SECTION 01010
SUMMARY OF WORK

PART 1 GENERAL

1.01 DESCRIPTION

A. The work to be performed under this Contract consists of furnishing and installing all labor, materials, tools, equipment and incidentals required for construction of new pump station and demolition of the existing Pump Station 1 as shown on the drawings and as defined in these specifications

B. All work shall be as specified and in accordance with the City of Atlanta, Department of Public Works Rules and Regulations Governing Development of. If there is a conflict with any section of these specifications and the Rules and Regulations, the Engineer shall determine which will govern.

1.02 PROJECT LOCATION

The work of this Contract is in Fulton County in the City of Atlanta, Georgia at the southeast corner of the intersection of Woodward Way and Northside Drive.

1.03 SCOPE OF WORK

A. The work of this Contract is shown on the Drawings and may consist of all or some of the following:

1. Connection of discharge piping to existing downstream force main.
2. Installation of an underground, cast-in-place, rectangular concrete wet well.
3. Installation and startup of five (5) submersible pumps, two (2) of which are for dry weather flow and three (3) of which are for wet weather flow.
4. Installation of control panels for the pumps.
5. Installing of free-standing bridge crane and pump removal system.
6. Installing of a retaining wall on the southern boundary.
7. Installing of a perimeter fence with gate around the entire site.
8. Connection of site's electrical system to existing Georgia Power distribution lines.
9. Installation of standby diesel generator.
10. Installation of site lighting and security pole mounting.
11. Installation of gravel access driveway.
12. Decommissioning and Demolition of existing Pump Station 1.
13. Installing of fire hydrant on site.
14. Traffic control during construction.
15. Temporary and Permanent Erosion and Sedimentation Control
16. All associated miscellaneous work, including site grading, site restoration and

cleanup.

B. The Contractor shall furnish and install all labor, materials, equipment and incidentals which are reasonable and properly inferable and necessary for the proper completion of the work, whether specifically indicated in the Contract Documents or not.

C. The Contractor shall perform the work complete, in place and ready for continuous service and shall include repairs, replacements and restoration required as a result of all damages that occur as a result of construction under this contract.

1.04 WORK COORDINATION

A. The Contractor shall coordinate his/her work with all public and private utilities. The Contractor shall insure that all utilities in each street are field marked by the utility owner or designated agent prior to beginning any excavation in that street.

B. The Contractor shall also coordinate his/her work with owners of private and public property where access is required for the performance of the work. Legal access will be acquired and provided by the Owner.

1.05 PMATERIALS

Materials shall be as shown on the Drawings or provided within these specifications.

1.06 QUANTITIES

A. The quantities shown on the Drawings and Bid Schedule are estimated based on the approximate linear feet of pipe to be installed. Portions of the project may require field design or modifications by the Engineer due to added scope or unforeseen field conditions or conflicts.

B. The City reserves the right to alter the quantities of work to be performed or extend or shorten the length of pipe to be furnished and installed at any time when, and as found necessary, and the Contractor shall perform the work as altered, increased or decreased. No allowance will be made for any change in anticipated profits nor shall such changes be considered as waiving or invalidating any conditions or provisions of the Contract and Bond.

1.07 CONDITIONS OF THE SITE

A. The Contractor shall make all necessary investigations to determine the site conditions in the project area and any unique features that may affect the prosecution of the work.

B. The Contractor will be held responsible for any damage to and for maintenance and protection of existing utilities and structures.

1.08 PARTIAL CITY OCCUPANCY

The existing facilities or pipelines to which these improvements are being made or connected to will remain in operation during construction.

PART 2 PRODUCTS

(NOT USED)

PART 3 EXECUTION

(NOT USED)

+ + + END OF SECTION 01010 + + +

SECTION 01020
DEFINITIONS

PART 1 GENERAL

DEFINED TERMS

1. *Addenda* - Written or graphic instruments issued prior to the opening of Bids which clarify, correct, or change the Bidding Requirements or the proposed Contract Documents.
2. *Agreement* - The written instrument which is evidence of the agreement between Owner and Contractor covering the Work.
3. *Abandonment* - Shall mean the permanent termination of the use of, or of service from in or on, a facility.
4. *Acceptance* - The formal written acceptance by the City of the fully and finally completed Work.
5. *Addenda* - Revisions to the Proposal Documents issued by the City prior to opening of the Bid.
6. *Agreement* - The written agreement for the performance of and payment for the Work, which includes by reference and is a part of the Agreement Documents, executed on behalf of the City and the Contactor, also called City-Contractor Agreement.
7. *Agreement Documents* - Includes this Agreement and its Exhibits, Appendices, Work Orders, Change Orders, Documentation, Drawings, and Specifications, including
8. Construction Services Agreement
    a. Exhibit A- General Scope of Services
    b. Exhibit A.1- Compensation and Fee Schedule
    c. Exhibit A.2- Work Orders
    d. Exhibit B- Legislation
    e. Exhibit C- Supplement Conditions and Technical Specifications
    f. Exhibit D- Additional Contract Documents
    g. Appendix A- Office of Contract Compliance
    h. Appendix B- Insurance and Bonding Requirements
9. *Agreement Price* - The price or prices for the Work or items of Work set forth in the Bid.
10. *Agreement Term* - "The meaning is set forth in Article 2, unless otherwise expressly amended or changed, pursuant to the City's authorized approval in conformance with the City of Atlanta Code of Ordinances and applicable law.
11. *AMR System* - The Automatic Meter Reading (AMR) system being used by the City.
12. *Applicant* - Shall mean any person, company or corporation who intends or plans to request for water services for a new development.
13. *Application for Payment* - The form approved by the City that is to be used by Contractor in requesting progress payments or final payment, together with such supporting documentation as is required in the Agreement Documents. The Application for Payment may also be called Payment Application or Progress

Payment.

14. *Approved, Directed, Ordered, Or Their Derivatives* - Approved, as directed, or ordered by the Engineer or the City, unless otherwise clearly indicated.
15. *Asbestos* - Any material that contains more than one percent asbestos and is friable or is releasing asbestos fibers into the air above current action levels established by the United States Occupational Safety and Health Administration.
16. *Bid* - The offer or bid of the Bidder submitted in the prescribed manner on the prescribed form setting forth the prices for the Work to be performed together with supplemental information as required by the Agreement Documents.
17. *Bidder* - Any person, firm, partnership, corporation or any combination thereof submitting a Bid for the Work.
18. *Bidding Documents* - The Bidding Requirements and the proposed Contract Documents (including all Addenda).
19. *Bidding Requirements* - The advertisement or invitation to bid, Instructions to Bidders, Bid security of acceptable form, if any, and the Bid Form with any supplements.
20. *Bonds* - "Bid, Performance Bonds, Payment Bonds, and other instruments of security furnished by Contractor and its surety in accordance with the Agreement Documents.
    a. Bond means a written instrument of surety approved by the City with a valid Certificate of Authority issued by the United States Department of Treasury under Sections 9304 to 9308 of Title One of the United States Code as security to the City, on behalf of a Bidder or the Contractor, to guaranty faithful performance of acts, duties or obligations under the Contract Documents and includes the following.
    b. Bid Bond means the security instrument furnished with a Bid to guaranty that, if the Bidder is awarded the Contract, the Bidder will execute the Agreement within the time specified in the Bidding Documents.
    c. Payment Bond means the security instrument furnished by the Contractor and its surety on the Payment Bond Form as a guaranty that Contractor will pay in full all bills and accounts for materials and labor used in the Work. "
21. *Change* - Any change in the Work authorized by the City's Authorized Representative, including Field Changes, Work Authorizations or Change Orders.
22. *Change Directive* - A written order prepared by the Owner and signed by the Owner directing a Change in the Work prior to or absent an agreement or adjustment, if any, in the Agreement Price or Agreement Time, or both.
23. *Change Order* - The meaning is set forth in Specification 01260 Contract Modifications and Procedures.
24. *City* - Shall mean the City of Atlanta, Georgia, and shall include all agencies, establishments or officials of the government of the City. The City may also be referred to from time to time as the "Owner."
25. *City Representative* - The meaning is set forth in City of Atlanta or duly authorized representative assigned to administer the technical aspects of the Agreement.
26. *City-Contractor Agreement* - The written agreement for the performance of and payment for the Work executed on behalf of the City and the Contactor, which is both a part of the Agreement Documents and includes all Agreement Documents by

reference. The City-Contractor Agreement may also be called "Agreement."

