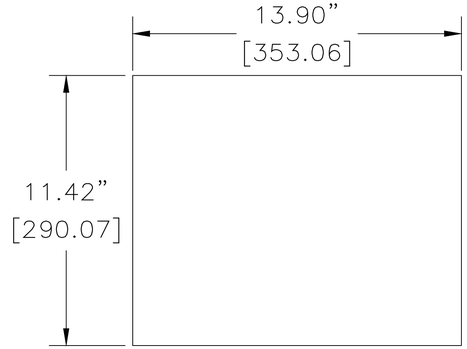
DETAIL A
C&H PT#
SHR00N4X



DETAIL C
NOT TO SCALE
(3 PL)



DETAIL D



DETAIL B
HMI-2711P-T15C22D9P

REV	DESCRIPTION	ECO	DWN	APPR	APPR	DATE
A	INITIAL RELEASE	-	VM	MS	SKH	26MAY2020

TOLERANCES UNLESS NOTED
DECIMALS ANGLES
.X - -
.XX - FRAC
.XXX - -

CUSTOMER INFORMATION
CITY OF CANTON
WATER POLLUTION
CONTROL PLANT (WPCP)

CUTOUT DETAILS

MAIN CONTROL PANEL, CP-01

DRAWING NUMBER				REVISION
506357-WTS-EL-T03-0330-DA-001				A
REF.: -	DOC. OWNER: -			
PROJECT NO.	PART/MATERIAL NO.	SCALE	SIZE	SHEET
506357	-	NONE	D	5 OF 8

LAST SAVED: Thursday, May 28, 2020 6:14:36 PM

FILE LOCATION: C:_AS3KV\dat\VNAM\506357 - CITY OF CANTON\4. Electrical Drawings\506357-MAIN CONTROL PANEL\506357-WTS-EL-T03-0330-DA-001-05.dwg

ITEM	TAGS	QTY	MFG	CATALOG	DESCRIPTION
1	LS0312	1	HOFFMAN	ALFSWD	DOOR SWITCH, FOR ENCLOSURE INTRUSION DETECTION DS
2		4	HOFFMAN	CMFKSS	STAINLESS STEEL MOUNTING FOOT KIT MOUNTING BRACKET KIT
3		1	HOFFMAN	CP7236	BACK PLATE 70.20 X 34.20 INCHES NEMA 4X
4		1	HOFFMAN	CSD723612SSR	STAINLESS STEEL TYPE 4X ENCLOSURE NEMA 4X, 72X36X12 INCH
5		28	AB	1492-EAJ35	END ANCHOR
6		8	AB	1492-EBL3T	END BARRIER, EBL3T, GREY (STANDARD) END SECTION
7	FU0306	1	AB	1492-FB1C30-L	
36			BUSSMANN	LP-CC-20	FUSE, 20A 600VAC
8	FU0526 FU1001 FU1601	3	AB	1492-H5	TERMINAL BLOCK/STRIP 12AMPS
34			BUSSMANN	ABC-2-R	FUSE, 2A 250V
8	FU0516 FU0519 FU0522 FU0533 FU0539 FU0545 FU0603 FU0610 FU0617 FU0627 FU0634 FU0801 FU0901 FU1101 FU1201 FU1401 FU1601 FU1701	18	AB	1492-H5	TERMINAL BLOCK/STRIP 12AMPS
33			BUSSMANN	ABC-1-R	FUSE, 1A 250V
8	FU0513	1	AB	1492-H5	TERMINAL BLOCK/STRIP 12AMPS
35			BUSSMANN	ABC-3-R	FUSE, 3A 250V
9	TB-N(1) TB-VAC	2	AB	1492-J10	SCREW CONNECTION TERMINAL BLOCK; 1492-J 65AMPS

ITEM	TAGS	QTY	MFG	CATALOG	DESCRIPTION
10	TB-0VDC TB-FLD-DC TB-INT(1) TB-N	92	AB	1492-L3T	IEC SPRING CLAMP TERMINAL BLOCK, STANDARD FEED-THROUGH BLOCK, 1492-L 25AMPS
11	RECP0325	1	AB	1492-REC20	RECEPTACLE DUPLEX RECEPTACLE, DIN-RAIL MOUNT
12	ETH0516	1	N-TRON	708TX	8 PORT MANAGED INDUSTRIAL ETHERNET SWITCH
13	ETH0519 ETH0522	2	AB	1794-AENTR	I/O COMMUNICATION ADAPTER, ETHERNET/IP COMMUNICATION ADAPTER
14	PLC0801 PLC0901 PLC1401	3	AB	1794-IB16	1794 FLEX I/O DC INPUT MODULE DISCRETE INPUT
		3	AB	1794-TB3	PLC, FLEX, 3 WIRE TERMINAL
15	PLC1101	1	AB	1794-IE8	1794 FLEX I/O ANALOG INPUT MODULE ANALOG INPUT
		1	AB	1794-TB3	PLC, FLEX, 3 WIRE TERMINAL
16	PLC1001 PLC1501	2	AB	1794-OB16	1794 FLEX I/O DC OUTPUT MODULE DISCRETE OUTPUT
		2	AB	1794-TB2	PLC, FLEX, 2 WIRE TERMINAL
17	PLC1201 PLC1601 PLC1701	3	AB	1794-OE4	1794 FLEX I/O ANALOG OUTPUT MODULE ANALOG OUTPUT
		3	AB	1794-TB3	PLC, FLEX, 3 WIRE TERMINAL
18		7	AB	199-DR1	ZINC/STEEL DIN RAIL EN 50022 (35mm x 7.5mm x 1m) SLOTTED
19	HMI0513	1	AB	2711P-T15C22D9P	PANELVIEW PLUS 7 PERFORMANCE TERMINAL, TOUCH SCREEN, 15 XGA, TFT COLOR, ETHERNET DLR, 24V DC, WINDOWS CE OS LICENSE PRO
20	CPU	1	AB	1756-L72	CONTROLLOGIX 1756-L72 CONTROLLER AB
21	CR0315	1	AB	700-HK36A1	HK TYPE SLIM LINE RELAY WITH SOCKET 700-HN221 120VAC
			AB	700-HN221	SCREW TERMINAL MINIATURE SOCKET SOCKET

REV	DESCRIPTION	ECO	DWN	APPR	APPR	DATE
A	INITIAL RELEASE	-	VM	MS	SKH	26MAY2020

TOLERANCES UNLESS NOTED
DECIMALS ANGLES
.X - -
.XX - FRAC
.XXX - -

CUSTOMER INFORMATION
CITY OF CANTON
WATER POLLUTION
CONTROL PLANT (WPCP)

BILL OF MATERIALS

MAIN CONTROL PANEL, CP-01

DRAWING NUMBER: 506357-WTS-EL-T03-0330-DA-001
REVISION: A
REF.: -
DOC. OWNER: -
PROJECT NO.: 506357
PART/MATERIAL NO.: -
SCALE: NONE
SIZE: D
SHEET: 6 OF 8

FILE LOCATION: C:_ADS\Vault\NAM\506357 - CITY OF CANTON\4. Electrical Drawings\506357-MAIN CONTROL PANEL\506357-WTS-EL-T03-0330-DA-001-06.dwg

LAST SAVED: Thursday, May 28, 2020 6:14:57 PM

ITEM	TAGS	QTY	MFG	CATALOG	DESCRIPTION
23	CR1003 CR1005 CR1007 CR1009 CR1011 CR1025 CR1027 CR1029 CR1503 CR1505 CR1507 CR1509 CR1511 CR1513 CR1525 CR1527 CR1529 CR1531 CR1533	19	AB	700-HN121	SCREW TERMINAL MINIATURE SOCKET SOCKET
22			AB	700-HK36Z24	HK TYPE SLIM LINE RELAY WITH SOCKET 700-HN121 24VDC
24	PB0933	1	AB	800FP-MT44PX01S	SWITCH-PUSH PULL, A-B, IEC, MUSHRM, RED
25	AL1035	1	AB	800FP-P0	LIGHT, PILOT, LED, 24VDC, AMBER, 800F
26	PL0314	1	AB	800FP-P7PN5W	LIGHT, PILOT, LED, WHITE, 120VAC
27	CB0401 CB0405 CB0409 CB0413 CB0417	5	ABB	S 201-C 0.5	S200 MINIATURE CIRCUIT BREAKER, PRO M COMPACT 0.5AMP
28	CB0312 CB0314 CB0322 CB0420 CB0422	5	ABB	S 201-C 1	S200 MINIATURE CIRCUIT BREAKER, PRO M COMPACT 1AMP

ITEM	TAGS	QTY	MFG	CATALOG	DESCRIPTION
29	CB0425	1	ABB	S 201-C 10	S200 MINIATURE CIRCUIT BREAKER, PRO M COMPACT 10AMPS
30	CB0325 CB0328 CB0331 CB0334 CB0337 CB0340 CB0343 CB0346	8	ABB	S 201-C 2	S200 MINIATURE CIRCUIT BREAKER, PRO M COMPACT 2AMPS
31	CB0430 CB0435	2	ABB	S 201-C 4	S200 MINIATURE CIRCUIT BREAKER, PRO M COMPACT 4AMPS
39	SPD0307	1	PHOENIX CONTACT	2856812	SURGE SUPPRESSOR, 2856812, PHOENIX CONTACT, 120 VAC.
37			PHEONIX CONTACT	2817738	Type 2 surge protection base element - VAL-MS BE/FM - 2817738 250 VAC
40	PWS0430	1	PHOENIX CONTACT	2904601	QUINT POWER Power Supply , Selective Fuse Breaking, NFC Interface, Input 1-phase, Output: 24V DC QUINT SERIES, UL/CSA
41	RECP0322	1	PHOENIX CONTACT	2963860	RECEPTACLE,SINGLE,PHOENIX,DIN,125VAC SINGLE RECEPTACLE WITH LIGHT INDICATOR
42	LUG	1	BURNDY	K2A25U	TERMINAL GROUNDING LUG ALUMINUM
43	DISC0303	1	CUTLER HAMMER	R5A3030U/SHR00N4X/DMK	DISCONNECT SWITCH, CUTLER HAMMER R5A3030U/SHR00N4X/DMK
44		A/R	PANDUIT	F1.5X4LG6	NARROW FINGER, SLOTTED WIRING DUCT SLOTTED 1X4
45		A/R	PANDUIT	F2X4LG6	NARROW FINGER, SLOTTED WIRING DUCT SLOTTED 2X4
46		A/R	PANDUIT	F3X4LG6	NARROW FINGER, SLOTTED WIRING DUCT SLOTTED 3X4
47		4	PANDUIT	UGB-B-SO	COPPER/ TIN PLATED, UNIVERSAL GROUND BAR BONDING STAND OFFS COPPER/ TIN PLATED
48		4	PANDUIT	UGB-IN-SO	PLASTIC, UNIVERSAL GROUND BAR BONDING STAND OFFS PLASTIC

REV	DESCRIPTION	ECO	DWN	APPR	APPR	DATE
A	INITIAL RELEASE	-	VM	MS	SKH	26MAY2020

TOLERANCES UNLESS NOTED
DECIMALS ANGLES
.X - -
.XX - FRAC
.XXX - -

CUSTOMER INFORMATION
CITY OF CANTON
WATER POLLUTION
CONTROL PLANT (WPCP)

BILL OF MATERIALS

MAIN CONTROL PANEL, CP-01

DRAWING NUMBER	REVISION
506357-WTS-EL-T03-0330-DA-001	A

REF.: -
DOC. OWNER: -

PROJECT NO.	PART/MATERIAL NO.	SCALE	SIZE	SHEET
506357	-	NONE	D	7 OF 8

LAST SAVED: Monday, June 1, 2020 5:06:27 PM

FILE LOCATION: C:_ACSKVault\NAM\506357 - CITY OF CANTON\4. Electrical Drawings\506357-MAIN CONTROL PANEL\506357-WTS-EL-T03-0330-DA-001-107.dwg

ITEM	TAGS	QTY	MFG	CATALOG	DESCRIPTION
49	BB	2	PANDUIT	UGB2 0-414-18	18-PORT UNIVERSAL GROUND BAR COPPER
50		2	PANDUIT	UGB2 0-414-6	6-PORT UNIVERSAL GROUND BAR COPPER
51	L2	1	PANEL SHOP	MFG-LABEL	
52	L1	1	SUEZ	5025-61DHPK	LABEL, HAZARDOUS VOLATGE CUSTOM
54	WLT0312	1	VISIONEERING	UC124-T817R120 -B11B13X	LIGHT FIXTURE, 17W, 120 VAC, 60 HZ 120 VAC
56	RECP0317	1	GRACE PORT	P-R2-K3RF3	PLC, ETHERNET, PROGRAMMING PORT, 120V 3A, GFCI GFCI
57	NP1	1	SUEZ		NAME PLATE, 10" X 2.5"
58	LABEL	3	SUEZ		NAME PLATE, 2.5" X 1"
59	L4	1	UL		L5, UL LABEL
60	UPS	1	SOLA	SDU850A	UPS, 850 VA, 120 VAC, 510W, SOLAHD
61	PWS0526	1	AB	1756-PB72	1756 CONTROLLOGIX POWER SUPPLY, 1756-PB72, AB 24VDC
62	COMM	1	AB	1756-EN2T	1756 CONTROLLOGIX ETHERNET INTERFACE MODULE, AB, 1756-EN2T.
63	COMM	1	AB	1756-EN2TR	1756 CONTROLLOGIX ETHERNET INTERFACE MODULE, AB, 1756-EN2TR.
64	PLC	1	AB	1756-N2	1756 CONTROLLOGIX SLOT FILLER MODULE, AB, 1756-N2
64	PLC	1	AB	1756-A4	1756 CONTROLLOGIX CHASSIS

REV	DESCRIPTION	ECO	DWN	APPR	APPR	DATE
A	INITIAL RELEASE	-	VM	MS	SKH	26MAY2020

TOLERANCES UNLESS NOTED
DECIMALS .X - .XX - .XXX - ANGLES - FRAC -

CUSTOMER INFORMATION
CITY OF CANTON
WATER POLLUTION
CONTROL PLANT (WPCP)

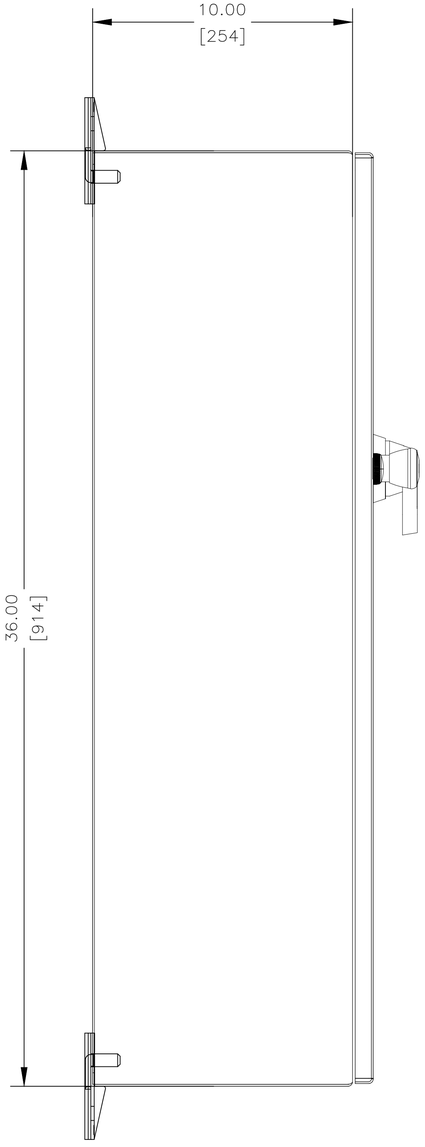
BILL OF MATERIALS

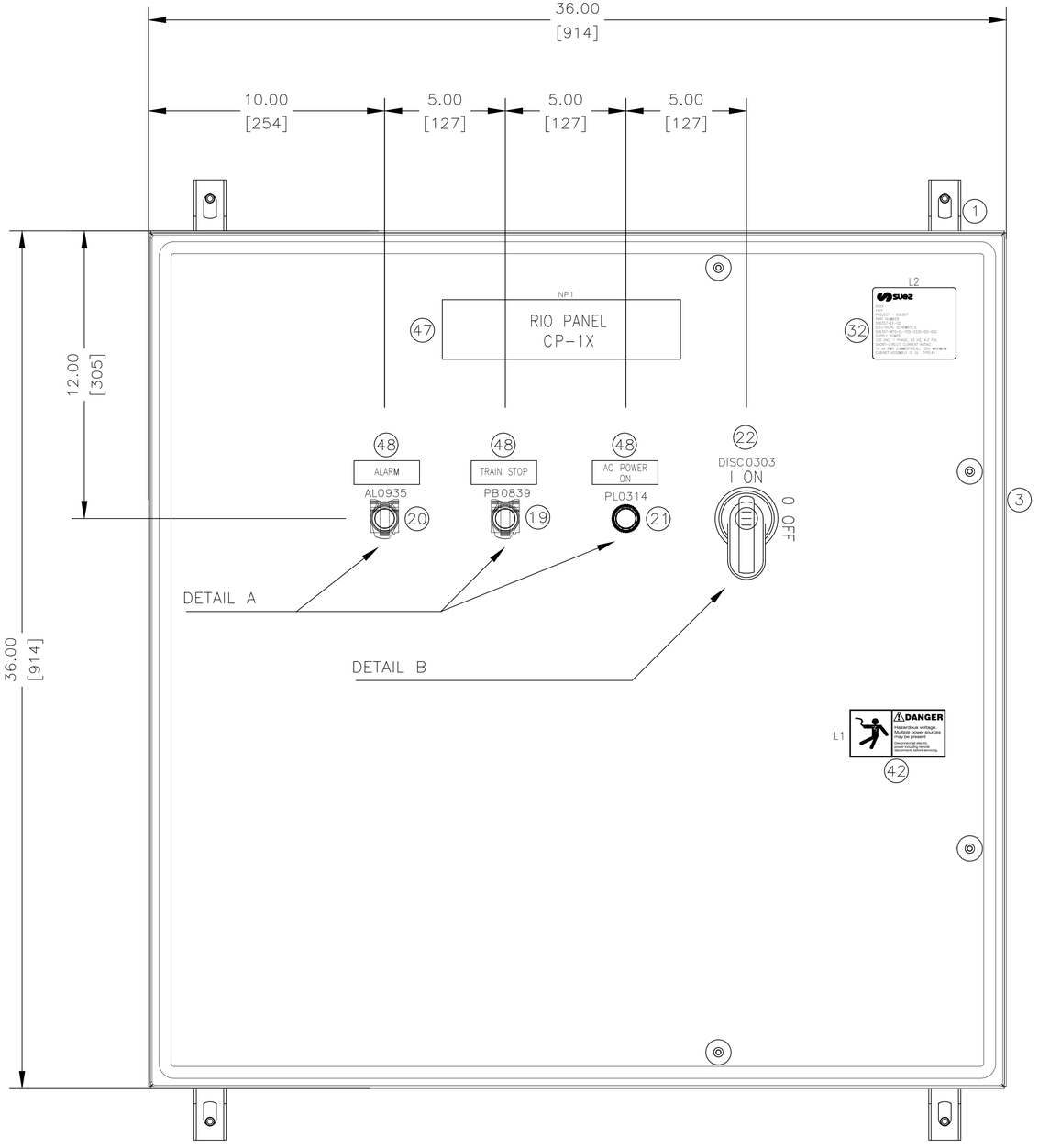
MAIN CONTROL PANEL, CP-01

DRAWING NUMBER: 506357-WTS-EL-T03-0330-DA-001
REVISION: A
REF.: -
DOC. OWNER: -
PROJECT NO.: 506357
PART/MATERIAL NO.: -
SCALE: NONE
SIZE: D
SHEET: 8 OF 8

LAST SAVED: Monday, June 1, 2020 5:06:32 PM

FILE LOCATION: C:_ADSKVault\MAIN\506357 - CITY OF CANTON\4 Electrical Drawings\506357-MAIN CONTROL PANEL\506357-WTS-EL-T03-0330-DA-001-08.dwg





L2

SUEZ

XXXX
YYYY
PROJECT – 506357
PART NUMBER:
506357–EE–02
ELECTRICAL SCHEMATICS:
506357–WTS–EL–T05–0330–DD–002
SUPPLY POWER:
120 VAC, 1 PHASE, 60 HZ, 4.0 FLA
SHORT–CIRCUIT CURRENT RATING
10 kA RMS SYMMERTRICAL, 120V MAXIMUM
CABINET ASSEMBLY IS UL TYPE 4X

SEE NOTE 1

SUEZ WTS
CONTROLLED DOCUMENT

DC

NOTE:

1. MANUFACTURER'S PRODUCT DATA CONTAINED ON LABEL L1. YYYY = LOCATION OF SUEZ WTS MANUFACTURING FACILITY. (i.e. CITY. STATE/PROVINCE, COUNTRY) XXXX = CONTROL PANEL MANUFACTURING FACILITY (i.e. MANUFACTURED BY: PANEL SHOP NAME, CITY, STATE/PROVINCE, COUNTRY) IF DIFFERENT FROM SUEZ WTS MANUFACTURING FACILITY. OTHERWISE THIS LINE IS LEFT BLANK.
2. UL STICKER (L4) AND SUPPLY/FUSE TORQUE LABEL (L5) AFFIXED TO INSIDE OF FRONT DOOR.
3. REFERENCE DEVICE CUT–OUT INFORMATION ON PAGE 4.

REV	DESCRIPTION	ECO	DWN	APPR	APPR	DATE
A	INITIAL RELEASE	-	VM	MS	SKH	26-MAY-2020

TOLERANCES UNLESS NOTED
DECIMALS ANGLES
.X - -
.XX - FRAC
.XXX - -

SUEZ

CUSTOMER INFORMATION
CITY OF CANTON
WATER POLLUTION
CONTROL PLANT (WPCP)

ENCL-ASSY,

RIO PANEL, CP-1X

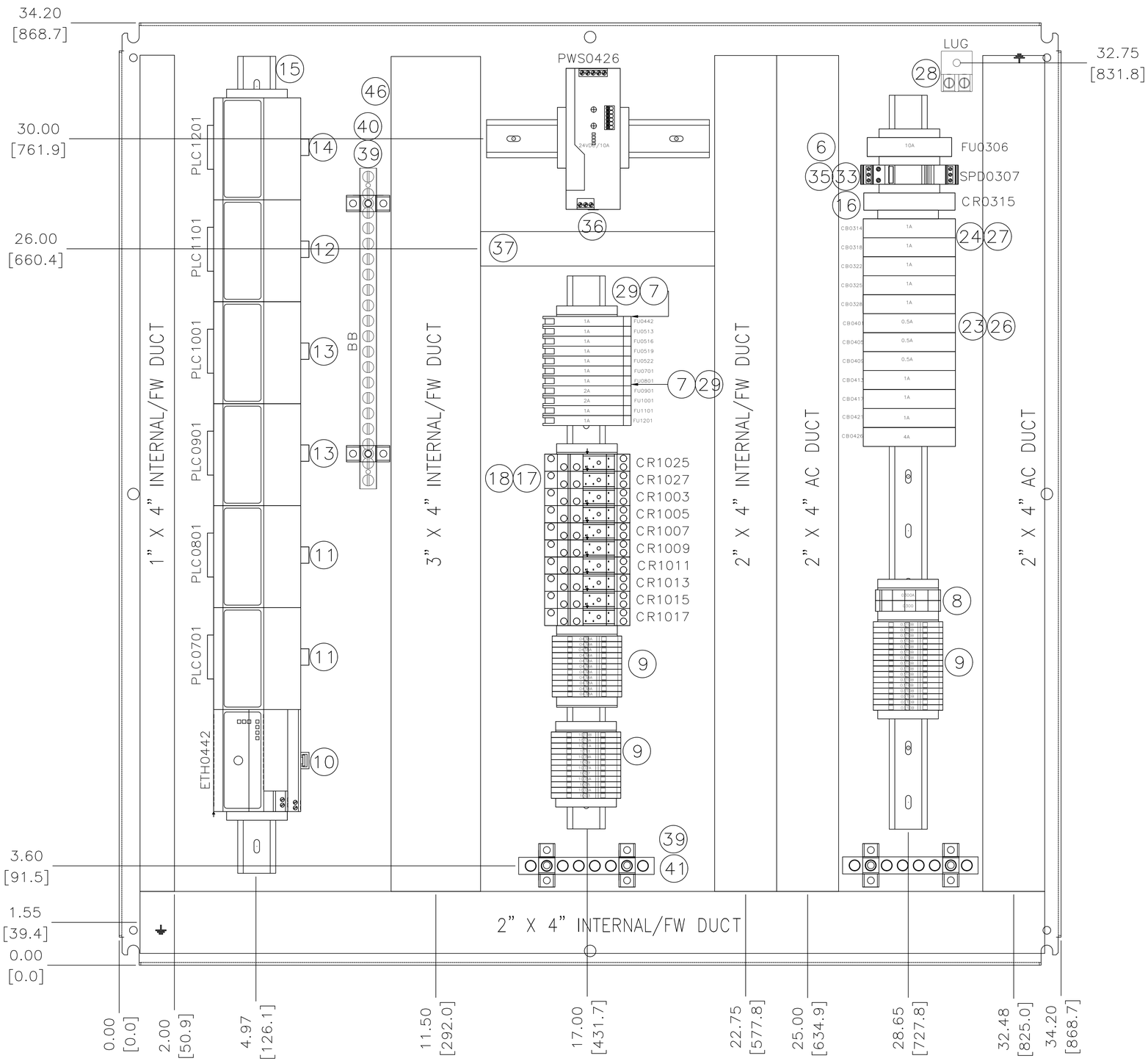
DRAWING NUMBER	REVISION
506357-WTS-EL-T03-0330-DA-002	A

REF.: - DOC. OWNER: -

PROJECT NO.	PART/MATERIAL NO.	SCALE	SIZE	SHEET
506357	-	NONE	D	1 OF 6

LAST SAVED: Monday, June 1, 2020 11:06:04 PM

FILE LOCATION: C:_ADKVault\MAIN\506357 - CITY OF CANTON\4 Electrical Drawings\506357-WTS-EL-T03-0330-DA-002-01.dwg



NOTE:
1. INSTALL A BONDING JUMPER THAT IS SIZED FOR THE RATING OF THE OVER CURRENT PROTECTION FOR THE CONTROL PANEL'S INCOMING SUPPLY BETWEEN RESPECTIVE BUSS BARS.
2. DIMENSIONS IN INCHES [MM].

REV	DESCRIPTION	ECO	DWN	APPR	APPR	DATE
A	INITIAL RELEASE	-	VM	MS	SKH	26-MAY-2020

TOLERANCES UNLESS NOTED
DECIMALS ANGLES
.X - -
.XX - FRAC
.XXX - -

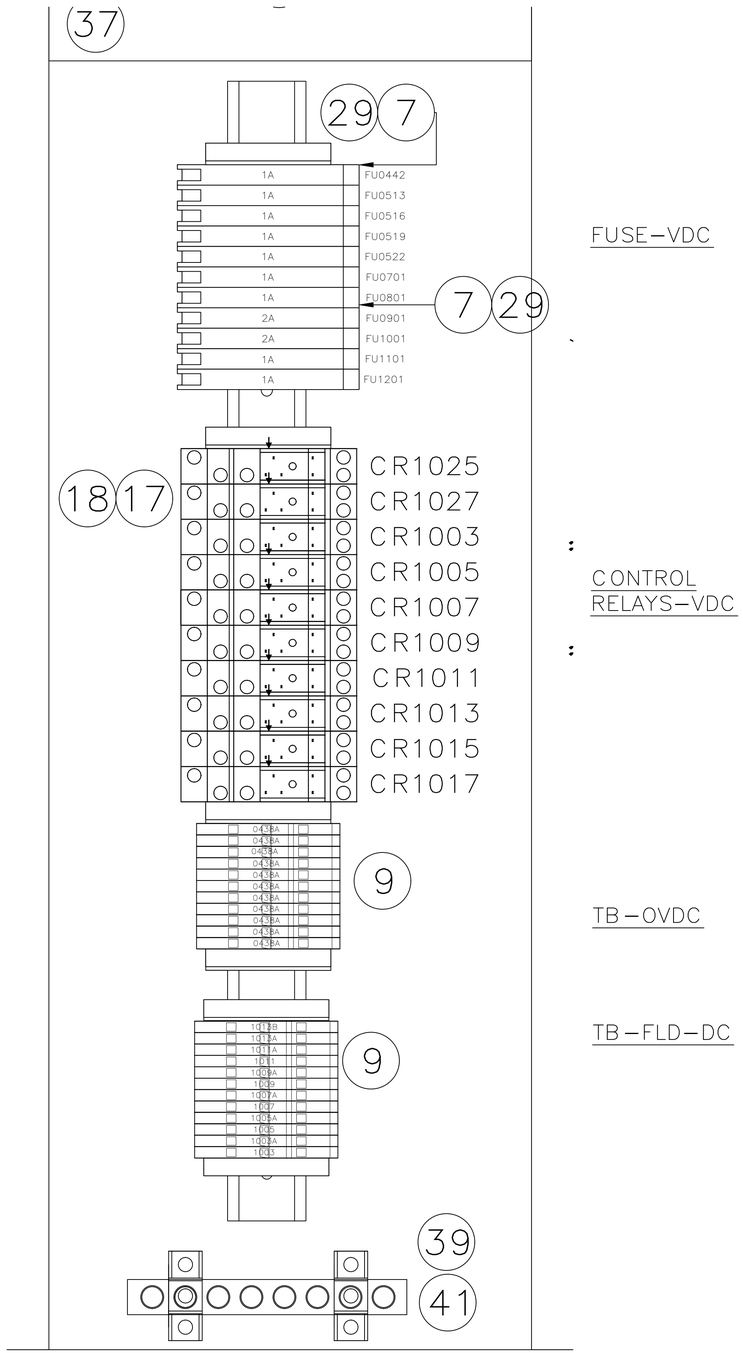
CUSTOMER INFORMATION
CITY OF CANTON
WATER POLLUTION
CONTROL PLANT (WPCP)

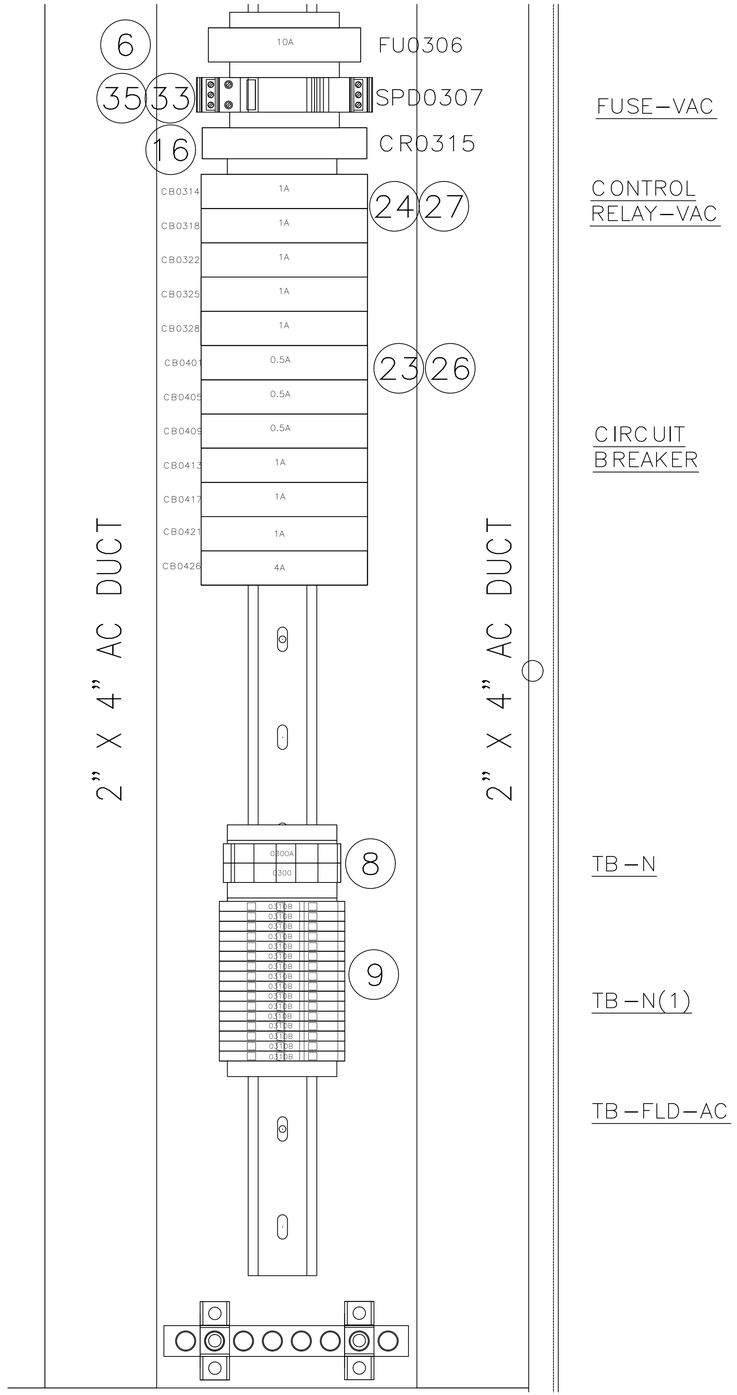
PANEL-ASSY,

RIO PANEL, CP-1X

DRAWING NUMBER: 506357-WTS-EL-T03-0330-DA-002
REVISION: A
REF.: -
DOC. OWNER: -
PROJECT NO.: 506357
PART/MATERIAL NO.: -
SCALE: NONE
SIZE: D
SHEET: 2 OF 6

FILE LOCATION: C:_ADSK Vault\NAAM\506357 - CITY OF CANTON\4. Electrical Drawings\506357-WTS-EL-T03-0330-DA-002-002.dwg
LAST SAVED: Monday, June 1, 2020 9:32:55 PM





REV	DESCRIPTION	ECO	DWN	APPR	APPR	DATE
A	INITIAL RELEASE	-	VM	MS	SKH	26-MAY-2020

TOLERANCES UNLESS NOTED
DECIMALS: .X - , .XX - , .XXX - ANGLES - FRAC -

CUSTOMER INFORMATION
CITY OF CANTON
WATER POLLUTION
CONTROL PLANT (WPCP)

TERMINAL BLOCK LAYOUTS

RIO PANEL, CP-1X

DRAWING NUMBER	REVISION
506357-WTS-EL-T03-0330-DA-002	A

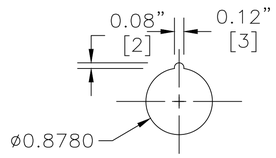
REF.: - DOC. OWNER: -

PROJECT NO.	PART/MATERIAL NO.	SCALE	SIZE	SHEET
506357	-	NONE	D	3 OF 6

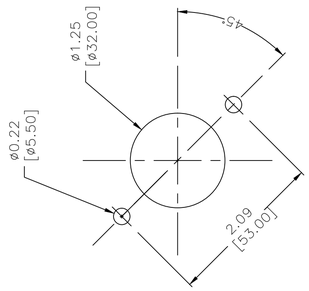
LAST SAVED: Monday, June 1, 2020 9:32:42 PM

FILE LOCATION: C:_ADSKVault\NAM\506357 - CITY OF CANTON\4. Electrical Drawings\506357-RIO PANEL\506357-WTS-EL-T03-0330-DA-002-03.dwg

CUTOUT DETAILS FOR MANUFACTURING ONLY



DETAIL A
NOT TO SCALE
(3 PL)



DETAIL B
NOT TO SCALE
TO BE DRILLED BY THE ELECTRICAL PANEL
SHOP TO MATCH DISCONNECT SWITCH
LOCATION ON BACKPANEL

REV	DESCRIPTION	ECO	DWN	APPR	APPR	DATE
A	INITIAL RELEASE	-	VM	MS	SKH	26-MAY-2020

TOLERANCES UNLESS NOTED
DECIMALS ANGLES
.X - -
.XX - FRAC
.XXX - -

CUSTOMER INFORMATION
CITY OF CANTON
WATER POLLUTION
CONTROL PLANT (WPCP)

CUT OUT DETAILS

RIO PANEL, CP-1X

DRAWING NUMBER: 506357-WTS-EL-T03-0330-DA-002
REVISION: A
REF.: -
DOC. OWNER: -
PROJECT NO.: 506357
PART/MATERIAL NO.: -
SCALE: NONE
SIZE: D
SHEET: 4 OF 6
LAST SAVED: Monday, June 1, 2020 7:39:42 PM

FILE LOCATION: C:_ASSV\vault\VAAM\506357 - CITY OF CANTON\4. Electrical Drawings\506357-RIO PANEL\506357-WTS-EL-T03-0330-DA-002-04.dwg

ITEM	TAGS	QTY	MFG	CATALOG	DESCRIPTION
1		4	HOFFMAN	CMFKSS	STAINLESS STEEL MOUNTING FOOT KIT ENCLOSURE ACCESSORIES MOUNTING BRACKET KIT
2		1	HOFFMAN	CP3636	BACK PLATE 34.20 X 34.20 INCHES NEMA 4X
3		1	HOFFMAN	CSD363610SSR	CONCEPT WALL-MOUNT ENCLOSURE NEMA 4X, 36X36X10 INCH
4		18	AB	1492-EAJ35	END ANCHOR
5		6	AB	1492-EBL3T	END BARRIER, EBL3T, GREY (STANDARD) END SECTION
6	FU0306	1	AB	1492-FB1C30-L	
			BUSSMANN	LP-CC-20	FUSE, 20A 600VAC
7	FU0901 FU1001	2	AB	1492-H5	TERMINAL BLOCK/STRIP 12AMPS
30			BUSSMANN	ABC-2-R	FUSE, 2A 250V
7	FU0442 FU0513 FU0516 FU0519 FU0522 FU0701 FU0801 FU1101 FU1201	9	AB	1492-H5	TERMINAL BLOCK/STRIP 12AMPS
29			BUSSMANN	ABC-1-R	FUSE, 1A 250V
8	TB-N TB-VAC(1)	2	AB	1492-J10	SCREW CONNECTION TERMINAL BLOCK; 1492-J 65AMPS
9	TB-0VDC TB-FLD-AC TB-FLD-DC TB-N(1)	43	AB	1492-L3T	IEC SPRING CLAMP TERMINAL BLOCK, STANDARD FEED-THROUGH BLOCK, 1492-L 25AMPS
10	ETH0442	1	AB	1794-AENTR	I/O COMMUNICATION ADAPTER, ETHERNET/IP COMMUNICATION ADAPTER
11	PLC0701 PLC0807	2	AB	1794-IB16	1794 FLEX I/O DC INPUT MODULE DISCRETE INPUT
		2	AB	1794-TB3	PLC, FLEX, 3 WIRE TERMINAL

ITEM	TAGS	QTY	MFG	CATALOG	DESCRIPTION
12	PLC1101	1	AB	1794-IE8	1794 FLEX I/O ANALOG INPUT MODULE ANALOG INPUT
		1	AB	1794-TB3	PLC, FLEX, 3 WIRE TERMINAL
13	PLC0901 PLC1001	2	AB	1794-OB16	1794 FLEX I/O DC OUTPUT MODULE DISCRETE OUTPUT
		2	AB	1794-TB2	PLC, FLEX, 2 WIRE TERMINAL
14	PLC1201	1	AB	1794-OE4	1794 FLEX I/O ANALOG OUTPUT MODULE ANALOG OUTPUT
		1	AB	1794-TB3	PLC, FLEX, 3 WIRE TERMINAL
15		4	AB	199-DR1	ZINC/STEEL DIN RAIL EN 50022 (35mm x 7.5mm x 1m) SLOTTED
16	CR0315	1	AB	700-HK36A1	HK TYPE SLIM LINE RELAY WITH SOCKET 700-HN221 120VAC
			AB	700-HN221	SCREW TERMINAL MINIATURE SOCKET SOCKET
18	CR1025 CR1027 CR1003 CR1005 CR1007 CR1009 CR1011 CR1013 CR1015 CR1017	10	AB	700-HN121	SCREW TERMINAL MINIATURE SOCKET SOCKET
17			AB	700-HK36Z24	HK TYPE SLIM LINE RELAY WITH SOCKET 700-HN121 24VDC
19	PB0839	1	AB	800FP-MT44PX01S	SWITCH-PUSH PULL, A-B, IEC, MUSHRM, RED
20	AL0935	1	AB	800FP-P0	LIGHT, PILOT, LED, 24VDC, AMBER, 800F 24 VDC
21	PL0314	1	AB	800FP-P7PN5W	WHITE PILOT LT - NEMA 4 120VAC
22	DISC0303	1	ABB	OHB65L6	DISCONNECT SWITCH HANDEL NEMA 4
23	CB0401 CB0405 CB0409	3	ABB	S 201-C 0.5	S200 MINIATURE CIRCUIT BREAKER, PRO M COMPACT 0.5AMP

REV	DESCRIPTION	ECO	DWN	APPR	APPR	DATE
A	INITIAL RELEASE	-	VM	MS	SKH	26-MAY-2020

TOLERANCES UNLESS NOTED
DECIMALS: .X - ,XX - ,XXX -
ANGLES: - FRAC -

CUSTOMER INFORMATION
CITY OF CANTON
WATER POLLUTION
CONTROL PLANT (WPCP)

BILL OF MATERIALS

RIO PANEL, CP-1X

DRAWING NUMBER: 506357-WTS-EL-T03-0330-DA-002
REVISION: A
REF.: -
DOC. OWNER: -
PROJECT NO.: 506357
PART/MATERIAL NO.: -
SCALE: NONE
SIZE: D
SHEET: 5 OF 6

LAST SAVED: Monday, June 1, 2020 11:07:06 PM

FILE LOCATION: C:_ADSKVault\NAM\506357 - CITY OF CANTON\4. Electrical Drawings\506357-RIO PANEL\506357-WTS-EL-T03-0330-DA-002-05.dwg

ITEM	TAGS	QTY	MFG	CATALOG	DESCRIPTION
24	CB0314 CB0318 CB0322 CB0325 CB0328	5	ABB	S 201-C 1	S200 MINIATURE CIRCUIT BREAKER, PRO M COMPACT 1AMP
	CB0413 CB0417 CB0421	3	ABB	S 201-C 1	S200 MINIATURE CIRCUIT BREAKER, PRO M COMPACT 1AMP
25	CB0426	1	ABB	S 201-C 4	S200 MINIATURE CIRCUIT BREAKER, PRO M COMPACT 4AMPS
28	LUG	1	BURNDY	K2A25U	TERMINAL GROUNDING LUG ALUMINUM
32	L2	1	PANEL SHOP	MFG-LABEL	
35	SPD0307	1	PHOENIX CONTACT	2856812	
33			PHEONIX CONTACT	2817738	Type 2 surge protection base element - VAL-MS BE/FM - 2817738 250 VAC
36	PWS0426	1	PHOENIX CONTACT	2904601	QUINT POWER Power Supply , Selective Fuse Breaking, NFC Interface, Input 1-phase, Output: 24V DC QUINT SERIES, UL/CSA
37		A/R	PANDUIT	F1X4LG6	NARROW FINGER, SLOTTED WIRING DUCT SLOTTED 1X4
38		A/R	PANDUIT	F2X4LG6	NARROW FINGER, SLOTTED WIRING DUCT SLOTTED 2X4
39		6	PANDUIT	UGB-IN-SO	PLASTIC, UNIVERSAL GROUND BAR BONDING STAND OFFS PLASTIC
40	BB	1	PANDUIT	UGB2 0-414-18	18-PORT UNIVERSAL GROUND BAR COPPER
41		2	PANDUIT	UGB2 0-414-6	6-PORT UNIVERSAL GROUND BAR COPPER
42	L1	1	SUEZ	5025-61DHPK	LABEL, HAZARDOUS VOLATGE CUSTOM

ITEM	TAGS	QTY	MFG	CATALOG	DESCRIPTION
46		A/R	PANDUIT	F3X4LG6	NARROW FINGER, SLOTTED WIRING DUCT SLOTTED
47	NP1	1	SUEZ		NAME PLATE, 10" X 2.5"
48	LABEL	3	SUEZ		NAME PLATE, 2.5" X 1"
49	L4	1	UL		L5, UL LABEL

REV	DESCRIPTION	ECO	DWN	APPR	APPR	DATE
A	INITIAL RELEASE	-	VM	MS	SKH	26-MAY-2020

TOLERANCES UNLESS NOTED
DECIMALS ANGLES
.X - -
.XX - FRAC
.XXX - -

CUSTOMER INFORMATION
CITY OF CANTON
WATER POLLUTION
CONTROL PLANT (WPCP)

BILL OF MATERIALS

RIO PANEL, CP-1X

DRAWING NUMBER: 506357-WTS-EL-T03-0330-DA-002
REVISION: A
REF.: -
DOC. OWNER: -
PROJECT NO.: 506357
PART/MATERIAL NO.: -
SCALE: NONE
SIZE: D
SHEET: 6 OF 6

LAST SAVED: Monday, June 1, 2020 7:37:04 PM

PREVAILING CODES AND SPECIFICATIONS

NFPA 70 – NATIONAL ELECTRICAL CODE
UL 508A – INDUSTRIAL CONTROL PANELS
CONTROL PANELS TO BE CSA OR UL LISTED

CONTROL PANEL CONSTRUCTION AND INTERNAL WIRING

- DESIGN, MATERIAL SELECTION, AND WORKMANSHIP SHALL RESULT IN A NEAT APPEARANCE OUTSIDE AND INSIDE, WITH NO WELDS, RIVETS OR BOLT HEADS APPARENT FROM THE FRONT FACE OF THE BOARDS AND ALL EXTERIOR SURFACES TRUE AND SMOOTH.
- ANY INSTRUMENTS, RELAYS, AND OTHER DEVICES MOUNTED ON OR WITHIN THE ENCLOSURE SHALL BE CLEARLY TAGGED WITH ENGRAVED 1/16" THICK LAMINATED PLASTIC MARKERS. MARKERS SHALL BE SECURED TO THE MOUNTING PANEL OR INSIDE OF THE ENCLOSURE WITH DOUBLE FACED TAPE. MARKERS SHALL NOT BE MOUNTED ON THE COMPONENT OR WIRE DUCT.
- ALL WIRES SHALL TERMINATE WITH FORK TYPE INSULATED WIRE COMPRESSION TYPE LUGS. UNLESS THE DEVICE IS EQUIPPED WITH A WIRE CLAMP, PRESSURE PLATE, OR TUBULAR SCREW CLAMP.
- ALL INCOMING AND OUTGOING FIELD CONTROL WIRING SHALL TERMINATE AT TERMINAL BLOCKS.
- NO MORE THAN 2 WIRES AT ANY SINGLE TERMINAL.
- ALL CONDUCTORS SHALL RUN CONTINUOUSLY, SPLICING IS NOT ACCEPTABLE.
- MOUNTING OF RELAY SOCKETS, TERMINAL BLOCKS, FUSED TERMINAL BLOCKS/SWITCHES AND THEIR MOUNTING TRACKS SHALL BE ON ONE PIECE SPACERS OR UNISTRUT. THE SPACERS SHALL BE OF A HEIGHT TO ALLOW WIRE ENTERING THESE DEVICES NOT TO BE MORE THAN 1 INCH BELOW COVERS OF THE PLASTIC WIREWAY ADJACENT TO THESE DEVICES.
- GROUND ALL PANEL METAL TO THE PANEL'S EARTH–GROUND BUS.
- WHERE WIRING CROSSES HINGED SURFACE, PROVIDE A 18" "U" SHAPE HINGE LOOP OF EXTRA FLEXIBLE WIRING

WIRING

CONTROL WIRING SHALL BE #16 AWG STRANDED COPPER, THHN & THWN, 600 VOLT INSULATION., 90 DEG. C, ALL WIRING SHALL BE COLOR CODED AS FOLLOWS:

WIRE COLORS	CONDUCTOR TYPE
GREEN WITH YELLOW STRIPE (OR GREEN)	EQUIPMENT GROUNDING AND BONDING CONDUCTORS
WHITE	GROUNDED AC (L2/NEUTRALS) CURRENT–CARRYING CONDUCTORS
BLACK	UNGROUNDED AC (L1) OR DC POWER CIRCUITS CONDUCTORS
RED	UNGROUNDED AC CONTROL CIRCUITS CONDUCTORS
BLUE	UNGROUNDED DC CONTROL CIRCUITS CONDUCTORS
BLUE WITH WHITE STRIPE	GROUNDED DC (0VDC) CONTROL CIRCUIT CONDUCTORS
YELLOW	UNGROUNDED CONDUCTORS FOR AC AND DC REMOTE CONTROL CIRCUITS
WHITE(+), BLACK(–)	ANALOG TWISTED SHIELD PAIR CABLE

TESTING

PRE–SUEZ INSPECTION

- WHEN ALL WIRING OF ELECTRICAL SYSTEM IS COMPLETE, THE FABRICATOR SHALL TEST EACH CIRCUIT FOR CONTINUITY, SHORT CIRCUIT AND FAULT GROUNDS AND COMPLETE WIRING INSPECTION CHECKLIST 210–001–010.

FACILITIES

- PANEL VENDOR SHALL SUPPLY A WORK/TEST AREA FOR PANEL CHECK–OUTS. FOR WALL MOUNTED ENCLOSURES, THIS AREA SHALL INCLUDE A STAND OR PLATFORM TO MOUNT AND SUPPORT THE PANEL VERTICALLY AT BENCH HEIGHT.
- THE WORK/TEST AREA SHALL BE ISOLATED/SEPARATED FROM THE PANEL ASSEMBLY/MFG. AREA SO TESTING CAN BE DONE WITHOUT INTERRUPTION.
- THE WORK/TEST ARE SHALL BE PROVIDED WITH ADEQUATE LIGHTING COMPLETE WITH TABLE/BENCH FOR INSPECTORS USE TO WORK WITH TEST EQUIPMENT AND DRAWINGS.

SUEZ INSPECTION

- PANEL VENDOR SHALL SUBJECT TO BACK–CHARGES, IF AFTER ARRIVAL OF SUEZ INSPECTOR(S) FOR INSPECTION, IS DETERMINED THAT PANEL VENDOR HAS NOT PREPARED FOR SUEZ INSPECTION AND OR NOT COMPLETED "PRE–SUEZ INSPECTION" OR PROVIDED ITEMS NOTED UNDER "FACILITIES".
- AFTER VENDOR CIRCUIT TESTING IS COMPLETE, SUEZ WILL PERFORM FUNCTION TESTING OF THE CONTROL PANEL COMPONENTS AS A SYSTEM TO CONFIRM OPERATION AND MAKE CALIBRATION ADJUSTMENT, IF NECESSARY. PANEL VENDOR SHALL PROVIDE TEMPORARY POWER AND/OR INSTRUMENT QUALITY AIR SUPPLY AS REQUIRED BY PANEL DESIGN. PANEL VENDOR SHALL PROVIDE TEMPORARY WIRING INCLUDING BUT NOT LIMITED TO TOGGLE SWITCHES, 120VAC AND/OR 24VDC INDICATING LIGHTS TO FACILITATE THE TESTING. THE PANEL VENDOR WILL ALSO BE RESPONSIBLE FOR CONNECTING VARIOUS WIRE JUMPERS ON THE PANEL FIELD TERMINALS. ALL TEMPORARY TEST WIRING WILL BE REMOVED BY THE VENDOR BEFORE THE PANEL IS SHIPPED.
- PANEL VENDOR TO PROVIDE QUALIFIED QUALITY CONTROL INSPECTOR/TESTER TO SUEZ PERSONNEL WITH FUNCTION TESTING OF THE CONTROL PANEL. PANEL VENDOR'S PERSONNEL MUST BE FAMILAR WITH CONTROL PANEL FABRICATION, WIRING INSTALLATION/CIRCUITRY, AND FULLY UNDERSTAND SUEZ SCHEMATIC WIRING DIAGRAMS. PANEL VENDOR'S PERSONNEL TO BE AVAILABLE TO ASSIST SUEZ INSPECTOR AS NEEDED.

RUNG NUMBERS

USED WHEN A COMMON DRAWING NUMBER IS ASSIGNED FOR SEVERAL SHEETS

- FIRST CHARACTER: SYSTEM
- SECOND AND THIRD CHARACTERS: SHEET NUMBER
- FOURTH AND FIFTH CHARACTERS: RUNG IDENTIFIER

– EXAMPLE: 1 1 2 0 4

SYSTEM (OPTIONAL): 1
SHEET: 12
RUNG: 04

TERMINAL AND WIRE NUMBERS

ALL WIRE SHALL BE TAGGED AT TERMINATIONS WITH WIRE NUMBERS SHOWN ON DRAWINGS WITH ONE PIECE HEAT SHRINK TUBULAR WIRE MARKERS. MARKERS SHALL BE BRADY SLEEVE COMPUTER–PRINTED TYPE B–321 HEAT–SHRINK POLYOLEFIN STOCK NO. HCPS.9–3336W OR APPROVED EQUAL.

USE THE FOLLOWING SCHEME FOR WIRES AND TERMINALS NOT CONNECTED TO PLC I/O

- THE RUNG NUMBER IS USED TO IDENTIFY A WIRE AND IT'S CORRESPONDING TERMINALS
- WHEN THERE IS NO TERMINAL NUMBER SHOWN, THE TERMINAL NUMBER IS THE SAME AS THE WIRE NUMBER
- WHERE THERE IS MORE THEN ONE WIRE ON A RUNG, THE OTHER WIRES ARE IDENTIFIED USING THE RUNG NUMBER FOLLOWED BY A LETTER.
- USE THE FOLLOWING SCHEME FOR WIRES AND TERMINALS CONNECTED TO PLC I/O

- FIRST CHARACTER: I FOR INPUTS, O FOR OUTPUTS
- SECOND * CHARACTER: RACK NUMBER
- THIRD AND FOURTH CHARACTER: SLOT NUMBER
- FIFTH AND SIXTH CHARACTER: POINT NUMBER

– EXAMPLE: I *1 0 3 0 0

TYPE: INPUT
RACK: 1
SLOT: 03
POINT: 00

* = 2 CHARACTERS IF THERE ARE MORE THAN 9 RACKS

EQUIPMENT AND INSTRUMENT TAG NUMBERS

11–XXX–222A–3

PROCESS AREA
EQUIPMENT ABBREVIATION/INSTRUMENT FUNCTION
EQUIPMENT NUMBER/INSTRUMENT LOOP NUMBER
MULTIPLE INSTRUMENT IDENTIFIER (IF NECESSARY)
IDENTICAL SKID/TRAIN IDENTIFIER (IF NECESSARY)

DESIGNATIONS FOR ELECTRICAL PANELS OR ENCLOSURES

THE FOLLOWING DESIGNATIONS ARE USED IN THIS ELECTRICAL SCHEMATIC TO IDENTIFY THE LOCATION OF EACH TERMINAL BLOCK

DESIGNATION ON SCHEMATIC	DESCRIPTION	COMPLETE TAG NUMBER
CP–01	MAIN CONTROL PANEL	CP–01
CP–1X	RIO PANEL	CP–1X

NOTE:
1. X=1, 2, 3, 4 FOR THE RESPECTIVE TRAIN PANELS.

TERMINAL BLOCKS DESIGNATIONS

TB–VAC(x)	UNGROUNDED AC POWER
TB–N(x)	GROUNDED AC POWER
TB–MCR(x)	MASTER CONTROL RELAY WIRING
TB–VDC(x)	UNGROUNDED DC CONTROL POWER
TB–DCCOM(x)	GROUNDED DC CONTROL POWER
TB–DI(x)	DISCRETE INPUT SIGNAL WIRING
TB–DO(x)	DISCRETE OUTPUT SIGNAL WIRING
TB–AI(x)	ANALOG INPUT SIGNAL WIRING
TB–AO(x)	ANALOG OUTPUT SIGNAL WIRING
TB–INT(x)	OTHER INTERNAL WIRING
TB–FLD(x)	OTHER FIELD WIRING

(x) DENOTES SUB–GROUPS

EQUIPMENT WIRING AND RACEWAYS

- USE LIQUID–TIGHT FLEXIBLE PVC CONDUIT WITH LISTED FITTINGS.
- CONDUCTOR AMPACITY IS FOR A MAXIMUM AMBIENT TEMPERATURE OF 40°C (104°F).

NOISELESS GROUND FOR INSTRUMENTATION

- A CONTROL PANEL MAY INCLUDE A SEPARATE NOISELESS GROUND BUS THAT PROVIDES A COMMON GROUND REFERENCE POINT FOR INSTRUMENTATION CIRCUITS AND SHIELDS. WHERE THE NOISELESS GROUND BUS IS INSTALLED FROM THE PANEL ON WHICH IS MOUNTED, THERE IS A BONDING JUMPER FROM THIS GROUND BUS TO A POINT ON THE PANEL NEAR THE GROUND BUS.

  IF POSSIBLE, THE NOISELESS GROUND BUS SHOULD BE CONNECTED TO AN EXTERNAL GROUND THAT IS FREE OF ELECTRICAL NOISE. TO PROVIDE LOW IMPEDANCE, THIS GROUND CONNECTION SHOULD USE COPPER BRAID, COPPER STRIP, OR A 6 AWG OR LARGER WIRE. IF THERE IS AN EXTERNAL GROUND CONNECTION, THE WIRE FROM THE GROUND BUS TO THE PANEL MUST BE REMOVED (THE JUMPER MAY BE LABELED "REMOVE THIS WIRE WHEN USING AN ISOLATED GROUND SYSTEM").

FIELD INTERCONNECTING WIRING

- FIELD WIRING MATERIALS AND INSTALLATION LABOR ARE NOT PROVIDED BY SUEZ.
- ALL FIELD CONNECTIONS TO FIELD WIRING TERMINALS IN ENCLOSURES SHALL MEET ANY MARKED REQUIREMENTS FOR WIRE TYPE, TEMPERATURE RATING AND TIGHTENING TORQUE. TYPICALLY STRANDED COPPER CONDUCTORS ARE REQUIRED. TYPICALLY CONDUCTOR AMPACITIES MUST BE CALCULATED AT 60°C FOR TERMINALS RATED FOR LESS THAN 100 AMPS OR AT 75°C FOR TERMINALS RATED FOR 100 AMPS OR MORE.
- THE SUEZ DESIGN IN THIS DRAWING SET IS FOR THE INSTALLATION CONDITIONS SPECIFIED FOR THE SUEZ EQUIPMENT. ANY CONDUCTOR SIZE, WIRING MATERIAL OR OTHER DESIGN ELEMENT SPECIFIED IN THIS DRAWING SET IS THE MINIMUM REQUIRED BY THE SUEZ DESIGN FOR THE SPECIFIED INSTALLATION CONDITIONS. THE INSTALLATION LOCATION MIGHT HAVE UNSPECIFIED PROBLEMATIC CONDITIONS SUCH AS ELECTROMAGNETIC INTERFERENCE, HIGH VOLTAGE DROP IN LONG CABLE RUNS OR SPECIAL ENVIRONMENTAL CONDITIONS INCLUDING ULTRAVIOLET LIGHT (UV OR SUNLIGHT), HIGH TEMPERATURE, LOW TEMPERATURE, HIGH VIBRATION, OIL, CORROSIVE SALTS, VAPORS OR FUMES. THE ELECTRICAL EQUIPMENT PRODUCED ACCORDING TO THIS DRAWING SET IS NOT DESIGNED TO BE SUITABLE FOR MANY OF THE POSSIBLE UNSPECIFIED INSTALLATION CONDITIONS.

  THE INSTALLER IS RESPONSIBLE FOR PROVIDING A FIELD ELECTRICAL INSTALLATION THAT IS SUITABLE FOR THE ACTUAL INSTALLATION CONDITIONS. THIS RESPONSIBILITY INCLUDES LOCAL CODE REQUIREMENT COMPLIANCE AND DAMAGE REPAIR DUE TO SIGNIFICANT DETERIORATION (AT LEAST FOR THE SUEZ WARRANTY PERIOD) OR INADEQUATE PROTECTION FROM PHYSICAL DAMAGE. IF UNSPECIFIED INSTALLATION CONDITIONS OR DEFICIENT INSTALLATION WORKMANSHIP REQUIRE MODIFICATION OF THE INSTALLATION OR EQUIPMENT, SUEZ IS NOT RESPONSIBLE FOR THE MODIFICATION COSTS WHICH CAN INCLUDE BUT ARE NOT LIMITED TO LARGER CONDUCTORS, REPLACEMENT WIRING MATERIALS, LABOR, AND LIQUIDATED DAMAGES.

SUEZ WTS CONTROLLED DOCUMENT

REV	DESCRIPTION	ECO	DWN	APPR	APPR	DATE
A	INITIAL RELEASE	-	VM	MS	SKH	26MAY2020

TOLERANCES UNLESS NOTED
DECIMALS: .X - / .XX - / .XXX - ANGLES - FRAC -

CUSTOMER INFORMATION
CITY OF CANTON
WATER POLLUTION
CONTROL PLANT (WPCP)

ELEC-SCHEM
MAIN CONTROL PANEL
LEGEND NOTES

DRAWING NUMBER	REVISION
506357-WTS-EL-T03-0330-DD-001	A

REF.: - DOC. OWNER: -

PROJECT NO.	PART/MATERIAL NO.	SCALE	SIZE	SHEET
506357	-	NONE	D	1 OF 17

LAST SAVED: Thursday, May 28, 2020 2:21:25 PM

FILE LOCATION: C:_ADSKVault\NAM\506357 - CITY OF CANTON\4. Electrical Drawings\506357-MAIN CONTROL PANEL\506357-WTS-EL-T03-0330-DD-001-01.dwg

SWITCHES

SELECTOR SWITCH

SINGLE POLE 2 POSITION SELECTOR

2 POLE 2 POSITION SELECTOR

FLOW (WATER, AIR, ETC.) SWITCH

NORMALLY OPEN (LOW)

NORMALLY CLOSED (HIGH)

TEMPERATURE SWITCH

NORMALLY OPEN (LOW)

NORMALLY CLOSED (HIGH)

LIQUID LEVEL SWITCH

NORMALLY OPEN (LOW)

NORMALLY CLOSED (HIGH)

PRESSURE VACUUM SWITCH

NORMALLY OPEN (LOW)

NORMALLY CLOSED (HIGH)

LIMIT SWITCH

NORMALLY OPEN

NORMALLY CLOSED

PUSH BUTTONS

NORMALLY OPEN SINGLE CIRCUIT

EMERGENCY STOP

NORMALLY CLOSED SINGLE CIRCUIT

MOTORS AND HEATERS

3 PHASE MOTOR

SINGLE PHASE MOTOR

3 PHASE HEATER

SINGLE PHASE HEATER

MOTOR–DRIVEN METERING PUMP

SOLENOID–DRIVEN METERING PUMP

RELAYS

NORMALLY OPEN

COIL

NORMALLY CLOSED

ON DELAY NORMALLY OPEN

ON DELAY NORMALLY CLOSED

OFF DELAY NORMALLY OPEN

OFF DELAY NORMALLY CLOSED

CONNECTIONS

PROTECTIVE EARTH GROUND

SHIELD

NOISELESS GROUND

XXXX FROM 1210

TO 1210 XXXX

CONTINUED CONNECTION FROM 1210 DENOTES PAGE 12 RUNG 10 XXXX DENOTES WIRE NUMBER

CONTINUED CONNECTION TO 1210 DENOTES PAGE 12 RUNG 10 XXXX DENOTES WIRE NUMBER

CROSSING OF CONDUCTORS (NOT CONNECTED)

JUNCTION OF CONDUCTORS

POWER

CONTROL

PLUG AND RECEPTACLE

CIRCUIT BREAK

OTHER COMPONENTS

PUSH TO TEST

HOUR METER

GENERAL PILOT LIGHT

GENERAL SOLENOID

VOLTMETER

RECEPTACLE

SURGE PROTECTIVE DEVICE

AMMETER

DIODE

CAPACITOR

H3 H2 X1 X2

CONTROL CIRCUIT TRANSFORMER

ALARM HORN

RESISTOR

INDUCTOR, REACTOR

CIRCUIT PROTECTORS AND CONTROLLERS

3–POLE DISCONNECT

1–POLE DISCONNECT

3–POLE CIRCUIT BREAKER WITH OVERLOAD TRIP

1–POLE CIRCUIT BREAKER

FUSE

OVERLOAD ELEMENT

3–POLE CIRCUIT BREAKER WITH MAGNETIC TRIP ONLY

MOTOR STARTER

AC TO DC POWER CONVERTER (POWER SUPPLY, RECTIFIER)

AC TO AC POWER CONVERTER (VFD, UPS, ETC)

TERMINAL BLOCKS

CONTROL TERMINAL BLOCK

POWER TERMINAL BLOCK

FUSED TERMINAL BLOCK

FUSED TERMINAL BLOCK WITH BLOWN FUSE INDICATOR

EXTERNAL TERMINAL BLOCK

DISCONNECT / ISOLATION TERMINAL BLOCK

ISOLATED GROUND TERMINAL / BUSBAR

GROUNDED TERMINAL BLOCK

– EXAMPLE:

CP–1 ELECTRICAL PANEL OR ENCLOSURE LOCATION

619A TERMINAL NUMBER (OPTIONAL)

TB1–VAC TERMINAL BLOCK DESIGNATION

DESIGNATIONS AND ABBREVIATIONS

AH	ALARM HORN
AM	AMMETER
AUX	AUXILIARY CONTACT
C	CAPACITOR, CELSIUS
CB	CIRCUIT BREAKER
COM	COMMON
COMM	COMMUNICATION DEVICE
CON	CONTACTOR
CP	CONTROL PANEL
CR	CONTROL RELAY
CRM	MASTER CONTROL RELAY
CT	CURRENT TRANSFORMER
DISC	DISCONNECT SWITCH
DISP	DISPLAY
FS	FLOW SWITCH
FU	FUSE
FV	VALVE (FLOW VALVE)
FY	SOLENOID PILOT VALVE
GFCI	GROUND FAULT CIRCUIT INTERRUPTER
GND	GROUND
HM	HOUR METER
HTR	HEATER
IE	CURRENT SENSING ELEMENT
JB	JUNCTION BOX
LT	LEVEL TRANSMITTER, PILOT LIGHT
LS	LEVEL SWITCH
MCC	MOTOR CONTROL CENTER
MCP	MOTOR CIRCUIT PROTECTOR
MS	MOTOR STARTER
M	MOTOR
NC	NORMALLY CLOSED
NO	NORMALLY OPEN
OL	OVERLOAD RELAY
PB	PUSHBUTTON SWITCH
PBL	ILLUMINATED PUSHBUTTON SWITCH
PDB	POWER DISTRIBUTION BLOCK
PLC	PROGRAMMABLE LOGIC CONTROLLER
PWS	POWER SUPPLY
R	RESISTOR
RECP	RECEPTACLE
RECT	RECTIFIER
SB	SOLENOID BOX
SHLD	CABLE SHIELD
SPD	SURGE PROTECTIVE DEVICE
SS	SELECTOR SWITCH
SSR	SOLID STATE RELAY
T	TRANSFORMER
TB	TERMINAL BLOCK
TR	TIME DELAY RELAY, TIMER
TS	TEMPERATURE SWITCH, THERMOSTAT
UPS	UNINTERRUPTIBLE POWER SUPPLY
VFD	VARIABLE FREQUENCY DRIVE
VM	VOLTMETER
X	INDUCTOR, REACTOR
ZS	POSITION OR LIMIT SWITCH

LIGHT COLOR LEGEND

A	AMBER (YELLOW)
B	BLUE
G	GREEN
R	RED
W	WHITE

WIRE COLOR ABBREVIATIONS

BLK	BLACK
BLU	BLUE
BRN	BROWN
GRN	GREEN
GRY	GRAY
ORN	ORANGE
VIO	VIOLET
RED	RED
WHT	WHITE
YEL	YELLOW

FOR WIRES WITH COLOR STRIPES, THE FIRST ABBREVIATION IS THE BASE COLOR AND SECOND ABBREVIATION IS THE STRIPE COLOR. FOR EXAMPLE, GRN/YEL IS A GREEN WIRE WITH A YELLOW STRIPE.

——————— DENOTES CONTROL PANEL AND EQUIPMENT WIRING

— — — — — DENOTES FIELD INTERCONNECTING WIRING

REV	DESCRIPTION	ECO	DWN	APPR	APPR	DATE
A	INITIAL RELEASE	-	VM	MS	SKH	26MAY2020

TOLERANCES UNLESS NOTED
DECIMALS .X - .XX - .XXX -
ANGLES - FRAC -

CUSTOMER INFORMATION
CITY OF CANTON
WATER POLLUTION
CONTROL PLANT (WPCP)

ELEC-SCHEM

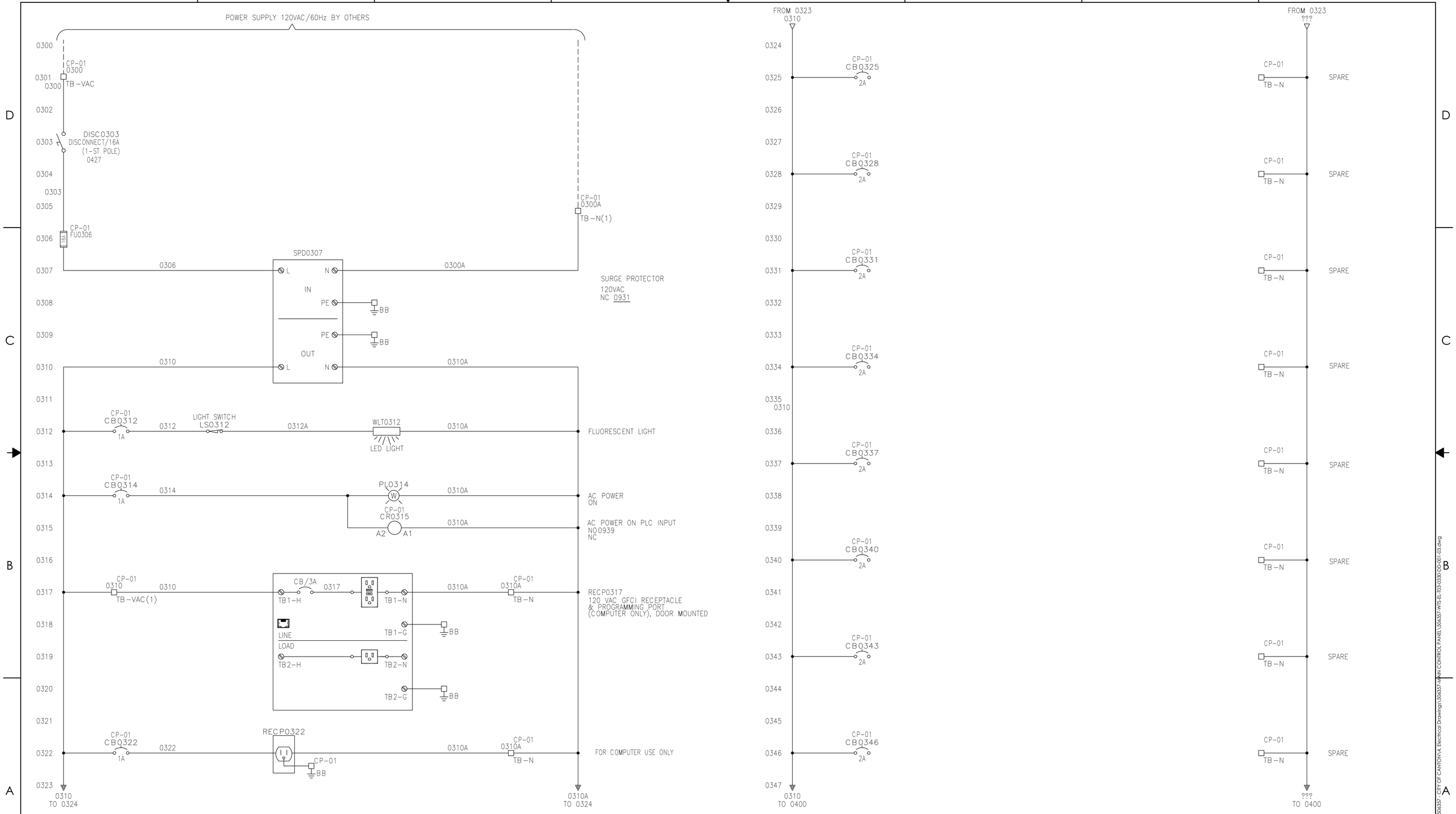
MAIN CONTROL PANEL

SYMBOL LEGEND

DRAWING NUMBER: 506357-WTS-EL-T03-0330-DD-001
REVISION: A
REF.: -
DOC. OWNER: -
PROJECT NO.: 506357
PART/MATERIAL NO.: -
SCALE: NONE
SIZE: D
SHEET: 2 OF 17

FILE LOCATION: C:_ADSKVault\MAIN\506357 - CITY OF CANTON\4 Electrical Drawings\506357-MAIN CONTROL PANEL\506357-WTS-EL-T03-0330-DD-001-02.dwg

LAST SAVED: Thursday, May 28, 2020 2:21:26 PM



REV	DESCRIPTION	ECO	DWN	APPR	APPR	DATE
A	INITIAL RELEASE	-	VM	MS	SKH	26MAY2020

TOLERANCES UNLESS NOTED
DECIMALS: .X -, .XX -, .XXX -
ANGLES -
FRAC -

CUSTOMER INFORMATION
CITY OF CANTON
WATER POLLUTION
CONTROL PLANT (WPCP)

ELEC-SCHEM

MAIN CONTROL PANEL

DRAWING NUMBER: 506357-WTS-EL-T03-0330-DD-001
REVISION: A
REF.: -
DOC. OWNER: -
PROJECT NO.: 506357
PART/MATERIAL NO.: -
SCALE: NONE
SIZE: D
SHEET: 3 OF 17

LAST SAVED: Monday, June 1, 2020 4:15:02 PM

FILE LOCATION: C:_ASKVault\VAM\506357 - CITY OF CANTON\4. Electrical Drawings\506357-MAIN CONTROL PANEL\506357-WTS-EL-T03-0330-DD-001-03.dwg

FROM 0347
0310

FROM 0347
0310A

0400
0401
0402
0310
0403
0404
0405
0406
0407
0408
0409
0410
0411
0412
0413
0414
0415
0416
0417
0418
0419
0420
0421
0422
0423

CP-01
CBQ401
0.5A
23-FIT-301
+ −
PE
BB
CP-01
0310A
TB−N
23-FIT-301
CITRIC ACID
PUMP DISCHARGE
FLOW TRANSMITTER
AI 1106

CP-01
CBQ405
0.5A
23-FIT-101
+ −
PE
BB
CP-01
0310A
TB−N
23-FIT-101
SODIUM HYPOCHLORITE
PUMP DISCHARGE
FLOW TRANSMITTER
AI 1109

CP-01
CBQ409
0.5A
16-FIT-705
+ −
PE
BB
CP-01
0310A
TB−N
16-FIT-705
WAS TO WAS
HOLDING
FLOW TRANSMITTER
AI 1112

CP-01
CBQ413
0.5A
CP-01
0310A
TB−N
SPARE

CP-01
CBQ417
0.5A
CP-01
0310A
TB−N
SPARE

CP-01
CBQ420
1A
CP-01
0310A
TB−N
SPARE

CP-01
CBQ422
1A
CP-01
0310BA
TB−N
SPARE

0310
TO 0424

0310A
TO 0424

0424
0425
0426
0427
0428
0429
0430
0431
0432
0433
0434
0435
0436
0437
0438
0439
0440
0441
0442
0443
0444
0445
0446
0447

FROM 0423
0310

FROM 0423
0310A

0310
CBQ425
10A
0425
UPS0425
L N
INPUT
OUTPUT
L N
0310A
UPS
850 VA
120 VAC, 60HZ

DISC0303
0303
(3-RD POLE)
CP-01
CBQ429
4A
CP-01
0426A
TB−N
SPARE

CP-01
CBQ431
4A
0431
PWS0430
L N
120V
IN
PE
BB
24VDC
OUT
− +
CP-01
0426A
TB−N
POWER SUPPLY 1
HEALTHY

0428

0434

0434A

0434A
TO 0600,0607,0614,0624,0631

0434A
0434A
24VDC TRANSMITTER/
SWITCHES POWER

0434
TO 0500

0434A
TO 0500

REV	DESCRIPTION	ECO	DWN	APPR	APPR	DATE
A	INITIAL RELEASE	-	VM	MS	SKH	26MAY2020

TOLERANCES UNLESS NOTED
DECIMALS ANGLES
.X - -
.XX - FRAC -
.XXX -

CUSTOMER INFORMATION
CITY OF CANTON
WATER POLLUTION
CONTROL PLANT (WPCP)

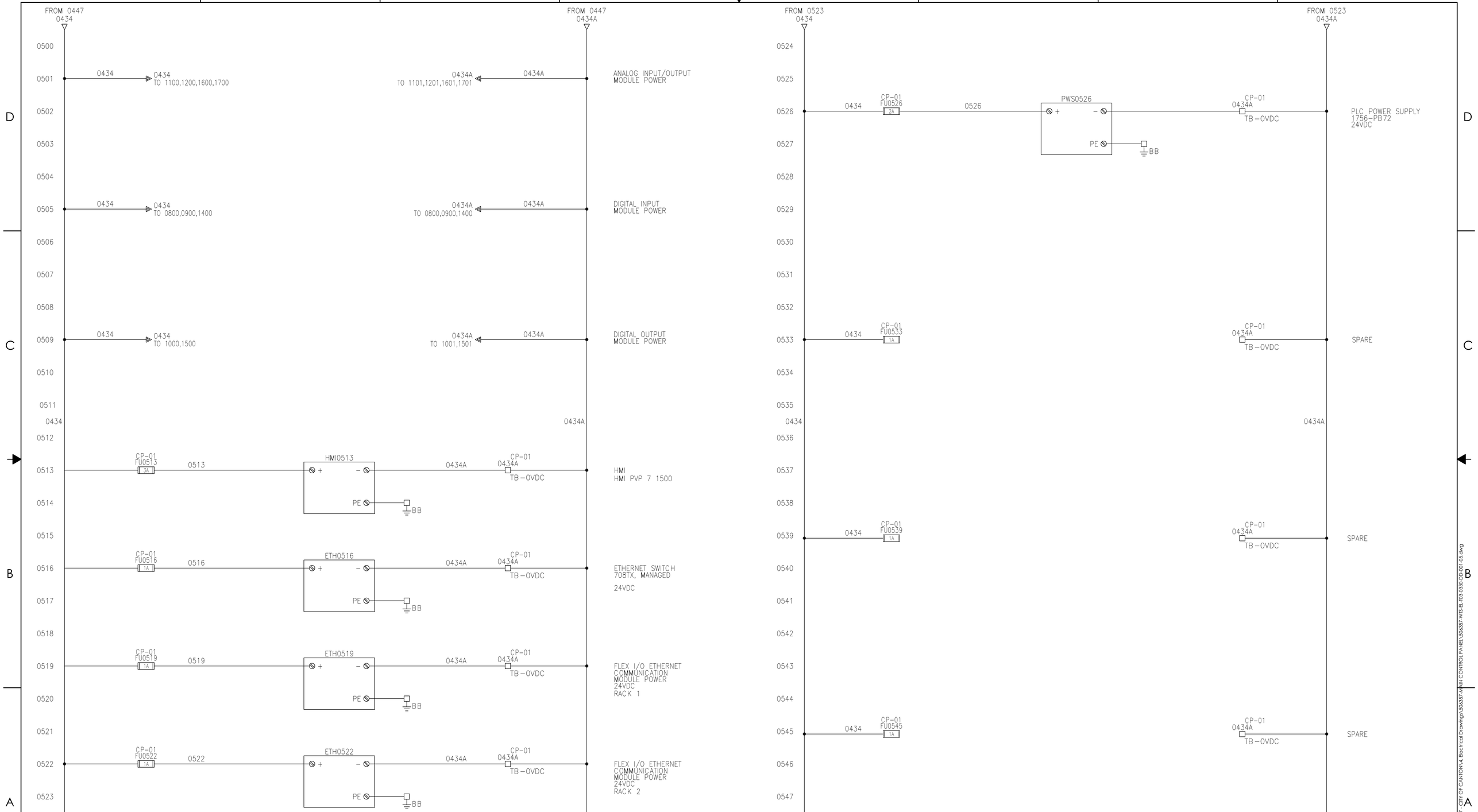
ELEC-SCHEM

MAIN CONTROL PANEL

DRAWING NUMBER: 506357-WTS-EL-T03-0330-DD-001
REVISION: A
REF.: -
DOC. OWNER: -
PROJECT NO.: 506357
PART/MATERIAL NO.: -
SCALE: NONE
SIZE: D
SHEET: 4 OF 17

LAST SAVED: Monday, June 1, 2020 4:14:55 PM

FILE LOCATION: C:_ASKVault\VAM\506357 - CITY OF CANTON\4. Electrical Drawings\506357-MAIN CONTROL PANEL\506357-WTS-EL-T03-0330-DD-001-04.dwg



REV	DESCRIPTION	ECO	DWN	APPR	APPR	DATE
A	INITIAL RELEASE	-	VM	MS	SKH	26MAY2020

TOLERANCES UNLESS NOTED
DECIMALS ANGLES
.X - -
.XX - FRAC
.XXX - -

CUSTOMER INFORMATION
CITY OF CANTON
WATER POLLUTION
CONTROL PLANT (WPCP)

ELEC-SCHEM

MAIN CONTROL PANEL

DRAWING NUMBER: 506357-WTS-EL-T03-0330-DD-001
REVISION: A
REF.: -
DOC. OWNER: -
PROJECT NO.: 506357
PART/MATERIAL NO.: -
SCALE: NONE
SIZE: D
SHEET: 5 OF 17

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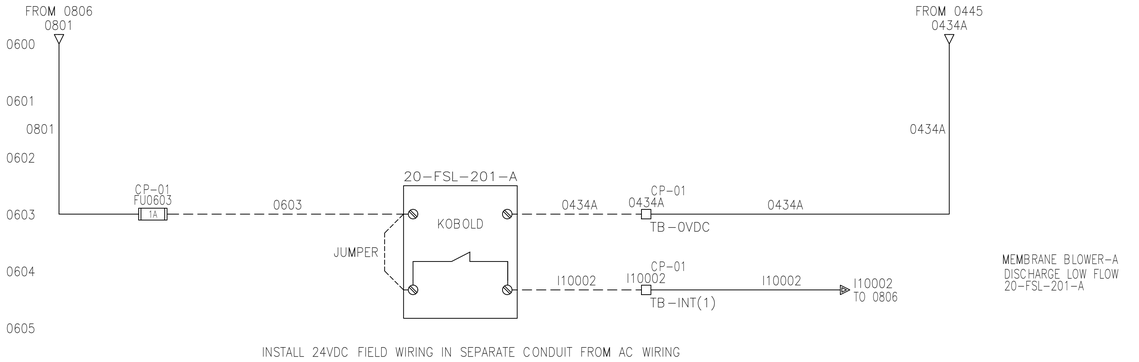

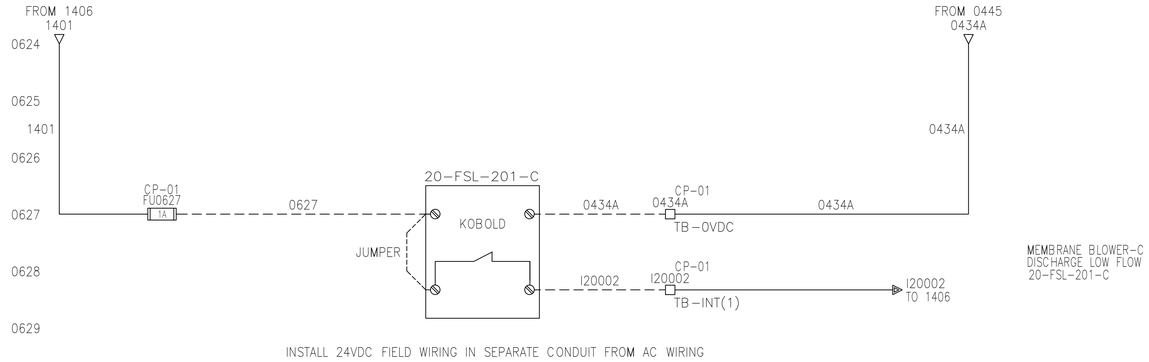

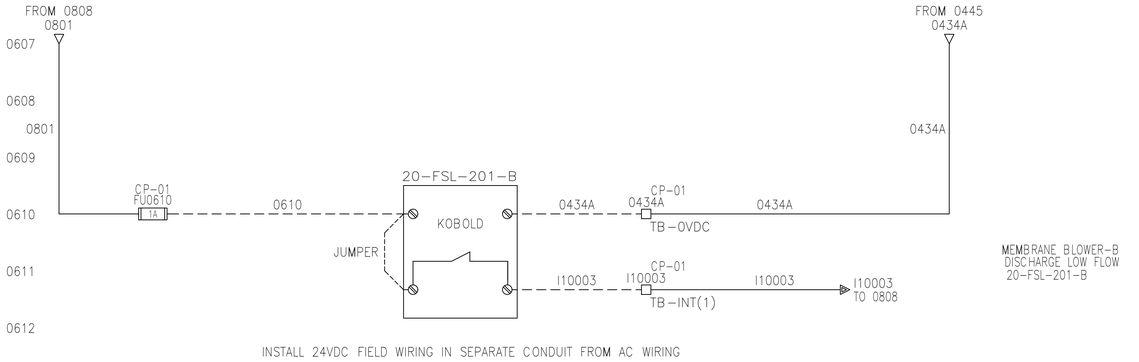

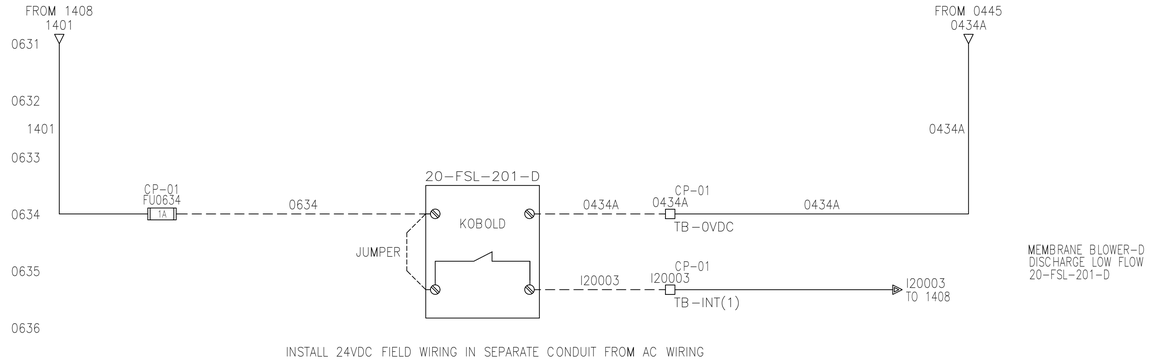

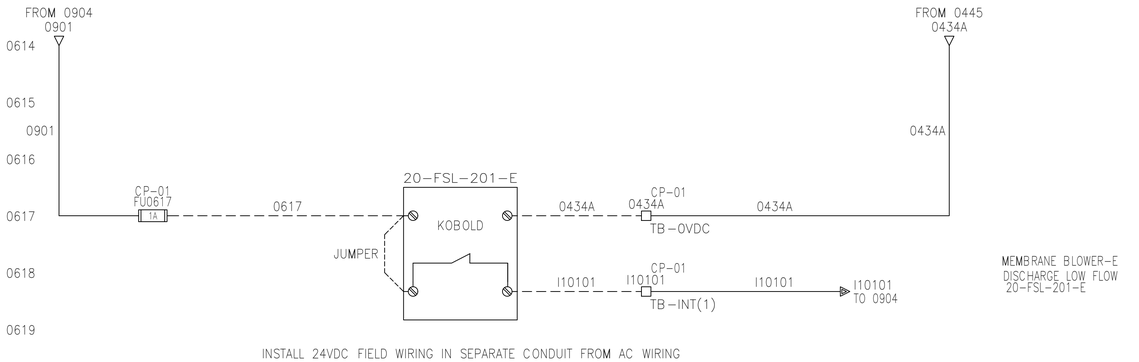

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REV	DESCRIPTION	ECO	DWN	APPR	APPR	DATE
A	INITIAL RELEASE	-	VM	MS	SKH	26MAY2020

TOLERANCES UNLESS NOTED
DECIMALS: .X - ±0.1, .XX - ±0.01, .XXX - ±0.005
ANGLES - ±0.5°
FRAC - ±1/64

CUSTOMER INFORMATION
CITY OF CANTON
WATER POLLUTION
CONTROL PLANT (WPCP)

ELEC-SCHEM

MAIN CONTROL PANEL

DRAWING NUMBER	REVISION
506357-WTS-EL-T03-0330-DD-001	A
REF.: -	DOC. OWNER: -

PROJECT NO.	PART/MATERIAL NO.	SCALE	SIZE	SHEET
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LAST SAVED: Thursday, May 28, 2020 4:37:34 PM

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REV	DESCRIPTION	ECO	DWN	APPR	APPR	DATE
A	INITIAL RELEASE	-	VM	MS	SKH	26MAY2020

TOLERANCES UNLESS NOTED
DECIMALS ANGLES
.X - -
.XX - FRAC
.XXX - -

CUSTOMER INFORMATION
CITY OF CANTON
WATER POLLUTION
CONTROL PLANT (WPCP)

ELEC-SCHEM

MAIN CONTROL PANEL

DRAWING NUMBER: 506357-WTS-EL-T03-0330-DD-001
REVISION: A
REF.: -
DOC. OWNER: -
PROJECT NO.: 506357
PART/MATERIAL NO.: -
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SIZE: D
SHEET: 7 OF 17