27. *City's Contractor* - Shall mean the legally authorized representative of the City, a private contractor, or other concerned agency performing Work under a direct Agreement with the City.
28. *Claim* - Any demand, contention, or assertion seeking additional time or money under the terms of this Agreement. Claims by the Contractor must be made in writing and contain all of the following or such Claims are released: (a) a narrative statement describing the amount and bases of the Claim; (b) the precise number of days claimed as a result of any delay; and (c) a detailed calculation of the precise amount of additional compensation claimed with all required supporting Documentation.
29. *Construction* - Shall mean the actual site preparation, building and all related Work, including facility relocation and adjustments.
30. *Construction Easement/Temporary Easement* - Any space or area dedicated to the City or other entity for the purpose of utilities or location of utilities for a specific period of time.
31. *Construction Equipment* - Equipment used in the performance of the Work but not incorporated therein.
32. *Contract* - The entire and integrated written agreement between the Owner and Contractor concerning the Work. The Contract supersedes prior negotiations, representations, or agreements, whether written or oral.
33. *Contract Documents* - The Agreement Documents referenced above.
34. *Contract Price* - The moneys payable by Owner to Contractor for completion of the Work in accordance with the Contract Documents as stated in the Agreement.
35. *Contract Times* - The number of days or the dates stated in the Agreement to: (i) achieve Milestones, if any; (ii) achieve Substantial Completion; and (iii) complete the Work so that it is ready for final payment as evidenced by Engineer's written recommendation of final payment.
36. *Contractor* - Any firm, partnership, corporation, joint venture, LLC or any combination thereof who enters into a contractual Agreement with the City. This excludes Subcontractors/Sub-consultants.
37. *Cost of the Work* – The sum of all costs necessarily incurred and paid by Contractor in the proper performance of the Work.
38. *Customer* - The authorized representative of the entity which owns the private water service line to which the Water Service being constructed will be connected.
39. CPM Schedule - A logic tied computerized network schedule incorporating all elements of the Work, prepared and updated in accordance with the requirements of the Special Conditions, subject to approval of the City.
40. *Day* - A calendar day of twenty-four (24) hours lasting from midnight one day to midnight the next day.
41. *Department* - Shall mean the Department of Watershed Management.
42. *Design Clarification Memoranda* – Correspondence issued by the Owner to the Contractor providing clarifying details to the Contract.
43. *Designer* - Shall refer to the firm licensed to practice engineering in the State of Georgia that seals the plans and specifications prior to bid.

44. *Detector Check* - A specific type of check valve used on a fire service line to prevent water from flowing backwards from a facility into a water distribution system.
45. *Detector Check Vault* - The enclosure around a Detector Check including the top slab and hatch which comprise the top of the vault.
46. *Documentation* - The meaning is set forth in Article 4.
47. *Drawings* - Include, without limitation: all renderings, technical and design drawings, specifications, plans, layouts, diagrams, illustrations, descriptions, calculations, schedules, graphs, performance charts, shop drawings; as-built drawings; all graphic or pictorial material needed to show locations, dimensions, elevations, sections, and details; all documents necessary to fix and describe the size, quality and composition of the Project (or parts thereof); supplier operating and maintenance manuals, recommended spare parts lists, documents required to support permitting and licensing, and any other data pertinent to operation of the Project.
48. *Effective Date of the Agreement* - The date indicated in the Agreement on which it becomes effective, but if no such date is indicated, it means the date on which the Agreement is signed and delivered by the last of the two parties to sign and deliver.
49. *Emergency Work* – Work to be performed by the Contractor which poses an imminent threat to the public health, safety, general welfare or the City's water or wastewater system.
50. *Engineer* – shall refer to the firm licensed to practice engineering in the State of Georgia that seals plans and specifications prior to bid.
51. *Equipment* - Equipment incorporated or to be incorporated in the Work.
52. *Field Change* - A Change in Work that includes changes or adjustments to quantities or budget items but does not include a Change in the overall Agreement Price, overall Agreement Time or use of allowance items, which is required as a result of field conditions that require such adjustments. A Field Change does not include a Work Authorization, a Change Order or a Change Directive and is agreed upon and executed by an authorized City representative and the Contractor.
53. *Field Order* - A written order issued by Engineer which requires minor changes in the Work but which does not involve a change in the Contract Price or the Contract Times.
54. *Field Test Records* – The body of information collected by the Contractor during construction containing Quality Control and other technical verifications specific to the Contract.
55. *Final Completion* - Point in time where the City has confirmed to the Contractor in writing that the Services required by a Work Order have achieved Substantial Completion, Contractor has completed all punch-list items associated with a Work Order, and Contractor has provided all Documentation required by the Agreement Documents and Work Orders for Final Completion.
56. *Final Payment* - The final amount of compensation due under a Work Order or this Agreement (as applicable) and shall not become due until Contractor satisfies all of the requirements of the Agreement Documents.
57. *Force Account* - A method of payment, other than lump sum or unit price, for Work ordered by Change Order and paid for in accordance with force account procedures.
58. *GDOT* - The Georgia Department of Transportation.

59. *General Conditions* - The General Conditions of the Agreement for construction that govern the rights, duties, and obligations of the parties.
60. *General Requirements* - Sections of Division 01 of the Specifications. The General Requirements are applicable to all Sections of the Specifications and to the entire Work.
61. *Hazardous Environmental Condition* - The presence at the Site of Asbestos, PCBs, Petroleum, Hazardous Waste, or Radioactive Material in such quantities or circumstances that may present a substantial danger to persons or property exposed thereto.
62. *Hazardous Waste* - The term Hazardous Waste shall have the meaning provided in Section 1004 of the Solid Waste Disposal Act (42 USC Section 6903) as amended from time to time.
63. *Inspector* - The authorized representative of the City assigned to make detailed inspection of any or all portions of the Work or Materials thereof.
64. *Laws and Regulations; Laws or Regulations* - Any and all applicable laws, rules, regulations, ordinances, codes, and orders of any and all governmental bodies, agencies, authorities, and courts having jurisdiction.
65. *Liens* - Charges, security interests, or encumbrances upon Project funds, real property, or personal property.
66. *Liquidated Damages* - Amounts shall be as stipulated in the Agreement. Liquidated damages shall apply to the Contract Times for the Project. Liquidated Damages shall be both additive and cumulative. Liquidated Damages shall end upon Substantial Completion, Completion of the Work associated with each Milestone Date, and upon final completion of the Work.
67. *Long Side* – A term which identifies that the water main to which a Meter or Detector Check is connected is located on the opposite side of the road as the Meter or Detector Check. In this situation the Water Service Line which connects the Meter or Detector Check to the water main is often referred to as a long side water service line or a long side service line.
68. *MARTA* - Shall mean the Metropolitan Atlanta Rapid Transit Authority, or its designated legal representatives.
69. *Materials* - Materials incorporated or to be incorporated in the Work unless otherwise clearly indicated.
70. *Meter* – A meter including all components of the meter and meter reading system located within or on a Meter Box, Meter Vault, or Detector Check Vault (e.g. the strainer, registers, meter interface units, antennas, antenna cables, etc.)
71. *Meter Box* - The enclosure around a water meter including the frame and lid which comprise the top of the box. Meter Boxes are used for Meters that are $\leq$ 2-inches in diameter,
72. *Meter Vault* - The enclosure around a water meter including the top slab and hatch which comprise the top of the vault. Meter Vaults are used for Meters that are $\geq$ 3-inches in diameter,

73. *Milestone* - A principal event specified in the Contract Documents relating to an intermediate completion date or time prior to Substantial Completion of all the Work.
74. *Minimum Quantity* - One dollar ($1.00) in United States Currency, which is the minimum amount of Services that shall be ordered by the City pursuant to this Agreement.
75. *Modifications* - Binding changes, addenda, revisions, or the like, to the Work or the Agreement Documents, including Changes to Work made by Change Order, Work Authorization, Field Change or Change Directive as required by GC-41.
76. *Notice of Award* - The written notice by Owner to the Successful Bidder stating that upon timely compliance by the Successful Bidder with the conditions precedent listed therein, Owner will sign and deliver the Agreement.
77. *Notice of Intent or Letter of Intent to Award* - The written notice of the acceptance of the Bid from the City to a Bidder.
78. *Notice to Proceed ("NTP")* - Written communication issued by the City to Contractor authorizing it to proceed with the Work and establishing the date of commencement of the Agreement time and on which Contractor shall start to perform its obligations in accordance with the Agreement Documents.
79. *Owner* - Same as "City" above.
80. *Parts* - Any equipment, supplies, parts, etc., provided by the City or a City Third Party Service Provider to the Contractor.
81. *PCBs* - Polychlorinated biphenyls.
82. *Permanent Easement* - Any space or area dedicated to the City or other entity for the purpose of constructing and/or maintain existing or future utilities.
83. Petroleum - Petroleum, including crude oil or any fraction thereof which is liquid at standard conditions of temperature and pressure (60 degrees Fahrenheit and 14.7 pounds per square inch absolute), such as oil, petroleum, fuel oil, oil sludge, oil refuse, gasoline, kerosene, and oil mixed with other non-Hazardous Waste and crude oils."
84. *Plans* - That portion of the Agreement Documents describing in drawings, the shapes, outlines, dimensions, characteristics, scope and other similar requirements governing the Work, or portions thereof, prepared by the Designer and including revisions thereto. The term is used interchangeably with the word "Drawings" and includes without limitation Standard Details and Drawings.
85. *Preassembled Detector Check Vault* – A Detector Check Vault provided by a Third Party City Service Provider which has been preassembled with the internal piping, Detector Check, Detector Check bypass assembly, Meter, and piping stubouts to which the Water Service Line will be connected. The antenna and antenna cable for the Meter, and the pipe supports for the piping and appurtenances, will be provided with the Preassembled Detector Check Vault, but will be installed by the Contractor at the Project Site.
86. *Preassembled Meter Vault* – A Meter Vault provided by a Third Party City Service Provider which has been preassembled with the internal piping, Meter, gate valves, bypass, and piping stubouts to which the Water Service Line will be connected. The antenna and antenna cable for the Meter, and the pipe supports for the piping and

appurtenances, will be provided with the Preassembled Meter Vault, but will be installed by the Contractor at the Project Site.

87. *Progress Schedule* - A schedule, prepared and maintained by Contractor, describing the sequence and duration of the activities comprising the Contractor's plan to accomplish the Work within the Contract Times.
88. *Project* - Project(s) specifically identified in Work Orders issued pursuant to this Agreement.
89. *Project Manual* - The bound documentary information prepared for bidding and constructing the Work. A listing of the contents of the Project Manual, which may be bound in one or more volumes, is contained in the table(s) of contents.
90. *Project Site* - The location where the Work Order is being performed.
91. Public Space/Public Right-of-Way - Shall mean the area between private property lines under the jurisdiction of the City, county, state or federal government, including, but not limited to, an alley, roadway, median, sidewalk, public way, or any combination thereof.
92. *Punch List* - Shall mean the lists prepared by the City's Representative or Design Consultant prior to Substantial Completion and through Final Completion indicating items of Work not in accordance with the requirements of the Contract Documents and which must be performed, corrected and accomplished prior to acceptance of the Work.
93. *Quality Assurance* – Shall mean the procedure or procedures performed by the Owner to ensure conformity to the Contract Documents.
94. *Quality Control* – Shall mean the procedure or procedures performed by the Contractor to ensure that quality parameters outlined in the Contract documents are being fully met.
95. *Radioactive Material* - Source, special nuclear, or byproduct material as defined by the Atomic Energy Act of 1954 (42 USC Section 2011 et seq.) as amended from time to time.
96. *Record Drawings* – The latest detailed representation of all installed water facilities associated with the Work for use by the Owner with all necessary information included to effectively operate and maintain the system.
97. *Replacement Facility* - Shall mean that facility, meeting the Department's current standards, which will be constructed or provided, as a consequence of the rearrangement of an existing facility or portion thereof.
98. *Request for Information* – A formal inquiry from the Contractor to the City requesting additional information or clarification to the Contract.
99. *Resident Engineer* - The City's Engineer who is assigned to the Site or any part thereof.
100. Resident Project Representative - The authorized representative of Engineer who may be assigned to the Site or any part thereof.
101. *Responsive Bid* - A Bid which is accurate and complete with respect to Bid schedules and information submitted relative to the technical qualifications and financial responsibility and is able to comply with Equal Opportunity and other requirements of the Agreement Documents.
102. *Samples* - Shall mean physical examples furnished by Contractor, which illustrate

materials, equipment or workmanship. Approved Samples in conformance with the Contract Documents establish the standards of the Work.

103. *Schedule of Submittals* - A schedule, prepared and maintained by Contractor, of required submittals and the time requirements to support scheduled performance of related construction activities.
104. *Schedule of Values* - A schedule, prepared and maintained by Contractor, allocating portions of the Contract Price to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.
105. *Scope of Services* - See "Work."
106. *Services* - The specific tasks and activities to be performed by Contractor as identified in a Work Order issued pursuant to this Agreement, as well as all ancillary and incidental tasks and activities not expressly identified in a Work Order but which are reasonably necessary to be performed in order to complete the tasks and activities expressly identified in a Work Order.
107. *Shop Drawings* - Shall mean drawings, diagrams, illustrations, schedules or other data illustrating the Work, and all illustrations, brochures, standard schedules, performance charts, specifications, instructions, diagrams, and other information prepared by a Subcontractor, Supplier, vendor or manufacturer and submitted by Contractor as required in the Contract Documents.
108. *Short Side* – A term which identifies that the water main to which a Meter or Detector Check is connected is located on the same side of the road as the Meter or Detector Check. In this situation the Water Service Line which connects the Meter or Detector Check to the water main is often referred to as a short side water service line or a short side service line.
109. *Sidewalk Area* - Shall mean that portion of a street between the curb lines and the adjacent property lines intended primarily for the use of pedestrians whether paved or in use.
110. *Site* - The areas required for the performance of the Work.
111. *Special Conditions* - Terms which supplement items covered in General Conditions.
112. *Specifications, Technical Specifications* - Shall mean those portions of the Contract Documents consisting of written technical descriptions, provisions or requirements of the Work to be performed under the Contract Documents, including, but not limited to, the quantities or quality of materials, equipment, construction systems or applications. Standards for specifying materials or testing that are cited in the Specifications are part of the Contract Documents.
113. *Standards* - Shall mean those current Standards of Engineering analysis and design, including Installation and Material Specifications, which the City utilizes in the design and construction of its own projects.
114. *State* - The State of Georgia.
115. *Subcontractor* - An individual, firm, corporation or any combination thereof having a direct contract with Contractor for the performance of a part of the Work at the site.
116. *Submittals* - All administrative documents, Shop Drawings, Samples, product data, manufacturer's literature, quality control documents, design related documents, record documents, contract close-out documents, and/or any other specified document prepared or assembled by or for Contractor and submitted by Contractor to the Owner

and/or Engineer.

117. *Substantial Completion* - As applicable to a Work Order, means that point in time in which the Services that are the subject of a Work Order are capable of being used for their intended purpose and comply with all of the requirements of Article 9, the Specifications, and the other Agreement Documents.
118. *Successful Bidder* - The Bidder submitting a responsive Bid to whom Owner makes an award.
119. *Supplementary Conditions* - That part of the Contract Documents which amends or supplements these General Conditions.
120. *Supplier* - Any individual, firm, or corporation who supplies Material or Equipment for the Work (including that fabricated to a special design) but who does not perform or provide significant labor at the Site.
121. *Temporary Facility* - Shall mean a facility constructed for whatever purpose and not intended to be permanent.
122. *Third Party City Service Provider* – An entity which provides services to the City and who is connected or associated with the Work being performed by the Contractor, but for whom the Contractor is not responsible.
123. *Total Sum* - The total maximum amount of compensation for which all Work Orders may potentially be issued pursuant to this Agreement. Contractor's entitlement to payment under this Agreement shall not exceed the Total Sum.
124. *Transfer Meter Service* – A designation used to identify that an existing Water Service which is connected to an existing water main is to be transferred to a different water main. Typically this involves abandoning the existing Water Service and constructing a new Water Service that taps into a new water main.
125. *Underground Facilities* - All underground pipelines, conduits, ducts, cables, wires, manholes, vaults, tanks, tunnels, or other such facilities or attachments, and any encasements containing such facilities, including those that convey electricity, gases, steam, liquid petroleum products, telephone or other communications, cable television, water, wastewater, storm water, other liquids or chemicals, or traffic or other control systems.
126. *Unit Price Work* - Work to be paid for on the basis of unit prices.
127. *Utility* - Shall mean and include all public, private, or cooperatively owned lines, facilities and systems for producing, transmitting or distributing communications, power, electricity, heat, gas, oil, crude products, water, steam, waste, storm water, and other similar commodities, such as public owned fire and police signal systems, which directly or indirectly serve the public or any part thereof.
128. *Water Mains* – Physical structures, located primarily underground, composed of pipe and fittings designed to convey potable water.
129. *Water Service* - A piping system which extends from a City water main to the point of connection with a private water service line, including all piping, equipment, and appurtenances associated with providing water to a customer. A Water Service includes, but is not limited to, the tapping sleeve and gate valve or curb cock; the Water Service Line, a Meter and/or Detector Check with all associated appurtenances (e.g. gate valves, bypass, Detector Check bypass assembly, etc.); and the Meter Box, Meter Vault or Detector Check Vault.