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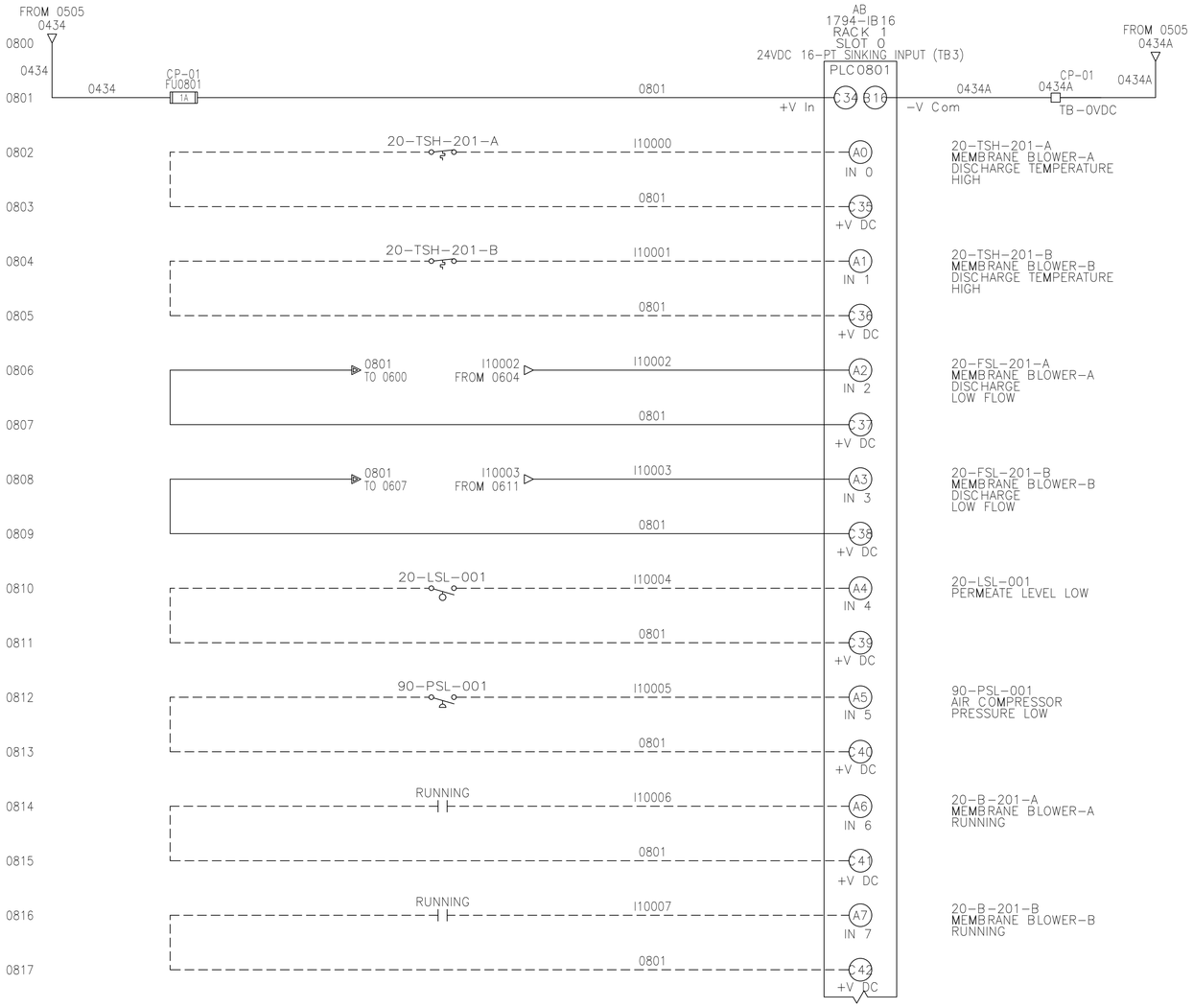

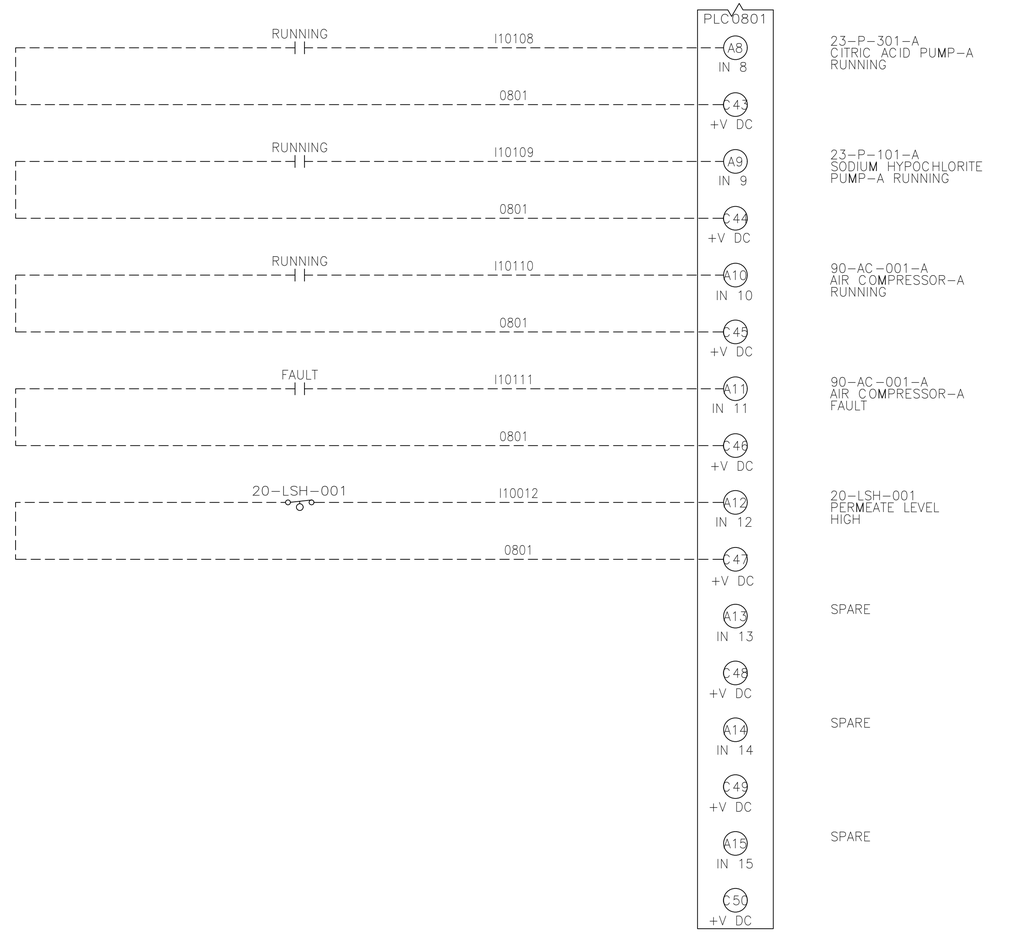

NOTES:

1. PLC COMMON TERMINALS B16 TO B33 ARE INTERNALLY CONNECTED TOGETHER.

REV	DESCRIPTION	ECO	DWN	APPR	APPR	DATE
A	INITIAL RELEASE	-	VM	MS	SKH	26MAY2020

TOLERANCES UNLESS NOTED
DECIMALS: .X -, .XX -, .XXX -
ANGLES: -
FRAC: -

CUSTOMER INFORMATION
CITY OF CANTON
WATER POLLUTION
CONTROL PLANT (WPCP)

ELEC-SCHEM

MAIN CONTROL PANEL

DRAWING NUMBER: 506357-WTS-EL-T03-0330-DD-001
REVISION: A
REF.: -
DOC. OWNER: -
PROJECT NO.: 506357
PART/MATERIAL NO.: -
SCALE: NONE
SIZE: D
SHEET: 8 OF 17

FILE LOCATION: C:_ADSKVault\MAIN\506357 - CITY OF CANTON\4. Electrical Drawings\506357-MAIN CONTROL PANEL\506357-WTS-EL-T03-0330-DD-001-08.dwg

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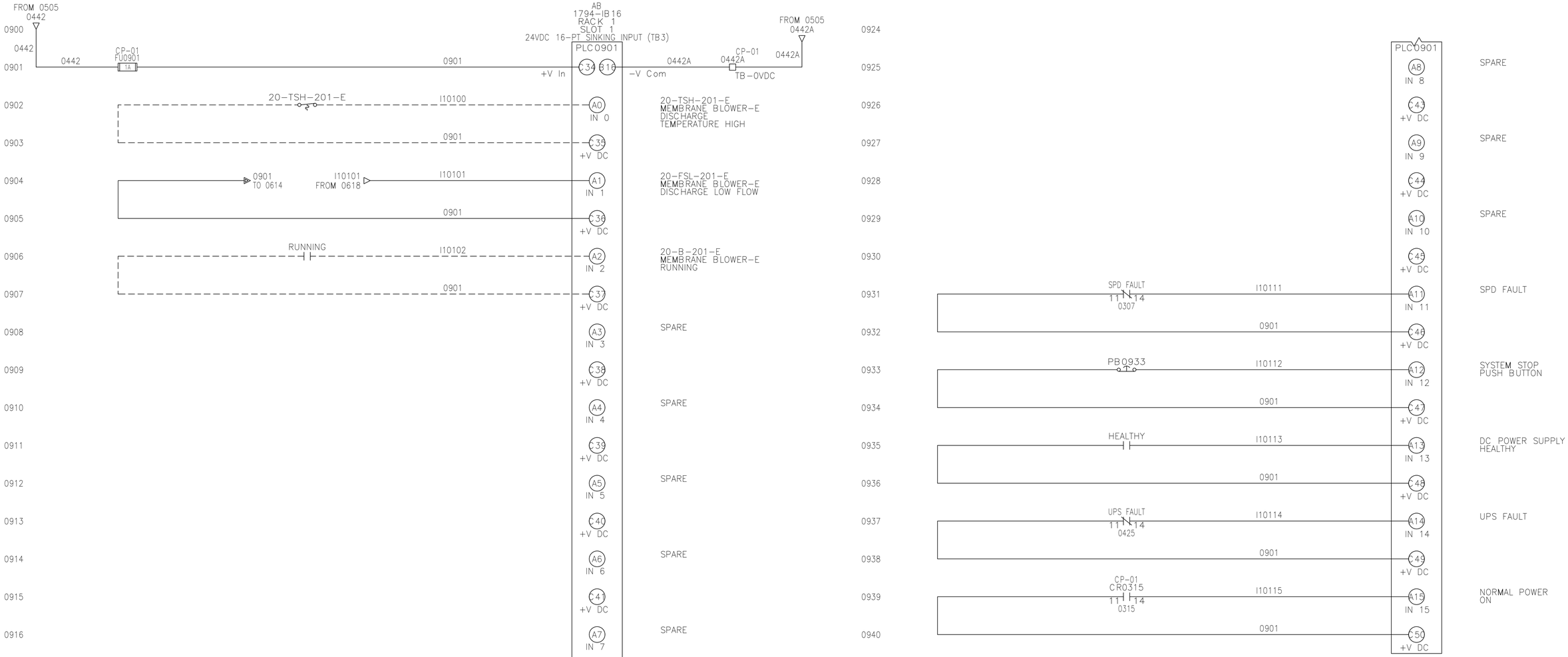

REV	DESCRIPTION	ECO	DWN	APPR	APPR	DATE
A	INITIAL RELEASE	-	VM	MS	SKH	26MAY2020

TOLERANCES UNLESS NOTED
DECIMALS: .X - , .XX - , .XXX - ANGLES: - FRAC: -

CUSTOMER INFORMATION
CITY OF CANTON
WATER POLLUTION
CONTROL PLANT (WPCP)

ELEC-SCHEM

MAIN CONTROL PANEL

DRAWING NUMBER: 506357-WTS-EL-T03-0330-DD-001
REVISION: A
REF.: -
DOC. OWNER: -
PROJECT NO.: 506357
PART/MATERIAL NO.: -
SCALE: NONE
SIZE: D
SHEET: 9 OF 17

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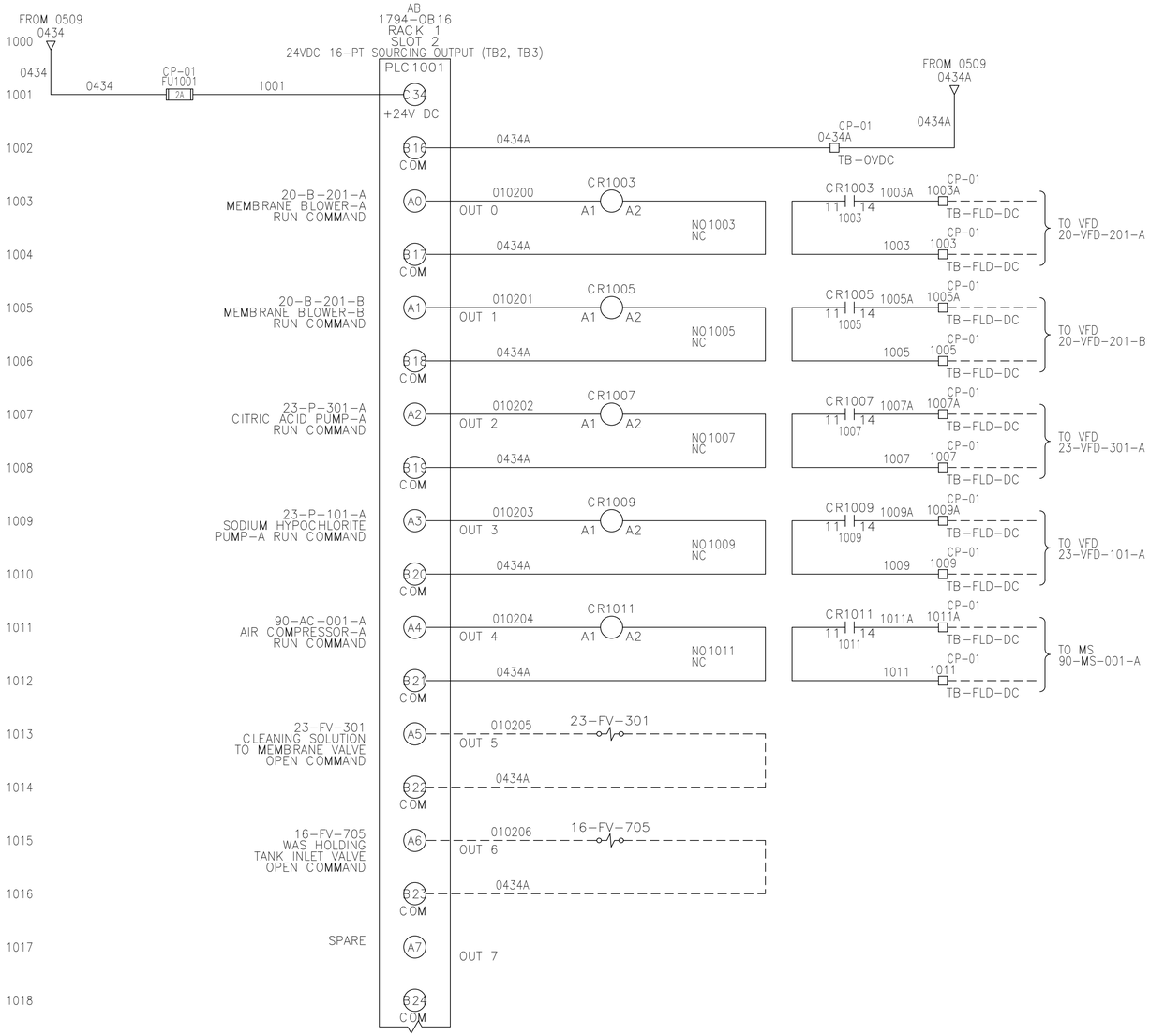

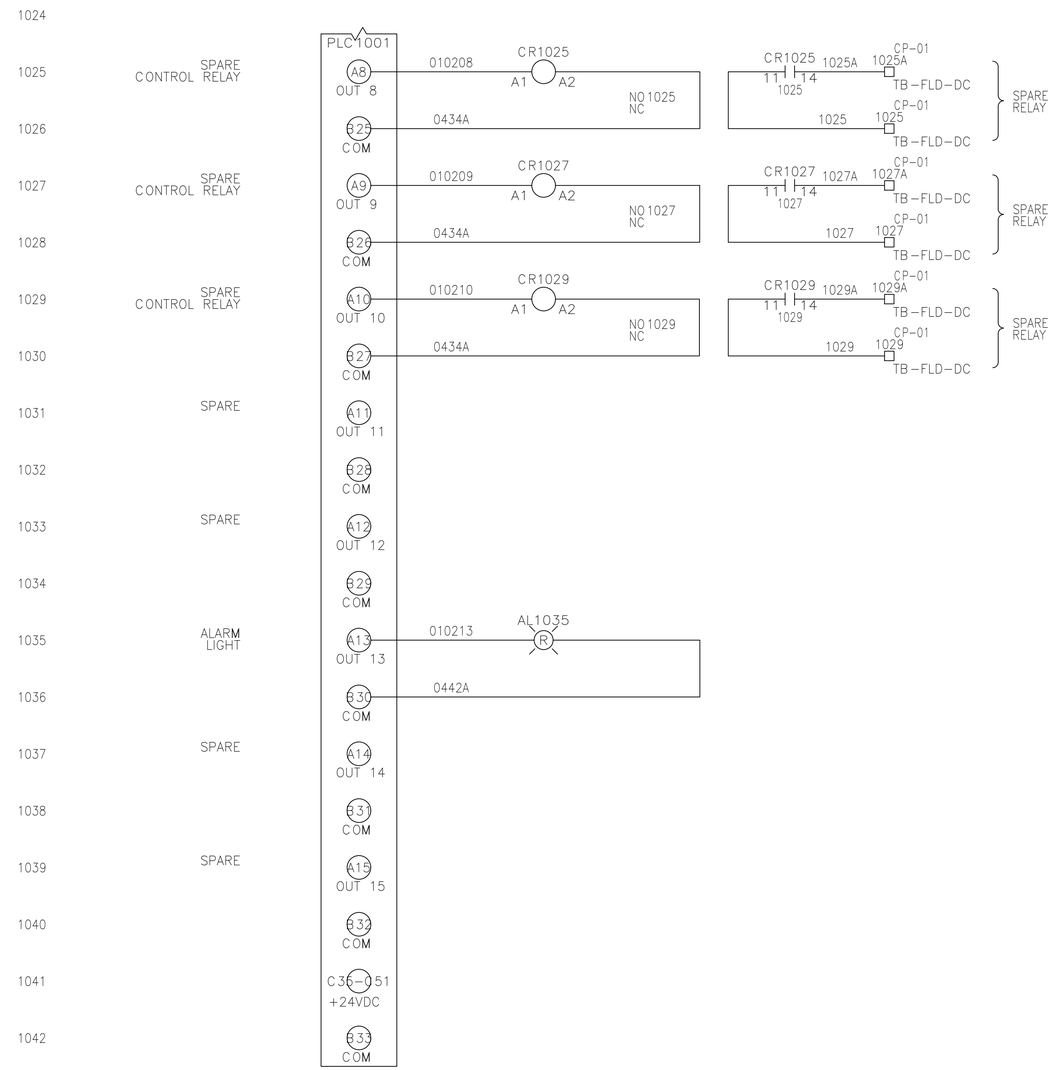

NOTES:

1. PLC COMMON TERMINALS B16 TO B33 ARE INTERNALLY CONNECTED TOGETHER.

REV	DESCRIPTION	ECO	DWN	APPR	APPR	DATE
A	INITIAL RELEASE	-	VM	MS	SKH	26MAY2020

TOLERANCES UNLESS NOTED
DECIMALS: .X - ; .XX - ; .XXX -
ANGLES: -
FRAC: -

CUSTOMER INFORMATION
CITY OF CANTON
WATER POLLUTION
CONTROL PLANT (WPCP)

ELEC-SCHEM

MAIN CONTROL PANEL

DRAWING NUMBER	REVISION
506357-WTS-EL-T03-0330-DD-001	A
REF.: -	DOC. OWNER: -

PROJECT NO.	PART/MATERIAL NO.	SCALE	SIZE	SHEET
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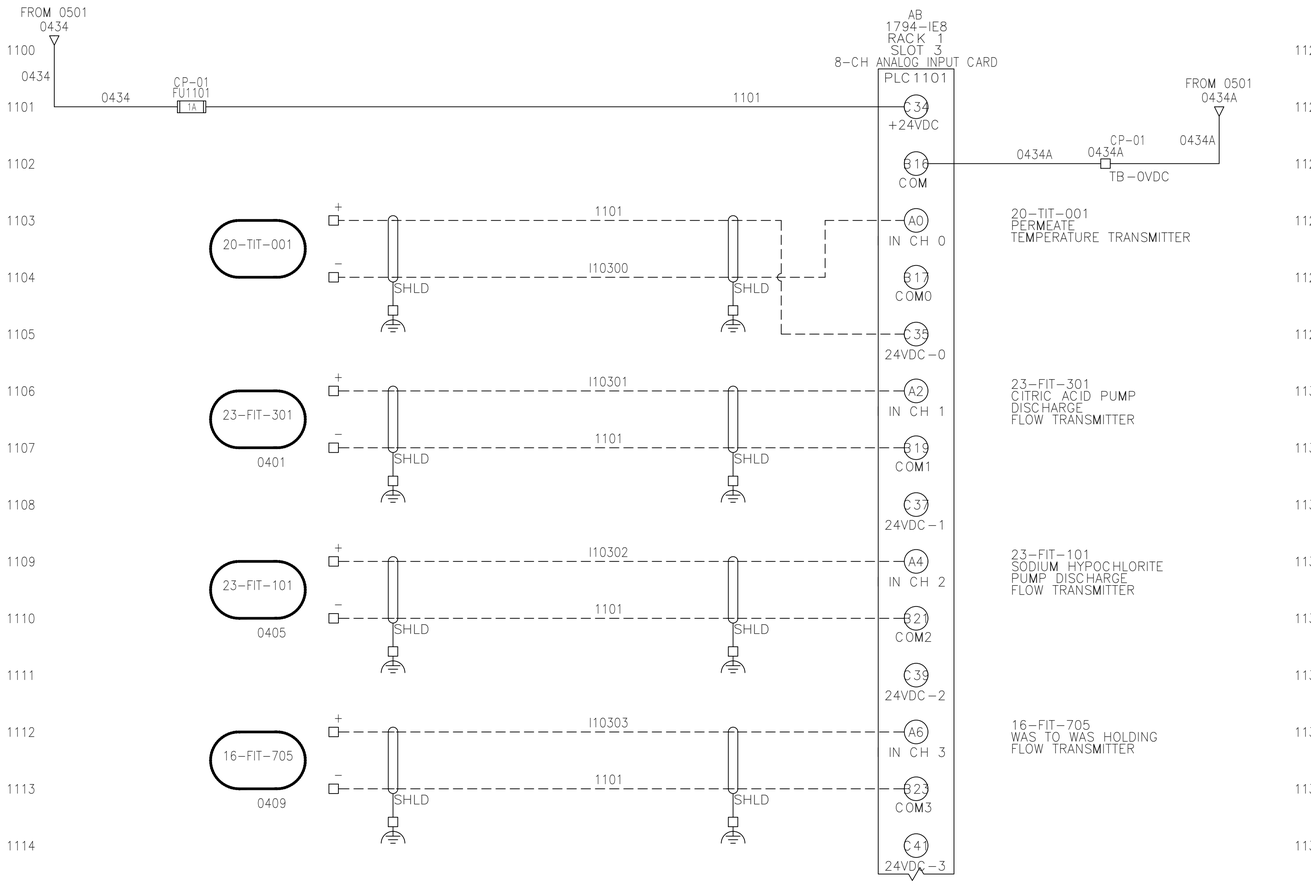

NOTES:

1. ALL ANALOG COM TERMINALS TERMINALS B16 TO B33 ARE INTERNALLY CONNECTED TOGETHER.

REV	DESCRIPTION	ECO	DWN	APPR	APPR	DATE
A	INITIAL RELEASE	-	VM	MS	SKH	26MAY2020

TOLERANCES UNLESS NOTED
DECIMALS ANGLES
.X - -
.XX - FRAC
.XXX - -

CUSTOMER INFORMATION
CITY OF CANTON
WATER POLLUTION
CONTROL PLANT (WPCP)

ELEC-SCHEM

MAIN CONTROL PANEL

DRAWING NUMBER				REVISION
506357-WTS-EL-T03-0330-DD-001				A
REF.: -	DOC. OWNER: -			
PROJECT NO.	PART/MATERIAL NO.	SCALE	SIZE	SHEET
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LAST SAVED: Monday, June 1, 2020 4:09:06 PM

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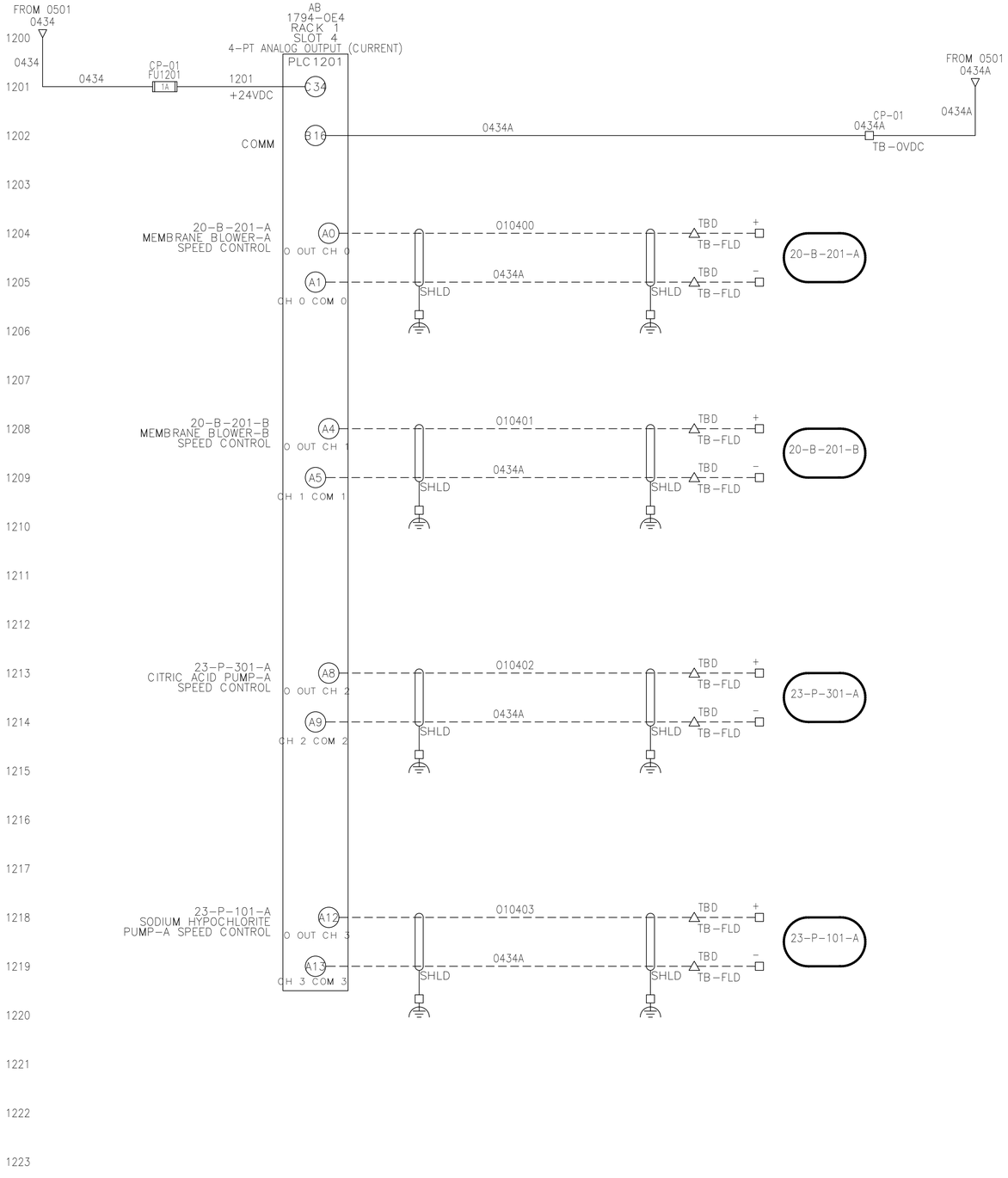

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A	INITIAL RELEASE	-	VM	MS	SKH	26MAY2020

TOLERANCES UNLESS NOTED
DECIMALS: .X - ; .XX - ; .XXX -
ANGLES: - ; FRAC -

CUSTOMER INFORMATION
CITY OF CANTON
WATER POLLUTION
CONTROL PLANT (WPCP)

ELEC-SCHEM

MAIN CONTROL PANEL

DRAWING NUMBER: 506357-WTS-EL-T03-0330-DD-001
REVISION: A
REF.: -
DOC. OWNER: -
PROJECT NO.: 506357
PART/MATERIAL NO.: -
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SPARE PAGE

A	INITIAL RELEASE	-	VM	MS	SKH	26MAY2020
REV	DESCRIPTION	ECO	DWN	APPR	APPR	DATE

TOLERANCES UNLESS NOTED
DECIMALS ANGLES
.X - -
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CUSTOMER INFORMATION
CITY OF CANTON
WATER POLLUTION
CONTROL PLANT (WPCP)

ELEC-SCHEM

MAIN CONTROL PANEL

DRAWING NUMBER				REVISION
506357-WTS-EL-T03-0330-DD-001				A
REF.: -	DOC. OWNER: -			
PROJECT NO.	PART/MATERIAL NO.	SCALE	SIZE	SHEET
506357	-	NONE	D	13 OF 17

LAST SAVED: Thursday, May 28, 2020 2:21:37 PM

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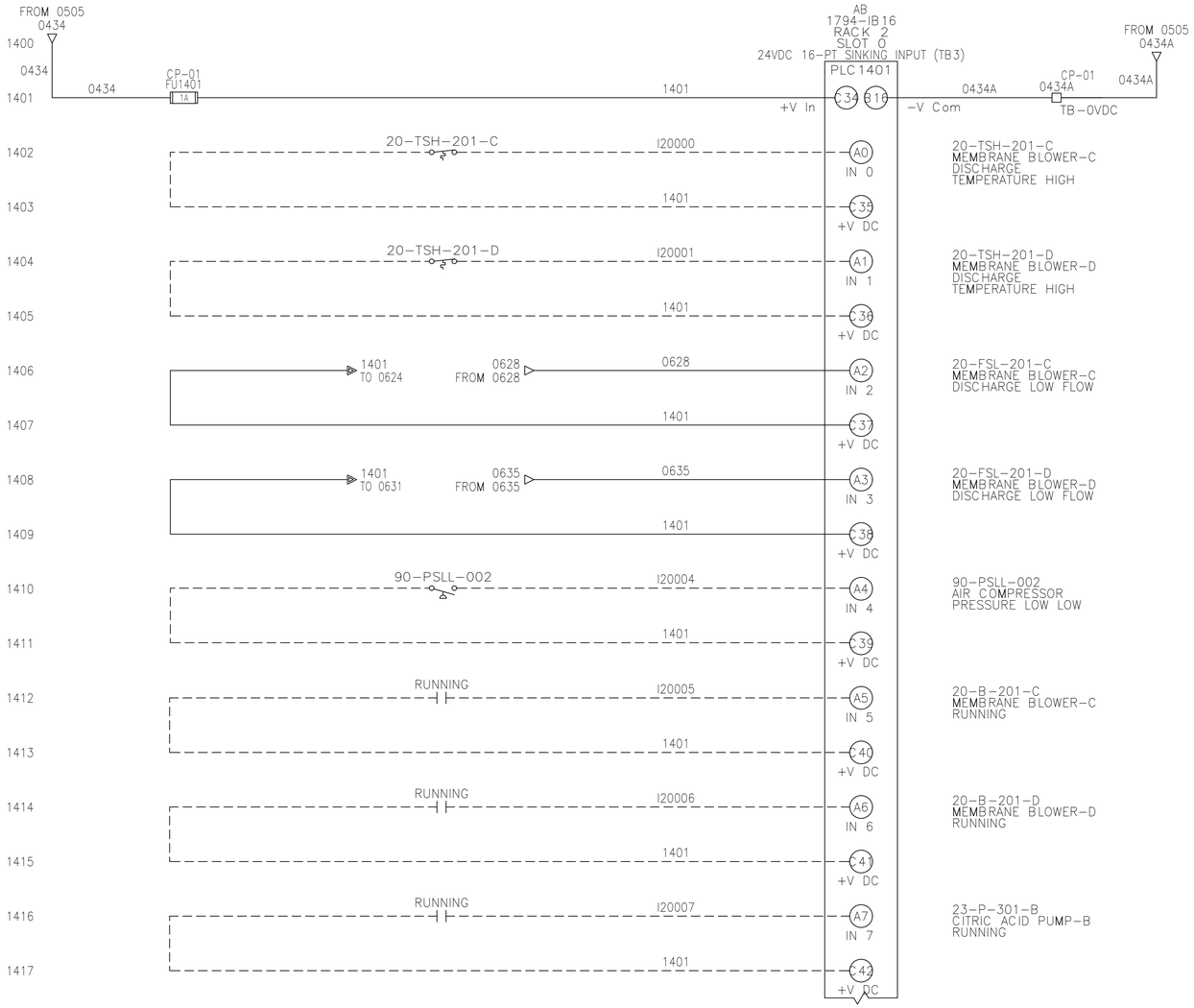

NOTES:

1. PLC COMMON TERMINALS B16 TO B33 ARE INTERNALLY CONNECTED TOGETHER.

REV	DESCRIPTION	ECO	DWN	APPR	APPR	DATE
A	INITIAL RELEASE	-	VM	MS	SKH	26MAY2020

TOLERANCES UNLESS NOTED
DECIMALS ANGLES
.X - -
.XX - FRAC
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CUSTOMER INFORMATION
CITY OF CANTON
WATER POLLUTION
CONTROL PLANT (WPCP)

ELEC-SCHEM

MAIN CONTROL PANEL

DRAWING NUMBER: 506357-WTS-EL-T03-0330-DD-001
REVISION: A
REF.: -
DOC. OWNER: -
PROJECT NO.: 506357
PART/MATERIAL NO.: -
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SIZE: D
SHEET: 14 OF 17

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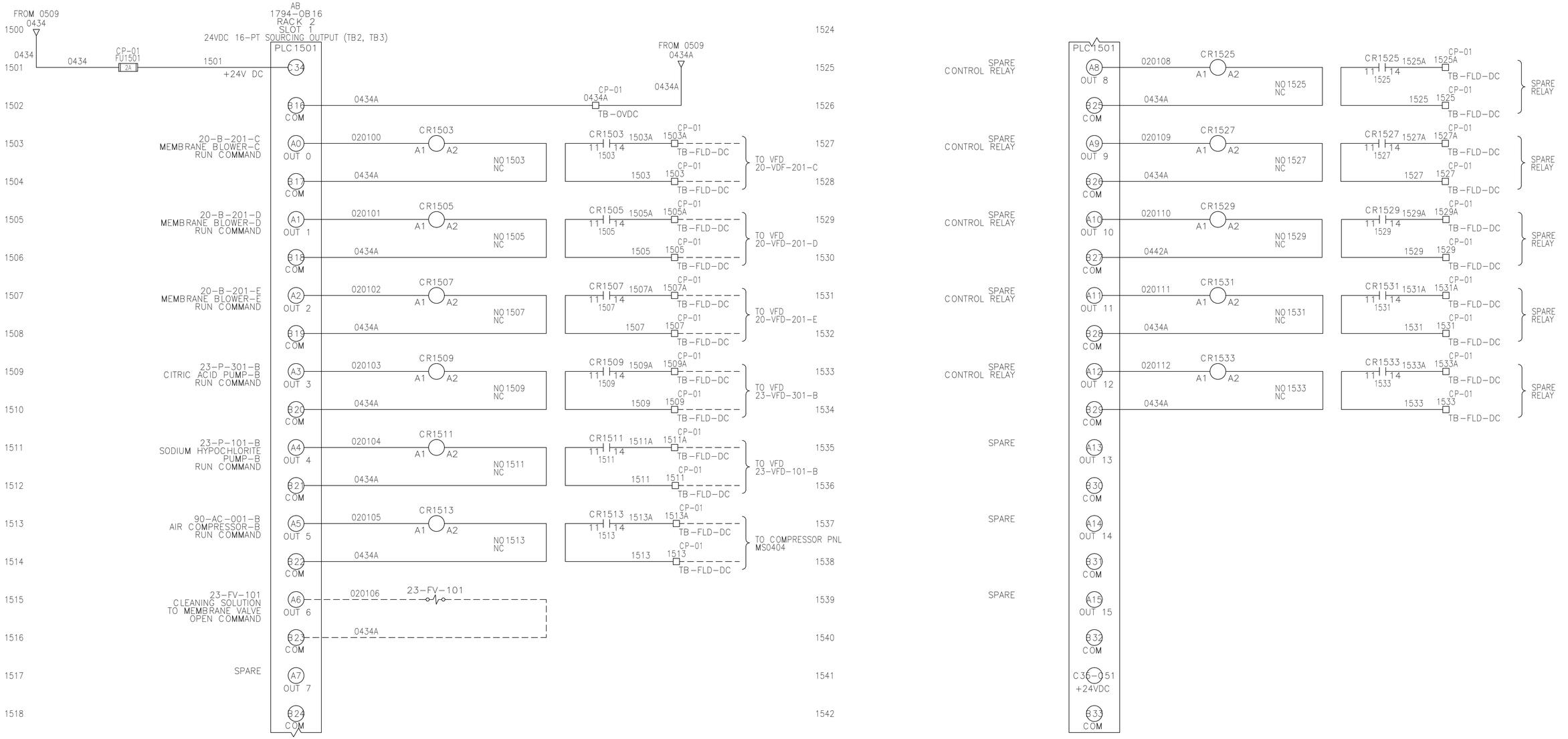

NOTES:

1. PLC COMMON TERMINALS B16 TO B33 ARE INTERNALLY CONNECTED TOGETHER.

REV	DESCRIPTION	ECO	DWN	APPR	APPR	DATE
A	INITIAL RELEASE	-	VM	MS	SKH	26MAY2020

TOLERANCES UNLESS NOTED
DECIMALS ANGLES
.X - -
.XX - FRAC
.XXX - -

CUSTOMER INFORMATION
CITY OF CANTON
WATER POLLUTION
CONTROL PLANT (WPCP)

ELEC-SCHEM

MAIN CONTROL PANEL

DRAWING NUMBER: 506357-WTS-EL-T03-0330-DD-001
REVISION: A
REF.: -
DOC. OWNER: -
PROJECT NO.: 506357
PART/MATERIAL NO.: -
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SIZE: D
SHEET: 15 OF 17

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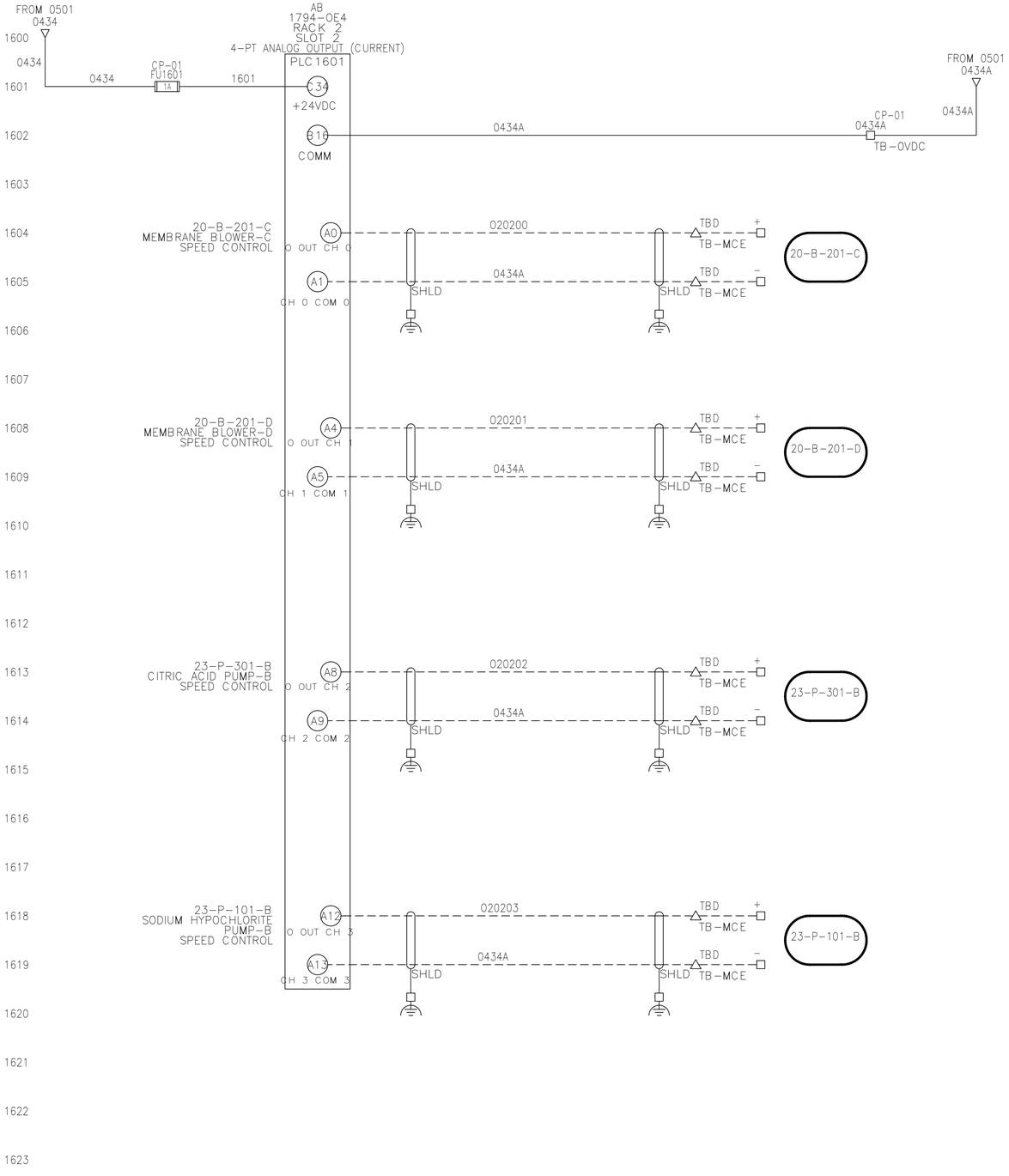

REV	DESCRIPTION	ECO	DWN	APPR	APPR	DATE
A	INITIAL RELEASE	-	VM	MS	SKH	26MAY2020

TOLERANCES UNLESS NOTED
DECIMALS: .X ± .XX ± .XXX ±
ANGLES ±
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CUSTOMER INFORMATION
CITY OF CANTON
WATER POLLUTION
CONTROL PLANT (WPCP)

ELEC-SCHEM

MAIN CONTROL PANEL

DRAWING NUMBER	REVISION
506357-WTS-EL-T03-0330-DD-001	A
REF.: -	DOC. OWNER: -

PROJECT NO.	PART/MATERIAL NO.	SCALE	SIZE	SHEET
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LAST SAVED: Thursday, May 28, 2020 4:36:24 PM

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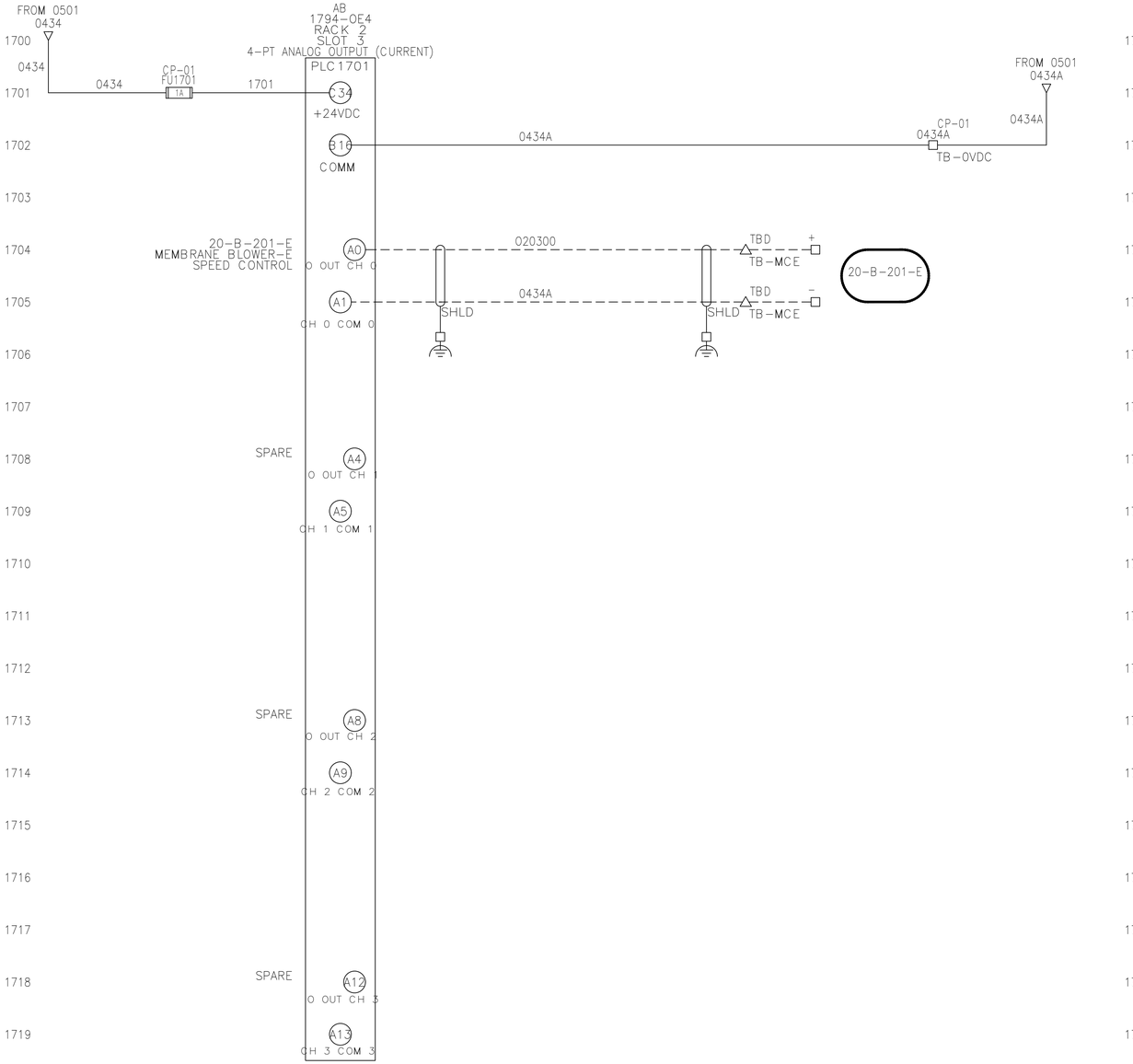

REV	DESCRIPTION	ECO	DWN	APPR	APPR	DATE
A	INITIAL RELEASE	-	VM	MS	SKH	26MAY2020

TOLERANCES UNLESS NOTED
DECIMALS ANGLES
.X - -
.XX - FRAC
.XXX - -

CUSTOMER INFORMATION
CITY OF CANTON
WATER POLLUTION
CONTROL PLANT (WPCP)

DRAWING NUMBER: 506357-WTS-EL-T03-0330-DD-001
REVISION: A
REF.: -
DOC. OWNER: -
PROJECT NO.: 506357
PART/MATERIAL NO.: -
SCALE: NONE
SIZE: D
SHEET: 17 OF 17

LAST SAVED: Thursday, May 28, 2020 4:37:18 PM

FILE LOCATION: C:_ADSKVault\MAIN\506357 - CITY OF CANTON\4 Electrical Drawings\506357-MAIN CONTROL PANEL\506357-WTS-EL-T03-0330-DD-001-17.dwg

PREVAILING CODES AND SPECIFICATIONS

NFPA 70 – NATIONAL ELECTRICAL CODE
UL 508A – INDUSTRIAL CONTROL PANELS
CONTROL PANELS TO BE OR UL LISTED

CONTROL PANEL CONSTRUCTION AND INTERNAL WIRING

- DESIGN, MATERIAL SELECTION, AND WORKMANSHIP SHALL RESULT IN A NEAT APPEARANCE OUTSIDE AND INSIDE, WITH NO WELDS, RIVETS OR BOLT HEADS APPARENT FROM THE FRONT FACE OF THE BOARDS AND ALL EXTERIOR SURFACES TRUE AND SMOOTH.
- ANY INSTRUMENTS, RELAYS, AND OTHER DEVICES MOUNTED ON OR WITHIN THE ENCLOSURE SHALL BE CLEARLY TAGGED WITH ENGRAVED 1/16" THICK LAMINATED PLASTIC MARKERS. MARKERS SHALL BE SECURED TO THE MOUNTING PANEL OR INSIDE OF THE ENCLOSURE WITH DOUBLE FACED TAPE. MARKERS SHALL NOT BE MOUNTED ON THE COMPONENT OR WIRE DUCT.
- ALL WIRES SHALL TERMINATE WITH FORK TYPE INSULATED WIRE COMPRESSION TYPE LUGS. UNLESS THE DEVICE IS EQUIPPED WITH A WIRE CLAMP, PRESSURE PLATE, OR TUBULAR SCREW CLAMP.
- ALL INCOMING AND OUTGOING FIELD CONTROL WIRING SHALL TERMINATE AT TERMINAL BLOCKS.
- NO MORE THAN 2 WIRES AT ANY SINGLE TERMINAL.
- ALL CONDUCTORS SHALL RUN CONTINUOUSLY, SPLICING IS NOT ACCEPTABLE.
- MOUNTING OF RELAY SOCKETS, TERMINAL BLOCKS, FUSED TERMINAL BLOCKS/SWITCHES AND THEIR MOUNTING TRACKS SHALL BE ON ONE PIECE SPACERS OR UNISTRUT. THE SPACERS SHALL BE OF A HEIGHT TO ALLOW WIRE ENTERING THESE DEVICES NOT TO BE MORE THAN 1 INCH BELOW COVERS OF THE PLASTIC WIREWAY ADJACENT TO THESE DEVICES.
- GROUND ALL PANEL METAL TO THE PANEL'S EARTH–GROUND BUS.
- WHERE WIRING CROSSES HINGED SURFACE, PROVIDE A 18" "U" SHAPE HINGE LOOP OF EXTRA FLEXIBLE WIRING

WIRING

CONTROL WIRING SHALL BE #16 AWG STRANDED COPPER, THHN & THWN, 600 VOLT INSULATION., 90 DEG. C, ALL WIRING SHALL BE COLOR CODED AS FOLLOWS:

WIRE COLORS	CONDUCTOR TYPE
GREEN WITH YELLOW STRIPE (OR GREEN)	EQUIPMENT GROUNDING AND BONDING CONDUCTORS
WHITE	GROUNDED AC (L2/NEUTRALS) CURRENT–CARRYING CONDUCTORS
BLACK	UNGROUNDED AC (L1) OR DC POWER CIRCUITS CONDUCTORS
RED	UNGROUNDED AC CONTROL CIRCUITS CONDUCTORS
BLUE	UNGROUNDED DC CONTROL CIRCUITS CONDUCTORS
BLUE WITH WHITE STRIPE	GROUNDED DC (0VDC) CONTROL CIRCUIT CONDUCTORS
YELLOW	UNGROUNDED CONDUCTORS FOR AC AND DC REMOTE CONTROL CIRCUITS
WHITE(+), BLACK(–)	ANALOG TWISTED SHIELD PAIR CABLE

TESTING

PRE–SUEZ INSPECTION

- WHEN ALL WIRING OF ELECTRICAL SYSTEM IS COMPLETE, THE FABRICATOR SHALL TEST EACH CIRCUIT FOR CONTINUITY, SHORT CIRCUIT AND FAULT GROUNDS AND COMPLETE WIRING INSPECTION CHECKLIST 210–001–010.

FACILITIES

- PANEL VENDOR SHALL SUPPLY A WORK/TEST AREA FOR PANEL CHECK–OUTS. FOR WALL MOUNTED ENCLOSURES, THIS AREA SHALL INCLUDE A STAND OR PLATFORM TO MOUNT AND SUPPORT THE PANEL VERTICALLY AT BENCH HEIGHT.
- THE WORK/TEST AREA SHALL BE ISOLATED/SEPARATED FROM THE PANEL ASSEMBLY/MFG. AREA SO TESTING CAN BE DONE WITHOUT INTERRUPTION.
- THE WORK/TEST ARE SHALL BE PROVIDED WITH ADEQUATE LIGHTING COMPLETE WITH TABLE/BENCH FOR INSPECTORS USE TO WORK WITH TEST EQUIPMENT AND DRAWINGS.

SUEZ INSPECTION

- PANEL VENDOR SHALL SUBJECT TO BACK–CHARGES, IF AFTER ARRIVAL OF SUEZ INSPECTOR(S) FOR INSPECTION, IS DETERMINED THAT PANEL VENDOR HAS NOT PREPARED FOR SUEZ INSPECTION AND OR NOT COMPLETED "PRE–SUEZ INSPECTION" OR PROVIDED ITEMS NOTED UNDER "FACILITIES".
- AFTER VENDOR CIRCUIT TESTING IS COMPLETE, SUEZ WILL PERFORM FUNCTION TESTING OF THE CONTROL PANEL COMPONENTS AS A SYSTEM TO CONFIRM OPERATION AND MAKE CALIBRATION ADJUSTMENT, IF NECESSARY. PANEL VENDOR SHALL PROVIDE TEMPORARY POWER AND/OR INSTRUMENT QUALITY AIR SUPPLY AS REQUIRED BY PANEL DESIGN. PANEL VENDOR SHALL PROVIDE TEMPORARY WIRING INCLUDING BUT NOT LIMITED TO TOGGLE SWITCHES, 120VAC AND/OR 24VDC INDICATING LIGHTS TO FACILITATE THE TESTING. THE PANEL VENDOR WILL ALSO BE RESPONSIBLE FOR CONNECTING VARIOUS WIRE JUMPERS ON THE PANEL FIELD TERMINALS. ALL TEMPORARY TEST WIRING WILL BE REMOVED BY THE VENDOR BEFORE THE PANEL IS SHIPPED.
- PANEL VENDOR TO PROVIDE QUALIFIED QUALITY CONTROL INSPECTOR/TESTER TO SUEZ PERSONNEL WITH FUNCTION TESTING OF THE CONTROL PANEL. PANEL VENDOR'S PERSONNEL MUST BE FAMILAR WITH CONTROL PANEL FABRICATION, WIRING INSTALLATION/CIRCUITRY, AND FULLY UNDERSTAND SUEZ SCHEMATIC WIRING DIAGRAMS. PANEL VENDOR'S PERSONNEL TO BE AVAILABLE TO ASSIST SUEZ INSPECTOR AS NEEDED.

RUNG NUMBERS

USED WHEN A COMMON DRAWING NUMBER IS ASSIGNED FOR SEVERAL SHEETS

- FIRST CHARACTER: SYSTEM
- SECOND AND THIRD CHARACTERS: SHEET NUMBER
- FOURTH AND FIFTH CHARACTERS: RUNG IDENTIFIER

– EXAMPLE: 1 1 2 0 4

SYSTEM (OPTIONAL): 1
SHEET: 12
RUNG: 04

TERMINAL AND WIRE NUMBERS

ALL WIRE SHALL BE TAGGED AT TERMINATIONS WITH WIRE NUMBERS SHOWN ON DRAWINGS WITH ONE PIECE HEAT SHRINK TUBULAR WIRE MARKERS. MARKERS SHALL BE BRADY SLEEVE COMPUTER–PRINTED TYPE B–321 HEAT–SHRINK POLYOLEFIN STOCK NO. HCPS.9–3336W OR APPROVED EQUAL.

USE THE FOLLOWING SCHEME FOR WIRES AND TERMINALS NOT CONNECTED TO PLC I/O

- THE RUNG NUMBER IS USED TO IDENTIFY A WIRE AND IT'S CORRESPONDING TERMINALS
- WHEN THERE IS NO TERMINAL NUMBER SHOWN, THE TERMINAL NUMBER IS THE SAME AS THE WIRE NUMBER
- WHERE THERE IS MORE THEN ONE WIRE ON A RUNG, THE OTHER WIRES ARE IDENTIFIED USING THE RUNG NUMBER FOLLOWED BY A LETTER.
- USE THE FOLLOWING SCHEME FOR WIRES AND TERMINALS CONNECTED TO PLC I/O

- FIRST CHARACTER: I FOR INPUTS, O FOR OUTPUTS
- SECOND * CHARACTER: RACK NUMBER
- THIRD AND FOURTH CHARACTER: SLOT NUMBER
- FIFTH AND SIXTH CHARACTER: POINT NUMBER

– EXAMPLE: I *1 0 3 0 0

TYPE: INPUT
RACK: 1
SLOT: 03
POINT: 00

* = 2 CHARACTERS IF THERE ARE MORE THAN 9 RACKS

EQUIPMENT AND INSTRUMENT TAG NUMBERS

11–XXX–222A–3

- PROCESS AREA
- EQUIPMENT ABBREVIATION/INSTRUMENT FUNCTION
- EQUIPMENT NUMBER/INSTRUMENT LOOP NUMBER
- MULTIPLE INSTRUMENT IDENTIFIER (IF NECESSARY)
- IDENTICAL SKID/TRAIN IDENTIFIER (IF NECESSARY)

DESIGNATIONS FOR ELECTRICAL PANELS OR ENCLOSURES

THE FOLLOWING DESIGNATIONS ARE USED IN THIS ELECTRICAL SCHEMATIC TO IDENTIFY THE LOCATION OF EACH TERMINAL BLOCK

DESIGNATION ON SCHEMATIC	DESCRIPTION	COMPLETE TAG NUMBER
CP–01	MAIN CONTROL PANEL	CP–01
CP–1X	RIO PANEL	CP–1X

NOTE:
1. X=1,2,3,4 FOR THE RESPECTIVE TRAIN PANELS.

TERMINAL BLOCKS DESIGNATIONS

TB–VAC(x)	UNGROUNDED AC POWER
TB–N(x)	GROUNDED AC POWER
TB–MCR(x)	MASTER CONTROL RELAY WIRING
TB–VDC(x)	UNGROUNDED DC CONTROL POWER
TB–DCCOM(x)	GROUNDED DC CONTROL POWER
TB–DI(x)	DISCRETE INPUT SIGNAL WIRING
TB–DO(x)	DISCRETE OUTPUT SIGNAL WIRING
TB–AI(x)	ANALOG INPUT SIGNAL WIRING
TB–AO(x)	ANALOG OUTPUT SIGNAL WIRING
TB–INT(x)	OTHER INTERNAL WIRING
TB–FLD(x)	OTHER FIELD WIRING

(x) DENOTES SUB–GROUPS

EQUIPMENT WIRING AND RACEWAYS

- USE LIQUID–TIGHT FLEXIBLE PVC CONDUIT WITH LISTED FITTINGS.
- CONDUCTOR AMPACITY IS FOR A MAXIMUM AMBIENT TEMPERATURE OF 40°C (104°F).

NOISELESS GROUND FOR INSTRUMENTATION

- A CONTROL PANEL MAY INCLUDE A SEPARATE NOISELESS GROUND BUS THAT PROVIDES A COMMON GROUND REFERENCE POINT FOR INSTRUMENTATION CIRCUITS AND SHIELDS. WHERE THE NOISELESS GROUND BUS IS INSTALLED FROM THE PANEL ON WHICH IS MOUNTED, THERE IS A BONDING JUMPER FROM THIS GROUND BUS TO A POINT ON THE PANEL NEAR THE GROUND BUS.

  IF POSSIBLE, THE NOISELESS GROUND BUS SHOULD BE CONNECTED TO AN EXTERNAL GROUND THAT IS FREE OF ELECTRICAL NOISE. TO PROVIDE LOW IMPEDANCE, THIS GROUND CONNECTION SHOULD USE COPPER BRAID, COPPER STRIP, OR A 6 AWG OR LARGER WIRE. IF THERE IS AN EXTERNAL GROUND CONNECTION, THE WIRE FROM THE GROUND BUS TO THE PANEL MUST BE REMOVED (THE JUMPER MAY BE LABELED "REMOVE THIS WIRE WHEN USING AN ISOLATED GROUND SYSTEM").

FIELD INTERCONNECTING WIRING

- FIELD WIRING MATERIALS AND INSTALLATION LABOR ARE NOT PROVIDED BY SUEZ.
- ALL FIELD CONNECTIONS TO FIELD WIRING TERMINALS IN ENCLOSURES SHALL MEET ANY MARKED REQUIREMENTS FOR WIRE TYPE, TEMPERATURE RATING AND TIGHTENING TORQUE. TYPICALLY STRANDED COPPER CONDUCTORS ARE REQUIRED. TYPICALLY CONDUCTOR AMPACITIES MUST BE CALCULATED AT 60°C FOR TERMINALS RATED FOR LESS THAN 100 AMPS OR AT 75°C FOR TERMINALS RATED FOR 100 AMPS OR MORE.
- THE SUEZ DESIGN IN THIS DRAWING SET IS FOR THE INSTALLATION CONDITIONS SPECIFIED FOR THE SUEZ EQUIPMENT. ANY CONDUCTOR SIZE, WIRING MATERIAL OR OTHER DESIGN ELEMENT SPECIFIED IN THIS DRAWING SET IS THE MINIMUM REQUIRED BY THE SUEZ DESIGN FOR THE SPECIFIED INSTALLATION CONDITIONS. THE INSTALLATION LOCATION MIGHT HAVE UNSPECIFIED PROBLEMATIC CONDITIONS SUCH AS ELECTROMAGNETIC INTERFERENCE, HIGH VOLTAGE DROP IN LONG CABLE RUNS OR SPECIAL ENVIRONMENTAL CONDITIONS INCLUDING ULTRAVIOLET LIGHT (UV OR SUNLIGHT), HIGH TEMPERATURE, LOW TEMPERATURE, HIGH VIBRATION, OIL, CORROSIVE SALTS, VAPORS OR FUMES. THE ELECTRICAL EQUIPMENT PRODUCED ACCORDING TO THIS DRAWING SET IS NOT DESIGNED TO BE SUITABLE FOR MANY OF THE POSSIBLE UNSPECIFIED INSTALLATION CONDITIONS.

  THE INSTALLER IS RESPONSIBLE FOR PROVIDING A FIELD ELECTRICAL INSTALLATION THAT IS SUITABLE FOR THE ACTUAL INSTALLATION CONDITIONS. THIS RESPONSIBILITY INCLUDES LOCAL CODE REQUIREMENT COMPLIANCE AND DAMAGE REPAIR DUE TO SIGNIFICANT DETERIORATION (AT LEAST FOR THE SUEZ WARRANTY PERIOD) OR INADEQUATE PROTECTION FROM PHYSICAL DAMAGE. IF UNSPECIFIED INSTALLATION CONDITIONS OR DEFICIENT INSTALLATION WORKMANSHIP REQUIRE MODIFICATION OF THE INSTALLATION OR EQUIPMENT, SUEZ IS NOT RESPONSIBLE FOR THE MODIFICATION COSTS WHICH CAN INCLUDE BUT ARE NOT LIMITED TO LARGER CONDUCTORS, REPLACEMENT WIRING MATERIALS, LABOR, AND LIQUIDATED DAMAGES.

SUEZ WTS CONTROLLED DOCUMENT

REV	DESCRIPTION	ECO	DWN	APPR	APPR	DATE
A	INITIAL RELEASE	-	VM	MS	SKH	26-MAY-2020

TOLERANCES UNLESS NOTED
DECIMALS: .X - / .XX - / .XXX - ANGLES: - / FRAC: -

CUSTOMER INFORMATION
CITY OF CANTON
WATER POLLUTION
CONTROL PLANT (WPCP)

ELEC-SCHEM
RIO PANEL
LEGEND NOTES

DRAWING NUMBER	REVISION
506357-WTS-EL-T03-0330-DD-002	A

REF.: - DOC. OWNER: -

PROJECT NO.	PART/MATERIAL NO.	SCALE	SIZE	SHEET
506357	-	NONE	D	1 OF 12

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FILE LOCATION: C:_ADSKVault\NAM\506357 - CITY OF CANTON\4. Electrical Drawings\506357-WTS-EL-T03-0330-DD-002-01.dwg

SWITCHES

SELECTOR SWITCH

SINGLE POLE 2 POSITION SELECTOR

2 POLE 2 POSITION SELECTOR

FLOW (WATER, AIR, ETC.) SWITCH

NORMALLY OPEN (LOW)

NORMALLY CLOSED (HIGH)

TEMPERATURE SWITCH

NORMALLY OPEN (LOW)

NORMALLY CLOSED (HIGH)

LIQUID LEVEL SWITCH

NORMALLY OPEN (LOW)

NORMALLY CLOSED (HIGH)

PRESSURE VACUUM SWITCH

NORMALLY OPEN (LOW)

NORMALLY CLOSED (HIGH)

LIMIT SWITCH

NORMALLY OPEN

NORMALLY CLOSED

PUSH BUTTONS

NORMALLY OPEN SINGLE CIRCUIT

EMERGENCY STOP

NORMALLY CLOSED SINGLE CIRCUIT

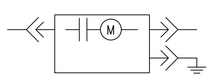
MOTORS AND HEATERS

3 PHASE MOTOR

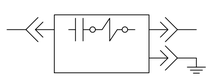
SINGLE PHASE MOTOR

3 PHASE HEATER

SINGLE PHASE HEATER



MOTOR–DRIVEN METERING PUMP



SOLENOID–DRIVEN METERING PUMP

RELAYS

NORMALLY OPEN

COIL

NORMALLY CLOSED

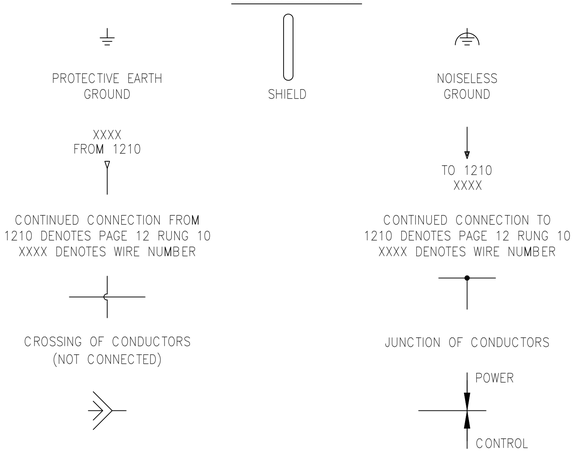
ON DELAY NORMALLY OPEN

ON DELAY NORMALLY CLOSED

OFF DELAY NORMALLY OPEN

OFF DELAY NORMALLY CLOSED

CONNECTIONS



PROTECTIVE EARTH GROUND

SHIELD

NOISELESS GROUND

XXXX FROM 1210

TO 1210 XXXX

CONTINUED CONNECTION FROM 1210 DENOTES PAGE 12 RUNG 10 XXXX DENOTES WIRE NUMBER

CONTINUED CONNECTION TO 1210 DENOTES PAGE 12 RUNG 10 XXXX DENOTES WIRE NUMBER

CROSSING OF CONDUCTORS (NOT CONNECTED)

JUNCTION OF CONDUCTORS

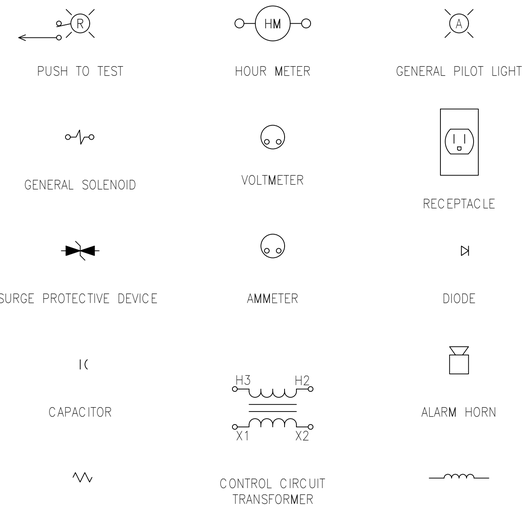
POWER

CONTROL

PLUG AND RECEPTACLE

CIRCUIT BREAK

OTHER COMPONENTS



PUSH TO TEST

HOUR METER

GENERAL PILOT LIGHT

GENERAL SOLENOID

VOLTMETER

RECEPTACLE

SURGE PROTECTIVE DEVICE

AMMETER

DIODE

CAPACITOR

H3 H2 X1 X2

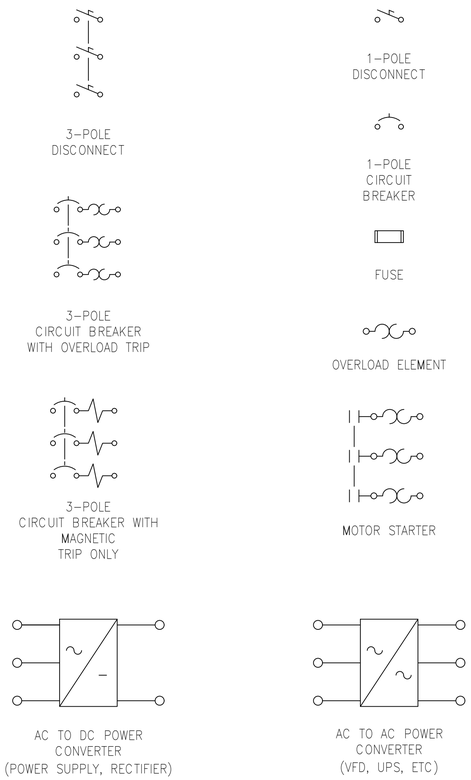
ALARM HORN

CONTROL CIRCUIT TRANSFORMER

RESISTOR

INDUCTOR, REACTOR

CIRCUIT PROTECTORS AND CONTROLLERS



3–POLE DISCONNECT

1–POLE DISCONNECT

1–POLE CIRCUIT BREAKER

3–POLE CIRCUIT BREAKER WITH OVERLOAD TRIP

FUSE

OVERLOAD ELEMENT

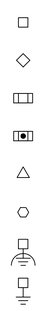
3–POLE CIRCUIT BREAKER WITH MAGNETIC TRIP ONLY

MOTOR STARTER

AC TO DC POWER CONVERTER (POWER SUPPLY, RECTIFIER)

AC TO AC POWER CONVERTER (VFD, UPS, ETC)

TERMINAL BLOCKS



CONTROL TERMINAL BLOCK

POWER TERMINAL BLOCK

FUSED TERMINAL BLOCK

FUSED TERMINAL BLOCK WITH BLOWN FUSE INDICATOR

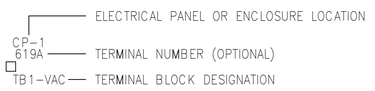
EXTERNAL TERMINAL BLOCK

DISCONNECT / ISOLATION TERMINAL BLOCK

ISOLATED GROUND TERMINAL / BUSBAR

GROUNDED TERMINAL BLOCK

– EXAMPLE:



DESIGNATIONS AND ABBREVIATIONS

AH	ALARM HORN
AM	AMMETER
AUX	AUXILIARY CONTACT
C	CAPACITOR, CELSIUS
CB	CIRCUIT BREAKER
COM	COMMON
COMM	COMMUNICATION DEVICE
CON	CONTACTOR
CP	CONTROL PANEL
CR	CONTROL RELAY
CRM	MASTER CONTROL RELAY
CT	CURRENT TRANSFORMER
DISC	DISCONNECT SWITCH
DISP	DISPLAY
FS	FLOW SWITCH
FU	FUSE
FV	VALVE (FLOW VALVE)
FY	SOLENOID PILOT VALVE
GFCI	GROUND FAULT CIRCUIT INTERRUPTER
GND	GROUND
HM	HOUR METER
HTR	HEATER
IE	CURRENT SENSING ELEMENT
JB	JUNCTION BOX
LT	LEVEL TRANSMITTER, PILOT LIGHT
LS	LEVEL SWITCH
MCC	MOTOR CONTROL CENTER
MCP	MOTOR CIRCUIT PROTECTOR
MS	MOTOR STARTER
M	MOTOR
NC	NORMALLY CLOSED
NO	NORMALLY OPEN
OL	OVERLOAD RELAY
PB	PUSHBUTTON SWITCH
PBL	ILLUMINATED PUSHBUTTON SWITCH
PDB	POWER DISTRIBUTION BLOCK
PLC	PROGRAMMABLE LOGIC CONTROLLER
PWS	POWER SUPPLY
R	RESISTOR
RECP	RECEPTACLE
RECT	RECTIFIER
SB	SOLENOID BOX
SHLD	CABLE SHIELD
SPD	SURGE PROTECTIVE DEVICE
SS	SELECTOR SWITCH
SSR	SOLID STATE RELAY
T	TRANSFORMER
TB	TERMINAL BLOCK
TR	TIME DELAY RELAY, TIMER
TS	TEMPERATURE SWITCH, THERMOSTAT
UPS	UNINTERRUPTIBLE POWER SUPPLY
VFD	VARIABLE FREQUENCY DRIVE
VM	VOLTMETER
X	INDUCTOR, REACTOR
ZS	POSITION OR LIMIT SWITCH

LIGHT COLOR LEGEND

A	AMBER (YELLOW)
B	BLUE
G	GREEN
R	RED
W	WHITE

WIRE COLOR ABBREVIATIONS

BLK	BLACK
BLU	BLUE
BRN	BROWN
GRN	GREEN
GRY	GRAY
ORN	ORANGE
VIO	VIOLET
RED	RED
WHT	WHITE
YEL	YELLOW

FOR WIRES WITH COLOR STRIPES, THE FIRST ABBREVIATION IS THE BASE COLOR AND SECOND ABBREVIATION IS THE STRIPE COLOR. FOR EXAMPLE, GRN/YEL IS A GREEN WIRE WITH A YELLOW STRIPE.

———— DENOTES CONTROL PANEL AND EQUIPMENT WIRING

— — — — — DENOTES FIELD INTERCONNECTING WIRING

REV	DESCRIPTION	ECO	DWN	APPR	APPR	DATE
A	INITIAL RELEASE	-	VM	MS	SKH	26-MAY-2020

TOLERANCES UNLESS NOTED
DECIMALS .X - .XX - .XXX -
ANGLES - FRAC -

CUSTOMER INFORMATION
CITY OF CANTON
WATER POLLUTION
CONTROL PLANT (WPCP)

ELEC-SCHEM

RIO PANEL

SYMBOL LEGEND

DRAWING NUMBER	REVISION
506357-WTS-EL-T03-0330-DD-002	A
REF.: -	DOC. OWNER: -

PROJECT NO.	PART/MATERIAL NO.	SCALE	SIZE	SHEET
506357	-	NONE	D	2 OF 12

LAST SAVED: Monday, June 1, 2020 9:17:03 PM

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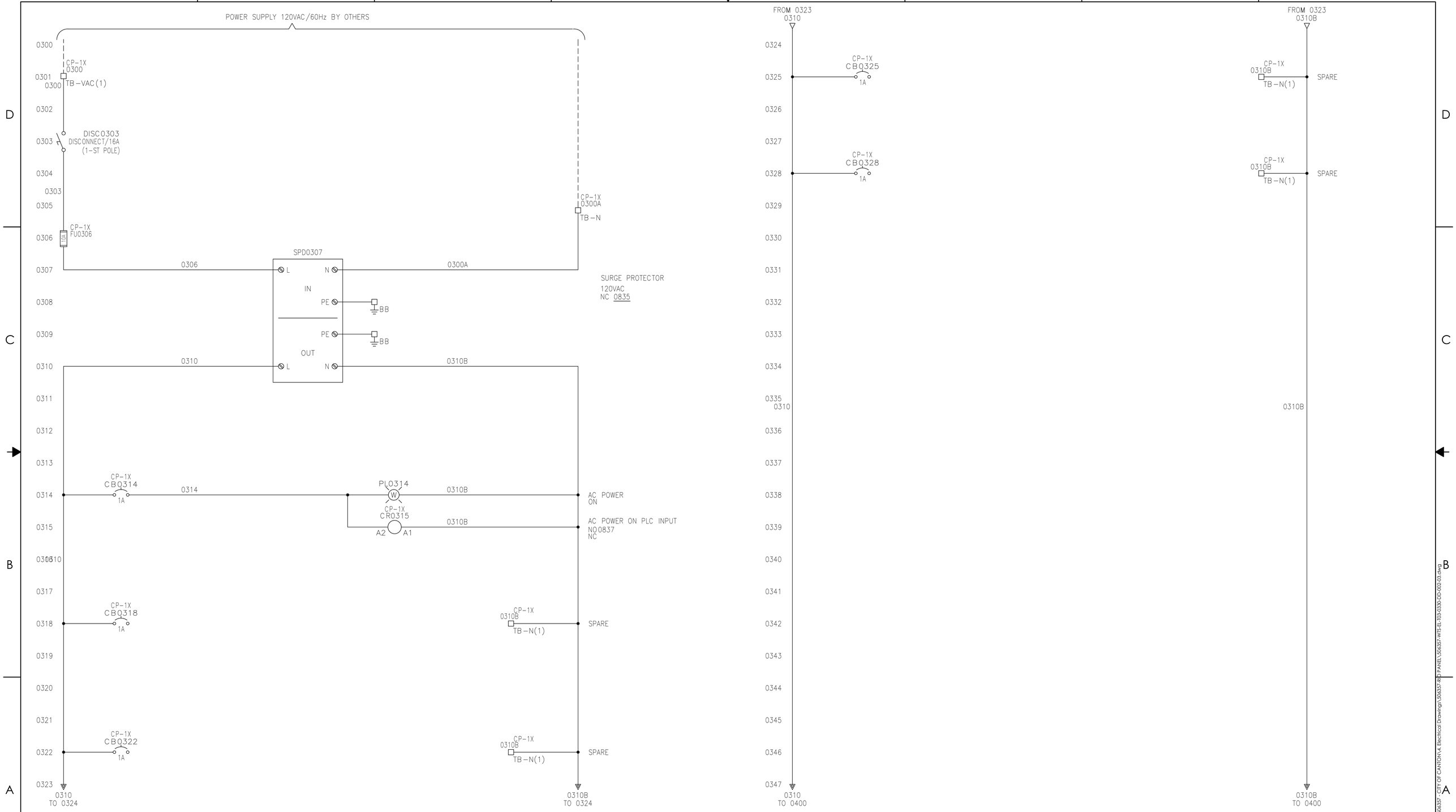

REV	DESCRIPTION	ECO	DWN	APPR	APPR	DATE
A	INITIAL RELEASE	-	VM	MS	SKH	26-MAY-2020

TOLERANCES UNLESS NOTED
DECIMALS: .X - ; .XX - ; .XXX -
ANGLES: -
FRAC: -

CUSTOMER INFORMATION
CITY OF CANTON
WATER POLLUTION
CONTROL PLANT (WPCP)

ELEC-SCHEM

RIO PANEL

DRAWING NUMBER				REVISION
506357-WTS-EL-T03-0330-DD-002				A
REF.: -	DOC. OWNER: -			
PROJECT NO. 506357	PART/MATERIAL NO. -	SCALE NONE	SIZE D	SHEET 3 OF 12

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FILE LOCATION: C:_ASKVault\NAM\506357 - CITY OF CANTON\4. Electrical Drawings\506357-RIO PANEL\506357-WTS-EL-T03-0330-DD-002-03.dwg

FROM 0347 0310

FROM 0347 0310B

FROM 0423 0310

FROM 0423 0310B

0400 0401 0402 0310 0403 0404 0405 0406 0407 0408 0409 0410 0411 0412 0413 0414 0415 0416 0417 0418 0419 0420 0421 0422 0423

CP-1X CB0401 0.5A → 20-FIT-307-X (+, −, PE → BB) → CP-1X 0310B TB-N(1) → 0310B → 20-FIT-307-X PROCESS PUMP FLOW TRANSMITTER AI 1109

CP-1X CB0405 0.5A → 20-AIT-320-X (+, −, PE → BB) → CP-1X 0310B TB-N(1) → 20-AIT-320-X PROCESS PUMP TURBIDITY ANALYZER AI 1112

CP-1X CB0409 0.5A → 20-FIT-507-X (+, −, PE → BB) → CP-1X 0310B TB-N(1) → 20-FIT-507-X RAS/DRAIN PUMP DISCHARGE FLOW TRANSMITTER AI 1126

CP-1X CB0413 1A → CR1025 11 14 1025 → CP-1X TB-FLD → CP-1X 0310B TB-N(1) → SPARE REALY CONTACT

CR1027 11 14 1027 → CP-1X TB-FLD → CP-1X 0310B TB-N(1) → SPARE REALY CONTACT

CP-1X CB0417 1A → CR1009 1009 → CP-1X TB-FLD → 20-FV-209-X (SEE NOTE 1) → CP-1X 0310C TB-N(1) → SLUICE GATE OPEN COMMAND

CR1011 1011 → CP-1X TB-FLD → 20-FV-209-X (SEE NOTE 1) → CP-1X 0310B TB-N(1) → SLUICE GATE COLSE COMMAND

CP-1X CB0421 1A → CP-1X TB-N(1) → SPARE

NOTES:

1. SLUICE GATE MOTORIZED VALVE WRING AND CONTROLS TO BE CONFIRMED ONCE VALVE IS SELECTED.

0424 0425 0426 0427 0428 0429 0430 0431 0432 0433 0434 0435 0436 0437 0438 0439 0440 0441 0442 0443 0444 0445 0446 0447

CB0426 4A → 0426 → PWS0426 L, N → 0310B → POWER SUPPLY 1 HEALTHY

120V IN: PE → BB

24VDC OUT: − , + → 0429 → 0429A

0310B

CP-1X FU0442 1A → 0442 → ETH0442 (+, −, PE → BB) → 0429A → CP-1X 0429A 0429A TB-0VDC → FLEX I/O ETHERNET COMMUNICATION MODULE POWER RACK 3

0310 TO 0424

0310B TO 0424

0429 TO 0500

0429A TO 0500

REV	DESCRIPTION	ECO	DWN	APPR	APPR	DATE
A	INITIAL RELEASE	-	VM	MS	SKH	26-MAY-2020

TOLERANCES UNLESS NOTED
DECIMALS: .X -, .XX -, .XXX -
ANGLES: -
FRAC: -

CUSTOMER INFORMATION
CITY OF CANTON
WATER POLLUTION
CONTROL PLANT (WPCP)

ELEC-SCHEM

RIO PANEL

DRAWING NUMBER: 506357-WTS-EL-T03-0330-DD-002
REVISION: A
REF.: -
DOC. OWNER: -
PROJECT NO.: 506357
PART/MATERIAL NO.: -
SCALE: NONE
SIZE: D
SHEET: 4 OF 12

FILE LOCATION: C:_ADSKVault\MAIN\506357 - CITY OF CANTON\4. Electrical Drawings\506357-RIO PANEL\506357-WTS-EL-T03-0330-DD-002-04.dwg

LAST SAVED: Monday, June 1, 2020 11:01:25 PM

FROM 0447
0429

FROM 0447
0429A

0500				0524
0501	0429 → 0429 TO 1100,1200	0429A TO 1101,1201 ← 0429A	ANALOG INPUT/OUTPUT MODULE POWER	0525
0502				0526
0503				0527
0504				0528
0505	0429 → 0429 TO 0700,0800	0429A TO 0700,0800 ← 0429A	DIGITAL INPUT MODULE POWER	0529
0506				0530
0507				0531
0508				0532
0509	0429 → 0429 TO 0900,1000	0429A TO 0901,1001 ← 0429A	DIGITAL OUTPUT MODULE POWER	0533
0510				0534
0511				0535
0512	0429	0429A		0536
0513	0429 → CP-1X FU0513 1A	CP-1X 0429A TB-0VDC ← 0429A	SPARE	0537
0514				0538
0515				0539
0516	0429 → CP-1X FU0516 1A	CP-1X 0429A TB-0VDC ← 0429A	SPARE	0540
0517				0541
0518				0542
0519	0429 → CP-1X FU0519 1A	CP-1X 0429A TB-0VDC ← 0429A	SPARE	0543
0520				0544
0521				0545
0522	0429 → CP-1X FU0522 1A	CP-1X 0429A TB-0VDC ← 0429A	SPARE	0546
0523				0547

REV	DESCRIPTION	ECO	DWN	APPR	APPR	DATE
A	INITIAL RELEASE	-	VM	MS	SKH	26-MAY-2020

TOLERANCES UNLESS NOTED
DECIMALS: .X - , .XX - , .XXX - | ANGLES - | FRAC -

CUSTOMER INFORMATION
CITY OF CANTON
WATER POLLUTION
CONTROL PLANT (WPCP)

ELEC-SCHEM

RIO PANEL

DRAWING NUMBER: 506357-WTS-EL-T03-0330-DD-002
REVISION: A
REF.: -
DOC. OWNER: -
PROJECT NO.: 506357
PART/MATERIAL NO.: -
SCALE: NONE
SIZE: D
SHEET: 5 OF 12

LAST SAVED: Monday, June 1, 2020 9:18:25 PM

FILE LOCATION: C:_ADKVault\MAIN\506357 - CITY OF CANTON\4 Electrical Drawings\506357-RIO PANEL\506357-WTS-EL-T03-0330-DD-002-05.dwg

0600
0601
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SPARE PAGE

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0647

REV	DESCRIPTION	ECO	DWN	APPR	APPR	DATE
A	INITIAL RELEASE	-	VM	MS	SKH	26-MAY-2020

TOLERANCES UNLESS NOTED
DECIMALS ANGLES
.X - -
.XX - FRAC
.XXX - -

CUSTOMER INFORMATION
CITY OF CANTON
WATER POLLUTION
CONTROL PLANT (WPCP)

ELEC-SCHEM

RIO PANEL

DRAWING NUMBER				REVISION
506357-WTS-EL-T03-0330-DD-002				A
REF.: -	DOC. OWNER: -			
PROJECT NO.	PART/MATERIAL NO.	SCALE	SIZE	SHEET
506357	-	NONE	D	6 OF 12

LAST SAVED: Monday, June 1, 2020 8:15:20 PM

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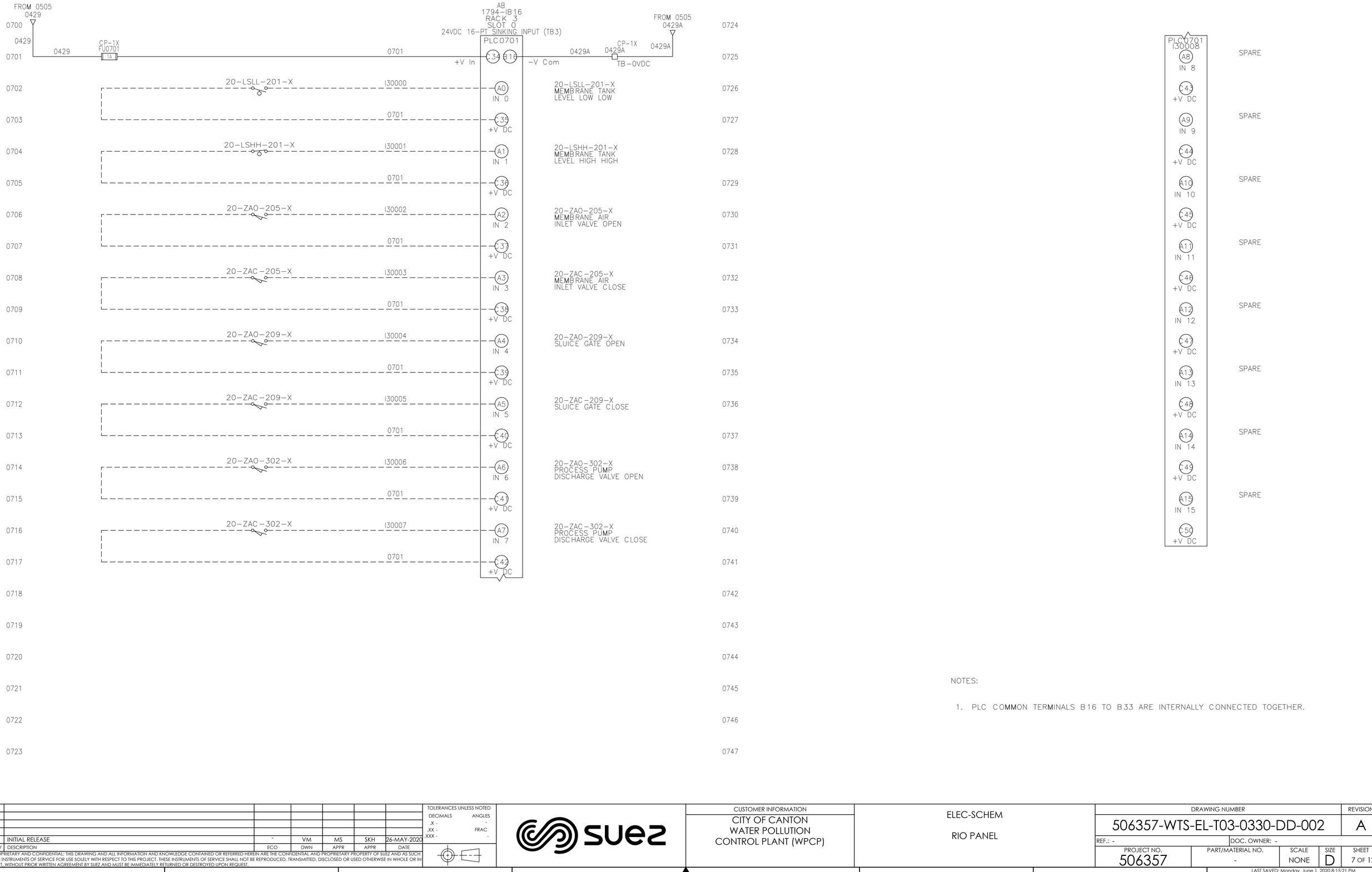

NOTES:

1. PLC COMMON TERMINALS B16 TO B33 ARE INTERNALLY CONNECTED TOGETHER.

REV	DESCRIPTION	ECO	DWN	APPR	APPR	DATE
A	INITIAL RELEASE	-	VM	MS	SKH	26-MAY-2020

TOLERANCES UNLESS NOTED
DECIMALS: .X - ; .XX - ; .XXX -
ANGLES - ; FRAC -

CUSTOMER INFORMATION
CITY OF CANTON
WATER POLLUTION CONTROL PLANT (WPCP)

ELEC-SCHEM

RIO PANEL

DRAWING NUMBER: 506357-WTS-EL-T03-0330-DD-002
REVISION: A
REF.: -
DOC. OWNER: -
PROJECT NO.: 506357
PART/MATERIAL NO.: -
SCALE: NONE
SIZE: D
SHEET: 7 OF 12

LAST SAVED: Monday, June 1, 2020 8:15:21 PM

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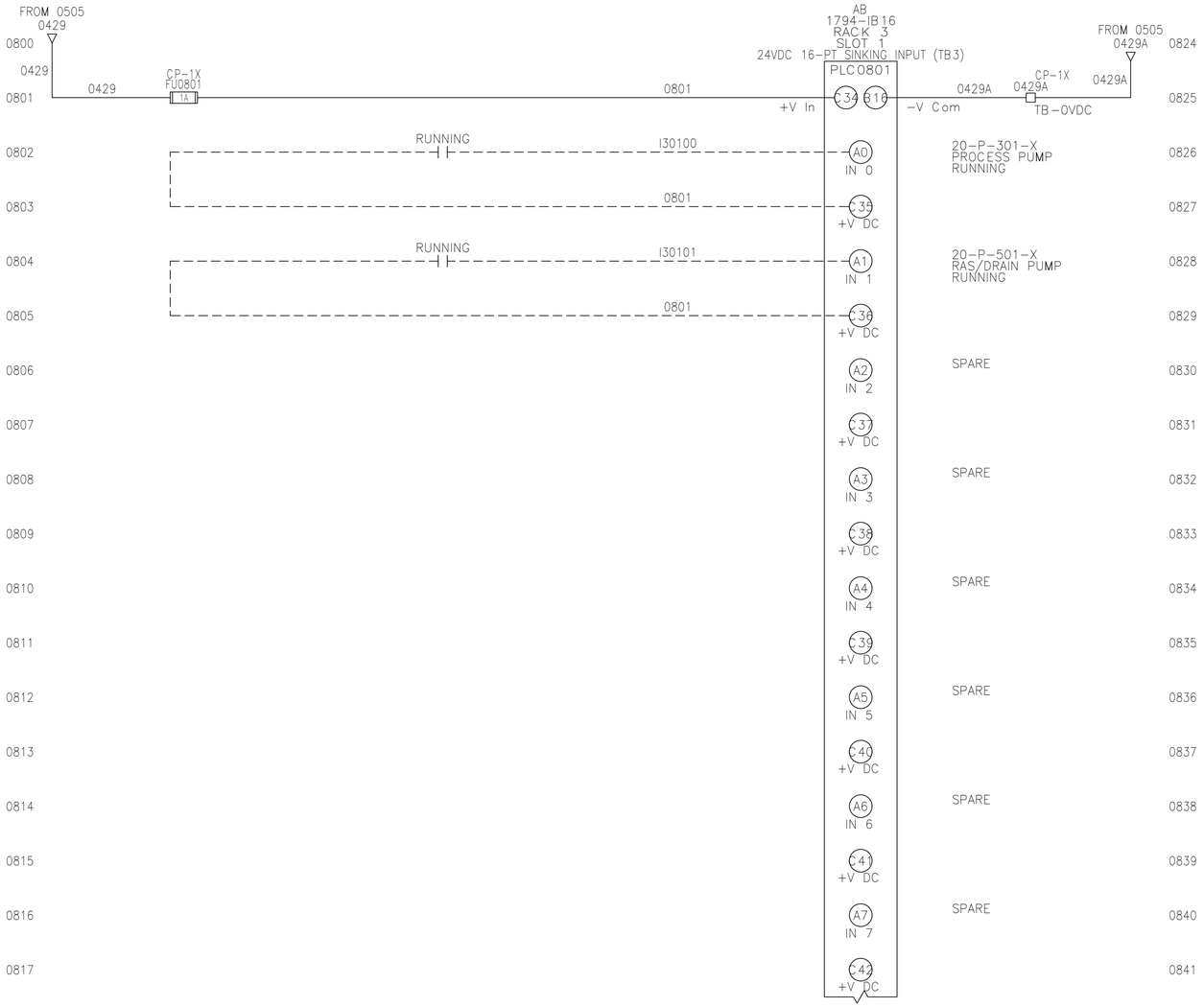

NOTES:

1. PLC COMMON TERMINALS B16 TO B33 ARE INTERNALLY CONNECTED TOGETHER.

REV	DESCRIPTION	ECO	DWN	APPR	APPR	DATE
A	INITIAL RELEASE	-	VM	MS	SKH	26-MAY-2020

TOLERANCES UNLESS NOTED
DECIMALS: .X -, .XX -, .XXX -
ANGLES -
FRAC -

CUSTOMER INFORMATION
CITY OF CANTON
WATER POLLUTION
CONTROL PLANT (WPCP)

ELEC-SCHEM

RIO PANEL

DRAWING NUMBER	REVISION
506357-WTS-EL-T03-0330-DD-002	A

REF.: -
DOC. OWNER: -

PROJECT NO.	PART/MATERIAL NO.	SCALE	SIZE	SHEET
506357	-	NONE	D	8 OF 12

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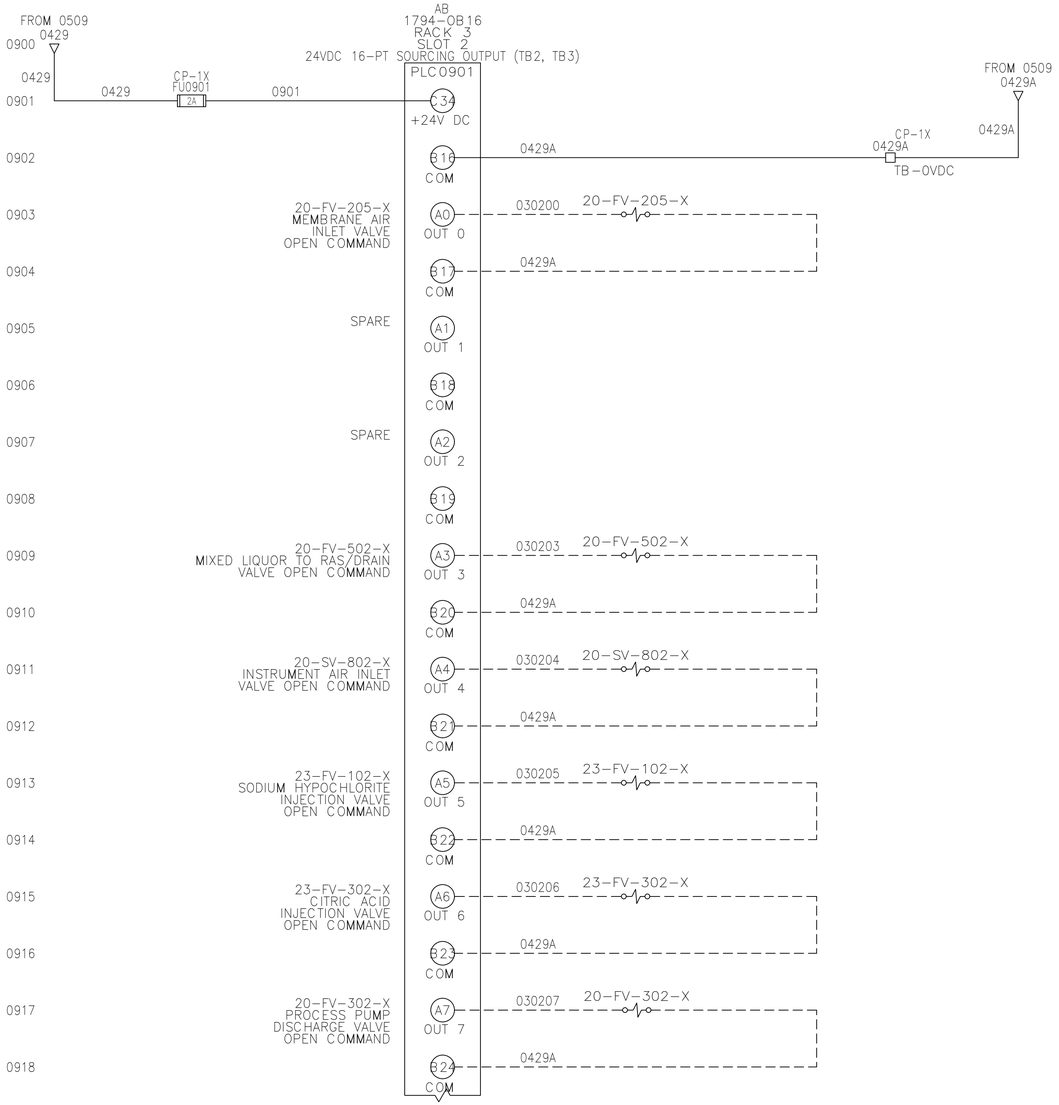

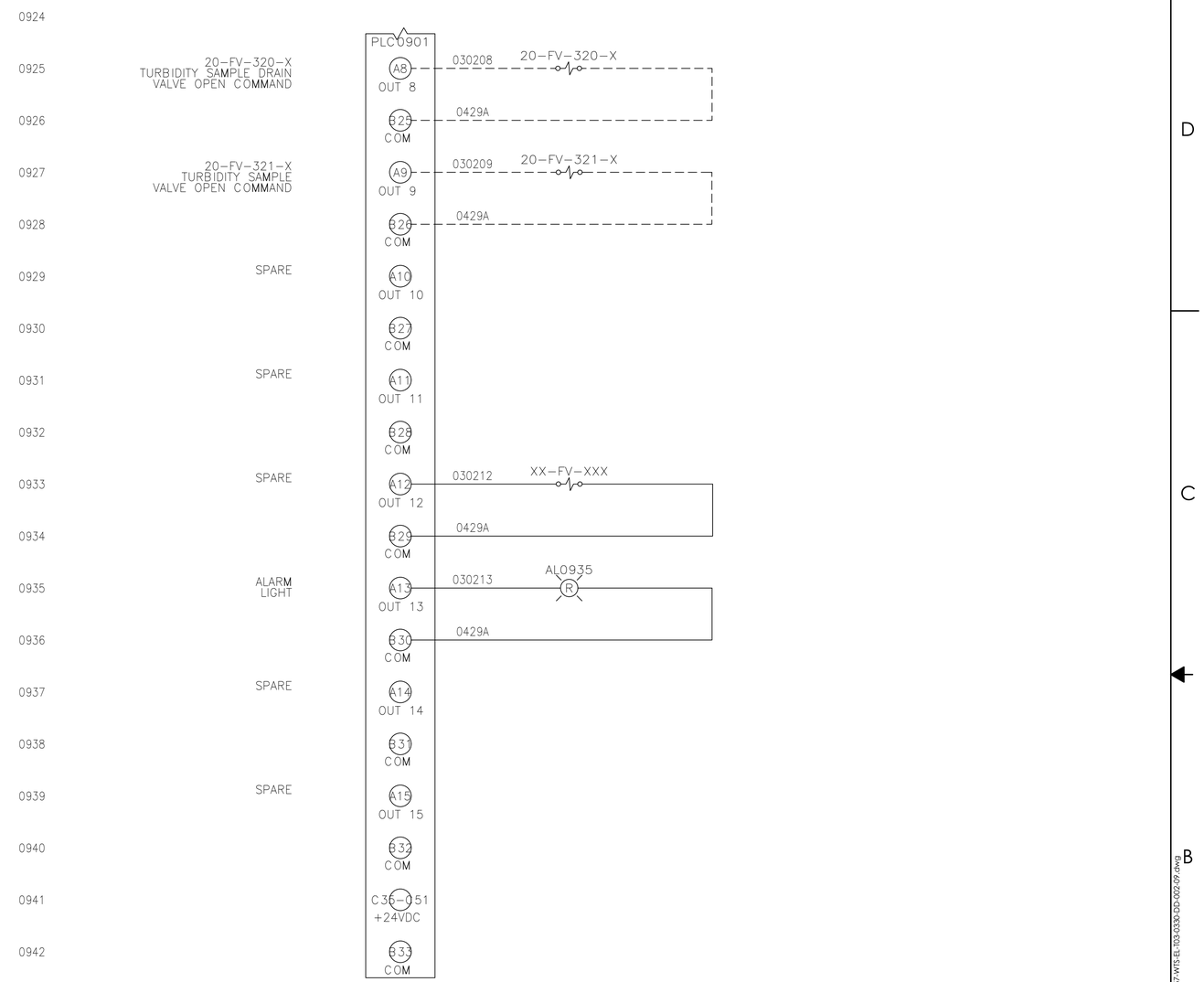

NOTES:

1. PLC COMMON TERMINALS B16 TO B33 ARE INTERNALLY CONNECTED TOGETHER.
2. SLUICE GATE MOTORIZED VALVE WRING AND CONTROLS TO BE CONFIRMED ONCE VALVE IS SELECTED.