130. *Water Service Line* – The piping which extends from the water main to the point of connection with a private water service line.
131. *Work* - All the Services specified, indicated, shown, or contemplated by the Agreement Documents and applicable Work Orders, as well as the furnishing by Contractor of all materials, equipment, labor, methods, processes, construction, manufacturing, tools, plants, design, supplies, power, water, transportation and any other things necessary or incidental to complete such Services in accordance with the Agreement Documents and applicable Work Orders that will ensure a functional and complete Project(s).
132. *Work Authorization* - A Change in Work that adds, changes or removes scope of work from the Agreement but does not include a change in Agreement Time or Agreement Price; or the utilization of an allowance or contingency item, as permitted and defined by the Agreement documents. A Work Authorization does not include a Change Order, a Field Change or a Change Directive and is agreed upon and executed by an authorized City representative and the Contractor.
133. *Work Change Directive* - A written statement to Contractor issued on or after the Effective Date of the Agreement and signed by Owner and recommended by Engineer ordering an addition, deletion, or revision in the Work, or responding to differing or unforeseen subsurface or physical conditions under which the Work is to be performed or to emergencies. A Work Change Directive will not change the Contract Price or the Contract Times but is evidence that the parties expect that the change ordered or documented by a Work Change Directive will be incorporated in a subsequently issued Change Order following negotiations by the parties as to its effect, if any, on the Contract Price or Contract Times.
134. *Work Order* - An order executed by the City, substantially in the form and substance provided in Exhibit A to this Agreement that specifies the Services to be provided by Contractor to the City, the agreed amount of payment for such Services, and the time limitations for completing the Services.
135. *Work Order Commencement Date* - The date identified in a notice to proceed and/or a Work Order issued by the City, which instructs the Contractor to start the performance of Services required by a Work Order. The times for Substantial Completion and Final Completion will be measured from the Work Order Commencement Date.
136. *Work Product* - The meaning is set forth in Article 6.
137. *Working Days* - Generally, Monday, Tuesday, Wednesday, Thursday, and Friday; however, on some projects, Saturday and/or Sunday may be considered working days, if specified as working days by the City. Holidays are not considered Working Days.
138. *Written Notice* - A written statement transmitted from one party to an authorized representative of another party.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

+ + + END OF SECTION 01010 + + +

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SECTION 01040
COORDINATION

PART 1 GENERAL

1.01 DESCRIPTION

A. Coordinate execution of the Work with subcontractors and the City's Authorized Representative as required to maintain operation of the existing facilities and satisfactory progress of the Work.

B. Requirements of this Section will be in addition to those stated in 01300 Submittals Specification.

C. The City's Authorized Representative may require a written explanation of the Contractor's plan for accomplishing separate phases of the Work.

PART 2 PRODUCTS

(NOT USED)

PART 3 EXECUTION

3.01 CUTTING AND PATCHING

A. The Contractor shall leave all chases or openings for the installation of its own or any of its subcontractor's work, or shall cut the same in existing work, and shall see that all sleeves or forms are at the work and properly set in ample time to prevent delays. See that all such chases, openings and sleeves are located accurately and are of proper size and shape, and shall consult with the City's Authorized Representative and its subcontractors concerned in reference to this work. In case of its failure to leave or cut all such openings or have all such sleeves provided and set in proper time, the Contractor shall cut them or set them afterwards at its own expense, but in so doing shall confine the cutting to the smallest extent possible consistent with the work to be done. In no case shall structural members be cut without the written consent of the City's Authorized Representative.

B. Carefully fit around, close up, repair, patch, and point around the work specified herein to the satisfaction of the City's Authorized Representative.

C. All of this work shall be done by careful workers competent to do such work and with the proper small hand tools. Power tools shall not be used except where, in the opinion of the City's Authorized Representative, the type of tool proposed can be used without damage to any work or structures and without inconvenience or interference with the operation of any facilities. The City's Authorized Representative 's concurrence with the type of tools shall not in any way relieve or

diminish the responsibility of the Contractor for such damage, inconvenience, or interference resulting from the use of such tools.

D. Do not cut or alter the work of any subcontractor, except with the written consent of the subcontractor whose work is to be cut or altered, or with the written consent of the City's Authorized Representative. All cutting and patching or repairing made necessary by the negligence, carelessness or incompetence of the Contractor or any of its subcontractors, shall be done by, or at the expense of, the Contractor and shall be the responsibility of the Contractor.

3.02 COORDINATION

A. The Contractor shall consult with the City's Authorized Representative on a daily basis while performing demolition, excavation, or any other alteration activity. No water or sewer function, utility or structure shall be altered, shut off or removed unless approved in advance, and in writing, by the City's Authorized Representative. The Contractor shall give the City's Authorized Representative at least 48 hours advanced notice, in writing, of the need to alter, shut off or remove such function. These restrictions apply with the exception of Emergency work orders. Emergency work orders shall be coordinated and executed in the presence and under the direction of the City's Authorized Representative.

B. Coordinate the Work with the City's Authorized Representative and revise daily activities if needed so as to not adversely affect system operations. Such revisions in the proposed work schedule will be accomplished with no additional compensation to the Contractor.

3.03 OWNER'S RESPONSIBILITIES

A. All existing water system valves shall be located, uncovered as necessary and operated by the Owner.

3.04 PROTECTION AND RESTORATION OF WORK AREA

A. General: Return all items and all areas disturbed, directly or indirectly by work under these Specifications, to their original condition or better, as quickly as possible after work is completed.

1. The Contractor shall plan, coordinate, and execute the work such that disruption to personal property and business is held to a practical minimum.
2. All construction areas abutting lawns and yards of residential or commercial property shall be restored promptly. Backfilling of underground facilities, ditches, and disturbed areas shall be accomplished on a daily basis as work is completed. Finishing, dressing, and grassing shall be accomplished immediately thereafter, as a continuous operation within each area being constructed and with emphasis placed on completing each individual yard or business frontage. Care shall be taken to

provide positive drainage to avoid ponding or concentration of runoff.

3. Handwork, including raking and smoothing, shall be required to ensure that the removal of roots, sticks, rocks, and other debris is removed in order to provide a neat and pleasing appearance.
4. The City's Authorized Representative shall be authorized to stop all work by the Contractor when restoration and cleanup are unsatisfactory and to require appropriate remedial measures.

B. Man-made Improvements: Protect, or remove and replace with the City or City's Representative's approval, all fences, walkways, mail boxes, pipe lines, drain culverts, power and telephone lines and cables, property pins and other improvements that may be encountered in the Work.

C. Cultivated Growth: Do not disturb cultivated trees or shrubbery unless approved by the City's Authorized Representative. Any such trees or shrubbery which must be removed shall be heeled in and replanted under the direction of an experienced nurseryman.

D. Cutting of Trees: Do not cut trees for the performance of the work except as absolutely necessary. Protect trees that remain in the vicinity of the work from damage from equipment. Do not store spoil from excavation against the trunks. Remove excavated material stored over the root system of trees within 30 days to allow proper natural watering of the root system. Repair any damaged tree over 3-inches in diameter, not to be removed, under the direction of an experienced nurseryman. All trees and brush that require removal shall be promptly and completely removed from the work area and disposed of by the Contractor. No stumps, wood piles, or trash piles will be permitted on the work site.

E. Disposal of Rubbish: Dispose of all materials cleared and grubbed during the construction of the Project in accordance with the applicable codes and rules of the appropriate county, state and federal regulatory agencies.

F. Swamps and Other Wetlands

1. The Contractor shall not construct permanent roadbeds, berms, drainage structures or any other structures which alter the original topographic features within the easement.
2. All temporary construction or alterations to the original topography will incorporate measures to prevent erosion into the surrounding swamp or wetland. All areas within the easement shall be returned to their original topographic condition as soon as possible after work is completed in the area. All materials of construction and other non-native materials shall be disposed by the Contractor.
3. The Contractor shall provide temporary culverts or other drainage structures, as necessary, to permit the free migration of water between portions of a swamp, wetland or stream which may be temporarily divided by construction.
4. The Contractor shall not spread, discharge or dump any fuel oil, gasoline, pesticide,

or any other pollutant to adjacent swamps or wetlands.

G. Refer to Section 02920, Site Restoration

3.05 WATER FOR CONSTRUCTION PURPOSES

A. All water required for construction shall be furnished by the Owner. It shall be available by connecting to the Owner's water system at a point approved by the City's Authorized Representative. There shall be installed in every connection to the Owner's water supply, and water meter with backflow preventer meeting the requirements of the City. The Contractor shall meter all water usage. The Contractor shall notify the City one week in advance prior to connecting to the water system.

B. A total of the metered water used shall be submitted to the City's Authorized Representative with each monthly application for payment

3.06 EXISTING UTILITIES AND OBSTRUCTIONS

A. The Drawings indicate utilities or obstructions that are known to exist according to the best information available. The Contractor shall call the Utilities Protection Center (UPC) at 811 or (800-282-7411) as required by Georgia Law (O.C.G.A. Sections 25-9-1 through 25-9-13) at least 72 hours (three business days) prior to construction to verify the location of the existing utilities.

B. Water and Sewer Separation

1. Water mains should maintain a minimum 10 foot edge-to-edge separation from sewer lines, whether gravity or pressure. If the main cannot be installed in the prescribed easement or right-of-way and provide the 10 foot separation, the separation may be reduced, provided the bottom of the water main is a minimum of 18-inches above the top of the sewer. Should neither of these two separation criteria be possible, the water main shall be installed below the sewer with a minimum vertical separation of 18-inches.
2. The water main, when installed below the sewer, shall be encased in concrete with a minimum 6-inch concrete thickness to the first joint in each direction. Where water mains cross the sewer, the pipe joint adjacent to the pipe crossing the sewer shall be cut to provide maximum separation of the pipe joints from the sewer.
3. No water main shall pass through, or come in contact with, any part of a sanitary sewer manhole.

C. Work shall be located substantially as indicated on the Drawings, but the City's Authorized Representative reserves the right to make such modifications in locations as may be found desirable to avoid interference with existing structures, utilities or for other reasons. Where fittings are noted on the Drawings, such notation is for the Contractor's convenience and does not relieve the Contractor for laying and joining different or additional items where required or when directed by the City's Authorized

Representative.

3.07 PIPE DISTRIBUTION

A. Pipe shall be distributed and placed in such a manner that will not interfere with traffic.

B. Distribution and stringing of pipe along the route will be limited to the total length which will be installed in one work day/work shift. The Owner reserves the right to reduce the distance in residential and commercial areas based on the effects of the pipe distribution on the adjacent property owners.

C. No street or roadway may be closed for unloading of pipe without first obtaining permission from the proper authorities. The Contractor shall furnish and maintain proper warning signs and obstruction lights for the protection of traffic along highways, streets and roadways upon which pipe is distributed.

D. No distributed pipe shall be placed inside drainage ditches.

E. Distributed pipe shall be placed as far as possible from the roadway pavement, but no closer than five feet from the roadway pavement, as measured edge-to-edge.

3.08 CONSTRUCTION OPERATIONS

A. Do not open the trench any further ahead of pipe laying operations than is necessary. Backfill and remove excess material immediately behind laying operations. Complete excavation and backfill for any portion of the trench in the same day.

B. Construction operations shall be limited to 250 feet along the water main route, including clean-up and utility exploration.

C. The Contractor shall insure that all work areas and roadways are free from excess excavated material, debris, mud, soil, and rocks etc. at the end of each work day. Contractor shall be responsible for sweeping all areas at the end of each work day.

3.09 CONNECTIONS TO WORK BY OTHERS

A. As shown on the Drawings, pipelines constructed under this Contract are to be connected to pipelines to be constructed by others.

B. Pipelines built under this Contract will be connected to pipelines constructed by others by removing the plugs and making the connection.

C. If the pipelines have not been constructed by others, the pipeline (under this Contract) shall be laid to the required line and grade, terminated with a plugged connection at the location indicated on the Drawings and then backfilled. The connection point shall be located by survey methods for future reference and construction tie-in.

+ + + END OF SECTION 01040 + + +

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SECTION 01050
PROJECT MEETINGS

PART 1 GENERAL

1.01 SCOPE

A. Work under this Section includes all scheduling and administering of pre-construction and progress meetings as herein specified and necessary for the proper and complete performance of this Work.

B. Scheduling and Administration by Owner (City):

1. Make physical arrangements for the meetings.
2. Preside at meetings.
3. Record minutes and include significant proceedings and decisions.
4. Distribute copies of the minutes to participants.

C. Project meetings associated with Emergency work orders shall be arranged and directed by the City's Authorized Representative. Contractor's representatives shall be in attendance on an as-needed basis as determined by the City.

1.02 PRECONSTRUCTION CONFERENCE

A. The City shall schedule the preconstruction conference prior to the issuance of the Notice to Proceed.

B. Representatives of the following parties are to be in attendance at the meeting:

1. Owner (City)
2. Contractor's project staff including at a minimum the project manager, field superintendent, quality control coordinator, subcontractor coordinator
3. Major subcontractors
4. Representatives of governmental or regulatory agencies when appropriate.

C. The agenda for the preconstruction conference shall consist of the following as a minimum:

1. Distribute and discuss a list of major subcontractors and a tentative construction schedule.
2. Critical work sequencing.
3. Designation of responsible personnel and emergency telephone numbers.

4. Processing of field decisions and change orders.
5. Adequacy of distribution of Contract Documents.
6. Schedule and submittal of shop drawings, product data and samples.
7. Pay request format, submittal cutoff date, pay date and retainage.
8. Procedures for maintaining record documents.
9. Use of premises, including office and storage areas and Owner's requirements.
10. Major equipment deliveries and priorities.
11. Safety and first aid procedures.
12. Security procedures.
13. Housekeeping procedures.
14. Work hours.

1.03 PROJECT COORDINATION MEETINGS

A. Schedule regular monthly meetings or more frequently as directed by the Owner.

B. Hold called meetings as the progress of the Work dictates.

C. The meetings shall be held at the location indicated by the Owner.

D. Representatives of the following parties are to be in attendance at the meetings:

1. Contractor’s project staff including at a minimum the project manager, superintendent, quality control coordinator, subcontractor coordinator
2. Major subcontractors as pertinent to the agenda.
3. Owner's representative as appropriate.
4. Representatives of governmental or other regulatory agencies as appropriate.

E. The minimum agenda for progress meetings shall consist of the following:

1. Review and approve minutes of previous meetings.
2. Review work progress since last meeting.
3. Review work progress planned for the next period.
4. Status of Overall Project Schedule, identify problems which impede planned progress.
5. Review Contractor's corrective measures and procedures to regain plan schedule.
6. Review Contractor's revision to the construction schedule.
7. Review submittal schedule.
8. Review Request for Information process.
9. Review Change Management items and status of individual Change documents.
10. Review Notices, Punch lists, and project coordination issues.
11. Note field observations, problems and decisions.
12. Review testing and quality control measures and associated issues.
13. Complete other current business.

1.04 SHUTDOWN COORDINATION MEETINGS:

A. One week minimum prior to significant planned shutdowns, Contractor shall arrange and convene a coordination meeting.

B. Meeting participants shall include Owner, Contractor and Contractor's Engineer (if applicable), including involved subcontractors.

C. Meeting agenda shall include Contractor's review/presentation of a detailed work plan and schedule as required in Section 01310, Owner input regarding facility operations, and all other pertinent coordination topics.

1.05 QUALITY CONTROL AND COORDINATION MEETINGS

A. Scheduled by the City's Authorized Representative on a regular basis and as necessary to review test and inspection reports, and other matters relating to quality control of Work and work of other contractors.

B. Attendees will include:

1. Contractor's project staff including at a minimum the project manager, superintendent, quality control coordinator, subcontractor coordinator.
2. Subcontractors and Suppliers, as necessary.
3. Engineer's representatives.

1.06 PRE-INSTALLATION MEETINGS

A. When required in individual Specification Sections, convene at site prior to commencing Work of that section.

B. Require attendance of entities directly affecting, or affected by, Work of that Section.

C. Notify City's Authorized Representative four (4) days in advance of meeting date.

D. Provide suggested agenda to City's Authorized Representative to include reviewing conditions of installation, preparation and installation or application procedures, and coordination with related Work and work of others.

1.07 OTHER MEETINGS

In accordance with Contract Documents and as may be required by the Owner.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

+ + + END OF SECTION 01050 + + +

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SECTION 01055
CONSTRUCTION STAKING

PART 1 GENERAL

1.01 SCOPE

A. Construction staking shall include all of the surveying work required to layout the Work and control the location of the finished Project defined as a Work Order. The Contractor shall have the full responsibility for constructing the Project to the correct horizontal and vertical alignment, as shown on the Drawings, as specified, or as ordered by the City's Authorized Representative.

B. The Contractor shall assume all costs associated with rectifying work constructed in the wrong location.

C. Work under this Section also includes surveying work required to prepare Record Drawings as specified herein.

1.02 REFERENCES

A. Related Sections include:

1. Section 01720 Record Documents

1.03 SUBMITTALS

A. Submit name, certification, and address of Registered Surveyor to City's Authorized Representative.

B. On request of City's Authorized Representative, submit documentation to verify accuracy of construction staking.

C. Submit record drawings in accordance with the Record Documents Specification 01720.

1.04 QUALITY CONTROL

A. The Contractor shall hire, at the Contractor's own expense, a Surveyor with current registration in the State of Georgia, acceptable to the Owner, to provide project construction staking and confirmation of the vertical and horizontal alignment.

B. Any deviations from the Drawings shall be confirmed by the City's Authorized Representative prior to construction of that portion of the Project.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 PROJECT CONDITIONS

A. The Drawings provide the location of principal components of the Project. The City's Authorized Representative may order changes to the location of some of the components of the Project or provide clarification to questions regarding the correct alignment.