REV	DESCRIPTION	ECO	DWN	APPR	APPR	DATE
A	INITIAL RELEASE	-	VM	MS	SKH	26-MAY-2020

TOLERANCES UNLESS NOTED
DECIMALS: .X - ; .XX - ; .XXX -
ANGLES: -
FRAC: -

CUSTOMER INFORMATION
CITY OF CANTON
WATER POLLUTION
CONTROL PLANT (WPCP)

ELEC-SCHEM

RIO PANEL

DRAWING NUMBER: 506357-WTS-EL-T03-0330-DD-002
REVISION: A
REF.: -
DOC. OWNER: -
PROJECT NO.: 506357
PART/MATERIAL NO.: -
SCALE: NONE
SIZE: D
SHEET: 9 OF 12

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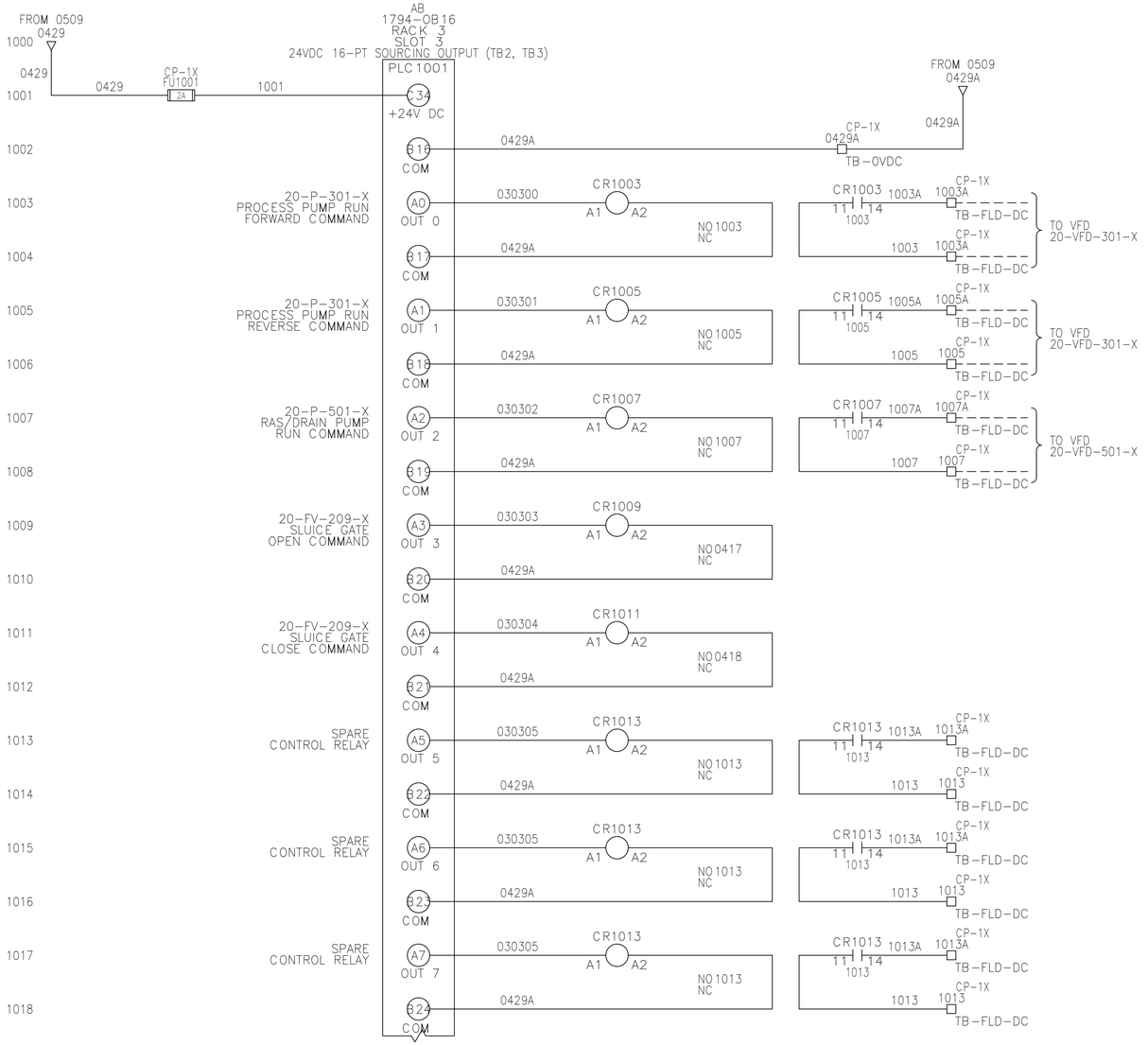

NOTES:

1. PLC COMMON TERMINALS B16 TO B33 ARE INTERNALLY CONNECTED TOGETHER.

REV	DESCRIPTION	ECO	DWN	APPR	APPR	DATE
A	INITIAL RELEASE	-	VM	MS	SKH	26-MAY-2020

TOLERANCES UNLESS NOTED
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CUSTOMER INFORMATION
CITY OF CANTON
WATER POLLUTION
CONTROL PLANT (WPCP)

ELEC-SCHEM

RIO PANEL

DRAWING NUMBER: 506357-WTS-EL-T03-0330-DD-002
REVISION: A
REF.: -
DOC. OWNER: -
PROJECT NO.: 506357
PART/MATERIAL NO.: -
SCALE: NONE
SIZE: D
SHEET: 10 OF 12

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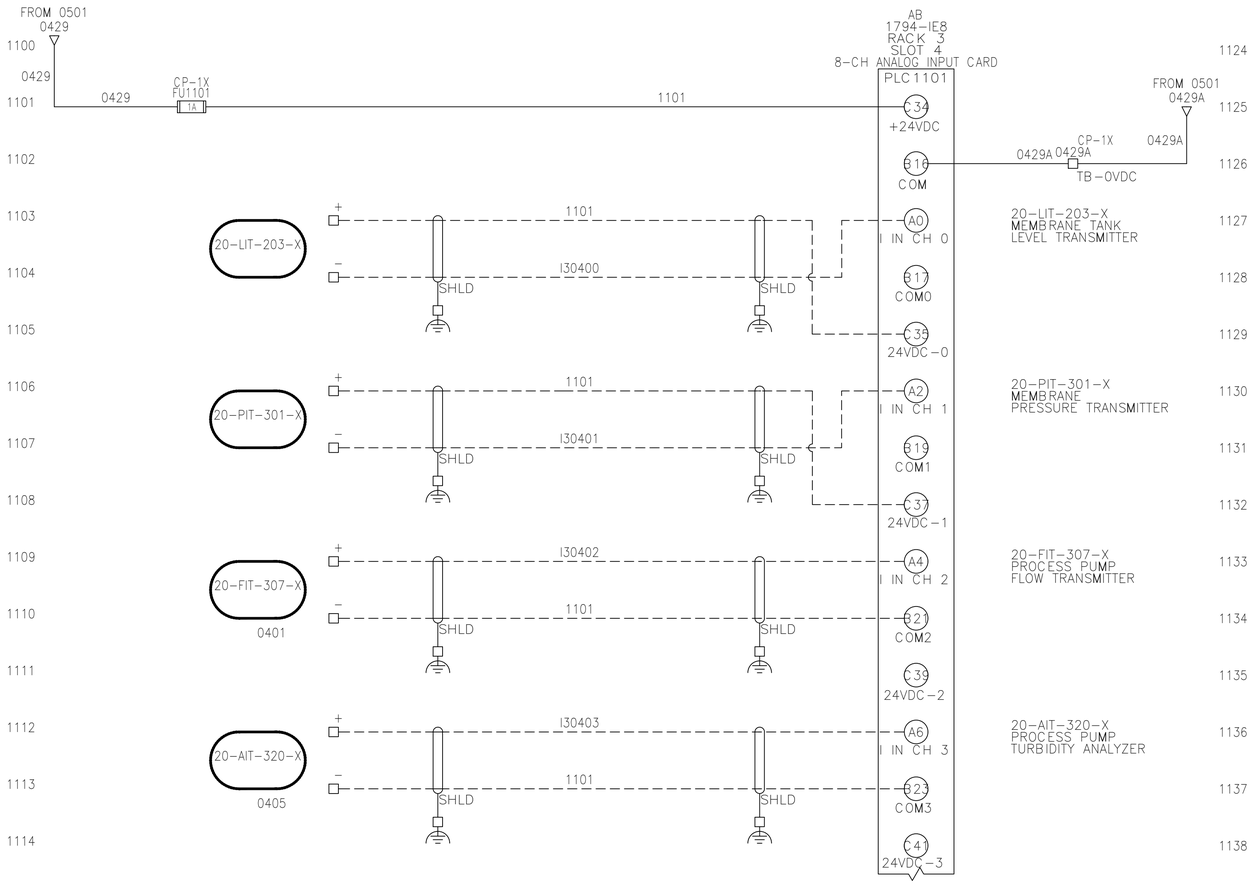

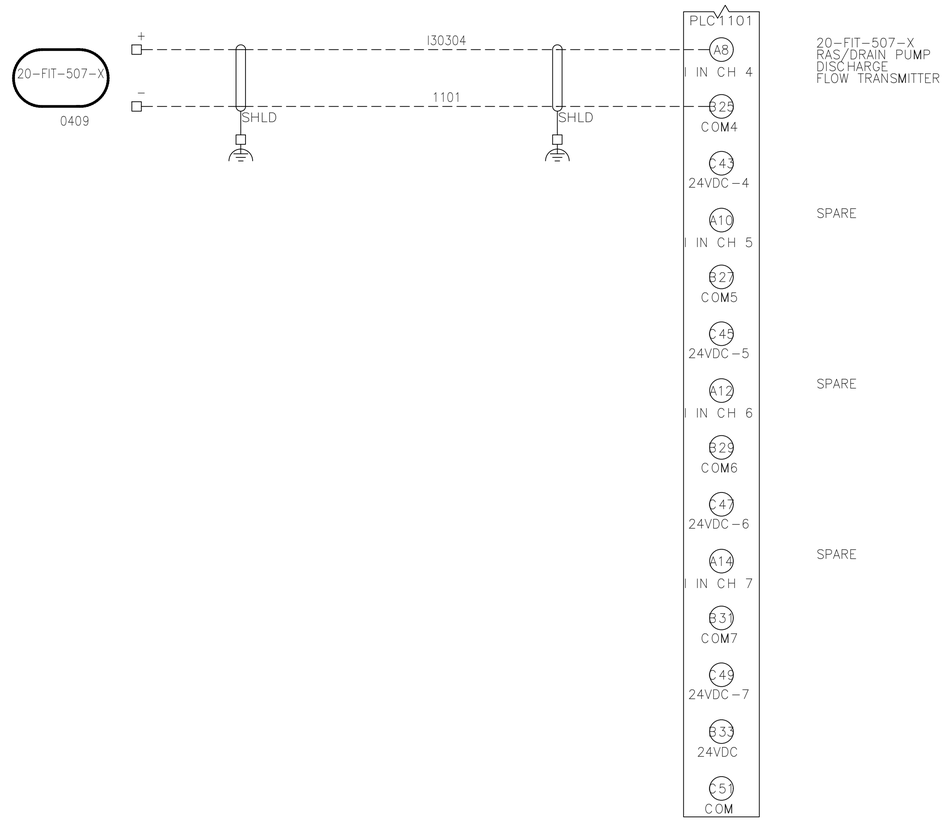

NOTES:

1. ALL ANALOG COM TERMINALS TERMINALS B16 TO B33 ARE INTERNALLY CONNECTED TOGETHER.

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CUSTOMER INFORMATION
CITY OF CANTON
WATER POLLUTION
CONTROL PLANT (WPCP)

ELEC-SCHEM

RIO PANEL

DRAWING NUMBER: 506357-WTS-EL-T03-0330-DD-002
REVISION: A
REF.: -
DOC. OWNER: -
PROJECT NO.: 506357
PART/MATERIAL NO.: -
SCALE: NONE
SIZE: D
SHEET: 11 OF 12

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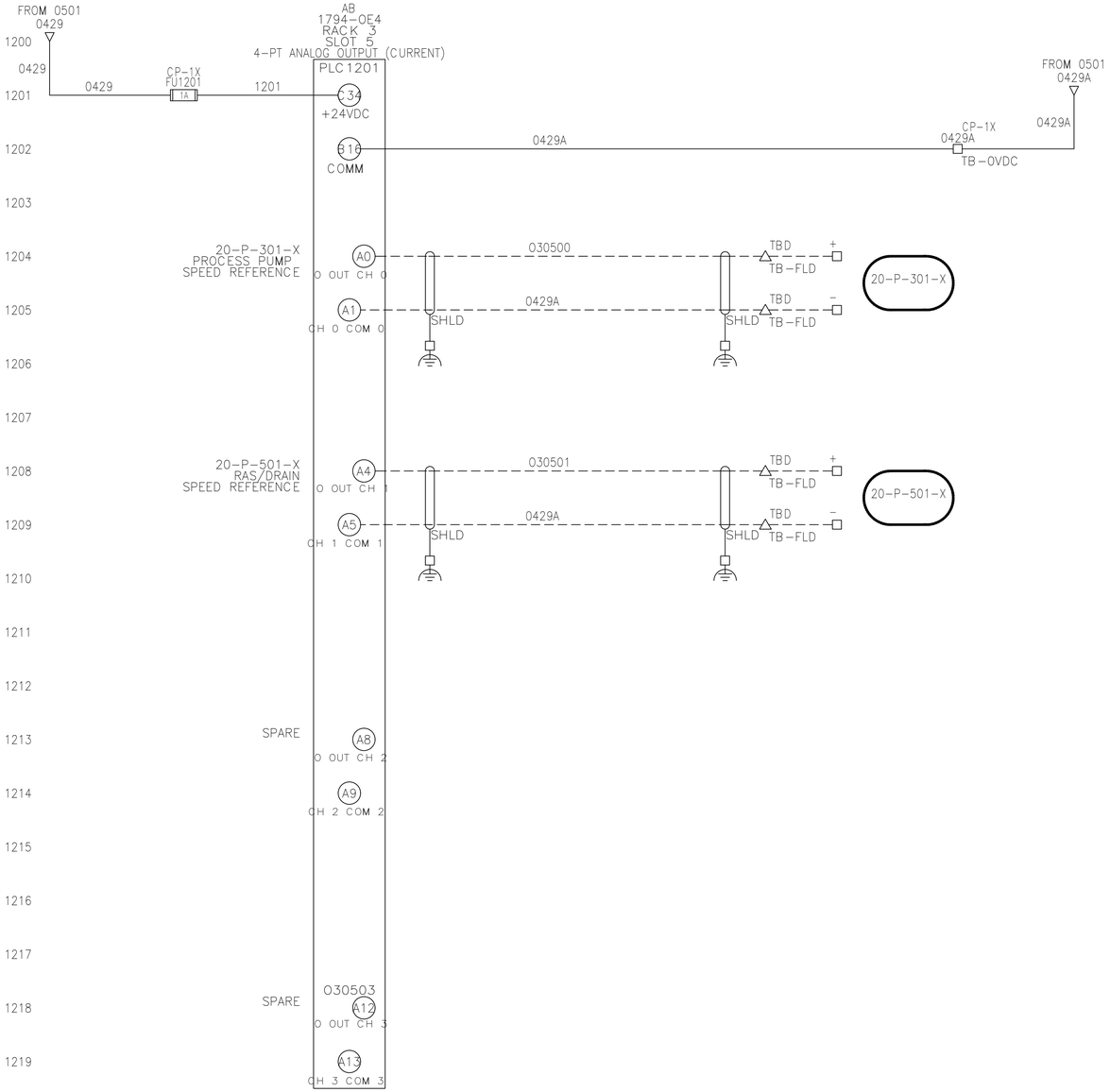

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TOLERANCES UNLESS NOTED
DECIMALS ANGLES
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.XXX - -

CUSTOMER INFORMATION
CITY OF CANTON
WATER POLLUTION
CONTROL PLANT (WPCP)

ELEC-SCHEM

RIO PANEL

DRAWING NUMBER: 506357-WTS-EL-T03-0330-DD-002
REVISION: A
REF.: -
DOC. OWNER: -
PROJECT NO.: 506357
PART/MATERIAL NO.: -
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SIZE: D
SHEET: 12 OF 12
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SUEZ Water Technologies & Solutions Proposal

Supplement – 1C

DC

WATER TECHNOLOGIES & SOLUTIONS

REV	DESCRIPTION	WRITTEN BY	CHECKED BY	APPROVED BY	DATE DD-MMM-YY
C	Issued for Review After E10 review	DMC	JC	FA	29-May-20
B	Issued for Information & Comments	DMC			22-Apr-20
A	Issued for Information	DMC		FA	2-Apr-20

DOCUMENT TYPE:	SUEZ DOCUMENT NUMBER : **506357-WTS-AU-T02-8523-PH-001**					
	CONTRACT	ISSUER	DISCIPLINE	PRODUCT	PHASE	TYPE	CHRONO
CP	**506357**	**WTS**	**AU**	**T02**	**8523**	**PH**	**001**

City of Canton

SUEZ WTS
CONTROLLED DOCUMENT

Control Philosophy

WW UF System

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1 Introduction

The City of Canton Water Pollution Control Plant (WPCP) is a Wastewater Ultra-Filtration facility. Four UF Trains operate together to treat the mixed liquor. The influent flows from the biological trains by gravity to the membrane tank common splitter and then to the membrane tanks. The clean water "permeate" is drawn through the membranes by the process pumps and pumped via the common permeate collector to disinfection system.

The train dedicated RAS/Drain pumps draw mixed liquor from the membrane tanks and pump it to the RAS splitter box.

The reader should refer to the Piping and Instrumentation Diagrams (P&ID's), the Control Logic & Sequence Chart. This document contains the following tabs: Legend, Device Controls, Train Sequence Chart (SC), the Control Logic Chart (CLC), Control Loop, and Communication for a complete understanding of the plant control scheme as described below.

The PLC follows specific steps to automatically control valves, pumps, etc. during the operating states of the treatment plant. These steps are listed and described in the SC.

Details of the control logic, setpoints, etc. that are required to operate the plant are given in the CLSC.

In the documentation, the Programmable Logic Controller is referred to as the PLC. The PLC provides automated control of the UF equipment. All the programming for the control of the UF plant is stored in the PLC.

Setpoints, alarms, calculated parameters, etc., have assigned tags in the PLC code. When tags are used in the Control Philosophy, they are identified by an alpha-numeric label, for example, 20-P-301-1, for a Process pump for UF train 1. For tagging -x is used to refer to the train number. For example, 20-P-301-x is the general tag for the process pump for the train where x has the values 1 to 4.

States are a series of steps the train follows to perform various operations, such as a cleaning. A specific mode discussed in this document is shown in capital letters, such as MAINTENANCE CLEAN.

1.1 Process Areas

This document covers a general description of the controls by SUEZ for the following unit processes:

- Ultra-Filtration (UF) Trains,
- Aeration Equipment,
- Clean-In-Place (CIP) Equipment,
- Ejectors and Compressed air system.

1.2 Definitions and Acronyms

Alarm	An alert sounded on the HMI when there is a system disruption or condition failed. There are different alarms for different severity of faults (Ex: Critical Alarm when tank is overflowing). An advisory alarm does not prevent a train in the Production Cycle from operating or the alarm will clear automatically based on level/pressure. A critical alarm does send a train to the fault step or there is the danger of an overflow. This type of alarm requires an operator to resolve the issue before it can return to service.

CIP	Clean-In-Place
Command	Every action made on the PLC that produces a change in equipment status
CP	Control Philosophy
CLSC	Control Logic & Sequence Charts
CV	Control Variable, sometimes called the manipulated variable
DO	Dissolved Oxygen
Faceplate	Used in the HMI to display dynamic process variables. Oftentimes, the faceplate is a pop-up and controls/modes can be selected on it.
FCE	Final Control Element, Equipment that physically controls a desired output variable
HMI	Human Machine Interface, screen used by plant personnel to view/display/control real-time/dynamic process data
I/O	Inputs and Outputs of the PLC
Interlock	In place to prevent undesired actions/situations from occurring
LCP	Local Control Panel
Local Controls	These controls are set via the HOA switch in the plant, usually on a piece of equipment
Loop	A management system to regulate a process
MCC	Motor Control Center
P&ID	Process and Instrumentation Diagram
Permissive	Conditions or pre-requisite steps that must be met in order to continue / progress further in process scheme
PFD	Process Flow Diagram, Chart to show the flow of the system/plant
Remote/Local	These controls are set via the Hand-Off-Auto (HOA) switch in the plant, usually on a piece of equipment
PID	Proportional Integrate Derivative control. This type of control is used to handle changes in process such as varying flow, etc.
PLC	Programmable Logic Controller
Proportional	This control is used to adapt to process changes (not predictive, but reactive) (Ex: injecting a quantity of chemical based on current flow values)
PV	Process Variable, Variable being measured in a control loop (compared to the set point)
RAS	Recirculated Activated Sludge
Remote Controls	These controls are operated via the HMI, soft control
Sequence	Order of specific tasks or steps of process
SC	Sequence Chart
Signal	The communication between the user and the control system
Soft Controls	These controls are operated via the HMI
SP	Set Point, The target value for a variable in the process
SS, TSS	Suspended Solids, Total Suspended Solid

State	Sequence of automated steps (e.g. for UF Trains: OFF, PRIME, STANDBY, PRODUCTION, BACKPULSE, RELAX, MAINTENANCE CLEAN, RECOVERY CLEAN, NEUTRALIZATION)

System Mode	Placement of complete system (AUTO, SEMI-AUTO, and OFF).
Unit Operations	A basic step in a process, functional box (Ex: UF train)
VFD	Variable-Frequency Drive
WAS	Waste Activated Sludge

2 HMI Graphics

An PLC is provided to control and monitor the system operation remotely. The system is designed to communicate with the customer's PLC. See the network architecture drawing (506357-WTS-EL-T02-8513-DN-001) for the specifics of the PLC, HMI and software.

The state, step and in steps with a duration timer the time remaining in the step is displayed on the train screen at the HMI.

2.1 Security & Passwords Access & Privileges

The ability to de-energize the "general alarm" output (e.g. for a horn) and acknowledge alarms does not require a password, but alarms cannot be reset.

The Guest access, no username or password required, is permitted the following actions:

- Access to major screens.
- Acknowledge alarms.
- No access to Alarm Reset button.

There are three levels of password protection; Operator, Supervisor, & Administrator, which is the SUEZ standard. To gain access to make changes on the HMI, the operator is required to enter the correct password. The operator password is factory set. The supervisor password can be modified from the HMI. The Administrator password would be used by someone modifying the programming. Note: after commissioning the program is owned by the client and can be changed without the permission of SUEZ. There is no limit to the number of times another password can be attempted. The password must be re-entered after a set amount of time of inactivity.

The Operator, username "oper/oper2/oper3", using passwords "1111/1111/1111", is permitted the following actions:

- Access to view all screens.
- Access only to view setpoints.
- Access to view and adjust of all train operational modes.
- Access to view and selection of train state button views.
- Resetting of all alarms.
- Access to operate pumps and valves.
- Access to operate and configure PID controllers, except for PID tuning constants.

The Supervisor, username "super/super2/super3", using passwords "2222/2222/2222", is permitted the following actions:

- Access to view all screens.
- Access to view and adjust setpoints.
- Access to view and adjust of all train operational modes.
- Access to view and selection of train state button views.
- Resetting of all alarms.
- Access to operate pumps and valves.
- Access to operate and configure PID controllers, including PID tuning constants.

HMI Administrator user Names: admin/admin2/admin3, using passwords: water/water/water is permitted the following actions:

- Access to view all screens.
- Access to view and adjust setpoints.
- Access to view and adjust for equipment operation.
- Resetting of all alarms.
- Access to operate pumps and valves.
- Access to operate and configure PID controllers, including PID tuning constants.
- Access to installation options for the design.
- Permission to exit the runtime application.

The end user is encouraged to customize the default user names and default passwords shown above.

A screensaver blanks the screen after a set amount of time of inactivity, typically 60 minutes. The screen is reactivated by a single touch. Reactivation cannot select a device or operating sequence.

2.2 HMI Navigation

From the Main Overview, screens can be accessed by:

- Selecting the graphic of the equipment.
- Pressing the “Select Screen” pop-up and selecting a screen.

From the remaining screens the following navigation options are available:

- Select an upstream or downstream system by selecting the off-screen connector.
- Pressing the “Index” pop-up and selecting a screen.
- A “Go Back” button is provided to return to the previous screen.

2.3 Date and Time Synchronization

The PLC date and time are synchronized to the HMI Date and Time.

2.4 Status and Color Schemes

Analog Equipment Speed/Position:

Pump Speed - %

Valve Status:

Green (Open) / Red (Closed)
Changing Position, a block of Green beside a block of Red
Yellow (Position Fault) – with limit switches

Pump/Blower Motor Status:

Green (On)
Switching between on and off a block of Green beside a block of Red
Red (Off)
Yellow (Fault)

Alarms:

Displayed on the HMI using the text shown in the Alarm & Setpoints sheet, Tag/Mnemonic and Description cells.
Alarm Status:

- Alarm - Advisory (Yellow)
- Alarm - Critical (Red)

2.5 UF Triggers & Alarms

2.5.1 Triggers

A trigger is a normal event that can clear an alarm or be one of several points in a sequence of events.

2.5.2 Alarms

Alarms are used to identify a problem with the system.

2.5.2.1 System Shutdown

When a shutdown alarm is active, the train proceeds to the fault steps in the current state. Critical Alarms can be used to initiate a callout to notify an operator who is off-site that there is a problem. There are three fault steps: step 29, step 30 and step 31.

If a loss power alarm is active, then the train proceeds directly to fault step 31. In Step 31, the valves are in safe position and there is no demand for pumps/blowers.

When a shutdown alarm except for loss of power is active, then the train proceeds proceed to the first fault step of the current state.

MAINTENANCE CLEAN, RECOVERY CLEAN and NEUTRALIZATION have fault step 29, which has a duration of 120 minutes. During this step, the membrane tank is not refilled with mixed liquor and all pumps/blower are off and the valves are closed. This step allows the operator to resolve the shutdown alarm without diluting the cleaning solution with mixed liquor. The operator can then resume the clean. See the fault step in the Sequence Chart (SC) for how the train recovers after the alarm is resolved.

In STANDBY, PRODUCTION, PRIME, BACKPULSE, RELAX, MAINTENANCE CLEAN, RECOVERY CLEAN, NEUTRALIZATION step 30 refills the membrane tank with mixed liquor. In Step 31, the valves are in safe position and there is no demand for pumps/blowers. After the operator has resolved the alarm and reset the alarm, then the train proceeds according to the Sequence Chart. (The CLC lists under the reset column the requirements to reset the alarm. Several of these alarms require the operator to press the Train Alarm Reset Button.)

In MAINTENANCE CLEAN step 31, when the shutdown alarm is reset, the train proceeds to MAINTENANCE CLEAN step 10 to flush the cleaning solution from the permeate header.

In RECOVERY CLEAN step 31, the train proceeds to NEUTRALIZATION, since the membrane tank has been refilled with mixed liquor. In NEUTRALIZATION step 31, the train proceeds to NEUTRALIZATION step 1.

The table of train shutdown alarms has been removed to the Control Philosophy. A complete list of alarms is found in the Control Logic Chart. There is a low membrane tank level alarm which sends the train to the first fault step.

See the CLC tab in the CLSC for a complete list of the alarms for this system.

2.5.2.2 Reset

It is understood that the operator will acknowledge the alarm and address the situation. If the problem is not corrected, and the train is returned to service, production quality and quantity may drop off quickly.

After the following alarms are resolved (Low membrane tank Level, Power Failure, and Low Compressed Air) the trains automatically return to operation from the faulted steps.

To return the equipment to its previous mode, the alarm condition must be cleared and the “RESET” key (on the device face plate or HMI screen bottom banner) is pressed. Delay timers will reset to zero for each “RESET”. Each component is reset independently from the other components.

An alarm that is activated by an instrument, pressure transmitter, flow transmitters, or level instrumentation, typically requires a pump or certain device to be on to generate the required flow or pressure. Otherwise, the alarm will be ignored if the device to be protected is off.

All alarms are indicated with a message on the screen. The operator cannot reset the alarm without the correct password. All alarms and the time they occurred are recorded on the alarm history screen.

2.5.2.3 Alarm Acknowledge

The alarm acknowledge button cancels the flashing indicating display lights, and alarm signals. For diagnostic reasons, the specific alarm indication on the operator interface does not clear until the alarm condition is corrected.

2.6 HMI Trending

All transmitters and derived values, such as TMP, are trended for 10-minute duration, which is standard practice.

3 Device Control

3.1 Device AOI

3.1.1 Device Status

When a device is in MANUAL control at the HMI:

- "M" is displayed above or beside the device.

When a device is Faulted:

- "F" is displayed on the device.

When a device is Interlocked:

- "I" is displayed above or beside the device.

3.1.2 Device Modes

Select a device to display the pop-up controls. The pop-up will have the following momentary pushbuttons:
Auto / Manual:

- Auto – The operator sets the device for automatic operation. The device operates with all alarm interlocks enabled, operating as shown in the Sequence Chart or as defined in the Control Logic Chart (CLC).
- Manual – The operator sets the device for manual operation. In this position the Start and Stop buttons are active for a pump/blower, etc. or Open and Close buttons are active for a valve. The device operates with all alarm interlocks enabled, only operating when required by the operator at the HMI.

All devices controlled by the SUEZ PLC are listed in the CLSC in the Device Controls sheet, showing devices which have “Auto” and “Manual” device modes.

3.2 Motor Lead Rotation

Lead is changed when the button is pressed. OR

If Auto Rotation on Run Time is enabled, when the duty cycle timer times out (range: 0-100 hours, default 12 hours, 0 hours disables selection). A lag device must be stopped for one hour before it can rotate in for the run time of another device.

OR

If Auto Rotation on Demand Loss is enabled, when the number of devices required for demand is reduced.

If the lead device is interlocked or faulted, the lag device starts automatically. The interlocked or faulted device retains the lead position, with the lag device operating in its place.

4 Operator Operations

4.1 Loss of Power/System Stop

4.1.1 Power Interruption/Power Up

The SUEZ WTS PLC monitors the plant control power supply.

On loss of plant control power supply, the SUEZ PLC:

- All automatic valves will move to their fail positions,
- All motors will stop,

- All trains proceed immediately to the Faulted step 31 of the current state and wait for power to resume.

On disruption of power to individual SUEZ WTS control panels:

- the affected trains immediately proceed to the Faulted step 31 of the current state.

When a train is Faulted due to loss of power, the system blocks all fail safe inputs that are normally closed (to avoid nuisance alarms).

When power is restored and auto restart is enabled:

- all trains are restarted one at a time, following the Start-Up sequence detailed in the Control Logic Chart.

4.1.2 System Stop

A mechanical System Stop pushbutton is also provided at the panel to allow for the operator to immediately stop all equipment through the PLC.

When the button is pressed, an alarm occurs and:

- all common equipment is stopped immediately
- all trains transition to the Faulted step of their current state.

When the button is reset:

- all trains are restarted one at a time, following the Start-Up sequence detailed in the Control Logic Chart.

4.1.3 Start-Up Sequence

The start-up sequence is the order in which the devices in the plant are re-enabled after a power interruption or after a system stop is reset.

When re-enabled, each train proceeds according to the SC, generally returning to their previous state, or STANDBY.

A delay is provided in each step to allow for devices to start before advancing to the next step. Steps are skipped for those devices which are not ready. See the CLC tab in the CLSC for the startup sequence list.

5 Communication

For the SUEZ membrane system to maintain optimal performance, information must be communicated between the plant PLC and the SUEZ PLC. The signals required are both analog and digital.

Operating parameters of the SUEZ system such as flow rates, pressures, train sequences, etc. are available for communication, if necessary, when the plant SCADA is required to only monitor these parameters. A list showing this information, however, is not provided in this document due to the large number of parameters available.

The SUEZ PLC and plant PLC both generate a heartbeat signal. Each “heartbeat” signal increments at a regular rate, (e.g. each second), and is monitored by the other PLC. When communication with a PLC is lost, the PLC that is monitoring the “heartbeat” signal detects that the state of the signal has not changed for a pre-set time, for example after 5 seconds, and alarms.

During operation of the SUEZ system, there are “heartbeat” signals generated by each PLC. Each “heartbeat” signal is a counter that increases by one unit each second. When the communication with a PLC is lost, the PLC that is monitoring the “heartbeat” counter detects that the value of the counter has not changed for a pre-set time, for example after 5 seconds, and alarms. When the counter reaches 10,000 it restarts counting from zero.

Discussions of the alarms and the changes that occur to the control systems are given in the following sections.

5.1 Plant PLC to the SUEZ PLC Signals

The list given below shows the signals that are communicated from the plant PLC over the network to the SUEZ PLC to operate the membrane system.

- heartbeat,
- feed flowrate,
- UV running (UV System OK),
- UV faulted (UV System Not OK)
- Sodium Hypochlorite Tank Level.
- Flume channel level

5.2 SUEZ PLC to the Plant PLC Signals

The list given below shows the signals that are communicated from the SUEZ PLC over the network to the plant PLC to assist in the operation of the membrane system.

- Heartbeat,
- UV Run Demand (request for the UV system to run),

5.3 Loss of Communication Alarm with Plant PLC

When there is a loss of communication with the plant PLC, the plant permeate flow demand is based on the trim factor (average membrane tank level).

6 Analog Control

The following Proportional and PID controls are provided.

6.1 PID Control

The Single PID Control Loops have several features:

1. Provisions for setting the tuning parameters (Proportional, Integral, Derivative).
2. Each PID Control Loop has an “Auto/Manual” selector switch. In the “Auto” position, the PID output (CV) is calculated automatically from the built in PID algorithms. In the “Manual” position, the operator enters a value for the output CV. This manually set value is usually 0 to 100 percent.
3. Graphically each PID Control Loop has a bar graph for PV (process variable), SP (setpoint), and CV (control variable).
4. Bumpless transfer from “Auto” to “Manual” mode.

Refer to the Control Logic chart in the CLSC for details about which devices are controlled using PID controllers.

6.2 Totalizers

The PLC sums the flows and displays a current total, day total and previous day total.

7 Pre-treatment

The plant biological treatment is designed and controlled by others. The reader should reference documents supplied by others for the control of the bioreactors. Aeration blowers and diffusers for the bioreactors are supplied by others and controlled by the Plant control system.

8 UF Train

A UF train is functionally described as a group of ZeeWeed modules and cassettes connected by a common permeate collection header. The process pump draws the clean water (permeate) through the membranes and pumps it to discharge via the disinfection system.

8.1 UF Train Modes

Modes define how the transitions occur for a Train from one operating state to another. A specific mode discussed in this document is shown in capital letters, such as AUTO. Modes can only be selected by the operator, using pushbuttons on the HMI. The mode button SEMI-AUTO is available in all states. The Off-mode button is available in all states except OFF state. The Auto mode button is available in all states except RECOVERY CLEAN & NEUTRALIZATION.

The sequencing of each Train can be described by the mode, state, and step of the Train. Each Train is in only one state and mode at any given time.

Buttons displayed on the HMI screen that the operator can press to initiate a mode or state or other operation are shown with the first letter capitalized. For example, one button that is used to put a train to the OFF mode is the Off button. The specific sequencing of Modes and States and the steps involved are detailed in the Sequence Chart (SC).

8.1.1 AUTO Mode

This is the normal mode of operation for a UF Train to produce clean water.

For the train equipment to operate automatically, the operator needs to have all related devices set to AUTO and the train set to AUTO. The operation of the train is automatic when in AUTO, and there is minimal operator attention required unless an alarm is activated.

In AUTO mode with Demand Override button not enabled, the train changes state between the Production Cycle and STANDBY according to train start & stop triggers, which are based on the plant permeate flow demand and the train rotation trigger. In AUTO mode with the Demand Override button enabled, the UF train proceeds to the Production Cycle without waiting for a start trigger and the stop trigger, and train rotation triggers do not send the train to STANDBY.

A MAINTENANCE CLEAN is automatically triggered as required by a schedule.

8.1.2 OFF Mode

This mode immediately places the train to OFF state and prevents the operator from manually selecting other states until the Train is placed in another mode.

The operator may turn a train OFF at any time. Pressing the Off button places the train into OFF mode and OFF state. It is the responsibility of the operator to ensure that if the Off button is pressed when a train is in a clean, the tank's contents are suitable for a train to proceed to another mode. When the Off button was selected in RECOVERY CLEAN, then NEUTRALIZATION state may be required. When the Off button was selected in MAINTENANCE CLEAN, then BACKPULSE state may be required to remove the cleaning chemical from the permeate header.

8.1.3 SEMI-AUTO Mode

This mode safely places the train to OFF state but permits the operator to manually select other states such as a PRIME, BACKPULSE, MAINTENANCE CLEAN, AND RECOVERY CLEAN/NEUTRALIZATION. Upon completion, the train will return to the OFF state and wait for further operator selection.

8.2 UF Train States

States are a series of steps the train follows to perform various operations, such as producing water. A specific state discussed in this document is shown in capital letters, such as PRODUCTION. The states available to each train are: OFF, PRIME, STANDBY, PRODUCTION, RELAX, BACKPULSE, MAINTENANCE CLEAN, RECOVERY CLEAN & NEUTRALIZATION. Each of these states is discussed further in the following sections and detailed sequencing information is available in the SC.

8.2.1 State Interlocks

The train proceeds to the selected state once the resources are available. There are interlocks preventing more than one train from entering the same state at the same time.

The state interlocks are:

- Only one train can be in PRIME at a time;
- Only one train can be in BACKPULSE, MAINTENANCE CLEAN, RECOVERY CLEAN and NEUTRALIZATION at a time.
- The train only proceeds to the BACKPULSE state if no other train is in either BACKPULSE (excluding the fault steps), MAINTENANCE CLEAN (including fault steps), RECOVERY CLEAN steps 1 to 20 or NEUTRALIZATION (including fault steps).

There are no state interlocks for STANDBY, RELAX and PRODUCTION.

8.2.2 Prime

Each train is provided with an ejector (20-E-801-x), which uses compressed air to operate. The ejector primes the permeate piping in PRIME and at the beginning of BACKPULSE, RELAX, MAINTENANCE CLEAN, & RECOVERY CLEAN.

The train's ejector compressed air valve (20-SV-802-x) opens which also opens the permeate header isolation valve (20-FV-801-x). During this time, air in the permeate header is pulled up and out through

the ejector, which pulls water into the membranes and process pump (20-P-301-x) suction. Any water that is drawn into the ejector drains out of it by gravity.

The PRIME state is used to remove air from the suction of the process pump. A train proceeds to PRIME after the Auto button is pressed in the OFF state. The ejector operates for typically 60 seconds, a longer duration than what is used for intermittent operation, and the duration is adjustable at the HMI.

Trains are intermittently primed in STANDBY. The frequency of the priming is controlled by the Master Ejector Cycle timer. The Master Ejector Cycle timer operates when there is at least one train in STANDBY. There is a time assigned for each train when the ejector operates. The duration of the priming is controlled by an adjustable setpoint, typically 15 seconds. The duration of the Master Ejector Cycle timer is typically 8 minutes.

The operator can manually initiate PRIME by pressing the Prime button at the HMI. The Prime button is available in SEMI AUTO mode and OFF state.

8.2.3 Production Cycle

The Production Cycle is the alternation of the train's states between PRODUCTION and either BACKPULSE or RELAX. The Production Cycle is controlled by a timer, typically the duration is 12 minutes. In the Production Cycle, BACKPULSE/RELAX is initiated based on time. The duration of Backpulse/Relax is included in the duration of the 12-minute timer. For example, the train would be in Production for 11 minutes and 12 seconds and then go to Backpulse for 48 seconds.

The master Production cycle timer starts when there are no trains in Production and one train is requested to start PRODUCTION. The timer restarts every time it times out.

There is a button to select either Backpulse or Relax for the Production Cycle. In SEMI AUTO, there is another button to manually initiate BACKPULSE from OFF state.

When the supervisory flow setpoint is enabled, the process pump's flow setpoint is an operator entered value. When the auto flow setpoint is enabled, the process pump's flow setpoint is a calculated value. See Section 8.3.1 Permeate Flow Control.

8.2.4 Standby

The steps for the STANDBY are:

1. Fills the membrane tank to a level above the membranes;
    1. While a train is in STANDBY intermittently, the ejector runs based on the master cycle timer; the membranes are aerated, and RAS is recirculated based on the frequency and duration aeration timers. The train remains in this step until one of the following is active:
        - start trigger,
        - train rotation trigger,
        - maintenance clean request with schedule.

8.2.5 Production

In Production, the train is producing permeate. The steps for the PRODUCTION are:

1. The membrane blower continues to run if already running. Align the valves;

2. The membrane blower starts if not already running. The process pump starts and runs until the production cycle timer triggers one of the following: BACKPULSE, RELAX. MAINTENANCE CLEAN can be triggered by the schedule in place of either BACKPULSE or RELAX.

8.2.6 Backpulse

During BACKPULSE, treated water is periodically reversed back through the membranes to maintain stable transmembrane pressures. The Production Cycle has a 12-minute timer. See Section 8.2.3 Production Cycle. The time slots to do backpulse/relax are evenly distributed throughout the production cycle. The distribution is based on the maximum number of trains installed in the plant. The production cycle is 12 minutes and there are 4 trains. A backpulse is scheduled to occur every 3 minutes. Each train is assigned a time slot to do backpulse according its train number.

The selection of either BACKPULSE or RELAX for the Production Cycle does not affect the duration of this timer.

The steps for the BACKPULSE are:

1. The membrane blower continues to run if already running. Stops the process pump, typically 6 seconds.
2. The membrane blower starts if not already running. Align the valves, typically 6 seconds.
3. Starts the process pump and it runs for the backpulse duration time, typically 30 seconds. The water is drawn from the Common Permeate Collector and pumped through the membranes into the membrane tank.
4. Stops the process pump, typically 6 seconds. After the BACKPULSE is complete and if there is demand for the train to run or the Demand Override button is enabled the train proceeds to PRODUCTION. After the BACKPULSE is complete and if there is no demand for the train to run the train proceeds to STANDBY.

The PLC controls the pump speed to backpulse the trains at a set flow rate per train up to a maximum TMP. A pressure transmitter on the membrane header is used to calculate the BACKPULSE TMP. This TMP limit provides membrane protection against over-pressurization. If the TMP is too high, the TMP high trigger is active and the flow control PID loop output is captured. This value becomes the maximum value for the output of the flow control PID loop.

When the TMP high trigger becomes active, the PLC gradually reduces the maximum for the flow PID loop output until the TMP high trigger is not active, (i.e., TMP is less positive). When the TMP high trigger becomes inactive, the maximum value is then gradually increased until the TMP high trigger is active again or continues to increase until the maximum value for the flow control PID loop output equals 100%. This control strategy allows the PLC to vary the pump speed to maximize flow while avoiding excessive TMP across the membranes.

The backpulse duration, production cycle duration, TMP limiting setpoint and the flow setpoint for all UF trains can be set through the HMI. All UF trains in the plant share the backpulse duration, production cycle duration, TMP setpoint and flow setpoint.

In SEMI AUTO, the operator can initiate a BACKPULSE from the HMI for any UF train by pressing the Backpulse button. This button is disabled if any other train is in BACKPULSE, MAINTENANCE CLEAN, RECOVERY CLEAN and NEUTRALIZATION.

8.2.7 Relax

During RELAX, the solids that have concentrated around the membrane fibers are distributed away from the membrane surface by the aeration. The steps for the RELAX are:

1. Stops the process pump, typically 6 seconds.
2. When the backpulse duration timer times out, the train proceeds to the next step, typically 30 seconds. (The same timer is used for BACKPULSE and RELAX.)
3. After the RELAX is complete, and if there is demand for the train to run the train proceeds to PRODUCTION. After the RELAX is complete and if there is no demand for the train to run the train proceeds to STANDBY, typically 6 seconds.

RELAX is the preferred state of operation for this plant and is an alternative to backpulsing.

8.2.8 Clean-In-Place (CIP) Controls

The membranes require cleaning to maintain peak performance. There are two types of cleaning methods: MAINTENANCE CLEANS, and RECOVERY CLEANS.

8.2.8.1 Maintenance Clean

MAINTENANCE CLEAN is scheduled through the HMI and are automatically initiated by the PLC based on a 24-hour clock. The operator may select to perform one scheduled MAINTENANCE CLEAN a train per day on the Maintenance Clean schedule screen, the program allows this functionality. From the proposal, each train does one sodium hypochlorite maintenance clean per week.

The operator selectable options:

- Day of week for cleaning;
- Time of day for cleaning;
- Sodium hypochlorite for cleaning solution;
- Citric acid for cleaning solution.

When it is time to carry out a MAINTENANCE CLEAN, the PLC compares the current plant permeate flow demand with the available capacity of the plant if one train is not in service. If the plant permeate flow demand exceeds this capacity, then the scheduled MAINTENANCE CLEAN is skipped but the request remains active and is started when this demand is lower. When a MAINTENANCE CLEAN is skipped or aborted, an alarm occurs to inform the operator.

If the plant permeate flow demand does not exceed this capacity, when it is time to carry out a MAINTENANCE CLEAN, the train completes its current production cycle before starting the cleaning procedure. If a train is in STANDBY, it goes directly to MAINTENANCE CLEAN.

The default steps for MAINTENANCE CLEAN are:

1. Open the aeration valve if it is not already open, typically for 6 seconds.
2. The membrane blower aerates the membranes, typically for 5 minutes.
3. Stop the blower demand and close the aeration valve and align the valves for backpulse with cleaning chemical, typically for 6 seconds.

4. The process pump pulses all cassettes with the selected cleaning solution (sodium hypochlorite or citric acid), typically for 2 minutes. If the level in the Common Permeate Collector is low, the train proceeds to the next step otherwise the UF train proceed to step 6.
5. Stop the process pump and chemical pump. Waits for the Common Permeate Collector to refill. When there is sufficient water in the Collector return to step 3.
6. The PLC stops the process pump and chemical pump. Relaxation period for all cassettes, typically for 4.5 minutes.
7. The PLC aligns the valves for backpulse with the cleaning chemical, typically for 6 seconds.
8. The process pump and the chemical pump pulses the cassettes with the cleaning solution, typically for 30 seconds.
9. The PLC stops the process pump and chemical pump. Relaxation period for the cassettes, typically for 4.5 minutes. Steps 7 to 9 are repeated for several iterations, typically 8 iterations.
10. The PLC aligns the valves for backpulse, typically for 6 seconds.
11. The process pump pulses the cassettes with permeate to remove the cleaning solution from the permeate header, typically for 2 minutes. If the level in the Common Permeate Collector is low, the train proceeds to the next step otherwise the UF train proceed to step 13.
12. Waits for the Common Permeate Collector to refill. When there is sufficient water in the Collector return to step 10.
13. The PLC stops the process pump and aligns the valves, typically for 6 seconds.
14. The membrane blower aerates the membranes, typically for 5 minutes.
15. The train proceeds to STANDBY state in AUTO mode and to OFF state in SEMI-AUTO mode.

8.2.8.2 Recovery Clean Controls

RECOVERY CLEANS can only be carried out for a train if it is in SEMI-AUTO. The operator is required to turn the train to SEMI AUTO mode and OFF state then select the R. Clean button and then either the Acid or Hypochlorite button, for the cleaning to begin. During a Recovery Clean there are several prompts which the operator must address. Consult the SC and CLC for further details. As a result, it is suggested to have the operator present during the RECOVERY CLEAN so that these prompts can be responded to in a timely manner. From the proposal, the train does three sodium hypochlorite RECOVERY CLEANS per year and three citric acid RECOVERY CLEANS per year. The duration of the RECOVERY CLEAN is 10 to 18 hours. Normally, the steps 1 to 20 are done during the day shift and the membranes are allowed to soak overnight. The duration is dependent on the soaking time.

RECOVERY CLEANS can be done with citric acid or sodium hypochlorite depending on which cleaning chemical the operator selects.

1. Valve alignment, typically for 6 seconds with the membrane tank inlet gate closed.
2. Aerates the membranes typically for 5 minutes.
3. Stops the blower demand, typically for 6 seconds.
4. Drains the membrane tank with RAS/drain pump.
5. Stops the RAS/drain pump demand.

6. Manual drain and flush step. The PLC will proceed to the next step after a defined duration.
7. Valve alignment. Steps 7 to 14 are repeated for several iterations and then proceed to step 15. The number of iterations is determined on site and is adjustable at the HMI.
8. The process pump backpulses the membranes with permeate if the level in the Common Permeate Collector is low then the train proceeds to next step. OR until the membrane tank is at a defined level then the train proceeds to step 10.
9. Relaxation period for all cassettes until there is sufficient water in the Common Permeate Collector and then proceed to step 7.
10. Valve alignment, typically for 6 seconds.
11. The blower aerates the membranes for a defined duration, typically for 5 minutes.
12. Valve alignment, typically for 6 seconds.
13. Drains the membrane tank with a RAS/drain pump.
14. Stop the drain pump demand, typically for 6 seconds.
15. Valve alignment, typically for 6 seconds
16. The process pump backpulses the membranes with cleaning solution, if the level in the Common Permeate Collector is low then proceeds to the next step. Or when in this step and the membrane tank level is at or above 90% of the Chemical Fill level trigger then proceeds to RECOVERY CLEAN step 18.
17. Holds this step until there is sufficient water in the Common Permeate Collector then returns to step 15.
18. Valve alignment, typically for 6 seconds.
19. The process pump backpulses the membranes with permeate if the level in the Common Permeate Collector is low then proceeds to the next step. OR When in this step and the membrane tank level is at or above the Chemical Fill level trigger setpoint then the train proceeds to step 21.
20. Holds this step until there is sufficient water in the Common Permeate Collector then returns to step 18.
21. Final, extended relaxation period with intermittent aeration, typically twelve hours;
22. The operator selects the Neutralization button to proceed to NEUTRALIZATION state.

The Neutralization button is available in SEMI AUTO mode and OFF state and in all steps of RECOVERY CLEAN. The neutralization is initiated by the operator after the extended chemical soak step of the RECOVERY CLEAN. The default steps for NEUTRALIZATION are:

1. The membrane tank inlet gate opens. The membrane tank is filled to defined level with mixed liquor.
2. Valve alignment, typically for 6 seconds;
3. The blower aerates the membranes, typically for 1 minute.
4. Relaxation period for all cassettes for a defined duration typically 900 seconds and then proceed to next step.

5. Valve alignment, typically for 6 seconds;
6. The process pump backpulse the membranes to flush the permeate header. Holds this step for step duration then proceeds to step 8. If there is insufficient water in the Common Permeate Collector, then proceeds to the next step.
7. Holds this step until there is sufficient level in the Common Permeate Collector then returns to step 5.
8. The operator checks the chlorine concentration and the pH. If the free chlorine and pH are with permitted limits, then press the Confirm Neutralization button and proceed to step 12. Otherwise press the Resume Neutralization button and proceed to the next step. The testing is one on a grab sample. There are no instruments included for this functionality.
9. Valve alignment, typically for 6 seconds;
10. Adds additional mixed liquor for a defined duration typically 1 minute, and then proceeds to the next step.
11. The operator checks the chlorine concentration and the pH. If the free chlorine and pH are with permitted limits, then press the Confirm Neutralization button and proceed to step 12. Otherwise press the Resume Neutralization button and proceed to the step 9.
12. Proceeds to OFF state.

8.3 Calculations

8.3.1 Permeate Flow Control

The influent flow signal is used for the plant permeate flow demand. As the influent flow increases the plant permeate flow demand increases, causing the process pump(s) to speed up. To prevent standby and overflow conditions, the average level in the membrane tanks is used to trim the plant permeate flow demand. Level control is accomplished with Proportional control. The PLC performs these calculations. The plant permeate flow demand is the net permeate flowrate required from the SUEZ system and does not include additional permeate the system produces for non-production operations, such as BACKPULSE.

The trim flowrate, which is a calculated flow, is added to or subtracted from the influent flowrate according to the average level in the membrane tanks and the difference from the level setpoint. As the level increases above the setpoint in the membrane tanks, the trim increases causing the overall plant permeate flow demand to increase. When the plant permeate flow demand increases, the process pumps for the trains in operation are ramped up to increase the plant permeate production which brings the average level down in the membrane tanks. Conversely, if the average level in the membrane tanks is below the setpoint, the calculated trim flowrate is a negative flow and the overall plant permeate flow demand decreases. The process pumps are ramped down, decreasing permeate production, and the membrane tanks level increases because of the decreased permeate production.

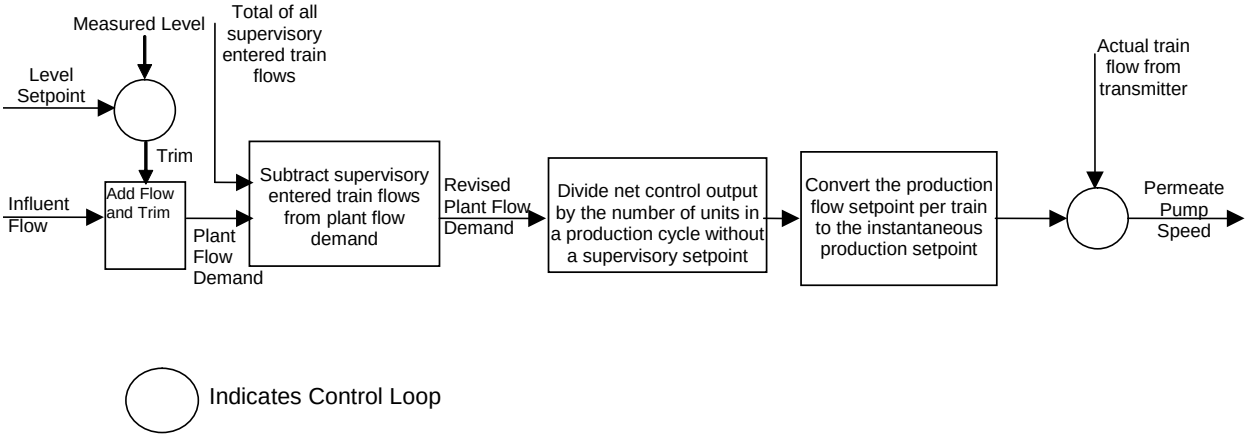
In Auto Setpoint mode, the flow setpoints for trains with a manual (Supervisory) flow setpoint are added together and subtracted from the plant permeate flow demand which includes the level trim. This adjusted plant permeate flow demand is then divided by the number of trains in operation without a manually entered flow setpoint. This becomes the net production flow setpoint for a train. A correction factor is calculated to account for the time when the train is not producing water (i.e. Backpulse) and to

produce additional water required for backpulsing the train, when trains are being backpulsed. The net production flow setpoint multiplied by the correction factor is then used to calculate the instantaneous flow setpoint for the train. The process pump speed is controlled by the flow PID loop.

In Supervisory Setpoint mode, a flow setpoint may also be entered for each train manually. The supervisor can do this by setting the production flowrate for some or all the trains on the HMI.

The PLC maintains the operator entered production flow rate or PLC calculated production flow rate up to a maximum TransMembrane Pressure (TMP) or a minimum membrane tank level.

Figure 1: Influent Flow, Level Control & Permeate Flow Control Chart



8.3.1.1 Level Trim

The plant permeate demand is the influent flow trimmed to the average membrane tank level for the trains in STANDBY, PRODUCTION, BACKPULSE, RELAX.

Tank Level Trim Calculation

To produce a full-range trim flow (negative flow to positive flow);

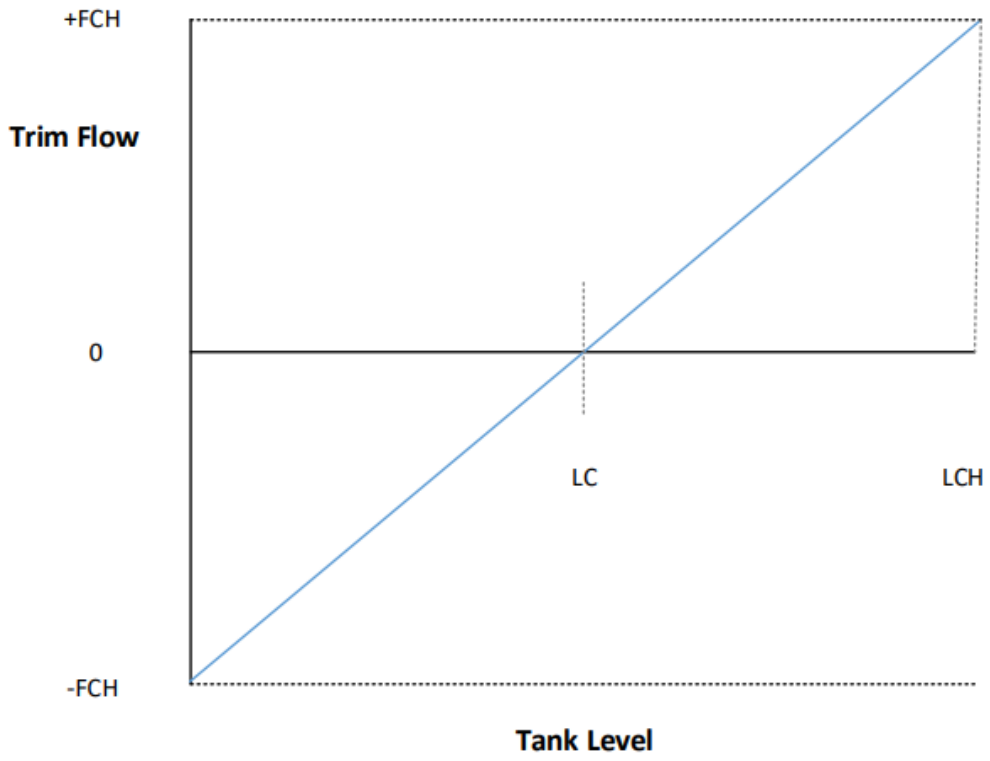
Trim Flow = FCH x (Level – LC) / (LCH – LC)

FCH is the maximum permeate flow for the plant.

LCH is the level at top of the membrane tank operating band.

LC is the level at middle of the membrane tank operating band.

Figure 2 Level Trim



8.3.2 Production TransMembrane Pressure (TMP)

TransMembrane Pressure is the differential pressure across the membranes as measured by a combination of a level transmitter in the membrane tank and a pressure transmitter on the permeate header. In PRODUCTION, the process pump draws the water through the membranes so the pressure in the permeate header is lower than on the outside of the membranes resulting in a negative value for TMP. During BACKPULSE and backpulsing steps in CIP the water is flowing in the opposite direction so the pressure in the permeate header is higher than the outside of the membranes resulting in a positive value for TMP.

8.3.2.1 TransMembrane Pressure (TMP) Calculation

TMP is calculated by using the equation below. During PRODUCTION the value is negative; for backpulses and CIP, it is positive.

$$TMP = \text{Header Pressure} + C \times (A + B - \text{Membrane Tank Level})$$

Where:

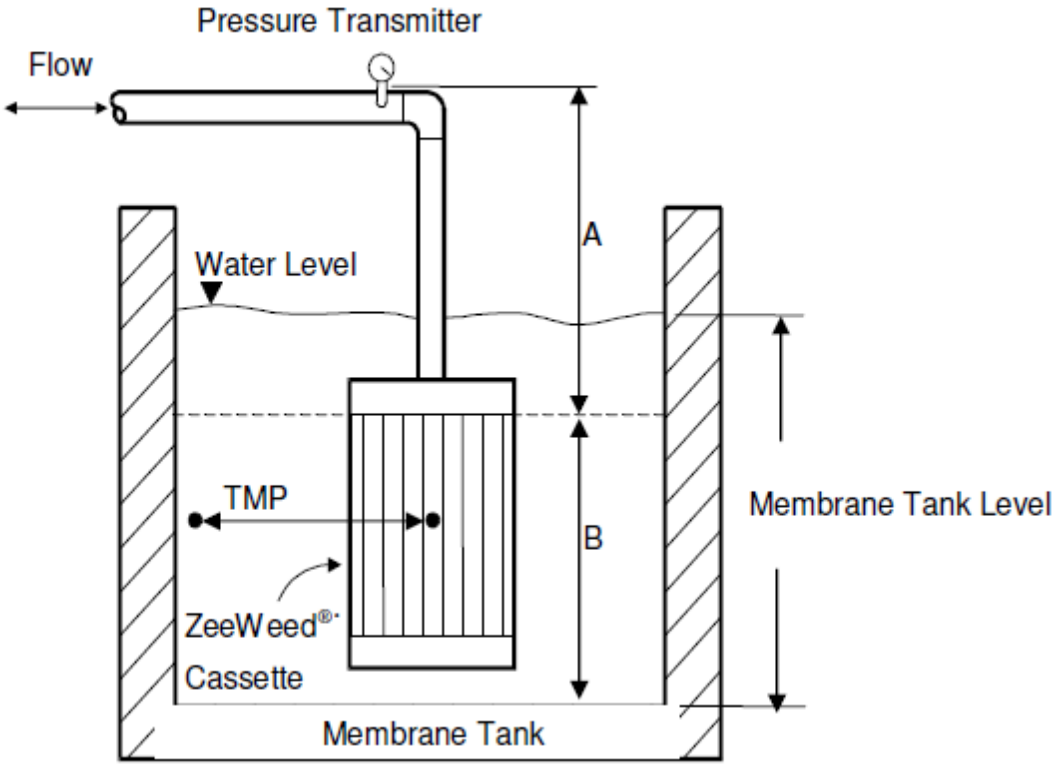
A is the height of the pressure transmitter above the top of the membranes.

B is the height to the top of membranes in the membrane tank.

C is a conversion factor (water depth to pressure) = 0.036127 psig/inch.

In PRODUCTION, an increased TMP value means a larger pressure differential because the pressure inside the membranes is lower than outside the membranes. This corresponds to a lower number as expressed in engineering units. Therefore, a high production TMP is expressed as a Pressure Differential Alarm Low.

Figure 3 TMP Chart



8.3.2.2 TMP Limiting the Process Pump Speed

The PLC continuously calculates the TMP value while in PRODUCTION. If the TMP is too low (i.e. too negative), the TMP low trigger is active and the flow control PID loop output is captured. This value becomes the maximum value for the flow control PID loop output.

When the TMP low trigger becomes active, the PLC gradually reduces the maximum for the flow PID loop output until the TMP low trigger is not active (i.e., TMP is less negative). When the TMP low trigger becomes inactive, the maximum value is then gradually increased until the TMP low trigger is active again or continues to increase until the maximum value for the flow control PID loop output equals 100%. This control strategy allows the PLC to vary the pump speed to maximize flow while avoiding excessive TMP across the membranes.

8.3.3 Start & Stop Train Triggers

The number of trains in operation at any given time varies depending on the plant permeate flow demand. As this demand increases, the number of trains in PRODUCTION increases. When a Start train trigger is active, a train switches from STANDBY to PRODUCTION. When a Stop train trigger is active, a

train switches from PRODUCTION/BACKPULSE/RELAX to STANDBY. The setpoint values for these triggers are defined in the CLC. When a start trigger is active, the SUEZ PLC communicates a UV run demand to the plant PLC. The UF train proceeds to PRODUCTION from STANDBY without waiting for the UV running communicated signal. The UV fault signal is for notification only, the trains continue in the Production Cycle.

A train that has been in the Production Cycle the longest time has the highest priority to proceed to STANDBY from PRODUCTION. A train that has been in STANDBY the longest time has the highest priority to proceed to PRODUCTION/BACKPULSE/RELAX from STANDBY.

8.3.4 Normal Train Rotation

Trains are automatically rotated from PRODUCTION to STANDBY when another train is in STANDBY based on an adjustable cycle timer, typically set to 1 hour. If there is at least one train in the Production cycle, the cycle timer operates, and when the timer times out, a Standby request is initiated to stop one train, the train that has operated the longest compared to the other operating trains. This lead train is put to STANDBY at the end of its next BACKPULSE/RELAX, and a train that is in STANDBY starts in PRODUCTION. When at least one train is in STANDBY, Train rotation allows each available train to operate as the lead train for no more than the duration of the cycle timer, such as 1 hour, plus the time remaining in the train's Production cycle when the train is triggered to proceed to STANDBY.

When the cycle timer times out and there is no train available in STANDBY to start in PRODUCTION, the lead train continues in the Production cycle and the request to put a train to STANDBY is maintained, waiting for a train to become available.

If the plant permeate flow demand decreases and triggers a train to STANDBY, the normal train rotation timer resets and resumes timing, or when a train is in STANDBY, the timer resets and resumes timing.

8.3.5 Freeze Protection Enabled

Freeze Protection is used when there is a danger of the permeate headers freezing. When Freeze Protection is selected it replaces Train Rotation. Freeze Protection only works as long as there is demand for at least one train to be in the Production cycle.

The PLC is programmed to force a train, which is in STANDBY for more than 30 minutes to go to PRODUCTION (this train stays in the Production cycle for at least 200 seconds) another train in the Production cycle switches to STANDBY.

After 200 seconds, the PLC checks all Standby trains and selects the train, which has more than 30 minutes standby time and the highest standby time to repeat the same process again, one train at the time. The timers are operator adjustable at the HMI. The number of trains in the Production cycle is still controlled by the start/standby triggers. There are buttons on the HMI to select either Enable Freeze Protection or Enable Train Rotation.

During this switching time the request for the number of running blowers is held constant.

8.4 Analog Controller

8.4.1 Membrane Tank Inlet Valve

The Membrane Tank Inlet Gate is open continuously in PRIME, STANDBY, PRODUCTION, RELAX, BACKPULSE, MAINTENANCE CLEAN and in some steps of NEUTRALIZATION.

8.4.2 Process Pump

The process pump (20-P-301-x) is controlled by a flow PID loop. The pump starts/stops based on the state and step of the train. In Production, the setpoint for the flow PID loop is calculated from the plant permeate flow demand. In Backpulsing steps, the flow setpoint is an operator adjustable value.

8.4.2.1 Permissive

The process pump cannot start until the open limit switch for the to/from Permeate Collector valve (20-FV-302-x) is true.

8.4.2.2 Hardwired Interlock

The process pump has pressure switches (20-PSH-301-x and 20-PSH-302-x) on the suction and discharge sides of the pump. These switches are hardwired to the VFD. When a switch trips, the VFD is shut down, which causes the pump to stop. This trip must be manually reset. This hardwired interlock is for pump protection. The process pump also has a Temperature switch (20-TSH-301), which hardwired to the VFD. When a switch trips, the VFD is shut down, which causes the pump to stop. This trip must be manually reset.

The PLC sees these trips as a loss of running.

8.4.3 Membrane Aeration Control

There are five membrane aeration blowers, designated as four duty blowers and one standby blower. The blowers supply low pressure air into a common air header for all the UF trains. This common air header then divides into multiple air headers to the membrane tanks.

UF Trains are aerated in PRODUCTION, BACKPULSE, RELAX, intermittently in STANDBY and some steps of MAINTENANCE CLEAN & RECOVERY CLEAN & NEUTRALIZATION. For further details on blower operation, refer to the SC and CLC for the occurrence and number of blowers to be running at any given time.

The blower's VFD varies the volume of air through the blower. The PLC uses the sum of the trains air flow demand to determine the speed of the blower(s) using a lookup table.

The PLC starts and stops blowers as necessary to maintain the desired air flow. All the blowers operate at the same speed when running.

8.4.3.1 Aeration

When a train is in a step with an aeration demand, the aeration isolation valve for that train is open.

The PLC automatically determines when the UF trains run in Leap High Flow Aeration or Leap Low Flow. The change from High to Low aeration only occurs when STANDBY aeration timer (30-minute) times out and all the following conditions are true:

1. The plant is enabled to operate in Low Flow Aeration;
2. The net permeate flow setpoints for all trains in the Production Cycle are below the average day design value for the membranes;

3. All the trains in the production cycle have resistance calculation value which permits Low Flow Aeration.

The change from Low to High aeration occurs when standby aeration timer (30-minute) times out and any of the following conditions are true:

1. The net permeate flow setpoint for any train in the production cycle is above the average day design value for the membranes. OR
2. Any train in the production cycle has resistance calculation value which does not permit Low Flow Aeration. OR
3. High Flow Aeration Twice Daily Frequency is active.

Or

- When any train in the production cycle has a flow greater than average day design value for the membranes for five minutes.

Or

- Low Flow Aeration is disabled by the button on the HMI - then immediately.

The resistance calculation runs from the last step of either BACKPULSE OR RELAX state to the first step of either BACKPULSE OR RELAX state for production cycle for each train. The result of each train's resistance calculation is saved for the last complete train's production cycle.

If any of these trains in the Production cycle require high flow aeration, then all the trains are aerated in high flow aeration.

When the standby aeration timer (30 minutes) times out, the membrane aeration demand (i.e. # of blowers and blower speed) is calculated for the standby trains and operating trains, to minimize start stops on the blowers.

If an aeration isolation valve is requested to close and fails to close, aeration continues, and the train does not proceed to STANDBY due to an active Standby Trigger. An alarm is triggered to alert the operator. If an aeration isolation valve fails to open, the train is shutdown to prevent fouling of the membranes due to inadequate air scouring.

Table 1: Membrane Aeration Chart

High Flow Aeration	Low Flow Aeration	Number of trains requiring aeration	Number of blowers	Required Air Flow SCFM	Required Motor Speed %
✓		1	1	1138 @5.5 psi	82% (49 Hz)
	✓	1	1	569 @4.4 psi	45% (27 Hz)
✓		2	2	2276 @5.5 psi	82% (49 Hz)
	✓	2	1	1138 @5.5 psi	82% (49 Hz)
✓		3	3	3414 @5.5 psi	82% (49 Hz)
	✓	3	2	1707 @5.5 psi	60% (38 Hz)

High Flow Aeration	Low Flow Aeration	Number of trains requiring aeration	Number of blowers	Required Air Flow SCFM	Required Motor Speed %
✓		4	4	4552 @5.5 psi	82% (49 Hz)
	✓	4	2	2276	82% (49 Hz)

8.4.3.2 Standby Aeration

The trains in STANDBY are aerated sequentially to limit the number of starts and stops on the membrane aeration blowers. The trains in STANDBY are aerated starting with the first train followed by the second train, then the third train, without stopping the blower. Trains are aerated in the order of their train number. If, for example, train 2 and 3 are in Standby, train 2 is aerated first, and then train 3. Sequential aeration involves an overlap of aeration to allow the membrane aeration blower to continue to operate as one train completes its aeration and another train begins its aeration.

8.4.3.3 Blower Low Airflow

A low air flow switch is located on the discharge of each blower, for blower protection. If the switch is active, an alarm occurs, and the PLC changes the lead to the next available blower. If there are no blowers available, a different alarm occurs, and the PLC shuts down all trains.

8.4.3.4 Blower High Temperature

A high temperature switch is located on the discharge of each blower, for blower protection. If the switch is active, an alarm occurs, and the PLC changes the lead to the next available blower. If there are no blowers available, a different alarm occurs, and the PLC shuts down all trains.

8.4.4 Recirculation Flow Control

The RAS/drain pump (20-P-501-x) for the train transfers mixed liquor from the membrane tank to the bioreactor splitter box. The RAS/drain pumps are configured to operate as one duty per train.

The speed of the RAS/drain pump is controlled by a flow PID loop. The RAS flow setpoint is an operator adjustable ratio based on the net train permeate flow setpoint, which the PLC calculates, or the operator enters. In the Production Cycle, as the net train permeate flow setpoint increases the RAS flow demand increases, causing the RAS/drain pump(s) to speed up. In STANDBY and NEUTRALIZATION, the setpoint is operator entered. In RECOVERY CLEAN, the setpoint is operator entered.

The RAS/drain pumps operate continuously during PRODUCTION, BACKPULSE, RELAX and intermittently in STANDBY and in some steps of RECOVERY CLEAN & NEUTRALIZATION.

8.4.4.1 Standby Recirculation

When trains are in STANDBY, intermittently the RAS is recirculated. This RAS recirculation is controlled by the same timers used in Standby Aeration.

Standby trains are intermittently aerated based on a duration timer and a frequency timer. When the frequency timer times out, the Standby trains are aerated, and RAS is circulated through the membrane tank one after another. The aeration and RAS circulation duration is controlled by the setpoint of the aeration duration timer.

8.4.5 Sodium Hypochlorite Cleaning Equipment

Sodium hypochlorite is used to remove organic contaminants from the membranes. The SUEZ PLC requests the duty Sodium hypochlorite pump, 23-P-101-A/B for MAINTENANCE CLEANS or RECOVERY CLEANS, to run in specific steps during the cleaning procedure. The pump's speed is controlled by a flow PID loop. There is a setpoint for Maintenance Clean and another setpoint for Recovery Clean. The hand flow control valve is set up to throttle for Maintenance Clean. The automatic valve is open during Recovery Cleans. The flow setpoints are set up to deliver the required chemical volume in the duration of the chemical dosing steps.

8.4.6 Citric Acid Cleaning Equipment

Citric acid is periodically used to remove inorganic contaminants from the membranes such as calcium carbonate, manganese and iron compounds. The SUEZ PLC requests the duty citric acid pump, 23-P-301-A/B for MAINTENANCE CLEANS or RECOVERY CLEANS, to run in specific steps during the cleaning procedure. The pump's speed is controlled by a flow PID loop. There is a setpoint for Maintenance Clean and another setpoint for Recovery Clean. The hand flow control valve is set up to throttle for Maintenance Clean. The automatic valve is open during Recovery Cleans. The flow setpoints are set up to deliver the required chemical volume in the duration of the chemical dosing steps.

9 Integrity Monitoring & Control

Integrity of each train is monitored with on-line turbidity meters (20-AI-320-x). Turbidity is displayed but not monitored for alarms when trains are in STANDBY, BACKPULSE, RELAX, MAINTENANCE CLEAN, RECOVERY CLEAN, NEUTRALIZATION.

There are three turbidity alarms used to assist the operator in running the system. One alarm is used to detect a problem that is not a spike and immediately shuts down the train in PRODUCTION. For example, a train is shutdown when the turbidity is above the setpoint, 0.2 NTU, for 2 minutes.

A second alarm is used to detect a spike in turbidity and sets all trains that are in BACKPULSE to RELAX. For example, the alarm is active when the turbidity is above the setpoint, 5 NTU, for 10 seconds. The alarm also skips all scheduled MAINTENANCE CLEANS until the turbidity alarm condition no longer exists. After the turbidity alarm condition clears, the Maintenance Cleans are completed as scheduled, but the BACKPULSE must be manually selected by the operators, if required.

The third alarm also detects turbidity spikes but at a lower setpoint and is used to notify the operator of a potential problem which needs to be addressed. For example, the alarm is active when the turbidity is above the setpoint, 0.5 NTU for 60 seconds.

The turbidity alarm setpoints and the time delays, before the alarms become active, are adjustable at the HMI. For further details consult the CLC.

10 Sludge Wasting

The operator is required to waste sludge from the membrane basins in order to maintain good membrane performance. The operator should analyze the sludge to ensure a mixed liquor concentration of less than 10,000 mg/L, for example, to maximize membrane performance.

At the HMI, the operator enters in the total volume of sludge to waste for the day. When a pre-set time of day is reached, typically midnight, sludge wasting is started.

The WAS valve opens. The flow is totalized. When the total volume of sludge wasted reaches the setpoint, the valve is closed, and the flow totalizer is reset to zero at midnight.

11 Air Compressor Control

The system comes with two air compressors and two refrigerated air dryers. The air compressors provide compressed air for all the pneumatic actuated valves and ejectors in the SUEZ supplied system.

The PLC enables one air compressor at a time during normal operation. The air compressors alternate on a pre-defined period, which is operator adjustable, or alternate when selected by the operator, selectable at the PLC HMI. When an air compressor is enabled, its local pressure switch will control the start and stop of the compressor based on the system pressure. When the system pressure reaches the low setpoint, the switch will trip starting the compressor and when the system pressure reaches the high setpoint, the contact will open stopping the compressor.

If the system pressure falls to 90 psi, either due to a large demand or the Lead (enabled) compressor fails, a low-pressure switch located upstream of the instrument air regulator, activates, and the lag compressor is enabled to start in an attempt to restore air pressure back to normal pressure. Both compressors could be running in this scenario and will turn off when their local pressure switch reaches the shutoff pressure set point. In the event that the system pressure falls below the low-low trigger pressure, another pressure switch downstream of the pressure regulator will activate creating a callout alarm and put all trains to Fault step as the actuated valves cannot reliably be operated. Trains will re-start when the low-low pressure switch pressure condition is cleared if the auto restart option has been selected.

If the enabled (LEAD) compressor experiences a fault an alarm is triggered, and an enable signal will be provided to the LAG compressor. It will stay enabled without rotation of the compressor until the fault is cleared.

Reciprocating compressors have a duty cycle around 70% which means they should not run longer than 42 minutes in any 60-minute period. The controls include an excessive runtime alarm that will occur if one of the compressors is running more than 45 minutes, to alert the Operations staff to check the system.

The supplied air dryers run independently and are not controlled by the PLC. The function of the air dryer is to remove the moisture in the air supply. Excessive moisture could cause pre-mature failure of the valve solenoids. Refer to the Operation & Maintenance Manual for more details.

DC

Water Technologies & Solutions

A	Issued for Review	DMC	JC	FA	29-May-20
REV	DESCRIPTION	WRITTEN BY	CHECKED BY	APPROVED BY	DATE DD-MMM-YY

DOCUMENT TYPE : SUEZ DOCUMENT NUMBER : **506357-WTS-AU-T02-8533-FD-001**

List	CONTRACT	ISSUER	DISCIPLINE	PRODUCT	PHASE	TYPE	CHRONO
	506357	WTS	AU	T02	8533	FD	001

City of Canton

SUEZ WTS
CONTROLLED DOCUMENT

Control Logic & Sequence Charts

WW UF System

SUEZ Water Technologies & Solutions
Control Logic Chart Legend

Document Number: 506357-WTS-AU-T02-8533-FD-001
Revision: A

Column Name		Definition
Tag/Mnemonic		Tag name of the device as shown on the P&ID, i.e.. 20-FIC-301-x. An "x" in the tag's suffix is used to represent multiple trains. A "Y" in the tag's suffix is used to represent multiple units/devices.
Description		The description of the logic, e.g. "Feed Flow, Flow Low" alarm. Alarm descriptions will be used for the HMI alarm banner.
Type		The following are the available types:
	Alarm - Advisory	A condition requiring operator attention. All alarms are displayed on the Alarm Summary page when active.
	Alarm - Critical	A condition requiring immediate operator attention. All alarms are displayed on the Alarm Summary page when active. A critical alarm generates a Callout.
	Analog In	A reading from a field instrument that is connected, hard-wired or directly communicating (e.g. ModBus), to the control system. The scaled input is displayed on the HMI in the process flow, in a position defined by the instrument in the P&ID.
	General Info	Information given when further explanation is needed. No HMI indication.
	Button	A button that can be pressed at the HMI by the operator. Buttons are shown on the HMI.
	Comm In	Information that is communicated from another PLC over the network to the SUEZ WT&S PLC. Generally specified where the information is stored (plant PLC) in SET or DESCRIPTION. All inputs are displayed on the HMI. Discrete status inputs are displayed as "Lights" in a position dictated by the related process stream.
	Comm Out	Information that is communicated from the SUEZ WT&S PLC over the network to another PLC. Generally specified where the information is stored (SUEZ WT&S PLC) in SET or DESCRIPTION. All outputs should be displayed on the HMI, unless repeating information already displayed.
	Derived - Display	An analog value, such as TMP, that requires a calculation. This also includes throughput calculations. These signals must be displayed on the HMI.
	Derived - Internal	An analog value, such as TMP, that requires a calculation. This also includes throughput calculations. These signals do not need to be displayed on the HMI.
	Dig. Out	Digital Outputs that appear in the electrical drawings. Only displayed on the HMI if required.
	Interlock	An Interlock may prevent a piece of equipment from operating when a hazard exists. Usually displayed on HMI using device "I" indication. If not related to device, must be displayed as status light.
	Indicator	Displays the status of a system or device on HMI.
	PID	Proportional Integral Derivative control, used in processes where the process variable must be controlled to the setpoint. Displayed on HMI using standard PID popup.
	PController	Proportional control, used in processes where required. Calculation displayed on HMI in pop-up.
	Setpoint	A numeric value for use in a control system program. Typically, if the setpoint is not an alarm or a trigger, it is identified as a Setpoint. All setpoints, whether hard-coded or operator-entered must be displayed on an HMI popup.
	Trigger	A condition used to start an event without alarming. Status not displayed on HMI, unless otherwise requested.
Category		Typically includes the relevant device such as a pump, or blower, a process parameter, such as flow, or level, or can include another descriptor such as Sequence or Control, etc.
Range Min		Lowest value permitted for the alarm, trigger, setpoint, etc. The number of decimal places shown will be displayed on the HMI.
Range Max		Highest value permitted for the alarm, trigger, setpoint, etc. The number of decimal places shown will be displayed on the HMI.
Setpoint		Default Setpoint for alarm, trigger, etc.
Units		The units used for Range Min, Range Max, and Setpoint.
Set		The conditions for setting an Alarm or Trigger. May indicate the mode for condition to be set. Indicates if the setpoint is common to all trains with multiple alarms.
Action or Derivation		The action that occurs for the given event. Actions may be defined separately for various modes. Used to show calculations. Used as a explanation field for other types.
Reset		The conditions for resetting the event. May indicate the mode for condition to be reset.
Notes		A brief description of the purpose for the logic shown in the row of the document.

SUEZ Water Technologies & Solutions
Device Control Chart

Document Number: 506357-WTS-AU-T02-8533-FD-001
Revision: A

	TAGS	DEVICE DESCRIPTION	DEVICE MODES	DEVICE MOTOR STATUS	DEVICE DELAY START (seconds)	DEVICE DELAY CLOSE (seconds)	CONTROL VALVE RAMP CLOSE (seconds)	VALVE CYCLES	MOTOR STARTS	RUN TIME METERS
			A = Auto, **M = Manual**, operation with alarm interlocks (See Gen. Info. tab for mode definitions)	The input signals for a motor. **R = Running**, **O = Open**, **C = Close**, **E = Remote (Auto)** **F = Fault**	If a motor is requested to start in a step, then the starting command is delayed for the associated duration to allow the valves to align.	If a valve is requested to close in a step, then the closing command is delayed for the associated duration to allow motors to stop.	When a flow control valve is asked to close (and the Device Delay Close is complete) the valve will slowly close from the current position over the set duration to prevent water hammer.	A cycle counter is increased by one each time the valve is called to open. When the Reset Cycles button is pressed, the counter resets to zero.	A start counter is increased by one each time the motor is called to start. When the Reset Hours & Starts button is pressed, the runtime meter and start counter are simultaneously reset to zero.	A runtime meter accumulates in hours when the motor is running. When the Reset Hours & Starts button is pressed, the runtime meter and start counter are simultaneously reset to zero.
UF Train Dedicated Devices	20-FV-205-x	Aeration Valve	AM			6		y		
	20-FV-209-x	Membrane Tank Inlet Gate	AM	OC		0			y	Y
	20-FV-502-x	Mem. Tk Recirc Valve	AM			6		y		
	23-FV-302-x	CIP - Train Citric Acid Valve	AM			6		y		
	23-FV-102-x	CIP - Train Hypochlorite Valve	AM			6		y		
	20-FV-320-x 20-FV-321-x	Turbidity Valves	AM			0		y		
	20-FV-302-x	To/from Collector Valve	AM			10		y		
	20-SV-802-x	Ejector Valve	AM			0		y		
	20-P-301-x	Process Pump	AM(N1)	R	0				y	Y
	20-P-501-x	RAS/drain Pump	AM	R	0				y	Y
Common Devices	20-B-201-A/B/C/D/E	Membrane Blower	AM	R	0				y	Y
	23-P-301-A/B	Citric Acid Pump	AM						y	Y
	23-FV-301	Citric Acid R.C. Valve	AM			6		y		
	23-P-101-A/B	Sodium Hypochlorite Pump	AM		0				y	Y
	23-FV-101	Sodium Hypochlorite R.C. Valve	AM			6		y		
	90-AC-001-A/B	Air Compressor	AM	RF		0		y	y	Y
	16-FV-705	WAS Valve	AM							

NOTES:

N1 Only the mode selected and the Stop button are visible on the HMI. Other buttons are hidden from view. To change the pump operating mode, operator must press the Stop button on the HMI

N2 When the demand is going from one aeration valve open to zero valves open then the valve remains open for 30 seconds after the blower stops. The 30 sec. timer is reset when an aeration valve is requested to open.

SUEZ Water Technologies & Solutions
Operations Sequence Chart

Document Number: 506357-WTS-AU-T02-8533-FD-001
Revision: A

Legend
1 : Indicates that the valve is requested to open or the motor is requested to run in Auto.
- : Indicates that the valve is not requested to open or the motor is not requested to run in Auto.
T : Indicates that the valve is throttling in Auto to control a process variable.
N#: (Note number), Indicates that the state of the valve or motor depends on the conditions in the associated note in the sequencing logic.
-x : Indicates that there are multiple trains associated with this tag number.

OPERATING STATE Step Description	Step #	Step Duration Tag	Range Min	Range Max	Time Setpoint	Units	Description: Aeration Valve	Membrane Tank Inlet Gate	Mem. Tk Recirc. Valve	CIP - Train Citric Acid Valve	CIP - Train Hypochlorite Valve	Turbidity Valves	To/from Collector Valve	Ejector Valve	Process Pump	RAS/drain Pump	Membrane Blower	Citric Acid R.C. Valve	Citric Acid Pump	Sodium Hypochlorite R.C. Valve	Sodium Hypochlorite Pump	**The Sequence Chart (SC), Control Logic Chart (CLC) and the Control Philosophy (CN) should all be read to assist in the understanding of plant operations.** **Comments & Sequencing Logic**
							Tags: 20-FV-205-x	20-FV-209-x	20-FV-502-x	23-FV-302-x	23-FV-102-x	20-FV-320-x 20-FV-321-x	20-FV-302-x	20-SV-802-x	20-P-301-x	20-P-501-x	20-B-201-A/B/C/D/E	23-FV-301	23-P-301-A/B	23-FV-101	23-P-101-A/B	
							Dedicated Devices										Common Devices					
OFF																						INTERLOCKS: There are no interlocks preventing entry to the OFF state. MODE SELECTION: The OFF state exists in SEMI-AUTO and OFF modes. If the operator selects AUTO mode while in the OFF state, the train proceeds immediately to PRIME. STATE SELECTION: In SEMI-AUTO mode, the operator can initiate these states: PRIME, BACKPULSE, MAINTENANCE CLEAN, RECOVERY CLEAN, and NEUTRALIZATION.
Stopped	Step 1					--		-	-	-	-	-	-	-	-	-	-	-	-	-	-	The train remains in the OFF state until the operator selects another mode or state.
PRIME																						INTERLOCKS: The train only proceeds to PRIME state if no other train is in PRIME state. This interlock excludes the fault steps of PRIME. MODE SELECTION: The PRIME state exists in AUTO and SEMI-AUTO modes. If the operator selects OFF mode while in the PRIME state, the train proceeds immediately to the OFF state. STATE SELECTION: No state selections are permitted in PRIME.
Prime	Step 1	PRIMING-DUR	30	300	60	sec.	-	-	-	-	-	-	-	**1**	-	-	-	-	-	-	-	Holds this step for step duration then In AUTO, the train proceeds to STANDBY. In SEMI-AUTO, the train proceeds to OFF state.
Fault - Fill	Step 30					--		-	**1**	-	-	-	-	-	-	-	-	-	-	-	-	When the membrane tank Above Membranes level trigger (20-LS-203-TOP-MEM-x) is active, the train proceeds to the next step.
Faulted	Step 31					--		-	-	-	-	-	-	-	-	-	-	-	-	-	-	The train remains in this step until all shutdown alarms are reset then proceeds to PRIME step 1.
STANDBY																						INTERLOCKS: There are no interlocks preventing entry to the STANDBY state. MODE SELECTION: The STANDBY state exists in AUTO mode. If the operator selects OFF or SEMI-AUTO mode while in the STANDBY state, the train proceeds immediately to the OFF state. STATE SELECTION: In any non-faulted step of the STANDBY state, the operator can initiate MAINTENANCE CLEAN with the schedule.
Tank Fill	Step 1					--		**LS**	**1**	-	-	-	-	-	-	-	-	-	-	-	-	When the membrane tank Above Membranes level trigger (20-LS-203-TOP-MEM-x) is active, the train proceeds to the next step.
Ready	Step 2					--		**N1**	**1**	**N1**	-	-	-	-	**N2**	-	**N1**	**N1**	-	-	-	-	N1: Aerates and recirculates RAS for 20-KQS-201C seconds every 20-KQS-201D seconds. See CLC for details. N2: Runs the ejector intermittently according to the Master Ejector Cycle Timer. See CLC for details. The train remains in this step until one of the following occurs: When the Demand Override button is selected, the train proceeds to PRODUCTION. In AUTO, if there is demand for the train to run, the train proceeds to PRODUCTION. In AUTO, if a scheduled MAINTENANCE CLEAN request is active, the train proceeds to MAINTENANCE CLEAN.
Fault - Fill	Step 30					--		-	**1**	-	-	-	-	-	-	-	-	-	-	-	-	When the membrane tank Above Membranes level trigger (20-LS-203-TOP-MEM-x) is active, the train proceeds to the next step.
Faulted	Step 31					--		-	-	-	-	-	-	-	-	-	-	-	-	-	-	The train remains in this step until all shutdown alarms are reset then proceeds to PRIME step 1.
PRODUCTION																						INTERLOCKS: There are no interlocks preventing entry to the PRODUCTION state. MODE SELECTION: The PRODUCTION state exists in AUTO mode. If the operator selects OFF or SEMI-AUTO mode while in the PRODUCTION state, the train proceeds immediately to the OFF state. STATE SELECTION: In any non-faulted step of the PRODUCTION state, the operator can initiate these states: MAINTENANCE CLEAN (schedule). The train will proceed to MAINTENANCE CLEAN when it completes the PRODUCTION state.
Valve Alignment	Step 1		n/a	n/a	6	sec.	**1**	**1**	**1**	-	-	**1**	**N1**	-	-	**1**	**LS**	-	-	-	-	Waits for step duration, then proceeds to the next step.
Production	Step 2					--	**1**	**1**	**1**	-	-	**1**	**N1**	-	**N4 FWD**	**1**	**1**	-	-	-	-	N4: The pump runs only if To/from Permeate Collector Valve 23-FV-302-x is open confirmed by limit switches In AUTO and demand override is not selected, if there is no demand for the train to run, then proceeds immediately to STANDBY. In AUTO, the train remains in this step until the end of the current PRODUCTION cycle, then: - if a Maintenance Clean request is active, the train proceeds to MAINTENANCE CLEAN (if the resources are available). (A Maintenance Clean requests refers to a scheduled request .) - if there is no Maintenance Clean request, the train proceeds to BACKPULSE or RELAX (dependent upon the preselected option). The train proceeds to RELAX if a train is in BACKPULSE (all steps excluding the fault steps), MAINTENANCE CLEAN all steps (including fault steps), or in RECOVERY CLEAN steps 1 to 20 or NEUTRALIZATION (including fault steps).
Fault - Fill	Step 30					--		-	**1**	-	-	-	-	-	-	-	-	-	-	-	-	When the membrane tank Above Membranes level trigger (20-LS-203-TOP-MEM-x) is active, the train proceeds to the next step.
Faulted	Step 31					--		-	-	-	-	-	-	-	-	-	-	-	-	-	-	The train remains in this step until all shutdown alarms are reset then proceeds to PRIME step 1.
BACKPULSE																						INTERLOCKS: The train only proceeds to the BACKPULSE state if no other train is in either BACKPULSE (excluding the fault steps), MAINTENANCE CLEAN (including fault steps), RECOVERY CLEAN steps 1 to 20 or NEUTRALIZATION (including fault steps).

SUEZ Water Technologies & Solutions
Operations Sequence Chart

Document Number: 506357-WTS-AU-T02-8533-FD-001
Revision: A

Legend
1 : Indicates that the valve is requested to open or the motor is requested to run in Auto.
- : Indicates that the valve is not requested to open or the motor is not requested to run in Auto.
T : Indicates that the valve is throttling in Auto to control a process variable.
N#: (Note number), Indicates that the state of the valve or motor depends on the conditions in the associated note in the sequencing logic.
-x : Indicates that there are multiple trains associated with this tag number.

							Description	Aeration Valve	Membrane Tank Inlet Gate	Mem. Tk Recirc. Valve	CIP - Train Citric Acid Valve	CIP - Train Hypochlorite Valve	Turbidity Valves	To/from Collector Valve	Ejector Valve	Process Pump	RAS/drain Pump	Membrane Blower	Citric Acid R.C. Valve	Citric Acid Pump	Sodium Hypochlorite R.C. Valve	Sodium Hypochlorite Pump	
							Tags	20-FV-205-x	20-FV-209-x	20-FV-502-x	23-FV-302-x	23-FV-102-x	20-FV-320-x 20-FV-321-x	20-FV-302-x	20-SV-802-x	20-P-301-x	20-P-501-x	20-B-201-A/B/C/D/E	23-FV-301	23-P-301-A/B	23-FV-101	23-P-101-A/B	**The Sequence Chart (SC), Control Logic Chart (CLC) and the Control Philosophy (CN) should all be read to assist in the understanding of plant operations.** **Comments & Sequencing Logic**
																							MODE SELECTION: The BACKPULSE state exists in AUTO and SEMI-AUTO modes. If the operator selects OFF mode while in the BACKPULSE state, the train proceeds immediately to the OFF state. STATE SELECTION: No state selections are permitted in BACKPULSE.
Permeation Stops	Step 1		n/a	n/a	6	sec.	**1**	**1**	**1**	-	-	-	**1**	**1**	-	**LS**	**LS**	-	-	-	-	Waits for step duration, for process pump to stop, then proceeds to the next step.
Valve Alignment	Step 2		n/a	n/a	6	sec.	**1**	**1**	**1**	-	-	-	**1**	**1**	-	**1**	**1**	-	-	-	-	Waits for step duration, then proceeds to the next step.
Backpulse	Step 3	BP-DUR-SP	5	200	30	sec.	**1**	**1**	**1**	-	-	-	**1**	-	**N4 REV**	**1**	**1**	-	-	-	-	N4: The pump runs only if To/from Permeate Collector Valve 23-FV-302-x is open confirmed by limit switches Backpulses the membrane train. Holds this step for step duration, then proceeds to the next step
BACKPULSE Complete	Step 4				--		**1**	**1**	**1**	-	-	-	**1**	-	-	**1**	**1**	-	-	-	-	Holds this step for step duration, then proceeds as follows: In AUTO with the demand override button selected the train proceeds to PRODUCTION. In AUTO, if there is a demand for the train to run, proceeds to PRODUCTION. In AUTO, if there is no demand for the train to run, proceeds to STANDBY. In SEMI-AUTO, the train proceeds to OFF.
Fault - Fill	Step 30				--		-	**1**	-	-	-	-	-	-	-	-	-	-	-	-	-	When the membrane tank Above Membranes level trigger (20-LS-203-TOP-MEM-x) is active, the train proceeds to the next step.
Faulted	Step 31				--		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	In AUTO, the train remains in this step until all shutdown alarms are reset then proceeds to PRIME step 1. In SEMI-AUTO, the train remains in this step until all shutdown alarms are reset then proceeds to OFF step 1.
RELAX																							INTERLOCKS: There are no interlocks preventing entry to the RELAX state. MODE SELECTION: The RELAX state exists in AUTO modes. If the operator selects SEMI-AUTO or-OFF mode while in the RELAX state, the train proceeds immediately to the OFF state. STATE SELECTION: No state selections are permitted in RELAX.
Permeation Stops	Step 1		n/a	n/a	6	sec.	**1**	**1**	**1**	-	-	-	**1**	**1**	-	**1**	**1**	-	-	-	-	Waits for step duration, for process pump to stop, then proceeds to the next step.
Relax	Step 2	BP-DUR-SP	5	200	30	sec.	**1**	**1**	**1**	-	-	-	-	**N1**	-	**1**	**1**	-	-	-	-	N1: The ejector runs for the first 6 seconds of this step. Holds this step for step duration, then proceeds to the next step
RELAX Complete	Step 3		n/a	n/a	6	sec.	**1**	**1**	**1**	-	-	-	-	-	-	**1**	**1**	-	-	-	-	Holds this step for step duration, then proceeds as follows: In AUTO with the demand override button selected the train proceeds to PRODUCTION. In AUTO, if there is a demand for the train to run, proceeds to PRODUCTION. In AUTO, if there is no demand for the train to run, proceeds to STANDBY.
Fault - Fill	Step 30				--		-	**1**	-	-	-	-	-	-	-	-	-	-	-	-	-	When the membrane tank Above Membranes level trigger (20-LS-203-TOP-MEM-x) is active, the train proceeds to the next step.
Faulted	Step 31				--		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	In AUTO, the train remains in this step until all shutdown alarms are reset then proceeds to PRIME step 1.
MAINTENANCE CLEAN																							INTERLOCKS: The train only proceeds to MAINTENANCE CLEAN state if no other train is in MAINTENANCE CLEAN, RECOVERY CLEAN or NEUTRALIZATION state. This interlock includes the fault steps of the states. MODE SELECTION: The MAINTENANCE CLEAN state exists in AUTO and SEMI-AUTO modes. If the operator selects OFF mode while in the MAINTENANCE CLEAN state, the train proceeds immediately to the OFF state. STATE SELECTION: No state selections are permitted in MAINTENANCE CLEAN.
Valve Alignment	Step 1		n/a	n/a	6	sec.	**1**	**1**	**1**	-	-	-	**1**	**1**	-	-	**LS**	-	-	-	-	Waits for step duration, for process pump to stop, then proceeds to the next step.
Initial Aeration	Step 2	MC-AERA-SP	120	300	300	sec.	**1**	**1**	-	-	-	-	-	**N1**	-	-	**1**	-	-	-	-	Aerates the membrane train. N1: The ejector runs for the first 6 seconds of this step. Holds this step for step duration then proceeds to the next step.
Stop Blower	Step 3		n/a	n/a	6	sec.	-	**1**	-	**N2**	**N2**	-	**1**	-	-	-	-	-	-	-	-	Waits for step duration, then proceeds to the next step.
Initial Chemical Backpulse	Step 4	MC-PULSE-SP	5	200	120	sec.	-	**1**	-	**N2**	**N2**	-	**1**	-	**N4 REV**	-	-	-	**N2**	-	**N2**	N2: The state of the pump/valve is dependent on the type of cleaning chemical that is selected at the HMI N4: The pump runs only if To/from Permeate Collector Valve 23-FV-302-x is open confirmed by limit switches Backpulses the membrane train. Backpulses the membrane train for the step duration and then the train proceeds to step 6. If the Flume Channel Level High trigger (FLUME-LVL-H) is not active then proceeds to the next step. Retain time left in the step. Use the time left as step duration when in this step again.
Pause Tank Fill	Step 5				--		-	**1**	-	-	-	-	-	-	-	-	-	-	-	-	-	Holds this step until the Flume Channel Level High trigger (FLUME-LVL-H) is active then returns to MAINTENANCE CLEAN - step 3.
Initial Soak	Step 6	MC-SOAK-SP	5	6000	270	sec.	-	**1**	-	-	-	-	-	-	-	-	-	-	-	-	-	Holds this step for step duration then proceeds to the next step.
Valve Alignment	Step 7		n/a	n/a	6	sec.	-	**1**	-	**N2**	**N2**	-	**1**	-	-	-	-	-	-	-	-	Waits for step duration, then proceeds to the next step. N2: The state of the pump/valve is dependent on the type of cleaning chemical that is selected at the HMI

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Legend
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T : Indicates that the valve is throttling in Auto to control a process variable.
N#: (Note number), Indicates that the state of the valve or motor depends on the conditions in the associated note in the sequencing logic.
-x : Indicates that there are multiple trains associated with this tag number.

Description							Aeration Valve	Membrane Tank Inlet Gate	Mem. Tk Recirc. Valve	CIP - Train Citric Acid Valve	CIP - Train Hypochlorite Valve	Turbidity Valves	To/from Collector Valve	Ejector Valve	Process Pump	RAS/drain Pump	Membrane Blower	Citric Acid R.C. Valve	Citric Acid Pump	Sodium Hypochlorite R.C. Valve	Sodium Hypochlorite Pump	
Tags							20-FV-205-x	20-FV-209-x	20-FV-502-x	23-FV-302-x	23-FV-102-x	20-FV-320-x 20-FV-321-x	20-FV-302-x	20-SV-802-x	20-P-301-x	20-P-501-x	20-B-201-A/B/C/D/E	23-FV-301	23-P-301-A/B	23-FV-101	23-P-101-A/B	**The Sequence Chart (SC), Control Logic Chart (CLC) and the Control Philosophy (CN) should all be read to assist in the understanding of plant operations.** **Comments & Sequencing Logic**
Repeated Chemical Backpulse	Step 8	MC-SP			30	sec.	-	1	-	N2	N2	-	1	-	N4 REV	-	-	-	N2	-	N2	N4: The pump runs only if To/from Permeate Collector Valve 23-FV-302-x is open confirmed by limit switches Backpulses the membrane train. N2: The state of the pump/valve is dependent on the type of cleaning chemical that is selected at the HMI Holds this step for step duration then proceeds to the next step.
Repeated Soak	Step 9	MC-SOAK-SP	5	6000	270	sec.	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	Holds this step for step duration: Repeats MAINTENANCE CLEAN - steps 7 to 9 for MC-ITR-SP iterations. After the last iteration proceeds to the next step.
Valve Alignment	Step 10		n/a	n/a	6	sec.	-	1	-	-	-	-	1	-	-	-	-	-	-	-	-	Waits for step duration, then proceeds to the next step.
Final Water Backpulse	Step 11	MC-PULSE-SP	5	200	120	sec.	-	1	-	-	-	-	1	-	N4 REV	-	-	-	-	-	-	N4: The pump runs only if To/from Permeate Collector Valve 23-FV-302-x is open confirmed by limit switches Backpulses the membrane train for the step duration and then the train proceeds to step 13. If the Flume Channel Level High trigger (FLUME-LVL-H) is not active then proceeds to the next step. Retain time left in the step. Use the time left as step duration when in this step again.
Pause Tank Fill	Step 12				--		-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	Holds this step until the Flume Channel Level High trigger (FLUME-LVL-H) is active then returns to MAINTENANCE CLEAN - step 10.
Stop Backpulsing	Step 13		n/a	n/a	6	sec.	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	Waits for step duration, then proceeds to the next step.
Final Aeration	Step 14	MC-AERA-SP	120	300	300	sec.	1	1	-	-	-	-	-	-	-	-	1	-	-	-	-	Aerates the membrane train. Holds this step for step duration then proceeds to the next step.
MAINTENANCE CLEAN Complete	Step 15		n/a	n/a	6	sec.	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	Holds this step for step duration then: In AUTO, the train proceeds to STANDBY. In SEMI-AUTO, the train proceeds to the OFF state.
Fault - Fill	Step 30				--		-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	When the membrane tank Above Membranes level trigger (20-LS-203-TOP-MEM-x) is active, the train proceeds to the next step.
Faulted	Step 31				--		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	The train remains in this step until all shutdown alarms are reset then proceeds to the MAINTENANCE CLEAN step 10.
RECOVERY CLEAN																						INTERLOCKS: The train only proceeds to RECOVERY CLEAN state if no other train is in MAINTENANCE CLEAN, RECOVERY CLEAN or NEUTRALIZATION state. This interlock includes the fault steps of the states. MODE SELECTION: The RECOVERY CLEAN state exists in SEMI-AUTO mode. If the operator selects OFF mode while in the RECOVERY CLEAN state, the train proceeds immediately to the OFF state. The operator is prohibited from selecting AUTO mode while in RECOVERY CLEAN state. STATE SELECTION: In any step of the RECOVERY CLEAN state, the operator can initiate the state: NEUTRALIZATION
Valve Alignment	Step 1		n/a	n/a	6	sec.	1	-	-	-	-	-	-	1	-	-	-	-	-	-	-	Waits for step duration, then proceeds to the next step.
Initial Aeration	Step 2	RC-AERA-SP	0	3600	300	sec.	1	-	-	-	-	-	-	N1	-	-	1	-	-	-	-	Aerates the membrane train. N1: The ejector runs for the first 6 seconds of this step. Holds this step for step duration then proceeds to the next step.
Valve Alignment	Step 3		n/a	n/a	6	sec.	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	Waits for step duration, then proceeds to the next step.
Initial Tank Drain	Step 4				--		-	-	1	-	-	-	-	-	-	1	-	-	-	-	-	Drains the membrane tank. When the membrane tank Empty Tank level trigger (20-LS-203-EMPTY-x) is active then proceeds to the next step.
Valve Alignment	Step 5		n/a	n/a	6	sec.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Waits for step duration, then proceeds to the next step.
Manual Flush	Step 6	RC-MANUAL-SP	0	1800	0	sec.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Holds this step for step duration then: If RC-ITR-SP is 0, proceeds to RECOVERY CLEAN - step 15; Otherwise, proceeds to the next step.
Valve Alignment	Step 7		n/a	n/a	6	sec.	-	-	-	-	-	-	1	-	-		-	-	-	-	-	Waits for step duration, then proceeds to the next step.
Tank Fill with Water	Step 8				--		-	-	-	-	-	-	1	-	N4 REV	-	-	-	-	-	-	RECOVERY CLEAN - steps 7 to 14 are executed for RC-ITR-SP iterations (typically 1 Iteration, adjustable from 0 - 3). N4: The pump runs only if To/from Permeate Collector Valve 23-FV-302-x is open confirmed by limit switches. Backpulses the membrane train. Holds this step until the Flume Channel Level High trigger (FLUME-LVL-H) is not active then proceeds to the next step. OR When in this step and the Chemical Fill level trigger (20-LS-203-CIP-FILL-x) is active then proceeds to RECOVERY CLEAN step 10.
Pause Tank Fill	Step 9				--		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Holds this step until the Flume Channel Level High trigger (FLUME-LVL-H) is active then returns to RECOVERY CLEAN - step 7.
Valve Alignment	Step 10		n/a	n/a	6	sec.	1	-	-	-	-	-	-	-	-		-	-	-	-	-	Waits for step duration, then proceeds to the next step.
Repeated Aeration	Step 11	RC-AERA-SP	0	3600	300	sec.	1	-	-	-	-	-	-	-	-	-	1	-	-	-	-	Aerates the membrane train. Holds this step for step duration then proceeds to the next step.
Valve Alignment	Step 12		n/a	n/a	6	sec.	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	Waits for step duration, then proceeds to the next step.
Repeated Tank Drain	Step 13				--		-	-	1	-	-	-	-	-	-	1	-	-	-	-	-	Drains the membrane tank. When the membrane tank Empty Tank level trigger (20-LS-203-EMPTY-x) is active then proceeds to the next step.
Valve Alignment	Step 14		n/a	n/a	6	sec.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	If the number of iterations completed is less than RC-ITR-SP setpoint, waits for step duration, then proceeds to step 7. After the last iteration proceeds to RECOVERY CLEAN - step 15.
Valve Alignment	Step 15		n/a	n/a	6	sec.	-	-	-	N2	N2	-	1	-	-	-	-	N2	-	N2	-	Waits for step duration, then proceeds to the next step. N2: The state of the valve is dependent on the type of cleaning chemical that is selected at the HMI

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N#: (Note number), Indicates that the state of the valve or motor depends on the conditions in the associated note in the sequencing logic.
-x : Indicates that there are multiple trains associated with this tag number.

Description							Aeration Valve	Membrane Tank Inlet Gate	Mem. Tk Recirc. Valve	CIP - Train Citric Acid Valve	CIP - Train Hypochlorite Valve	Turbidity Valves	To/from Collector Valve	Ejector Valve	Process Pump	RAS/drain Pump	Membrane Blower	Citric Acid R.C. Valve	Citric Acid Pump	Sodium Hypochlorite R.C. Valve	Sodium Hypochlorite Pump	
						Tags	20-FV-205-x	20-FV-209-x	20-FV-502-x	23-FV-302-x	23-FV-102-x	20-FV-320-x 20-FV-321-x	20-FV-302-x	20-SV-802-x	20-P-301-x	20-P-501-x	20-B-201-A/B/C/D/E	23-FV-301	23-P-301-A/B	23-FV-101	23-P-101-A/B	**The Sequence Chart (SC), Control Logic Chart (CLC) and the Control Philosophy (CN) should all be read to assist in the understanding of plant operations.** **Comments & Sequencing Logic**
Tank Fill with Chemical	Step 16				--		-	-	-	N2	N2	-	1	-	N4 REV	-	-	N2	N2	N2	N2	N4: The pump runs only if To/from Permeate Collector Valve 23-FV-302-x is open confirmed by limit switches. Backpulses the membrane train. N2: The state of the pump/valve is dependent on the type of cleaning chemical Holds this step until the Flume Channel Level High high level trigger (FLUME-LVL-H) is not active then proceeds to the next step. OR When the membrane tank level is at or above 90% of the Chemical Fill level trigger (90% x20-LS-203-CIP-FILL-x setpoint) then proceeds to RECOVERY CLEAN step 17.
Pause Tank Fill	Step 17				--		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Holds this step until the Flume Channel Level High trigger (FLUME-LVL-H) is active then returns to RECOVERY CLEAN - step 15.
Valve Alignment	Step 18		n/a	n/a	6	sec.	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	Waits for step duration, then proceeds to the next step.
Final Water Backpulse	Step 19				--		-	-	-	-	-	-	1	-	N4 REV	-	-	-	-	-	-	Backpulses the membrane train. N4: The pump runs only if To/from Permeate Collector Valve 23-FV-302-x is open confirmed by limit switches Holds this step until the Flume Channel Level High trigger (FLUME-LVL-H) is not active then proceeds to the next step. OR When in this step and the Chemical Fill level trigger (20-LS-203-CIP-FILL-x) is active then proceeds to RECOVERY CLEAN step 21.
Pause Tank Fill	Step 20				--		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Holds this step until the Flume Channel Level High trigger (FLUME-LVL-H) is active then returns to RECOVERY CLEAN - step 18.
Chemical Soak	Step 21	RC-SOAK-SP	3	24	12	hr.	N3	-	-	-	-	-	-	-	-	-	N3	-	-	-	-	N3: Runs blower and aeration valve opens, if enabled, for RC-SOAK-MIX-DUR-SP seconds every RC-SOAK-MIX-FREQ-SP seconds in this step. Holds this step for step duration then proceeds to the next step.
RECOVERY CLEAN Complete	Step 22				--		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	When NEUTRALIZATION button STATE-NEUTR-PB-x is pressed, proceeds to NEUTRALIZATION step 1.
Fault - Delay	Step 29				120	min	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Waits in this step. If the shutdown alarm clears before the step duration timer times out then proceeds as follows: if the alarm occurred in steps 1 or 2 return to step 1; in steps 3, 4, return to step 3; in steps 7, 8 return to step 7; in steps 10, 11 return to step 10; in steps 12, 13, return to step 12; step 14 return to step 14, steps 15, 16, return to step 15; in steps 18, 19 return to step 18; in steps 5, 6, 9, 17, 20, 21 and 22 return to the step where the alarm occurred. If the step duration timer times out, then proceeds to the next step.
Fault - Fill	Step 30				--		-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	When the membrane tank Above Membranes level trigger (20-LS-203-TOP-MEM-x) is active, the train proceeds to the next step.
Faulted	Step 31				--		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	The train remains in this step until all shutdown alarms are reset. . When NEUTRALIZATION button STATE-NEUTR-PB-x is pressed, proceeds to NEUTRALIZATION step 1.
NEUTRALIZATION																						INTERLOCKS: The train only proceeds to NEUTRALIZATION state if no other train is in MAINTENANCE CLEAN, RECOVERY CLEAN or NEUTRALIZATION state. This interlock includes the fault steps of the states. MODE SELECTION: The NEUTRALIZATION state exists in SEMI-AUTO mode. If the operator selects OFF mode while in the NEUTRALIZATION state, the train proceeds immediately to the OFF state. The operator is prohibited from selecting AUTO mode while in the NEUTRALIZATION state. STATE SELECTION: No state selections are permitted in NEUTRALIZATION.
Tank Fill	Step 1	--			--		-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	Holds step until the Neutralization Fill level trigger (20-LS-203-NEUT-FILL-x) is active then proceeds to next step.
Valve Alignment	Step 2	6 s	n/a	n/a	6	sec.	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	Waits for step duration, then proceeds to the next step.
Tank Aeration	Step 3	NEUT-AREA-SP	5	900	60	sec.	1	1	-	-	-	-	-	-	-	-	1	-	-	-	-	Aerates the membrane train. Holds this step for step duration then proceeds to the next step.
Tank Soak	Step 4	NEUT-SOAK-SP	5	1200	900	sec.	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	Train soaks without aeration for step duration, proceeds to the next step.
Valve Alignment	Step 5	6 s	n/a	n/a	6	sec.	-	1	-	-	-	-	1	-	-	-	-	-	-	-	-	Waits for step duration, then proceeds to the next step.
Flush Piping	Step 6	NEUT-PULSE-SP	30	7200	120	sec.	-	1	-	-	-	-	1	-	N4 REV	-	-	-	-	-	-	Backpulses the membrane train for the step duration and then the train proceeds to step 8. N4: The pump runs only if To/from Permeate Collector Valve 23-FV-302-x is open confirmed by limit switches If the Flume Channel Level High trigger (FLUME-LVL-H) is not active then proceeds to the next step. Retain time left in the step. Use the time left as step duration when in this step again.
Pause Tank Fill	Step 7	--			--		-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	Holds this step until the Flume Channel Level High trigger (FLUME-LVL-H) is active then returns to NEUTRALIZATION - step 5.
Confirm Neutralization	Step 8	--			--		-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	Prompts operator. 'Check the free chlorine concentration AND pH in the membrane tank. Proceed if free chlorine concentration AND pH are within permitted limits.' Operator presses CONFIRM NEUTRALIZATION to proceed to step 12, or presses RESUME NEUTRALIZATION to return to NEUTRALIZATION next step.
Valve Alignment	Step 9	6 s	n/a	n/a	6	sec.	1	1	1	-	-	-	-	-	-	-	LS	-	-	-	-	Waits for step duration, then proceeds to the next step.
Additional Mixed Liquor	Step 10	NEUT-FILL-SP	5	120	60	sec.	1	1	1	-	-	-	-	-	-	1	1	-	-	-	-	Holds step to add additional mixed-liquor and aerates the membrane train. Waits for step duration, then proceeds to the next step.
Confirm Neutralization	Step 11	--					1	1	-	-	-	-	-	-	-	-	1	-	-	-	-	Prompts operator. 'Check the free chlorine concentration AND pH in the membrane tank. Proceed if free chlorine concentration AND pH are within permitted limits.' Operator presses CONFIRM NEUTRALIZATION to proceed to next step, or presses RESUME NEUTRALIZATION to return to NEUTRALIZATION step 9.
NEUTRALIZATION Complete	Step 12	6 s	n/a	n/a	6	sec.	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	Holds this step for step duration then proceeds to the OFF state.

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						Description	Aeration Valve	Membrane Tank Inlet Gate	Mem. Tk Recirc Valve	CIP - Train Citric Acid Valve	CIP - Train Hypochlorite Valve	Turbidity Valves	To/from Collector Valve	Ejector Valve	Process Pump	RAS/drain Pump	Membrane Blower	Citric Acid R.C. Valve	Citric Acid Pump	Sodium Hypochlorite R.C. Valve	Sodium Hypochlorite Pump	
						Tags	20-FV-205-x	20-FV-209-x	20-FV-502-x	23-FV-302-x	23-FV-102-x	20-FV-320-x 20-FV-321-x	20-FV-302-x	20-SV-802-x	20-P-301-x	20-P-501-x	20-B-201-A/B/C/D/E	23-FV-301	23-P-301-A/B	23-FV-101	23-P-101-A/B	**The Sequence Chart (SC), Control Logic Chart (CLC) and the Control Philosophy (CN) should all be read to assist in the understanding of plant operations.** **Comments & Sequencing Logic**
Fault - Delay	Step 29				120	min	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	If the shutdown alarm is reset before the step duration timer times out, then if the alarm occurred: in step 1, return to step 1; in step 2, return to step 2; in step 3, return to step 2; in step 4, return to step 4; in step 5, return to step 5; in step 6, return to step 5; in step 7, return to step 5; in step 8, return to step 8; in step 9, return to step 8; in step 10, return to step 8; in step 11, return to step 8; in step 12, return to step 12. If the step duration timer times out, proceeds to the next step.
Fault - Fill	Step 30				--		-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	When the membrane tank Above Membranes level trigger (20-LS-203-TOP-MEM-x) is active, the train proceeds to the next step.
Faulted	Step 31				--		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	The train remains in this step until all shutdown alarms are reset then When NEUTRALIZATION button STATE-NEUTR-PB-x is pressed, proceeds to NEUTRALIZATION step 1.

GENERAL INFORMATION:

1 For operator protection, sodium hypochlorite pumps are interlocked at the PLC with the citric acid pumps to prevent them from running at the same time Mixing sodium hypochlorite and citric acid generates chlorine gas. Chlorine gas is toxic at levels greater than 1 ppm. Refer to CLC for further information.
2 Devices will follow the start-up sequence described in the CLC when powering up.
3 A train proceeds to the first fault step when a normal shutdown alarm is active. A train proceeds to the last fault step when an immediate shutdown alarm is active (loss of power or loss of communication between the train panel and the PLC). Shutdown alarms are described in detail in the CLC.
4 In all state transitions, the PLC proceeds to the first step of the state.

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Tag/Mnemonic	Description	Type	Category	Range Min	Range Max	Setpoint	Units	Set	Action or Derivation	Reset	Notes
Plant Information and Control Panel Devices											
UF-QTY	Number of Ultrafilter Trains	General Info	Trains	N/A	N/A	4	Trains		There are x similar Ultrafilter Trains.		
	UF Membrane Area Per Module	General Info	Membrane	N/A	N/A	370	ft^2		Hardcoded		
	Number of UF Membranes Per Train	General Info	Membrane	N/A	N/A	292			Hardcoded		
AREA-x	UF Membrane Area Per Train	General Info	Area	N/A	N/A	108040	ft^2		Hardcoded		
PLANT-DEM-MAX-SP	Maximum UF Permeate Flow Demand	Setpoint	Flow	N/A	N/A	8332	gpm		Hard-coded peak flow demand.		
LOGOUT-PB	Log Out	Button	Security					When the button is pressed.	Logs out the current user and restores the guest level of security access.		
ALARM-SILENCE-PB	Alarm Silence	Button	Panel					When the button is pressed.	Silences the alarm horn.		
ALARM-CALLOUT	General Callout	Trigger	Panel					When any critical alarm is on.	Energizes a callout relay.	When all critical alarms are clear.	
PLC-RESET-PB	Main Panel Alarm Reset	Button	Panel					When the area reset button is pressed.	Resets alarms associated with the PLC processor, main panel, and ancillary panel (PLC Processor Power, PLC Battery, etc.).		
UF-RESET-PB-x	UF Train Alarm Reset	Button	Panel					When the area reset button is pressed.	Resets alarms to restore normal operation of the UF Train.		
UF-BLW-MEM-RESET	Membrane Blower Alarm Reset	Button	Panel					When the area reset button is pressed.	Resets alarms to restore normal operation of Membrane Aeration Blowers.		
UF-AC-RESET	Air Compressor alarm Reset	Button	Panel					When the area reset button is pressed.	Resets alarms to restore normal operation of Air Compressors		
UFCIP-RESET-PB	UF CIP Alarm Reset	Button	Panel					When the area reset button is pressed.	Resets alarms to restore normal operation of UF CIP equipment. This area includes the chemical dosing pumps.		
WASTE-RESET-PB	Wasting Area Alarm Reset	Button	Panel					When the area reset button is pressed.	Resets alarms to restore normal operation of Wasting Area		
System Power and Communications											
PLC-BATTERY-FAULT	PLC Battery Fault	Alarm - Advisory	Control					When the fault status is active.	Alarm only.	When the fault status is no longer active.	
IO-RING-BROKEN	I/O Ring Broken Alarm	Alarm - Advisory	Panel					When a break is detected in the Ethernet ring that connects the PLC with its i/o network, for 10	Alarm only. The ring architecture allows uninterrupted operation, unless broken	When the ring is restored.	
SYSTEM-STOP	System Stop Alarm	Alarm - Critical	Panel					When the system stop button on the control panel is pressed. Inhibited if the PLC cannot communicate with the i/o, or if DC power to the panel is not on.	All UF trains proceed to the first Fault step of the current state. All pumps/blowers are interlocked Resets the PLC Power Up Step sequence.	When the Main Panel Reset Button is pressed AND the SYSTEM-STOP input signal is no longer active.	Note the System stop button is on the panel. It is a mechanical button
TRAIN-STOP-x	UF Train Stop Alarm	Alarm - Critical	Panel					When the operation stop button on the UF panel is pressed. Inhibited if the PLC cannot communicate with the i/o, or if DC power to the panel is not on.	Proceeds to the first Fault step of the current state. Interlocks the Process Pump.	When the train's Alarm Reset button is pressed.	Note the System stop button is on the panel. It is a mechanical button
PLC-FLASH-LOAD	PLC Program Loaded from Flash	Alarm - Critical	Panel					When the PLC program has been loaded from flash memory.	Alarm only. Serves as an indicator that the PLC has drawn an archive from its flash memory, in response to a critical memory corruption. All data, including operating modes, setpoints, totalizers, and alarms, has been lost. Any unarchived change to the PLC logic has also been lost. Assuming equipment was stopped when the flash memory was burned, equipment will be stopped when the program is restored. If undesirable to load from flash, the flash memory can be removed. If removed, a programmer must reload the processor in response to a memory corruption.	When the Main Panel Alarm Reset button is pressed.	
PLC-FORCES-ENABLED	PLC I/O Forces Enabled	Alarm - Advisory	Panel					When any I/O point is forced.	Alarm only.	When all forces are removed.	
CLOCK-SYNCH	Repeated PLC Clock Synchronization	Alarm - Advisory	Panel					When the PLC clock has synchronized to an HMI clock twice in 30 minutes.	Alarm only. Typically an indicator that more than one HMI station is configured to be the master time source for PLC/HMI clock synchronization.	When the Main Panel Alarm Reset button is pressed. If 30 minutes has elapsed since a clock synchronization event, the alarm is automatically reset.	
CP-01-SURGE-SUPPRESSOR	CP-01 Panel Surge Suppressor Fault	Alarm - Advisory	Panel					When the fault switch is active for 10 seconds.	Alarm only.	When the switch is no longer active.	
UF-SURGE-SUPPRESSOR-x	UF Panel Surge Suppressor Fault (CP-11, CP-12, CP-13, CP-14)	Alarm - Advisory	Panel					When the fault switch is active for 10 seconds.	Alarm only.	When the switch is no longer active.	
PLC-COMM-ENET	Communication with other PLCs has been lost	Alarm - Critical	Settings					When the "heartbeat" in the client's PLC is not incremented in 5 seconds.	The plant permeate demand is based on the calculated trim value. Wasting is inhibited.	When the "heartbeat" in the client's PLC is incremented.	Do not need to wait for the UV signal. Client comment
POWER-RESTART-AUTO-PB/ POWER-RESTART-MANUAL-PB	Auto Restart/Manual Restart	Panel	Panel					When the Auto Restart button is pressed.	When the button is selected allows the PLC Power Up Step sequence to automatically restart the UF trains and associated equipment. When Manual: Requires user to manually reset the alarms to restart a UF trains.	When the Manual Restart button is pressed.	
POWER-RESTART-AUTO	Power Restored Auto Restart	Plant	Plant					When the Auto Restart button is pressed.	When on: - Allows the PLC Power Up Step sequence to automatically restart a process area. When off: - Requires user reset to restart a process area.	When the Manual Restart button is pressed.	

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PLANT-PLC-POWER	PLC Processor Power Restored	Plant	Plant					When power is restored to the PLC processor.	Alarm only.	120 seconds after power is restored.	
PLC-NODE-ENET	Main Panel CP-01 Primary Rack Ethernet Module Alarm	Panel	Panel					When Ethernet Module Status is Failed for 5 seconds.	All trains proceed to the Faulted step of the current state. Resets the PLC Power Up Step sequence.	When the Main Panel CP-01 Alarm Reset button is pressed. If the Power Restored Auto Restart option is on, the alarm is automatically reset when communications are restored.	
MAIN1-NODE-ENET	Main Panel I/O Rack 1 Alarm	Panel	Panel					When communications between the PLC and Rack 1 is lost for 5 seconds. Inhibited if the Main Panel CP-01 Primary Rack Ethernet Module Alarm PLC-NODE-ENET is active.	Resets the PLC Power Up Step sequence. Proceeds to Faulted step 31 of the current state.	When the Main Panel Alarm Reset button is pressed. If the Power Restored Auto Restart option is on, the alarm is automatically reset when communications are restored.	
MAIN2-NODE-ENET	Main Panel I/O Rack 2 Alarm	Panel	Panel					When communications between the PLC and Rack 2 is lost for 5 seconds. Inhibited if the Main Panel CP-01 Primary Rack Ethernet Module Alarm PLC-NODE-ENET is active.	Resets the PLC Power Up Step sequence. Proceeds to Faulted step 31 of the current state.	When the Main Panel Alarm Reset button is pressed. If the Power Restored Auto Restart option is on, the alarm is automatically reset when communications are restored.	loss of compressed air switch
PLANT-AC-POWER	Main Panel AC Power Alarm	Panel	Panel					When AC power to the main panel is interrupted. Inhibited if the PLC cannot communicate with the i/o.	Resets the PLC Power Up Step sequence. Proceeds to Fault step 31 of the current state.	When the Main Panel Alarm Reset button is pressed. If the Power Restored Auto Restart option is on, the alarm is automatically reset when power has been restored for 10 seconds.	
UF-NODE-ENET-x	UF Train I/O Rack Alarm	Panel	Panel					When communications between the PLC and the i/o rack is interrupted for 5 seconds. Inhibited if the PLC cannot connect to the i/o network or Main Panel AC Power Alarm UF-AC-POWER is active.	Inhibits fault alarms from process instruments. Proceeds to Faulted step 31 of the current state.	When the train's Alarm Reset button is pressed. If the Power Restored Auto Restart option is on, the alarm is automatically reset when communications are restored.	
UF-AC-POWER-x	UF Train AC Power Alarm	Panel	Panel					When AC power to the UF panel is interrupted. Inhibited if the PLC cannot communicate with the i/o.	Proceeds to Faulted step 31 of the current state. Inhibits fault alarms from process instruments.	When the train's Alarm Reset button is pressed. If the Power Restored Auto Restart option is on, the alarm is automatically reset when power has been restored for 10 seconds.	
POWER-PLC-STEP0	PLC Power Up Step 0 (immediate start)	Plant	Plant					Requires all of the following: - Communications between the PLC and the i/o network. - Communications between the PLC and main panel i/o. - Main Panel AC Power. - system stop alarm is not active 90-PALL-002 instrument pressure low alarm is not active	Starts the PLC Power Up Step sequence.	Reset by any of the following: - first scan of PLC after power up - Main Panel Processor Rack Alarm - Main Panel I/O Rack Alarm - Main Panel AC Power Alarm - System Stop Alarm SYSTEM-STOP is active 90-PALL-002 instrument pressure low alarm is active	
POWER-UP-PLANT	Power Up for Plant Equipment	Plant	Plant					0 seconds after PLC Power Step 0 is complete.	When reset: - If the Power Restored Auto Restart option is off, alarms for individual process areas are activated. This alarm is UF Train Power Down Alarm. Normal operation is restored on reset of these alarms. - If the Power Restored Auto Restart option is on, shutdown commands are set for individual process areas UF Train x). These commands trigger a transition to the first Fault step of the current state, without individual alarms for each area. Normal operation is restored by the Power Up Step sequence. When set, if the Power Restored Auto Restart option is off: - Power alarms for individual process areas can be reset. Shutdown commands for these areas remain active until these alarms have been reset. When set, if the Power Restored Auto Restart option is on: - Power loss and communications alarms for individual process areas are inhibited and/or automatically reset. For these process areas, shutdown commands remain active until cleared by the PLC Power Up Step sequence. These shutdown commands are also used to inhibit fault alarms from process instruments.		
POWER-UP-I/O	Power Up for I/O Hardware	Plant	Plant					10 seconds after PLC Power Step 0 is complete.	Allows fault alarms from process instruments (unless inhibited by other alarms and/or triggers).		
POWER-PLC-STEP1	PLC Power Up Step 1	Plant	Plant					30 seconds after the previous power step is complete.	If the Power Restored Auto Restart option is on: Sends a UV request to run.		
POWER-PLC-STEP2	PLC Power Up Step 2	Plant	Plant					30 seconds after the previous power step is complete.	If the Power Restored Auto Restart option is on: - Ends the shutdown command for UF Train 1, allowing its sequences to automatically transition from a Faulted step.		

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POWER-PLC-STEP3	PLC Power Up Step 3	Plant	Plant					30 seconds after the previous power step is complete.	If the Power Restored Auto Restart option is on: - Ends the shutdown command for UF Train 2, allowing its sequences to automatically transition from a Faulted step.		
POWER-PLC-STEP4	PLC Power Up Step 4	Plant	Plant					30 seconds after the previous power step is complete.	If the Power Restored Auto Restart option is on: - Ends the shutdown command for UF Train 3, allowing its sequences to automatically transition from a Faulted step.		
POWER-PLC-STEP5	PLC Power Up Step 5	Plant	Plant					30 seconds after the previous power step is complete.	If the Power Restored Auto Restart option is on: - Ends the shutdown command for UF Train 4, allowing its sequences to automatically transition from a Faulted step.		
UF Train Rotation											
	Freeze Protection Rotation	General Info	Mode						There are selector switches on the HMI to enable/disable Freeze Protection Rotation. During this switching time the request for the number of running blowers is the same as before.		Freeze Protection Rotation is intended for use during periods of lower flow demand in cold weather to prevent permeate from freezing in headers. Freeze Protection Rotation operation is for plants that can freeze and is programmed to force a train which is in STANDBY more than 30 minutes (typically) to go to service (this train will stay in service for at least 200 sec (typically)) other service trains will be pushed (by logic) into STANDBY because of high production time.
FREEZE-EN/ROTATION-EN-PB	Enable All-Day Freeze Protection Rotation /Enabled Freeze Protection Rotation between Hr.-Start and Hr.-Stop/ Enable Train Rotation	Button	Mode					When the Enable All-Day Freeze Protection Rotation or Enabled between Hr.-Start and Hr.-Stop is pressed	All-Day Freeze Protection Rotation: Trains will Proceed to Production according to the Starting Priority, Start Triggers and FREEZE-PROD-TRIG. This rotation will continue until the operator switches to another rotation. Enabled between Hr.-Start and Hr.-Stop: Trains will Proceed to Production according to the Starting Priority, Start Triggers and FREEZE-PROD-TRIG when the HR-START trigger is active and rotate according train rotation when HR-STOP trigger is active. Enable Train Rotation: Trains Proceed to Production according to Starting Priority / Start Trigger and Train Rotation		membrane tanks are outside
HR-START	Start Time for Freeze Protection Rotation	Trigger	Schedule	0	23	Determined by Operator	hr.		Operator entered value to start Freeze Protection on each day when Freeze Protection is time limited.		
HR-STOP	Stop Time for Freeze Protection Rotation	Trigger	Schedule	0	23	Determined by Operator	hr.		Operator entered value to stop Freeze Protection on each day when Freeze Protection is time limited.		
FREEZE-PROD-TRIG	Freeze Protection Rotation - Force Train to PRODUCTION from STANDBY Trigger	Trigger	Sequence					IN STANDBY: - all steps, when Freeze Protection Rotation is Enabled AND FREEZE-STBY-DUR-SP is active, AND the Train has the highest Starting Priority AND FREEZE-PROD-MIN-SP has timed out for any train in PRODUCTION.	IN STANDBY: - the train proceeds to PRODUCTION as per the SC.	IN PRODUCTION: - after timer for FREEZE-PROD-MIN-SP is started.	
FREEZE-STBY-DUR-SP	Freeze Protection Rotation STANDBY duration	Trigger	Sequence	600	3600	1800	sec.	IN STANDBY & Freeze Protection Rotation IS ENABLED: - all steps, the train is in STANDBY for the setpoint duration or longer.	Trigger is used in the SET conditions for FREEZE-PROD-TRIG.		This timer prevents trains from spending extended time in STANDBY during cold weather.
FREEZE-PROD-MIN-SP	Freeze Protection Rotation Train Minimum time in PRODUCTION	Trigger	Sequence	100	500	200	sec.	IN PRODUCTION: step 1, when FREEZE-PROD-TRIG is active. OR IN PRODUCTION & TRAIN HAS HIGHEST PRIORITY FOR STANDBY: - when the 'Enable Freeze Protection Rotation' button is pressed.	IN PRODUCTION: step 1, starts timer.	When not in PRODUCTION, BACKPULSE, RELAX, timer resets.	This is the minimum time to wait between cycling trains.
ROTATION-TIME-SP	Train Rotation Time	Trigger	Trains	0.5	72	1	hr.	Freeze Protection Rotation is disabled. When timer times out, at the setpoint; System triggers a Standby request, if there is a train in STANDBY step 2 for two seconds with no Standby alarms and is available to start If there are no trains in STANDBY step 2 available to start, when timer times out, Standby request is ignored and maintained. Note: Trains in Demand Override are not affected by Rotation time	When timer times out and there is at least one train in STANDBY, timer resets and resumes timing, OR when the train with the highest priority to stop is not in the Production cycle, timer resets and resumes timing, OR when there are no trains in PRODUCTION, BACKPULSE, or RELAX, timer resets and stops.	When timer times out and there is at least one train in STANDBY, timer resets and resumes timing, OR when the train with the highest priority to stop is not in the Production cycle, timer resets and resumes timing, OR when there are no trains in PRODUCTION, BACKPULSE, or RELAX, timer resets and stops.	This timer balances the usage of trains and prevents trains from spending extended time in STANDBY.
InSight											

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TRAIN-SHUTDOWN-CNTR-x	Train Shutdown Counter	Derived - Internal	Sequence	0	100000			When the train proceeds to the first Fault step of a state	Adds 1 to the counter.	At midnight, resets count to 0 after current value is put into TRAIN-SHUTDOWN-CNTR-YDAY-x	Counter increases by one each time a Critical Alarm is active and proceeds to the first Fault step of a state.
TRAIN-SHUTDOWN-CNTR-YDAY-x	Train Yesterday's Shutdown Counter	Derived - Internal	Sequence	0	100000			At midnight	Set to TRAIN-SHUTDOWN-CNTR-x		
	UF Train Mode	InSight	Sequence						InSight capture		
	UF Train State	InSight	Sequence						InSight capture		
Feed System											
FEED-FLOW	Feed Flow	Comm. In	Flow	0.0	25200.0		gpm	Feed flow is communicated over the Ethernet to the SUEZ WT&S PLC.	Displays value with engineering units on screen.		The Plant Feed flow is the basis for permeate demand.
FEED-FLOW-AVG	Moving Average Plant Feed Flow	Derived - Display	Flow	0.0	25200.0		gpm		This is a moving average of FEED-FLOW for 15 minutes and the sample time is once every 1 minute. These times can be adjusted if required. Default times are used unless process provides other information.		A moving average is used to prevent rapid changes and equalize intermittent spikes in plant demand.
FEED-FLOW-TOT	Today's Feed Volume	Derived - Display	Volume				gal		Totalized the flow FEED-FLOW Includes a running total for the current day total (_TODAY), yesterday day total (_DAY1)		
Permeability											
FLUX-x	Instantaneous Train Flux	Derived - Display	Flux				gfd		Train Flux = Permeate flow /membrane area FLUX-x= (20-FI-307-x)(1440 min/day)/AREA-x This value is to trended.		
PERMEABILITY-x	Train Instantaneous Permeability at Actual Temperature	Derived - Display	Permeability				gfd/psi		Permeability = Flux/TransMembrane Pressure (TMP) PERMEABILITY-x = FLUX-x/TMP-PV-x The absolute value of the number.		
ZeeWeed Process Information											
	Display of Operational State and step number.	General Info	Mode						The current operating state and the step number is displayed on the screen. Time remaining for steps with a timed duration is displayed.		Only the mode name and step number are required. Step descriptions are not required.
	Number of trains permitted in a given mode	Interlock	Mode						Consult the SC for details.		Interlocks are shown in the SC in the first line of each mode.
MODE-AUTO-PB-x	AUTO Mode Button	Button	Mode					When the button is pressed.	Changes mode to AUTO and proceeds as per SC.		The train cycles through states automatically as required provided all necessary equipment is in auto and available.
MODE-SEMI-AUTO-PB-x	SEMI-AUTO Mode Button	Button	Mode					When the button is pressed.	Changes mode to SEMI-AUTO and proceeds as per SC.		
MODE-OFF-PB-x	OFF Mode Button	Button	Mode					When the button is pressed.	Changes mode to OFF and proceeds as per SC.		NOTE: User is responsible for the use of this button to ensure that a cleaning solution will be handled as required before proceeding to production.
STATE-PRIME-PB-x	PRIME Button	Button	State					When the button is pressed.	In states as per SC, proceeds to PRIME if interlocks are not present. If interlocks are present, sets Prime Pending Indicator.		
STATE-BP-PB-x	BACKPULSE Button	Button	State					When the button is pressed.	In states as per SC, proceeds to BACKPULSE if interlocks are not present.		
STATE-MC-ACID-PB-x	M. CLEAN with CITRIC ACID Button	Button	State					When the button is pressed.	In states as per SC, proceeds to MAINTENANCE CLEAN for an Acid Clean if interlocks are not present. Consult interlocks in CLC and SC for more information.		
STATE-MC-CHL-PB-x	M. CLEAN with SODIUM HYPOCHLORITE Button	Button	State					When the button is pressed.	In states as per SC , proceeds to MAINTENANCE CLEAN for a Chlorine Clean if interlocks are not present. Consult interlocks in CLC and SC for more information.		
STATE-RC-ACID-PB-x	R. CLEAN WITH CITRIC ACID Button	Button	State					When the button is pressed.	In states as per SC, proceeds to RECOVERY CLEAN for an Acid Clean if interlocks are not present. Consult interlocks in CLC and SC for more information.		
STATE-RC-CHL-PB-x	R. CLEAN WITH SODIUM HYPOCHLORITE Button	Button	State					When the button is pressed.	In states as per SC, proceeds to RECOVERY CLEAN for a Chlorine Clean if interlocks are not present. Consult interlocks in CLC and SC for more information.		
STATE-NEUTR-PB-x	NEUTRALIZATION Button	Button	State					When the button is pressed.	In states as per SC, proceeds to NEUTRALIZATION if interlocks are not present.		
	Standby Priority	General Info	Demand						A train that has been in the Production Cycle the longest time has the highest priority to proceed to STANDBY from PRODUCTION. A train in demand override, has the lowest priority to proceed to STANDBY.		
	Starting Priority	General Info	Demand						A train that has been in STANDBY the longest time has the highest priority to proceed to PRODUCTION from STANDBY.		
TRAINS-PROD-QTY	Number of Trains Cycling through the Production Cycle	Derived - Internal	Trains						This is the number of trains in the non faulted steps of PRODUCTION, BACKPULSE RELAX.		

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TRAINS-PROD-SUPER-QTY	Number of Trains Cycling through the Production Cycle with Supervisory Flow Setpoint	Derived - Internal	Trains						This is the number of trains in PRODUCTION, BACKPULSE, or RELAX, with a supervisory flow setpoint.		
TRAINS-MC-QTY	Number of Trains in Maintenance Clean	Derived - Internal	Trains						This is the number of trains in MAINTENANCE CLEAN.		
TRAINS-STBY-QTY	Number of Trains Ready for Production	Derived - Internal	Trains						This is the number of trains in step 2 of STANDBY.		
PROD-CYCLE-SP	Production Cycle Timer - total time to complete one Production sequence plus one Backpulse/Relax sequence.	Setpoint	Sequence	8	15	12	min.	When a train enters the production cycle for the first time and no other train is in the production cycle.	Value entered at the HMI, in minutes. Time remaining in the production cycle for each train, (PROD-CYCLE-x,) is displayed. The timer keeps running through all of the valve alignment steps and through backpulse. If all trains are in OFF / STANDBY the time is retained. When trains enter the production cycle the timer resumes."	When the full production duration has expired.	
MC-ABORT-ALM-x	Maintenance Clean Aborted	Alarm - Advisory	Sequence					In MAINTENANCE CLEAN & PRODUCTION: When MC-DELAY-ALM-x is active or In MAINTENANCE CLEAN When the operator selects the OFF button or the train is in a fault step	Alarm only.	When the UF train's Alarm Reset button is pressed	
RC-ABORT-ALM-x	Recovery Clean Aborted	Alarm - Advisory	Sequence					In RECOVERY CLEAN: When an alarm puts the train to the any Fault step or the operator selects the OFF button.	Alarm only.	When the UF train's Alarm Reset button is pressed	
NEUTR-ABORT-ALM-x	Neutralization Aborted	Alarm - Advisory	Sequence					In NEUTRALIZATION: When an alarm puts the train to any Fault step or the operator selects the OFF button.	Alarm only.	When the UF train's Alarm Reset button is pressed	
REQ-CANCEL-PB-x	Cancel Request Button	Button	Sequence					When the Cancel button is pressed.	Cancels any pending request for the following modes: PRIME, BACKPULSE, Maintenance Clean, Recovery Clean and Neutralization		
REQ-WAS-CANCEL-PB-x	WAS Cancel Request Button	Button	Sequence					When the WAS Cancel button is pressed.	Cancels the wasting schedule and resets the value of WAS-TARGET		
PRIME-PENDING-MSG-x	Prime Pending Indicator	Button	Sequence					When a train is unable to start a requested PRIME sequence.	Displays next to Train State Indicator: Prime Pending	Indicator clears when the train is in PRIME step 1.	
MC-PENDING-MSG-x	Maintenance Clean Pending Indicator	Indicator	Sequence					When a train is unable to start a requested MAINTENANCE CLEAN sequence.	Displays on HMI screen "Maintenance Clean Pending"	Indicator clears when the train is in MAINTENANCE CLEAN step 1.	
DEMAND-OVERRIDE-EN/DIS-PB-x	Enable/Disable Demand Override	Button	Sequence						When ENABLED the trains proceed to the production cycle but without waiting for the start trigger. The stop trigger for the train is inhibited, the train is not affected by the rotation timer. The UV Run Demand UV_SYS_REQ is communicated When DISABLED the trains proceed to production cycle based on the start /stop triggers and the train rotation trigger.		Client comments in CP UF not required to wait for UV.
Membrane Aeration System											
UF-STBY-AIR	Standby Aeration Order	Derived - Internal	Sequence						IN STANDBY: - step 2, trains are aerated for 20-KQS-201C seconds one at a time, immediately one after another until the last train in STANDBY is aerated. Trains are aerated in order according to the train number. For example, if trains 1, and 2 are in STANDBY, train 1 is aerated first, followed by train 2 . The aeration order is repeated for the trains in STANDBY every 20-KQS-201D seconds.		
ASB-INSUF-BLR	Insufficient Membrane Blowers Available	Alarm - Critical	Blower					IN STANDBY, RELAX, PRODUCTION, BACKPULSE, MAINTENANCE CLEAN, RECOVERY CLEAN & NEUTRALIZATION: - all steps, when the number of blowers required to run is above the number of blowers available.	Shutdown trains in the following order until there are sufficient blowers IN STANDBY: - close the aeration valve and do not run a blower for this aeration demand. -delay six seconds and if there are still insufficient blowers IN MAINTENANCE CLEAN, RECOVERY CLEAN & NEUTRALIZATION: - all steps, continues steps without blower and close the aeration valve. -delay six seconds and if there are still insufficient blowers IN PRODUCTION, RELAX, & BACKPULSE: - the train with the highest standby priority goes to the first Fault step. -delay six seconds and if there are still insufficient blowers, repeat this process until the available blowers can meet the aeration demand or all the trains are Shutdown.	When the number of blowers required to run is less than the number of blowers available.	

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20-MQAL-201	Membrane Blowers Not Available	Alarm - Critical	Blower					When there are no blowers available for membrane aeration in auto for 2 seconds.	IN STANDBY, PRODUCTION, RELAX, & BACKPULSE: - trains proceed to the first Fault step of the current state. IN MAINTENANCE CLEAN, RECOVERY CLEAN & NEUTRALIZATION: - all steps, continues steps without blower and closes the aeration valve.	When the Membrane Blower Alarm Reset button UF-BLW-MEM-RESET is pressed	the membranes will sludge due to lack of aeration
STANDBY-AER-PB	Enable/Disable Train Standby Aeration	Button	Sequence						When enabled the trains are aerated in Standby step 2 according to the frequency and duration timers. When disabled the trains are not aerated in Standby step 2.		
20-KQS-201C	Train in Standby Aeration/RAS Duration	Setpoint	Sequence	120	600	300	sec.	IN STANDBY: step 2 when intermittent Standby aeration is enabled STANDBY-AER-PB.	IN STANDBY: step 2, aerates the membranes for 20-KQS-201C every 20-KQS-201D and recirculates the RAS. The 20-KQS-201D times out before 20-KQS-201C can start.	When no trains are in STANDBY step 2.	Trains are periodically aerated in STANDBY to prevent the membrane tank from going anoxic and to desludge the membranes.
20-KQS-201D	Train in Standby Aeration/RAS Frequency for Leap	Trigger	Sequence	N/A	N/A	1800	sec.	Initially, in STANDBY: step 2 and there after every time the timer times out. This setpoint is hardcoded.	IN STANDBY: step 2, aerates the membrane tank and circulates the RAS for 20-KQS-201C seconds every 20-KQS-201D seconds. IN PRODUCTION, BACKPULSE, RELAX - when the timer times out, make the decision to use High or Low flow aeration for all trains, based on; 1) the resistance controller, and if Low Flow aeration is enabled, and 2) if the flow is below the setpoint for Net Permeate Flow Trigger, High Flow Aeration for Plant 20-FY-307-x . In Standby/M.C./R.C./Neut the results of the train's resistance calculation is not included in the decision to use High or Low flow aeration.	When the timer times out.	
	Standby RAS	trigger	Sequence					When no RAS/DRAIN pump is requested to run according to the SC.	IN STANDBY step 2: Open Membrane Tank Recirc Valve and start and run RAS pump on the train with the highest starting Priority.	When there is demand for RAS/drain pump in STANDBY, PRODUCTION, RELAX, BACKPULSE	
20-YA-201-A/B/C/D/E	Membrane Aeration Blower Fail	Alarm - Advisory	Sequence					When blower is called to run: - if running confirmation is missing for 5 seconds. When 10 seconds has elapsed since blower last called to run: - if running confirmation is detected for 5 seconds.	Faults and interlocks blower	When the blower Alarm Reset button is pressed or When the Membrane Blower Alarm Reset button UF-BLW-MEM-RESET is pressed	
20-MQIC-201	Membrane Blowers Lead Alternation	Button	Blower						Chooses which device or devices will run in response to a demand. When running based on time switch without waiting for the blower to stop Refer to Gen. Info. tab for lead alternation logic. See the control philosophy for the number of operating blowers. Transition Overlap = 0 seconds		
20-OMIN-201	Minimum Membrane Blowers Speed	Setpoint	Blower	35	100	35	%		Operator entered minimum Blower speed for speed setpoint, 20-SC-201-A/B/C/D/E Plant setpoint.		
20-FAL-201-A/B/C/D/E	Membrane Aeration Blower Air Flow Low	Alarm - Advisory	Flow			discrete		When the Blower has been running and the switch is active for 10 seconds.	Faults and interlocks blower	When the Membrane Blower Alarm Reset button UF-BLW-MEM-RESET is pressed or the blower Alarm Reset button is pressed	The blower is stopped when its low flow switch is active. The blower is not providing the required aeration and has probably failed (broken belt).
20-TAH-201-A/B/C/D/E	Membrane Aeration Blower Temperature Alarm	Alarm - Advisory	Temperature			discrete		When the Blower has been running and the switch is active for 10 seconds.	Faults and interlocks blower	When the Membrane Blower Alarm Reset button UF-BLW-MEM-RESET is pressed or the blower Alarm Reset button is pressed	blower protection
B-201-WD-DUR	Wind Down Time for Membrane Aeration Blower	Setpoint	Blower	N/A	N/A	30	sec.	IN ALL STATES: - all steps, when a blower runs then stops, timer starts. One setpoint with multiple equipment run times. This is a hard coded setpoint	Each blower will be unavailable to start until it has been stopped for this length of time. When a blower's wind down timer is active, it is considered available.	When the timer times out.	Check with mechanical engineer to find out the wind down time. This is required for all blowers
20-SC-201-A/B/C/D/E	Aeration Motor Speed Setpoint	Setpoint	Blower	20-OMIN-201	100		%		In the Control Philosophy, the aeration table for the blower speed per aeration demand provides the speed setpoint.		
Leap Aeration											
20-ZAO-205-x	MEMBRANE AIR - Aeration Valve Failed to Open	Alarm - Critical	Valve					When valve is called to open: - if open confirmation is missing or closed confirmation is detected, for 6 seconds.	IN STANDBY, PRODUCTION, BACKPULSE & RELAX - all steps, proceeds to the Fault step of the current state. IN MAINTENANCE CLEAN & RECOVERY CLEAN & NEUTRALIZATION & PRIME: - all steps, continues Maintenance Clean or Recovery Clean or Neutralization without aeration.	When the valve's Reset Alarm button is pressed or the UF train reset button is pressed.	An aeration valve that fails to open will prevent proper aeration and may dead head the blower. The train must be shut down to prevent fouling.

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Tag/Mnemonic	Description	Type	Category	Range Min	Range Max	Setpoint	Units	Set	Action or Derivation	Reset	Notes
20-ZAC-205-x	MEMBRANE AIR - Aeration Valve Failed to Close	Alarm - Critical	Valve					When valve is called to close: - if closed confirmation is missing or open confirmation is detected, for 6 seconds.	IN PRODUCTION & BACKPULSE, RELAX, & NEUTRALIZATION: - all steps, continues. Train does not proceed to Standby due to an active Plant Permeate Demand Standby Trigger, (i.e., PLANT-DEM-STOP has no effect for this train). Maintenance Cleans and Recovery Cleans are prevented. IN MAINTENANCE CLEAN & RECOVERY CLEAN: - all steps, proceeds to the first Fault step of the current state.	When the valve's Reset Alarm button is pressed or the UF train reset button is pressed.	If there's a UF Permeate Demand Start Trigger active (e.g. PLANT-DEM-START1, PLANT-DEM-START2, etc.), the train will have the highest priority to proceed to PRODUCTION as it is receiving aeration The train will preferentially remain in PRODUCTION until there no longer is a UF Permeate Demand (i.e. UF Permeate Demand Standby Trigger - One to No Trains Running PLANT-DEM-STOP1 is active.
	Low Flow Aeration	General Info	Membrane Aeration						The low aeration flow setpoint is half the high aeration flow setpoint. See the Control Philosophy.		
	Resistance Calculation for Low Flow Aeration	General Info	Membrane Aeration						The resistance calculation will be run from the end of a BP/relax to the beginning of a BP/relax for every cycle for each train (i.e. permeation cycle). The trigger to be in High or Low (outputs from Ri-resistance initial and Rc-resistance cake) will always be saved for the last complete cycle.		
20-FY-307-x	Net Permeate Flow Trigger, High Flow Aeration	Trigger	Membrane Aeration					IN BACKPULSE, RELAX, PRODUCTION: - when NET-PERM-CALC-SP-x or NET-PERM-SUPER-SP-x is greater than this setpoint 20-FY-307-SP-x for 5 minutes	IN STANDBY, BACKPULSE, RELAX, PRODUCTION: - the plant's aeration status is switched to High Flow Aeration, and the High Flow Aeration status is displayed on the HMI. - the number of blowers operating is adjusted as required.	When the Train in Standby Aeration/RAS Frequency for Leap 20-KQS-201D times out, the code recalculates the setpoint, 20-FY-307-SP-x, and if NET-PERM-CALC-SP-x or NET-PERM-SUPER-SP-x is at or below the setpoint, 20-FY-307-SP-x, the trigger is reset.	
20-FY-307-SP-x	Net Permeate Flow Trigger, High Flow Aeration Setpoint	Derived - Internal	Membrane Aeration				gpm		This is the setpoint for the Net Permeate Flow Trigger, High Flow Aeration. It is a function of the total membrane surface area and the permeate temperature as described below. The Net Permeate Flow = Net flux for ZW500D membranes * Membrane Area per Train/ 1440 20-FY-01-SP = Net flux * AREA-x / 1440 *For this calculation, the temperature is in °C for the look up table, the membrane area is in square feet. The flow is in gpm to match units for the Leap Aeration Block. The factor 1440 is to convert from day to minutes		
LOW-AER-EN-PB	Enable/Disable Low Flow Aeration for Plant	Button	Membrane Aeration						Low flow aeration is enabled/disable for the plant This is button is on the HMI. On the HMI display aeration type; train resistance status and train's flow status for permeate flow.		
AER-HIGH-FLOW-FREQ	High Flow Aeration Twice Daily Frequency	Trigger	Membrane Aeration	N/A	N/A	24		When the timer; Train in Standby Aeration/RAS Frequency for Leap 20-KQS-201D, has timed out for the setpoint number of times. The setpoint is hard coded.	IN STANDBY, BACKPULSE, RELAX, & PRODUCTION: - opens the aeration valve. The trains are aerated in High flow aeration for the duration of AER-HIGH-FLOW-DUR, starting blowers if required to meet the higher aeration demand.	Trigger and counter reset when High Flow Aeration Twice Daily Frequency, AER-HIGH-FLOW-FREQ timer times out. The aeration type returns to the type determined by the resistance controller and Net Permeate Flow Trigger, High Flow Aeration 20-FY-307-x.	
AER-HIGH-FLOW-DUR	High Flow Aeration Twice Daily Duration	Setpoint	Membrane Aeration	300	900	300	sec.		Operator setpoint for high flow aeration when triggered twice a day.		
Membrane Tank											
20-LI-203-x	Membrane Tank Level Transmitter	Analog In	Level	0	156		in		Value scaled from 4-20 mA input.		
20-LAT-203-x	Membrane Tank Level Transmitter Out of Range	Alarm - Critical	Level					When the transmitter signal is below 3.7 mA or above 20.9 mA for 2 seconds. If the PLC IO is not capable of reading >20.9 mA, this alarm will detect low-range only.	Proceeds to the Fault step 31 of the current state.	When the train's Alarm Reset button is pressed.	Membrane trains must be shutdown if the level in the tank cannot be determined to protect the membranes.
20-LXI-203	Average Membrane Tank Level	Derived - Display	Level						The average of all trains in Standby, Prime, Production, Backpulse, Relax.		The plant permeate flow demand is based on the average membrane tanks level. The inlet valves/gates must be open in standby to allow the level to change when the trains are not in operation
20-LXAHH-203	Membrane Tank Average Level High-High	Alarm - Critical	Level					When the level Alarm high has been active for more than 90 seconds.	Alarm only	When the level Alarm high is no longer active.	This indicates that a high level alarm was not solved by ramping up production. This alarm is for pump from systems
20-LXAH-203	Membrane Tank Average Level High	Alarm - Critical	Level	80	156	116	in	When the average level is at or above this level for 8 seconds. This is a common setpoint for all trains.	IN ALL STATES EXCEPT MAINTENANCE CLEAN & RECOVERY CLEAN & NEUTRALIZATION: Sets the plant flow demand equal to the peak flow for the plant. The trains will proceed to the Production Cycle even if the UV Okay signal is not active.	When the level is below the setpoint by the deadband value. Deadband = 2 in.	The plant demand must be set to the maximum to prevent possible overflow of mixed liquor. This level is set above the normal operating band, but below the overflow level.

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Tag/Mnemonic	Description	Type	Category	Range Min	Range Max	Setpoint	Units	Set	Action or Derivation	Reset	Notes
20-LS-203-TOP-MEM-x	Membrane Tank Level Above Membranes	Trigger	Level	80	156	108	in	When the level is at or above this level for 8 seconds. This is a common setpoint for all trains.	Train proceeds as per the SC step description.	When the level is below the setpoint.	This level is the lowest point in the normal operating range. The train will come out of standby and resume production if there is a demand to produce water.
20-LAL-203-x	Membrane Tank Level Low	Alarm - Critical	Level	80	156	95	in	IN ALL STATES except RECOVERY CLEAN: When the level is at or below this level for 8 seconds. This is a common setpoint for all trains.	IN PRODUCTION & STANDBY: - all steps, proceeds to the first Fault step of current state.	When the level is above the setpoint by the deadband value. Deadband = 2 in.	
20-LALL-203-x	Membrane Tank Level Low-Low	Alarm - Critical	Level					IN ALL STATES: When the level is below the setpoint value for Membrane Tank Chemical Fill Level 20-LS-203-CIP-FILL-x for more than 3600 seconds.	Displays on alarm banner "Membrane Tank 'X' Possible Membrane Exposure."	When the level is above the setpoint.	This alarm indicates that the membranes have been exposed for an extended duration and the operator is required to immediately raise the tank level.
20-LS-203-NEUT-FILL-x	Membrane Tank Level Neutralization Fill	Trigger	Level	80	156	114	in	When the level is at or above the setpoint for 8 seconds in the steps as indicted in the SC. This is a common setpoint for all trains.	IN NEUTRALIZATION: - proceeds to the next step.	When the level is below the setpoint.	Target setpoint is a level about 12 inches above the Membrane Tank Chemical Fill Level setpoint but prevents the membrane tank from overflowing.
20-LS-203-CIP-FILL-x	Membrane Tank Chemical Fill Level	Trigger	Level	80	156	95	in	When the level is at or above the setpoint for 5 seconds in the steps as indicted in the SC . This is a common setpoint for all trains.	IN RECOVERY CLEAN: - proceeds as per the SC description	When the level is below the setpoint.	
20-LS-203-EMPTY-x	Membrane Tank Empty Tank	Trigger	Level	0	20	1	in	When the level is at or below this setpoint for 15 seconds in the steps as indicated in the SC . This is a common setpoint for all trains.	IN RECOVERY CLEAN: - proceeds as per the SC description	When the level is above the setpoint.	This level is the bottom of the level transmitter range. The time delay allows the Drain pump to run until the level is into the sump but not cavitating the Drain pump.
20-LAHH-201-x	Membrane Tank Level High-high	Alarm - Critical	Level			discrete		All steps, when switch is active for 5 seconds.	IN ALL STATES EXCEPT MAINTENANCE CLEAN & RECOVERY CLEAN & NEUTRALIZATION: Sets the plant flow demand equal to the peak flow for the plant.	When the switch is no longer active.	Tank overflow protection
20-LAL-201-x	Membrane Tank Level Low	Alarm - Critical	Level			discrete		IN ALL STATES except RECOVERY CLEAN: When switch 20-LSLL-201-x is active for 5 seconds.	IN PRODUCTION & STANDBY: - all steps, proceeds to the first Fault step of current state.	When the switch is no longer active.	Membrane protection
20-LALL-201-x	Membrane Tank Level Low-Low	Alarm - Critical	Level					When switch 20-LSLL-201-x is active for 3600 seconds.	Displays on alarm banner "Membrane Tank 'X' Possible Membrane Exposure."	When the switch is no longer active.	This switch is set below the below the operating band to protect the membranes from exposure. This level is just above the membrane fibers in the cassette. This alarm is used as a backup for the level transmitter.
20-LCH-203	Membrane Tank Average Level High Setpoint	Setpoint	Level	100	116	116	in		This is the maximum Membrane Tank Average Level setpoint where flow demand is at the maximum value. Used to calculate PLANT-DEM-TRIM-SP. Operator entered value.		Typically set to about 12 in. above middle of the operating band.
20-LC-203	Membrane Tank Average Level Control Setpoint	Setpoint	Level	100	116	112	in		Operator entered level setpoint.		This level is used to calculate the trim plant flow demand. It is typically set in the middle between the maximum and minimum operating levels.
PLANT-DEM-TRIM-SP	Plant Demand Trim Flow rate	Derived - Display	Flow	-PLANT-DEM-MAX-SP	PLANT-DEM-MAX-SP		gpm		Trim Flow for Plant Demand = proportional to Membrane Tank Average Level, as shown below. PLANT-DEM-TRIM-SP = [PLANT-DEM-MAX-SP × (20-LXI-203 - 20-LC-203) / (20-LCH-203 20-LC-203))] Where: Maximum control level is 20-LCH-203 where plant permeate flow demand must equal the maximum peak flow for the entire plant, PLANT-DEM-MAX-SP gpm. Control level is 20-LC-203 is in the middle of the maximum and minimum levels for the trim volume. This is the plant permeate trim flow used to calculate the net permeate flow for each train in PRODUCTION, NET-PERM-CALC-SP .		The plant trim is calculated to correct for errors between the flow meters and time delay between influent flow and permeate flow. This value is added to the flow demand to establish the plant permeate demand. The trim can range between the maximum plant demand in the positive and negative directions, which allows the trim to drive the plant demand to the maximum or zero, in case of the loss of the influent flow signal.
20-ZAC-209-x	Mem. Tk. Feed Gate Failed to Close	Alarm - Advisory	Gate					When gate is called to close: - if closed confirmation is missing or open confirmation is detected, for 600 seconds..	Alarm only	When the gate's Reset Alarm button is pressed	
20-ZAO-209-x	Mem. Tk. Feed Gate Failed to Open	Alarm - Advisory	Gate					When gate is called to open: - if open confirmation is missing or closed confirmation is detected, for 600 seconds.	Alarm only	When the gate's Reset Alarm button is pressed	
Permeate Demand											

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Tag/Mnemonic	Description	Type	Category	Range Min	Range Max	Setpoint	Units	Set	Action or Derivation	Reset	Notes
PLANT-DEM	UF Permeate Flow Demand	Derived - Display	Flow	0	PLANT-DEM-MAX-SP		gpm		Plant Flow Demand = feed flow trimmed to membrane tank average level, as shown below. PLANT-DEM = FEED-FLOW-AVG + PLANT-DEM-TRIM-SP This is the PLANT permeate flow used to calculate the net permeate flow for each train in PRODUCTION, NET-PERM-CALC-SP-x.		The plant demand is calculated relative to the level in the bioreactor. The demand can range between zero and the maximum plant demand.
NET-PERM-MAX-SP1	Net Permeate Flow Maximum Setpoint 1	Setpoint	Flow	1000	2085	2083	gpm	When all trains are available. All trains are available when there are no trains in OFF, any Fault steps, MAINTENANCE CLEAN or RECOVERY CLEAN/NEUTRALIZATION.	This is the upper limit for NET-PERM-CALC-SP-x and NET-PERM-SUPER-SP-x		**6 MGD design**
NET-PERM-MAX-SP2	Net Permeate Flow Maximum Setpoint 2	Setpoint	Flow	900	1045	1042	gpm	When there is one train, or more than one train, not in available A train is not in available when it is in OFF, any Fault steps, MAINTENANCE CLEAN or RECOVERY CLEAN/NEUTRALIZATION.	This is the upper limit for NET-PERM-CALC-SP-x and NET-PERM-SUPER-SP-x		**6 MGD design**
PLANT-DEM-START1	UF Permeate Demand Start Trigger for One Train Running	Trigger	Demand	700	800	710	gpm	When PLANT-DEM is at or above this setpoint for 10 seconds and TRAINS-PROD-QTY is zero.	In STANDBY, the train with the highest Starting Priority proceeds to PRODUCTION.		Start & Stop triggers are calculated based on plant permeate flow demand In comments in the Control Philosophy, the trains will run while the UV is faulted. 4/17/2020
PLANT-DEM-START2	UF Permeate Demand Start Trigger for Two Trains Running	Trigger	Demand	868	1000	990	gpm	When PLANT-DEM is at or above this setpoint for 10 seconds and TRAINS-PROD-QTY is less than two.	In STANDBY, the train with the highest Starting Priority proceeds to PRODUCTION.		
PLANT-DEM-START3	UF Permeate Demand Start Trigger for Three Trains Running	Trigger	Demand	1736	2000	1980	gpm	When PLANT-DEM is at or above this setpoint for 10 seconds and TRAINS-PROD-QTY is less than three.	In STANDBY, the train with the highest Starting Priority proceeds to PRODUCTION.		
PLANT-DEM-START4	UF Permeate Demand Start Trigger for Four Trains Running	Trigger	Demand	2604	3000	2970	gpm	When PLANT-DEM is at or above this setpoint for 10 seconds and TRAINS-PROD-QTY is less than four.	In STANDBY, the train with the highest Starting Priority proceeds to PRODUCTION.		
PLANT-DEM-STOP1	UF Permeate Demand Standby Trigger - One to No Trains Running	Trigger	Demand	field set	field set	field set	gpm	When PLANT-DEM is at or below this setpoint for 10 seconds and TRAINS-PROD-QTY is greater than zero.	In PRODUCTION, the train with the highest Standby Priority proceeds to STANDBY.		
PLANT-DEM-STOP2	UF Permeate Demand Standby Trigger - Two to One Train Running	Trigger	Demand	784	900	850	gpm	When PLANT-DEM is at or below this setpoint for 10 seconds and TRAINS-PROD-QTY is greater than one.	In PRODUCTION, the train with the highest Standby Priority proceeds to STANDBY.		
PLANT-DEM-STOP3	UF Permeate Demand Standby Trigger - Three to Two Trains Running	Trigger	Demand	1302	1500	1485	gpm	When PLANT-DEM is at or below this setpoint for 10 seconds and TRAINS-PROD-QTY is greater than two	In PRODUCTION, the train with the highest Standby Priority proceeds to STANDBY.		
PLANT-DEM-STOP4	UF Permeate Demand Standby Trigger - Four to Three Trains Running	Trigger	Demand	2170	2500	2475	gpm	When PLANT-DEM is at or below this setpoint for 10 seconds and TRAINS-PROD-QTY is greater than three	In PRODUCTION, the train with the highest Standby Priority proceeds to STANDBY.		
NET-PERM-AUTO-SUPER-PB-x	Permeate Flow Auto Setpoint Button or Permeate Flow Supervisory Setpoint Button	Button	Flow					When the Enable button is pressed.	When Auto is selected: Allows the operator to use the calculated setpoint (NET-PERM-CALC-SP-x) for the train's net permeate flow. When Supervisory is selected: Allows the operator to use a supervisory setpoint (NET-PERM-SUPER-SP-x) for the train's net permeate flow.	When the Disable button is pressed.	
NET-PERM-CALC-SP-x	Target Net Permeate Flow Calculated	Derived - Display	Flow	20-FAL-307-x	When all trains available then NET-PERM-MAX-SP1. When not all trains are available then NET-PERM-MAX-SP2		gpm	When auto setpoint is selected.	This is the value used in the calculation of 20-FC-307-x. Target Net Permeate Flow = (Plant Flow Demand - ∑ Supervisory Entered Flows) ÷ (Number of Trains In Production/Backpulse/Relax - Number of Trains In Production/Backpulse/Relax with a Supervisory Setpoint) NET-PERM-CALC-SP-x = (PLANT-DEM - ∑ NET-PERM-SUPER-SP-x for trains with supervisory SP) ÷ (TRAINS-PROD-QTY - TRAINS-PROD-SUPER-QTY). Initially: NET-PERM-CALC-SP-x = NET-PERM-SUPER-SP-x when alternating between auto and supervisory setpoint. This is a bumpless transfer.		This is the Net Permeate each train is required to produce to meet the desired plant production rate.
NET-PERM-SUPER-SP-x	Target Net Permeate Flow Operator Entered	Setpoint	Flow	20-FAL-307-x	When all trains available then NET-PERM-MAX-SP1. When not all trains are available then NET-PERM-MAX-SP2	868	gpm	When supervisory setpoint is selected.	This is the value used in the calculation of 20-FC-307-x. Initially: NET-PERM-CALC-SP-x = NET-PERM-SUPER-SP-x when alternating between auto and supervisory setpoint. This is a bumpless transfer.		The operator can use this setpoint to override the calculated permeate requirement.
20-FCL-307	Instantaneous Permeate Flow Minimum Flow Setpoint	Setpoint	Flow	field set	field set	field set	gpm	This is a plant setpoint	This is the lower limit for 20-FC-307-x		This flow is the minimum stable flow that the permeate pump can safely supply.