3.02 GENERAL

A. From the information shown on the Drawings and the information to be provided as indicated in paragraph 3.01 above, the Contractor shall:

1. Be responsible for establishing GPS control coordinate control system, setting reference points and/or offsets, establishment of baselines, and all other layout, staking, and all other surveying required for the construction of the Project.
    a. The horizontal position of all points shall be referenced to the North American datum of 1983 (1986 adjustment) in the Georgia State Plane West 1002 Coordinate System.
    b. The vertical position of all points shall be referenced to the North American Vertical datum of 1988.
    c. All coordinate values shall be delivered as grid coordinates in US Survey Feet.
    d. The minimum data accuracy required for all record drawings shall be within 3 (3) centimeters horizontal and three (3) centimeters vertical.
2. Safeguard all reference points, stakes, grade marks, horizontal and vertical control points, and shall bear the cost of re-establishing same if disturbed.
3. Stake out the limits of construction to ensure that the Work does not deviate from the indicated limits.
4. Stake out the pipeline horizontal and vertical alignment.
5. Be responsible for all damage done to reference points, baselines, center lines and temporary bench marks, and shall be responsible for the cost of re-establishment of reference points, baselines, center lines and temporary bench marks as a result of the operations.
6. Maintain a complete, accurate log of all control and survey work as it progresses.

B. Baselines shall be defined as the line to which the location of the Work is referenced, i.e., edge of pavement, road centerline, property line, right-of-way or survey line.

3.03 STAKING PRECISION

A. The precision of construction staking shall match the precision of components location indicated on the Drawings and shall be within 3 (3) centimeters horizontal

and three (3) centimeters vertical. Staking of utilities shall be done in accordance with standard accepted practice for the type of utility.

B. The precision of construction staking required shall be such that the location of the water main can be established for construction and verified by the City's Authorized Representative. Where the location of components of the water main, (i.e. fittings, valves, road crossings, etc.) are not dimensioned, the establishment of the location of these components shall be based upon scaling these locations from the Drawings with relation to readily identifiable land marks, i.e. survey reference points, power poles, manholes etc.

C. Paved Surfaces: The Contractor shall establish a reference point for establishing and verifying the paving subgrade and finished grade elevations. Any variance with grades shown on the Drawings shall be identified by the Contractor and confirmed by the City's Authorized Representative prior to constructing the base.

D. The Contractor's attention is directed to Section 01040, Paragraph 3.06, Existing Utilities and Obstructions.

3.04 RECORD DRAWINGS

The Contractor's attention is directed to Section 01720 relative to maintenance and submittal of Record Drawings.

+ + + END OF SECTION 01055 + + +

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SECTION 01060
REGULATORY REQUIREMENTS

PART 1 GENERAL

1.01 SCOPE

A. Permits and Responsibilities: The Contractor shall be responsible for complying with all applicable federal, state, county and municipal laws, codes and regulations, in connection with the prosecution of the Work and for obtaining all permits including but not limited to NPDES permits for storm water discharges from the Work site.

B. Permits and applications for this project are identified in PART 3 of this Section.

C. The Contractor shall comply with all requirements of the permitting authority, whether permits were obtained by the Contractor or not.

PART 2 PRODUCTS

(NOT USED)

PART 3 EXECUTION

3.01 NPDES PERMITS FOR STORM WATER DISCHARGES

The Contractor shall comply with the provisions of the Authorization to Discharge under the National Pollutant Discharge Elimination System, Storm Water Discharges Associated with Construction Activity for Infrastructure Construction Projects, Georgia Environmental Protection Division General Permit No. GAR 100002, including but not limited to filing permit applications, filing Notice of Intent (NOI), filing Notice of Termination (NOT), performing inspections and monitoring and performing record keeping as required.

3.02 GDOT ENCROACHMENT PERMITS

A. Several portions of this project will be constructed within right of ways under the jurisdiction of GDOT as indicated in the following table:

Site/Drawing No.	Street Name	GDOT Right of Way

B. The Engineer, in conjunction with the Contractor, will submit permit applications to

GDOT for Right of Way Encroachment for installation of pipelines and appurtenances and connections to existing pipelines within the GDOT right of ways..

3.03 CITY LANE CLOSURE PERMITS

The Engineer, in conjunction with the Contractor, will submit permit applications to the City's Department of Public Works, Office of Transportation for all lane closures required for completion of the project. Refer to Section 01550, Traffic Regulation.

3.04 OTHER PERMITS

The Contractor shall submit applications for and obtain all other permits required in conjunction with completion of the Work of the Contact.

3.05 GENERAL

A. The Contractor shall pay for all remaining permits, fees and licenses required for construction of the Project.

B. The Contractor shall examine all permits and conform to the requirements contained therein, including the purchase of additional bonds or insurance as specified therein, and such requirements are hereby made a part of these Contract Documents as though the same were set forth herein. Failure to examine the permit and agreement applications will not relieve the Contractor from compliance with the requirements stated therein.

C. Payment for all permits, fees and licenses required for construction of the Project shall be reimbursed to the Contractor under Allowance Item XX, Special Permit Requirements.

+ + + END OF SECTION 01060 + + +

SECTION 01091
CODES AND STANDARDS

PART 1 GENERAL

1.01 DESCRIPTION

A. Whenever reference is made to conforming to the standards of any technical society, organization, body, code or standard, it shall be construed to mean the latest standard, code, specification or tentative specification adopted and published at the time of advertisement for Bids. This shall include the furnishing of materials, testing of materials, fabrication and installation practices. In those cases where the Contractor's quality standards establish more stringent quality requirements, the more stringent requirement shall prevail. Such standards are made a part hereof to the extent which is indicated or intended.

B. The inclusion of an organization under one category does not preclude that organization's standards from applying to another category.

C. In addition, all work shall comply with the applicable requirements of local codes, utilities and other authorities having jurisdiction.

D. All material and equipment, for which a UL Standard, an AGA or NSF approval or an ASME requirement is established, shall be so approved and labeled or stamped. The label or stamp shall be conspicuous and not covered, painted, or otherwise obscured from visual inspection.

E. The standards which apply to this Project are not necessarily restricted to those organizations which are listed in paragraph 1.02 of this Section.

1.02 STANDARD ORGANIZATIONS

A. Piping and Valves:

ACPA	American Concrete Pipe Association
ANSI	American National Standards Institute
ASME	American Society of Mechanical Engineers
AWWA	American Water Works Association
CISPI	Cast Iron Soil Pipe Institute
DIPRA	Ductile Iron Pipe Research Association
FCI	Fluid Controls Institute
MSS	Manufacturers Standardization Society
NCPI	National Clay Pipe Institute
NSF	National Sanitation Foundation
PPI	Plastic Pipe Institute

B. Materials:

AASHTO	American Association of State Highway and Transportation Officials
ANSI	American National Standards Institute
ASTM	American Society for Testing and Materials

C. Painting and Surface Preparation:

NACE	National Association of Corrosion Engineers
SSPC	Steel Structures Painting Council

D. Aluminum:

AA	Aluminum Association
AAMA	American Architectural Manufacturers Association

E. Steel and Concrete:

ACI	American Concrete Institute
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
CRSI	Concrete Reinforcing Steel Institute
NRMA	National Ready-Mix Association
PCA	Portland Cement Association
PCI	Pre-stressed Concrete Institute

F. Welding:

ASME	American Society of Mechanical Engineers
AWS	American Welding Society

G. Government and Technical Organizations:

APHA	American Public Health Association
APWA	American Public Works Association
ASCE	American Society of Civil Engineers
ASQC	American Society of Quality Control
ASSE	American Society of Sanitary Engineering
CFR	Code of Federal Regulations
CSI	Construction Specifications Institute
EPA	Environmental Protection Agency
FS	Federal Specifications
ISEA	Industrial Safety Equipment Association
ISO	International Organization for Standardization
ITE	Institute of Traffic Engineers
MUTCD	Manual of Uniform Traffic Control Devices

NBFU	National Board of Fire Underwriters
NFPA	National Fluid Power Association
NBS	National Bureau of Standards
OSHA	Occupational Safety and Health Administration
SPI	Society of the Plastics Industry, Inc.
USDC	United States Department of Commerce
WEF	Water Environment Federation

H. Roadways:

AREMA	American Railway Engineering and Maintenance–of-Way Association
GDOT	Georgia Department of Transportation

I. Plumbing:

AGA	American Gas Association
PDI	Plumbing Drainage Institute
SPC	SBCC Standard Plumbing Code

J. Equipment:

AFBMA	Anti-Friction Bearing Manufacturers Association, Inc.
AGMA	American Gear Manufacturers Association
OPEI	Outdoor Power Equipment Institute, Inc.
PTI	Power Tool Institute, Inc.

1.03 SYMBOLS

Symbols and material legends shall be as scheduled on the Drawings.