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Tag/Mnemonic	Description	Type	Category	Range Min	Range Max	Setpoint	Units	Set	Action or Derivation	Reset	Notes
Transmembrane Pressure											
20-PI-301-x	Permeate Membrane Header Pressure Transmitter	Analog In	Pressure	-15.0	15.0		psi		Value scaled from 4-20 mA input.		
20-PAT-301-x	Permeate Membrane Header Pressure Transmitter Out of Range	Alarm - Critical	Pressure					When the transmitter signal is below 3.7 mA or above 20.9 mA for 2 seconds. If the PLC IO is not capable of reading >20.9 mA, this alarm will detect low-range only.	IN PRODUCTION, BACKPULSE, MAINTENANCE CLEAN, RECOVERY CLEAN & NEUTRALIZATION: - all steps, proceeds to the first Fault step of the current state.	When the train's Alarm Reset button is pressed.	Trains must shut down if the pressure cannot be determined, to protect the membranes. If the PLC IO is not capable of reading >20.9 mA, this alarm will detect low-range only.
TMP-PV-x	TransMembrane Pressure (TMP)	Derived - Display	TMP						TMP = Membrane Header Pressure + Conversion Factor x (Height of the Pressure Transmitter Above the Top of the Membranes + Height from the Bottom of the Tank to the Top of the Membrane Fibers - Membrane Tank Level) Consult Control Philosophy for Further Details. WHEN 20-LI-203-x IS ABOVE 80in: TMP-PV-x = 20-PI-301-x + C × (A+B - 20-LI-203-x) WHEN 20-LI-203-x IS AT OR BELOW 80in.: TMP-PV-x = 20-PI-301-x + C × (A+B - 80) Var.A = xx in. (Top of Membranes to Pressure Transmitter) Var.B = 93 in. (Bottom of Tank to top of the Membrane Fibers) C = 0.0098066 kPa/mm. C = 0.036127 psig/in.		TMP (Trans Membrane Pressure) is a measurement of the pressure differential across the surface of the membranes. TMP is what drives water (permeate) to cross the membrane. Excessive TMP can damage the membranes.
TMP-LL-ALM-x	TMP Low-Low	Alarm - Critical	TMP	-8	-7	-8	psi	IN PRODUCTION: - all steps, when the TMP is at or below this setpoint for 5 seconds. This is a common setpoint for all trains.	IN PRODUCTION: - all steps, proceeds to the first Fault step of the current state.	When the train's Alarm Reset button is pressed.	When the TMP is too high, the process pump is stopped to protect the membranes.
TMP-LL-CTRL2-x	TMP Low-Low - Control	Trigger	TMP			TMP-LL-ALMx	psi	IN PRODUCTION: - all steps, when the TMP is at or below this setpoint with no time delay.	IN PRODUCTION: - all steps, captures the initial value for the maximum of the 20-FIC1-307-x CV Initial value for the maximum CV = (CV value of 20-FIC1-307-x minus 10.00%). This action only occurs once per production cycle.		There is no time delay. This works best with PD pumps
TMP-LL-CTRL1-x	TMP Low-Low	Trigger	TMP	TMP-LL-ALM-x	0	-7	psi	IN PRODUCTION: - all steps, when the TMP is at or below this setpoint. This is a common setpoint for all trains.	IN PRODUCTION: - all steps, captures the initial value for the high limit of the 20-FIC1-307-x CV as: Initial value for the high limit for the CV = (CV value of 20-FIC1-307-x) - 0.25% Then reduces the high limit for 20-FIC1-307-x CV by 0.25% every second until it reaches to the its minimum of 20-OMIN-301-x.	When the TMP is above the setpoint, then increases the high limit for 20-FIC1-307-x CV by 0.25% every second until it reaches 100%.	This trigger allows the PLC to manage TMP by ramping down the pump. This allows the train to maintain a reduced level of production without shutting down or damaging membranes.
TMP-LL-CTRL-MSG-x	TMP Low-Low Display	Indicator	TMP					IN PRODUCTION: - all steps, when high limit for 20-FIC1-307-x CV is below 100%.	IN PRODUCTION: -all steps, the maximum value for 20-FIC1-307-x CV is limited to a value below 100% . Displays 'TMP at limit!' indication on the train overview screen.	IN PRODUCTION: - all steps, when the high limit for 20-FIC1-307-x CV is at 100%.	The operator is informed when TMP limiting is occurring.
TMP-HH-ALM-x	Backpulsing, TMP High-High	Alarm - Critical	TMP	7	8	8	psi	IN MAINTENANCE CLEAN & RECOVERY CLEAN & NEUTRALIZATION: - all steps, when the TMP is at or above this setpoint for 5 seconds during backpulse. This is a common setpoint for all trains.	IN MAINTENANCE CLEAN & RECOVERY CLEAN & NEUTRALIZATION: - all steps, proceeds to the first Fault step of the current state.	When the train's Alarm Reset button is pressed.	When the TMP is too high, the process/backpulse pump is stopped to protect the membranes.
TMP-HH-BP-ALM-x	Backpulsing, TMP High-High	Alarm - Critical	TMP	7	8	8	psi	IN BACKPULSE: - all steps, when the TMP is at or above this setpoint for 5 seconds during backpulse. This is a common setpoint for all trains.	IN BACKPULSE: - Stop the pump in auto and continue steps.	In Production step 1	

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Tag/Mnemonic	Description	Type	Category	Range Min	Range Max	Setpoint	Units	Set	Action or Derivation	Reset	Notes
TMP-HH-CTRL2-x	Backpulse TMP High-High - Control Process Pump	Trigger	TMP			TMP-HH-BP-ALM-x	psi	IN BACKPULSE, MAINTENANCE CLEAN & RECOVERY CLEAN & NEUTRALIZATION: - all steps, when the TMP is at or above this setpoint with no time delay.	IN BACKPULSE, MAINTENANCE CLEAN, RECOVERY CLEAN & NEUTRALIZATION: - all steps, captures the initial value for the maximum of the 20-FIC2-307-x CV Initial value for the maximum CV = (CV value of 20-FIC2-307-x minus 10.00%). This action only occurs once per production cycle.		
TMP-HH-CTRL1-x	TMP High-High for Process Pump	Trigger	TMP	0	TMP-HH-BP-ALM-x	7	psi	IN BACKPULSE, MAINTENANCE CLEAN & RECOVERY CLEAN & NEUTRALIZATION: - all steps, when the TMP is at or above this setpoint.	IN BACKPULSE, MAINTENANCE CLEAN & RECOVERY CLEAN & NEUTRALIZATION: - all steps, captures the initial value for the high limit of the 20-FIC2-307-x CV as: Initial value for the high limit for the CV = (CV value of 20-FIC2-307-x) - 0.25% Then reduces the high limit for 20-FIC2-307-x CV by 0.25% every second until it reaches to the its minimum of 20-OMIN2-301-x.	When the TMP is below the setpoint, then increases the high limit for 20-FIC2-307-x CV by 0.25% every second until it reaches 100%.	This trigger allows the PLC to manage TMP by ramping down the pump. This allows the train to maintain a reduced level of backpulse without shutting down or damaging membranes.
TMP-HH-MSG-x	TMP High-High Display for Process Pump	Indicator	TMP					N BACKPULSE, MAINTENANCE CLEAN & RECOVERY CLEAN & NEUTRALIZATION: - all steps, when high limit for 20-FIC2-307-x CV is below 100%.	IN BACKPULSE, MAINTENANCE CLEAN & RECOVERY CLEAN & NEUTRALIZATION: -all steps, the high limit for 20-FIC2-307-x CV is limited to a value below 100% . Displays 'TMP at limit!' indication on the train overview screen.	IN IN BACKPULSE, MAINTENANCE CLEAN & RECOVERY CLEAN & NEUTRALIZATION: - all steps, when the high limit for 20-FIC2-307-x CV is at 100%. Or In PRODUCTION	The operator is informed when TMP limiting is occurring.
Process Pump											
20-MQAL-301-x	Process Pump Not Available	Alarm - Critical	Pump					When the Process Pump 20-P-301-x is not available to run in auto for 2 seconds.	IN PRODUCTION, BACKPULSE, MAINTENANCE CLEAN, RECOVERY CLEAN & NEUTRALIZATION: - all steps, proceeds to the first Fault step of the current state.	When the Process Pump is available to run in auto.	
20-YA-301-x	Process Pump Fail	Alarm - Critical	Pump					When pump is called to run: - if running confirmation is missing for 5 seconds. When 10 seconds has elapsed since pump last called to run: - if running confirmation is detected for 5 seconds.	Faults and Interlocks pump.	When the pump Alarm Reset button is pressed OR the train's Alarm Reset button is pressed.	
20-OMIN-301-x	Minimum Process Pump Speed	Setpoint	Pump	0	100	10	%		Operator entered minimum pump speed for PID flow controller, 20-FIC1-307-x in Production. For Backpulse, Maintenance Clean, Recovery Clean, Neutralization the controller is 20-FIC2-307-x.		
20-FI-307-x	Instantaneous Permeate Flow Transmitter	Analog In	Flow	0	3000		gpm		Value scaled from 4-20 mA input.		
20-FAT-307-x	Permeate Flow Transmitter Out of Range	Alarm - Critical	Flow					When the transmitter signal is below 3.7 mA or above 20.9 mA for 2 seconds. If the PLC IO is not capable of reading >20.9 mA, this alarm will detect low-range only.	IN PRODUCTION: - all steps, proceeds to the first Fault step of the current state and interlock the process pump. IN BACKPULSE: - no demand for the pump, and continue steps IN MAINTENANCE CLEAN, RECOVERY CLEAN steps 1 to 20, NEUTRALIZATION - all steps, proceeds to the first Fault step of the current state and interlock the process pump.	When the train's Alarm Reset Alarm button is pressed.	Trains must shut down if the permeate flow cannot be determined as there is no way to set pump speed.
20-FAH-307-x	Instantaneous Permeate Flow High	Alarm - Critical	Flow	1000	2655	2654	gpm	PRODUCTION in step 2: - all steps when the flow is at or above the setpoint for 10 seconds. This is a common setpoint for all trains.	IN PRODUCTION: - all steps, proceeds to the first Fault step of the current state.	When the train's Alarm Reset button is pressed.	This alarm is usually set to 110% of the maximum instantaneous flow setpoint to protect the membranes from over-fluxing. See alarms for backpulsing flows
20-FAL-307-x	Instantaneous Permeate Flow, Low	Alarm - Critical	Flow	field set	field set	field set	gpm	IN PRODUCTION in step 2: - all steps, when the pump requested to run and the flow is at or below the setpoint for 10 seconds. This is a common setpoint for all trains.	IN PRODUCTION: - all steps, proceeds to the first Fault step of the current state.	When the train's Alarm Reset button is pressed.	This alarm is usually set to 90% of the minimum instantaneous flow setpoint to protect the pump from under-speed conditions.
INSTANT-PERM-TOT-x	Instantaneous Permeate Flow Volume	Derived - Display	Volume				gal		Total Train Production Volume for Last Production Cycle = Totalized Permeate volume during Production steps 1 through to the end of the cycle INSTANT-PERM-TOT-x = Totalized 20-FI-307-x (In Production) Includes a running total for the current day total (_TODAY), a previous day total (_DAY1)		
NET-PERM-TOT-CYCLE-x	Last Production Cycle's Net Permeate Volume	Derived - Display	Volume				gal		Total Train Net Production Volume for Last Production Cycle = Totalized Permeate volume during Production steps 1 through to the end of the cycle minus Total Backpulse volume from Backpulsing pump. NET-PERM-TOT-CYCLE-x = Totalized 20-FI-307-x (In Production) - Totalized 20-FI-307-x (During Backpulse) Includes a Includes a running total for the current day total (_TODAY), yesterday day total (_DAY1)		
20-ZAO-302-x	To/from Permeate Collector Valve Fail to Open	Alarm - Critical	Valve					When valve is called to open: - if open confirmation is missing or closed confirmation is detected, for 6 seconds.	All steps, proceeds to the first Fault step of the current state.	When the valve's Reset Alarm button is pressed or the UF train reset button is pressed.	
20-ZAC-302-x	To/from Permeate Collector Valve Fail to Close	Alarm - Critical	Valve					When valve is called to close: - if closed confirmation is missing or open confirmation is detected, for 6 seconds.	Alarm only	When the valve's Reset Alarm button is pressed or the UF train reset button is pressed.	

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20-ZAO2-302-x	To/from Permeate Collector Valve Fail to Open	Alarm - Critical	Valve					When the process pump 20-P-301-x is requested to run or is running and the open confirmation is missing or the closed confirmation is detected for 6 seconds.	Faults and Interlocks Process pump 20-P-301-x .	When the valve's Reset Alarm button is pressed or the UF train reset button is pressed.	
Backpulse System											
	Staggered Backpulse Order	Derived - Internal	Sequence						Staggered Backpulsing/Relax: The time slots to do backpulse/relax are evenly distributed throughout one production cycle. The distribution is based on the maximum number of trains installed in the plant. The production cycle is 12 minutes and there are 4 trains. A backpulse is scheduled to occur every 3 minutes. Each train is assigned a time slot to do backpulse according its train number. Train 1 is backpulsed in the first time slot, t = 0 min, Train 2 is backpulsed in the second time slot, t = 3 min, Train 3 is backpulsed at t = 6 min Train 4 is backpulsed at t = 9 min Any train that is not in a production cycle will be skipped.		Staggered backpulsing involves backpulsing each train separately and spreading the backpulses evenly throughout the global production timer.
BP-EN-PB RELAX-EN-PB	Enable Backpulse Button or Enable Relax Button	Button	Sequence						Enable Backpulse for the Production Cycle Train will use backpulse state and not relax state. Enable Relax for the Production Cycle Train will use relax state and not backpulse state		This selection will drive trains to BACKPULSE at the end of each production cycle. This selection will drive trains to RELAX instead of BACKPULSE at the end of each production cycle.
20-FAH-307-B-x	Backpulsing Flow High	Alarm - Advisory	Flow	1100	2654	2654	gpm	IN BACKPULSE, MAINTENANCE CLEAN, RECOVERY CLEAN, NEUTRALIZATION: - all steps when the backpulse flow is at or above the setpoint for 5 seconds. This is a common setpoint for all trains.	IN BACKPULSE: Stops the backpulsing pump and continue steps. IN MAINTENANCE CLEAN, RECOVERY CLEAN, NEUTRALIZATION: Interlocks pump to stop it from operating.	When the train's Alarm Reset button is pressed or in BACKPULSE step 4.	
20-FAL-307B-x	Backpulsing Flow Low In Backpulse	Alarm - Advisory	Flow	630	2172	2172	gpm	IN BACKPULSE: - all steps when the pump is running and the backpulse flow is at or below the setpoint for 10 seconds. This is a common setpoint for all trains.	Stops the backpulsing pump and continue steps.	When not in Backpulse.	
20-FAL-307C-x	Backpulsing Flow Low In Cleaning	Alarm - Advisory	Flow	630	938	810	gpm	IN MAINTENANCE CLEAN, RECOVERY CLEAN, NEUTRALIZATION: - all steps when the pump is running and the backpulse flow is at or below the setpoint for 10 seconds. This is a common setpoint for all trains.	Interlocks pump to stop it from operating.	When the train's Alarm Reset button is pressed.	
20-FQ-307-BP-x	Train Backpulse Volume	Derived - Display	Volume				gal	IN BACKPULSE steps 3 and 4:	IN BACKPULSE: - all steps, totalizes backpulse flow. Includes a running total for the current day total (_TODAY), yesterday day total (_DAY1)	IN BACKPULSE & RELAX: step 1	
20-FQ-307-BP	Total Plant Backpulse Volume	Derived - Display	Backpulse				gal		ANY TRAIN IN PRODUCTION: - step 1, sums the Backpulse volumes for all trains in the Production cycle. 20-FQ-307-BP = sum of 20-FQ-307-BP-x for trains in PRODUCTION, BACKPULSE, and RELAX. Includes a running total for the current day total (_TODAY), yesterday day total (_DAY1)	Reset at midnight	
FLUME-LVL	Flume Channel Level	Comm In	Level	0	100		%		Display with units on the HMI		
FLUME-LVL-LL	Common Permeate Header Level Low-Low	Alarm - Critical	Level	0	100	field set	%	When the level is at or below this setpoint for 10 seconds.	IN MAINTENANCE CLEAN, RECOVERY CLEAN, NEUTRALIZATION: - steps requiring the Backpulse/Process Pump, interlocks Backpulse/Process Pump and the train proceeds to the first fault step	When the Common Permeate Header level is above this setpoint.	When the level in the Common Permeate Header is low, the pump is stopped for pump protection.
FLUME-LVL-H	Flume Channel Level High	Trigger	Level	0	100	field set	%	When the level is at or above this setpoint for 10 seconds and the Common Permeate Header level low switch is not tripped.	IN MAINTENANCE CLEAN, RECOVERY CLEAN & NEUTRALIZATION: steps as noted in the SC . Consult the SC , for details.	When the low level switch 20-LSL-001 is tripped	

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20-LSL-001	Common Permeate Header Level Low	Trigger	Level					When the low level switch is active for 3 seconds.	IN BACKPULSE: - All steps, continue steps without commanding the process pump to run In PRODUCTION. - for trains with Backpulse selected for the production cycle switch to Relax IN MAINTENANCE CLEAN steps 1 to 7 and steps 9 to 15, RECOVERY CLEAN, NEUTRALIZATION: - proceed according to the sequence chart	When the FLUME-LVL-H is active	
20-LAL-001	Common Permeate Header Level Low	Alarm - Advisory	Level					When the low level switch is active for 5 seconds.	In MAINTENANCE CLEAN step 8, proceed to the first fault step	When the high level switch 20-LSH-001 is tripped	
Permeate Quality											
20-AI-320-x	Permeate Turbidity Transmitter	Analog In	Quality	0.00	10.00		NTU		Value scaled from 4-20 mA input.		
20-AAT-320-x	Permeate Turbidity Transmitter Out of Range	Alarm - Advisory	Quality					When the transmitter signal is below 3.7 mA or above 20.9 mA for 2 seconds. If the PLC IO is not capable of reading >20.9 mA, this alarm will detect low-range only.	Alarm only	When the transmitter is in range.	Turbidity transmitter must be configured to fail high. If the PLC IO is not capable of reading >20.9 mA, this alarm will detect low-range only.
20-AAH1-320-x	Permeate Turbidity High 1	Alarm - Advisory	Quality	0.00	10.00	5	NTU	IN PRODUCTION: - all steps, when the turbidity reading is at or above this setpoint for 20-AAH1-TMR-320 seconds. This is a plant setpoint for all trains	For all trains, for trains with Backpulse selected for the production cycle switch to Relax for the production cycle. Maintenance and Recovery Cleans are prevented from starting	When the turbidity reading is below this setpoint.	Backpulsing is prevented during times of turbidity spikes to prevent forcing foulants or air back into the membranes.
20-AAH2-320-x	Permeate Turbidity High 2	Alarm - Advisory	Quality	0.00	10.00	0.5	NTU	IN PRODUCTION: - all steps, when the turbidity reading is at or above this setpoint for 20-AAH2-TMR-320 seconds. This is a plant setpoint for all trains	Alarm only	When the turbidity reading is below this setpoint.	This alarm is to notify the operator of a potential problem to be addressed before the trains must shut down.
20-AAH3-320-x	Permeate Turbidity High 3	Alarm - Critical	Quality	0.00	10.00	0.2	NTU	IN PRODUCTION: - all steps, when the turbidity reading is at or above this setpoint for 20-AAH3-TMR-320 seconds. This is a plant setpoint for all trains	IN PRODUCTION: - all steps, proceeds to the first Fault step of the current state.	When the train's Alarm Reset button is pressed.	The train will be shut down to prevent improperly cleaned water form being delivered to the permeate discharge.
20-AAH1-TMR-320	Permeate Turbidity High 1 Timer	Setpoint	Quality	0.0	60.0	10	sec.	IN PRODUCTION: - all steps, when turbidity reading is at or above 20-AAH1-320-x setpoint, timer operates. This is a plant setpoint for all trains.	Timer is used to trigger High 1 Alarm. When timer times out, 20-AAH1-320-x is active.	When turbidity reading is below 20-AAH1-320-x setpoint.	
20-AAH2-TMR-320	Permeate Turbidity High 2 Timer	Setpoint	Quality	0.0	300.0	60	sec.	IN PRODUCTION: - all steps, when turbidity reading is at or above 20-AAH2-320-x setpoint, timer operates. This is a plant setpoint for all trains.	Timer is used to trigger High 2 Alarm. When timer times out, 20-AAH2-320-x is active.	When turbidity reading is below 20-AAH2-320-x setpoint.	
20-AAH3-TMR-320	Permeate Turbidity High 3 Timer	Setpoint	Quality	0.0	300.0	120	sec.	IN PRODUCTION: - all steps, when turbidity reading is at or above 20-AAH3-320-x setpoint, timer operates. This is a plant setpoint for all trains.	Timer is used to trigger High 3 Alarm. When timer times out, 20-AAH3-320-x is active.	When turbidity reading is below 20-AAH3-320-x setpoint.	
Data Logging Triggers											
PROD-INFO-PREBP-TRG-x	Pre-Backpulse Snapshot Trigger	Trigger	Data Logging					In PRODUCTION - step 2: at the end of the step.	Captures the current Flow (20-FI-307-x) and TMP (TMP-PV-x).	When PROD-INFO-BP-DATA-RDY-x is reset.	This is the step where the pump is running.
PROD-INFO-BP-TRG-x	Backpulse Snapshot Trigger	Trigger	Data Logging					When PROD-INFO-PREBP-TRG-x is active: In BACKPULSE - step 3 or RELAX - step 2 at the end of the step.	Captures the current Flow (20-FI-307-x) and TMP (TMP-PV-x).	When PROD-INFO-BP-DATA-RDY-x is reset.	This is the step where the pump is running. Note in Relax the pump is not running and the flow is zero.
PROD-INFO-POSTBP-TRG-x	Post-Backpulse Snapshot Trigger	Trigger	Data Logging					When PROD-INFO-BP-TRG-x is active: In PRODUCTION: 60 seconds into step 2	Captures the current Flow (20-FI-307-x) and TMP (TMP-PV-x).	When PROD-INFO-BP-DATA-RDY-x is reset.	This is the step where the pump is running.
PROD-INFO-BP-DATA-RDY-x	Backpulse Data Ready	Trigger	Data Logging					When PROD-INFO-PREBP-TRG-x and PROD-INFO-BP-TRG-x and PROD-INFO-POSTBP-TRG-x are all active.	Allows data logging of PROD-INFO-PREBP-TRG-x and PROD-INFO-BP-TRG-x and PROD-INFO-POSTBP-TRG-x.	After 10 seconds.	
RAS/Drain Pump											
20-MQAL-501-x	RAS/Drain Pump Not Available	Alarm - Critical	Pump					When the RAS/drain Pump 20-P-501-x- is not available to run in auto for 2 seconds. A pump is available in auto and it is not interlocked or faulted for 2 seconds.	IN PRODUCTION, RELAX, BACKPULSE, RECOVERY CLEAN & NEUTRALIZATION: - all steps, proceeds to the first Fault step of the current state.	When the RAS /drain Pump is available to run in auto.	

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Tag/Mnemonic	Description	Type	Category	Range Min	Range Max	Setpoint	Units	Set	Action or Derivation	Reset	Notes
20-YA-501-x	RAS /Drain Pump Fail	Alarm - Advisory	Pump					When pump is called to run: - if running confirmation is missing for 5 seconds. When 10 seconds has elapsed since pump last called to run: - if running confirmation is detected for 5 seconds.	Faults and Interlocks pump.	When the pump Reset Alarm button is pressed OR the train's Reset Alarm button is pressed.	
20-OMIN-501-x	Minimum RAS /Drain Pump Speed	Setpoint	Pump	0	100	25	%	This is a plant setpoint	Operator entered minimum pump speed for PID flow controller, 20-FIC-507-x		
20-FI-507-x	RAS Recirculation Flow Transmitter	Analog In	Flow	0	4700		gpm		Value scaled from 4-20 mA input.		
20-FAT-507-x	RAS Recirculation Flow Transmitter Out of Range	Alarm - Critical	Flow					When the transmitter signal is below 3.7 mA or above 20.9 mA for 2 seconds. If the PLC IO is not capable of reading >20.9 mA, this alarm will detect low-range only.	Interlock pumps to stop them from operating.	When the train's Reset Alarm button is pressed.	
20-FAH-507-x	RAS Recirculation Flow High	Alarm - Advisory	Flow	105	112	110	%	When the percent ratio of the RAS flow to the RAS flow setpoint is above this setpoint for 5 seconds. This is a common setpoint for all trains.	Alarm only	When the percent ratio of the RAS flow to the RAS flow setpoint is below the setpoint for this alarm.	
20-FAL-507-x	RAS Recirculation Flow Low	Alarm - Advisory	Flow	88	95	90	%	When the percent ratio of the RAS flow to the RAS flow setpoint is below this setpoint for 5 seconds and the pump is requested to run. This is a common setpoint for all trains and a RAS pump is running.	Alarm only	When the percent ratio of the RAS flow to the RAS flow setpoint is above the setpoint for this alarm.	
20-FALL-507-x	RAS Recirculation Flow Low-Low	Alarm - Critical	Flow	1500	2500	1544	gpm	When the RAS flow is at or below this setpoint for 5 seconds and the pump is requested to run. This is a common setpoint for all trains and a RAS pump is running.	Faults and Interlocks pump to stop it from operating.	When the train's Reset Alarm button is pressed.	
UV											
UV_SYS_REQ	UV Run Demand	Comm. Out	UV					When a train has a start trigger active or a train has demand override selected	Communicate the UV system request	When no train has a start trigger active and no train has in demand override selected	
UV_SYS_OK	UV System OK	Comm. In	UV					When the signal is active.	Display status on the HMI	When the signal is no longer active.	Direction from client in control philosophy markups. 4/17/2020
UV_SYS_NOT_OK	UV Fault	Comm. In Alarm - Critical	UV					When the signal is active.	Alarm only	When the signal is no longer active.	
Waste System											
WAS-EN/DIS-PB	WAS Enabled Button or WAS Disabled Button	Sequence	Control						Enable Wasting button. Enable or Disable WAS operation. Selectable by the operator.		This button enables/disables automatic wasting.
WAS-SCH-TRG	WAS Schedule	Trigger	Schedule					When Wasting (WAS) is Enabled, AND When the system time is greater than or equal to the operator entered time WAS-SCH-TIME-SP AND there is at least one RAS pump (20-P-501-x) operating, AND WAS-TARGET is not active.	Opens WAS valve, 16-FV-705, and begins totalizing the flow through 16-FI-705 until WAS-TARGET is active.	When the set conditions are not true or the Waste cancel button is pressed.	The WAS schedule is used to determine when automatic wasting should occur.
WAS-SCH-TIME-SP	WAS Start/Enable Time	Setpoint	Schedule	0:00	23:59	Determined by Operator	hr.		Operator entered value to start/enable WAS on each day.		
16-FI-705	Wasting Flow Transmitter	Analog In	Flow	0	200		gpm		Value scaled from 4-20 mA input.		
16-FAT-705	Wasting Flow Transmitter Out of Range	Alarm - Advisory	Flow					When the transmitter signal is below 3.7 mA or above 20.9 mA for 2 seconds. If the PLC IO is not capable of reading >20.9 mA, this alarm will detect low-range only.	Closes and interlocks the WAS.	When the Wasting Area Alarm Reset button is pressed.	
WAS-TODAY	Today's Total Plant WAS Volume	Derived - Display	Volume				gal		Totalized flow through 16-FI-705. Includes a running total for the current day total (_TODAY), yesterday day total (_DAY1)		
WAS-TARGET	Daily Target Plant WAS Volume	Trigger	Volume	0	3900	3840	gal	When WAS-TODAY is at or above this setpoint.	Condition for the WAS schedule Operator entered value	At midnight or the WAS Cancel Request Button WAS-TARGET was pressed	Wasting will run until this volume has been removed. Check with the process person for this value. It comes from Biowin
Clean In Place (CIP) System											
UF-RC-CL-x	Membrane Tank Contains Cleaning Solution - Chlorine	Trigger	CIP					IN RECOVERY CLEAN (with Sodium Hypochlorite): step 16.	Displays banner "Train contains cleaning solution." Contains Cleaning Solution, as indicated in the SC , is defined as a train that is (or was) in a RECOVERY CLEAN and the chemical has not been neutralized. The type of chemical solution is also noted. This status is used in the event of a shutdown during a RECOVERY CLEAN.	IN NEUTRALIZATION: - last step.	

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UF-RC-ACID-x	Membrane Tank Contains Cleaning Solution - Acid	Trigger	CIP					IN RECOVERY CLEAN (with acid): step 16.	Displays banner "Train contains cleaning solution." Contains Cleaning Solution, as indicated in the SC , is defined as a train that is (or was) in a RECOVERY CLEAN and the chemical has not been neutralized. The type of chemical solution is also noted. This status is used in the event of a shutdown during a RECOVERY CLEAN.	IN NEUTRALIZATION: - last step.	
CIP - Citric Acid Chemical Systems											
23-YA-301-A/B	Citric Acid Pump - Fault	Alarm - Advisory	Pump					When the fault signal is active for 5 seconds.	Faults and Interlocks pump.	When the Pump Alarm Reset button is pressed or UF CIP Alarm Reset button is pressed.	
23-MQIC-301	Citric Acid Pump Lead Alternation	Button	Pump						Chooses which device or devices will run in response to a demand. When running based on time switch after the pump stops Refer to Gen. Info. tab for lead alternation logic. Citric Acid Pump operate 1 duty/standby. Transition Overlap = 0 seconds		
23-MQAL-301	Citric Acid Pumps Not Available	Alarm - Critical	Pump					When there are no Citric Acid Pumps available to run in auto for Maintenance Clean for 2 seconds.	Interlocks transition of train to Maintenance clean if Citric Acid would be required for that clean. In Maintenance Clean continue steps Interlocks transition of train to Recovery Clean if Citric Acid would be required for that clean. In RECOVERY CLEAN, if Citric Acid required: - proceeds to the first Fault step of the current state.	When Pump Alarm Reset button is pressed OR the UF CIP Alarm Reset button is pressed.	
	Prevent Starting of Citric Acid Pumps	Interlock	Pump					When a Sodium Hypochlorite Pump is running When any train is in Maintenance Clean Chlorine Clean or Recovery Clean Chlorine Clean.	Blocks starting of any Citric Acid Pump, in auto or manual modes.		
23-FI-301	Citric Acid Flow	Analog In	Flow	0	6		gpm		Value scaled from 4-20 mA input.		
23-FAT-301	Citric Acid Flow Out of Range	Alarm - Advisory	Flow					When the transmitter signal is below 3.7 mA or above 20.9 mA for 2 seconds. If the PLC IO is not capable of reading >20.9 mA, this alarm will detect low-range only.	Interlocks transition of train to Maintenance clean if Citric Acid would be required for that clean. In Maintenance Clean continue steps Interlocks transition of train to Recovery Clean if Citric Acid would be required for that clean. In RECOVERY CLEAN, if Citric Acid required: - proceeds to the first Fault step of the current state.	When the transmitter is in range and the UF CIP Alarm Reset button is pressed.	
23-FAL-301	Recovery Clean Citric Acid Flow Low	Alarm - Critical	Flow	0	4	2.755	gpm	When the pump is command to run and the flow is at or below the setpoint for 5 seconds.	Faults and Interlocks pump.	When the Pump Alarm Reset button is pressed or UF CIP Alarm Reset button is pressed.	
23-FALL-301	Maintenance Clean Citric Acid Flow Low-low	Alarm - Critical	Flow	0	4	2.61	gpm	When the pump is command to run and the flow is at or below the setpoint for 5 seconds.	Faults and Interlocks pump.	When the Pump Alarm Reset button is pressed or UF CIP Alarm Reset button is pressed.	
23-FQ1-301-x	UF Train Citric Acid MC Volume -x refers to the UF train number	Derived - Display	Volume					In Maintenance Clean when the pump is command to run	Totalize the citric acid flow	IN MAINTENANCE CLEAN with citric acid step 1.	
23-FQ2-301-x	UF Train Citric Acid RC Volume -x refers to the UF train number	Derived - Display	Volume					In Recovery Clean when the pump is command to run	Totalize the citric acid flow	IN RECOVERY CLEAN with citric acid step 1.	
CITRIC-ACID-CONC	Citric Acid Concentration	Setpoint	Citric Acid	0	1	0.5			Entered Value The 50 % is stored as 0.50 to allow for the correct units in the calculation of the cleaning solution concentration		
CITRIC-ACID-GRAVITY	Citric Acid Specific Gravity	Setpoint	Citric Acid	0.9	1.5	1.25			Entered Value		
MC-BP-VOL-CITRIC-x	MC BP Volume During Citric Acid	Derived - Display	Citric Acid				gal	In Maintenance Clean steps 4 & 8	Totalize the Backpulse Volume (23-FI-301) This value is used in the MC Citric Acid Concentration MC-CITRIC-ACID-x	IN MAINTENANCE CLEAN with citric acid step 1.	
RC-BP-VOL-CITRIC-x	RC BP Volume During Citric Acid	Derived - Display	Citric Acid				gal	In Recovery Clean steps 16 & 19	Totalize the Backpulse Volume (23-FI-301) This value is used in the MC Citric Acid Concentration MC-CITRIC-ACID-x	IN RECOVERY CLEAN with citric acid step 1.	This calculation includes the dilution water in step 19
MC-CITRIC-ACID-x	MC Citric Acid Concentration	Derived - Display	Citric Acid					The MC Citric Acid Concentration is calculated in Maintenance Clean step 17	MC Citric Acid Concentration = ChemVolume / MC BP Volume During Citric Acid * ChemConc * SpecGravity * 1000000 MC-CITRIC-ACID-x = 23-FQ1-301-x/MC-BP-VOL-CITRIC-x * CITRIC-ACID-CONC * CITRIC-ACID-GRAVITY * 1000000 Division by zero is inhibited.	IN MAINTENANCE CLEAN with citric acid step 1.	
RC-CITRIC-ACID-x	RC Citric Acid Clean Solution	Derived - Display	Citric Acid					The RC Citric Acid Concentration is calculated in Recovery Clean step 21	RC Citric Acid Concentration = ChemVolume / MC BP Volume During Citric Acid * ChemConc * SpecGravity * 1000000 RC-CITRIC-ACID-x = 23-FQ2-301-x/RC-BP-VOL-CITRIC-x * CITRIC-ACID-CONC * CITRIC-ACID-GRAVITY * 1000000 Division by zero is inhibited.	IN RECOVERY CLEAN with citric acid step 1.	
	Prevent Starting of Citric Acid Pumps	Interlock	Pump					When a Sodium Hypochlorite Pump is running ON. OR When any train is in Maintenance Clean Hypochlorite Clean or Recovery Clean Hypochlorite Clean.	Blocks starting of any Citric Acid Pump, in auto or manual modes.		
CIP - Sodium Hypochlorite Chemical Systems											

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Tag/Mnemonic	Description	Type	Category	Range Min	Range Max	Setpoint	Units	Set	Action or Derivation	Reset	Notes
23-YA-101-A/B	Sodium Hypochlorite Pump - Fault	Alarm - Advisory	Pump					When the fault signal is active for 5 seconds.	Faults and Interlocks pump.	When the Pump Alarm Reset button is pressed or UF CIP Alarm Reset button is pressed.	
23-MQIC-101	Sodium Hypochlorite Pump Lead Alternation	Button	Pump						Chooses which device or devices will run in response to a demand. When running based on time switch after the pump stops Refer to Gen. Info. tab for lead alternation logic. Sodium Hypochlorite Pump operate 1 duty/standby. Transition Overlap = 0 seconds		
23-MQAL-101	Sodium Hypochlorite Pumps Not Available	Alarm - Critical	Pump					When there are no Sodium Hypochlorite Pumps available to run in auto for Maintenance Clean for 2 seconds.	Interlocks transition of train to Maintenance clean if Sodium Hypochlorite would be required for that clean. In Maintenance Clean continue steps Interlocks transition of train to Recovery Clean if Sodium Hypochlorite would be required for that clean. In RECOVERY CLEAN, if Sodium Hypochlorite required: - proceeds to the first Fault step of the current state.	When Pump Alarm Reset button is pressed OR the UF CIP Alarm Reset button is pressed.	
	Prevent Starting of Sodium Hypochlorite Pumps	Interlock	Pump					When a Sodium Hypochlorite Pump is running When any train is in Maintenance Clean Chlorine Clean or Recovery Clean Chlorine Clean.	Blocks starting of any Sodium Hypochlorite Pump, in auto or manual modes.		
23-FI-101	Sodium Hypochlorite Flow	Analog In	Flow	0	10		gpm		Value scaled from 4-20 mA input.		
23-FAT-101	Sodium Hypochlorite Flow Out of Range	Alarm - Advisory	Flow					When the transmitter signal is below 3.7 mA or above 20.9 mA for 2 seconds. If the PLC IO is not capable of reading >20.9 mA, this alarm will detect low-range only.	Interlocks transition of train to Maintenance clean if Sodium Hypochlorite would be required for that clean. In Maintenance Clean continue steps Interlocks transition of train to Recovery Clean if Sodium Hypochlorite would be required for that clean. In RECOVERY CLEAN, if Sodium Hypochlorite required: - proceeds to the first Fault step of the current state.	When the transmitter is in range and the UF CIP Alarm Reset button is pressed.	
23-FAL-101	Recovery Clean Sodium Hypochlorite Flow Low	Alarm - Advisory	Flow	0	4	6.0	gpm	When the pump is command to run and the flow is at or below the setpoint for 5 seconds.	Faults and Interlocks pump.	When the Pump Alarm Reset button is pressed or UF CIP Alarm Reset button is pressed.	
23-FALL-101	Maintenance Clean Sodium Hypochlorite Flow Low-low	Alarm - Advisory	Flow	0	4	1.1	gpm	When the pump is command to run and the flow is at or below the setpoint for 5 seconds.	Faults and Interlocks pump.	When the Pump Alarm Reset button is pressed or UF CIP Alarm Reset button is pressed.	
23-FQ1-101-x	UF Train Sodium Hypochlorite MC Volume -x refers to the UF train number	Derived - Display	Volume					In Maintenance Clean when the pump is command to run	Totalize the Sodium Hypochlorite flow	IN MAINTENANCE CLEAN with sodium hypochlorite step 1.	
23-FQ2-101-x	UF Train Sodium Hypochlorite RC Volume -x refers to the UF train number	Derived - Display	Volume					In Recovery Clean when the pump is command to run	Totalize the Sodium Hypochlorite flow	IN RECOVERY CLEAN with sodium hypochlorite step 1.	
HYPO-CONC	Sodium Hypochlorite Concentration	Setpoint	Sodium Hypochlorite	0	1	0.1			Entered Value The 50 % is stored as 0.50 to allow for the correct units in the calculation of the cleaning solution concentration		
HYPO-GRAVITY	Sodium Hypochlorite Specific Gravity	Setpoint	Sodium Hypochlorite	0.9	1.5	1.2			Entered Value		
MC-BP-VOL-HYPO-x	MC BP Volume During Sodium Hypochlorite	Derived - Display	Sodium Hypochlorite				gal	In Maintenance Clean steps 4 & 8	Totalize the Backpulse Volume (23-FI-101) This value is used in the MC Sodium Hypochlorite Concentration MC-HYPO-x	IN MAINTENANCE CLEAN with sodium hypochlorite step 1.	
RC-BP-VOL-HYPO-x	RC BP Volume During Sodium Hypochlorite	Derived - Display	Sodium Hypochlorite				gal	In Recovery Clean steps 16 & 19	Totalize the Backpulse Volume (23-FI-101) This value is used in the MC Sodium Hypochlorite Concentration MC-HYPO-x	IN RECOVERY CLEAN with sodium hypochlorite step 1.	This calculation includes the dilution water in step 19
MC-HYPO-x	MC Sodium Hypochlorite Concentration	Derived - Display	Sodium Hypochlorite					The MC Sodium Hypochlorite Concentration is calculated in Maintenance Clean step 17	MC Sodium Hypochlorite Concentration = ChemVolume / MC BP Volume During Sodium Hypochlorite * ChemConc * SpecGravity * 1000000 MC-HYPO-x = 23-FQ1-101-x/MC-BP-VOL-HYPO-x * HYPO-CONC * HYPO-GRAVITY * 1000000 Division by zero is inhibited.	IN MAINTENANCE CLEAN with sodium hypochlorite step 1.	
RC-HYPO-x	RC Sodium Hypochlorite Clean Solution	Derived - Display	Sodium Hypochlorite					The RC Sodium Hypochlorite Concentration is calculated in Recovery Clean step 21	RC Sodium Hypochlorite Concentration = ChemVolume / MC BP Volume During Sodium Hypochlorite * ChemConc * SpecGravity * 1000000 RC-HYPO-x = 23-FQ2-101-x/RC-BP-VOL-HYPO-x * HYPO-CONC * HYPO-GRAVITY * 1000000 Division by zero is inhibited.	IN RECOVERY CLEAN with sodium hypochlorite step 1.	
HYPO-LVL	Sodium Hypochlorite Tank Level	Comm. In	Level	0	100		%		Displays value with engineering units on screen. Signal is communicated from plant PLC.		
HYPO-LVL-L	Sodium Hypochlorite Tank Level Low	Alarm - Advisory	Level	0	100	10	%	When the level is at or below the setpoint for 10 seconds.	Alarm only.	When the level is above the setpoint	
HYPO-LVL-LL	Sodium Hypochlorite Tank Level Low-low	Alarm - Critical	Level	0	100	5	%	When the level is at or below the setpoint for 10 seconds.	Displays on alarm banner 'Insufficient cleaning chemical.' Interlocks transition of train to Maintenance clean or Recovery Clean if Sodium Hypochlorite would be required for that clean. Interlocks the chemical pump's pump 23-P-101-A/B In RECOVERY CLEAN: - all steps requesting pump 23-P-101-A/B to run and proceeds to the first fault step.	When the UF CIP Alarm Reset button is pressed.	change wording for metering pump

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Tag/Mnemonic	Description	Type	Category	Range Min	Range Max	Setpoint	Units	Set	Action or Derivation	Reset	Notes
	Prevent Starting of NaOCl Pumps	Interlock	Pump					When a Citric Acid Pump is running ON. OR When any train is in Maintenance Clean Acid Clean or Recovery Clean Acid Clean.	Blocks starting of any Sodium Hypochlorite Pump, in auto or manual modes.		
CIP - Maintenance Clean											
MC-SCH-TRG-x	Maintenance Clean Schedule	Trigger	Schedule					IN PRODUCTION & STANDBY: - all steps, when the system time is greater than or equal to the operator entered time to enable the Maintenance Cleans, MC-SCH-TIME-SP[day]-x, and a Maintenance Clean has been enabled to occur that day.	IN PRODUCTION: - in permeate step, proceeds to MAINTENANCE CLEAN step 1. IN STANDBY: -proceeds to MAINTENANCE CLEAN step 1. there is one time slot per day for Maintenance Clean .	IN MAINTENANCE CLEAN: step 1.	
MC-SCH-EN/DIS-PB[day]-x	Maintenance Clean to Occur on Given Day Enable/Disable Button	Button	Schedule						Operator can select to have a Maintenance Clean on specific days of the week. ENABLE allows the schedule to initiate a Maintenance Clean for the train that day. DISABLE does not allow the schedule to initiate a Maintenance Clean for the train that day.		Only one Maintenance Clean can be scheduled per day, Sunday to Saturday. Each day can have a different start/enabled and stop/disabled time.
MC-SCH-TIME-SP[day]-x	Maintenance Clean Enable Time	Setpoint	Schedule	0:00	23:59	Determined by Operator	hr.		Operator entered time to initiate a request for a Maintenance Clean on the given day.		Operator- entered time to start M. CLEAN.
MC-SCH-CHLOR-PB[day]-x MC-SCH-ACID-PB[day]-x	Maintenance Clean Sodium Hypochlorite or Citric Acid Selection	Button	Sequence						Allows the operator to select Sodium Hypochlorite or Citric Acid for each scheduled Maintenance Clean.		
MC-DELAY-TRG	High Demand Setpoint to Delay/Abort Maintenance Cleans	Trigger	Sequence	PLANT-DEM-STOP1	PLANT-DEM-MAX-SP	Derived	gpm	When PLANT-DEM is above the setpoint for 10 seconds.	Setpoint for MC-DELAY-TRG = NET-PERM-MAX-SP2 × (TRAINS-PROD-QTY + TRAINS-MC-QTY + TRAINS-STBY-QTY - 1)	When the set condition is no longer active.	
MC-DELAY-ALM-x	Maintenance Clean Delay/Abort Alarm	Alarm - Advisory	Sequence					When MC-DELAY-TRG is active AND This train is in AUTO mode AND Is in a MAINTENANCE CLEAN, OR has a MAINTENANCE CLEAN pending.	The MAINTENANCE CLEAN request is blocked and remains active. In MAINTENANCE CLEAN: Sets MC-ABORT-ALM-x Steps 1 to 3 proceeds to Standby Steps 4 to 9: proceed to step 10 Step 13 to 14: proceed to step 15.	When MC-DELAY-TRG is no longer active.	
MC-ITR-SP	Maintenance Clean Number of iterations	Setpoint	Sequence	2	10	8	N/A	IN MAINTENANCE CLEAN: steps as noted in the SC .	Operator entered number of iterations for the chemical pulses in Maintenance Clean state. This is the number of iterations the chemical pulses in Maintenance Clean are repeated. The number of iterations is retained in the fault steps. Consult the SC , Maintenance Clean state, for details.		This value is set by process requirements.
CIP - Recovery Clean											
RC-ITR-SP	Number of Iterations for Recovery Clean Mem Tk Flushing	Setpoint	Sequence	0	3	0	N/A	IN RECOVERY CLEAN: steps as noted in the SC .	Operator entered number of iterations for flushing the membrane tank in Recovery Clean. The number of iterations is retained in the fault steps. Consult the SC , Recovery Clean state, for details.		
RC-SOAK-MIX-EN/DIS-PB-x	Extended Soak Mixing Enable/Disable Button	Button	Sequence						Operator can select to have intermittent aeration during the soak step of Recovery Clean. ENABLE allows for intermittent aeration while DISABLE prevents intermittent aeration.		When selected, the cleaning solution will be intermittently mixed during the extended soak period of RECOVERY CLEAN.
RC-SOAK-MIX-DUR-SP	Recovery Clean Soak Extended Soak - Mixing Duration	Setpoint	Sequence	30	300	60	sec.		Operator entered value		
RC-SOAK-MIX-FREQ-SP	Recovery Clean Soak Extended Soak Mixing Frequency	Trigger	Sequence	600	7200	1200	sec.	IN RECOVERY CLEAN: - as per SC and aeration is enabled.	IN RECOVERY CLEAN: - setpoint is mixing frequency. Timer restarts when it times out. - When time left on the timer RC-SOAK-MIX-FREQ-SP is equal to RC-SOAK-MIX-DUR-SP then the membrane are aerated until the timer times out.	IN RECOVERY CLEAN: - as per SC .	
Neutralization System											
NEUT-RESUME-PB-x	RESUME Button	Button	Sequence						IN NEUTRALIZATION: steps as per SC , proceeds according to the SC . Consult interlocks in CLC and SC for more information.		The operator can resume NEUTRALIZATION if the pH and/or the residual chlorine readings are not acceptable.
NEUT-CONFIRM-PB-x	CONFIRM Button	Button	Sequence						IN NEUTRALIZATION: steps as per SC , proceeds to next step. Consult interlocks in CLC and SC for more information.		The operator is required to confirm that NEUTRALIZATION is complete.
Vacuum System											
PRIME-PRES-HI-ALM-x	Re-Priming Pressure High	Alarm - Critical	Pressure	N/A	N/A	9	psi	ALL STEPS: - Requiring the valve to open and the pressure, 20-PI-301-x, is at or above this setpoint with no time delay.	Closes the ejector valve then proceeds to the first Fault step of the current state. Displays on alarm banner "Priming Aborted"	When the train's Alarm Reset button is pressed.	membrane protection from over pressurization

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Tag/Mnemonic	Description	Type	Category	Range Min	Range Max	Setpoint	Units	Set	Action or Derivation	Reset	Notes
EJECT-FREQ-SP	Train Ejector Operating Frequency - Master Ejector Cycle Timer	Trigger	Sequence	4	90	8	min.	Master Ejector Cycle Timer runs continuously.	Operator entered value used as a Master Ejector Cycle Timer. This calculation determines when ejector operation starts for each train. Ejector for train X operates every EJECT-FREQ-SP seconds. Train # ejector opens at time = # x EJECT-FREQ-SP / Number of Ultrafilter Trains, of the Master Ejector Cycle Timer For example, there are 4 trains and EJECT-FREQ-SP is 6 min., so the sequence is as follows: Train 1 ejector opens at start time = 2 min. Train 2 ejector opens at start time = 4 min. Train 3 ejector opens at start time = 6 min. Train 4 ejector opens at start time = 8 min.		This is the duration between ejector opening on a single train.
EJECT-DUR-SP	Train Ejector Open Duration	Trigger	Sequence	5	30	15	sec.	IN STANDBY step 2: - When ejector is required to operate according to the start time calculated in EJECT-FREQ-SP	Operator entered value. Ejector opens for this duration.		This is the length of time each ejector is open during the master cycle. This is a train setpoint.
Treated Water System											
PLANT-FLOW-PV	Plant Permeate Flow	Derived - Display	Flow	0	45100		gpm		IN PRODUCTION and BACKPULSE: - all steps, sums permeate flows (Sum of 20-FI-307-x) minus the backpulse flows (Sum of 20-FI-307-x) for ALL TRAINS.		
PLANT-VOL-TOT	Today's Plant Production Volume	Derived - Display	Volume				gal		Totalized value from flow input Plant Permeate Flow PLANT-FLOW-PV Includes a running total for the current day total (_TODAY), yesterday day total (_DAY1)		Negative value because backpulse flow is subtracted
20-TI-001	Plant Permeate Temperature Transmitter	Analog In	Temperature	0	50		deg. C		Value scaled from 4-20 mA input.		
20-TAT-001	Plant Permeate Temperature Transmitter Out of Range	Alarm - Advisory	Temperature					When the transmitter signal is below 3.7 mA or above 20.9 mA for 2 seconds. If the PLC IO is not capable of reading >20.9 mA, this alarm will detect low-range only.	Alarm only	When the transmitter is in range.	
20-TX-001	Plant Permeate Average Temperature	Derived - Internal	Plant Permeate	0	50		deg. C	When at least one train is in the Production cycle, calculates the permeate average temperature. (NOTE: Units for average temperature **must** be in degrees Celsius)	The system calculates an hourly running average temperature by capturing the combined permeate temperature, 20-TI-001, every 6 minutes for 60 minutes, calculates the average, converts it to degrees Celsius, and then rounds if off. This average is not displayed. The system maintains this running average temperature to determine the Net Permeate Flow Trigger setpoint for Leap Low aeration, 20-FY-307-x.		This is used in the resistance calculation for determining the type of aeration. This line for leap The temperature T in degrees Fahrenheit (°F) is equal to the temperature T in degrees Celsius (°C) times 9/5 plus 32: T(°F) = T(°C) × 9/5 + 32
Utility Air System											
	Air Compressor	General Info	Utility Air						The lead compressor is always enabled.		
90-YA-001-A/B	Air Compressor "Y" Fault	Alarm - Advisory	Utility Air					IN ALL MODES: - all steps, when the fault signal is present.	Faults and Interlocks compressor. IN ALL MODES: - all steps, alarm only. Continues steps.	When the fault signal is no longer present.	
90-MQAL-001	No Air Compressors Available	Alarm - Critical	Compressor					When there are no air compressors available to run in auto. A compressor is available in auto and it is not interlocked or faulted for 2 seconds.	Alarm only.	When either air compressor is available to run in auto.	The PLC is controlling the alternation of the compressors
90-MQIC-001	Air Compressor Lead Alternation	Button	Compressor						Lead alternation is based on Compressor Runtime. The Compressor with least Runtime becomes the lead. The HMI indicates which device is the lead.		The PLC is controlling the alternation of the compressors
90-PAL-001	Filtered Compressed Air Pressure Low	Alarm - Advisory	Pressure			discrete		When the switch is active for 5 seconds.	Enables the lag compressor.	When the switch is no longer active	Switch is set to 90 psig, activated on decreasing pressure.
90-PALL-002	Instrument Air Pressure Low	Alarm - Critical	Pressure					When the switch is active for 5 seconds.	IN STANDBY, PRIME, PRODUCTION, BACKPULSE, RELAX, MAINTENANCE CLEAN, RECOVERY CLEAN & NEUTRALIZATION: - all steps, proceeds to the first Fault step of the current state.	When the switch is no longer active.	Pump protection since there is insufficient compressed air to ensure the valves are in the correct position. Alarm critical - means a call out
COMP-DUTY-CYCLE-HIGH-A/B	Air Compressor "Y" Excessive Duty Cycle	Alarm - Advisory	Compressor					When the compressor has been running for 45 minutes of the last 60 minutes.	Alarm only.	When the set condition is no longer true.	When customizing for a rotary screw or rotary vane compressor, this alarm is deleted from the design.

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Base Code Tag	Project Tag/Mnemonic	Description	Parameter	Range Min	Range Max	Set Point	Units	Comment	Sample Calc.	Information
	PLANT-DEM-TRIM-SP	**Plant Demand Trim Flow rate**		-PLANT-DEM-MAX-SP	PLANT-DEM-MAX-SP		gpm	Trim Flow for Plant Demand = proportional to Membrane Tank average Level, as shown below. PLANT-DEM-TRIM-SP = [PLANT-DEM-MAX-SP × (20-LXI-201 - 20-LC-201) / (20-LCH-201 - 20-LC-201))]		The plant permeate trim flow is used to calculate the plant permeate demand flow, which is used to calculate the net permeate flow for each train in PRODUCTION, NET-PERM-CALC-SP.
	20-LXI-201		Membrane Tank Level	0	156					
SP_LEVEL_LCH	20-LCH-201		Membrane Tank Level High Setpoint	100	116	116	inches	Operator setpoint.		Maximum control level is 20-LCH-201 where plant permeate flow demand must equal the maximum peak flow for the entire plant, PLANT-DEM-MAX-SP gpm.
SP_LEVEL_LC	20-LC-201		Membrane Tank Level Control Setpoint	100	116	112	inches	Operator setpoint.		Control level is 20-LC-201 is in the middle of the maximum and minimum levels for the trim volume.
G20_FIC_307-x	**20-FIC1-307-x**	**Process Pump PID Control - E=SP-PV**								
			PV: flow indicated on Instantaneous permeate flow transmitter 20-FI-307-x	0	3000		gpm			
G20_FIC_307-x	20-FC-307-x		SP: is the calculated instantaneous permeate flow	20-FCL-307-x	If BP-EN-PB is selected, then the max range is (NET-PERM-MAX-SP2) × 1.25 If RELAX-EN-PB is selected, then the max range is (NET-PERM-MAX-SP2) × 1.15	Derived	gpm	Instantaneous Permeate Flow Setpoint = Target Net Permeate Flow × Net Instantaneous Production Correction Factor In Backpulse In Auto SP: 20-FC-307-x = (NET-PERM-CALC-SP-x) × 1.25 In Sup SP: 20-FC-307-x = (NET-PERM-SUPER-SP-x) × 1.25 In Relax In Auto SP: 20-FC-307-x = (NET-PERM-CALC-SP-x) × 1.15 In Sup SP: 20-FC-307-x = (NET-PERM-SUPER-SP-x) × 1.15		
	20-SC-301-x		Cv = speed of the process pump 20-P-301-x	min. pump speed	100% unless limited by TMP		%	CV is the speed of the Process Pump in PRODUCTION & driven to zero when the pump is not called to run. When the pump is called to run CV = 50% for 5 seconds, then released for PID control to achieve the setpoint (starting CV and duration are adjustable). Bumpless transfer between Manual & Auto The tuning parameters are per train.		
G20_FIC2_307-x	**20-FIC2-307-x**	**Backpulse Flow PID Control - E=SP-PV**								
	20-FI-307-x		PV: flow indicated on Instantaneous permeate flow	0	3000		gpm			

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SP-MC-FLOW	BP-FLOW-SP		SP: Backpulse flow	1000	2413	2413	gpm	Operator entered flow setpoint for backpulsing the entire train in Backpulse, RECOVERY CLEAN steps 8 & 19 & NEUTRALIZATION. This is a plant setpoint.		In Backpulse, Recovery Clean (except step 16), and Neutralization.
G20_FIC2_307-x	CHEM-ADD-SP		SP: CIP Flow Setpoint	700	1042	900	gpm	Operator entered CIP flow setpoint for Maintenance Clean and RECOVERY CLEAN step 16. This is a plant setpoint		In Maintenance Clean and Recovery Clean step 16
	20-SC-301-x		Cv = speed of the process pump 20-P-301-x	min. pump speed	100% unless limited by TMP		%	CV is the speed of the Process Pump for BACKPULSE, MAINTENANCE CLEAN, RECOVERY CLEAN, NEUTRALIZATION & to zero when the pump is not called to run. When the pump is called to run in Backpulse, CV = 50% for 5 seconds, then released for PID control to achieve the setpoint (starting CV and duration are adjustable). When the pump is called to run in R.C & Neutralization, CV = 50% for 5 seconds, then released for PID control to achieve the setpoint (starting CV and duration are adjustable). When the pump is called to run in Maintenance Clean CV = 50% for 5 seconds, then released for PID control to achieve the setpoint (starting CV and duration are adjustable). The tuning parameters are per train for Backpulse, Neutralization, Maintenance Clean There is a separate set of tuning parameters per train for Recovery Clean Bumpless transfer between Manual & Auto		
G20_FIC_507-x	**20-FIC-507**	**RAS/drain Pump Flow Proportional Integral Derivative Controller - E=SP-PV**								
G20_FI_507-x	20-FI-507		PV: flow indicated on RAS flow transmitter	0	4700		gpm			
FC-RAS-x	20-FC-507-x		RAS Flow Setpoint					When the train is in Production, Relax or Backpulse (Production Cycle): When a train is in Auto Flow Control RAS Flow Setpoint = Flow Factor multiplied by Target Net Permeate Flow Calculated 20-FC-507-x = 20-FFY-507 * NET-PERM-CALC-SP-x When a train is in Supervisory Flow Control 20-FC-507-x = 20-FFY-507 * NET-PERM-SUPER-SP-x In STANDBY, NEUTRALIZATION: 20-FC-507-x = 20-FC1-507-x In RECOVERY CLEAN: 20-FC-507-x = 20-FC2-507-x		
FIC_RAS.SPLOC-x	20-FC1-507-x		RAS Flow Setpoint	1715	4167	3472	gpm	Operator entered setpoint for STANDBY, NEUTRALIZATION This is a plant setpoint		
FIC_RAS.SPLOC-x	20-FC2-507-x		RAS Flow Drain Setpoint	856	4167	856	gpm	Operator entered setpoint for RECOVERY CLEAN This is a plant setpoint		The RAS pump requires the lower flow to drain the membrane tank
SP-FLOW-RAS-FFY	20-FFY-507		Flow Factor For Recirculation Pumps	2	6	4		Operator setpoint.		

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	20-SC-501-x		Cv = speed of the RAS/drain pump 20-P-501-x	min. pump speed	100%		%	CV is the speed of the RAS/drain Pump, with the minimum value limited to 20-OMIN-501-x. CV is driven to zero when the pump is not called to run. PV is the recirculation flow rate, 20-FI-507-x SP = 20-FC-507-x all pumps operate at the same speed CV = 60% for 5 seconds, then released for PID control to achieve the setpoint (starting CV and duration are adjustable) E=SP-PV-x		
	23-FIC-301	Citric Acid Flow Proportional Integral Derivative Controller								
	23-FI-301		Citric Acid Flow	0	10		gpm			
	23-FIC-301-SP		Citric Acid Flow Setpoint	0	10		gpm	In MAINTENANCE CLEAN 23-FIC-301-SP = 23-FIC-301-SP1 In RECOVERY CLEAN 23-FIC-301-SP = 23-FIC-301-SP2		
	23-FIC-301-SP1		Maintenance Clean Citric Acid Flow Setpoint	0	4	2.9	gpm	Entered Value		
	23-FIC-301-SP2		Recovery Clean Citric Acid Flow Setpoint	0	4	3.2	gpm	Entered Value		
	23-SC-301		Cv = speed of the citric acid 23-P-301-A/B	min. pump speed	100%		%	CV is the speed of the citric acid pump CV is driven to zero when the pump is not called to run. PV is the flow rate, 23-FI-301 SP = 23-FIC-301-SP CV = 60% for 5 seconds, then released for PID control to achieve the setpoint (starting CV and duration are adjustable) E = SP-PV		
	23-FIC-101	Sodium Hypochlorite Flow Proportional Integral Derivative Controller								
	23-FI-101		Sodium Hypochlorite Flow	0	15		gpm			
	23-FIC-101-SP		Sodium Hypochlorite Flow Setpoint	0	15		gpm	In MAINTENANCE CLEAN 23-FIC-101-SP = 23-FIC-101-SP1 In RECOVERY CLEAN 23-FIC-101-SP = 23-FIC-101-SP2		
	23-FIC-101-SP1		Maintenance Clean Sodium Hypochlorite Flow Setpoint	0	2	1.2	gpm	Entered Value		
	23-FIC-101-SP2		Recovery Clean Sodium Hypochlorite Flow Setpoint	0	10	6.63	gpm	Entered Value		
	23-SC-101		Cv = speed of the Sodium Hypochlorite 23-P-101-A/B	min. pump speed	100%		%	CV is the speed of the Sodium Hypochlorite pump CV is driven to zero when the pump is not called to run. PV is the flow rate, 23-FI-307 SP = 23-FIC-307-SP CV = 60% for 5 seconds, then released for PID control to achieve the setpoint (starting CV and duration are adjustable) E = SP-PV		

Document Number: 506357-WTS-AU-T02-8533-FD-001
Revision: A

Tag	Description	Engineering Range	Engineering Units	Data Type	SUEZ PLC Address (all tags controller scoped)	Client PLC Address	
n/a	Heartbeat from Plant PLC	n/a value increments on a one second pulse	n/a	DINT	PLANT_IN[0]		
FEED-FLOW	Feed Flow	0 to 25200	gpm		PLANT_IN[1]		
UV_SYS_OK	UV System OK	0-1	n/a	DINT	PLANT_IN[2]		
UV_SYS_NOT_OK	UV Fault	0-1	n/a	DINT	PLANT_IN[3]		
HYPO-LVL	Sodium Hypochlorite Tank Level	0 to 100	%		PLANT_IN[5]		
FLUME-LVL	Flume Channel Level	0 to 100	%		PLANT_IN[6]		
	{available for future use}				PLANT_IN[7]		
	{available for future use}				PLANT_IN[8]		
	{available for future use}				PLANT_IN[9]		
	{available for future use}				PLANT_IN[10]		
	{available for future use}				PLANT_IN[11]		
	{available for future use}				PLANT_IN[12]		
	{available for future use}				PLANT_IN[13]		
	{available for future use}				PLANT_IN[14]		
	{available for future use}				PLANT_IN[15]		
	{available for future use}				PLANT_IN[16]		
	{available for future use}				PLANT_IN[17]		
	{available for future use}				PLANT_IN[18]		
	{available for future use}				PLANT_IN[19]		

Tag	Description	Engineering Range	Engineering Units	Data Type	SUEZ PLC Address (all tags controller scoped)	Client PLC Address	
n/a	Heartbeat to Plant PLC	n/a value increments on a one second pulse	n/a	DINT	PLANT_OUT[0]		
UV_SYS_REQ	UV Run Demand	0-1	n/a	DINT	PLANT_OUT[1]		
	{available for future use}			DINT	PLANT_OUT[3]		
	{available for future use}			DINT	PLANT_OUT[4]		

ATKINS

Membrane System Supplier Request for Proposal

City of Canton, Georgia
Wastewater Treatment Plant Expansion to 6 mgd

January 2020

Proposal Due Date: February 3, 2020

Owner Contact:

Mr. David Hatabian, P.E.

Canton City Hall

110 Academy Street

Canton, Georgia 30114

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1. General Information

1.1. Introduction

City of Canton, Georgia, (CITY), is expanding their wastewater treatment facility from 4 MGD to 6 MGD. The biological treatment process selected for this project is the University of Cape Town UCT, where it was developed. The UCT process consists of anaerobic, anoxic and aerobic treatment basins. The UCT process will biologically reduce phosphorus and total nitrogen. Membrane ultrafiltration will follow the UCT process.

The CITY is hereby publicly soliciting proposals for a membrane system supplier (MSS) for the project. The project is a Design-Bid-Build Project. The selected membrane proposal and pricing will be incorporated into the Construction Bid Documents issued to GENERAL CONTRACTOR's for soliciting construction bids.

This Request for Proposal (RFP) is being issued to Pre-selected membrane system suppliers as identified herein. Proposals submitted by non-pre-selected membrane system suppliers will be returned unopened.

There is no guarantee this project will be constructed. All costs associated with the preparation and submittal of the supplier's proposal will be borne by the PROPOSER.

1.2. Objectives

The CITY is selecting the MSS to accomplish the following:

1. Select the wastewater membrane treatment system that is, overall, the most advantageous for the City of Canton in terms of its flexibility and with reasonable operational and maintenance requirements.
2. Cost effective.
3. Effective in improving the wastewater quality entering the Etowah River.
4. Provides long term reliability and meets the process performance specified herein.
5. Safe in operations and meets EPA Class 1 Reliability.
6. Meets the system useful life specified herein.
7. Assign the selected proposal to the GENERAL CONTRACTOR for installation during the construction phase of the project.
8. To assist the consultant (Atkins) in completing their design efforts associated with the wastewater membrane system. This includes but not limited to attending meetings, workshops, providing design submittals, preparing AutoCAD files, sizing equipment, developing plan layouts, preparation of specifications.

9. Commission the membrane treatment system within 24 months of construction notice to proceed.

10. Train plant operations staff.

1.3. Pre-Proposal Conference

The CITY will hold a mandatory pre-proposal conference on **January 9th, 2020** at 10:00 a.m. at Canton City Hall, second floor conference room, 110 Academy Street, Canton Georgia. The purpose of the pre-proposal conference is to provide information regarding the project and services sought from the PROPOSER.

A site visit at the project location will follow the pre- proposal conference.

1.4. Pre-Selected Membrane System Suppliers

This RFP is being issued to only pre-approved membrane system suppliers. The pre-approved system suppliers for the project are listed in alphabetical order:

- Koch
- Memcor
- Mycrodyn
- Suez

The pre-selection of the named membrane system suppliers was identified during the Membrane Implementation phase of this project.

1.5. Proposal Due Date

Details of the proposals will be public information. The proposal will be received at Canton City Hall, 110 Academy Street, Canton, Georgia. If mailing or use of courier, please address the proposal to Mr. David Hatabian, P.E., City Engineer. The submittal will be time and date stamped with the clock at the Canton City Hall reception desk.

E-mailed proposals will not be accepted.

Submission Date for Proposal: 2:00 pm EST, February 3, 2020

The CITY reserves the right to waive any informality or to reject any or all proposals. It shall be the sole responsibility of the PROPOSER to have his or her proposal delivered to Canton City Hall for receipt on or before the date and time above. If the proposal is sent via US Mail Service, the PROPOSER remains responsible for timely delivery.

1.6. Late Submittals

Proposals received after the scheduled proposal date and time will be returned unopened.

1.7. Schedule

Anticipated schedule for procurement of services described herein is summarized in **Table 1**. The days are shown as calendar days. The CITY reserves the right to modify, amend any or all dates included in the schedule at its sole discretion.

Table 1 – Anticipated Schedule

Anticipated Schedule	
Item	**Target Date**
RFP Phase	
Issue Request for Proposal	January 3, 2020
Pre-Proposal Meeting	January 9, 2020
Last Date for Questions	January 22, 2020
Final Addendum	January 28, 2020
Proposal Due Date	February 3, 2020
Interviews (if required)	February 10, 2020
MSS selection	February 13,2020
Design Phase	
Design Phase NTP for MSS	Selection + 7 days
Design Meeting 1	14 days from Design NTP
Design Submittal 1 Due Date	4 weeks from Design NTP
Design Meeting 2	1 week after receipt of Submittal 1
Design Submittal 2 Due Date	4 weeks from date of Meeting 2
Design Meeting 3	1 week after receipt of Submittal 2
Construction Phase Services	
Construction NTP	TBD
Construction Purchase Order for Membrane System	TBD
Submittals	Per construction schedule
Installation Services	Per construction schedule
System programming and Start-up	Per construction schedule
Operation Training	Per construction schedule
System Commissioning and Testing	Per construction schedule

1.8. Proposal Preparation Cost

The CITY and ENGINEER will not be liable in any way for costs incurred by the PROPOSER in the preparation of their bid proposal for the presentation of said proposal or for participation in any discussions or negotiations.

1.9. Withdrawal of Proposal before Closing

The PROPOSER may request in writing the withdrawal if their proposal at any time prior to the schedule proposal opening time and date (closing). Upon receiving request to withdrawal their proposal, the CITY will consider the PROPOSER's proposal null and void and will be returned opened to the PROPOSER.

1.10. Confidential Information

If any proposal contains technical, financial, or other confidential information that the PROPOSER believes is exempt from disclosure, the PROPOSER must clearly label the specific portions sought to be kept confidential and specify on what the exemption is based. The City of Canton, Georgia at its sole discretion and subject to applicable law, will determine whether such exemption applies. The City of Canton, Georgia has sole discretion to make such determination regarding the disclosure of information, and by responding to this request for proposal, PROPOSER's waive any challenge to the City of Cantons' decisions in this regard. Marking all or substantially all of a proposal as confidential may result in the PROPOSER being deemed non-responsive to this RFP.

Notwithstanding the foregoing, PROPOSERS recognize and agree that the City of Canton, Georgia, its staff, and the Engineer will not be responsible or liable in any way for any losses that the PROPOSER may suffer from the disclosure of information or materials to third parties.

1.11. Indemnification

The MSS agrees to defend, indemnify and hold harmless the CITY and all of this officers, agents , employees, and elected officials whole and harmless against any claim and all claims for damages, costs, and expenses of persons or property that may arise out of, or be occasioned by, or from any negligent act or omission of the MSS in the execution of the performance of this agreement. Any claims, interpretations or litigation arising, regarding this agreement or performance of work contemplated under the terms of this agreement, shall be heard and determined by the presiding Judge of the Superior Court of Cherokee County, Georgia.

1.12. Termination of Project

No payment will be made to the MSS or PROPOSER in advance of the construction project. All payments to the MSS will be made through the GENERAL CONTRACTOR. The selected PROPOSER will assist the consultant (Atkins) in completing their design efforts associated with the wastewater membrane system. This includes but not limited to meetings, workshops, preparation of AutoCAD files, equipment sizing, layouts, BioWin modeling, specifications and training.

If the CITY decides to terminate the project during bidding of the construction contract or if the CITY does not award the construction contract, the MSS will be compensated by the CITY in the amount of $ 5000 US, for time and effort for work performed during the design phase of the project. This compensation does not include overhead and profit.

1.13. Proposal Price Adjustment

The GENERAL CONTRACTOR who is awarded the construction project will purchase the membrane system at the proposed / pre-negotiated price from the selected MSS. The MSS proposal will be included in the bidding Contract Documents for Construction of the treatment plant expansion that is distributed to the GENERAL CONTRACTORs. The MSS proposal cost, will be fixed for a period of fifteen (15) months from receipt of proposals for this RFP.

If the GENERAL CONTRACTOR has not issued a purchase order for the membrane system by the end of the 15 months period, the proposed/pre-negotiated price of the membrane system will be adjusted based the US Department of Labor Price Index (CPI) for Urban Customers (CPI-U) U.S. City Average. All items as of the 15 month and the month of purchase order is made as follows;

Escalated Cost= (Proposed 0r Pre-negotiated Price x CPI $_{\text{month of PO}}$) / (CPI $_{\text{month 15}}$)

1.14. Method of Payment

Partial Payment of the Total LUMP SUM PRICE shall be made through the GENERAL CONTRACTOR to the SELECTED PROPOSER in accordance with the following schedule:

1. Upon ENGINEER's Approval of Shop Drawings: 10%

2. Upon Delivery, Acceptance by the GENERAL CONTRACTOR of the Equipment at the plant site, and title transfer to the OWNER: 65%

3. Upon Substantial Completion: 15%

4. Upon Successful Completion of the Performance Test: 10% (minus value of incomplete work)

Progress invoices shall be paid by the GENERAL CONTRACTOR in accordance with applicable state laws.

1.15. Equipment

The MSS to provide all equipment required for a complete and operable system including but not limited to membrane units, pumps, air scour blowers, back pulse tank (if required), all membrane associated piping, piping within the membrane tanks, all membrane process valves and valve actuators, MBR automated valve actuators, process analyzers, clean in place (CIP) systems equipment, instrumentation and controls.

All equipment shall be new and unused and shall be standard products of the MSS having used such equipment successfully in other projects. The equipment must be from a reputable supplier, operate satisfactorily and safely.

1.16. Warranty

Equipment Warranty – The PROPOSER to guarantee all components of the membrane system supplied including appurtenances against material defect for a period of one (1) year after completion of performance testing. All replacement materials to be provided at no cost to the City during the warranty period. The GENERAL CONTRACTOR shall be responsible for providing all labor and equipment to make needed repairs to the membrane system.

Membranes shall be warranted for ten (10) years from the date of meeting the performance requirements. Membranes shall be capable of processing peak hour design flow rates with all units in service. Replacement of membranes that fail or underperform from faulty materials or workmanship or fail to produce permeate requirements specified herein shall be replaced at no cost to the CITY during the warranty period. Membrane system supplier will not be required to replace membranes that fail due to improper operation and maintenance by the CITY operations staff.

Performance Warranty- The membrane system supplier must warrant the performance of the membrane equipment to meet or exceed the performance requirements included in this RFP for a period of 5 years upon completion of the Performance Testing. Failure to meet performance requirements during the 5-year warranty period will result in the membrane supplier being responsible for undertaking modifications, and/or providing technical assistance to incorporate operational changes and/or changes to the system as required and at no cost to the City to meet the Performance Requirements. Performance Warranty will not be prorated.

Warranty Reporting- The membrane system supplier shall monitor the operation of the membrane system for a period of 12 months after completion of performance testing. The CITY will provide a high-speed connection to the membrane master control panel.

Warranty Operational Requirements- The CITY is required to operate the biological treatment system within the MLSS parameters identified in this RFP. However, an upset in the MLSS concentration exceeding 20,000 mg/l for a period of 72 continuous hours shall not void the warranty coverage.

1.17. Proposal Process

Submit proposals in strict compliance with the requirements of this Request for Proposals. Failure to submit in accordance with the requirements of this Request for Proposals will result in rejection of the proposal.

The SELECTED MSS proposal will be used as the Basis of Design for final design of the new membrane treatment facility and the MSS will supply equipment and other services for the project, as agreed between the OWNER and the MSS.

Based on the design criteria set forth by the SELECTED MSS, the OWNER's Consultant: Atkins (ENGINEER) will design: the associated yard piping, electrical supply to membrane system, membrane system instrumentation interface to plant SCADA, civil site modifications; reinforced concrete structures and other major structural and architectural facilities including the building to house the membrane system support equipment.

The ENGINEER will specify in the construction phase contract documents the GENERAL CONTRACTOR will install the membrane system, including ancillary equipment furnished by the SELECTED MSS. The GENERAL CONTRACTOR will supply and install required electrical connections, motor starters, power, and control wiring that is beyond the scope of this RFP.

The equipment selection, sizing, specification, pricing data, and related contractual terms and conditions submitted by the SELECTED MSS will be inserted into the **City of Canton Wastewater Plant Expansion to 6 MGD** construction documents to establish and control the guaranteed scope, price, terms, and conditions for the subject equipment. This scope of supply and price shall be fixed in US Dollars.

If the GENERAL CONTRACTOR awarded the construction phase of this project is assigned liquidated damages due to any action, or inaction, of the MSS (assuming a valid purchase order from the GENERAL CONTRACTOR has been issued to the MSS), the GENERAL CONTRACTOR may assess liquidated damages on the MSS. Liquidated damages for the construction contract will be set to $1,000 per day.

1.18. Clarification and Addenda

PROPOSERS may submit requests for clarifications or interpretations regarding this RFP. PROPOSERS must prepare such requests in writing for the CITY's consideration as set forth in this section of this RFP. While the CITY has not placed an initial limitation on the number of requests which can be submitted, PROPOSERS are cautioned that if PROPOSERS do not request meaningful clarifications or interpretations in an organized manner (e.g., limited frequency of requests), the CITY will set restrictions on the frequency and number of requests permitted. The CITY/ENGINEER will not respond to requests, oral or written, received after **January 22, 2020 at 5:00 PM,** local prevailing time. PROPOSERS are advised that this section places no obligation on the part of the CITY/ENGINEER to respond to any or all requests for clarification or interpretation, and that the CITY/ENGINEERS' failure to respond to any such request will not relieve the PROPOSER of any obligations or conditions required by this RFP.

Requests for clarification or interpretation regarding this RFP shall only be submitted in writing (letter or email) to: Mr. Hector Casablanca, ATKINS North America, hector.casablanca@atkinsglobal.com for evaluation and/or response.

All correspondence will be forwarded to all PROPOSERS in the form of an Addendum. Only questions answered by Addenda will be binding. Questions received less than five (5) calendar days prior to the date for submission of the proposals may not be answered.

No oral interpretation, instruction, or information concerning this RFP given by any employee or agent of the CITY shall be binding on the CITY. PROPOSERS who submit a Proposal in reliance on any such oral information risk having their response to this RFP deemed non-responsive by the CITY. Only written responses issued by addendum to this RFP should be considered by the PROPOSERS.

During the period provided for the preparation of Proposals, the CITY may issue addenda to this RFP. These addenda will be numbered consecutively and will be posted on the City of Canton website, www.cityofcanton.gov. These addenda will be issued by, or on behalf of, the CITY and will constitute a part of this RFP. **Each PROPOSER is required to acknowledge receipt of each addendum distributed prior to the Proposal Submission Date**. All responses to this RFP shall be prepared with full consideration of the addenda issued prior to the Proposal Submission Date.

1.19. Definitions

Average daily flow (ADF)- the average flow rate occurring over a 24- hour period based on annual flow rate information.

Maintenance Clean- the periodic application of chemicals to the membrane train or basin for a short duration to remove accumulated membrane foulants that have not been removed by the use of relaxation or backpulsing.

Maximum Month Flow (MMF)- the average flow rate occurring over a 24 -hour period during the 30-day period with the highest flow based on annual flow rate data.

Membrane System- the complete functional membrane process consisting of membrane tanks, membranes, membranes racks, pipes, valves, chemical feed systems, pumps, blowers, instrumentation and control, associated electrical.

Net Flux Rate- the flux (flow rate in gallons per day per square of membrane area) adjusted for lost capacity due to relaxation, backflow or other losses when averaged over normal operations of cyclic operations.

Peak Hour Flow (PHF)- maximum flow rate over a 1 -hour period based on annual flow rate data.

Peak Day Flow (PDF)- the maximum flow rate over a 24-hour period, based on annual flow data.

Recovery Clean – a periodic application of more concentrated chemicals to the membrane train or basin for a longer duration than maintenance clean to restore the permeability of the membranes to the greatest possible level.

UVPA- the proposed ultraviolet disinfection and post aeration structure.

2. Proposal Selection and Scoring

2.1. General

The CITY and ENGINEER will evaluate each proposal and select the proposal that is most advantageous to the CITY.

Alternate designs and innovative concepts may be submitted for consideration. Submit alternate design proposals as separate Proposals. The alternate proposal must comply with the full requirements of this RFP.

All PROPOSERS will be notified of the evaluation results. The CITY will not make an award or enter into a contract with the SELECTED MSS, nor will the CITY guarantee the timing and/or the realization of this project. Information provided by the SELECTED MSS will be used for facilitating the design of the membrane system. The construction phase of the membrane system will be separate from the design phase. Anticipated construction to begin the third quarter of year 2020 with completion second quarter year 2024. The membrane system shall include all equipment accessories and other services described herein.

There shall be no separate payment to the PROPOSER for design services to assist the ENGINEER during the design phase of this project. There is no contract between the ENGINEER and PROPOSER during the design services phase of this project.

Proposals that do not contain the required form(s) and information will be considered incomplete and will not be reviewed.

2.2. Selection Criteria and Scoring

The following selection criteria including financial and non-financial criteria will be used to score the proposals. A total of 100 points will be allocated. The PROPOSER with the highest score will be the selected as the MSS.

- Total Capital Cost (**Appendix A**)
- Present Worth (**Appendix C**)
- Technical Information Form (**Appendix C**)
- Product Support
- Past Performance

Criteria 1- Total Capital Cost

Total capital cost for the equipment and services- based upon the scope of supply and services. A maximum of 25 points will be awarded for the membrane system with the overall lowest capital cost. The Membrane Supplier with the lowest cost (based upon Appendix A) will be awarded the maximum number of points. All other suppliers will receive lesser points based on the percentage difference from the lowest cost, as shown in the example below shown in **Table 2.**

Table 2 – Points awarded for total capital cost

Membrane system supplier	Total Capital Cost	Points
A	$ 100,000	25.00
B	$ 125,000	18.75
C	$ 150,000	12.75
D	$ 170,000	7.50

Example Calculation for Points Distribution

Supplier A receives 25 points (lowest cost)

Supplier B receives points as follows:

25 – [25 x (125,000 – 100,000)/100,000] = 18.75 points

Supplier C receives points as follows:

25 – [25 x (150,000 – 100,000)/100,000] = 12.75 points

Supplier D receives points as follows:

25 – [25 x (170,000 – 100,000)/100,000] = 7.5 points

Criteria 2- Present Worth Cost to Operate

Present Worth Cost – The life cycle cost to include the capital cost as well as operational costs over the lifetime of the installed system. The capital cost shall include all equipment cost, operational costs for chemicals, power consumption, membrane replacement over a 10- year net present value. Present worth factors are listed in the **Table 3**. **Appendix C** includes a complete list of present worth factors and the calculation formulas to be used in the preparation of the proposal. **Appendix C** includes the Present Worth Form required for submittal. The PROPSER is required to fill out all tables in **Appendix C** and submit with the proposal.

Table 3 - Present Worth Factors

Item	Value
Max Month Flow rate	6 mgd
Present Worth Factor	7.36 (6%, 10 years)
Interest Rate	6%
Period of Evaluation	10 year
Membrane replacement	1 replacement during 10- year life cycle

Points for Present Worth Points will be calculated by the CITY and ENGINEER and awarded in the example shown in **Table 4**.

Table 4- Points awarded for Present Worth Cost to Operate

Membrane system supplier	PW cost	Points Awarded
A	$ 1,200,000	25
B	$ 1,450,000	19.79
C	$ 2,000,000	8.33
D	$ 2,200,000	4.17

Example Calculation for Points Distribution

Supplier A receives 25 points

Supplier B receives points as follows:

25 – [25 x (1,450,000 – 1,200,000)/1,200,000] = 19.79

Supplier C receives points as follows:

25 – [25 x (2,000,000 – 1,200,000)/1,200,000] = 8.33

Supplier D receives points as follows:

25 – [25 x (2,20,000 – 1,200,000)/1,200,000] = 4.17

Criteria 3- Product Support

Product Support- Product services and support (on line factory monitoring, authorized local factory authorized repair/service shop personnel), 24/7 e-mail and/or telephone support service, maintenance service contract agreement capabilities will be evaluated.

Points will be awarded to each membrane system PROPOSER. Points will be awarded to each PROPOSER based upon the product support capabilities listed in **Table 5.** A total of 25 points is available for **Criteria 3**.

Table 5 – Points awarded for Product Support

Item	Points Awarded
Local support services*	Up to 10
Email and 24/7 services	Up to 2.5
Service contract capabilities**	Up to 10
On-line factory monitoring	Up to 2.5
*Local support services: This is defined as all-ready in place service shops/factory authorized personnel located within 120 miles (one-way) of City of Canton, GA. Zero points will be awarded if local support cannot be demonstrated.	
** To receive 10 points, the PROPOSER must demonstrate they have been awarded at least 2 service/maintenance agreements within the last 7 years.	

Criteria 4- Past Performance

Past Performance- The PROPOSERS past performance of Membrane systems in existing municipal wastewater treatment plants of similar capacity, using similar membrane technology as proposed in this RFP in the last 10 years, will be reviewed and points awarded. The distribution of points will be allocated based upon the responses provided. A maximum of 25 points is allocated for past performance.

For the PROPOSERS requested referenced facilities in **3.4 Format and Content**, Section 3, line item 10 of this RFP. Answer the following questions for each facility:

- Question 1- Has /was your membrane replaced by a competitor within the warranty period?
- Question 2- Has/was your membrane replaced by a competitor after the warranty period?
- Question 3- Did your firm replace your membrane within the warranty period?
- Question 4- If membrane replacement was required during the warranty period, provide a description of the reason for the replacement.
- Question 5- Has/was the facility re-rated to a higher capacity without increasing the installed membrane total area?

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3. Proposal Organization and Submission Requirements

3.1. Labelling

Proposal for the selection of the MSS will be sealed and clearly labelled on the outside of the package with the following:

"Request for Proposals- CITY OF CANTON, GEORGIA WASTEWATER PLANT EXPANSION MEMBRANE SYSTEM SUPPLIER SELECTION"

3.2. Copies

Submit six (6) copies of the proposal and one (1) electronic copy of the proposal. The electronic copy shall be in portable document format (PDF) and shall be submitted on a USB flash drive. The PDF shall be bookmarked.

3.3. Page Size and Page Limit

Proposals shall be submitted on 81/2" x 11" paper and 11"x17" paper (folded). There is no page limit for this proposal.

3.4. Format and Content

Proposals shall be organized with a Table of Contents at the front and tabbed dividers between sections. Sections required are as follows:

Cover Page- include the title of the proposal

Table of Contents- Provide a Table of Contents for the Proposal

Section 1- Cover Letter

Provide a Cover Letter no more than two (2) pages in length, signed by an authorized representative of the MSS. The letter shall include:

1. Brief statement describing the services to be provided with the proposal.
2. The name, address, email address, mailing address of the person who will respond to questions about this proposal.
3. Highlight MSS qualifications and ability to provide services requested in the proposal.
4. Acknowledgment of receipt of addendum (and number).
5. Provide a clear statement of indemnification against all third-party claims of infringement of patents and proprietary technology covering the equipment and process configuration as proposed.

Section 2- Executive Summary

The executive summary shall include a brief description of the approach to the work, understanding of the project goals and objectives, with identification of potential problems or concerns associated with the project. Avoid presenting duplication of information from other sections of the proposal.