PART 2 PRODUCTS

(NOT USED)

PART 3 EXECUTION

(NOT USED)

+ + + END OF SECTION 01091 + + +

SECTION 01200
MEASUREMENT AND PAYMENT (SANITARY SEWER/STORM DRAIN)

PART 1 GENERAL

1.01 SCOPE

A. Work includes furnishing all plant, labor, equipment, tools, materials, and performing all operations required to complete the Work satisfactorily, in-place, as specified and as indicated on the Drawings.

B. All costs of required items of work and incidentals necessary for the satisfactory completion of the Work shall be considered as included in the Total Bid. The cost of work not directly covered by the pay items shall be considered incidental to the contract and no additional compensation shall be allowed.

C. The Contractor shall take no advantage of any apparent error or omission on the Drawings or Specifications, and the Engineer shall be permitted to make corrections and interpretations as may be deemed necessary for fulfillment of the intent of the Contract Documents.

1.01 SUBMITTALS

A. The Contractor shall submit to the Engineer for approval, in the form directed or acceptable to the Engineer, a complete schedule of values of the various portions of the Work, including quantities and unit prices, aggregating the Contract Price. An unbalanced breakdown providing for overpayment to the Contractor on items of Work, which would be performed first, will not be approved.

B. Submit application for payment on a form approved by the Engineer. Form shall contain unit price items, lump sum items and allowance items in accordance with Special Condition SC-16.

1.02 UNIT PRICE ITEMS

A. Payment for all work shall be in accordance with the unit price bid items in the Bid Schedule and shall be full compensation for all labor, materials, and equipment required to furnish, install, construct, and test the Work covered under the unit price bid item. Work for which there is no price schedule item will be considered incidental to the Work and no additional compensation shall be allowed.

B. Payment will be made only for the actual quantities of work performed in compliance with the Drawings and Specifications. The Contractor will be paid an amount equal to the approved quantity times the applicable unit price. Any unused balance of the unit price work shall revert to the City upon completion of the project.

C. All unit price work shall be considered as part of the Work to be performed within the time limits specified elsewhere for Substantial Completion and Project Completion. No increase in contract time will be allowed for increases in quantities of unit price work performed beyond the quantities shown in the Bid Schedule, unless it can be demonstrated that the additional Work performed under the unit price item is on the critical path of the Project Schedule.

1.03 LUMP SUM ITEMS

A. Payment of the lump sum items established in the Contractor's Bid shall be full compensation for all labor, materials, and equipment required to furnish, install, construct, and test the Work covered under the lump sum bid item.

B. Payment of the lump sum items established in the Contractor's Bid shall also fully compensate the Contractor for any other work which is not specified or shown, but which is necessary to complete the Work.

C. The lump sum item shall be specifically subdivided by activity, broken-out in the Schedule of Values.

D. Payments for the lump sum items specifically broken out in the Schedule of Values will be based upon physical progress for each activity in accordance with the breakdown of the Lump Sum prices agreed to in the Schedule of Values.

1.05 MEASUREMENT OF QUANTITIES

A. Final payment quantities shall be determined from the record drawings. The record drawing lengths, dimensions, quantities, etc. shall be determined by a survey after completion of all required work. The precision of final payment quantities shall match the precision shown for that item in the Bid Schedule. Measurements will be taken according to the United States standard measurements and in the manner as specified in these Specifications.

B. Measurement Devices

1. Scales shall be inspected, tested, and certified by the applicable Weights and Measures Department within the past year and shall be of sufficient size and capacity to accommodate the conveying vehicle.

2. Metering devices shall be inspected, tested, and certified by the applicable department within the past year.

3. Volume shall be determined by cubic dimension by multiplying mean length by mean width by mean height or thickness.

4. Area shall be determined by square dimension by multiplying mean length by mean width or height.

5. Linear measurement shall be measured by linear dimension, along the item centerline or mean chord.

6. Stipulated price measurement shall include items measured by number, weight, volume area, length or combination thereof as appropriate.

Item	Method of Measurement
AC	Acre - Field Measure
AL	Allowance
CY	Cubic Yard - Field Measure within limits specified or shown, or measured in vehicle by volume, as specified
EA	Each - Field Count
GAL	Gallon - Field Measure
HR	Hour
LB	Pound(s) - Weight Measure by Scale
LF	Linear Foot - Field Measure
LS	Lump Sum - Unit is one; no measurement will be made
SF	Square Foot – Field Measure
SY	Square Yard – Field Measure
TON	Ton - Weight Measure by Scale (2,000 pounds)
VF	Vertical Foot - Field Measure

C. General

1. No separate or additional payment shall be made for the requirements contained in the Special Conditions of the Contract Documents. The cost for complying with these requirements shall be included in the unit price bid for the items to which they pertain.

2. No separate or additional payment shall be made for the requirements contained in the individual specification sections contained in Division1 – General Requirements of the Technical Specifications. The cost for complying with these requirements shall be included in the unit price bid for the items to which they pertain.

3. No separate or additional payment shall be made for mobilization of the Project Site. The cost for mobilization shall be included in the unit price bid for the items to which it pertains.

SECTION 1 - BID ITEMS

1.06 ITEMS 1A THROUGH 1X – FURNISH AND INSTALL SEWER/DRAIN PIPE AND APPURTENANCES

A. Measurement

1. Sewer/drain pipe of the size and type specified in the Bid Schedule when furnished

and installed, excavated and backfilled and tested and accepted will be measured for payment. Measurement for payment does not signify that the sewer/drain pipe is accepted. Measurement for length shall be along the center line of the pipe and will continue through manhole openings to the center of manholes. Measurement for depth will be from the ground surface existing at the time of excavation for pipe installation, as determined by the Engineer, to the invert of the pipe.

2. The quantity of wyes and tees to be paid for will be the number actually installed and accepted by the Engineer.

3. Risers shall be measured in vertical feet of pipe actually installed, measured from the center line of the sewer to the center of the top 45 degree elbow, as shown on the Drawings.

4. Plugged stubs in manholes will be measured as 2-feet of pipe.

B. Payment

1. Payment for furnishing and installing the various sizes of sewer /drain pipe, as specified in the bid schedule will be made for the respective quantities, as determined above, at the applicable unit price established in the Bid Schedule and will be full compensation for all labor, materials, equipment, tools, and incidentals necessary to complete the Work in accordance with the Drawings and Specifications, including, clearing and grubbing, saw cutting asphalt pavement, removal and disposal of asphalt or concrete pavement, test pits, all excavation (except rock excavation), disposal of excavated material, drainage and dewatering, excavation support system, utility support system, connections to manholes/vaults, flow diversion, pipe, backfill material, backfilling (including flowable fill if authorized by the Engineer), compaction, 6-inch graded aggregate base, cleaning, testing, site restoration and all else incidental thereto for which separate payment is not provided under other items in the Bid Schedule.

2. Payment for furnishing and installing wyes and tees, where directed by the Engineer, will be made for the quantity as above determined at the applicable unit price established in the Bid Schedule, and will be full compensation for furnishing and installing the fittings, plugs, cutting the sewer pipe, if necessary, and all else incidental thereto for which separate payment is not provided under other items in the Bid Schedule.

3. Payment for furnishing and installing risers in place will be made for the quantity actually installed in vertical feet as above determined, at the applicable price per vertical foot established in the Bid Schedule and will be full compensation for all materials and labor required to install the riser including crushed stone encasement and all else incidental thereto for which separate payment is not provided under other items in the Bid Schedule.

4. Payment under these items will also include temporary and permanent erosion and sedimentation control as specified in Section 02125 and as shown on the Drawings

5. Payment under these items will also include compaction testing as specified in paragraph 3.16.B.2 of Section 02225.

6. Payment under these items shall also include furnishing sulfide resistant additives to pipe including all work necessary to incorporate the additive in the concrete mix, including quality control, adding dye to concrete mix (optional), special labeling of pipe sections, labor, materials, equipment, tools and incidentals necessary to complete the work all as specified in Section 02536.

1.07 ITEM 1Y – 6-INCH SEWER LATERAL

A. 6-inch sewer laterals of the type specified in the Bid Schedule when furnished, installed and backfilled, tested and accepted will be measured for payment on a per linear foot basis. Measurement for payment does not signify that the sewer lateral is accepted. Measurement for length will be along the center of the pipe from the center of the main line sewer to the end of the lateral or to the point where it connects into an existing lateral. There will be no measurement for depth.

B. Payment

1. Payment for furnishing and installing 6-inch sewer laterals will be made for the respective quantities, as determined above, at the unit price established in the Bid Schedule and will be full compensation for all labor, materials, equipment and incidentals required to furnish and install 6-inch sewer laterals, including saw cutting pavement as necessary, excavation, connecting new sewer laterals to existing or new sanitary sewers, installation of cleanouts and associated fittings as shown on the Drawings and connection of new service laterals to existing sewer connection or terminating the lateral at the right of way, backfill and compaction, 6-inch graded aggregate base, cleaning, testing and cleanup.