Section 3- Membrane Equipment Supplier Information

This Section shall include specific information listed below:

1. Company name
2. Type of Organization (i.e. partnership, LLC, corporation etc.)
3. Location and address of main headquarters
4. Location and address of regional offices
5. Local sales offices
6. Location of factory "certified" membrane maintenance office/shop
7. Number of years company has been in operation
8. Previous company names
9. List of at least three (3) existing municipal wastewater treatment facilities using the PROPOSER's technology. Include the following:
    a. Facility name, contact name, location, phone number
    b. Capacity in MGD and brief narrative of the plant
    c. Design MLSS and operating MLSS
    d. Design net flux rate at Maximum Month Average Daily Flow and Peak Day Flow
    e. Operating net flux rate at Maximum Month Average Daily Flow and Peak Day Flow.
    f. Provide responses to Past Performance Questions listed under Scoring Criteria 4 of this RFP for each facility listed.
10. NPDES permit violations that occurred during the first year of membrane system operation.

Section 4- Technical Approach

This section presents the PROPOSERS technical approach to this project. At a minimum, this section shall include the following:

1. **Technical Approach**- provide a complete technical design for the membrane treatment system proposed using the influent design criteria, that can reliably meet the NPDES effluent permit requirements for BOD_5, TSS, Total Phosphorus identified herein. List all assumptions made in the development of the technical design.

2. **Scope of Services and Supply**- Include a detailed scope of services and supply that will be provided for the proposed membrane treatment system. The scope at a minimum must include all services provided, equipment, piping, valving, instrumentation, electrical gear, appurtenances required for a complete and operational system. Provide a listing of all major equipment and horsepower. Provide a listing of all Services during the design, bidding phase (by GENERAL CONTRACTOR) and during construction of the membrane system. Include information listed in the Technical Information Form located in **Appendix C.**

3. **Scope of Supply by Others**- include a detailed scope of supply required by others that for a complete and operational membrane treatment system that are not included with the PROPOSER's scope of supply. For example, this may include structures, piping, supports, cable and conduit, hoists, etc.).

4. **Schedule**- Time is of the essence. Provide a schedule for anticipated equipment delivery after approval of shop drawings, estimate of time to install and commission the membrane system, a list of milestones and/or deliverables during the construction phase of the project. Include in the schedule time for operations training, commissioning and testing.

5. **Layout Drawings**- Provide conceptual, to scale, plan views and a minimum of 3 section views of the proposed membrane system including the membranes channels, RAS pump and WAS pumps locations, and anticipated maximum water surface. For equipment such as CIP, air scour blowers, pumps, tanks and controls located in the membrane building, provide the equipment arrangement and recommended spacing. Provide a recommended building square footage. Provide process flow drawings for the membrane system, CIP, RAS, WAS, back pulse system and permeate pumps, air scour blowers.

   Assume the limits of yard piping connections for influent, permeate discharge, WAS discharge and RAS pump discharge and drain piping are 5 feet outside the limits of the membrane system. All CIP piping, air scour and back-pulse system piping is the responsibility of the MSS. Back-pulse tank is to be provided by the MSS.

6. **Calculations**- The membrane supplier shall prepare detailed design calculations for the biological nutrient removal process and the membrane wastewater treatment system. Process calculations shall include the use of standard kinetic design equations. These process calculations will be used to cross-check those prepared by the ENGINEER. In addition, the membrane supplier shall provide calculations for membrane basins sizing, membrane sizing, air scour requirement, air volumes, permeate volumes, recycle rates, RAS rate and WAS rates, CIP systems and back-pulsing.

   BioWin models are allowed for submittal.

Section 5- Warranty

Provide an equipment warranty certificate and a performance warranty certificate. Both certificates to meet the requirements presented in **Section 1** of the RFP. Each warranty certificate to be signed by an authorized individual with knowledge and responsibility for the product technology.

Section 6- Exceptions

The PROPOSER may wish to list exceptions to any of the conditions, terms or content of this RFP. In the proposal identify by section, page number and paragraph the exception and include a detailed description of exception and a proposed alternative. If the PROPOSER is making no exception, in this Section include the statement," PROPOSER has no exceptions to this RFP".

Section 7- Cost Proposal

The PROPOSER shall submit a cost proposal. All royalties or license fees to be included in the proposal cost. Such royalties and license fees shall not be listed separately. Utilize the proposal form included in **Appendix A.** The cost proposal is a guaranteed price for equipment and services identified in this RFP. The cost proposal submitted will be used in the evaluation process.

The selected PROPOSER's price shall be fixed for 15 months from date of proposal submission. Escalation of the price, if necessary, will be per **Section 1.13** of this RFP.

Section 8-Guaranteed Membrane Replacement Cost

The PROPOSER shall submit a cost for guaranteed membrane replacement on the Form in **Appendix B.**

Section 9- Present Worth to Operate the Membrane System Cost

The PROPOSER shall submit the present worth cost to operate the membrane system. Fill out all tables and forms in **Appendix C** and submit with proposal.

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4. Design Conditions

4.1. General

The membrane system shall be designed to meet the effluent requirements presented herein. The biological wastewater treatment process will be designed by the ENGINEER. The proposed biological process is located adjacent to the membrane facility. The biological process selected for this project is the UCT process consisting of anaerobic, anoxic and aerobic treatment basins. The UCT process will biologically reduce phosphorus and total nitrogen.

Influent wastewater flow is not equalized at this facility. Magnesium hydroxide system is added to provide alkalinity in the wastewater as needed. Liquid alum will be added to the biological process basins to assist in the removal of phosphorus.

The membrane tankage will be cast in place concrete, or pre-cast/post tensioned concrete and provided and installed by the GENERAL CONTRACTOR.

Appendix D includes preliminary drawings (Figures) prepared by the ENGINEER to assist the PROPOSER in preparing their proposal.

4.2. Codes

The MSS to comply with the following codes and standards when furnishing work covered in the project. The codes as follows:

1. American National Standards Institute (ANSI)
2. American society of Civil Engineers (ASME)
3. American Water Works Association (AWWA)
4. Hydraulic Institute Standards (HI)
5. Institute of Electrical and Electronic Engineers (IEEE)
6. International Building Code (IBC)
7. National Electric Code (NEC)
8. National Electrical Manufacturing Association (NEMA)
9. Underwriters Laboratories, Inc. (UL)
10. American Welding Society (AWS)

4.3. Influent Flow and Wastewater Characteristics

Design influent wastewater flow and influent wastewater characteristics are presented in the tables below.

Table 6 -Influent wastewater flows

Item	Value
Average Annual (AAF), mgd	5.0
Maximum Month Average (MMF), mgd	6.0
Peak Day (PDAF), mgd	9.0
Peak Hour (PIF), mgd	12.0

Table 7-Influent wastewater characteristics

Item	Value	
Parameter, mg/l	Average for Maximum Month	Range
BOD_5	443	N/A
TSS	400	N/A
Total Phosphorus	18.6	N/A
Ammonia as Nitrogen	40	N/A
Total Kjeldahl Nitrogen	50	50.0 – 55.0
Alkalinity (as CaCO3)	220	100 - 220
pH	6.7	7.0 – 7.5
Water Temperature	55 ºF	55 ºF – 72 ºF

4.4. UCT Biological Process Design Summary

The UCT process will minimize the effect of nitrate in the anaerobic contact zone, which is important for maintaining truly anaerobic conditions and allowing biological phosphorus release. UCT consists of three stages: an anaerobic stage, an anoxic stage, and an aerobic stage.

The RAS from membrane system is returned to the anoxic zone instead of anaerobic zone to allow membrane system and to avoid interference from nitrate with the activation of the PAO's in the anaerobic stage. A nitrate rich stream is recycled from the aerobic zone to the anoxic zone. Denitrified rich liquor is recycled from the anoxic zone is recycled to the anaerobic zone. Total HRT is 14.25 hours and SRT is 12 days.

The ENGINEER has modeled the UCT process using BioWin 5.3 software. All modeling for this project was performed at the minimum wastewater temperature of 13-degree F. Modeling results indicate that an effluent TP less than 0.10 mg/L can be achieved using the UTC process. The

BioWin model was run using two different return activated sludge rates from the membrane system. These rates are 50% and 400%.

Located upstream of the UCT process is a 1 mm fine screen. The screen performance is estimated to reduce the BOD_5 and TSS. The ENGINEEER estimates an approximate 20% reduction in raw sewage BOD_5 and 10% reduction in raw sewage TSS. This reduction in influent wastewater strength is the reason why **Table 7** values for BOD_5 and TSS are different.

Table 8 presents a summary of the UCT operating parameters, the predicted effluent results at various RAS rates.

Table 8- UCT operating parameters

Parameters	**UCT Process & MBR with Alum with 50% RAS**	**UCT Process & Alum with 400% RAS**
Influent Characteristics to UCT Biological Process		
Flow, MGD	6	6
CBOD, mg/L	354	354
TSS, mg/L	366	366
Ammonia-N, mg/L	40.1	40.1
TKN, mg/L	60.8	60.8
TP, mg/L	18.6	18.6
Alkalinity, mm/L	8	8
Biological Reactors		
Number of Biological Reactors	4	4
Anaerobic Volume Required, MG, each reactor	0.438	0.438
Anoxic Volume Required, MG, each reactor	0.625	0.625
Aerobic Volume Total, MG, each reactor	2.500	2.500
Total Volume, MG, each reactor	3.563	3.563
Design Parameters		
Temperature, C	13	13

HRT, Anaerobic, hr.	1.75	1.75
HRT, Anoxic, hr.	2.50	2.50
HRT, Aerobic, hr.	10.00	10.00
Total HRT, hr.	14.25	14.25
Anaerobic, SRT, day	1.47	1.48
Anoxic, SRT, day	2.11	2.11
Aerobic, SRT, day	8.42	8.42
Total SRT, day	12.00	12.00
RAS circulation, % influent flow	50%	400%
RAS circulation, MGD	3.00	24.00
Recirculation, Aero-Anox, % influent flow	200%	200%
Recirculation, Aero-Anox, MGD	12.00	12.00
Recirculation, Anox-Anaerobic, % influent flow	200.0%	200.0%
Recirculation, Anox-Anaerobic, mgd	12.00	12.00
Anaerobic MLSS	4,678	4,846
Anoxic MLSS	6,817	7,059
Aerobic MLSS	6,805	7,050
Alum used, lb./day	4549	4,687
Alum used, gal/d	330	340
Solids wasted, lb./d	16,347	16,686
UCT Effluent Characteristics		
CBOD, mg/L	0.8	1
Ammonia-N, mg/L	0.1	0.1
Nitrite-N, mg/l	0.02	0.03
Nitrate-N, mg/L	13.8	9.5
TN, mg/L	15.8	11.5

TP, mg/L	0.05	0.09
Anticipated MBR, MLSS		
MBR TSS Concentration	20,160	8,743
MBR VSS Concentration	10,860	4,797
Anticipated WAS		
Sludge Wasted TSS (lb./day)	16,347	16,737
Sludge Wasted VSS (lb./day)	8,806	9,184

4.5. Membrane System Design and Requirements

The mixed liquor from the suspended growth biological process tanks will be fed by gravity to the membrane system. The design intent is to locate air scour blowers, permeate pumps, CIP system/ pumps and controls in a new building adjacent to the membrane tanks. The ENGINEER will design the building.

The membrane system design requirements include:

1. The membrane system shall operate as an integrated process with other plant processes. The membrane facility will be located adjacent to the biological process. The connection (size and location) at the membrane tankage, to receive mixed liquor flow from the biological process, will be the design responsibility of the MSS. The mixed liquor connection at the membrane tankage will be provided by the MSS and installed by the GENERAL CONTRACTOR.

2. The membrane treatment system will utilize submerged ultrafiltration membranes to process wastewater.

3. Provide ultrafiltration system with a minimum of ten (10) percent spare membrane space in each membrane tank.

4. The membrane units/ racks provided by the MSS will be installed by the GENERAL CONTRACTOR in concrete tanks. The membrane system tank configuration will be designed by the MSS. Headloss through the membrane system designed by the MSS will be provided to the ENGINEER.

5. The membrane system shall have a minimum of (4) process tanks, all of equal size and volume. All tanks in service. Tanks shall be located outdoors and covered by removable grating. Hoisting system to remove membranes from tanks will be designed by the ENGINEER.

6. The membrane system shall meet Class I reliability. This is defined by the EPA -430-99-74-001.

7. The CITY will introduce liquid alum into the last Oxic Zone of the UCT process to assist in phosphorus removal.

8. Flow distribution system within the membrane system. Designed by the MSS and installed by the GENERAL CONTRACTOR. The design to provide uniform flow equal flow distribution to each membrane tanks in service under all flow conditions.

9. Level in the membrane tanks shall be controlled by weirs and measured with level transmitters. Isolation gates are required as part of the flow distribution system for to control flow entering each membrane tanks. The number of gates, location and size of the gates to be determined by the MSS. All required control gates, and weir plates within the membrane system tankage will be provided by MSS for installation by the GENERAL CONTRACTOR.

10. Permeate pumping. The permeate collection header and variable speed permeate pump(s) for each membrane tank will be designed and sized by the MSS to draw vacuum through the membranes and discharge to the head end of the disinfection system. The MSS to provide the permeate pumps, header and controls. The GENERAL CONTRACTOR shall be responsible for providing and installing all permeate force main piping (beginning 5 feet outside of the new membrane building). Check valves, isolation valves including valve actuators to be provided by the MSS and installed by the GENERAL CONTRACTOR. All supports to be supplied by and installed by the GENERAL CONTRACTOR.

11. Air scour system. This includes one duty blower for each membrane tank and one (1) stand-by blower to serve any membrane tank. Include air distribution piping header and ejectors/diffusers) for each membrane tank to provide turbulence to scour the surface of the membranes. The air scour system to be designed by the MSS and supplied by the MSS. Provide an acoustical enclosure for each blower. Air scour piping to and from the blowers to the application point will be provided by the MSS and installed by the GENERAL CONTRACTOR.

12. Master Control Panel. The MSS will provide one master membrane system control panel with Allen Bradley Control Logic PLC and PanelView plus HMI with fiberlogic I/O. All control will be from the Master Control Panel provided by the MSS. Provide all PLC programming for the membrane system including graphical displays and interface for connection to the plant SCADA system for remote monitoring of system operation. Use Wonderware® HMI system.

    Include provisions to remote monitor the entire membrane system operation by the MSS and remote reprogramming capabilities. The CITY will provide a high-speed connection to the membrane master control panel.

13. All instruments to monitor, control and operate the membrane system will be selected and provided by the MSS as part of the membrane system and installed by the GENERAL CONTRACTOR.

14. The RAS return rate from the membrane tank back to the biological process will be variable with a maximum rate of 4Q, where Q is the Maximum Month Average Daily Influent Flow.

15. The maximum design net membrane flux rate at Maximum Monthly Average Daily Flow shall not exceed 14 gallons per day per square foot.

16. The maximum design net membrane flux rate at Peak Day Flow shall not exceed 28 gallons per day per square foot. This rate shall be for a 24- hour period.

17. Clean in Place (CIP) shall not require a membrane tank to be out of service for more than 6 hours.

18. Membrane tankage design shall a minimum freeboard of 3 feet, at Peak Day Flow rate.

19. Motor ratings 460-volt, 3 phase, 60 Hz. Single phase motor power 120-volt.

4.5.1. Membrane system effluent criteria

The membrane system effluent design criteria are presented in **Table 9** below. The MSS design shall meet the **design target values** for this project.

Table 9- Membrane System Effluent Design Parameters

Item	Value, mg/l	Value, mg/l
Parameter	Monthly Average Permit	Design Target Monthly Average
BOD_5	5	≤ 5
TSS	5	≤ 5
Total Phosphorus (P)	0.12	≤ 0.06[1]
Ammonia as (N)	≤ 2.0 July-October ≤ 5.0 November- June	≤ 1.0
Total Kjeldahl Nitrogen	Monitor	Monitor
Total Nitrogen	Monitor	Monitor
pH	6-9	6-9
Turbidity (NTU)	3	≤ 1.0
Note 1: With alum addition to the UCT process.		

4.5.2. Membrane System Equipment Specifications

The equipment specifications listed in this section are considered as minimum criteria. It is the responsibility of the MSS to provide all valves, automatic actuators/operators, piping, level measurement devices, membrane process monitoring equipment, flow meters, pumps and controls to furnish a complete and operational system. Pneumatic controls for valves are acceptable.

All equipment is to be provided by the MSS will include Local-Off-Remote (LOR) selector switches for control. In the LOCAL position, control will be through start-stop pushbuttons. In REMOTE, the control of the equipment will be through the membrane Master Control Panel.

4.5.2.1. Air Scour Blowers

Provide Aerzen USA blowers (no equal) for air scouring. Provide one blower for each membrane tank. Provide one (1) common blower as a stand-by.

Blowers shall be tri-lobe, positive displacement type complete with sound enclosure, inlet filter, discharge silencer, blow-off silencer, pressure relief valve, check valve, inverter duty motor, temperature and pressure gauges, expansion joint, belts, baseplate, over temperature switch/sensor. Provide thermal motor overload protection on motors. 460V, 3 phase, 60 Hertz. Blowers to be controlled from the Master Control Panel.

4.5.2.2. Air Flow Meters and Valves

Provide one air flow meter for each membrane tank. Meter to include flow indicating transmitter. Provide one modulating air control valve for each membrane tank.

4.5.2.3. Compressed Air System

If pneumatic control of valves is desired, the MSS shall provide a compressed air system consisting of redundant air compressors, one receiver tank, redundant refrigerated air dryers, all filters, stainless steel piping. Provide a common compressed air control panel.

Compressor: Provide one duty and one stand-by compressor. The compressors shall be an air-cooled, rotary screw type and capable of maintaining proper compressor temperatures in ambient conditions of 115° F. An air-cooled aftercooler with a 99.9% efficient moisture separator trap shall be provided for each compressor. The air-cooled aftercooler shall be included as an integral part of the compressor package. The compressor shall be designed 100% continuous duty cycle. Compressor motors shall be 460-volt, 3 phase, inverter duty, premium efficiency motor type.

Dryer: Provide refrigerated true-cycling type, complete with stainless steel heat exchanger and NEMA 4 control panel housing digital controller and all other electrical components required for proper dryer operation.

Dryer shall be 460- volt, 3- phase. The digital controller shall be completely assembled, prewired to the dryer and shall be capable of the following:

1. Air in temperature
2. Refrigerant suction temperature
3. Inlet air temperature
4. Inlet air pressure
5. Condenser water inlet temperature
6. Fahrenheit or Centigrade selection
7. Refrigerant compressor running light
8. Service due light
9. Start/stop controls
10. “Zero Air Loss” Pneumatic Drain

Coalescing Filter: Provide 1 heavy-duty, self-cleaning coalescing type air filter to remove oil and water aerosols from the compressed air system. The filter shall be capable of handling the design air flow rate and pressure required. The rated performance pressure drop shall not exceed 1 psi.

Filter shall contain a replaceable filter element with an expected lifetime of 5 years. The filter shall be capable of removing 99.9 percent of oil micron particles and lubricant aerosols.

4.5.2.4. WAS, Back Pulse and Permeate Flow Meters

Provide one (1) WAS magnetic flow meter with transmitter to measure the waste sludge volume discharged. For meters and transmitters provide a sun screen and weather shield, if located outdoors.

Provide one (1) back pulse magnetic flow meter with transmitter to measure flow rate and control pump speed. Meters shall be manufactured by Khrone (no equal). For meters and transmitters provide a sun screen and weather shield if located outdoors.

Provide one (1) permeate magnetic flow meter with transmitter for each membrane tank to measure flow rate and control permeate pump speed. Meters shall be manufactured by Khrone (no equal). For meters and transmitters provide a sun screen and weather shield if located outdoors.

4.5.2.5. Permeate Pumps

Provide duty and stand-by permeate pumps for each membrane tank. Provide skid mounted variable speed, positive displacement, reversible rotary lobe pump. Include all valves and isolation plug valves. Acceptable manufacturers include Boerger, Vogelsang, or equal. MSS to determine the pump flow, head and horsepower. Pumps must be self-priming and suitable for wastewater applications. Provide inverter duty motor with thermal motor overload protection on motors. Motors shall be 460V, 3 phase, 60 Hertz.

4.5.2.6. Back Pulse Pumps and Storage Tank

Permeate pumps to serve as back pulse pumps. Provide no-flow thru back pulse tank with level transmitter and control valves. Tank shall be sized by the MSS to meet the required storage.

4.5.2.7. WAS and RAS Pumps

Provide dedicated WAS and RAS pumps. Utilize variable speed submersible pumps manufactured by Flygt (Xylem), Ebara, or approved equal. MSS to determine the pump flow, head and horsepower for the WAS and RAS pumps. Multiple RAS pumps are required. Provide multiple WAS pumps with at least one (1) duty and one (1) as stand-by. Submersible pumps shall be non -clog type capable of handling unscreened wastewater and wastewater containing mixed liquor suspended solids.

Pumps shall be provided with base elbow, stainless steel guide rail system with support brackets for retrieval, stainless steel lifting cable or chain and stainless-steel lifting davit and one portable lifting hoist for the WAS pumps and the RAS pumps. Bearings shall be rated for B-10 life of 100,000 hours. Motors shall be inverter duty rated for use with VFD. Include thermal overload and leakage sensors/ monitors. Motors shall be 460 volt, 3-phase, 60-Hertz.

Provide one (1) spare un-installed WAS pump and one (1) spare un-installed RAS pump complete with power cable of suitable length for the application.

Provide flanged swing type check valves for the WAS and RAS pumps. Include flanged discharge plug valves for each WAS and RAS pump.

4.5.2.8. CIP systems

Provide chemical cleaning systems that is capable of cleaning the membranes in place using citric acid, sodium hypochlorite and hydrochloric acid. Provide complete systems for each chemical cleaning agent. Each system to include all chemical metering pumps (peristaltic pumps are preferred), skid, control panels, isolation valves, pressure relief valves, flow meters, piping, pressure gauges and appurtenances. Each chemical skid will include 2 pumps (one duty, one stand-by). Include monitoring and alarm capabilities from the membrane Master control panel.

Assume chemicals suppled in tote tanks will be used and the totes with chemicals will be provided by the CITY.

4.5.2.9. Turbidity Meters

Hach Model 1720E with sc2000 controller for each membrane tank. Include bubble trap to prevent false turbidity readings. Include 120-volt power and 4-20 mA signal surge suppression. Turbidity to be monitored at the Master membrane control panel.

4.5.2.10. Piping

MSS shall furnish all piping and components internal to the membrane system. Refer to **Appendix E** for additional information.

4.5.2.11. Valves and Valve Actuators

Plug valves shall be quarter turn style. Air valves shall be butterfly type. Valves shall be manufactured by DeZurik, Val-Matic or approved equal. Provide position indication on all automatic valves.

4.5.2.12. Membrane Tank Drain Valve

Provide drain sump with drain valve (or sluice gate) with manual operator for each membrane tank. Tank drainage system shall be installed by the GENERAL CONTRACTOR.

4.5.2.13. Master Control System

The MSS will provide a complete and fully tested membrane control system that contains the controls and monitoring capabilities for all equipment and appurtenances required for the operation of the proposed membrane system. The controls shall be housed in a NEMA 4, type 304 stainless steel enclosure (stand-up). At a minimum the control panel will include the following:

- Programmable logic controller (PLC) and all control switches, push-buttons and alarm indicators. Allen Bradley Control Logic PLC and PanelView plus HMI with fiberlogic I/O.
- Human Machine Interface (HMI) containing graphical representations of all equipment, instrumentation, indication and trending of all process values. Provide 15-inch HMI screen. Use Wonderware® HMI system.
- Provide all required hardware, converters, software and drivers for communication with the plant SCADA system.
- Provide a communication port to connect to the plant SCADA system.
- Provide all PLC programming for the membrane system including graphical displays and interface for connection to the plant SCADA system for remote monitoring of system operation. Include provisions to remote monitor the entire membrane operation by the MSS and remote reprogramming capabilities.
- 120-volt UPS to back up the PLC, HMI, DC power supplies power to the instruments. Minimum size of UPS to be 2kVa.
- I/O's shall be protected by surge protection
- Controls shall be designed to allow full HAND operation of the membrane system.

5. Scope of Services

5.1. Design Services

The MSS will be responsible for the design of the membrane system. The following major areas of design are anticipated.

- The membrane system tank configuration will be designed by the MSS working in conjunction with the ENGINEER for site location.
- Hydraulic design through the membrane system designed by the MSS will be provided to the ENGINEER.
- Design the flow distribution system entering and within the membrane tanks.
- Design the permeate collection header piping and variable speed permeate pumping equipment.
- Design Back pulse storage tank and piping and pumping using reversible permeate pumps.
- Design the air scour system for the membrane system.
- Design the RAS pumping system within the limits of the membrane facility. The RAS return rate from the membrane system back to the biological process will be variable with a maximum rate of 4Q, where Q is the Maximum Month Average Daily Influent Flow.
- Design the WAS pumping system inside the limits of the membrane system.
- Design a complete Instrumentation and Control System for the membrane system.
- MSS to prepare design drawings. Drawings must adhere to the AutoCAD format and labeling convention provided by the ENGINEER.
- Control Programming. Provide all hardware and programming for the control of the membrane system. Provide an Allen Bradley (or approved equal) PLC control-based system. Provide a graphical display and interface for connection to the plant SCADA system. Use Wonderware® HMI system. The membrane system shall be controlled remotely from the plant SCADA system or locally from the local control panel.

  Control programming by the MSS to include RAS pumps, air scour blowers, permeate pumps, CIP systems, control valves within the membrane system, back-pulse pumps, WAS pumps and other associated components within the membrane system.
- Prepare specifications in Word 2016 format.
- Prepare P&ID's, loop diagrams, I/O's and flow diagrams and control descriptions of operation for the membrane system.

5.1.1. Engineering Submittals and Services During Design

The following information is to be submitted in both electronic format and hard copy by the SELECTED MSS during the design phase of this project. All electronic drawing submittals shall be compatible with AutoCAD Release 2016.

These submittals shall be in addition to Shop Drawings, Operation & Maintenance Manuals, and Training Manuals, which are to be submitted through the receipt of Purchase Order from the GENERAL CONTRACTOR.

5.1.1.1. Design Submittal 1

1. Detailed description and sequence of operation, and functional descriptions for the membrane system including a description of the control system.

2. Process calculations for the membrane system, with supporting data indicating ability to meet the effluent requirements, for the membranes, air scour blowers, permeate pumps, CIP systems, back pulse pumps, RAS and WAS pumps, and for other associated membrane equipment.

3. Membrane system hydraulic profile with supporting calculations.

4. Membrane system Process Flow Diagram indicating a flow and materials balance around the membrane system.

5. Scaled drawings in sufficient detail for the ENGINEER's use in designing reinforced concrete tanks required for the membrane facility. Drawings shall include inside wall dimensions and elevations for the membrane cells and identify the size and location of field piping connections.

6. Structural loadings and forces to be used by the ENGINEER for design of the concrete structures.

7. Conceptual equipment and piping layout drawings in both plan and section. The drawings shall include the membrane cells, the equipment room with CIP systems, pumps and the location of electrical/MCC. The drawings shall show size and location of all major mechanical and electrical equipment, piping, valves, instruments, and appurtenances within the membrane system facility. Identify all external interface connections. Piping may be illustrated using single lines.

8. Process and Instrumentation diagrams for the membrane system, in conformance with the ENGINEER's legends and graphics standards and ISA Standards.

9. Equipment list and manufacturer's catalog cut sheets for all membrane system equipment listing capacities, sizes, weights, materials of construction, installation requirements, name of manufacturer, and other pertinent information. The list should clearly indicate equipment that is not to be furnished by the MSS.

10. Valve list for all membrane system valves listing actuator type and requirements, capacities, sizes, weights, materials of construction, and other pertinent information. The list should clearly indicate valves that are not to be furnished by the MSS.

11. Instrumentation list for all membrane system instruments listing ranges, span, setpoints, installation requirements, name of manufacturer, and other pertinent information. The list should clearly indicate which instruments are not to be furnished by the MSS.

12. Control panel list indicating type, size, weight, name of manufacturer and other pertinent information.

13. Electric motor list for all membrane system motors provided by the MSS, including size, make, type of designation of electric motor, motor voltage, and motor mounting details. Also, a motor data sheet for each type and size of motor.

5.1.1.2. Design Submittal 2

1. All items listed in Design Submittal 1 with ENGINEER's comments incorporated.

2. Loop drawings for the membrane system, in conformance with the ENGINEER's legends and graphics standards and ISA Standards.

3. PLC input/output list.

4. Estimated delivery time for equipment provided by the SELECTED PROPOSER

5.1.1.3. Design Meetings

A total of three (3) design meetings are planned. Additional meetings may be required.

A design meeting shall be held at the ENGINEER's Atlanta, Georgia office prior to the first design submittal in order to confirm design. This meeting shall be held within two weeks of the MSS notification of award. Provide at this meeting a minimum of two people; one project person familiar with all aspects of the project and one controls specialist.

The first engineering submittal shall be made within 4-weeks of notice to the SELECTED MSS.

A second design meeting shall be held at the ENGINEER's Atlanta, Georgia office one 1-week after the first design submittal in order to review the first submittal. Provide at this meeting a minimum of two people; one project person familiar with all aspects of the project and one controls specialist.

The second engineering design submittal shall be made within 4-weeks of receiving the ENGINEER's comments on the first submittal.

A third design meeting shall be held at the ENGINEER's Atlanta, Georgia office within 1-week of the second submittal to review the second design submittal. Provide at this meeting a minimum of two people; one project person familiar with all aspects of the project and one controls specialist.

5.2. Bidding Support During Construction Phase

The MSS is responsible for providing the following services during the Bidding phase of the construction project. Specifically;

- Providing responses to questions submitted by the GENERAL CONTRACTORS related to the proposed scope of supply and services for the membrane system.

- Preparation of addenda material and design revisions (if required) associated with the scope of supply and services for the membrane system. The addenda material to be issued to the ENGINEER for incorporation into formal addenda.

5.3. Services and Submittals During Construction Phase

The following submittals and/or services shall be provided through the GENERAL CONTRACTOR upon receipt of Purchase Order from the GENERAL CONTRACTOR.

5.3.1. Shop Drawings

Shop drawings shall include, but not necessarily limited to the following. Costs for Shop Drawings shall be included in the Proposal as part of the Lump Sum Price.

a) Unit designation.

b) Unit dimensions and weight.

c) Clearance requirements.

d) Custom prepared data such as fabrication and erection/installation drawings of structural details and piping layout, scheduled information, setting diagrams, or custom templates.

e) Complete electrical data including wiring diagrams.

f) Storage and installation requirements

g) Complete description of materials and methods of construction.

h) Complete list of recommended spare parts.

i) Performance data, ratings, operating characteristics and operating limits.

j) Electrical ratings and characteristics.

k) Certifications requested, including UL label or listing.

l) Piping layout.

m) P&IDs and loop drawings.

n) All other information required by the detailed technical specifications.

5.3.2. Operation & Maintenance Manuals

Operation & Maintenance (O&M) manuals shall be furnished for each item of equipment furnished by the MSS as well as for the membrane system. Costs for O&M Manuals shall be included in the Proposal as part of the Lump Sum Price. Six copies of the O&M manual shall be submitted by the MSS for review and approval. An additional five copies of the reviewed and approved O&M manuals shall be furnished to the OWNER, including one electronic copy. Manuals shall include, but not necessarily limited to the following:

a) Table of contents and indexes.

b) Brief description of each system and components.

c) Starting and stopping procedures.

d) Special operating instructions.

e) Routine maintenance procedures.

f) Clear and concise manufacturer's printed operating and maintenance instructions, adjustments, lubricants, and other maintenance of equipment including parts list, illustrations, and diagrams.

g) One copy of all wiring diagrams.

h) One copy of approved shop drawings.

i) List of spare parts, manufacturer's price, and recommended quantity.

j) Name, address, and telephone numbers of local service representatives.

5.3.3. Services of the Manufacturer's Representative during Construction

5.3.3.1. Training

Training sessions shall be performed by the MSS two (2) months in advance of start-up and commissioning of the membrane system. Training sessions shall consist of digital power points instructional classes covering the operation and maintenance of the membrane system. A minimum of 40 hours of on-site instructional time is required. Training plan to be submitted to the ENGINEER for approval prior to training of staff.

5.3.3.2. Start-up and Commissioning of Membrane System

Prior to any equipment provided by the MSS is placed into service or operated by CITY, a service/installation representative of the MSS shall perform a final inspection of the membrane system installation. The inspection will provide a certificate of installation indicating the membrane installation has been installed in accordance with the MSS and is ready for commission. Should modifications to the installation be required, these modifications to the membrane system that must be performed by the GENERAL CONTRACTOR shall be made in consultation with the MSS.

The MSS representative shall be onsite for a minimum of four weeks. During the initial week on site, the MSS representative will be responsible to identify issues or problems that require the GENERAL CONTRACTOR's attention. During the second week on site, the MSS will work with the CITY staff to familiarize the staff with the controls, layout and commissioning plan.

During the third week on site, the membrane system will be placed into service by the GENERAL CONTRACTOR under the direction of the MSS representative on site. During the third week the MSS representative will work with the CITY operations staff to provide operational guidance and direction. The forth week, the MSS representative continue to assist the CITY operational staff in the operation of the membrane system.

5.3.3.3. Performance Testing

Guaranteed performance of the membrane system is contingent upon the UCT suspended biological process meeting its anticipated effluent criteria listed in **Table 8** in this RFP. Performance testing to begin after the biological suspended growth process acclimation period is complete and satisfactory start-up and commissioning of the membrane system has occurred.

Performance testing will be carried out over a 14- day continuous test. The performance test will be performed at the wastewater flow rate at the time of testing. It is anticipated this flow rate will be less than the design. To compensate for the difference between design and the flow rate at time of testing, a percentage of the membranes shall be taken out of service and the remainder shall be operated continuously at the maximum design net membrane flux rate at Maximum Monthly Average Daily Flow (plus or minus 10 percent).

5.3.3.3.1. Testing Procedure

1. The MSS shall be present during CITY operation of the membrane system for the process performance-testing period and may advise the CITY in its operation. The CITY will assist the MSS with sample collection, carrying out laboratory tests, and keeping records that may be necessary for determining whether the performance guarantees have been met.

2. During the process performance test, 24-hour flow-proportional sequential composite samples from the influent and effluent of the membrane system shall be obtained by the CITY for the measurement of BOD_5, TSS, TKN, ammonia-N, NO_2-N, NO_3-N, turbidity, and total P. Hourly influent and effluent pH measurement will be taken from both the influent and the effluent from the membrane system. Grab samples for mixed liquor concentrations will be performed once per day. The City will send the samples out to a certified laboratory of his choice for analysis. The cost of the laboratory analysis shall be the responsibility of the CITY. The MSS will indicate the method of analysis from Standard Methods for the Analysis of Water and Wastewater for each guarantee parameter to the CITY prior to performance testing. In respect to the analytical method, the minimum detection limit for nitrite-nitrogen shall be less than or equal to 0.02 mg/l and for nitrate-nitrogen shall be less than or equal to 0.05 mg/l to allow proper precision for assessment of system compliance.

3. Results of the laboratory analysis will be logged and the 14 -day average of each parameter will be determined. If any averaged parameter exceeds a value listed in Table 9, Design Target Monthly Average effluent concentration, the test shall be considered a failure.

4. During the performance testing the net flux rate shall be within the parameters identified in this RFP plus or minus the factor noted earlier in **Section 5.3.3.3** of this RFP.

5. In the event the membrane system does not meet the effluent, requirements stipulated herein, the MSS will be permitted to make changes to the equipment and methods of operation at his expense. The City shall operate the membrane system in accordance with the MSS's written instructions, provided they are in accordance with good engineering practice and are in accordance with the CIY's operating rules enforced at the plant. The changes shall be made as soon as practical within a period not to exceed thirty (30) calendar days. Following the changes, a second test run of the 14-day continuous calendar days similar to the first shall be conducted. Conformance with the process performance requirements must be achieved before the membrane system will be deemed acceptable.

6. If the membrane system fails to achieve the guaranteed effluent and operating process performance requirements stipulated herein during the first two process performance test periods, additional testing shall be done at the MSS's expense to determine the cause of the performance deficiencies. If cause of performance deficiencies is determined to be the MSS's responsibility, a report shall be prepared and submitted by the MSS within 30-days of the unsuccessful completion of the second performance test. The report shall outline causes for the failure and the proposed modifications to correct the performance deficiencies. Once the report has been accepted by the ENGINEER, the membrane system shall be modified, at no cost to the CITY, to correct the performance deficiencies to enable the treatment system to achieve the required effluent quality.

7. Upon termination of or failure to successfully complete the first performance test and the first retest, the MSS will have one (1) further opportunity to correct the failure and to conduct a third test. All costs associated with this third test shall be the responsibility of the MSS. Should failure of any performance test occur for reasons not the fault of the MSS, the MSS will not be held responsible for such test failures, and subsequent re-test will be at the CITY's expense.

8. If the first process performance test cannot be initiated within one year from the date of Substantial Completion for reasons not the fault of MSS, process performance will be based on one year of operational data.

9. The MSS reserves the right to terminate any performance test prior to the completion of that performance test period due to anticipation of an unsuccessful test. However, a performance test terminated at the MSS's request will be considered an unsuccessful test.

10. Upon the successful completion of the performance test, the MSS shall submit a written report to the ENGINEER. The report shall include pertinent details regarding the test as well as test results to demonstrate that the equipment complies with the process performance requirements indicated herein.

11. If the membrane system fails to achieve the guaranteed effluent performance requirements stipulated herein during the three process performance test periods or one calendar year after Substantial Completion, whichever should occur first, the CITY will declare the MSS in default and the Surety will compensate the CITY in the amount of 100 percent of the Lump Sum proposal price.

5.3.3.4. One Year MSS Service Agreement

This agreement shall include support services required to implement the project and assist with operations during the first year of operation. Support services should include, but not be limited to, the following:

1. Remote monitoring of the membrane system performance and quarterly performance reports highlighting MSS concerns and suggestions for operational improvement**.**

2. A minimum of 4 site visits totalling 2- 8-hour days on-site during each visit. Visits shall include staff operations, review of membrane cleaning procedures, Visual inspection of the membrane equipment.

3. After 4 months of membrane operation, provide 12 hours of on-site supplemental training of personnel.

4. 24/7 continuous telephone and PLC programming support.

END

Appendices

Appendix A. Cost Proposal

COST PROPOSAL FORM

The following Proposal is hereby made to the:

City of Canton, Georgia
ATTN: Mr. David Hatabian, P.E.
110 Academy Street
Canton, Georgia 30114

DESCRIPTION OF WORK.

The undersigned hereby proposes and agrees to furnish all labor, services, materials, equipment and all other items and facilities necessary to supply and deliver the equipment item(s) as specified in the attached PROPOSER'S PROPOSAL in accordance with the OWNER's Proposal Documents entitled " Membrane System Supplier Request for Proposal, City of Canton, Georgia Wastewater Treatment Plant Expansion to 6 mgd"

DOCUMENTS.

This proposal is a complete document that conforms to all of the requirements of the " Membrane System Supplier Request for Proposal, City of Canton, Georgia Wastewater Treatment Plant Expansion to 6 mgd. Included with this document are the PROPOSER's Proposal, General Requirements, and PROPOSER Proposal Submittals.

PROPOSAL FORM

Schedule of prices for the City of Canton Wastewater Expansion to 6 mgd Membrane System (including shop drawings, submittals, spare parts, start-up, design and factory services) shall be as stated herein. The PROPOSER shall submit a price excluding Georgia State Sales and Use Taxes. Such price shall be firm for delivery of products through March 3, 2021.

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MEMBRANE PRICE PROPOSAL FORM					
Item No.	**Description***	**Quantity**	**Unit**	**Unit Price**	**Total Price**
1	Design coordination with Engineer, including design submittals and meetings	1	LS		
2	Construction phase services including submittals/shop drawings, O&M manuals. Includes bidding services.	1	LS		
3	Factory representative services, including start-up, performance testing, and training, one-year service agreement	1	LS		
4	Membrane system equipment, pumps, blowers, CIP systems, WAS and RAS pumps	1	LS		
5	All associated membrane instrumentation and controls including PLC programming	1	LS		
6	All membrane system valves and appurtenances	1	LS		
7	All air, chemical, permeate, back pulse piping and appurtenances	1	LS		
8	All other items necessary to furnish a complete, Membrane System as indicated in the Request for Proposal.	1	LS		
*Include FOB jobsite, freight allowed					

LUMP SUM TOTAL, ITEMS 1 THROUGH 8, INCLUSIVE, THE AMOUNT OF:

$_____

_____US Dollars **

(print dollar amount)

**Based on attached PROPOSER's Proposal No._____.

PROPOSER AS PRINCIPAL

Company: (Corp. Seal)

(Company Name)

(Address)

(Telephone Number and Extension)

DATE: _____

Signature: _____

Name and Title:

_____

Appendix B. Guaranteed Membrane Replacement Cost Form

Guaranteed Membrane Replacement Cost Form

The dollar amount shall constitute the guaranteed maximum membrane replacement cost for all modules.

Membrane Replacement Cost (Years 11 through 20) $_____

_____

Dollars
(in words)

Appendix C. Present Worth of Membrane System & Forms

Present Worth Cost Calculations

The proposer shall compute the present worth costs to operate the system using the factors and formulas listed in **Appendix C**.

Present Worth Cost – The life cycle cost to include the capital cost as well as operational costs over the lifetime of the installed system. The capital cost shall include all equipment cost, operational costs for chemicals, power consumption, membrane replacement over a 10- year net present value. The calculation shall include the factors and or values listed in the table below/

Appendix C- Table 1

Present Worth Factors	
Item	**Value**
Max Month Flow rate	6 mgd
Present Worth Factor	7.36 (6%, 10 years)
Interest Rate	6%
Period of Evaluation	10 year
Citric acid cost	$5.00 /gallon as 50% by weight
Sodium hypochlorite	$1.00 /gallon as 12.5 % by weight
Hydrochloric acid	$2.00/gallon as 35% by weight, HCL
Membrane replacement	1 replacement during 10- year life cycle
Days per year	365
Hours of operation per year	8760
Motor efficiency	94%
VFD efficiency	98%
Power cost	$0.06/KWH
Blower air scour system efficiency	1.03 hp/scfm

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Calculation of Present Worth of the Membrane System

The present worth is calculated at maximum month average daily flow conditions. Under each component of the present worth calculation, enter the information in the associated tables and use this information

Total System Present Worth (PW) to operate the membrane system calculated is calculated using **Equation 1**.

Equation 1

Total System Present Worth to Operate = PW (RAS)of RAS pumping system + PW (BP)of back pulse pumps + PW (AS) of air scour system + PW (CH) or chemical system + PW (MB) of membrane replacement

Present Worth of RAS pumping system to be determined as follows:

1. Assume: Return rate of 4Q, with Q as Maximum Month Average Flow. Pump discharge pressure as a sum of static and dynamic losses. The pump efficiency from the selected pump curve for rate flow, head and speed.
2. Present worth of RAS pumping, enter values in table below for use in calculation.

RAS Pumping Information	Enter Value
Number of pump units in service.	
Average recycle flow, gpm/unit.	
Average pump efficiency.	
Average pump discharge pressure of feet	10

3. Calculate the PW (RAS) using **Equation 2,**
4. Enter calculated PW (RAS) in Present Worth Form, item 1.

Equation 2

$$PW\ (RAS) = \frac{(number\ of\ units) \times (gpm/unit) \times disch\ pressure,\ ft \times 8760\ hrs/year \times 0.7457\ Kw/hp \times \$0.06/KWH \times 7.36}{(Pump\ efficiency,\ \%) \times (3960) \times 94\% \times 98\%}$$

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Present Worth of Back pulse pumping system to be determined as follows:

1. Back pulse flow rate as determined by MSS.
2. The pump efficiency from the selected pump curve for rate flow, head and speed.
3. Average pump pressure is calculated as the average transmembrane backpressure times the module flow rate divided by the back-pulse flow rate plus 15 feet for elevation and dynamic losses.
4. Present worth of Back pulse pumping, enter values in table below for use in calculation.

Back Pulse Pumping Information	Enter Value
Number of pump units, in service.	
Back pulse flow, gpm/unit	
Pump efficiency, percent	
Number of Back pulses per day	
Back pulse duration per day, mins	
Back pulse pump pressure, feet	

5. Calculate the PW (BP) using **Equation 3,**
6. Enter calculated PW(BP) in Present Worth Form, line item 2

Equation 3

$$PW(BP) = \frac{(\text{number of units}) \times (\text{gpm/unit}) \times \text{BP duration, mins} \times \text{pump pressure (ft)} \times \text{bp/day} \times 0.7457\ \text{Kw/hp} \times \$0.06/\text{KWH} \times 7.36}{(\text{Pump efficiency, \%}) \times (3960) \times 94\% \times 98\% \times 60\ \text{min/hr} \times \text{yr/365 day}}$$

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Present Worth of Chemical System to be determined as follows:

1. Present worth of Chemical System, enter values in table below for use in calculation.
2. Use cost values identified in Present Worth Factor Table, Appendix C.

Chemical System Information	Enter Value
Cost of hypochlorite, $/gal, as 12.5% by weight	$1.00/gal
Volume of hypochlorite, gal/yr.	
Cost of citric acid, $/gal, as 50% by weight	$5.00/gal
Volume of citric acid, gal/yr.	
Cost of hydrochloric acid, $/gal, as 35% by weight	$2.00/gal
Volume of hydrochloric acid, gal/yr.	

3. Calculate the PW (CH) using **Equation 4**
4. Enter calculated PW(CH) in Present Worth Form, line item 3

Equation 4

PW (CH)=((hypo gal/yr) x (hypo $/gal) +(citric acid gal/yr) x (citric $/gal) + (hdcl acid gal/yr) x (hdcl $/gal)) x 7.36

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Present Worth of Air Scour system to be determined as follows:

1. Air scour flow rate determined by MSS
2. Present worth of air scour, enter values in table below for use in calculation.

Air Scour Information	Enter Value
Number of units	
Modules per unit	
Net air flow per module during air scour, cfm/module	
Blower conversion factor, hp/scfm	0.03

3. Calculate the PW (AS) using **Equation 5**
4. Enter calculated PW(AS) in Present Worth Form, line item 4

Equation 5

PW (AS)= (number of units) x (mods/unit) x (cfm/mod) x (hp/cfm) x (0.7457 Kw/hp) x ($0.06/KWH) x 7.36 x 8760

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Present Worth of membrane replacement to be determined as follows:

1. Assume: The number of modules requiring replacement does not include modules that are in place for redundancy/reliability.
2. Membrane replacement lifetime 10 year.
3. Present worth for membrane replacement, enter values in table below for use in calculation.

Membrane Replacement Information	Enter Value
Number of modules	
Membrane replacement price in Proposal Form, Appendix B	$
Membrane module warranty period, yrs.	10

4. Calculate the PW (MR) using **Equation 6**
5. Enter calculated PW(MR) in Present Worth Form, line item 5.

Calculate the PW (MR) using **Equation 6**

Equation 6

$$PW\ (MR) = \frac{C}{(1+i)^{mri}} \times \frac{C}{(1+i)^{mri \times 2}} \times \ldots\ldots \times \frac{C}{(1+i)^{mri \times n}}$$

Where: C is the actual membrane cost expended, n is the total number of membrane replacements in a 10-year period, *i* is the interest rate, mri is the membrane replacement interval

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Present Worth Form

Present Worth to Operate the Membrane System		
Item	Present Worth	Present Worth Calculated Value
1	***PW (RAS)***	$
2	***PW (BP)***	$
3	***PW (CH)***	$
4	***PW (AS)***	$
5	***PW (MR)***	$
6	**Total of (1+2+3+4+5)**	$

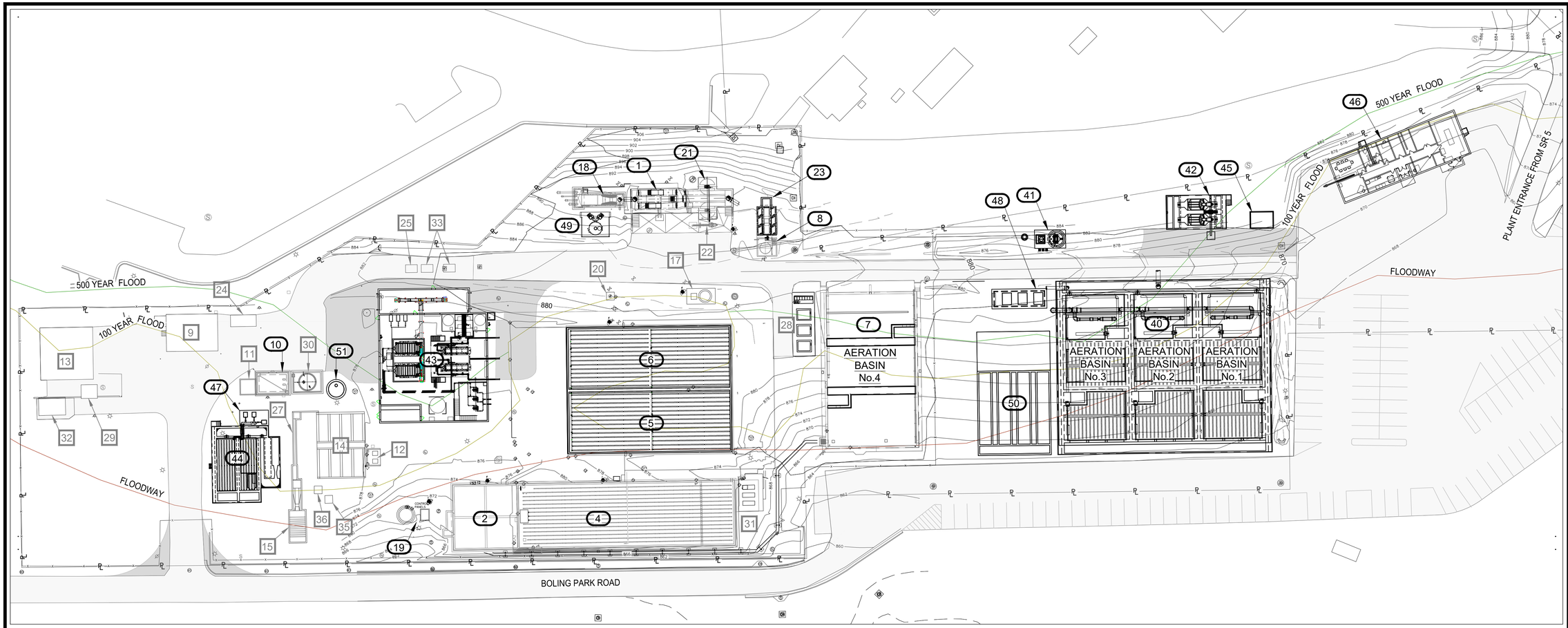
Technical Information Form

Parameter	Value	Units
Membranes Tank Information		
Number of Tanks		
Internal dimensions of each tank, width		ft
Internal dimensions of each tank, length		ft
Internal dimensions of each tank, SWD at PHF		ft
Do membrane tanks need to be drained for maintenance cleans?		y/n
Do membrane tanks need to be drained for recovery cleans?		y/n
Do membrane tank walls require a liner system to protect the concrete from the cleaning chemicals?		y/n
If a liner is required, what is the recommended liner system/material?		y/n
Membrane Parameters	**Units**	**Value**
Membrane Type		
Membrane Model		
Membrane Material		
Nominal Membrane Pore Size		µm
Maximum Membrane Pore Size		µm
Design MLSS Concentration in Membrane Tank		mg/l
Maximum Allowable MLSS Concentration in Membrane Tank		mg/l
Membrane Design Net Flux Rate at Maximum Month Average Daily Flow		GPD/ft2
Membrane Design Net Flux Rate at Peak Flow Rate (6 MGD for minimum 24 hours)		GPD/ft2
Maximum Allowable Hours of Continuous Operation at Peak Flow Rate		hours

Design Maximum Trans Membrane Pressure (TMP) at 13°C		PSI
Maximum Allowable Trans Membrane Pressure (TMP) at 13°C		PSI
Number of Membrane Elements (Smallest Membrane Unit)		elements
Surface Area of Membrane Element		ft2/element
Total Membrane Surface Area		ft2
Number of Membrane Elements per Membrane Unit		elements/unit
Number of Membrane Units per Membrane Tank		units/tank
Total Number of Membrane Units		unit
Permeate Pump Parameters	**Value**	**Units**
Number of duty pumps		
Maximum flow rate per pump		gpm
Total pump head		ft
Rated Horsepower per Pump		HP
Manufacturer		name
Number of Hours Operating per Day at AADF		hours
Number of Days Operating per Year at AADF		days
Percent of Time Operating at AADF		%
RAS Pumping Parameters	**Value**	**Units**
Number of duty pumps		
Maximum flow rate per pump		gpm
Total pump head		ft
Rated Horsepower per Pump		HP
Number of Hours Operating per Day at AADF		hours
Number of Days Operating per Year at AADF		days
Percent of Time Operating at AADF		%

Pump manufacturer		name
WAS Pumping Parameters	**Value**	**Units**
Number of duty pumps		
Maximum flow rate per pump		gpm
Total pump head		ft
Rated Horsepower per Pump		HP
Number of Hours Operating per Day at AADF		hours
Number of Days Operating per Year at AADF		days
Percent of Time Operating at AADF		%
Manufacturer		name
Air Scour Parameters	**Value**	**Units**
Number of duty blowers		
Maximum flow rate per blower		scfm
Total backpressure		psi
Rated Horsepower per blower		HP
Number of Hours Operating per Day at AADF		hours
Number of Days Operating per Year at AADF		days
Percent of Time Operating at AADF		%
Manufacturer	Aerzen US	name

Appendix D. Drawings



PROPOSED OVERALL SITE PLAN

SCALE: 1"=40'

LEGEND:
(EXISTING STRUCTURES/EQUIPMENT)

- 1 HEADWORKS
- 2 EQUALIZATION BASIN
- 4 SBR No.1
- 5 SBR No.2
- 6 SBR No.3
- 7 SBR No.4
- 8 MAGNESIUM HYDROXIDE SYSTEM
- 10 CHEMICAL BUILDING
- 11 SODIUM HYPOCHLORITE SYSTEM
- 12 POLYALUMINUM CHLORIDE SYSTEM
- 13 SLUDGE PRESS BUILDING
- 14 DYNASAND FILTER
- 15 CASCADE AERATOR

CONTINUED
(EXISTING STRUCTURES/EQUIPMENT)

- 16 OFFICE/ADMINISTRATION BUILDING
- 17 INFLUENT PUMP STATION
- 18 INFLUENT METERING FLUME
- 19 PLANT DRAIN PUMP STATION PS-1
- 20 FLOW METER VAULT
- 21 GRIT CHAMBERS
- 22 GRIT CLASSIFIER
- 23 SPLITTER BOX
- 24 EMERGENCY GENERATOR
- 25 WATER METER
- 27 UV SYSTEM AND PARTIAL FLUME
- 28 SBR No.4 BLOWERS
- 29 SLUDGE VAULT

CONTINUED
(EXISTING STRUCTURES/EQUIPMENT)

- 30 ALUM TANK
- 31 POST EQALIZATION BASIN BLOWERS
- 32 SLUDGE LOADING STATION
- 33 BACKFLOW PREVENTER
- 35 REUSE WATER METER VAULT
- 36 REUSE VALVE VAULT

LEGEND:
(MODIFIED/REPURPOSED STRUCTURES/EQUIPMENT)

- 1 HEADWORKS
- 2 POST EQUALIZATION BASIN TO BECOME RECLAIM WATER
- 4 SBR No.1 MODIFIED TO BECOME WAS STORAGE
- 5 SBR No. 2 MODIFICATIONS
- 6 SBR No. 3 MODIFICATIONS
- 7 SBR No. 4 MODIFICATIONS
- 8 MAGNESIUM HYDROXIDE SYSTEM
- 10 CHEMICAL BUILDING MODIFICATIONS
- 18 INFLUENT FLUME MODIFICATIONS
- 19 PLANT DRAIN PUMP STATION PS-1 MODIFICATIONS
- 21 GRIT CHAMBER MODIFICATIONS
- 23 SPLITTER BOX MODIFICATIONS

LEGEND:
(PROPOSED STRUCTURES/EQUIPMENT)

- 40 AERATION BASINS
- 41 PLANT DRAIN PUMP STATION No.2
- 42 FINE SCREENINGS FACILITY
- 43 THICKENING / DEWATERING BUILDING
- 44 UVPA FACILITY (UV AND POST AERATION)
- 45 EMERGENCY GENERATOR
- 46 ADMINISTRATION / CONTROL BUILDING
- 47 UVPA AERATION BLOWERS
- 48 AERATION BASIN BLOWERS
- 49 ODOR CONTROL EQUIPMENT
- 50 MEMBRANE FACILITY
- 51 ALUM TANK No.2

EXISTING SITE/SYMBOLS LEGEND

- ACCESS HATCH
- STORM DRAIN MAHNOLE
- SANITARY MANHOLE
- ELECTRICAL
- CATCH BASIN
- PIPE RISER
- YARD INLET
- DROP INLET
- CLEANOUT
- ELECTRIC BOX/CONTROL BOX
- ELECTRIC METER
- SIGN
- POWER POLE
- LIGHT POLE
- WATER VALVE
- SPIGOT
- BURIED ELECTRICAL
- TEMPORARY SURVEY CONTROL POINT

0 40 80 120
SCALE: 1" = 40'

ATKINS
1600 RiverEdge Parkway, NW, Suite 700
Atlanta,Ga 30328
P: 770-933-0280

REVISION	DATE
△	

PROJ. NO.: 100061831
DESIGNED BY: DLG
DRAWN BY: JN
CHECKED BY: ---
APPROVED BY: ---
DATE: November 2019
SCALE: AS SHOWN

CITY OF CANTON, GEORGIA
WASTEWATER TREATMENT PLANT EXPANSION TO 6 MGD

PROPOSED OVERALL SITE PLAN

FIGURE 1

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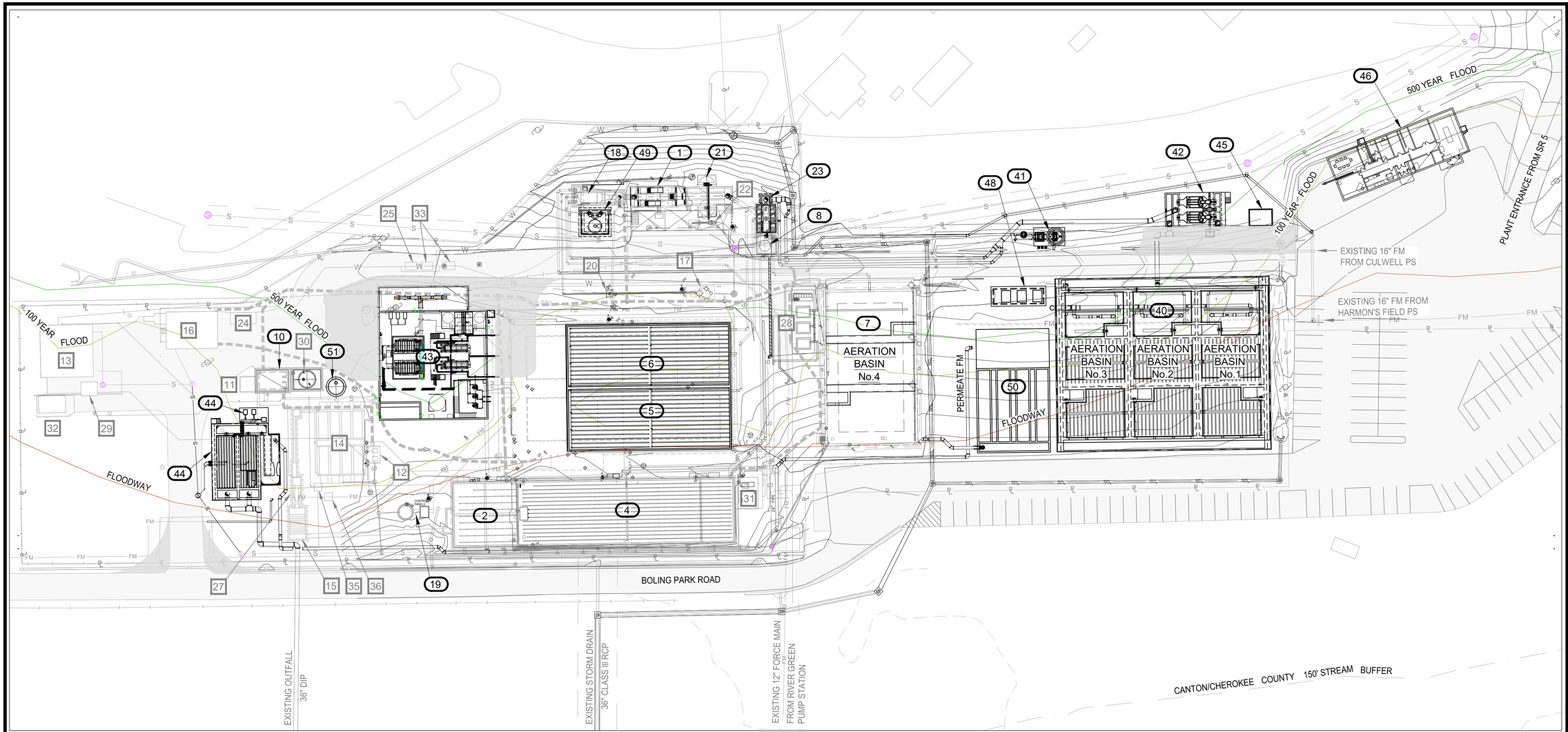

PROPOSED OVERALL YARD PIPING PLAN

SCALE: 1"=40'

LEGEND:
(EXISTING STRUCTURES/EQUIPMENT)

1 HEADWORKS
2 EQUALIZATION BASIN
4 SBR No.1
5 SBR No.2
6 SBR No.3
7 SBR No.4
8 MAGNESIUM HYDROXIDE SYSTEM
10 CHEMICAL BUILDING
11 SODIUM HYPOCHLORITE SYSTEM
12 POLYALUMINUM CHLORIDE SYSTEM
13 SLUDGE PRESS BUILDING
14 DYNASAND FILTER
15 CASCADE AERATOR

CONTINUED
(EXISTING STRUCTURES/EQUIPMENT)

16 OFFICE/ADMINISTRATION BUILDING
17 INFLUENT PUMP STATION
18 INFLUENT METERING FLUME
19 PLANT DRAIN PUMP STATION PS-1
20 FLOW METER VAULT
21 GRIT CHAMBERS
22 GRIT CLASSIFIER
23 SPLITTER BOX
24 EMERGENCY GENERATOR
25 WATER METER
27 UV SYSTEM AND PARTIAL FLUME
28 SBR No.4 BLOWERS
29 SLUDGE VAULT

CONTINUED
(EXISTING STRUCTURES/EQUIPMENT)

30 ALUM TANK
31 POST EQALIZATION BASIN BLOWERS
32 SLUDGE LOADING STATION
33 BACKFLOW PREVENTER
35 REUSE WATER METER VAULT
36 REUSE VALVE VAULT

LEGEND:
(MODIFIED/REPURPOSED STRUCTURES/EQUIPMENT)

1 HEADWORKS
2 POST EQUALIZATION BASIN TO BECOME RECLAIM WATER
4 SBR No.1 MODIFIED TO BECOME WAS STORAGE
5 SBR No. 2 MODIFICATIONS
6 SBR No. 3 MODIFICATIONS
7 SBR No. 4 MODIFICATIONS
8 MAGNESIUM HYDROXIDE SYSTEM
10 CHEMICAL BUILDING MODIFICATIONS
18 INFLUENT FLUME MODIFICATIONS
19 PLANT DRAIN PUMP STATION PS-1 MODIFICATIONS
21 GRIT CHAMBER MODIFICATIONS
23 SPLITTER BOX MODIFICATIONS

LEGEND:
(PROPOSED STRUCTURES/EQUIPMENT)

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41 PLANT DRAIN PUMP STATION No.2
42 FINE SCREENINGS FACILITY
43 THICKENING / DEWATERING BUILDING
44 UVPA FACILITY (UV AND POST AERATION)
45 EMERGENCY GENERATOR
46 ADMINISTRATION / CONTROL BUILDING
47 UVPA AERATION BLOWERS
48 AERATION BASIN BLOWERS
49 ODOR CONTROL EQUIPMENT
50 MEMBRANE FACILITY
51 ALUM TANK No.2

EXISTING SITE/SYMBOLS LEGEND

- ACCESS HATCH
- STORM DRAIN MAHNOLE
- SANITARY MANHOLE
- ELECTRICAL
- CATCH BASIN
- PIPE RISER
- YARD INLET
- DROP INLET
- CLEANOUT
- ELECTRIC BOX/CONTROL BOX
- ELECTRIC METER
- SIGN
- POWER POLE
- LIGHT POLE
- WATER VALVE
- SPIGOT
- BURIED ELECTRICAL
- TEMPORARY SURVEY CONTROL POINT

0 40 80 120
SCALE: 1" = 40'

ATKINS
1600 RiverEdge Parkway, NW, Suite 700
Atlanta,Ga 30328
P: 770-933-0280

DATE
REVISION
△

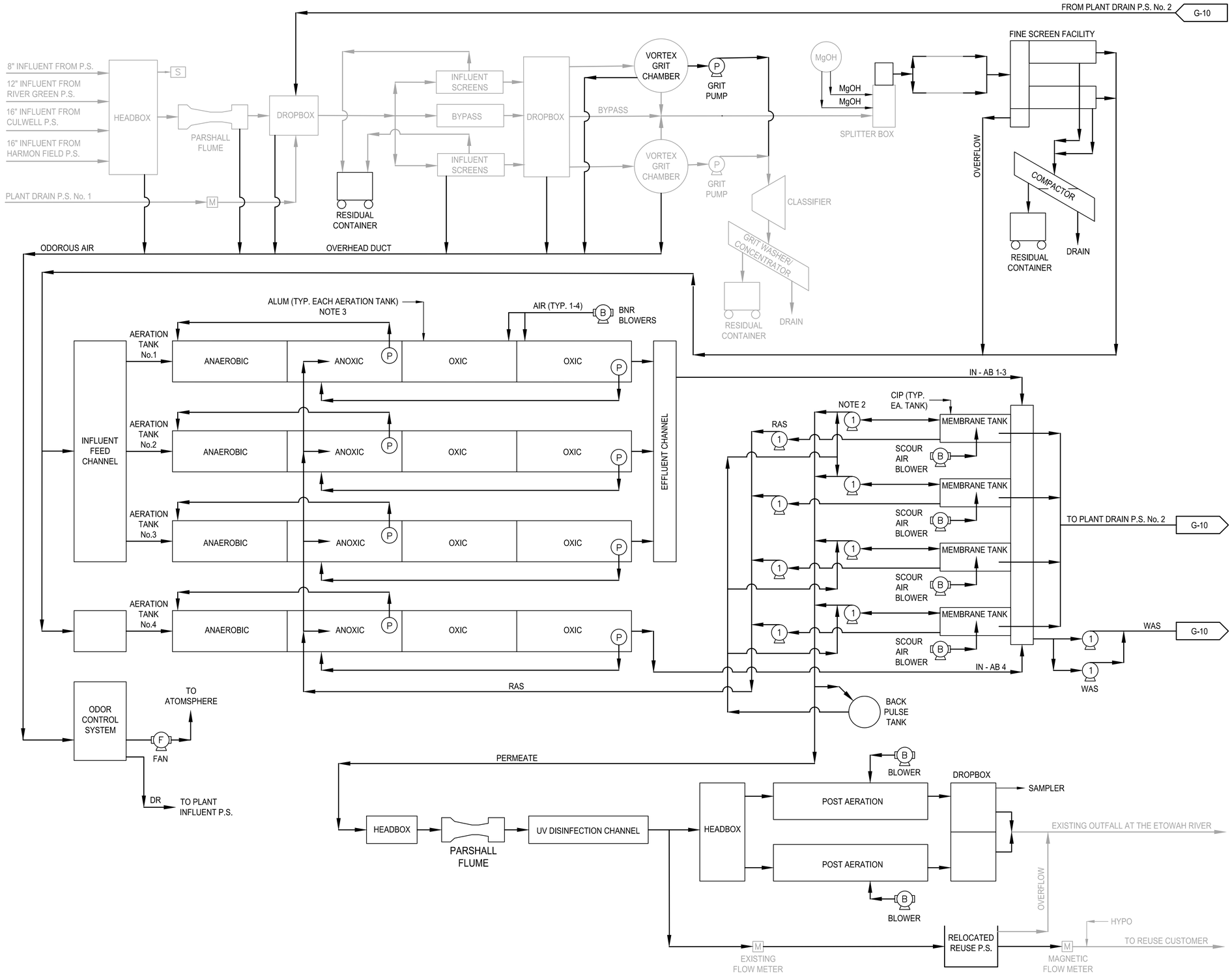
PROJ. NO.: 100061831
DESIGNED BY: DLG
DRAWN BY: JN
CHECKED BY: ---
APPROVED BY: ---
DATE: November 2019
SCALE: AS SHOWN

CITY OF CANTON, GEORGIA
WASTEWATER TREATMENT PLANT EXPANSION TO 6 MGD

PROPOSED OVERALL YARD PIPING PLAN

FIGURE 2

File Name: C:\PW_WORK\ATKNAGA01\NEWM7492\DM535899\0200 - C-20, 21, 22, 33, 24, 25, 26, 27.DWG|Tab:FIG 2|Plotted: January 03, 2020 2:06pm



LEGEND:

- FLOW METER
- PROGRESSIVE CAVITY PUMP
- POSITIVE DISPLACEMENT BLOWER
- CENTRIFUGAL PUMP
- INTERNAL RECYCLE PUMP
- SAMPLER
- FAN
- NEW
- SCREENED INDICATES EXISTING

NOTE:
1. EXISTING STRUCTURES, PIPING, AND EQUIPMENT IS DEPICTED SCREENED OR SHADED.
2. PERMEATE PUMP SERVES AS BACK PULSE PUMP.
3. UCT BIOLOGICAL PROCESS IS BASIS OF DESIGN.

ATKINS
1600 RiverEdge Parkway, NW, Suite 700
Atlanta,Ga 30328
P: 770-933-0280

DATE
REVISION

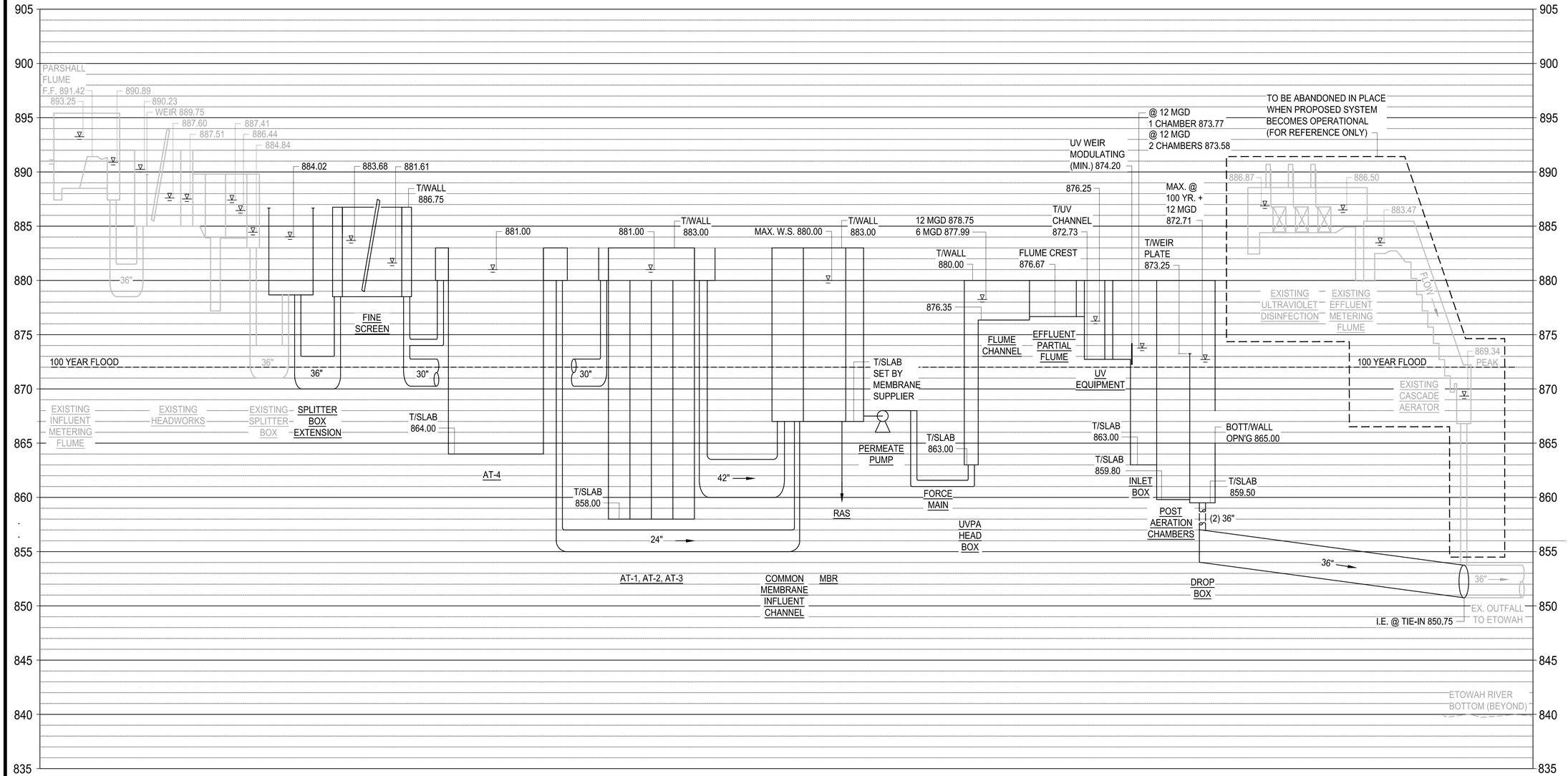
PROJ. NO.: 100061831
DESIGNED BY: DLG
DRAWN BY: JN
CHECKED BY: HIR
APPROVED BY: ND
DATE: November 2019
SCALE: NONE

CITY OF CANTON, GEORGIA
WASTEWATER TREATMENT PLANT EXPANSION TO 6 MGD

PROCESS FLOW DIAGRAM I

FIGURE 3

File Name: C:\PW_WORK\ATKNACA01\NEWM7492\DMS35898\0100 - G-09.DWGTab:FIG 3Plotted: January 03, 2020 3:13pm



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1600 RiverEdge Parkway, NW, Suite 700
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CITY OF CANTON, GEORGIA
WASTEWATER TREATMENT PLANT EXPANSION TO 6 MGD

HYDRAULIC PROFILE

FIGURE 4

File Name: C:\PW_WORK\ATKNAGA01\WEMM7492\DMS35898\0100 - G-12.DWG|Tab:FIG. 4|Plotted: January 03, 2020 2:33pm

Appendix E. Piping Schedule

PIPING MATERIAL DATA SHEET - Ductile Iron (DIP)	
PIPE DESCRIPTION	
Push-on joint, mechanical or restrained joint pipe 4” and larger	1. Ductile iron per AWWA C151/ANSI A21.51, latest revision. 2. Cement-mortar lined per AWWA C104/A21.4, Double Thickness with Seal Coat. 3. Thickness per AWWA C150/ANSI A21.50, Minimum Thickness Class 52. 4. Minimum Pressure Class: • 4” to 12” – Class 350 • 14” and larger – Class 250.
Flanged joint pipe 3” and larger	1. Ductile iron per AWWA C115/ANSI A21.15. 2. Cement mortar lined per AWWA C104/A21.4., Double Thickness with Seal Coat. 3. Thickness per AWWA C150/ANSI A21.51, Minimum Thickness Class 53.
END CONNECTIONS	
Push on joints	1. Dimensions per AWWA C151/ANSI A21.51-91. 2. Gaskets: Rubber per AWWA C111/ANSI A21.11.
Mechanical joints	1. Gasketed and bolted per AWWA C111/ANSI A21.11 and AWWA C153. 2. Restrained joints when required, EBAA Iron “Megalug” or equal.
Flanged joints	1. Dimensions AWWA C115/ANSI A21-15. 2. Flange drilling: Class 125 per ANSI B16.1 3. Type: Flat faced 4. Gaskets: 1/8-inch red rubber conforming to ANSI B16.21, AWWA C207 and ASTM D1330, Grades 1 and 2.
FITTINGS	
All	1. Material: Ductile Iron ASTM A536. 2. Coatings and linings: Same as pipe. 3. Dimensions AWWA C110, AWWA C111, and AWWA C153, as applicable. 4. End connections same as adjacent piping.
SPECIAL REQUIREMENTS	
	1. Delete asphaltic coating for interior piping that is to be painted. Provide shop primer per Section 09900. 2. Encase buried pipe in minimum 8 mil Polyethylene tube per AWWA C105. Secure overlap with at least two wraps of polyethylene tape. 3. For 36-inch and larger fittings, clearly mark the year, month, date cast, number lot, and the manufacturer’s fitting control number on each fitting. This is in addition to the marking requirements in AWWA C110. 4. Use CORTEN or equal nuts and bolts for mechanical joints as manufactured by NSS Industries; Plymouth, Michigan. 5. Cover entire face of blind flange with gasket. Cement to blind flange. 6. Victaulic couplings may be used in lieu of flanged pipe and fittings.
MANUFACTURERS	
	1. American Cast Iron Pipe Company. 2. United States Pipe and Foundry Company. 3. Or Approved Equal.

PIPING MATERIAL DATA SHEET – Polyvinyl Chloride (PVC)	
PIPE DESCRIPTION	
Solvent Welded, Threaded, and Flanged	1. Material: PVC ASTM D1784, Class 12454-B (Type 1, Grade 1). 2. Dimensions: ASTM D1785, Schedule 80.
Gasketed pipe (AWWA C-900, C-905 or SDR 35)	1. Material: PVC ASTM D1784. 2. Dimensions: ASTM F477, F679, D2122, D3034, or D3139, as appropriate.
END CONNECTIONS	
Solvent Welded	1. Materials: Same as pipe. 2. Dimensions: ASTM D2466 and D2467. 3. Cement: ASTM D2564.
Threaded	1. Materials: Same as pipe. 2. Dimensions: ASTM D2464. 3. Lubricant: Teflon Tape.
Flanged	1. Materials: Same as pipe. 2. Dimensions: ANSI B16.5, 150-pound, flat face mating flange. 3. Bolts: Carbon steel ASTM A307, grade B bolts. 4. Nuts: Carbon steel ASTM A563, grade A heavy head nuts. 5. Gaskets: Flat ring 1/8-inch ethylene propylene rubber (EPR). 6. Type: Flat faced.
Integral Bell and Gasket	1. Materials: Same as pipe. 2. Dimensions: ASTM D2122, D3034 and F679 as applicable. 3. Gaskets: Conform to ASTM F477
FITTINGS	
Solvent Welded	1. Materials and Dimensions: ASTM D1784 and ASTM D2467. 2. Cement: ASTM D2564. 3. Primer : ASTM F656.
Threaded	1. Materials and Dimensions: ASTM D1784 and ASTM D2464. 2. Lubricant: Teflon Tape
Flanged	1. Materials: Same as adjacent pipe. 2. Dimensions and bolt pattern: Same as pipe. 3. Pressure rating: Same as pipe.
Integral Bell and Gasket	1. Materials: Same as adjacent pipe. AWWA C900 and C905 fittings may also be ductile iron. 2. Dimensions: Same as pipe. 3. Pressure rating: Same as pipe.
SPECIAL REQUIREMENTS	
	1. Use AWWA C900 or C905 piping for buried pressure applications greater than 4-inches. 2. Use DR 35 pipe for buried, gravity flow applications.

PIPING MATERIAL DATA SHEET – Polyvinyl Chloride (PVC) Tubing	
PIPE DESCRIPTION	
Clear Reinforced Flexible Tubing (CRFT)	1. Material: Spiral steel wire reinforcement incorporated into wall of flexible PVC tubing 2. Dimensions: 1/4-inch ID through 2-inch ID
END CONNECTIONS	
	1. Make a clean-cut perpendicular to the tubing centerline.
FITTINGS	
Multi-Barbed Type	1. Materials: Nylon, Polyethylene, or Polypropylene. 2. Clamps: Worm gear, screw tightening type constructed of type 301 stainless steel
SPECIAL REQUIREMENTS	
	1. None.

PIPING MATERIAL DATA SHEET – Galvanized Steel (GALV)	
PIPE DESCRIPTION	
2 inch and smaller	1. Material: Conform to ANSI B31.1; ASTM A53, A134, A135, and A139; and AWWA C200, as applicable. 2. Type: Seamless or electric resistance welded 3. Grade: B 4. Schedule: 40 unless otherwise noted
2-1/2 inch and larger	1. Material: Conform to ANSI B31.1; ASTM A53, A134, A135, and A139; and AWWA C200, as applicable 2. Type: Seamless or electric resistance welded 3. Grade: B 4. Schedule: 2-1/2 inch through 6-inch use schedule 40 unless otherwise noted 6 inch and larger use schedule 20 unless otherwise noted.
END CONNECTIONS	
Flanged joints	1. Dimensions: ANSI B16.5, Class 150 2. Material: Forged and galvanized carbon steel conforming to ASTM A105, A153. 3. Type: Flat Faced 4. Gaskets: Cloth insert rubber 5. Bolts: Galvanized steel conforming to ASTM A307, A153, Grade A, Hex head. 6. Nuts: Galvanized steel conforming to ASTM A563, A153, Grade A, Hex head.
Threaded joints	1. Dimensions: ANSI B2.1 2. Thread Lubricant: Teflon Tape
Welded	1. 2-inch and smaller: Socket welded 2. 2-1/2 inch and larger: Butt welded 3. Mark each weld with the symbol of the person making the weld
FITTINGS	
Flanged	1. Dimensions: ANSI B16.5, Class 150 2. Materials: Same as pipe and end connections
Threaded	1. Dimensions: ANSI B16.3 2. Material: Malleable Iron, Class 150 conforming to ASTM A197 Cast Iron, Class 125 conforming to ASTM A126
Welded	1. 2-inch and smaller: Socket welded 2. 2-1/2 inch and larger: Butt welded 3. Mark each weld with the symbol of the person making the weld
SPECIAL REQUIREMENTS	
	None

PIPING MATERIAL DATA SHEET – Carbon Steel (STL)	
PIPE DESCRIPTION	
2 inch and smaller	1. Material: ASTM A106. 2. Type: Seamless 3. Grade: B 4. Schedule: 40 unless otherwise noted
2-1/2 inch and larger	1. Material: ASTM A54 2. Type: Seamless or electric resistance welded 3. Grade: B 4. Schedule: 2-1/2 inch through 6-inch use schedule 40 unless otherwise noted 6 inch and larger use schedule 20 unless otherwise noted.
END CONNECTIONS	
Flanged joints	1. Dimensions: ANSI B16.5, Class 150 2. Material: Forged carbon steel conforming to ASTM A105 3. Type: Flat Faced 4. Gaskets: Cloth insert rubber 5. Bolts: Carbon steel conforming to ASTM A307, Grade A, Hex head. 6. Nuts: Carbon steel conforming to ASTM A563, Grade A, Hex head.
Threaded joints	1. Dimensions: ANSI B2.1 2. Thread Lubricant: Teflon Tape
Welded	1. 2-inch and smaller: Socket welded 2. 2-1/2 inch and larger: Butt welded 3. Mark each weld with the symbol of the person making the weld
FITTINGS	
Flanged	1. Dimensions: ANSI B16.5, Class 150 2. Materials: Same as pipe and end connections
Threaded	1. Dimensions: ANSI B16.3 2. Material: Malleable Iron, Class 150 conforming to ASTM A197 Cast Iron, Class 125 conforming to ASTM A126
Welded	1. 2-inch and smaller: Socket welded 2. 2-1/2 inch and larger: Butt welded 3. Mark each weld with the symbol of the person making the weld
SPECIAL REQUIREMENTS	
Liner	1. Epoxy Line interior of the pipe. Conform to AWWA C213 standard

PIPING MATERIAL DATA SHEET – Stainless Steel (ST STL)	
PIPE DESCRIPTION	
General	1. Manufacture in accordance with ASTM A778
2-1/2 inch through 6 inches	1. Material: AISI type 316 stainless steel conforming to ASTM A240. 2. Schedule: 10S unless otherwise noted.
8 inch and larger	1. Material: AISI type 316 stainless steel conforming to ASTM A240 2. Schedule: 5S unless otherwise noted
END CONNECTIONS	
Flanged joints	1. Material: Type 316 stainless steel 2. Type: Slip on with rolled angle face ring perpendicular to the pipe axis. Provide ductile iron backing flanges drilled to ANSI B16.1, Class 125. 3. Gaskets: Graphite (Grafoil as manufactured by Crane Packing or equal) 4. Bolts: Conform to ANSI B18.2.1. 5. Nuts: Conform to ANSI B18.2.2.
Mechanical Couplings	1. Dresser Type
FITTINGS	
General	1. Manufacture in accordance with ASTM A774
Elbows	1. 16 inches and smaller: Provide smooth flow with centerline radius of 1.5 times the pipe diameter. 2. 18 inches and larger: Fabricate from five mitred sections with centerline radius of 1.5 times the pipe diameter. 3. Materials: Same as pipe 4. End connections: Same as pipe
SPECIAL REQUIREMENTS	
	1. Paint backing flanges with zinc rich paint prior to installation. Spray on in two coats, each of which is approximately 50 microns thick. 2. Passivate all pipe and fittings after manufacture by immersion in an air agitated pickling tank containing a 25% solution of nitric and hydrofluoric acids. Neutralize in a rinse tank containing water and tri-sodium phosphate. 3. Do not field weld unless authorized in writing by the City's resident project representative.

PIPING MATERIAL DATA SHEET - Copper (CU)	
PIPE DESCRIPTION	
Exposed – All Sizes	1. Material: ASTM B88 2. Type: L (Hard Drawn)
END CONNECTIONS	
All	1. Solder 2. Compression
FITTINGS	
All	1. Material and Dimensions: ANSI B16.22 2. Compression, Brass
SPECIAL REQUIREMENTS	
	1. Use dielectric couplings at material changes. 2. Use two-part coupling for copper to copper connections. Include tubing connection, a coupling nut and a friction ring. Threaded coupling nuts to conform to AWWA C800. 3. Apply polyethylene tape coating to buried piping. Spiral wrap with minimum 50 % overlap. Use tape or heat shrink wrap at joints. Follow manufacturer's instructions.

PIPING MATERIAL DATA SHEET – Polyvinyl Chloride Pressure Pipe (PVC 900) Pipe	
PIPE DESCRIPTION	
All Outside	1. Material: Type 1, Grade 1 PVC suitable for a 150-psi working pressure (minimum) to withstand (without failure) an internal hydrostatic pressure of 500 psi for 1000 hours per ASTM 1598. 2. Pipe: SDR 18 conforming to ASTM D1784, ASTM D2241 and AWWA C900 or C905 for Class 150 pipe. 3. Outside diameter to match the ductile iron pipe.
END CONNECTIONS	
Push-on	4. Gaskets – Synthetic rubber ring gaskets conforming to ASTM D1869 5. Lubricant – Vegetable origin that is non-toxic and water soluble.
FITTINGS	
Push-on	4. DIP fittings used with PVC pipe shall have a corrosion proof lining.

Contact name
Atkins company name
Office address

Email
Telephone
Direct telephone
Fax

SECTION 11410

ROTARY DRUM THICKENER

PART 1: GENERAL

1.01 SCOPE

A. This section covers the Work necessary to detail, manufacture, deliver to the jobsite, and to startup and test, complete and ready for operation two rotary drum thickeners including all equipment, appurtenances, and services as specified herein.

B. The rotary drum thickeners manufacturer shall assemble, detail, and provide all of the equipment components specified herein.

C. All like items of equipment shall be the end product of one equipment manufacturer, who shall assume complete responsibility for conformance with these specifications.

D. The rotary drum thickener manufacturer shall coordinate all facets of this project with the contractor to ensure compliance with the specifications and compliance with required performance. All facets include structural, mechanical, piping, electrical, and instrumentation.

E. Thickeners will be located outdoors. Manufacturer shall provide all accessories required to operate the equipment in the environmental conditions associated with the location of the pumps as shown on the construction drawings.

1.02 EQUIPMENT COMPONENTS PER THICKENER

A. Floc Tank Mixer

B. Rotary Drum Thickener

C. Washwater Booster Pump

D. Control Panel

E. Polymer Injection Ring and Vortex Mixing Valve

F. Solid Discharge Chute

G. Return Water Collection System

1.03 DEFINITIONS

A. Solids Capture: The percent of the feed solids that remain in the dewatered end product on a weight basis. For purpose of this specifications, solids capture is defined as:

Percent Capture = (C/F) x [(F-E)/(C-E)] x 100%

Where:

C = Dewatered sludge total solids (%TS)

F = Feed (%TSS); excluding any dilution from polymer solution flow

E = Filtrate (%TSS); excluding any dilution from polymer solution and wash water flows

B. Polymer consumption to be based on active polymer.

1.04 SUBMITTALS

A. Action Submittals:

1. Shop Drawings:

a. Make, model, weight and horsepower of each equipment assembly.

b. Complete catalog information, descriptive literature, specifications, and identification of materials of construction.

c. Detailed mechanical and electrical drawings showing the equipment dimensions, size, locations of connections, and weights of associated equipment.

d. Power and control wiring diagrams, including terminals and numbers.

e. Complete motor nameplate data, as defined by NEMA, motor manufacturer, and including any motor modifications.

f. Details of sludge/polymer mixer assembly.

g. Details of electrical components including enclosures.

h. Details of local control panel and operator control station showing panel mounted devices.

i. Factory finish system.

j. Panel heat dissipation calculations. Demonstrate that panel internal temperature does not exceed drive operating requirements.

2. Information, including technical catalogue, literature and specifications on factor prime and finish coating systems in accordance with Section 09900 PAINTING.

a. Where manufacture proposers paint system different from that specified, manufacture shall submit complete technical literature showing that the proposed paint system is equivalent or better that the paint system specified for the intended environmental conditions.

B. Information Submittal:

1. Special shipping, storage and protection, and handling instructions.

2. Manufacturer’s printed installations instructions.

3. Manufacturer’s Certificate of Proper Installation.

4. Suggested spare parts list to maintain the equipment in service for a period of 5 years. Include a list of special tools required for checking, testing, parts replacement, and maintenance with current price information.

5. List special tools, materials, and supplies furnished with equipment for use prior to and during startup and for the future maintenance.

6. Operation and Maintenance Data: Operation and Maintenance Manual as specified in Section 01730 OPERATION AND MAINTENANCE DATA.

1.05 SPARE PARTS

A. The following spare parts will be provided per sludge thickening unit:

1. One (1) set of six (6) trunnion wheels
2. One (1) driven sprocket
3. One (1) idler sprocket
4. One (1) drive chain

PART 2: PRODUCTS

2.01 GENERAL

A. Each rotary drum thickener shall consist of a rotating cylindrical screen that removes free water from sludge by dynamic gravity drainage. The sludge mixed with chemicals shall enter the floc development tank tangentially at the bottom and completes its flocculation. The flocculated solid and liquid shall flow from a tangential outlet into the rotary drum screen through a step-down header. In the rotary drum screen, the liquid shall separate from the flocculated solids through the woven wire mesh, collect in the return water tank, and exit through a drain in the bottom. The solids will pass through four (4) dewatering stages before being discharged from the end of the unit. The rotary drum screen shall include a self-cleaning wash water spray header to keep the rotary drum screen openings clear of solids.

B. Each rotary drum thickener shall consist of a floc development tank, driven impeller, multiple stage rotary drum with filtration media, support frame, spray deflection covering, spray wash header, and return water collection tank.

C. System components shall be skid mounted except for the wash water booster pump which shall be mounted separately.

D. The design shown on the Drawings is based on the “A” named manufacturer below.

2.02 MANUFACTURERS

A. Parkson Hycor Corporation; Model No. RDT400L ThickTech.

B. Vulcan; Model No. LFST-6010.

2.03 SERVICE CONDITIONS

A. The equipment specified herein shall be suitable for installations outdoors, for exposures to continuous 100 percent relative humidity conditions, for operation in ambient air temperature from 0 to 100 degrees F, and for exposure to typical local weather, biological sludge, splash, spill, and washdown conditions.

B. The material to be thickened will be waste activated sludge ranging resulting from the biological treatment of municipal wastewater by the activated sludge process.

2.04 PERFORMANCE AND DESIGN REQUIREMENTS

A. The rotary drum thickener shall continuously receive, flocculate, condition, and dewater the feed sludge specified herein, and neatly discharge the dewatered sludge to the thickened waste activated sludge (TWAS) feed pumps located below as shown on the drawings.

B. The rotary drum thickener shall conform to or exceed the following performance parameters:

1. Hydraulic Capacity: 400 gpm

2. Feed Solids Concentrations: 1.0 - 1.5 percent dry solids.

3. Thickened Sludge Concentrations: 3 to 7 percent dry solids.

4. Capture Efficiency: 98 percent

5. Maximum Polymer Consumption: 10 active pounds per dry ton of sludge at a minimum of 0.5 percent dry solids.

C. The rotary drum thickeners shall operate continuously or intermittently on demand. The rotary drum thickeners shall be suitable for dewatering the specified sludge continuously for 24 hours per day, 7 days per week.

2.05 EQUIPMENT

A. All wetted elements of the rotary drum thickeners unit will be fabricated from 304 stainless steel, or equally corrosion-resistant material. This includes the floc development tank, input connection, discharge assembly, and driven impeller; the rotary element composed of the input assembly, the multiple stages of the rotary element, the discharge assembly, the filtration media covering the various stages and all fasteners; the supporting frame assembly, the shower deflection covering and all fasteners; the washing header and fasteners; the return water collection tank, pull cord emergency stop switches, and the integrated central electrical control panel. The principal elements of the rotary sludge thickener are to be fully assembled for simplified movement and installation.

B. The flocculation tank shall be equipped with a 6-inch pipe stub tangential inlet near the bottom and a tangential outlet near the top. The driven impeller of the flocculation system shall be composed of a shaft and a double vertical flat blade on either side of the shaft with a nylon steady bearing centrally located on the bottom of the tank. The discharge flume assembly shall include a step down delivery for the transfer of conditioned sludge to the receiving surface in the first stage of the rotary element. It is recommended that provisions to drain the floc tank be installed in the influent piping.

C. The Rotary System

1. The rotary system shall be composed of multiple stages. Each stage, starting with the input stage, shall function in a distinct progression of the intended dewatering program. Each stage shall be covered with stainless steel woven wire mesh selected on the basis of porosity or percent openness, the opening size and the wire diameter used in the weaving process. Each stage wire mesh may vary with each of the other stages, and wire selections will be made

on the basis of maximizing flow consistent with the requirements for high quality filtrate.

2. The woven wire meshes covering each stage shall be easily changed with simple tools. The woven meshes shall be fastened as the outer covering of each stage and shall be flanged to the outer surface of the perforated metal housing surrounding each stage.

3. Each stage shall be equipped with roll bars, split augers, ports, closures and/or deflectors to influence shear, water release and drainage rate independent of flow. Delivery of output solids shall be by gravity resulting from a series of detention rings, separating the stages, progressively lower in the direction of delivery and influenced by the split augers.

D. A single self-cleaning washing header shall be oriented in a horizontal position the length of the rotary system to maintain positive cleaning with each revolution of the rotary system, forcing the washed off solids to return to the mass of solids tumbling inside the rotary element. The washing header shall contain spray tips of varying orifice size to emit a progressively reduced flow of high pressure washing water in the direction of the rotary system delivery end. The washing header shall be mounted with U-bolts permitting the adjustment of the angle of impact of the water, from tangential to square, permitting the restriction of water re-entering the stages to only that quantity required to maintain openness of the filtration woven wire mesh. Spray header to be fitted with an Ashcroft stainless steel pressure gauge, liquid filled type 1008S with a 1/4-inch NPT back connection, 2-1/2 inches dial dual scaled at 0/160 psi and 0/1100 kPa.

E. Each rotary drum thickener shall include a booster pump that is mounted on the skid frame or separate but adjacent to the frame. The wash water booster pump shall be provided and sized by the manufacturer. The booster pump shall maintain a minimum of 15 gpm at 120 psi. The booster pump shall be a constant speed centrifugal pump with mechanical seal and shall accept plant water at 30 psi.

F. The solenoid valve shall be a 1-inch 2-way, pilot operated, ASCO 8210 series brass body valve with NBR seals and discs with a Red Hat II 120 VAC watertight NEMA 4X solenoid enclosure.

G. All elements of the rotary system and supporting frame shall be contained and mounted over the return water or filtrate water collection tank. Delivery of collected filtrate water shall be by gravity through one (1) 8-inch filtrate tank drain.

H. Each unit shall be provided with an end enclosure and solids discharge chute constructed of 14 gauge Type 304 stainless steel to convey the solids from the rotary drum thickener to the aerobic digester located below the thickener as shown on the Drawings. Discharge chute shall have hinged panels for access. End enclosure shall include a hard rubber boot that extends from the thickener chute through the concrete pad to 2 inches below the pad.

I. Vortex Mixing Valve and Polymer Injection Ring

1. Each rotary drum thickener shall be provided with a sludge conditioning system designed to efficiently mix polymer with the sludge and to adequately condition the sludge for optimum dewatering. The vortex mixing valve, polymer injection ring, and manifold are to be installed by others.

2. The sludge conditioning system shall be mounted upstream of the thickener in an indoor environment. The system shall consist of an in-line vortex mixer with a variable orifice, polymer injection ring, and polymer solution distribution manifold. The rotary drum thickener manufacturer shall be required to provide to the engineer a proper layout system.

3. The sludge conditioning shall meet the following mechanical specifications:

   a. Vortex Mixer - The in-line mixer shall have a flanged housing, an adjustable orifice connected to an externally mounted lever and counterweight and a removable side plate for inspection and cleaning.

   b. The open throat area shall be fully adjustable downward and shall open automatically to prevent clogging.

   c. The position of the counterweight on the externally mounted orifice plate lever shall be fully adjustable, within a 360 degree circle, to allow for adjustment of the mixing energy, regardless of the mounting angle, while the unit is in operation.

4. Polymer Injection Ring: The injection ring shall have four (4) injection points evenly distributed along its circumference for injecting polymer into the sludge flow.

5. Manifold Block: The manifold distribution block shall divide the single polymer solution feed line into four (4) separate flows for connection to the polymer injection ring.

2.06 DRIVES

A. Main drive unit shall be provided and sized according to the specific unit requirements. Eurodrive 3.0 horsepower, AC gear motor rated for severe duty, transmitting power to the sprockets and chain-driven rotary cylinder. The controller shall be a variable frequency drive (VFD) built for 460 volts, 3- phase, and 60 Hz input power.

B. Floc tank drive shall be provided and sized according to the specific unit requirements. Eurodrive 0.5 horsepower minimum, AC gear motor rated for severe duty flange mounted to the flocculation tank. The controller shall be a variable frequency drive (VFD) built for 460 volts, 3-phase, and 60-Hz input power.

C. Wash Water Booster Pump shall be provided and sized according to the specific unit requirements. The pump will be driven by a fixed speed, 460 volts, 3-phase, and 60-Hz, 3,500 RPM direct coupled to a 5.0 horsepower TEFC.

2.07 CONTROL SYSTEMS

A. General: Each Rotary Drum Thickener shall be provided with Type 304 SST NEMA 4X control panel

B. Operators Controls and Indicators: Provide the following panel mounted operator controls and indicators on each panel:

1. Emergency STOP pushbutton.

2. Washwater Booster Pump: ON/OFF/REMOTE switch

3. Washwater Booster Pump: ON/OFF indicator.
4. Washwater Booster Pump: FAIL indicator.
5. Floc Tank Mixer: ON/OFF/REMOTE switch.
6. Floc Tank Mixer: ON/OFF indicator.
7. Floc Tank Mixer: FAIL indicator.
8. Floc Tank Mixer: SPEED potentiometer.
9. Floc Tank Mixer: SPEED indicator.
10. Rotary Drum Thickener: ON/OFF/REMOTE switch.
11. Rotary Drum Thickener: ON/OFF indicator.
12. Rotary Drum Thickener: FAIL indicator.
13. Rotary Drum Thickener: SPEED potentiometer.
14. Rotary Drum Thickener: SPEED indicator.

C. External Interfaces for each Panel:

1. Analog Inputs:
   a. Rotary Drum Thickener: SPEED command
   b. Floc Tank Mixer: SPEED command
2. Analog Outputs:
   a. Rotary Drum Thickener: SPEED feedback.
   b. Floc Tank Mixer: SPEED feedback
3. Discrete Inputs:
   a. Washwater Booster Pump: RUN command
   b. Floc Tank Mixer: RUN command
   c. Rotary Drum Thickener: RUN command
4. Discrete Outputs:
   a. Washwater Booster Pump: in REMOTE
   b. Washwater Booster Pump: OM
   c. Washwater Booster Pump: FAIL
   d. Floc Tank Mixer: in REMOTE
   e. Floc Tank Mixer: ON
   f. Floc Tank Mixer: FAIL
   g. Rotary Drum Thickener: in REMOTE
   h. Rotary Drum Thickener: ON
   i. Rotary Drum Thickener: FAIL

D. Special Requirements:

1. Control panel will receive one 480 V, three-phase feeder. Provide control power transformer in panel for any 120 V power needed for the system.

2. Motor starters and AFD's shall be provided in the control panel.

3. Panel shall be sized to properly dissipate heat from the AFDs. Provide cooling fans or cooling fins as required. If fans are required, power for fans shall come from the same 480 V feed to the panel. To maintain the integrity of the NEMA 4X panel, louver penetrations will not be permitted.

4. Control Panel shall include a PLC based control system, Allen Bradley ControLogix or equal with Ethernet communications. The plant control system shall integrate with this PLC for transmission of data for remote monitoring and control of the system. Provide coordination of the complete database with the system integrator.

2.08 ACCESSORIES

A. Equipment Identification Plate: 16-guage stainless steel with ¼ inch die-stamped equipment tag number securely mounted in a readily visible location.

B. Lifting Lugs: Equipment weighing over 100 pounds.

C. Anchor Bolts: Type 316 stainless steel, sized by equipment manufacturer, ½ inch minimum diameter, and as specified in Section 05500 METAL FABRICATIONS.

2.09 FACTORY FINISHING

A. Prepare, prime and finish coat in accordance with Section 09900 PAINTING.

2.10 SOURCE QUALITY CONTROL

A. Factory Tests and Adjustments: Test all equipment for proper alignment, operation, and intended function.

B. Function Test: Perform manufacturer's standard motor test on equipment.

2.11 ADJUSTABLE FREQUENCY DRIVE SYSTEMS

A. Manufacturer shall be responsible for coordinating all the characteristics of the motor (i.e., voltage, rpm, full-load current, etc.)

B. Adjustable frequency drives shall satisfy the requirements of Section 16157 VARIABLE FREQUENCY DRIVE.

PART 3: EXECUTION

3.01 INSTALLATION

A. Install in accordance with the manufacturer's printed instructions.

B. Base shall be installed level.

C. All assemblies shall be adjusted such that the driving units are properly aligned, plumb, and level with the driven units and all interconnections.

D. Piping shall be connected without imposing strain.

E. Anchor Bolts: Accurately place using equipment templates and as specified in Section 05500 METAL.

3.02 FIELD QUALITY CONTROL

A. Functional Test: Conduct on each unit.

1. Prior to system startup, inspect components for proper alignment, connection and satisfactory operation.

2. Manufacturer's representative shall inspect installation, check for lubrication and minor adjustments, provide certification that the system components have been installed correctly and are ready for operation.

B. Performance Test: Conduct on each unit.

1. Test procedures and polymer recommendations shall be submitted to the ENGINEER for review 30 days prior to testing.

2. Prior to performance tests, the manufacturer shall perform testing as necessary to determine and recommend the polymer to produce the specified performance. Additional tests shall be at the manufacturer's own expense, if the test fails to meet the specified performance.

3. The OWNER shall provide sludge feed, water, electrical power, and sludge disposal necessary to conduct the performance tests. Polymer shall be provided by the OWNER at the recommendation of the equipment manufacturer.

4. Each unit shall be operated for a minimum of two 6-hour test runs. Six rounds of sampling shall be required for each run. Of the twelve rounds of samples collected, a minimum of eleven must meet the performance parameters specified.

5. The cost of laboratory tests necessary to confirm performance shall be paid by the manufacturer.

6. Performance test data and results shall be submitted to the ENGINEER in report format.

7. If after performance testing, in the opinion of the ENGINEER, the system meets the minimum performance requirements specified, the ENGINEER will recommend by letter the official acceptance of the results do not meet the requirements specified, the ENGINEER will notify the OWNER and CONTRACTOR of the non-acceptable performance.

8. In the case of non-acceptable performance, the manufacturer shall then have 60 days in which to perform at its sole expense, any supplemental testing, equipment adjustments, changes or additions and to perform a retest of the non-acceptable system.

9. If in the opinion of the ENGINEER a performance acceptance test or retest is successful and meets the requirements specified, the ENGINEER will recommend, by letter, the acceptance of the equipment.

3.03 MANUFACTURER'S SERVICES

A. Manufacturer's Representative: Present at site or classroom designated by OWNER, for minimum person-days listed below, travel time excluded:

1. 1 person-day for installation assistance and inspection.

2. 2 person-days for functional and performance testing and completion of Manufacturer's Certificate of Proper Installation.

3. 1 person-day for prestart up classroom or site training.

4. 2 person-days for facility startup.

5. 1 person-day for post-startup training of OWNER's personnel.

B. See Section 01640 MANUFACTURER'S SERVICES and Section 01650 FACILTY STARTUP AND TESTING.

END OF SECTION

SECTION 11440

DIFFUSED AERATION EQUIPMENT – BNR BASINS

PART 1: GENERAL

1.01 SCOPE

A. The Contractor shall provide and install diffused aeration equipment in BNR Basins 1 through 4.

B. Provide complete fine bubble diffused aeration systems with appurtenances as specified and as shown on the Contract Documents.

C. The diffused aeration system includes, but is not necessarily limited to, the following:

1. Stainless steel piping for "drop legs."

2. PVC air manifolds and distributors.

3. PVC diffuser holders and retainer rings.

4. Stainless steel supports and anchors.

5. Bolts, nuts, and gaskets for aeration system flange connections.

6. Air distributor purge systems.

7. Diffuser assemblies as required:

a. Membrane fine bubble diffuser elements, diffuser holders, sealing gaskets or O-rings, air flow control orifices, and retaining devices.

D. Blank inserts that can be installed to remove diffusers from service. Provide sufficient inserts to take 10% of the diffusers out of service.

1.02 RELATED WORK

A. Electrical work, except as specified herein, is included in Division 16.

B. Section 01300 SUBMITTALS

C. Section 01400 QUALITY CONTROL

D. Section 01600 DELIVERY, STORAGE AND HANDLING

E. Section 01650 FACILITY START-UP AND TESTING

1.03 SUBMITTALS

A. Submit in accordance with Section 01300 SUBMITTALS, copies of all materials required to establish compliance with this Section. Submittals shall include at least the following:

1. Submittal drawings showing plan, elevation, and cross sections of the equipment as installed in each zone.

2. Number of diffusers in each zone.

3. Certified test data from a shop clean water performance test.

a. Tests conducted by independent testing firm. In-house tests not acceptable.

b. Demonstrate capacity of equipment to meet specified oxygen requirements.

1) Conduct test with diffuser submergence and density within plus or minus 20% of that required by this project.

2) Provide data from at least three test runs.

3) Conduct tests per the ASCE Clean Water Test Procedure.

c. Manufacturer may also use oxygen transfer test performed in the factory to demonstrate compliance with this specification.

1) Meet same requirements specified above.

2) Test in tank with at least 200 square feet of surface area to eliminate potential wall effects.

3) Test at same submergence and diffuser density as required for this project.

4. Manufacturer's catalog information that includes the following:

a. Material and manufacturing specifications.

b. A complete bill of materials that identifies all materials of construction.

c. Performance data.

d. Descriptive literature and bulletins.

5. Design calculations.

a. Demonstrate acceptable performance for specified operating conditions. Include:

1) Oxygen transfer calculations.

2) Head loss calculations and pressure requirements.

3) Air distribution and balancing calculations within each treatment zone.

6. Certified installation drawings. Show:

a. Important details of construction.

b. Equipment dimensions.

c. Size and location of anchor bolts.

d. Locations of connections to other work.

7. Detailed list of exceptions to the specifications. Include:

a. Specification reference.

b. Proposed alternative.

c. Reason for the exception.

8. Special shipping, storing, protecting, and handling instructions.

9. A list of manufacturer's recommended parts, with current price information, required to maintain the equipment for a period of 1 year.

10. A list of special tools, materials, and supplies furnished with the equipment for use before and during start up, and for future maintenance.

11. Manufacturer's installation instructions

B. Submit operation and maintenance manuals in accordance with the General Conditions and Division 1. Include the following:

1. A list of manufacturer's recommended parts, with current price information, required to maintain the equipment for a period of 1 year.

2. A list of special tools, materials, and supplies furnished with the equipment for use before and during start up, and for future maintenance.

3. Manufacturer's installation instructions.

C. Submit Manufacturer's Certificate of Proper Installation per Section 01400.

1.04 REFERENCE STANDARDS

A. Comply with applicable standards including, but not limited to, the most recent editions of the following:

1. US EPA Fine Pore Design Manual (EPA/625/1-89/023)

2. WEF Manual of Practice FD-13

3. ASCE Clean Water Test Procedure.

4. ASTM A240: Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and General Application.

5. ASTM A 276: Standard Specification for Stainless Steel Bars and Shapes.

6. ASTM A380: Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems.

7. ASTM A 554: Standard Specification for Welded Stainless Steel Mechanical Tubing.

8. ASTM A774: Standard Specification for As-Welded Wrought Austenitic Stainless Steel Fittings for General Corrosive Service at Low and Moderate Temperatures.

9. ASTM A778: Standard Specification for Welded, Unannealed Austenitic Stainless Steel Tubular Products.

10. ASTM D412: Standard Test Method for Vulcanized Rubber and Thermoplastic Elastomers–Tension.

11. ASTM D573: Standard Test Method for Deterioration in an Air Oven.

12. ASTM D1171: Standard Test Method for Rubber Deterioration–Surface Ozone Cracking Outdoors or Chamber (Triangular Specimens).

13. ASTM D1784: Standard Test Method for Rigid Poly (Vinyl Chloride)(PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds.
14. ASTM D1785: Standard Test Method for Rigid Poly Vinyl Chloride (PVC) Plastic Pipe, Schedules 40, 80, 120.
15. ASTM D2240: Standard Test Method for Rubber Property–Durometer Hardness.
16. ASTM D2466: Standard Test Method for Rigid Poly Vinyl Chloride (PVC) Plastic Pipe Fittings, Schedule 40.
17. ASTM D3034: Standard Test Method for Type PSM Poly (Vinyl Chloride)(PVC) Sewer Pipe & Fittings.
18. ASTM D3915: Standard Test Method for Rigid Poly Vinyl Chloride (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds for Plastic Pipe and Fittings Used In Pressure Applications.
19. Military Standard 105E: Sampling Procedures and Tables for Inspection by Attributes

B. Where reference is made to a standard of one of the above, or other organizations, the version of the standard in effect at the time of bid opening shall apply.

1.05 QUALITY ASSURANCE

A. Comply with applicable portions of Section 01400.

B. Provide components that are the standard product of a manufacturer regularly engaged in the production of the required materials and equipment.

1. Provide all diffused aeration equipment, including appurtenances manufactured/supplied by a single manufacturer.

1.06 DELIVERY, STORAGE AND HANDLING

A. Provide in accordance manufacturers recommendations and with Section 01600 DELIVERY, STORAGE AND HANDLING.

B. Package PVC pipe and fittings on standard packing pallets or in standard packing crates and boxes.

1. Protect from dirt and dust.
2. Protect against the effects of UV light.

C. Store diffusers on or in their standard shipping pallets, crates, or boxes until ready for installation.

D. Store indoors rubber materials including, but not limited to, flexible membrane diffusers, O-rings, and gaskets.

1. Immerse items that have been crimped or bent in warm water to remove irregularities before installation.
2. Do not use components that cannot be restored to their original condition after this procedure.

E. Support PVC manifolds for their entire length to prevent warping.

1. Cover with waterproof, opaque material to protect from dirt and UV light.

2. Ventilate covered area.

F. Assemble items into components as large as practical in the factory to minimize field assembly.

G. Package and tag parts that are shipped unassembled to protect from damage and to facilitate final assembly in the field.

1.07 MAINTENANCE

A. Provide spare parts recommended by the manufacturer. At a minimum, provide the following spare parts for the Owner's inventory:

1. Ten of each type of air distributor and manifold support. Include anchor bolts.

2. One air distributor section of each type.

3. Fifteen air distributor repair couplings of each size.

4. Ten fixed joint assemblies.

5. Ten expansion fittings (tees and couplings).

6. Twenty diffuser elements and gaskets.

7. Twenty diffuser holder retainer rings.

8. Ten diffuser holders.

B. Furnish one complete set of special tools required to disassemble, service, repair, and adjust the equipment. Special tools are those that are not readily available through a commercial tool supplier such as Snap-On or Mac. Provide spare diffusers in a quantity equal to ten (10) percent of the total diffusers being installed.

1.08 WARRANTIES AND BONDS

A. The Contractor shall provide a warranty against defective or deficient materials and workmanship in accordance with the requirements of Section 01740 WARRANTIES AND BONDS.

B. The equipment manufacturer shall provide a warranty against defective or deficient equipment, workmanship and materials under normal use, operation and service. The warranty shall end one (1) year from the date of substantial completion. The warranty shall be in printed form and apply to all similar units.

PART 2: PRODUCTS

2.01 MANUFACTURERS

A. Sanitaire – A Brand of Xylem Water Solutions US.

B. Environmental Dynamics International

C. Or approved equal.

2.02 GENERAL

A. Provide a stainless steel drop leg from the air main connection to the drop leg connection on the manifold.

1. Use Van Stone-style flange with 150-pound bolt pattern for the top connection.

2. Use a band clamp coupling with gasket for the lower drop leg to manifold connection.

3. Provide air main supports to carry the full weight of the drop leg. Support to maintain a plumb position.

4. All metallic hardware, supports, straps, clamps, etc. shall be stainless steel.

B. Use PVC manifold to connect to the air distribution headers.

1. Use fixed threaded union or flanged joints to connect to the air distributors and to connect manifolds.

2. Design manifold, distributor connections, and supports for expansion and contraction.

a. Accommodate a temperature range of 130 degrees F.

b. Make joints air tight.

c. Provide for free and easy movement.

3. Provide at least two supports per manifold.

C. Provide air distributors perpendicular to the air manifold.

1. Solvent weld single diffuser holders to the crown of the air distributor.

2. Design distributors and holders to resist a 200-pound dead load applied vertically to the outer edge of the diffuser holder.

3. Provide removable end caps with gaskets, threaded couplings, and end plates at the end of each air distributor for use as a clean out.

4. Join air distributor sections with positive locking, fixed threaded union, or flange-type joints for all submerged header joints.

a. Do not use bell and spigot, slip on, or expansion-type joints.

b. Design threaded union joints as follows:

1) Connect spigot section to one end of the distribution header.

2) Connect threaded socket section to the mating distribution header.

3) Use an O-ring gasket and threaded screw on retainer ring.

4) Perform all solvent welding in the factory.

c. Design flanged joints with 125-pound drilling.

1) Use angle face ring.

2) Provide follower flange.

3) Use stainless steel hardware.

D. Use at least two supports for each manifold and air distributor section.

1. General

a. Maximum 8 foot spacing.

b. Accommodate thermal expansion and contraction. Design for minimum 130 degree F temperature range and minimize stress build up in the piping system.

c. Make supports adjustable without removing air distributor.

d. Design supports to be completely removable.

2. Manifold supports (6-inch-diameter and larger)

a. Include hold down guide straps, support structure, and anchor bolts.

b. Use minimum 2-inch-wide guide straps.

c. Provide at least 2 inches of vertical adjustment for leveling.

d. Use at least two stainless steel anchor bolts to attach to the floor.

3. Air distributor and manifold supports (4 inches in diameter)

a. Provide guide and fixed supports to accommodate expansion and contraction.

b. Include hold down guide straps, support structure, and anchor bolts.

c. Provide approximately 1.5 inches of vertical adjustment for leveling.

1) Account for floor slopes, if any.

2) Level to plus or minus 0.25 inches.

d. Guide supports

1) 1.5 inches wide (top and bottom)

2) Contoured bearing surface with chamfered edges.

3) Provide 0.125-inch clearance around distributor.

e. Fixed supports

1) 1.5 inches wide (top and bottom)

2) Contoured bearing surface with punched burrs to positively grip the air distributor when tightened.

3) Design strap to be self limiting to prevent stressing the distributor if over tightened.

f. Use one stainless steel anchor bolt to attach to the floor.

E. Diffuser assemblies

1. Include diffuser, diffuser gasket, holder, retaining ring, and air flow control orifice.

2. Provide uniform air distribution based on visual observations at specified scfm per diffuser and 2 inches submergence.

3. Membrane diffuser

a. Include integral check valve.

b. Design and test for dynamic wet pressure (DWP) of 12 inches water column plus or minus 20% at 1.0 scfm per diffuser and 2 inches submergence.

c. Test diffusers using sampling criteria per Military Standard 105E.

d. Provide PVC support plate to support the membrane when air is off and form an air plenum when air is flowing.

4. Diffuser holder and retainer rings

a. Provide air flow control orifice and plenum chamber below the diffuser.

b. Design holder to provide peripheral support for the diffuser.

c. Design retainer ring to seal the diffuser and O-ring in the holder and prevent air leakage around the gasket.

d. Design retainer ring threads with minimum cross section of 1/8 inch and allow for one complete turn to engage threads.

e. Diffuser holders shall be interchangeable with membrane and ceramic disc diffusers.

F. Provide a liquid purge system to drain the entire submerged aeration piping system for each aeration grid. Include an airlift purge eductor line and a control valve.

G. Diffuser Pressure Monitoring System: Provide monitoring equipment to measure the DWP and operating air flow rate of a typical diffuser in each aeration grid.

1. Furnish one portable monitoring panel in a NEMA 4X fiberglass enclosure with stainless steel handrail bracket.

2. Provide monitoring panel with differential pressure gauges (orifice and diffuser), PVC ball valves, quick disconnect couplings, and one set of calibration curves.

3. Furnish one NEMA 4X stainless steel connecting box with handrail mounting brackets and carrier column assembly per grid. Include connections to measure air distributor pressure, flow control orifice differential pressure, and diffuser element operating differential pressure (DWP).

2.03 SERVICE AND DESIGN CONDITIONS

A. Aeration Zone Dimensions: BNR Basins 1 through 4 each consist of two oxic zones and each oxic zone are further divided into two zones (Grids). The nominal dimensions of each aeration zone in BNR 1 through 3 are identical except for BNR4. The dimensions of each aeration zone are tabulated below. Exact dimensions are shown on the drawings.

Basins/Zone	Length	Width	SWD	Minimum Diffusers /Zone
BNR Basins 1-3				
Oxic Zone 1 – Grid 1	50’	18’-3”	21’	540
Oxic Zone 1 – Grid 2	50’	18’-3”	21’	450
Oxic Zone 2 – Grid 3	50’	18’-3”	21’	405
Oxic Zone 2 - Grid 4	50’	18’-3’	21’	315
Total 3 Basins				5130
BNR Basin 4				
Oxic Zone 1 - Grid 1	67’-6”	19’-8”	17’	732
Oxic Zone 1 - Grid 2	67’-6”	19’-8”	17’	549
Oxic Zone 2 – Grid 3	67’-6”	19’-8”	17’	549
Oxic Zone 2 – Grid 4	67’-6”	19’-8”	17’	427
Total 1 Basin				2257

B. Site Ambient Conditions

1. Temperature (maximum): 100^{o} F
2. Temperature (minimum): 20^{o} F
3. Relative humidity: 45% to 90%
4. Altitude at site: Approximately 968 feet above sea level

C. Actual Oxygen Requirement (AOR): The AOR for each zone shall be as follows. Determine OTRs (field oxygen transfer rates) and SOTRs (standard oxygen transfer rates) and provide a diffuser system capable of satisfying the AORs in accordance with the process and field conditions specified herein.

Basins/Zone	Maximum AOR (lb/day)	Minimum AOR (lb/day)	Maximum SCFM	Minimum SCFM
BNR Basins 1-3				
Oxic Zone 1 - Zone 1	4,696	1,594	1,298	395
Oxic Zone 1 - Zone 2	3,815	1,295	1,055	321
Oxic Zone 2 - Zone 3	3,522	1,195	978	298
Oxic Zone 2 - Zone 4	2,641	896	736	224
Total 3 Basins				
BNR Basin 4				
Oxic Zone 1 - Zone 1	4,696	1,594	1,499	449
Oxic Zone 1 - Zone 2	3,815	1,295	1,238	370
Oxic Zone 2 - Zone 3	3,522	1,195	1,132	339
Oxic Zone 2 - Zone 4	2,641	896	853	255
Total 1 Basin				

D. Process Conditions

1. Alpha Factor: 0.5
2. Beta Factor: 0.98
3. Theta Factor: 1.024

E. Mixed Liquor Temperatures and Solids Concentration:

1. 70 degrees F maximum
2. 55 degrees F minimum
3. Solids concentration range: 7,000 mg/L to 10,000 mg/L

F. Residual dissolved oxygen concentration for each zone is 2.0 mg/L

G. Diffuser Air Flow Rate

1. The maximum allowable air flow rate per diffuser shall be 2.5 scfm.

H. Mixing Levels

1. The minimum mixing requirement shall be 0.12 scfm/ft^2 of tank floor based on WEF Manual of Practice No 8.

I. Transfer Efficiencies

1. Design the aeration system to achieve minimum standard oxygen transfer efficiencies (SOTE) of 1.8% per foot of submergence. The most severe

conditions are defined as the maximum oxygen demand, the minimum residual dissolved oxygen concentration, the maximum ambient temperatures, the maximum mixed liquor temperature, and the maximum submergence depth.

J. Piping/Diffuser Arrangement

1. Maximum system pressure at maximum air flow at top of droplegs shall be 9.8 psi in BNR Basins 1 to 3 , and 8 psi in BNR Basin 4.

2. Diffuser mounting height above high point of tank floor shall not exceed 12 inches.

3. The diffuser diameter shall be 9.0 inches.

K. Pressure Drop

1. The maximum allowable pressure drop through each diffuser and orifice control in a clean condition at design operating depth shall not exceed the following values at the airflow rates designated below:

Diffuser Airflow Rate (scfm)	Pressure Drop (inches of water)
1.0	15
2.0	20
3.0	29
4.0	40

2. The aeration system shall be designed and air lateral orifices sized so that at minimum and maximum airflows, the airflow rate output of any two diffusers in the systems shall not differ by more than 10% (based on the diffuser with the lower flow rate). The distribution and balancing of air shall be controlled by the use of orifices and proper header size selection only. The use of flow distribution control devices requiring automatic and/or manual operation shall not be acceptable.

3. The fine bubble aeration equipment shall be capable of maintaining its structural integrity and location within the aeration basin under a variety of process conditions, including basin filling, dewatering, cleaning, and a dewatered condition.

2.04 STAINLESS STEEL PIPE, FITTINGS, AND SUPPORTS

A. Fabricate welded parts and assemblies from sheets and plates of 304L stainless steel.

1. Provide 2D finish.

2. Conform to ASTM A240, ASTM A554, ASTM A774, and ASTM A778.

B. Fabricate non-welded parts and flanges from sheets, plates, or bars of Type 304 stainless steel. Conform to ASTM A 240 or ASTM A276.

C. Welding

1. Weld in the factory.

2. Use MIG, TIG or plasma-arc inert gas process with ER 316L filler wire.

3. Provide a cross section equal to or greater than the parent metal.

D. Provide full penetration butt welds to the interior surface with gas shielding of interior and exterior of the joint.

E. Continuously weld both sides of the face rings and flanges.

1. Corrosion protection and finishing.

2. Clean all welded stainless steel surfaces and welds after fabrication.

a. Remove weld splatter using stainless steel brushes or deburring and finish grinding wheels.

b. Provide full immersion pickling.

3. Rinse with water.

4. Regenerate a uniform corrosion resistant chromium oxide film per ASTM A380, Section 6.2.11, and Section 8.3.

F. Corrosion protection that does not use full immersion is unacceptable.

2.05 NATURAL RUBBER

A. Use natural rubber/SBR (Styrene butadiene rubber) for all fixed and expansion joint O-ring gaskets.

B. Provide Shore A durometer of 45 plus or minus 5.

C. Provide expansion joints manufactured by Hyspan (1501 Fixed Flange type) or equal.

2.06 POLYVINYL CHLORIDE (PVC) PIPE AND FITTINGS

A. Manufacture from PVC compound with a minimum 7,000 psi tensile strength.

1. Add minimum of 2 parts titanium dioxide per 100 parts of resin to protect against UV degradation.

2. Solvent weld all joints in the factory.

a. Field solvent welding is not permitted unless approved in writing by the Engineer.

b. Field solvent welding may be allowed if shipment of assembled PVC pieces could result in damage.

3. Design to withstand mean wall temperature of at least 125 degrees F.

B. Design

1. Use SDR 24.5 for 4-inch-diameter pipe and fittings. Conform to ASTM D3915 and ASTM D3034.

2. Use Schedule 40 for 6-inch-diameter and larger pipe and fittings. Conform to ASTM D1784, ASTM D1785, and ASTM D2466.

2.07 MEMBRANE DIFFUSERS AND GASKETS

A. Manufacture circular membrane discs with integral O-ring of EPDM synthetic rubber compound.

1. Provide precision, die-formed slits.

2. Design as one piece, injection molded part without tears, voids, bubbles, creases, or other structural defects.

3. Use sufficient thickness to limit tensile stress to 10 psi when operating at 2.4 scfm/ft^2 of material.

4. Do not use thermoplastic materials (plasticized PVC or polyurethane).

5. Select material suitable for use in waste with a fats, oil, and grease (FOG) concentration that typically varies between 50 and 150 mg/L.

6. Add carbon black to resist UV degradation.

B. Provide diffuser material that complies with the following:

1. Base polymer for EPDM: ASTM D573

2. UV resistance: carbon black

3. Specific gravity: 1.25 or less

4. Minimum durometer: 58% plus or minus 5% measured per ASTM D2240.

5. Modulus of elasticity: 500 psi per ASTM D412.

6. Ozone resistance: No cracks at two times magnification per ASTM D1171, Test A.

7. Tensile strength: 1,200 psi per ASTM D412.

8. Elongation:

a. 75% maximum retained after 70 hours at 100 degrees C per ASTM D573.

b. At least 350% at break per ASTM D412.

C. Test membrane both before and after the perforation process. Sampling and acceptance shall be in accordance with Military Standard 105E.

1. Before perforation:

a. Durometer.

b. Tensile strength.

c. Modulus of elasticity.

d. Specific gravity.

2. After perforation:
    a. DWP.
    b. Air flow uniformity.

D. Provide PVC insert with a suitable gasket to seal in the diffuser assembly.
    1. Size to plug the diffuser orifice.
    2. Use to remove selected diffusers from service.

E. Provide sufficient inserts for 10% of the available diffusers

2.08 ANCHOR BOLTS

A. Design anchor bolts for embedment in 4,000 psi concrete with a pullout safety factor of 4.

B. Provide a mechanical stainless steel, expansion-type anchor bolt system.

PART 3: EXECUTION

3.01 SHOP TESTING

A. Demonstrate ability of the aeration equipment to meet the specified oxygen transfer requirements.

B. Perform a minimum of three tests for each specified condition in accordance with the ASCE Clean Water Test Procedure.
    1. Have all tests certified and sealed by a registered professional engineer.
    2. The Owner may choose to witness the tests at the Owner's own expense.

C. Test requirements
    1. Test by independent aeration testing firm.
    2. Test in a full-scale aeration test tank with a minimum surface area of 200 square feet.
    3. Provide specified submergence and water depth.
    4. Provide diffuser density equivalent to the specified tank configuration. Diffuser density shall be the ratio of the total tank surface area to the total active diffuser surface area.
    5. Test at an air flow rate and oxygen mass transfer rate proportional to the ratio of the shop test tank volume and the design tank volume.
    6. Plot the pounds of oxygen transferred per day per 1,000 cubic feet of tank volume versus the air flow rate per 1,000 cubic feet of tank volume. Report the results in terms of tap water at 14.7 psia, 68 degrees F, and zero dissolved oxygen at the specified submergence.

D. Submit test results for approval before manufacturing the equipment.

3.02 INSTALLATION

A. Install the aeration system and appurtenances in accordance with the manufacturer's instructions and in accordance with the Contract Documents.

B. Level the aeration system such that all diffusers connected to a header are within plus or minus 0.25 inches of a common horizontal plane.

3.03 FIELD QUALITY CONTROL AND TESTING

A. Perform testing in accordance with Section 01650 and the following.

B. Mixing Test

1. Test one zone in each BNR Basin as selected by the Engineer.
    a. Sample four locations in the selected zone as determined by the Engineer.
    b. Collect a mixed liquor sample at approximately quarter depth and mid-depth.
    c. Collect sufficient sample for three total suspended solids (TSS) analyses at each sampling point.
2. The Owner shall analyze the samples for TSS in accordance with the current edition of "Standard Methods."
    a. Using the data recorded, compute the average mixed liquor suspended solids (MLSS) concentration.
    b. Measured MLSS concentrations shall not vary by more than 15% from the calculated average.
3. If results are unsatisfactory, modify the aeration system and retest until satisfactory results are obtained.

C. Pressure Test

1. Test one diffuser grid in each BNR Basin.
2. Fill the tank or channel to its normal operating depth.
3. Test and record the operating pressure at maximum air flow rates.
4. Measure pressure at the top of the air drop pipe for the diffuser grid being tested.
5. If the specified pressure is exceeded, modify the aeration system and retest until satisfactory results are obtained.

D. Installation and Operating Tests

1. Witnessed by manufacturer and Engineer.
2. Leakage test for air manifolds, distribution headers, and diffuser assemblies.
    a. Submerge pipes in clean water.
    b. Turn on air.

c. Observe piping joints at minimum and maximum air flow rates.

d. Correct leaks and retest until installed system is leak free.

3. Verify diffuser mounting elevation using one of the following techniques:

a. Engineer's level.

b. Laser level.

c. Filling the tank with clean water to the top of the diffusers.

d. All diffusers in a treatment zone shall be at the required elevation within plus or minus 0.25 inches.

4. Air distribution test

a. Fill tank with clean water to a depth of 1 foot above the top of the diffusers.

b. Operate system at average air flow rate.

E. Monitor air uniformity by visual inspection.

3.04 MANUFACTURER'S FIELD SERVICES

A. Provide manufacturer's field services in accordance with Section 01400 and the following:

1. Inspect the installation and make adjustments as necessary for proper operation.

2. Verify proper operation and correct equipment deficiencies during testing, in accordance with Section 01650.

B. Training

1. Provide a factory representative to instruct representatives of the Owner and Engineer.

2. Allow a minimum of 8 hours for instruction.

END OF SECTION

SECTION 11441

DIFFUSED AERATION EQUIPMENT – POST AERATION

PART 1: GENERAL

1.01 SCOPE

A. The Contractor shall provide and install diffused aeration equipment in Post Aeration Chambers 1 and 2.

B. Provide complete fine bubble diffused aeration systems with appurtenances as specified and as shown on the Contract Documents.

C. The diffused aeration system includes, but is not necessarily limited to, the following:

1. Stainless steel piping for "drop legs."
2. PVC air manifolds and distributors.
3. PVC diffuser holders and retainer rings.
4. Stainless steel supports and anchors.
5. Bolts, nuts, and gaskets for aeration system flange connections.
6. Air distributor purge systems.
7. Diffuser assemblies as required:
    a. Membrane fine bubble diffuser elements, diffuser holders, sealing gaskets or O-rings, air flow control orifices, and retaining devices.

D. Blank inserts that can be installed to remove diffusers from service. Provide sufficient inserts to take 10% of the diffusers out of service.

1.02 RELATED WORK

A. Electrical work, except as specified herein, is included in Division 16.

B. Section 01300 SUBMITTALS

C. Section 01400 QUALITY CONTROL

D. Section 01600 DELIVERY, STORAGE AND HANDLING

E. Section 01650 FACILITY START-UP AND TESTING

1.03 SUBMITTALS

A. Submit in accordance with Section 01300 SUBMITTALS, copies of all materials required to establish compliance with this Section. Submittals shall include at least the following:

1. Submittal drawings showing plan, elevation, and cross sections of the equipment as installed in each zone.

2. Number of diffusers in each zone.
3. Certified test data from a shop clean water performance test.
    a. Tests conducted by independent testing firm. In-house tests not acceptable.
    b. Demonstrate capacity of equipment to meet specified oxygen requirements.
        1) Conduct test with diffuser submergence and density within plus or minus 20% of that required by this project.
        2) Provide data from at least three test runs.
        3) Conduct tests per the ASCE Clean Water Test Procedure.
    c. Manufacturer may also use oxygen transfer test performed in the factory to demonstrate compliance with this specification.
        1) Meet same requirements specified above.
        2) Test in tank with at least 200 square feet of surface area to eliminate potential wall effects.
        3) Test at same submergence and diffuser density as required for this project.
4. Manufacturer's catalog information that includes the following:
    a. Material and manufacturing specifications.
    b. A complete bill of materials that identifies all materials of construction.
    c. Performance data.
    d. Descriptive literature and bulletins.
5. Design calculations.
    a. Demonstrate acceptable performance for specified operating conditions. Include:
        1) Oxygen transfer calculations.
        2) Head loss calculations and pressure requirements.
        3) Air distribution and balancing calculations within each treatment zone.
6. Certified installation drawings. Show:
    a. Important details of construction.
    b. Equipment dimensions.
    c. Size and location of anchor bolts.
    d. Locations of connections to other work.
7. Detailed list of exceptions to the specifications. Include:
    a. Specification reference.
    b. Proposed alternative.

c. Reason for the exception.

8. Special shipping, storing, protecting, and handling instructions.

9. A list of manufacturer's recommended parts, with current price information, required to maintain the equipment for a period of 1 year.

10. A list of special tools, materials, and supplies furnished with the equipment for use before and during start up, and for future maintenance.

11. Manufacturer's installation instructions

B. Submit operation and maintenance manuals in accordance with the General Conditions and Division 1. Include the following:

1. A list of manufacturer's recommended parts, with current price information, required to maintain the equipment for a period of 1 year.

2. A list of special tools, materials, and supplies furnished with the equipment for use before and during start up, and for future maintenance.

3. Manufacturer's installation instructions.

C. Submit Manufacturer's Certificate of Proper Installation per Section 01400.

1.04 REFERENCE STANDARDS

A. Comply with applicable standards including, but not limited to, the most recent editions of the following:

1. US EPA Fine Pore Design Manual (EPA/625/1-89/023)

2. WEF Manual of Practice FD-13

3. ASCE Clean Water Test Procedure.

4. ASTM A240: Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and General Application.

5. ASTM A 276: Standard Specification for Stainless Steel Bars and Shapes.

6. ASTM A380: Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems.

7. ASTM A 554: Standard Specification for Welded Stainless Steel Mechanical Tubing.

8. ASTM A774: Standard Specification for As-Welded Wrought Austenitic Stainless Steel Fittings for General Corrosive Service at Low and Moderate Temperatures.

9. ASTM A778: Standard Specification for Welded, Unannealed Austenitic Stainless Steel Tubular Products.

10. ASTM D412: Standard Test Method for Vulcanized Rubber and Thermoplastic Elastomers–Tension.

11. ASTM D573: Standard Test Method for Deterioration in an Air Oven.

12. ASTM D1171: Standard Test Method for Rubber Deterioration–Surface Ozone Cracking Outdoors or Chamber (Triangular Specimens).

13. ASTM D1784: Standard Test Method for Rigid Poly (Vinyl Chloride)(PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds.

14. ASTM D1785: Standard Test Method for Rigid Poly Vinyl Chloride (PVC) Plastic Pipe, Schedules 40, 80, 120.

15. ASTM D2240: Standard Test Method for Rubber Property–Durometer Hardness.

16. ASTM D2466: Standard Test Method for Rigid Poly Vinyl Chloride (PVC) Plastic Pipe Fittings, Schedule 40.

17. ASTM D3034: Standard Test Method for Type PSM Poly (Vinyl Chloride)(PVC) Sewer Pipe & Fittings.

18. ASTM D3915: Standard Test Method for Rigid Poly Vinyl Chloride (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds for Plastic Pipe and Fittings Used In Pressure Applications.

19. Military Standard 105E: Sampling Procedures and Tables for Inspection by Attributes

B. Where reference is made to a standard of one of the above, or other organizations, the version of the standard in effect at the time of bid opening shall apply.

1.05 QUALITY ASSURANCE

A. Comply with applicable portions of Section 01400.

B. Provide components that are the standard product of a manufacturer regularly engaged in the production of the required materials and equipment.

1. Provide all diffused aeration equipment, including appurtenances manufactured/supplied by a single manufacturer.

1.06 DELIVERY, STORAGE AND HANDLING

A. Provide in accordance manufacturers recommendations and with Section 01600 DELIVERY, STORAGE AND HANDLING.

B. Package PVC pipe and fittings on standard packing pallets or in standard packing crates and boxes.

1. Protect from dirt and dust.

2. Protect against the effects of UV light.

C. Store diffusers on or in their standard shipping pallets, crates, or boxes until ready for installation.

D. Store indoors rubber materials including, but not limited to, flexible membrane diffusers, O-rings, and gaskets.

1. Immerse items that have been crimped or bent in warm water to remove irregularities before installation.

2. Do not use components that cannot be restored to their original condition after this procedure.

E. Support PVC manifolds for their entire length to prevent warping.

1. Cover with waterproof, opaque material to protect from dirt and UV light.

2. Ventilate covered area.

F. Assemble items into components as large as practical in the factory to minimize field assembly.

G. Package and tag parts that are shipped unassembled to protect from damage and to facilitate final assembly in the field.

1.07 MAINTENANCE

A. Provide spare parts recommended by the manufacturer. At a minimum, provide the following spare parts for the Owner's inventory:

1. Ten of each type of air distributor and manifold support. Include anchor bolts.

2. One air distributor section of each type.

3. Fifteen air distributor repair couplings of each size.

4. Ten fixed joint assemblies.

5. Ten expansion fittings (tees and couplings).

6. Twenty diffuser elements and gaskets.

7. Twenty diffuser holder retainer rings.

8. Ten diffuser holders.

B. Furnish one complete set of special tools required to disassemble, service, repair, and adjust the equipment. Special tools are those that are not readily available through a commercial tool supplier such as Snap-On or Mac. Provide spare diffusers in a quantity equal to ten (10) percent of the total diffusers being installed.

1.08 WARRANTIES AND BONDS

A. The Contractor shall provide a warranty against defective or deficient materials and workmanship in accordance with the requirements of Section 01740 WARRANTIES AND BONDS.

B. The equipment manufacturer shall provide a warranty against defective or deficient equipment, workmanship and materials under normal use, operation and service. The warranty shall end one (1) year from the date of substantial completion. The warranty shall be in printed form and apply to all similar units.

PART 2: PRODUCTS

2.01 MANUFACTURERS

A. Sanitaire – A Brand of Xylem Water Solutions US.

B. Environmental Dynamics International

C. Or approved equal.

2.02 GENERAL

A. Provide a stainless steel drop leg from the air main connection to the drop leg connection on the manifold.

1. Use Van Stone-style flange with 150-pound bolt pattern for the top connection.

2. Use a band clamp coupling with gasket for the lower drop leg to manifold connection.

3. Provide air main supports to carry the full weight of the drop leg. Support to maintain a plumb position.

4. All metallic hardware, supports, straps, clamps, etc. shall be stainless steel.

B. Use PVC manifold to connect to the air distribution headers.

1. Use fixed threaded union or flanged joints to connect to the air distributors and to connect manifolds.

2. Design manifold, distributor connections, and supports for expansion and contraction.

a. Accommodate a temperature range of 130 degrees F.

b. Make joints air tight.

c. Provide for free and easy movement.

3. Provide at least two supports per manifold.

C. Provide air distributors perpendicular to the air manifold.

1. Solvent weld single diffuser holders to the crown of the air distributor.

2. Design distributors and holders to resist a 200-pound dead load applied vertically to the outer edge of the diffuser holder.

3. Provide removable end caps with gaskets, threaded couplings, and end plates at the end of each air distributor for use as a clean out.

4. Join air distributor sections with positive locking, fixed threaded union, or flange-type joints for all submerged header joints.

a. Do not use bell and spigot, slip on, or expansion-type joints.

b. Design threaded union joints as follows:

1) Connect spigot section to one end of the distribution header.

2) Connect threaded socket section to the mating distribution header.

3) Use an O-ring gasket and threaded screw on retainer ring.

4) Perform all solvent welding in the factory.

c. Design flanged joints with 125-pound drilling.

1) Use angle face ring.

2) Provide follower flange.

3) Use stainless steel hardware.

D. Use at least two supports for each manifold and air distributor section.

1. General

a. Maximum 8 foot spacing.

b. Accommodate thermal expansion and contraction. Design for minimum 130 degree F temperature range and minimize stress build up in the piping system.

c. Make supports adjustable without removing air distributor.

d. Design supports to be completely removable.

2. Manifold supports (6-inch-diameter and larger)

a. Include hold down guide straps, support structure, and anchor bolts.

b. Use minimum 2-inch-wide guide straps.

c. Provide at least 2 inches of vertical adjustment for leveling.

d. Use at least two stainless steel anchor bolts to attach to the floor.

3. Air distributor and manifold supports (4 inches in diameter)

a. Provide guide and fixed supports to accommodate expansion and contraction.

b. Include hold down guide straps, support structure, and anchor bolts.

c. Provide approximately 1.5 inches of vertical adjustment for leveling.

1) Account for floor slopes, if any.

2) Level to plus or minus 0.25 inches.

d. Guide supports

1) 1.5 inches wide (top and bottom)

2) Contoured bearing surface with chamfered edges.

3) Provide 0.125-inch clearance around distributor.

e. Fixed supports

1) 1.5 inches wide (top and bottom)

2) Contoured bearing surface with punched burrs to positively grip the air distributor when tightened.

3) Design strap to be self limiting to prevent stressing the distributor if over tightened.

f. Use one stainless steel anchor bolt to attach to the floor.

E. Diffuser assemblies

1. Include diffuser, diffuser gasket, holder, retaining ring, and air flow control orifice.

2. Provide uniform air distribution based on visual observations at specified scfm per diffuser and 2 inches submergence.

3. Membrane diffuser

a. Include integral check valve.

b. Design and test for dynamic wet pressure (DWP) of 12 inches water column plus or minus 20% at 1.0 scfm per diffuser and 2 inches submergence.

c. Test diffusers using sampling criteria per Military Standard 105E.

d. Provide PVC support plate to support the membrane when air is off and form an air plenum when air is flowing.

4. Diffuser holder and retainer rings

a. Provide air flow control orifice and plenum chamber below the diffuser.

b. Design holder to provide peripheral support for the diffuser.

c. Design retainer ring to seal the diffuser and O-ring in the holder and prevent air leakage around the gasket.

d. Design retainer ring threads with minimum cross section of 1/8 inch and allow for one complete turn to engage threads.

e. Diffuser holders shall be interchangeable with membrane and ceramic disc diffusers.

F. Provide a liquid purge system to drain the entire submerged aeration piping system for each aeration grid. Include an airlift purge eductor line and a control valve.

G. Diffuser Pressure Monitoring System: Provide monitoring equipment to measure the DWP and operating air flow rate of a typical diffuser in each aeration grid.

1. Furnish one portable monitoring panel in a NEMA 4X fiberglass enclosure with stainless steel handrail bracket.

2. Provide monitoring panel with differential pressure gauges (orifice and diffuser), PVC ball valves, quick disconnect couplings, and one set of calibration curves.

3. Furnish one NEMA 4X stainless steel connecting box with handrail mounting brackets and carrier column assembly per grid. Include connections to measure air distributor pressure, flow control orifice differential pressure, and diffuser element operating differential pressure (DWP).

2.03 SERVICE AND DESIGN CONDITIONS

A. Aeration Zone Dimensions: Post Aeration consists of two Chambers (Chamber 1 and 2) and each chamber consists of 1 zone for aeration. The nominal dimensions

of each zone in each Chamber is tabulated below. Exact dimensions are shown on the drawings.

Chamber	Zone	Length	Width	SWD
Post Aeration Chamber 1	One	40’	15’	16.25’
Post Aeration Chamber 2	One	40’	15’	16.25’

B. Site Ambient Conditions

1. Temperature (maximum): 100^{o} F
2. Temperature (minimum): 20^{o} F
3. Relative humidity: 45% to 90%
4. Altitude at site: Approximately 968 feet above sea level

C. Standard Actual Oxygen Requirement (SOR): The maximum SOR for each chamber shall be as follows. Determine SOTRs (standard oxygen transfer rates) and provide a diffuser system capable of satisfying the SORs in accordance with the process and field conditions specified herein.

Chamber/Zone	Maximum SOR (lb/day)	Maximum SCFM	Minimum SCFM	Minimum No. Diffusers
Post Aeration Chamber 1	1,450	185	60	120
Post Aeration Chamber 2	1,450	185	60	120

D. Process Conditions

1. Alpha Factor: 0.5
2. Beta Factor: 0.98
3. Theta Factor: 1.024

E. Effluent Temperatures:

1. 70 degrees F maximum
2. 55 degrees F minimum

F. Residual dissolved oxygen concentration for chamber/zone is 6.0 mg/L

G. Diffuser Air Flow Rate

1. The maximum allowable air flow rate per diffuser shall be 4.0 scfm.

H. Mixing Levels

1. The minimum mixing requirement shall be 0.12 scfm/ft^2 of tank floor based on WEF Manual of Practice No 8.

I. Transfer Efficiencies

1. Design the aeration system to achieve minimum standard oxygen transfer efficiencies (SOTE) of 2% per foot of submergence. The most severe conditions are defined as the maximum oxygen demand, the minimum residual dissolved oxygen concentration, the maximum ambient temperatures, the maximum mixed liquor temperature, and the maximum submergence depth.

J. Piping/Diffuser Arrangement

1. Maximum system pressure at maximum air flow at top of droplegs shall be 7.25 psi.

2. Diffuser mounting height above high point of tank floor shall not exceed 12 inches.

3. The diffuser diameter shall be 9.0 inches.

K. Pressure Drop

1. The maximum allowable pressure drop through each diffuser and orifice control in a clean condition at design operating depth shall not exceed the following values at the airflow rates designated below:

Diffuser Airflow Rate (scfm)	Pressure Drop (inches of water)
1.0	9
2.0	14
3.0	21
4.0	32

2. The aeration system shall be designed and air lateral orifices sized so that at minimum and maximum airflows, the airflow rate output of any two diffusers in the systems shall not differ by more than 10% (based on the diffuser with the lower flow rate). The distribution and balancing of air shall be controlled by the use of orifices and proper header size selection only. The use of flow distribution control devices requiring automatic and/or manual operation shall not be acceptable.

3. The fine bubble aeration equipment shall be capable of maintaining its structural integrity and location within the aeration basin under a variety of process conditions, including basin filling, dewatering, cleaning, and a dewatered condition.

2.04 STAINLESS STEEL PIPE, FITTINGS, AND SUPPORTS

A. Fabricate welded parts and assemblies from sheets and plates of 304L stainless steel.

1. Provide 2D finish.

2. Conform to ASTM A240, ASTM A554, ASTM A774, and ASTM A778.

B. Fabricate non-welded parts and flanges from sheets, plates, or bars of Type 304 stainless steel. Conform to ASTM A 240 or ASTM A276.

C. Welding

1. Weld in the factory.

2. Use MIG, TIG or plasma-arc inert gas process with ER 316L filler wire.

3. Provide a cross section equal to or greater than the parent metal.

D. Provide full penetration butt welds to the interior surface with gas shielding of interior and exterior of the joint.

E. Continuously weld both sides of the face rings and flanges.

1. Corrosion protection and finishing.

2. Clean all welded stainless steel surfaces and welds after fabrication.

a. Remove weld splatter using stainless steel brushes or deburring and finish grinding wheels.

b. Provide full immersion pickling.

3. Rinse with water.

4. Regenerate a uniform corrosion resistant chromium oxide film per ASTM A380, Section 6.2.11, and Section 8.3.

F. Corrosion protection that does not use full immersion is unacceptable.

2.05 NATURAL RUBBER

A. Use natural rubber/SBR (Styrene butadiene rubber) for all fixed and expansion joint O-ring gaskets.

B. Provide Shore A durometer of 45 plus or minus 5.

C. Provide expansion joints manufactured by Hyspan (1501 Fixed Flange type) or equal.

2.06 POLYVINYL CHLORIDE (PVC) PIPE AND FITTINGS

A. Manufacture from PVC compound with a minimum 7,000 psi tensile strength.

1. Add minimum of 2 parts titanium dioxide per 100 parts of resin to protect against UV degradation.

2. Solvent weld all joints in the factory.

a. Field solvent welding is not permitted unless approved in writing by the Engineer.

b. Field solvent welding may be allowed if shipment of assembled PVC pieces could result in damage.

3. Design to withstand mean wall temperature of at least 125 degrees F.

B. Design

1. Use SDR 33.5 for 4-inch-diameter pipe and fittings. Conform to ASTM D3915 and ASTM D3034.

2. Use Schedule 40 for 6-inch-diameter and larger pipe and fittings. Conform to ASTM D1784, ASTM D1785, and ASTM D2466.

2.07 MEMBRANE DIFFUSERS AND GASKETS

A. Manufacture circular membrane discs with integral O-ring of EPDM synthetic rubber compound.

1. Provide precision, die-formed slits.

2. Design as one piece, injection molded part without tears, voids, bubbles, creases, or other structural defects.

3. Use sufficient thickness to limit tensile stress to 10 psi when operating at 2.4 scfm/ft^2 of material.

4. Do not use thermoplastic materials (plasticized PVC or polyurethane).

5. Select material suitable for use in waste with a fats, oil, and grease (FOG) concentration that typically varies between 50 and 150 mg/L.

6. Add carbon black to resist UV degradation.

B. Provide diffuser material that complies with the following:

1. Base polymer for EPDM: ASTM D573

2. UV resistance: carbon black

3. Specific gravity: 1.25 or less

4. Minimum durometer: 58% plus or minus 5% measured per ASTM D2240.

5. Modulus of elasticity: 500 psi per ASTM D412.

6. Ozone resistance: No cracks at two times magnification per ASTM D1171, Test A.

7. Tensile strength: 1,200 psi per ASTM D412.

8. Elongation:

a. 75% maximum retained after 70 hours at 100 degrees C per ASTM D573.

b. At least 350% at break per ASTM D412.

C. Test membrane both before and after the perforation process. Sampling and acceptance shall be in accordance with Military Standard 105E.

1. Before perforation:
    a. Durometer.
    b. Tensile strength.
    c. Modulus of elasticity.
    d. Specific gravity.
2. After perforation:
    a. DWP.
    b. Air flow uniformity.

D. Provide PVC insert with a suitable gasket to seal in the diffuser assembly.

1. Size to plug the diffuser orifice.
2. Use to remove selected diffusers from service.

E. Provide sufficient inserts for 10% of the available diffusers

2.08 ANCHOR BOLTS

A. Design anchor bolts for embedment in 4,000 psi concrete with a pullout safety factor of 4.

B. Provide a mechanical stainless steel, expansion-type anchor bolt system.

PART 3: EXECUTION

3.01 SHOP TESTING

A. Demonstrate ability of the aeration equipment to meet the specified oxygen transfer requirements.

B. Perform a minimum of three tests for each specified condition in accordance with the ASCE Clean Water Test Procedure.

1. Have all tests certified and sealed by a registered professional engineer.
2. The Owner may choose to witness the tests at the Owner’s own expense.

C. Test requirements

1. Test by independent aeration testing firm.
2. Test in a full-scale aeration test tank with a minimum surface area of 200 square feet.
3. Provide specified submergence and water depth.
4. Provide diffuser density equivalent to the specified tank configuration. Diffuser density shall be the ratio of the total tank surface area to the total active diffuser surface area.

5. Test at an air flow rate and oxygen mass transfer rate proportional to the ratio of the shop test tank volume and the design tank volume.

6. Plot the pounds of oxygen transferred per day per 1,000 cubic feet of tank volume versus the air flow rate per 1,000 cubic feet of tank volume. Report the results in terms of tap water at 14.7 psia, 68 degrees F, and zero dissolved oxygen at the specified submergence.

D. Submit test results for approval before manufacturing the equipment.

3.02 INSTALLATION

A. Install the aeration system and appurtenances in accordance with the manufacturer's instructions and in accordance with the Contract Documents.

B. Level the aeration system such that all diffusers connected to a header are within plus or minus 0.25 inches of a common horizontal plane.

3.03 FIELD QUALITY CONTROL AND TESTING

A. Perform testing in accordance with Section 01650 and the following.

B. Pressure Test

1. Test one diffuser grid in each Chamber.

2. Fill the tank or channel to its normal operating depth.

3. Test and record the operating pressure at maximum air flow rates.

4. Measure pressure at the top of the air drop pipe for the diffuser grid being tested.

5. If the specified pressure is exceeded, modify the aeration system and retest until satisfactory results are obtained.

C. Installation and Operating Tests

1. Witnessed by manufacturer and Engineer.

2. Leakage test for air manifolds, distribution headers, and diffuser assemblies.

a. Submerge pipes in clean water.

b. Turn on air.

c. Observe piping joints at minimum and maximum air flow rates.

d. Correct leaks and retest until installed system is leak free.

3. Verify diffuser mounting elevation using one of the following techniques:

a. Engineer's level.

b. Laser level.

c. Filling the tank with clean water to the top of the diffusers.

d. All diffusers in a treatment zone shall be at the required elevation within plus or minus 0.25 inches.

4. Air distribution test
    a. Fill tank with clean water to a depth of 1 foot above the top of the diffusers.
    b. Operate system at average air flow rate.

D. Monitor air uniformity by visual inspection.

3.04 MANUFACTURER'S FIELD SERVICES

A. Provide manufacturer's field services in accordance with Section 01400 and the following:

1. Inspect the installation and make adjustments as necessary for proper operation.

2. Verify proper operation and correct equipment deficiencies during testing, in accordance with Section 01650.

B. Training

1. Provide a factory representative to instruct representatives of the Owner and Engineer.

2. Allow a minimum of 8 hours for instruction.

END OF SECTION

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SECTION 11442

DIFFUSED AERATION EQUIPMENT – AEROBIC DIGESTERS

PART 1: GENERAL

1.01 SCOPE

A. The Contractor shall provide and install diffused aeration equipment in Aerobic Digesters 1 and 2.

B. Mixing for Aerobic Digesters 1 and 2 will be provided by the compressed air as specified in Section 11220 Compressed Air Mixing System.

C. Provide complete fine bubble diffused aeration systems with appurtenances as specified and as shown on the Contract Documents.

D. The diffused aeration system includes, but is not necessarily limited to, the following:

1. Stainless steel piping for "drop legs."
2. PVC air manifolds and distributors.
3. PVC diffuser holders and retainer rings.
4. Stainless steel supports and anchors.
5. Bolts, nuts, and gaskets for aeration system flange connections.
6. Air distributor purge systems.
7. Diffuser assemblies as required:
    a. Membrane fine bubble diffuser elements, diffuser holders, sealing gaskets or O-rings, air flow control orifices, and retaining devices.

E. Blank inserts that can be installed to remove diffusers from service. Provide sufficient inserts to take 10% of the diffusers out of service.

1.02 RELATED WORK

A. Electrical work, except as specified herein, is included in Division 16.

B. Section 01300 SUBMITTALS

C. Section 01400 QUALITY CONTROL

D. Section 01600 DELIVERY, STORAGE AND HANDLING

E. Section 01650 FACILITY START-UP AND TESTING

F. Section 11220 COMPRESSED AIR MIXING SYSTEM

1.03 SUBMITTALS

A. Submit in accordance with Section 01300 SUBMITTALS, copies of all materials required to establish compliance with this Section. Submittals shall include at least the following:

1. Submittal drawings showing plan, elevation, and cross sections of the equipment as installed in each zone.

2. Number of diffusers in each zone.

3. Certified test data from a shop clean water performance test.

a. Tests conducted by independent testing firm. In-house tests not acceptable.

b. Demonstrate capacity of equipment to meet specified oxygen requirements.

1) Conduct test with diffuser submergence and density within plus or minus 20% of that required by this project.

2) Provide data from at least three test runs.

3) Conduct tests per the ASCE Clean Water Test Procedure.

c. Manufacturer may also use oxygen transfer test performed in the factory to demonstrate compliance with this specification.

1) Meet same requirements specified above.

2) Test in tank with at least 200 square feet of surface area to eliminate potential wall effects.

3) Test at same submergence and diffuser density as required for this project.

4. Manufacturer’s catalog information that includes the following:

a. Material and manufacturing specifications.

b. A complete bill of materials that identifies all materials of construction.

c. Performance data.

d. Descriptive literature and bulletins.

5. Design calculations.

a. Demonstrate acceptable performance for specified operating conditions. Include:

1) Oxygen transfer calculations.

2) Head loss calculations and pressure requirements.

3) Air distribution and balancing calculations within each treatment zone.

6. Certified installation drawings. Show:

a. Important details of construction.

b. Equipment dimensions.

c. Size and location of anchor bolts.

d. Locations of connections to other work.

7. Detailed list of exceptions to the specifications. Include:

a. Specification reference.

b. Proposed alternative.

c. Reason for the exception.

8. Special shipping, storing, protecting, and handling instructions.

9. A list of manufacturer's recommended parts, with current price information, required to maintain the equipment for a period of 1 year.

10. A list of special tools, materials, and supplies furnished with the equipment for use before and during start up, and for future maintenance.

11. Manufacturer's installation instructions

B. Submit operation and maintenance manuals in accordance with the General Conditions and Division 1. Include the following:

1. A list of manufacturer's recommended parts, with current price information, required to maintain the equipment for a period of 1 year.

2. A list of special tools, materials, and supplies furnished with the equipment for use before and during start up, and for future maintenance.

3. Manufacturer's installation instructions.

C. Submit Manufacturer's Certificate of Proper Installation per Section 01400.

1.04 REFERENCE STANDARDS

A. Comply with applicable standards including, but not limited to, the most recent editions of the following:

1. US EPA Fine Pore Design Manual (EPA/625/1-89/023)

2. WEF Manual of Practice FD-13

3. ASCE Clean Water Test Procedure.

4. ASTM A240: Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and General Application.

5. ASTM A 276: Standard Specification for Stainless Steel Bars and Shapes.

6. ASTM A380: Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems.

7. ASTM A 554: Standard Specification for Welded Stainless Steel Mechanical Tubing.

8. ASTM A774: Standard Specification for As-Welded Wrought Austenitic Stainless Steel Fittings for General Corrosive Service at Low and Moderate Temperatures.

9. ASTM A778: Standard Specification for Welded, Unannealed Austenitic Stainless Steel Tubular Products.

10. ASTM D412: Standard Test Method for Vulcanized Rubber and Thermoplastic Elastomers–Tension.

11. ASTM D573: Standard Test Method for Deterioration in an Air Oven.

12. ASTM D1171: Standard Test Method for Rubber Deterioration–Surface Ozone Cracking Outdoors or Chamber (Triangular Specimens).

13. ASTM D1784: Standard Test Method for Rigid Poly (Vinyl Chloride)(PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds.

14. ASTM D1785: Standard Test Method for Rigid Poly Vinyl Chloride (PVC) Plastic Pipe, Schedules 40, 80, 120.

15. ASTM D2240: Standard Test Method for Rubber Property–Durometer Hardness.

16. ASTM D2466: Standard Test Method for Rigid Poly Vinyl Chloride (PVC) Plastic Pipe Fittings, Schedule 40.

17. ASTM D3034: Standard Test Method for Type PSM Poly (Vinyl Chloride)(PVC) Sewer Pipe & Fittings.

18. ASTM D3915: Standard Test Method for Rigid Poly Vinyl Chloride (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds for Plastic Pipe and Fittings Used In Pressure Applications.

19. Military Standard 105E: Sampling Procedures and Tables for Inspection by Attributes

B. Where reference is made to a standard of one of the above, or other organizations, the version of the standard in effect at the time of bid opening shall apply.

1.05 QUALITY ASSURANCE

A. Comply with applicable portions of Section 01400.

B. Provide components that are the standard product of a manufacturer regularly engaged in the production of the required materials and equipment.

1. Provide all diffused aeration equipment, including appurtenances manufactured/supplied by a single manufacturer.

1.06 DELIVERY, STORAGE AND HANDLING

A. Provide in accordance manufacturers recommendations and with Section 01600 DELIVERY, STORAGE AND HANDLING.

B. Package PVC pipe and fittings on standard packing pallets or in standard packing crates and boxes.

1. Protect from dirt and dust.

2. Protect against the effects of UV light.

C. Store diffusers on or in their standard shipping pallets, crates, or boxes until ready for installation.

D. Store indoors rubber materials including, but not limited to, flexible membrane diffusers, O-rings, and gaskets.

1. Immerse items that have been crimped or bent in warm water to remove irregularities before installation.

2. Do not use components that cannot be restored to their original condition after this procedure.

E. Support PVC manifolds for their entire length to prevent warping.

1. Cover with waterproof, opaque material to protect from dirt and UV light.

2. Ventilate covered area.

F. Assemble items into components as large as practical in the factory to minimize field assembly.

G. Package and tag parts that are shipped unassembled to protect from damage and to facilitate final assembly in the field.

1.07 MAINTENANCE

A. Provide spare parts recommended by the manufacturer. At a minimum, provide the following spare parts for the Owner's inventory:

1. Ten of each type of air distributor and manifold support. Include anchor bolts.

2. One air distributor section of each type.

3. Fifteen air distributor repair couplings of each size.

4. Ten fixed joint assemblies.

5. Ten expansion fittings (tees and couplings).

6. Twenty diffuser elements and gaskets.

7. Twenty diffuser holder retainer rings.

8. Ten diffuser holders.

B. Furnish one complete set of special tools required to disassemble, service, repair, and adjust the equipment. Special tools are those that are not readily available through a commercial tool supplier such as Snap-On or Mac. Provide spare diffusers in a quantity equal to ten (10) percent of the total diffusers being installed.

1.08 WARRANTIES AND BONDS

A. The Contractor shall provide a warranty against defective or deficient materials and workmanship in accordance with the requirements of Section 01740 WARRANTIES AND BONDS.

B. The equipment manufacturer shall provide a warranty against defective or deficient equipment, workmanship and materials under normal use, operation and service. The warranty shall end one (1) year from the date of substantial completion. The warranty shall be in printed form and apply to all similar units.

PART 2: PRODUCTS

2.01 MANUFACTURERS

A. Sanitaire – A Brand of Xylem Water Solutions US.

B. Environmental Dynamics International

C. Or approved equal.

2.02 GENERAL

A. Provide a stainless steel drop leg from the air main connection to the drop leg connection on the manifold.

1. Use Van Stone-style flange with 150-pound bolt pattern for the top connection.
2. Use a band clamp coupling with gasket for the lower drop leg to manifold connection.
3. Provide air main supports to carry the full weight of the drop leg. Support to maintain a plumb position.
4. All metallic hardware, supports, straps, clamps, etc. shall be stainless steel.

B. Use PVC manifold to connect to the air distribution headers.

1. Use fixed threaded union or flanged joints to connect to the air distributors and to connect manifolds.
2. Design manifold, distributor connections, and supports for expansion and contraction.
    a. Accommodate a temperature range of 130 degrees F.
    b. Make joints airtight.
    c. Provide for free and easy movement.
3. Provide at least two supports per manifold.

C. Provide air distributors perpendicular to the air manifold.

1. Solvent weld single diffuser holders to the crown of the air distributor.
2. Design distributors and holders to resist a 200-pound dead load applied vertically to the outer edge of the diffuser holder.
3. Provide removable end caps with gaskets, threaded couplings, and end plates at the end of each air distributor for use as a clean out.
4. Join air distributor sections with positive locking, fixed threaded union, or flange-type joints for all submerged header joints.

a. Do not use bell and spigot, slip on, or expansion-type joints.

b. Design threaded union joints as follows:

1) Connect spigot section to one end of the distribution header.

2) Connect threaded socket section to the mating distribution header.

3) Use an O-ring gasket and threaded screw on retainer ring.

4) Perform all solvent welding in the factory.

c. Design flanged joints with 125-pound drilling.

1) Use angle face ring.

2) Provide follower flange.

3) Use stainless steel hardware.

D. Use at least two supports for each manifold and air distributor section.

1. General

a. Maximum 8 foot spacing.

b. Accommodate thermal expansion and contraction. Design for minimum 130 degree F temperature range and minimize stress build up in the piping system.

c. Make supports adjustable without removing air distributor.

d. Design supports to be completely removable.

2. Manifold supports (6-inch-diameter and larger)

a. Include hold down guide straps, support structure, and anchor bolts.

b. Use minimum 2-inch-wide guide straps.

c. Provide at least 2 inches of vertical adjustment for leveling.

d. Use at least two stainless steel anchor bolts to attach to the floor.

3. Air distributor and manifold supports (4 inches in diameter)

a. Provide guide and fixed supports to accommodate expansion and contraction.

b. Include hold down guide straps, support structure, and anchor bolts.

c. Provide approximately 1.5 inches of vertical adjustment for leveling.

1) Account for floor slopes, if any.

2) Level to plus or minus 0.25 inches.

d. Guide supports

1) 1.5 inches wide (top and bottom)

2) Contoured bearing surface with chamfered edges.

3) Provide 0.125-inch clearance around distributor.

e. Fixed supports

1) 1.5 inches wide (top and bottom)

2) Contoured bearing surface with punched burrs to positively grip the air distributor when tightened.

3) Design strap to be self-limiting to prevent stressing the distributor if over tightened.

f. Use one stainless steel anchor bolt to attach to the floor.

E. Diffuser assemblies

1. Include diffuser, diffuser gasket, holder, retaining ring, and air flow control orifice.

2. Provide uniform air distribution based on visual observations at specified scfm per diffuser and 2 inches submergence.

3. Membrane diffuser

a. Include integral check valve.

b. Design and test for dynamic wet pressure (DWP) of 12 inches water column plus or minus 20% at 1.0 scfm per diffuser and 2 inches submergence.

c. Test diffusers using sampling criteria per Military Standard 105E.

d. Provide PVC support plate to support the membrane when air is off and form an air plenum when air is flowing.

4. Diffuser holder and retainer rings

a. Provide air flow control orifice and plenum chamber below the diffuser.

b. Design holder to provide peripheral support for the diffuser.

c. Design retainer ring to seal the diffuser and O-ring in the holder and prevent air leakage around the gasket.

d. Design retainer ring threads with minimum cross section of 1/8 inch and allow for one complete turn to engage threads.

e. Diffuser holders shall be interchangeable with membrane and ceramic disc diffusers.

F. Provide a liquid purge system to drain the entire submerged aeration piping system for each aeration grid. Include an airlift purge eductor line and a control valve.

G. Diffuser Pressure Monitoring System: Provide monitoring equipment to measure the DWP and operating air flow rate of a typical diffuser in each aeration grid.

1. Furnish one portable monitoring panel in a NEMA 4X fiberglass enclosure with stainless steel handrail bracket.

2. Provide monitoring panel with differential pressure gauges (orifice and diffuser), PVC ball valves, quick disconnect couplings, and one set of calibration curves.

3. Furnish one NEMA 4X stainless steel connecting box with handrail mounting brackets and carrier column assembly per grid. Include connections to measure air distributor pressure, flow control orifice differential pressure, and diffuser element operating differential pressure (DWP).

2.03 SERVICE AND DESIGN CONDITIONS

A. Aeration Zone Dimensions: Aerobic Digesters are each divided into two grids. Exact dimensions are shown on the drawings.

Zone	Length	Width	SWD	Minimum Diffusers /Grid
Aerobic Digester (Each)				
Grid 1	81’	46’	16.5’	1,110
Grid 2	81’	46’	16.5’	1,110
Total/Digester				2,220

B. Site Ambient Conditions

1. Temperature (maximum): 100^{o} F
2. Temperature (minimum): 20^{o} F
3. Relative humidity: 45% to 90%
4. Altitude at site: Approximately 868 feet above sea level

C. Actual Oxygen Requirement (AOR): The AOR for each zone shall be as follows.

Grid	AOR (lb/day)	SCFM
Aerobic Digester (Each)		
Grid 1	2,166	2,109
Grid 2	2.166	2,109
Total/Digester	8,664	4,218

D. Process Conditions

1. Alpha Factor: 0.15
2. Beta Factor: 0.98
3. Theta Factor: 1.024

E. Mixed Liquor Temperatures and Solids Concentration:

1. 70 degrees F maximum
2. 55 degrees F minimum

3. Solids concentration range: 20,000 mg/L to 50,000 mg/L

F. Residual dissolved oxygen concentration for each zone is 1.0 mg/L

G. Diffuser Air Flow Rate

1. The maximum allowable air flow rate per diffuser shall be 1.34 scfm.

H. Mixing Levels

1. Mixing for Aerobic Digesters 1 and 2 will be provided by the compressed air mixing system as specified in Section 11220 Compressed Air Mixing System.

I. Transfer Efficiencies

1. Design the aeration system to achieve minimum standard oxygen transfer efficiencies (SOTE) of 2.0% per foot of submergence. The most severe conditions are defined as the maximum oxygen demand, the minimum residual dissolved oxygen concentration, the maximum ambient temperatures, the maximum mixed liquor temperature, and the maximum submergence depth.

J. Piping/Diffuser Arrangement

1. Maximum system pressure at maximum air flow at top of droplegs shall be 7.02 psi.

2. Diffuser mounting height above high point of tank floor shall not exceed 12 inches.

3. The diffuser diameter shall be 9.0 inches.

K. Pressure Drop

1. The maximum allowable pressure drop through each diffuser and orifice control in a clean condition at design operating depth shall not exceed the following values at the airflow rates designated below:

Diffuser Airflow Rate (scfm)	Pressure Drop (inches of water)
1.0	15
2.0	20
3.0	29
4.0	40

2. The aeration system shall be designed and air lateral orifices sized so that at design airflows, the airflow rate output of any two diffusers in the systems shall not differ by more than 10% (based on the diffuser with the lower flow rate). The distribution and balancing of air shall be controlled by the use of orifices and proper header size selection only. The use of flow distribution control devices requiring automatic and/or manual operation shall not be acceptable.

3. The fine bubble aeration equipment shall be capable of maintaining its structural integrity and location within the digesters under a variety of process

conditions, including tank filling, dewatering, cleaning, and a dewatered condition.

2.04 STAINLESS STEEL PIPE, FITTINGS, AND SUPPORTS

A. Fabricate welded parts and assemblies from sheets and plates of 304L stainless steel.

1. Provide 2D finish.

2. Conform to ASTM A240, ASTM A554, ASTM A774, and ASTM A778.

B. Fabricate non-welded parts and flanges from sheets, plates, or bars of Type 304 stainless steel. Conform to ASTM A 240 or ASTM A276.

C. Welding

1. Weld in the factory.

2. Use MIG, TIG or plasma-arc inert gas process with ER 316L filler wire.

3. Provide a cross section equal to or greater than the parent metal.

D. Provide full penetration butt welds to the interior surface with gas shielding of interior and exterior of the joint.

E. Continuously weld both sides of the face rings and flanges.

1. Corrosion protection and finishing.

2. Clean all welded stainless steel surfaces and welds after fabrication.

a. Remove weld splatter using stainless steel brushes or deburring and finish grinding wheels.

b. Provide full immersion pickling.

3. Rinse with water.

4. Regenerate a uniform corrosion resistant chromium oxide film per ASTM A380, Section 6.2.11, and Section 8.3.

F. Corrosion protection that does not use full immersion is unacceptable.

2.05 NATURAL RUBBER

A. Use natural rubber/SBR (Styrene butadiene rubber) for all fixed and expansion joint O-ring gaskets.

B. Provide Shore A durometer of 45 plus or minus 5.

C. Provide expansion joints manufactured by Hyspan (1501 Fixed Flange type) or equal.

2.06 POLYVINYL CHLORIDE (PVC) PIPE AND FITTINGS

A. Manufacture from PVC compound with a minimum 7,000 psi tensile strength.

1. Add minimum of 2 parts titanium dioxide per 100 parts of resin to protect against UV degradation.

2. Solvent weld all joints in the factory.
    a. Field solvent welding is not permitted unless approved in writing by the Engineer.
    b. Field solvent welding may be allowed if shipment of assembled PVC pieces could result in damage.
3. Design to withstand mean wall temperature of at least 125 degrees F.

B. Design

1. Use SDR 24.5 for 4-inch-diameter pipe and fittings. Conform to ASTM D3915 and ASTM D3034.
2. Use Schedule 40 for 6-inch-diameter and larger pipe and fittings. Conform to ASTM D1784, ASTM D1785, and ASTM D2466.

2.07 MEMBRANE DIFFUSERS AND GASKETS

A. Manufacture circular membrane discs with integral O-ring of EPDM synthetic rubber compound.

1. Provide precision, die-formed slits.
2. Design as one piece, injection molded part without tears, voids, bubbles, creases, or other structural defects.
3. Use sufficient thickness to limit tensile stress to 10 psi when operating at 2.4 scfm/ft^2 of material.
4. Do not use thermoplastic materials (plasticized PVC or polyurethane).
5. Select material suitable for use in waste with a fats, oil, and grease (FOG) concentration that typically varies between 50 and 150 mg/L.
6. Add carbon black to resist UV degradation.

B. Provide diffuser material that complies with the following:

1. Base polymer for EPDM: ASTM D573
2. UV resistance: carbon black
3. Specific gravity: 1.25 or less
4. Minimum durometer: 58% plus or minus 5% measured per ASTM D2240.
5. Modulus of elasticity: 500 psi per ASTM D412.
6. Ozone resistance: No cracks at two times magnification per ASTM D1171, Test A.
7. Tensile strength: 1,200 psi per ASTM D412.
8. Elongation:
    a. 75% maximum retained after 70 hours at 100 degrees C per ASTM D573.
    b. At least 350% at break per ASTM D412.

C. Test membrane both before and after the perforation process. Sampling and acceptance shall be in accordance with Military Standard 105E.

1. Before perforation:
    a. Durometer.
    b. Tensile strength.
    c. Modulus of elasticity.
    d. Specific gravity.
2. After perforation:
    a. DWP.
    b. Air flow uniformity.

D. Provide PVC insert with a suitable gasket to seal in the diffuser assembly.

1. Size to plug the diffuser orifice.
2. Use to remove selected diffusers from service.

E. Provide sufficient inserts for 10% of the available diffusers

2.08 ANCHOR BOLTS

A. Design anchor bolts for embedment in 4,000 psi concrete with a pullout safety factor of 4.

B. Provide a mechanical stainless steel, expansion-type anchor bolt system.

PART 3: EXECUTION

3.01 SHOP TESTING

A. Demonstrate ability of the aeration equipment to meet the specified oxygen transfer requirements.

B. Perform a minimum of three tests for each specified condition in accordance with the ASCE Clean Water Test Procedure.

1. Have all tests certified and sealed by a registered professional engineer.
2. The Owner may choose to witness the tests at the Owner’s own expense.

C. Test requirements

1. Test by independent aeration testing firm.
2. Test in a full-scale aeration test tank with a minimum surface area of 200 square feet.
3. Provide specified submergence and water depth.
4. Provide diffuser density equivalent to the specified tank configuration. Diffuser density shall be the ratio of the total tank surface area to the total active diffuser surface area.

5. Test at an air flow rate and oxygen mass transfer rate proportional to the ratio of the shop test tank volume and the design tank volume.

6. Plot the pounds of oxygen transferred per day per 1,000 cubic feet of tank volume versus the air flow rate per 1,000 cubic feet of tank volume. Report the results in terms of tap water at 14.7 psia, 68 degrees F, and zero dissolved oxygen at the specified submergence.

D. Submit test results for approval before manufacturing the equipment.

3.02 INSTALLATION

A. Install the aeration system and appurtenances in accordance with the manufacturer's instructions and in accordance with the Contract Documents.

B. Level the aeration system such that all diffusers connected to a header are within plus or minus 0.25 inches of a common horizontal plane.

3.03 FIELD QUALITY CONTROL AND TESTING

A. Perform testing in accordance with Section 01650 and the following.

B. Pressure Test

1. Test one diffuser grid in each Aerobic Digester.

2. Fill the tank or channel to its normal operating depth.

3. Test and record the operating pressure at maximum air flow rates.

4. Measure pressure at the top of the air drop pipe for the diffuser grid being tested.

5. If the specified pressure is exceeded, modify the aeration system and retest until satisfactory results are obtained.

C. Installation and Operating Tests

1. Witnessed by manufacturer and Engineer.

2. Leakage test for air manifolds, distribution headers, and diffuser assemblies.

a. Submerge pipes in clean water.

b. Turn on air.

c. Observe piping joints at minimum and maximum air flow rates.

d. Correct leaks and retest until installed system is leak free.

3. Verify diffuser mounting elevation using one of the following techniques:

a. Engineer's level.

b. Laser level.

c. Filling the tank with clean water to the top of the diffusers.

d. All diffusers in a treatment zone shall be at the required elevation within plus or minus 0.25 inches.

4. Air distribution test
    a. Fill tank with clean water to a depth of 1 foot above the top of the diffusers.
    b. Operate system at average air flow rate.

D. Monitor air uniformity by visual inspection.

3.04 MANUFACTURER'S FIELD SERVICES

A. Provide manufacturer's field services in accordance with Section 01400 and the following:

1. Inspect the installation and make adjustments as necessary for proper operation.

2. Verify proper operation and correct equipment deficiencies during testing, in accordance with Section 01650.

B. Training

1. Provide a factory representative to instruct representatives of the Owner and Engineer.

2. Allow a minimum of 8 hours for instruction.

END OF SECTION

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SECTION 11450

RESIDENTIAL EQUIPMENT

PART 1: GENERAL

1.01 WORK INCLUDED

A. Extent of residential equipment required is indicated on the drawings.

B. Types of residential equipment required for the breakroom include the following:

1. Free-Standing Electric Range
2. Wall-mounted microwave oven (over range type)
3. Top-Freezer Refrigerator with Internal Dispenser

1.02 SUBMITTALS

A. Product Data: Submit manufacturer's specifications and installation instructions for each type of residential equipment, including data indicating compliance with requirements. Submit operating and maintenance instructions for each item of residential equipment.

B. Submit manufacturer's standard written warranty for each item of residential equipment.

1.03 QUALITY ASSURANCE

A. Provide units with UL labels and energy guide labels containing energy cost analysis (annual operating costs) and efficiency information required by Federal Trade Commission.

B. Provide residential equipment by single manufacturer to the greatest extent possible for the entire project.

1.04 DELIVERY, STORAGE AND HANDLING

A. All items of residential equipment shall be packaged and shipped in accordance with standard commercial requirements.

PART 2: PRODUCTS

2.01 MANUFACTURERS

A. Subject to compliance with requirements, provide residential appliances from one of the following, or equivalent:

1. General Electric
2. Sears/Kenmore
3. Whirlpool

B. Basis of Design: General Electric (GE) or as otherwise indicated.

2.02 APPLIANCES

A. Provide manufacturer’s standard stainless steel finish unless otherwise indicated.

B. Microwave Oven: Over-the-Range type; capacity (1.8 cubic foot total capacity); approximate dimensions: 16-13/32 inches x 15-1/4 inches x 29-7/8 inches; 1100 wattage; salient features including, but not limited to, clock, glass turntable with on/off control; electronic touch controls; 2 removable oven racks; 4-speed high capacity exhaust fan; 15 amp, 120 volt electrical input; net weight 56 pounds; 10 power levels; GE Spacemaker, Model #JNM1851DMWW or equivalent.

C. Free-Standing Electric Range: Approximate dimensions: 46-1/2 inches x 27-3/8 inches x 29-7/8 inches; self-cleaning; radiant smooth cooking surface with four (4) burner elements (two 6-inch, one 8-inch, and one 6-inch/9-inch dual heating elements) thermal bake and thermal roast oven cooking modes; oven auto self-clean feature; 2 oven racks; removable storage drawer; 10.10 KW rating at 208 volts (13.50 KW rating at 240 volts); manufacturer’s full one-year warranty; GE Profile 30” Free-Standing Electric Range, Model #PB750TNWW, or equivalent.

D. Top-Freezer Refrigerator with Internal Dispenser: Approximate dimensions: 67-1/2 inches x 33-5/8 inches x 32-7/8 inches; 21.70 cubic foot total capacity (freezer capacity: 6.35 cubic feet); internal water dispenser; factory-installed ice-maker; four (4) fresh food cabinet shelves; four (4) fresh food door bins; two (2) split freezer door bins (one adjustable); bi-level and removable freezer cabinet shelves; reversible door hinges; power rating: 120 volts/60 Hz/15 Amps; GE Profile 21.7 Cubic Foot Top-Freezer with Internal Dispenser, Model #PTS22LHSWW, or equivalent.

PART 3: EXECUTION

3.01 INSTALLATION

A. General: Comply with manufacturer's instructions and recommendations.

B. Freestanding Equipment: Place units in final locations after finishes have been completed in each area. Verify that clearances are adequate for proper operation of equipment.

C. Utilities: Refer to the Drawings and Divisions 15 and 16 for plumbing, mechanical and electrical requirements.

3.02 TESTING AND START-UP

A. General: Delay the start-up of residential equipment until service lines have been tested, balanced, and adjusted for pressure, voltage and similar consideration, and until water lines have been cleaned and treated for sanitation.

B. Test each item of operational equipment to demonstrate that it is operating properly, and that controls and safety devices are functioning. Run tests in the presence of the Architect/Engineer and the Owner’s representative.

END OF SECTION

SECTION 11500

ODOR CONTROL SYSTEM - HEADWORKS

PART 1: GENERAL

1.01 SCOPE

A. Contractor to provide and install one (1) Odor and Environmental Emissions Control Scrubber complete with two (2) fans (one spare) and a control panel to treat H2S foul air.

B. Furnish all labor, materials, equipment, incidentals, and services required to install, test, complete, and make ready for operation a dry chemical gas scrubbing system suitable for H2S removal (referred to as Odor Control System) specified herein. The Odor Control System and media shall be compatible with H2S gas, VOC, and all reaction byproducts.

C. Install and test all related appurtenances herein specified.

D. All power and control wiring required for a complete operating system, including power and control wiring from the system control panel to the various items of equipment furnished under this Section, shall be furnished and installed under this Section. All electric materials and installation shall conform to all applicable electrical Specification Sections. All control of the Odor Control System shall be PLC based and Ethernet connection shall be provided to the plant control system.

1.02 RELATED WORK

A. Plans and Specifications for the “City of Canton WPCP Expansion Design” (Project).

B. Section 15201 Fiberglass Reinforced Plastic Ductwork.

1.03 SUBMITTALS

A. Submit to the Engineer copies of all materials required to establish compliance with this Section. Submittals shall include the following and according to Section 01300 Submittals of the Contract Specifications:

1. Certified performance characteristics for both chemical and air flow performance of the system.

2. FRP piping resin and interior coating description for equipment interior surfaces.

3. Certified shop and erection drawings generated in AutoCAD, but provided in PDF format, showing details, sizes, grades, protective coatings, and materials of construction, dimensions, and any anchor bolt locations.

4. Literature and drawings describing the equipment in detail, including but not limited to, parts list, assemblies, operating weights, dimensions, materials, details of construction, air ducting fitting sizes, and complete installation instructions.

5. Manufacturer's catalog data, specifications, performance data, and calibration curves for draw fan and other auxiliary equipment not directly manufactured or constructed by the Odor Control System manufacturer, hereafter referenced as the scrubber manufacturer.

6. Complete description of instrumentation and electrical equipment including motor data, instruments data sheet, schematic electrical wiring diagrams, control panel data, conduit and wire electrical specifications, and complete bill of materials list.

7. Detailed calculations, certified by a registered professional engineer licensed in the State of Georgia, which demonstrate Odor Control System equipment meets the design and performance requirements specified herein. These calculations and supplied data shall include:

    a. Draft in inches water column (W.C.) provided by draw fan.

    b. Volume and wall thickness of vessels of Odor Control System.

    c. Rate and magnitude of temperature rise of media in odor control vessel.

    d. Showing that the equipment will be capable of meeting minimum system performance design requirements for the Odor Control System.

    e. The unit media vessels shall be capable of withstanding the load imposed by the media in the Odor Control System.

    f. The Odor Control System contain a minimum amount of media required to scrub the total design release amount of gas. Calculations shall include ventilation rate, system pressure, gas flow, and weight.

    g. The maximum (Max.) temperature of the media during the operation and the capability of the system to handle the developed temperatures.

    h. The capability of the draw fan(s) to handle the minimum required air flow from the influent channel and headworks, including the resistance of all ductwork, fittings, and system components at actual operating temperature during operations. Air flow rate, ambient and mixture, including head loss calculations for the duct system.

    i. Calculations shall include anchor lug attachment, imposed live loads, dead loads, and necessary anchor bolts and restraints.

    j. Detailed shop drawings and calculations for miscellaneous accessories required for the maintenance of the unit.

8. The Odor Control System product data

    a. Overall Dimensions.

    b. Net Weight.

    c. Operating Weight.

    d. Construction Materials.

    e. Anchor lug attachment and anchor bolt calculations shall be signed and sealed by professional engineer licensed in the State of Georgia.

9. Chemical Media
    a. Name of Manufacturer.
    b. Type of Material.
    c. Quantity.
    d. Media Hydrogen Sulfide and VOC absorption performance.
    e. Instructions and procedures for disposal of spent media.
    f. Media and spent media Material Safety Data Sheet (MSDS).
10. Draw fan(s) for Odor Control System
    a. Name of Manufacturer.
    b. Type and Model.
    c. Rotational Speed.
    d. Net Weight.
    e. Overall dimensions.
    f. Performance curves with Airflow Rate in cubic feet per minute (cfm) and Brake horsepower, Static Pressure and Fan efficiency.
    g. Construction Materials.
    h. Sound Power Level.
    i. Pedestal Base. Provide complete design calculations, dimensions and construction material showing that the base and anchoring system can support the draw fan, motor and blower stack and appurtenances and all loads required by International Building Code while operating at full load at full speed without vibration. Design shall be by professional engineer licensed in the state of Georgia.
11. Motor for Odor Control System
    a. Name of Manufacturer.
    b. Type and Model.
    c. Horsepower Rating and Service Factor.
    d. Full Load Rotating Speed.
    e. Net Weight.
    f. Efficiency and Power factor at Rated Load.
    g. Full Current load.
    h. Overall Dimensions.
12. Electrical and Control Equipment for Odor Control System
    a. Complete instrumentation, and power wiring diagram in sufficient detail to allow installation of the instrumentation, controls, and electrical components. Location for connections to remote monitoring and control shall be clearly called out with complete terminal number designations.

b. Sequence of operations.

c. Dimensioned Panel Face Layout Drawings.

d. Manufacturer's data on all components of the control system.

B. Submit installation and start up report upon completion.

C. Written certification from primary manufacturers that materials and equipment, including all coatings, are suitable for use in a hydrogen sulfide, dry chemical media, salt and acid by-product environment.

D. Provide odor control narrative with alarms and setpoints for Odor Control System.

E. Submit operation and maintenance manuals in accordance with the General Conditions and Division 1.

F. Submit certified copies of results from all factory and field tests.

G. Provide a warranty letter with start and end dates of the coverage for each item, including media, vessel, blowers, and motors.

1.04 REFERENCE STANDARDS

A. American Society for Testing and Materials (ASTM)

1. ASTM C 581 – Practice for Determining Chemical Resistance of Thermosetting Resins used in Glass Fiber Reinforced Structures, Intended for Liquid Service.

2. ASTM D 635 – Test Method for Rate of Burning and/or Extent and Time of Burning for Self-Supporting Plastics in a Horizontal Position.

3. ASTM D 638 – Test Method for Tensile Properties of Plastics.

4. ASTM D 648 – Test Method for Deflection Temperature of Plastics under Flexural Load.

5. ASTM D 695 – Test Method for Compressive Properties of Rigid Plastics.

6. ASTM D 790 – Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.

7. ASTM D 2310 – Standard Classification for Machine-Made "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe.

8. ASTM D 2563 – Recommended Practice for Classifying Visual Defects in Glass-Reinforcing Plastic Laminate Parts.

9. ASTM D 2583 – Test for Indentation Hardness of Rigid Plastics by Means of Barcol Impresser.

10. ASTM D 2584 – Test for Ignition Loss of Cured Reinforced Resins.

11. ASTM D 3299 – Standard Specification for Filament-Wound Glass-Fiber-Reinforced Thermoset Resin Chemical-Resistant Tanks.

B. American National Standards Institute (ANSI) B16.9 – Factory-Made Wrought Steel Buttwelding Fittings.

C. The International Society for Measurement and Control (ISA) S5.4 – Instrument Loop Diagrams.

D. Air Movement and Control Association (AMCA) 210 – Laboratory Methods of Testing Fans for Rating Purposes.

E. American Society of Mechanical Engineers (Latest Edition) – Power Test Code for Compressor and Exhauster.

F. National Bureau of Standards (NBS) Voluntary Product Standard PS 15-69 – Custom Contact Molded Reinforced Polyester Chemical-Resistant Process Equipment.

G. National Fire Protection Associates (NFPA) Code No. 255 – Standard Method of Test for Surface Burning Characteristics of Building Materials. H. National Electrical Manufacturers Association (NEMA).

H. Occupational Safety and Health Administration (OSHA).

I. American National Standards Institute (ANSI) ASC A 14.3 – American National Standards for Ladders-Fixed-Safety Requirements.

J. International Building Code.

K. 2018 International Fire Code.

L. National Electrical Code, NFPA 70, latest edition.

1.05 QUALITY ASSURANCE

A. The supplied odor control system shall comply with the 2015 Uniform Fire Code with local amendments, City of Canton Building Code (latest edition), NIOSH guidelines (latest edition), and all other applicable local, state, and federal rules and regulations.

B. The odor control system manufacturer for Odor Control System shall be experienced in the manufacture and installation of packaged scrubbing systems of the type and capacity as specified herein. Odor control system manufacturer shall, upon request of the Engineer provide a list of at least five installations using identical equipment manufactured by the scrubber manufacturer. Suppliers whose main occupation is fiberglass or HDPE fabrication, but not odor control system design, shall not be acceptable as the system vendor. Manufacturers shall provide verification of experience.

C. To prevent divided responsibility, the Odor Control System, including control panels, shall be supplied by a single manufacturer. It shall be the responsibility of the odor control system manufacturer, acting through the CONTRACTOR, to properly size and provide all equipment and accessories necessary for a complete, properly functioning system, whether shown and specified, or not. Odor control system manufacturer shall supervise the installation of the odor control system equipment by the CONTRACTOR and be in responsible charge of all initial startup, testing, and calibration efforts. Odor control system manufacturer shall provide three copies of a written certification that the system has been properly designed provided, installed, tested and calibrated for the specified condition.

1.06 DELIVERY, STORAGE AND HANDLING

A. Provide in accordance manufacturers recommendations and with Section 01600 DELIVERY, STORAGE AND HANDLING.

B. Assemble items into components as large as practical in the factory to minimize field assembly.

C. Equipment shall be protected against damage during storage at the site.

D. All units and components shall be handled in accordance with manufacturer's instructions. Lifting rings and soft harnesses shall be used for lifting the unit to prevent scratching or abrading of finished surfaces.

1.07 WARRANTIES AND BONDS

A. The Contractor shall provide a warranty against defective or deficient materials and workmanship in accordance with the requirements of Section 01740 WARRANTIES AND BONDS.

B. The equipment manufacturer shall provide a warranty against defective or deficient equipment, workmanship and materials under normal use, operation and service. The warranty shall end one (1) year from the date of substantial completion. The warranty shall be in printed form and apply to all similar units.

PART 2: PRODUCTS

2.01 MANUFACTURERS

A. Pure Air Filtration, Atlanta, Georgia.

B. BioRem

2.02 ODOR CONTROL SYSTEM DESCRIPTION

A. Odor Control System shall be vendor-supplied, packaged odor control system including dry scrubber chemical media, vertical FRP vessel, one draw fan, and all other equipment and accessories as specified to provide an integrated and complete odor control system. The configuration shall be arranged so that the air H2S mixture from the headworks area is drawn to the vessel passing from the bottom of the vessel through the media and out the top of the vessel to the blower. The odor control system shall comply with all applicable standards, and requirements specified herein. The odor control system shall be designed for outdoor installation and shall remain fully operational under all climate conditions.

B. Odor Control System will treat releases from the influent and headworks channels and the splitter box at the wastewater treatment plant. Odor control system shall draw foul air continuously from the pickup points as specified in the plans. A negative pressure of 0.1-inch W.C. shall be maintained at all times in each pickup points.

C. Odor Control System shall be designed for the following treatment criteria:

Treatment Criteria	Item or Value
Gas to be Treated	Hydrogen Sulfide (H2S)
Average Annual Contaminant Load	273 lbs Hydrogen Sulfide (H2S)
Inlet H2S Concentration (minimum)	3 ppm
Inlet H2S Concentration (Average)	5 ppm
Inlet H2S Concentration (Peak)	52 ppm
Design Flow Rate	1,200 cfm
H2S Removal rate	99%

D. Odor Control System shall be capable of treating a continuous flow of the air with the hydrogen sulfide load as listed. The odor control system vessel shall be sized so that there is adequate dry chemical media for the hydrogen sulfide odor control system to treat the design load without the concentration of H2S in the discharged air exceeding the stated limits and without excessive temperature rise of the media.

E. Odor Control System shall operate with a minimum air flow rate of 1,200 scfm (or as required by supplier) at ambient conditions. The system shall have a sufficient draft for the ductwork system. The odor control system supplier shall review the ductwork design to ensure the scrubbing system has sufficient draft.

F. Environmental Conditions: Odor Control System to be designed, fabricated, and constructed to provide satisfactory operation with minimum maintenance for outdoor installation.

G. Manufacturers shall pickle and passivate all stainless steel Unistrut, junction boxes, and cabinets. All stainless steel cabinets and junction boxes should have a polished 2B finish instead of brushed finish.

H. All equipment shall be designed for a minimum working pressure of 5 inch W.C. positive and 12 inch W.C. negative pressure.

I. The absorption capacity of the media shall at a minimum 273 pounds hydrogen sulfide during 1-year operation

2.03 ODOR CONTROL SYSTEM MATERIALS AND EQUIPMENT – GENERAL

A. All of the items specified for Odor Control System are intended to be standard equipment of proven ability for use in scrubbing hydrogen sulfide gas from air. The scrubbers and all appurtenances shall be constructed of materials that will resist corrosion from the specific gases being handled.

B. Odor Control System under this Contract shall be the product of a single manufacturer.

C. Major components of the Odor Control System shall include:

1. High density polyethylene (HDPE) vessel with 60-inch diameter and 60-inch height

2. Dry chemical media, or as required by supplier

3. Two (2) draw fan-motor assemblies (separate unit). A spare draw fan shall be stored at the owner's facility as a redundancy.

4. Hydrogen sulfide-compatible magnehelic media bed differential pressure gage.

5. Control and motor starter panel(s).

   a. The odor control system manufacturer shall provide for all wiring, conduit, fittings, and junction boxes for all equipment including motors and field devices and provide ethernet communication for plant control system.

D. Differential Pressure Instrumentation

1. Provide appropriate gage compatible with hydrogen sulfide to permit local read-out of pressure drop through the media.

2. The scale of the differential pressure gage and switch should be ranged from 0" W.C. to - 10" W.C.

E. All necessary foundation bolts, plates, nuts, and washers shall be furnished; Type 316 Stainless Steel.

F. The odor control systems shall be identified by painted letters. Identifications shall be a minimum of 4 inches and be plainly visible. The odor control systems shall be labeled "ODOR CONTROL SYSTEM."

2.04 ODOR CONTROL SYSTEM

A. Draw Fans

1. Fan shall be fiberglass reinforced plastic, centrifugal type with backward inclined blades, industrial fiberglass fan. Fan wheel shall be statically and dynamically balanced. Fiberglass construction shall conform to PS 15-69 product standards. Fan resin shall be suitable for exposure to the specific service conditions. Fan housing shall be constructed of fiberglass and reinforced with rigid bracing to increase structural integrity.

2. Fan intake and outlets shall have flanged nozzles. Fan shaft shall be Type 316 stainless steel. Fan shall have self- aligning grease-packed bearings, with neoprene shaft seals and OSHA approved weatherproof motor/drive cover. Two (2) fans shall be designed (one spare) and for the following specifications:

   a. Air Flow Rate: 1,200 cfm

   b. Pressure: 9.50-inch W.C.

   c. Pressure Drop through Odor Control System: As required by the supplier

   d. Motor HP: Max. 5 HP

3. The fan shall have a 3-phase, 60 Hz, 460 V, TEFC, 3,450 rpm motor with a 1.15 service factor. The fan shall be Cincinnati Blower New York Blower, or equal. The fan shall have AMCA seal.

4. The draw fan exhaust stack shall be equipped with a rain cap with ½" Type 316 stainless steel bird screen.

B. Odor Control Vessel

1. High density polyethylene (HDPE) vessel with 60-inch diameter, inlet nozzle with flexible connection to match FRP duct O.D, FRP reinforced lid and top mounted and shall conform to the following structural design criteria:
    a. Working pressure, Odor Control System portion: -12 inches W.C to 0 inches W.C.
    b. Material shall be linear, high density, polyethylene, 1/4" (6.4 mm) in thickness.
    c. Latches and Fasteners shall be stainless steel 316.
    d. Stainless steel 316 Media support structure and support screen.
    e. The media shall be supported by a system of pultruded FRP grating and stainless steel 316 screen for maximum diffusion.
    f. The inlet shall have a 10" flexible connection
    g. The vessel shall have a 3/4" diameter CPVC drain pipe and CPVC FPT x FPT union ball valve.
    h. FRP lid shall be suitably supported to hold the weight of the motor, blower, and any accessories. FRP lid shall be stiff enough to resist flexing while operating at full speed.
    i. Media sample ports on side of vessel with media extraction tool.
2. Air/hydrogen sulfide shall enter the bottom of the vessel and flow upward through the media bed to the draw fan inlet. Draw fan shall discharge to atmosphere through a discharge duct.
3. The manufacturer shall provide the odor control system media vessel to meet the minimum values specified for dimension, design, and intent of this specification. Vessel, draw fan, and media shall function as a system and shall be the end product of the manufacturer to achieve standardization in appearance, operation, maintenance, spare parts and manufacturer's services.
4. The media used shall be suitable for continuous exposure to a hydrogen sulfide/air mixture with max. operating temperature of 100°F.
5. Each vessel shall contain 1/2-inch side-mounted sample probes, which extend into the media 6 inches minimum. Probes shall be adequate to provide suitable extraction of media samples from the media bed and be non-binding. Probes shall extend outside the vessel wall and be blocked off with a ball valve. Probes and ball valve shall be of CPVC construction.
6. Provide a minimum of three (3) lifting lugs designed to handle the entire vessel weight.
7. Unless otherwise specified, all fasteners and metal attachments shall be Type 316 stainless steel. All gaskets shall be EPDM.

C. Media

1. Provide dry chemically impregnated media to scrub hydrogen sulfide, Media shall be spherical in shape, porous, non-flammable and capable of removing hydrogen sulfide throughout the full bed depth.
    a. Moisture Content: 25% (max.)
    b. Average crush strength: 60% (max)
    c. Average media diameter: 1/8 to 3/16” (4x6 mesh)
    d. Media will not dissociate in water
    e. Media containing activated carbon is not acceptable
    f. Media UL Fire Class 1 Non-flammable rating is required
        1) Media with carbon in the substrate will not be acceptable.
        2) Pressure Drop Characteristics

            Pressure drop of air flowing through the packed media bed shall not exceed the following limits:

Superficial Velocity (fpm)	Pressure Drop (inch w.c.)
50	0.45
100	1.85

D. Connecting Ductwork

1. Connection between the vessel and draw fan inlet shall be provided by the Odor Control System manufacturer, including flexible connector.
2. Ductwork assembly and design shall be compatible with the vessel and draw fan.

E. Accessories

1. Air inlet, air outlet, media sample connections, and all miscellaneous connections shall be provided by the manufacturer. Anchor bolts shall be Type 316 stainless and designed for the specified loads. Interior fasteners shall be of corrosion resistance materials such as PVC, Stainless Steel (SS 316) or FRP.

F. The control panel shall be NEMA 4X, Type 316 stainless steel construction. All resets shall be surface mounted.

G. Control Panel Wiring:

1. All panel equipment shall be mounted and wired on or within the cabinet. Wiring shall comply with NFPA 70, National Electrical Code and requirements. All wiring shall be identified in compliance with the system used on the wiring/connection diagrams and in compliance with Section 16120. Wiring and connection diagrams shall comply with ISA S5.4 and shall be submitted by the manufacturer as part of the Shop Drawings for review by the Engineer.

2. Power and low voltage DC signal wiring shall be routed in separate wireways. Crossing of the two system wires shall be at right angles.

3. Wire color shall be in accordance with Section 16120.

4. All wiring shall terminate in a master terminal board, rigid type and numbered. The master terminal board shall have a minimum of 25 percent spares.

H. At a minimum, the control panels shall include the following switches and indicating lights:

1. System HAND/ON-OFF Switch

2. System "READY" Status Light (White)

3. System Fan HAND/ON-OFF Switch

4. System Fan "Run" Light (Red)

I. The manufacturer shall provide a complete and fully functional control system to manually operate the control system as specified herein and in other applicable sections of these specifications. All manufacturers recommended safety devices shall be furnished to protect operators. All control devices, unless specified otherwise, shall be mounted in the Control Panel. In manual control, the odor control system shall operate continuously whenever the H-O selector switch for the scrubber draw fan is in the hand position.

PART 3: EXECUTION

3.01 INSTALLATION

A. Installation shall be in strict accordance with the manufacturer's instructions and recommendations in the locations shown on the Drawings. Anchor bolts shall be furnished by the equipment manufacturer and set in accordance with the manufacturer's recommendations.

B. The Contractor shall be responsible for coordinating related items, not covered in this section of the specifications, such as piping, fittings, additional valves, and supports.

C. Submit a certificate from the manufacturer stating that the installed equipment has been examined and found to be in complete accordance with the manufacturer's requirements, that the equipment is ready for operation and that the operating personnel have been suitably instructed in the operation, lubrication and care of the equipment.

3.02 FUNCTIONAL TESTING

A. Prior to startup, inspect all equipment to ensure proper alignment, proper operation, proper connection, and satisfactory operation of all equipment.

B. Functional Testing shall demonstrate that the odor control equipment and ancillary equipment are operating as specified.

C. Verification of electrical power and control panel operation, including data exchange with ancillary equipment and plant SCADA system, shall be included in Functional Testing.

D. If In the opinion of the Engineer, the system is operating as intended, Performance Testing may begin. If the system is determined to not be in compliance or is not operating as specified, the Contractor shall make all necessary improvements at no additional cost to the Owner.

3.03 PERFORMANCE TESTING

A. The equipment manufacturer and Contractor shall conduct a performance test to demonstrate the installed equipment meets the specified performance requirements. The test shall occur as soon as possible after successful equipment start-up and commissioning of the odor control equipment has been accomplished.

B. The performance test shall be run to determine the actual system operating conditions and verify that the systems meet the odor control Performance Requirements of this Specification.

C. It shall be the Contractor’s and Manufacturer’s responsibility to develop test procedures and coordinate with the Owner and Engineer on the scheduling of the Performance Test.

D. Contractor shall coordinate odor control equipment Performance Testing with Instrumentation and Controls Supplier to ensure that demonstration of odor control equipment function as intended.

E. Should the installed equipment and associated controls fail to meet the specified performance requirements, the manufacturer shall within 30 calendar days make changes in the equipment or method of operation as necessary and the equipment shall be retested. If after a second 30-day calendar period, the equipment still does not meet the performance criteria, the equipment will have failed the performance test, and the Owner shall require its removal and replacement (including labor, materials and equipment) with new equipment acceptable to the Engineer, at no additional cost to the Owner.

3.04 MANUFACTURER'S SERVICES

A. The manufacturer shall furnish the services of a competent and experienced person to the job site to check the installation, supervise the start-up, performance testing and provide operator instruction for the equipment furnished. Two (2) trips for a total of four (4) days are allotted.

END OF SECTION

SECTION 11501

ODOR CONTROL SYSTEM – SOLIDS HANDLING FACILITY

PART 1: GENERAL

1.01 SCOPE

A. Furnish all labor, materials, equipment, incidentals, and services required to install, test, complete, and make ready for operation a dual-technology biotrickling filter with secondary polishing odor control system complete with all appurtenances as specified herein.

B. All power and control wiring required for a complete operating system, including power and control wiring from the system control panel to the various items of equipment furnished under this Section, shall be furnished and installed under this Section. All electric materials and installation shall conform to all applicable electrical Specification Sections. All control of the Odor Control System shall be PLC-based and Ethernet connection shall be provided to the plant control system.

1.02 RELATED WORK

A. Plans and Specifications for the “City of Canton WPCP Expansion Design” (Project).

B. Section 15201 Fiberglass Reinforced Plastic Ductwork.

1.03 REFERENCE STANDARDS

A. American Society for Testing and Materials (ASTM)

1. ASTM E679: “Standard Practice of Odor and Taste Thresholds By a Forced-Choice Ascending Concentration Series Method of Limits”.

2. ASTM D-2563: “Recommended Practice for Classifying Visual Defects in Glass Reinforced Plastic Laminate Parts”.

3. ASTM D-2583: “Standard Test Method for Indentation Hardness of Rigid Plastics by Means of Barcol Impressor”.

4. ASTM C582: “Revision of C582-02 Standard Specification for Contact-Molded Reinforced Thermosetting Plastic (RTP) Laminates for Corrosion-Resistant Equipment”.

5. ASTM D-883: “Definition of Terms Relating to Plastics”.

6. ASTM D-3299: “Standard Specification for Filament-Wound Glass-Fiber-Reinforced Thermoset Resin Corrosion-Resistant Tanks”.

7. ASTM D-4097: “Standard Specification for Contact Molded Glass Fiber Reinforced Thermoset Resin Corrosion-Resistant Tanks”.

8. ASTM D3982: “Standard Specification for Contact ASTM C 581 – Practice for Determining Chemical Resistance of Thermosetting Resins used in Glass Fiber Reinforced Structures, Intended for Liquid Service.

9. ASTM D 635: Test Method for Rate of Burning and/or Extent and Time of Burning for Self-Supporting Plastics in a Horizontal Position.
10. ASTM D 638: Test Method for Tensile Properties of Plastics.
11. ASTM D 648: Test Method for Deflection Temperature of Plastics under Flexural Load.
12. ASTM D 695: Test Method for Compressive Properties of Rigid Plastics.
13. ASTM D 790: Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
14. ASTM D 2310: Standard Classification for Machine-Made "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe.
15. ASTM D 2563: Recommended Practice for Classifying Visual Defects in Glass-Reinforcing Plastic Laminate Parts.
16. ASTM D 2583: Test for Indentation Hardness of Rigid Plastics by Means of Barcol Impresser.
17. ASTM D 2584: Test for Ignition Loss of Cured Reinforced Resins.
18. ASTM D 3299: Standard Specification for Filament-Wound Glass-Fiber- Reinforced Thermoset Resin Chemical-Resistant Tanks.

B. PS 15-69: National Bureau of Standards Voluntary Product Standard “Custom Contact Molded Reinforced Polyester Chemical Resistant Process Equipment”.

1.04 SUBMITTALS

A. Submit to the Engineer copies of all materials required to establish compliance with this Section. Submittals shall include the following and according to Section 01300 SUBMITTALS of the Contract Specifications:

1. Literature and drawings describing the equipment in detail, including but not limited to, parts list, assemblies, operating weights, dimensions, materials, details of construction, air ducting fitting sizes, and complete installation instructions.
2. Technical data on each major piece of equipment including weights of all items greater than 200 Lbs.
3. Structural calculations and drawings for the main reactor vessel, to include wind and seismic load calculations and anchor bolt sizing.
4. Certified shop and erection drawings generated in AutoCAD, but provided in PDF format, showing details, sizes, grades, protective coatings, and materials of construction, dimensions, and any anchor bolt locations.
5. Complete description of instrumentation and electrical equipment including motor data, instruments data sheet, schematic electrical wiring diagrams, control panel data, conduit and wire electrical specifications, and complete bill of materials list.

6. Media
    a. Name of Manufacturer.
    b. Type of Material.
    c. Quantity.
    d. Media Hydrogen Sulfide and VOC absorption performance.
    e. Instructions and procedures for disposal of spent media.
    f. Media and spent media Material Safety Data Sheet (MSDS).
7. Draw fan(s) for Odor Control System
    a. Name of Manufacturer.
    b. Type and Model.
    c. Rotational Speed.
    d. Net Weight.
    e. Overall dimensions.
    f. Performance curves with Airflow Rate in cubic feet per minute (cfm) and Brake horsepower, Static Pressure and Fan efficiency.
    g. Construction Materials.
    h. Sound Power Level.
    i. Pedestal Base. Provide complete design calculations, dimensions and construction material showing that the base and anchoring system can support the draw fan, motor and blower stack and appurtenances and all loads required by International Building Code while operating at full load at full speed without vibration.

B. Provide odor control narrative with alarms and setpoints for Odor Control System.

C. Provide detailed Performance Testing Requirements.

1.05 OPERATION AND MAINTENANCE MANUALS

A. Submittal shall meet the requirements listed in Section 01730 - OPERATION AND MAINTENANCE MANUAL.

B. The Manufacturer shall submit the following information, as a minimum, for the Operation and Maintenance Manuals.

1. As-built dimensional drawings showing plan and elevation views of the System and all applicable connections.

2. As-built Process and Instrumentation Diagrams (P&IDs).

3. Detailed bill of material along with specification of System components and materials of construction. The list to include the make, model number and descriptive literature of all items furnished by the Manufacturer.

4. Performance data for the odor control blower, to include curves showing capacity, pressure, horsepower demand and efficiency over the entire

operating range, including blower manufacturer's descriptive literature and blower model number(s).

5. Special precautions for any components or materials associated with the System and its operation that should be subject to particular safety precautions, including MSDS.

6. Manufacturer's Service Department contact information and service order form.

7. Statement of Manufacturer's Warranty.

8. System startup and restart instructions.

9. Special maintenance procedures, including recommended weekly, monthly and annual preventative maintenance requirements.

10. Troubleshooting guide.

11. Individual Operation and Maintenance instructions for all major system components.

C. Submit certified copies of results from all factory and field tests.

D. Provide a warranty letter with start and end dates of the coverage for each item, including media, vessel, blowers, and motors.

1.06 QUALITY ASSURANCE

A. The supplied odor control system shall comply with the 2015 Uniform Fire Code with local amendments, City of Canton Building Code (latest edition), NIOSH guidelines (latest edition), and all other applicable local, state, and federal rules and regulations.

B. The odor control system manufacturer for Odor Control System shall be experienced in the manufacture and installation of packaged scrubbing systems of the type and capacity as specified herein. Odor control system manufacturer shall, upon request of the Engineer provide a list of at least five installations using identical equipment manufactured by the scrubber manufacturer. Suppliers whose main occupation is fiberglass or HDPE fabrication, but not odor control system design, shall not be acceptable as the system vendor. Manufacturers shall provide verification of experience.

C. To prevent divided responsibility, the Odor Control System, including control panels, shall be supplied by a single manufacturer. It shall be the responsibility of the odor control system manufacturer, acting through the CONTRACTOR, to properly size and provide all equipment and accessories necessary for a complete, properly functioning system, whether shown and specified, or not. Odor control system manufacturer shall supervise the installation of the odor control system equipment by the CONTRACTOR and be in responsible charge of all initial startup, testing, and calibration efforts. Odor control system manufacturer shall provide three copies of a written certification that the system has been properly designed provided, installed, tested and calibrated for the specified condition.

1.07 DELIVERY, STORAGE AND HANDLING

A. Provide in accordance manufacturers recommendations and with Section 01600 DELIVERY, STORAGE AND HANDLING.

B. Assemble items into components as large as practical in the factory to minimize field assembly.

C. Equipment shall be protected against damage during storage at the site.

D. All units and components shall be handled in accordance with manufacturer's instructions. Lifting rings and soft harnesses shall be used for lifting the unit to prevent scratching or abrading of finished surfaces.

1.08 WARRANTIES AND BONDS

A. The Contractor shall provide a warranty against defective or deficient materials and workmanship in accordance with the requirements of Section 01740 WARRANTIES AND BONDS.

B. The equipment manufacturer shall provide a warranty against defective or deficient equipment, workmanship and materials under normal use, operation and service. The warranty shall end one (1) year from the date of substantial completion. The warranty shall be in printed form and apply to all similar units.

PART 2: PRODUCTS

2.01 GENERAL

A. The odor control equipment supplied under this section must be provided by a single Manufacturer who will be solely responsible for the design, delivery and performance of the system. The equipment must be new and unused and meet the detailed specifications and warranty requirements stated herein.

2.02 MANUFACTURERS

A. BioAir Solutions, EcoPure EP4102

B. BioRem Technologies

2.03 OPERATING CONDITIONS

A. The System shall be suitable to treat air coming from a continuous supply from the odor source and all equipment must be suited to the operating conditions to which it will be subjected and the various compounds/substances with which they will reasonably be expected to come into contact. The operating conditions, at a minimum, include the following:

1. Number of Vessels: 1

2. Flowrate: 1,500 cfm

3. Continuous Duty

4. Location: Outdoors

5. Inlet Air Temperature: 59 -99°F

6. Maximum irrigation water flow: 14 gpm at 45 psi
7. Maximum pressure drop across the vessel: 2.4” wc

2.04 DESIGN REQUIREMENTS

A. The system shall treat the following:

1. Average hydrogen sulfide concentration: 3 ppmv
2. Peak hydrogen sulfide concentration: 10 ppmv
3. Average ammonia concentration: 3 ppmv
4. Peak ammonia concentration: 14 ppmv
5. Average VOC concentration: 55 ppmv
6. Peak VOC concentration: 80 ppmv

B. The system shall meet the following minimum performance criteria:

1. The **biological stage** of the system shall have passed the performance test if either one of the following conditions is true:

- Average biological stage H2S removal efficiency is ≥ 99% (applies when average inlet H2S concentration is ≥ 50 ppmv)
- Average biological stage outlet H2S concentration is ≤ 0.5 ppmv (applies when average inlet concentration is < 50 ppmv)

AND

- Average biological stage NH3 removal efficiency is ≥ 90% (applies when average inlet NH3 concentration is ≥ 5 ppmv)
- Average biological stage outlet NH3 concentration is ≤ 0.5 ppmv (applies when average inlet concentration is < 5 ppmv)

2. The **overall** system shall have passed the performance test if either one of the following conditions is true:

- Average biological stage H2S removal efficiency is ≥ 99.5% (applies when average inlet H2S concentration is ≥ 20 ppmv)
- Average biological stage outlet H2S concentration is ≤ 0.1 ppmv (applies when average inlet concentration is < 20 ppmv)

AND

- Average Odor removal efficiency is ≥ 95% for inlet air odor concentrations ≥ 4,000 D/T* but ≤ 60,000 ppmv
- Average Outlet odor concentration is ≤ 200 D/T for inlet air odor concentrations ≤ 4,000 D/T

2.05 BIOTRICKLING FILTER VESSEL

A. The System vessel shall be free standing and, with no exceptions, shall operate in a counter-current manner. Each vessel shall consist of one (1) or more modules containing biotrickling media, one carbon polishing bed and one (1) top piece.

Each module shall be constructed from Fiberglass Reinforced Plastic (FRP) and be designed with adequate strength to support the number of required modules. Each FRP module shall contain, as a minimum, a 100 mil vinyl ester resin corrosion barrier. The structural layer shall consist of isophthalic resin with chop strand and continuous glass. The exterior topcoat shall be isophthalic resin with UV resistant pigment (minimum service life of 10 years). The exterior color shall be CCP base white enamel (W005).

B. The reactor vessels shall be provided with 316 stainless steel hold down lugs to account for all anticipated loads to comply with local wind code requirements.

2.06 MEDIA

A. The synthetic structured media shall be high porosity, chemically resistant, engineered synthetic porous material.

B. The biological media characteristics (available surface area, density, and pressure drop) shall be structured and uniform throughout the media bed. Random media types (chips, balls, cubes, etc.) shall not be allowed.

C. The synthetic, biological media shall have a minimum available specific surface area of 230 ft^2/ft^3 and a void opening of more than 96%. Pressure drop shall not exceed 0.25” w.g. per ft or media depth.

D. The biological media shall be guaranteed not to clog or require cleaning, scrubbing, backwashing, acid-washing or replacement for a period of ten (10) years.

E. Media shall resist compaction or swelling due to varying moisture levels and shall not degrade when subjected to low pH (i.e. pH<2) conditions.

F. The uniform structure of the media shall minimize the potential for short circuiting and encourage a uniform water and air flow pattern over the entire media cross sectional area.

G. The manufacturer shall provide evidence that the airflow through the biological media at 24” height from the bottom of the media is homogeneous at the average airflow rate. For purposes of this specification, homogeneous is defined as being when the upflow velocity over the entire media cross sectional area is equal to the average upflow velocity ± 10%. The airflow modeling results with velocity contour plots at 24” media height over the entire cross section shall be provided in graphical format as part of the Submittal requirements.

H. Sufficient media shall be provided to ensure the performance requirements are met.

I. The polishing stage shall be suitable for the final polishing of organic compounds.

J. All synthetic media shall be pre-installed in the FRP module (s) prior to shipment to the job site.

2.07 IRRIGATION SYSTEM

A. Each reactor shall be configured with at least one (1) irrigation point which shall distribute the irrigation water evenly over the entire upper surface of the synthetic media layer.

B. Each irrigation system shall be tested by the Manufacturer and a certificate of conformity supplied with the shop drawings to show that the nozzle has been tested and meets the Manufacturers standards for uniform distribution.

C. The irrigation system shall be supplied with a nutrient addition system to provide the macro and micronutrients required by the bacteria for optimal metabolism of the odorous compounds being treated.

2.08 ODOR CONTROL BLOWER

A. The blower(s) shall be single-width wheel, single-inlet as designed and manufactured by The New York Blower Company or approved equal.

B. The blower shall be constructed such that all surfaces in contact with the odorous airstream are to be made of corrosion resistant FRP.

C. All nuts, bolts and fasteners in contact with the gas stream shall type 316 SS.

D. Blowers shall be AMCA Arrangement 9 or 10. AMCA Arrangement 4, which places the motor shaft in the odorous airstream, is not allowed.

E. Blower ratings shall be based on tests made in accordance with AMCA Standard 210 and licensed to bear the AMCA Certified Ratings Seal for Air Performance. Blowers not licensed to bear the AMCA Seal for performance shall be tested, at Contractor's expense, in an AMCA Registered Laboratory.

F. Blower brake horsepower shall be equal to or less than 1.8 BHP at 5 inches static pressure and 1,450 CFM.

G. Blower shall be constructed in accordance with ASTM D-4167 standard specification for FRP blowers and blowers to ensure structural integrity.

H. Blower housing shall be constructed of polyester resin.

I. Wheel shall be radial, or backwardly-inclined, non-overloading design. Wheel shall be fabricated of vinyl ester resin.

J. Wheel hub shall be securely fastened to the shaft and completely encapsulated in FRP to ensure corrosion-resistant integrity. Wheel shaft shall be ground and polished carbon steel, encapsulated in FRP.

K. The blower motor shall be a standard efficiency, explosion proof, 480V/3/60 electric motor as manufactured by US Electric Motors, Baldor, Reliance or approved equal.

2.09 CONTROL SYSTEM

A. Electrical Control Panel (ECP)

1. The ECP enclosure shall be NEMA 4X and constructed of 316 Stainless Steel, and the panel shall come with a 316SS panel stand.

2. The ECP shall house the necessary electronic components and an Allen Bradley Micrologix 1400 PLC with PanelView Component 800 human-machine interface (HMI) for the control and monitoring of the irrigation system. The system shall be controlled on the basis of time for the irrigation cycle and irrigation time and shall be adjustable to sustain conditions appropriate to the

activity of the bacteria. Dry contacts shall be provided for external notification of alarm status. Alarms, at a minimum, shall be provided for low irrigation water flow, high irrigation water flow, no nutrient flow (if applicable) and blower fail. There should be an allowance to manually open the irrigation spray valve (located in the WCP) for the purpose of routine maintenance checks but the valve should be normally closed.

3. The ECP shall require a single electrical connection of 480V/3Phase/60Hz. Transformers shall be provided as necessary for power and control voltages.

B. Water Control Panel (WCP)

1. The Water Control Panel shall be constructed of 316 Stainless Steel and be mounted on the common panel stand, back-to-back with the ECP.

2. The WCP shall contain a panel heater, valves, motorized ball valves, strainers, instruments and piping for the control of the irrigation system and shall operate from control signals from the ECP.

3. The WCP shall allow for a single connection to either a potable water source or suitable final effluent plant water source.

4. The WCP shall house a nutrient addition system.

5. The WCP shall also contain a flexible spray hose with a hand trigger to allow for convenient rinsing of the strainer, filling of the nutrient barrel, and general convenience. A dedicated ball valve shall be provided in front of the spray hose to allow for the operation of the water panel while simultaneously allowing for isolation in case of a leak in the hose.

2.10 SPARE PARTS

A. At a minimum, the following spare parts shall be supplied with the equipment.

1. One (1) set of fuses, one (1) for each fuse rating.

2. One (1) set of lamp lenses.

3. One (1) strainer.

B. Spare parts shall be stored, by the Contractor, on site and shall be handed over to the Owner at equipment handover.

2.11 EQUIPMENT NAME PLATES

A. Each separate piece of equipment shall be furnished with a unique name plate identifying the Manufacturer, model & serial number, date of manufacture and, if applicable, capacity and any performance limitations. The nameplates shall be 2 ply plastic or embossed stainless steel and firmly affixed to the exterior surface of the equipment and in a location that is accessible and easily read.

PART 3: EXECUTION

3.01 INSTALLATION

A. Installation shall be in strict accordance with the manufacturer's instructions and recommendations in the locations shown on the Drawings. Anchor bolts shall be furnished by the equipment manufacturer and set in accordance with the manufacturer's recommendations.

B. The Contractor shall be responsible for coordinating related items, not covered in this section of the specifications, such as piping, fittings, additional valves, and supports.

C. Submit a certificate from the manufacturer stating that the installed equipment has been examined and found to be in complete accordance with the manufacturer's requirements, that the equipment is ready for operation and that the operating personnel have been suitably instructed in the operation, lubrication and care of the equipment.

3.02 FUNCTIONAL TESTING

A. Prior to startup, inspect all equipment to ensure proper alignment, proper operation, proper connection, and satisfactory operation of all equipment.

B. Functional Testing shall demonstrate that the odor control equipment and ancillary equipment are operating as specified.

C. Verification of electrical power and control panel operation, including data exchange with ancillary equipment and plant SCADA system, shall be included in Functional Testing.

D. If In the opinion of the Engineer, the system is operating as intended, Performance Testing may begin. If the system is determined to not be in compliance or is not operating as specified, the Contractor shall make all necessary improvements at no additional cost to the Owner.

3.03 PERFORMANCE TESTING

A. The equipment manufacturer and Contractor shall conduct a performance test to demonstrate the installed equipment meets the specified performance requirements. The test shall occur as soon as possible after successful equipment start-up and commissioning of the odor control equipment has been accomplished.

B. The performance test shall be run to determine the actual system operating conditions and verify that the systems meet the odor control Performance Requirements of this Specification.

C. It shall be the Contractor’s and Manufacturer’s responsibility to develop test procedures and coordinate with the Owner and Engineer on the scheduling of the Performance Test.

D. Contractor shall coordinate odor control equipment Performance Testing with Instrumentation and Controls Supplier to ensure that demonstration of odor control equipment function as intended.

E. Should the installed equipment and associated controls fail to meet the specified performance requirements, the manufacturer shall within 30 calendar days make changes in the equipment or method of operation as necessary and the equipment shall be retested. If after a second 30-day calendar period, the equipment still does not meet the performance criteria, the equipment will have failed the performance test, and the Owner shall require its removal and replacement (including labor, materials and equipment) with new equipment acceptable to the Engineer, at no additional cost to the Owner.

3.04 MANUFACTURER'S SERVICES

A. The manufacturer shall furnish the services of a competent and experienced person to the job site to check the installation, supervise the start-up, performance testing and provide operator instruction for the equipment furnished. Two (2) trips for a total of four (4) days shall be provided.

END OF SECTION

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SECTION 11600

BIOSOLIDS STORAGE HOPPER

PART 1: GENERAL

1.01 SCOPE OF WORK

A. The hopper will be provided complete with mounting and support frame, load cells, live bottom with twin screws, twin leveling screws, variable frequency drives for the live bottom screws, discharge pipes, discharge knife gates, cover plates with connections for piping, ductwork and instrumentation, motor reducer, electrical controls, control panel, access ladder, top handrails, safety accessories and all appurtenances specified or required for a complete and operable system. The equipment and all appurtenances will be installed as shown on the plans, as recommended by the Manufacturer, and in compliance with all OSHA, local, state and federal codes and regulation.

B. Contractor shall coordinate hopper openings and elevation with Dryer Feed Pumps as specified in Specification Section 11315 Progressive Cavity Pumps.

C. Screws may be shafted or shaftless. Hopper shall be certified as watertight.

D. Contractor shall provide and install spray header inside of the hopper as shown in the Construction Documents. Header shall be routed inside the hopper within 12 inches of the top of the hopper and supported per the hopper manufacturer's recommendations.

E. All necessary safety equipment and guards to meet OSHA requirements shall be provided

F. All equipment included in this section shall be furnished by a single supplier who shall be responsible for the design, coordination, and satisfactory operation of the system.

G. All power and control wiring required for a complete operating system, including power and control wiring from the system control panel to the various items of equipment furnished under this Section, shall be furnished and installed under this Section. All electric materials and installation shall conform to all applicable electrical Specification Sections. All control of the BioSolids Sludge Hopper shall be PLC based and Ethernet connection shall be provided to the plant control system.

1.02 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Society for Testing and Materials (ASTM)
2. National Electrical Manufacturers Association (NEMA)
3. American Gear Manufacturers Association (AGMA)
4. American Welding Society (AWS)

5. Conveyor Equipment Manufacturers Association (CEMA)

1.03 SUBMITTALS

A. Submit in accordance with the Section 01300 Submittals, copies of all materials required to establish compliance with this Section. Submittals shall include at least the following:

1. Certified shop and erection drawings showing all details of construction, dimensions and anchor bolt locations.

2. Descriptive literature, bulletins, and/or catalogs of the equipment.

3. The total operational weight of the equipment including the single largest component.

4. Complete bill of materials of all equipment.

5. A list of the Manufacturer's recommended spare parts.

6. Complete motor data.

7. Complete control panel component and wiring schematics.

B. Operations and Maintenance Manuals

1. Complete operating and maintenance instructions shall be submitted in accordance with the requirements of Section 01730 – Operating and Maintenance Manual.

2. The manual shall include: Equipment Data Pages, Equipment Introduction and Operation, Warranty, Long Term Storage, Troubleshooting, Maintenance and Lubrication, Spare Parts List, Equipment Listing, Catalog Cuts, and Drawings.

1.04 QUALITY ASSURANCE

A. A single manufacturer shall furnish all the equipment specified under this Section and shall be standard units of proven ability as manufactured by a competent organization that is fully experienced, reputable and qualified in the manufacture of the equipment to be furnished. The equipment shall be designed, constructed and installed in accordance with the best practice and methods, and shall operate satisfactorily when installed.

B. All equipment furnished under this Section shall be new and unused and shall be the standard products of manufacturers having a successful record of manufacturing and servicing the equipment and systems specified herein for a minimum of five (5) years.

1.05 DELIVERY STORAGE AND HANDLING

A. Provide in accordance manufacturers recommendations and with Section 01600 Delivery, Storage and Handling.

B. All parts shall be properly protected so that no damage or deterioration will occur during a prolonged delay from the time of shipment until installation is completed and the units and equipment are ready for operation.

1.06 WARRANTY

A. The Contractor and the Manufacturer shall warrant all equipment supplied under this Section for a period of one (1) year. Warranty period shall commence as outlined in the General Conditions and Division 1.

PART 2: PRODUCTS

2.01 MANFACTURERS

A. Spirac

B. JMS (Jim Myers & Sons, Inc)

2.02 PERFORMANCE AND DESIGN REQUIREMENTS

A. Wet Cake Hopper

1. Number of Wet Cake Hoppers: 1
2. Type of Wet Cake: Dewatered Biosolids Sludge
3. Approximate Percent Solids (%): 16 - 20
4. Minimum Usable Volume Per Hopper: 65 cubic yards
5. Hopper Height: 18.5 feet
6. Hopper Width: 12 feet
7. Minimum Hopper Length: 23 feet
8. Number of Load Cells: One per support (Minimum 6 per hopper)

B. Live Bottom Screws

1. Number of Live Bottom Screws Per Hopper: 2
2. Screw Length: 17.7 feet
3. Minimum Screw Diameter: 12 inches
4. Minimum Shaft Diameter: 8 inches
5. Minimum Discharge Rate of Each Live Bottom Screw: 39 cu ft/hr.

C. Leveling Screws

1. Number of Leveling Screws per Hopper: 2
2. Screw Length: 23 feet
3. Minimum Screw Diameter: 12 inches
4. Minimum Shaft Diameter: 8 inches

D. Number of Knife Gates Per Hopper: 2

2.03 GENERAL

A. Wet cake hopper shall be self-supporting with structural steel support legs and framing complete with base plates drilled for mounting on concrete base. All necessary cross bracing and reinforcing members shall be fabricated within the support system. A 4-inch plate flanged connection shall be provided at the bottom of the hopper to drain the hopper during maintenance activities. Intermediate supports within the hopper will not be acceptable. Support system to be designed and stamped by a State of Georgia Professionally Licensed Engineer.

B. Unless otherwise specified, the materials used in the fabrication of the equipment under this section shall conform to the following:

1.	Hopper:	T-304 stainless steel
2.	Inlet/Outlet Chutes:	T-304 stainless steel
3.	Supports:	A53, A36 Carbon Steel, HDG
4.	Discharge Gates:	T-304 stainless steel wetted parts.
5.	Live Bottom Screws:	Abrasion resistant A-235 carbon steel coated.
6.	Leveling Screws:	Abrasion resistant A-235 carbon steel coated.
7.	Screw pipe:	A53, Carbon Steel, coated.
8.	Live Bottom Pan/Trough:	T-304 stainless steel
9.	Bolts, Nuts, and Washers:	18-8 Stainless Steel
10.	Handrails:	Aluminum
11.	Ladder:	Aluminum

C. All welds shall be sealed watertight by continuous welds, unless otherwise specified. Sharp corners of all cut and sheared edges shall be made smooth by a power grinder.

D. Wet cake hopper shall be constructed of welded steel plate of a thickness determined by the manufacturer. It shall be designed to limit maximum deflection of no more than 1/270. Minimum plate thickness shall be 1/4-inch. Interior surfaces of hopper shall be smooth to allow unobstructed flow.

E. Each wet cake hopper shall be covered and be constructed of welded steel plate of a thickness determined by the manufacturer. It shall be designed to limit maximum deflection of no more than 1/360. Minimum plate thickness shall be 1/4-inch diamond thread plate of the same material as the hopper. The cover shall be supported by members underneath of suitable size to achieve deflection and support equipment as shown on the drawings (not supported by other means) and a live load of 100 lbs./ft2 minimum. Provide one manway, odor control ports, sensor ports, inlet from feeding pumps, and/or other openings as shown on the drawings. Aluminum handrails shall encircle the perimeter of the cover.

F. Manufacturer shall provide an aluminum access ladder with aluminum safety cage and top grab rails complying with OSHA standards to wet cake hopper to top cover.

2.04 ASSEMBLY REQUIREMENTS

A. Include all material and equipment necessary to provide a complete working system, except such material and equipment specifically excluded. Provide all fasteners, whether shop installed or not, for structural supports and mechanical equipment.

B. Furnish equipment of the approximate dimensions shown or specified, to fit the spaces shown with adequate clearances, and capable of being handled through openings provided in the structure for this purpose. Provide equipment of such design that piping and electrical connections, ductwork and auxiliary equipment can be assembled and installed without causing major revisions to the location or arrangement of any of the facilities.

C. Furnish all fabricated steel sections shop assembled into units as large as practicable and as shipping regulations will permit and match marked for field assembly. Provide mechanical equipment and components shop mounted on the steel sections as much as practicable for shipment, in order to keep field assembly and welding to a minimum. Furnish required lifting lugs.

D. Shop assemble all screws, bearings, end plates, and trough.

E. Clearly identify all loose items by equipment number and erection mark numbers to facilitate assembly.

F. Provide continuous seal welds in conformance with AWS D1.1 at all welded joints. Skip welds will be permitted on external reinforcements. Grind welds smooth and to a uniform finish.

2.05 EQUIPMENT

A. Hopper

1. Hopper shall be designed such that each one may be shipped in as few sections as is practical for shipping. The hopper shall have bolted fit-up connections for field erection by the contractor. After field fit the contractor shall field weld the flange seams for a watertight vessel.

2. Troughs shall be lined with ultra high molecular weight polyethylene (UHMW-PE) based material, which has been specifically modified for the reduced friction and wear requirements of the application.

3. Provide flanges for connecting hopper knife gates to hopper discharge pipes.

4. Side slope angles of not less than 60 degrees from the horizontal.

5. Hopper shall be minimum ¼-inch plate which external stiffeners as required.

6. Design stiffening members to limit deflection of hopper to 1/270 of span.

7. Design hopper to rest on the support structure or floor as shown on the Drawings.

8. Provide continuous welds at all welded hopper joints. Stiffeners do not require continuous welds.

9. Provide connections as shown on the Drawings.

10. Hoppers shall have integral support structure with SST anchor and hardware suitable for mounting to concrete floor or support pad.

11. Design integral hopper supports for dead loads and live loads assuming hoppers completely full of biosolids of 65 lb/ft^3 density. Live loads are as specified on Drawings.

12. Design the hoppers to have the minimum vertical clearance as specified on the Drawings.

13. Provide anchor bolts for support structure.

B. Live Bottom Screw Conveyors

1. Provide a live bottom consisting of two nonreversible shafted screw conveyors.

2. Live bottom screws shall be mounted in a stainless-steel trough assembly. The trough shall be minimum 3/8” plate with external stiffeners and liner as required.

3. Screw flights to be minimum 12-inch diameter.

4. Single flights with variable pitch shall be provided. Flight outside diameter shall be CEMA standardized sizes. Flights shall be of the required diameter and thickness to convey the specified material at the specified rate.

5. Sectional flights shall have a constant cross section. Flights shall be butt welded into a continuous helix, continuous throughout its entire section. Flights may be full face or ribbon type.

6. Pipe shaft shall be A53 minimum schedule 40, 8” diameter pipe and shall deflect no more than 0.025”.

7. Flights shall be manufactured from A235 abrasion resistant alloy steel with a Brinnell hardness of 220, and maximum yield strength of 80,000 psi. Pipe shafts shall be manufactured from carbon steel. Carbon steel flights and pipe shall be coated with one coat of epoxy shop primer only.

8. Conveyor pitch design shall collect and pull sludge from the entire cross section of the hopper.

9. Provide radial and thrust flange bearings for screw flight drive and end shafts.

10. Provide externally flange mounted bearings, double tapered, grease lubricated roller bearings having an AFBMA C-10 rating life of 100,000 hours.

11. Provide grease fittings at each bearing.

12. Provide packing glands on outboard hopper wall to prevent contamination of bearings.

13. Designs incorporating inboard bearings, intermediate supports, or bearings located inside the hopper are not acceptable.

14. Fabricate screws to CEMA 300 Standards.

15. Each screw shall incorporate a speed switch to detect low or no speed.

C. Live Bottom Screw Conveyor Drive Units

1. Provide live bottom drive unit with gear motor
2. One drive will be provided for each live bottom screw.
3. Provide severe duty inverter duty motors. Live bottom screw conveyor motors shall have space heaters and temperature sensing and protection.
4. Ensure output speed of bottom screw conveyor secondary gear reducer is as required for specified discharge rate of 39 ft3/hr. min.
5. Provide minimum 3 Hp, 1,800 rpm, 460 volt, 60 Hz, 3 phase motors with a1.15 services factor, with Class F insulation. Furnish motors with TEFC enclosure and Design B speed/torque characteristics.
6. Provide all gear reducers with AGMA Class II, single or double reduction, helical gear units with high capacity roller bearings. Design bearings for thrust loads from the fully loaded startup condition with an AFBMA B10 life of 30,000 hours. Provide standard air-cooled reducer units with no auxiliary cooling. Size the gear reducer with a torque service factor of 1.5 times the absorbed power or 1.1 times the motor nameplate, at the driven shaft speed, whichever is greater.
7. Maximum continuous operating torque shall be determined by hopper manufacturer for worst combination of service conditions, feed or discharge rate, and biosolids consistency.

D. Leveling Screws

1. Screw flights to be minimum 12-inch diameter.
2. Single flights with variable pitch shall be provided. Flight outside diameter shall be CEMA standardized sizes. Flights shall be of the required diameter and thickness to convey the specified material at the specified rate.
3. Sectional flights shall have a constant cross section. Flights shall be butt welded into a continuous helix, continuous throughout its entire section. Flights may be full face or ribbon type.
4. Pipe shaft shall be A53 minimum schedule 40, 8 inch diameter pipe and shall deflect no more than 0.025”.
5. Flights shall be manufactured from A235 abrasion resistant alloy steel with a Brinnell hardness of 220, and maximum yield strength of 80,000 psi. Pipe shafts shall be manufactured from carbon steel. Carbon steel flights and pipe shall be coated with one coat of epoxy shop primer only.
6. Conveyor pitch design shall collect and pull sludge from the entire cross section of the hopper.
7. Provide radial and thrust flange bearings for screw flight drive and end shafts.
8. Provide externally flange mounted bearings, double tapered, grease lubricated roller bearings having an AFBMA C-10 rating life of 100,000 hours.

9. Provide grease fittings at each bearing.
10. Provide packing glands on outboard hopper wall to prevent contamination of bearings.
11. Designs incorporating inboard bearings, intermediate supports, or bearings located inside the hopper are not acceptable.
12. Fabricate screws to CEMA 300 Standards.
13. Each screw shall incorporate a speed switch to detect low or no speed.

E. Leveling Screw Drive Units

1. Provide leveling screw drive unit with gear motor
2. One drive will be provided for each leveling screw.
3. Provide severe duty inverter duty motors. Leveling screw motors shall have space heaters and temperature sensing and protection.
4. Ensure output speed of bottom screw conveyor secondary gear reducer is as required for specified discharge rate of 39 ft3/hr. min.
5. Provide minimum 3 Hp, 1,800 rpm, 460 volt, 60 Hz, 3 phase motors with a1.15 services factor, with Class F insulation. Furnish motors with TEFC enclosure and Design B speed/torque characteristics.
6. Provide all gear reducers with AGMA Class II, single or double reduction, helical gear units with high capacity roller bearings. Design bearings for thrust loads from the fully loaded startup condition with an AFBMA B10 life of 30,000 hours. Provide standard air-cooled reducer units with no auxiliary cooling. Size the gear reducer with a torque service factor of 1.5 times the absorbed power or 1.1 times the motor nameplate, at the driven shaft speed, whichever is greater.
7. Maximum continuous operating torque shall be determined by hopper manufacturer for worst combination of service conditions, feed or discharge rate, and biosolids consistency.

F. Live Bottom Knife Gates

1. Provide a knife gate for pump maintenance purposes.
2. Provide each gate frame with a gasketed, bolted connection to a flange on the hopper discharge pipe.
3. Provide each gate frame with suitable extension members and yokes to permit proper distribution of operating thrusts.
4. Gate clear opening shall be approximately 12”.
5. The knife gate blade shall be fully machined.
6. The throat opening shall seal against the gate blade with replaceable seals on all sides.
7. The knife gate shall have a rising stem.

8. Provide minimum gate blade thickness of 0.58 inch.
9. Design bottom knife gates to open and close when loaded with material.
10. All gate wetted parts are to be T-304 stainless steel.
11. All gate wetted and sealing parts shall be machined.
12. Knife gates shall utilize seals that do not allow leakage through the stem seal when in the open position.
13. Knife gate shall be by Dezurik, Wey or equal.

G. Live Bottom Knife Gate actuators:

1. The gate will operate by means of a manual handwheel.
2. The handwheel shall be 12” OD maximum.

2.06 FINISHES

A. After welding, clean stainless-steel components using a solvent free of chlorides. Remove embedded iron from stainless steel welds by pickling with nitric or hydrofluoric acid.

B. All carbon steel shall be hot dipped galvanized (HDG) to ASTM 123 except screw pipe and flights which shall have one coat of shop primer only.

C. All purchased components shall utilize the manufacturers standard epoxy coating.

2.07 ELECTRICAL CONTROL SYSTEM

A. Power supply to the equipment will be 480 volts, 60 Hz, 3-phase.

B. Control Panel:

1. Panels shall be NEMA 4X, stainless steel.
2. Equipment control panel shall be factory assembled, wired, and shall contain all necessary control devices for the operation of the discharge gates, load cells and other devices specified herein. Control devices include VFDs, motor starters, control power transformer, control switches, pilot lights, relays, interlocks with upstream and downstream process equipment, and other devices as required for a complete and operating system.
3. The panel shall include an AB MicroLogix 1400 PLC with a 10” Rockwell HMI. PLC shall have Ethernet connection for interface to plant control system. Coordinate with system integrator of plant control system.
4. Entire control panel assembly shall be UL listed and mounted for operator control.
5. Control panel shall include a main circuit breaker disconnect with externally operable handle lockable in the OFF position.
6. Control panel shall include an air conditioner.

7. An electric heater with integral thermostat shall be provided in the panel to prevent moisture accumulation.

C. Load Cells

1. Each support on the wet cake hopper shall have a load cell (minimum of 6) with controls to be used for continuously monitoring the amount of wet cake within the hopper.

2. Manufacturer to provide a closed loop level control system.

3. Each weighing assembly shall consist of a nickel-plated load cell of the shear beam strain gauge type and all appropriate mounting hardware.

4. A flexible cable shall connect each load cell to the indicators for easy remote installation of the readout. Cable lengths shall be a minimum of 50 feet.

5. Weighing assemblies shall be self-checking and have provisions for thermal expansion and contraction. Weighing assembly load plate shall be able to compensate for mounting surfaces up to 4 degrees off-level.

6. A remote mounted 4-1/2 digit LCD indicator shall be housed in a NEMA 4X, UL approved enclosure. LCD Indicator shall be backlit with 0.5" characters for ease of readability in low light conditions.

7. To allow indication of net weight, indicator shall be equipped with a sealed ten turn knob for tare adjustment. Indicator shall output net weight via a 4-20mA signal for remote monitoring.

8. Load cells shall be by Kistler Morse or approved equal.

D. Level Sensing Device Connections

1. The hopper shall be furnished with four connections for a level metering system consisting of an ultrasonic (or radar) level transmitter for measuring the level of wet cake in the hopper. An admittance probe, with level switch, shall be supported vertically from the top of the hopper such that it will normally not be in contact with any wet cake.

2. Ultrasonic Level Transmitter:

a. Ultrasonic level transmitter shall be a microprocessor-based electronic unit consisting of a sensor assembly, a signal converter/transmitter, and interconnecting cable.

b. Sensor shall be encapsulated in a chemical and corrosion-resistant material such as CPVC and shall be suitable for operation over a temperature range of -20°F to 150°F, with a relative humidity of 10 to 100 percent.

c. Ultrasonic level transmitter shall have automatic compensation for changes in air temperature at the sensor location. If separate temperature sensing probe is provided, it shall be mounted with or adjacent to the ultrasonic sensor.

d. The transmitter shall have a four-digit LCD display scaled to read in engineering units. Digit height shall be approximately 0.5 inch.

e. The transmitter shall be designed to ignore momentary level spikes, false targets, or momentary loss-of-echo. A loss-of-echo condition shall be indicated on the transmitter unit and shall be available as an alarm contact output.

f. Transmitter output shall be an isolated 4-20 mA DC signal linearly proportional to the measured level range. Calibration parameters shall be entered through a keypad on the unit and shall be stored in nonvolatile EEPROM memory. Accuracy of the transmitted signal shall be within 0.5 percent of the level range.

g. The transmitter shall contain four independently adjustable level alarm contact outputs. Contacts shall be single pole, double-throw, and rated not less than 5 amps at 120 volts AC.

h. An appropriate length of sensor-to-transmitter signal cable shall be furnished with the instrument. The sensor shall be capable of being located up to 100 feet away from the signal converter. The signal converter electronics shall be housed in a corrosion resistant NEMA 4X enclosure suitable for wall or pipe stand.

PART 3: EXECUTION

3.01 INSTALLATION

A. The hopper shall be installed in accordance with the manufacturer's written recommendations.

3.02 HYDROSTATIC TESTING

A. Contractor shall field verify hopper integrity through hydrostatic testing in the presence of the Owner or Owner's Representative.

B. Hopper shall be filled with water to 12 inches below the top of the hopper for 2 hours. Manufacturer shall repair any leaks as needed and Contractor shall re-test until Engineer and Owner are satisfied with hopper integrity.

3.03 LUBRICANTS AND LUBRICATING EQUIPMENT

A. Provide and install necessary grade quality oils, greases and anti-seize compounds for initial operation of all equipment provided that requires oil, grease or anti-seize.

B. Anti-seize shall be applied to the threads of all stainless-steel bolts before assembly at the factory and field assembly.

3.04 MANUFACTURER'S SERVICES

A. All manufacturers' field services shall be provided and performed in accordance with Sections 01400 Quality Control and 01640 Manufacturer's Services.

B. Manufacturer's Representative: Present at site or classroom designated by Owner, for minimum person-days listed below, travel time excluded:

1. 2 person-days for installation assistance and inspection

2. 1 person-day for functional and performance testing, including, but not limited to, verification of proper alignment, proper rotation, and panel operation
3. 2 person-days for facility startup
4. 1 person-day for training of Owner’s personnel

END OF SECTION

SECTION 11610

SHAFTLESS SPIRAL CONVEYORS

PART 1: GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment, and incidentals to install, test, complete and ready for operation, two (2) shaftless spiral conveyers, as shown on the Contract Drawings and as specified herein.

B. The conveying equipment shall be of the shaftless type, specifically designed for the conveyance of 98% dried sludge or for 16% dewatered sludge.

1.02 SUBMITTALS

A. Submit in accordance with the Section 01300 Submittals, copies of all materials required to establish compliance with this Section. Submittals shall include at least the following:

1. Certified shop and erection drawings showing all details of construction, dimensions and anchor bolt locations.
2. Descriptive literature, bulletins, and/or catalogs of the equipment.
3. The total operational weight of the equipment including the single largest component.
4. Complete bill of materials of all equipment.
5. A list of the Manufacturer's recommended spare parts.
6. Complete motor data.
7. Conveyor torque requirement calculations.
8. Torque calculations for the gear reducer and reducer motor.
9. Horsepower calculations for the drive motor(s).
10. Complete control panel component and wiring schematics.

B. Operations and Maintenance Manuals

1. Complete operating and maintenance instructions shall be submitted in accordance with the requirements of Section 01730 Operating and Maintenance Manual.
2. The manual shall include: Equipment Data Pages, Equipment Introduction and Operation, Warranty, Long Term Storage, Troubleshooting, Maintenance and Lubrication, Spare Parts List, Equipment Listing, Catalog Cuts, and Drawings.

1.03 QUALITY ASSURANCE

A. A single manufacturer shall furnish all the equipment specified under this Section. The equipment shall be designed, constructed and installed in accordance with the best practice and methods, and shall operate satisfactorily when installed.

B. All shop welding shall conform to the latest standards of the American Welding Society (AWS).

C. All equipment furnished under this Section shall be new and unused and shall be the standard products of manufacturers having a successful record of manufacturing and servicing the equipment and systems specified herein for a minimum of five (5) years.

1.04 DELIVERY STORAGE AND HANDLING

A. Provide in accordance manufacturers recommendations and with Section 01600 – Delivery, Storage and Handling.

B. All parts shall be properly protected so that no damage or deterioration will occur during a prolonged delay from the time of shipment until installation is completed and the units and equipment are ready for operation.

1.05 WARRANTY

A. The manufacturer shall warranty the equipment furnished under this section to be free from defects in material and workmanship for a period of twelve (12) months after the equipment was first placed into operation at the jobsite or eighteen (18) months after the equipment was first delivered to site, whichever date occurs first. Any warranted material defects found to exist shall be corrected (repaired or replaced) at no cost to the Owner.

B. The shaftless spiral and replaceable wear liner shall be warranted for a period of three years from factory start-up against wear.

1. Spiral: Excessive wear on the screw shall be indicated by loss of more than 50% of the height of the main outer screw section over 30% of the total length of the screw. If excessive screw wear is found the conveyor supplier shall provide new screw to replace the screw in the conveyor that has excessive wear.

2. Liner: For a wear indicator (two color) liner, excessive wear shall be indicated by appearance of the bottom indicator layer (second color) along more than 30% of the conveyor length during the first three years of service. If these wear indications occur the conveyor supplier shall provide new formed and banded liner to replace all the liner in the conveyor that has excessive wear.

3. Liner: If a one color liner is approved, excessive wear shall be indicated if the thickness of the liner, at three points over a 30% long section of the conveyor, is less than ¼” thick at the thinnest point of the liner, during the first three years of service. In addition, as single color liner prohibits a simple visual inspection to confirm wear, the conveyor manufacturer shall perform the annual inspections. Conveyor supply shall supply a field technician to the jobsite on the annual acceptance date for three consecutive years, to analyze the liner and demonstrate to the owner satisfaction that a minimum of ¼” of liner is

remaining. If excessive liner wear is found the conveyor supplier shall provide new formed and banded liner to replace all the liner in the conveyor that has excessive wear.

PART 2: PRODUCTS

2.01 MANUFACTURERS

A. Spirac
B. Keller Sales
C. Keystone Conveyor Corp.
D. JMS

2.02 DESIGN CRITERIA

Conveyor Tag Numbers	**15-S-C-1**	**15-S-C-2**
Trough, Cover, Inlets, Discharge, material/grade	304 SST	304 SST
Trough material thickness, min. ga./inch	10 ga.	10 ga.
Cover material thickness, min. ga.	12 ga.	12 ga.
Cover fastener type	SS	SS
Supports, material/grade	304	304
Supports min. thickness	0.25”	0.25”
Support type, floor/hanging/structure	F	S
Screw flight, material/grade	AR235	AR235
Screw flight, min. thickness	0.1875”	0.1875”
Rotor material/grade	A53	A53
Rotor pipe, schedule, min.	2”, 40	2”, 40
Hanger material/grade	304	304
Hanger, CEMA type	226	226
Bearing, hanger, material	Hard Iron	Hard Iron
Hanger bearing, max. distance	12’	12’
Hanger bearing lubrication type	SKF S24	SKF S24
Inlet chute, material thickness, ga./in. min.	10 Ga.	10 Ga.
Gaskets durometer	50	50
Gaskets, thickness	0.12”	0.12”
Slide gate material/grade	304	304
Slide gate, size W x L, inches	10” X 10”	10” X 10”
Spray nozzles, material	NA	NA
Control enclosures, material/grade	304	
Discharge Points		4

2.03 MATERIALS

A. Materials used in the fabrication of the equipment under this section shall conform to the following, as further detailed in the “Design Table A” at the end of this section:

1. Chutes, Troughs, End Plates, and Covers shall be of AISI 304 stainless steel sheet and plate.

2. Supports shall be AISI 304 stainless steel, minimum 1/4" thick, structural shapes.

3. Spiral Flighting shall be of High Tensile Micro Alloy Steel (HTMAS).

4. Wear Liner shall be of Ultra High Molecular Weight Polyethyline (UHMW-PE), and modified for wear applications.

5. Fasteners, except for power transmission or drive components, shall be of 18-8/304SS.

B. Gear Reducers, Motors, and other ancilliary items shall be designed and rated for the severe environment of this application.

C. Power supply to the equipment will be 460 volts, 60 Hz, 3 phase. Power supply for controls and control devices, shall be 120 volts, 60 Hz, single phase.

D. All electrical equipment shall conform to applicable standards of the National Electrical Manufacturers Association (NEMA) and the National Electrical Code (NEC).

2.04 FABRICATION

A. The shaftless spiral conveyor equipment shall include the following as defined and described within this specification section:

1. Troughs, Liners & Covers, and fabrications defined within this specification.

2. Spiral Flighting

3. Chutes

4. Drive Motor & Gear Reducer

5. Mounting and Support Structure

6. Safety or electrical items defined within this specification

7. Spare Parts

B. All welds to be continuous unless otherwise specified. Facing surfaces of field-welded components shall be beveled and match marked.

C. Sharp corners of all cut and sheared edges shall be made smooth by edge grinding.

2.05 SURFACE PREPARATION

A. All iron and mild steel surfaces to be painted shall be dry abrasive blasted in accordance with SSPC-SP6, and in accordance with the painting section of these specifications. Surfaces shall be painted or hot dip galvanized within 24 hours to prevent rusting and surface discoloration.

B. Stainless steel shall be cleaned with mild abrasive wheels and/or nonferrous blast media to remove heavy scale and welding carbon and/or passivated with stainless steel cleaner then rinsed.

C. After surface preparation, ferrous metal surfaces, if any, except for the spiral flighting shall receive a minimum of one (1) coat of epoxy primer. Provide a total minimum dry film thickness of 3 mils prior to shipment to jobsite. Primer shall be compatible with the paint system specified for the equipment under “Painting” section of these specifications. Finish coats shall be applied at the jobsite by the General Contractor.

D. The spiral shall be furnished with one coat of shop primer only.

E. Electric motors, gear reducers, electrical control panels, and other purchased sub-components shall be furnished with the manufacturer’s standard finish.

F. Stainless steel surfaces do not require painting.

2.06 SHAFTLESS SPIRAL

A. Spiral flighting for the shaftless screw conveyors shall be designed to convey material without a center shaft or hanger bearings.

B. Spiral flights shall be formed from corrosion resistant HTMAS (High Tensile Micro Alloy Steel) and shall be concentric to within +/- 2mm.

C. Spiral shapes shall be cold formed from continuous bar, in two distinct stages, in order to achieve optimum hardness. Shaftless spiral flighting shall not be fabricated from plate.

D. For increased efficiency, a second, inner spiral, concentric with the outside spiral shall also be provided.

E. Spiral strength calculations shall be supplied by the manufacturer, to show that torsional ratings of completed spirals exceed the torque load produced within the trough at 150% of the design load.

F. Spiral deformation calculations shall supplied by the manufacturer. Calculations shall be based on the formula for cylindrical helical springs of rectangular cross section, found in the latest edition of Marks’ Standard Handbook. Calculations cannot rely on use of a correction factor for close coils, and must result in demonstrating a "spring effect" of the completed spiral which does not exceed +/- 1/8” per linear foot of spiral under conditions of 100% trough fill.

G. The minimum outer spiral thickness shall be 0.50”..

2.07 SPIRAL WELDING

A. Spiral flighting shall have full penetration welds at all splice connections, to present a continuous and complete spiral upon installation.

B. Field welds at the jobsite by the installer may be necessary when any overall conveyor length presents shipping or handling constraints.

C. When welding spiral sections in the field during installation, the installing contractor shall be provided with complete instructions from the spiral manufacturer. Spiral ends requiring field welding, shall be prepped and match marked by the spiral manufacturer prior to delivery.

2.08 SPIRAL MOUNTING

A. The driveshaft with integral coupling disc, shall penetrate the end plate through a guarded, serviceable, gland packing housing prior to insertion to the gear reducer. The coupling disc shall be machine faced after fabrication, to include centering hub for spiral mounting and alignment.

B. The connection of the spiral to the drive system shall be through fastening of the driveshaft and spiral coupling discs. Fasteners shall be readily accessible and of a corrosion resistent high strength material.

C. The spiral coupling plate, shall be reinforced with a welded gusset, shaped and formed to provide a transition of load forces from the plate to the spiral. Connections which use torsion arms with point load connections to the spiral shall not be acceptable.

D. The drive shaft assembly shall incorporate a grease lubricated labyrinth seal, serviceable from the exterior of the conveyor, which is shaft mounted internally between the back plate and spiral coupling connection.

2.09 HORIZONTAL AND INCLINED TROUGHS (LESS THAN 35 DEGREE)

A. U-shaped troughs shall be formed of sheet or plate, similar to the dimensional standards of CEMA 300 and to CEMA enclosure classification IIE.

B. Troughs shall be constructed with formed upper faces integral to the body of the trough, in order to provide optimum sealing of the gasketed connection between lid and trough. Designs incorporating structural angle welded to the trough body for the upper faces, shall be fully welded and ground smooth on the inside, with stitch welding on no greater than 6inch centers on the outside.

C. Troughs shall be flange-joined when any section exceeds 24ft in length.

D. Non-drive ends shall be provided with flanged bolted end plates, where not axially connected to following equipment.

E. A drain outlet shall be integral to the conveyor trough, in order to facilitate cleaning. Drain outlet shall be located as shown on the contract drawings. Drain flushing connections shall be provided if and where specified by the contract drawings. The drain outlet shall be piped to a drain as shown on the drawings. The Contractor shall furnish all labor and materials to connect the conveyor drain and/or flush water to the plant water and drain system.

F. Each trough shall be equipped with inlet and/or discharge openings as shown on the contract drawings. If required, each inlet and discharge opening shall be flanged suitable for interconnection to other devices. Any interconnecting devices such as chutes or hoppers shall be fabricated from the same grade of material as the troughs and with a gauge thickness to suit the application requirements.

G. Bolted covers shall be furnished for any portion of each trough that is not covered by the filling chute. Covers shall be manufactured in maximum five (5) foot lengths to allow for ease of access during replacement of the (shorter) sectioned wear liner. Quick opening covers will not be allowed unless they are also bolted, in order to discourage direct access to the shaftless spiral during normal operation.

H. Inlet and discharge hoppers or chutes shall be provided of the same construction material as the conveyor troughs, as shown on the contract drawings. Flanges shall be a minimum 0.25” thick.

I. Safety Labelling shall be CEMA severe duty style, appropriate for the equipment, and affixed at the factory. In addition to warning of operation without covers, all warning labels shall include a callout for lockout of power before servicing. When indicated on the contract drawings, inspection hatches shall be provided with removable finger guards.

J. In order to avoid excessive wear and increased maintenance the conveyors shall be designed without the use of steel hold down bars or structural steel assemblys. Hold down liner segments which do not interfere with the flow of material are acceptable. Acceptable placement shall be limited to the underside of lids. Segments shall be removable without welding, and incorporate leading and trailing bevelled edges.

2.10 REPLACEABLE WEAR LINER

A. Conveyor troughs shall be lined with ultra high molecular weight polyethylene (UHMW-PE) based material.

B. Wear liner shall be supplied in maximum 4ft sections, in order to provide for ease of replacement during servicing.

C. Each section of liner shall be a single piece, formed and bonded with two (2) layers of the same material, each of a different color, to provide a visible indication when the liner is nearing the end of its useful life.

D. Each layer shall have been modified to have the same properties for reduced friction and wear. Liners which bond a second layer of unmodified UHMW can be readily dislodged after the primary layer is worn through, and will not be acceptable.

E. The liner shall be held in place with stainless steel cleats, permanently welded to the inside of the trough. No fasteners or penetrations through the trough wall shall be allowed.

F. Liner thickness shall be 3/8” for vertical conveyors; 1/2” for spirals up to 14” diameter, and 5/8” for larger spirals. On all sizes, the wear indicating color shall be at least 1/8” thick, in order to provide the strength to be retained in the trough while showing wear.

G. Replacement liner shall be readily available and stocked in the United States by the shaftless spiral conveyor equipment manufacturer.

2.11 CONVEYOR SUPPORTS

A. Conveyors shall be furnished complete with supports suitable for mounting as shown on the contract drawings.

B. Conveyor supports and support mounting brackets, shall be of stainless steel structural plate and shapes, all a minimum 0.25” thick.

C. Supports shall be fabricated, assembled and fit to the conveyor prior to its delivery to the jobsite. Supports and conveyor segments shall be clearly match marked by the manufacturer, for ease of installation by the contractor.

D. For design of floor supports with imbedded anchors, manufacturer shall allow for up to 1 inch of grout beneath each support foot pad for the Contractor to compensate for unevenly poured elevations.

E. All hanging supports furnished by the conveyor manufacturer shall be up to 6 inches longer than required for field fit and levelling by the Contractor during installation.

F. Hanging connections shall be designed and approved by the Engineer.

G. Conveyor supports shall not be restricted to flange joint locations.

H. Supports shall be coordinated and designed with the installing contractor, and located along the conveyor trough so as to avoid interference with other equipment, site features, or equipment supports.

I. The Contractor shall be responsible for all floor and hanging support anchoring fasteners.

2.12 GEAR REDUCTION UNIT

A. All gears shall be AGMA Class II, single or double reduction, constant speed gear reduction units, with high capacity roller bearings.

B. Bearings shall be designed for the thrust loads of the application, and shall have a minimum Bearing Service Life L_{10} of 30,000 hours (or L_{50} of 150,000 hours), as defined by the American Bearing Manufacturers Association (ABMA).

C. Manufacturer shall provide bearing service life calculations compiled by the gear reducer supplier. Results shall be based on the specific design load of the application, as calculated by the manufacturer. Bearing life shall not be based on a modified value from the specific drive manufacturer.

D. The reducer will be air-cooled unit with no auxiliary cooling requirement. The gear reducer shall be sized with a torque service factor of 1.5 times the absorbed power or 1.1 times the motor nameplate at the driven shaft speed, whichever is greater.

E. Conveyor gear reduction units shall be powered by direct coupled motors. Drive systems incorporating V-belts or separately supported drives and motors, shall not be acceptable.

F. Drives shall be completely supported by direct mounting to a dual flanged bellhousing adapter, providing connection to the drive end plate of the shaftless spiral conveyor.

G. Bellhousing adaptors shall set off the drive from the trough, in order to allow seepage of any material from the conveyor trough to atmosphere rather than onto the output seal of the gear reducer/ motor drive unit. Directly attaching the gear reducer to the drive end plate of the conveyor will not be acceptable.

H. The drive unit mounting to the end of the trough shall require no additional supports, and there shall be no visible "wobble" movement under any operating condition.

I. To allow for system upset, the drive system shall be designed at a minimum, to operate the conveyor with a trough filled to 1.5x the theoretical design load.

2.13 DRIVE MOTORS

A. All motors shall be 3 hp, 460 volt, 60 Hz, 3 phase, comply with the motor specification and be rated for the operational area noted in the contract drawings.

B. Motors shall be of energy efficient design meeting or exceeding the most current edition of NEMA MG1-Table 12-10.

C. Motors shall have a 1.15 nameplate service factor, a TEFC enclosure, and be designed with torque characteristics in accordance with NEMA MG1-12.35 and 12.38.

2.14 ELECTRICAL ACCESSORIES

A. Electrical items shall conform to the applicable standard of the National Electrical Manufactures Association (NEMA) and the National Electrical Code (NEC). Both power and control equipment shall be insulated for not less than 600 volts even though operating voltages may be lower.

B. Motion (Rotation) Sensor Probe. A non-contacting rotation sensor shall be lid or trough mounted on the conveyor, away from the drive. Sensor shall be rated for the environment of the application and shall not require a trough penetration for proper operation. Sensor shall be a model MSP-12 by Siemens Milltronics or approved equal.

C. Motion (Rotation) Failure Alarm Unit. Each probe shall be provided with a motion failure alarm controller, to report spiral or drive shaft failure. The Motion Failure Alarm shall be housed in an enclosure suitable for the environment. The unit shall be a model MFA-4P by Siemens Milltronics, or approved equal.

D. Emergency Pull Cord Switch.

1. Conveyors shall be furnished with emergency pull cords. The cords shall activate a dual relay, trough mounted emergency stop switch, intended to provide a signal to immediately stop the conveyor, and any feeding devices, when activated.

2. Pull cords shall run the full length of the conveyor in a straight path, guided through eyebolts spaced on not greater than 12-ft centers. Cording shall be orange colored, nylon coated, corrosion resistant safety cabling.

3. The pull cord switch shall be housed in an enclosure suitable for the environment.

2.15 SLIDE GATES

A. Slide gates to be provided in accordance with conveyor design schedule (qty., size, and material of construction).

B. The slide gate and actuator shall be fully supported by the conveyor or as otherwise indicated by the drawings.

C. The slide gates shall be fabricated with material as stated in conveyor design schedule – includes frame and gate blade.

D. Gates shall be factory assembled, adjusted, and tested.

2.16 SLIDE GATE FRAME

A. The slide gate body shall be 1/4-inch minimum thickness frame. Greater thickness shall be provided based on actual actuator thrust forces.

B. Construct gate frame of structural members or formed plate welded to create a rigid 1-piece frame.

C. The frame shall incorporate a dust-proof cover plate (expanded metal guard) to cover the blade retraction area. Guards or covers shall be bolted to facilitate maintenance.

D. Slide gate frame shall be flanged top and bottom with CEMA trough flange bolt hole patterns.

E. Frame shall be designed to support the gate actuator, accessories, and any required restraint connections.

2.17 BLADE

A. The minimum thickness of the gate blade shall be 1/4-inch minimum. Greater thickness shall be provided based on head pressure.

B. Blade will have provision for a ramping system that will ensure the gate blade will make positive contact with the gate seal in the closed position.

2.18 GUIDES & SEALS

A. The gate shall be provided with plastic guides, rollers and a ramping mechanism to seal when in the fully closed position. The seal shall be neoprene 60 Durometer, vulcanized at all corners or connections.

B. Frame shall have ultra-high molecular weight polyethylene insert in contact with gate blade edges to eliminate racking and misalignment during the open and closing cycling of the gate.

C. Sealing and sliding surfaces shall provide a low coefficient of friction with the surface of the slide.

D. Slide gates shall be designed for a 10 psig rating.

E. Rollers shall be T-440C stainless steel. Guides shall be UHMW PE.

2.19 ACTUATOR

A. The conveyor manufacturer shall provide electric motor operated actuators for open/close operation or as indicated in the conveyor design schedule.

B. The actuators shall have a rising stem with cover. The stem connection shall allow for movement of the blade during ramping. Stem shall be stainless steel machine cut or rolled threads.

C. The actuators shall be NEMA 4X,1 hp maximum, 460V, 3-phase.

D. The actuators shall include an integral reversing motor starter, internal adjustable limit switches, integral controls, and manual hand-wheel back-up with clutch release.

E. Electric actuators shall be Limitorque MX, Rotork IQ or Auma AC.

2.20 SPARE PARTS

A. All Spare Parts shall be provided in protective packaging for long-term storage.

B. Manufacturer shall clearly identify and furnish any special tools required for routine service and maintenance of the equipement. Special Tools shall be provided in packaging designed for storage and repeated use.

C. The following spare parts shall be supplied, as a minimum:

1. One (1) Packing gland set, for each conveyor supplied

2. One (1) complete set of liner for all conveyors if the second color of the liner is not the same material as the base liner.

D. Conveyors shall be supplied by the manufacturer fully and completely lubricated and ready to be placed into operation. No spare lubricant shall be required for the gear reduction units within the warranty period.

PART 3: EXECUTION

3.01 FUNCTIONAL TESTING

A. Prior to startup, inspect all equipment to ensure proper alignment, proper operation, proper connection, and satisfactory operation of all equipment.

B. Functional Testing shall demonstrate that the conveyor and ancillary equipment are operating as specified.

C. Verification of electrical power and control panel operation, including interfacing with the other solids handling equipment and the plant SCADA system, shall be included in Functional Testing.

D. If In the opinion of the Engineer, the system is operating as intended, Performance Testing may begin. If the system is determined to not be in compliance or is not operating as specified, the Contractor shall make all necessary improvements at no additional cost to the Owner.

3.02 MANUFACTURER'S SERVICES

A. All manufacturers’ field services shall be provided and performed in accordance with Sections 01400 Quality Control and 01640 Manufacturer’s Services.

B. Manufacturer’s Representative: Present at site or classroom designated by Owner, for minimum person-days listed below, travel time excluded:

1. 2 person-days for installation assistance and inspection
2. 1 person-day for functional and performance testing, including, but not limited to, verification of proper alignment, proper rotation, and panel operation
3. 2 person-days for facility startup
4. 1 person-day for training of Owner’s personnel

END OF SECTION