2. Payment under this item shall also include disconnection, removal and disposal of the existing sewer lateral that will no longer be used and reconnection of the sewer service connection to a new or existing main line sewer

3. Wyes and tees will be paid for under another item.

1.08 ITEM 2 - ROCK EXCAVATION

A. Measurement

1. When rock is encountered, the material will be uncovered and the Engineer notified. The Contractor will then take cross sections of the rock surface. Failure

to uncover the rock, notify the Engineer, and provide cross sections of the undisturbed material will give the Contractor no right of claim to any classification other than that allowed by the Engineer. Removal of old concrete foundations, if any, shall be classified as rock.

2. The quantity of rock excavation to be paid for will be the number of cubic yards of rock measured in place, as directed by the Engineer, within the limits herein specified.

3. Measurement for width will be limited to 12 inches beyond the outside of the pipe. Pipe trench width is defined as the distance separating the vertical planes between which the pipe is to be laid. No measurement or payment will be made for over breakage.

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4. Measurement for rock excavation will extend to a depth of 8-inches below the pipe barrel for pipes 21-inches in diameter or less and 12-inches for larger pipe. No measurement or payment will be made for over breakage.

5 At vaults, manholes and other structures, measurement will be to 24-inches from the outside face of the structure and 12-inches below bottom of the slab. No measurement or payment shall be made for over breakage.

B. Payment

1. Payment for rock excavation will be made for the quantities as determined above, measured in cubic yards, at the unit price established in the Bid Schedule and will be full compensation for excavation, blasting and disposal of rock, backfilling and providing borrow for any deficiency of backfill, and all work incidental thereto for which payment is not provided for under other items in the Bid Schedule.

2. No payment will be made under this item for refill materials to replace any deficiency or backfill material.

3. Payment under this item will also be full compensation for all labor, materials, equipment and incidentals required for rock excavation in accordance with the requirements of Section 02020.

4. Payment for rock excavation associated with jack and bore or tunnel installation will be paid for under another item.

1.09 ITEM 3 - EXCAVATION BELOW NORMAL GRADE AND CRUSHED STONE REFILL

A. Measurement

1. Measurement of excavation below normal grade and refill for trench excavation

will extend only downward from the elevation below the pipe bell as shown in the following table to a depth determined by the Engineer and for a width as defined for rock excavation.

Pipe Diameter	Normal Grade (elev.) below Pipe Bell
Up to 21 inches	8-inches
24-inches and greater	12-inches

2. If the trench bottom is below grade through error by the Contractor, or if improper drainage softens the sub grade and additional excavation in the trench is required before laying the pipe, such removal and replacement of material will not be measured for payment.

3. No material which may run or flow into the excavation from outside the payment limits, will be measured for payment.

4. Measurement by truck count will not be permitted.

5. Crushed stone placed or removed outside the above limits will not be measured for payment.

B. Payment

1. Payment for excavation below normal grade and crushed stone refill will be made for the quantity, as above determined, at the unit price established in the Bid Schedule and will be full compensation for excavation and disposal of all materials below normal grade, borrow pit operations, furnishing, hauling, placing, compacting the crushed stone, and all else in connection therewith or incidental thereto for which payment is not provided for under other items in the Bid Schedule.

2. Crushed stone for bedding pipes and appurtenances is to be furnished and paid for under other items.

3. Suitable borrow fill required to replace rock excavation where surplus excavation is inadequate or unsuitable will be furnished and paid for under another item.

4. Crushed stone used in the construction of creek crossings will be paid for under another item.

5. Crushed stone used for replacement of sewer service connections will be paid for under another item.

6. Crushed stone employed for drainage purposes will be paid for under other items.

1.10 ITEMS 4A THROUGH 4X - PRECAST CONCRETE MANHOLES

A. Precast concrete manholes with precast or cast-in place bases of the various sizes specified in the Bid Schedule will be measured in vertical feet from the invert of the lowest sewer pipe to the top of the manhole frame.

B. Payment

1. Payment for furnishing and installing manholes complete in place will be made for the quantity as determined above at the unit price established in the Bid Schedule, and will be full compensation for all excavation (except rock), backfill, sheeting, bracing, furnishing and installing precast sections, manhole frames and covers and manhole steps, crushed stone subbase, concrete and masonry materials, including the cast-in-place base portion for the precast manhole, waterstops, all as shown on the Drawings, and all else incidental thereto for which separate payment is not provided under other items in the Bid Schedule.

2. Payment under this item will also include flexible manhole sleeves (boots) with stainless steel clamps and bolt assemblies as well as bitumastic coated steel strap anchors.

3. Payment under this item shall also include furnishing sulfide resistant additives to manholes including all work necessary to incorporate the additive in the concrete mix, including quality control, adding dye to concrete mix (optional), special labeling of manhole sections, labor, materials, equipment, tools and incidentals necessary to complete the work all as specified in Section 02641.

4. Rock excavation will be paid for under another item.

1.11 ITEMS 4X THROUGH 4X – DROP MANHOLE CONNECTIONS

A. Drop manhole connections of the sizes as specified in the Bid Schedule will be measured in vertical feet of pipe actually installed, measured from the invert of drop to invert of sewer. Measurement will be the same regardless of size of drop or type of structure the drop connection is attached to.

B. Payment

1. Payment for furnishing and installing drop manhole connections complete in place will be made for the quantity as determined above at the unit price established in the Bid Schedule and shall be full compensation for all labor, materials, equipment and incidentals required to complete the drop connection including pipe, crushed stone base, concrete encasement, additional excavation (except rock), all as shown on the

Drawings and all else incidental thereto for which separate payment is not provided under other items in the Bid Schedule.

2. Rock excavation will be paid for under another item.

1.12 ITEM 5 - JACK AND BORE OR TUNNEL INSTALLATION

A. Measurement for payment for jack and bore or tunnel installations will be on a per linear foot basis for each location for boring and jacking a steel casing and installing the pipeline therein or constructing a tunnel and installing the pipeline therein at the location and between the limits as shown and detailed on the Drawings and as specified herein and accepted by the Engineer.

B. Payment

1. Payment of the unit price established in the Bid Schedule for each jack and bore or tunnel installation will be full compensation for all labor, materials, equipment and incidentals required to complete the installation between the limits as shown and detailed on the Drawings.

2. Payment of the unit price established in the Bid Schedule shall include all costs to complete the installation by either method.

3. Payment of the unit price established in the Bid Schedule for each installation shall include furnishing and installing the steel casing pipe or excavation and tunnel construction and all additional work and materials required for the completion of the crossings including furnishing and installing carrier pipe inside the casing or tunnel, annular fill, casing or tunnel end plugs, surface settlement monitoring, all excavation (including rock excavation), sheeting and bracing, dewatering and drainage, cleaning and testing of the pipe, backfill, cleaning the site, sodding and seeding as applicable, and for all else incidental thereto for which separate payment is not provided under other items in the Bid Schedule.

4. Payment shall fully reimburse the Contractor for cooperating with and meeting all the requirements of the Georgia Department of Transportation and the affected railroads relative to construction as may be required or necessary to complete the crossings.

5. Payment shall also be full compensation for excavation, backfill and compaction of jacking and receiving shafts and all steel sheeting left in place for the installation as specified.

1.13 ITEMS 6A THROUGH 6X – CLAY WATER STOP COLLAR

A. Measurement for payment to install clay water stop collars will be on a per each basis, in place, according to pipe diameter.

B. Payment of the unit price established in the Bid Schedule for each clay water stop collar will be full compensation for all work necessary for a complete clay water stop installation, including, but not limited to, labor, importing clay to work site, and all other materials and equipment required for constructing clay water stop collar as shown on the Drawings.

1.14 ITEMS 7A THROUGH 7X – CONCRETE COLLAR WALL

A. Measurement for payment to install concrete collar wall will be on a per each basis, in place, according to pipe diameter.

B. Payment of the unit price established in the Bid Schedule for each concrete collar wall will be full compensation for all work necessary for a complete concrete collar wall installation, including, but not limited to, labor, materials and equipment required for forming and pouring collar wall in place, all as shown on the Drawings.

1.15 ITEM 8A – TYPE B BASE FOR PERMANENT ASPHALT PAVEMENT REPLACEMENT

A. Measurement for payment for type B base for permanent asphalt pavement replacement will be on a per square yard basis, determined by multiplying the longitudinal length of the pavement cut times the specified pavement payment width as shown on the Drawings. Pavement thickness shall be as shown on the Drawings.

B. Payment

1. Payment for Type B base for permanent asphalt pavement will be made at the unit price established in the Bid Schedule and will be full compensation for furnishing all labor, materials, tools, and equipment necessary to install type B base for permanent asphalt pavement replacement and shall include cutting edge of existing pavement, furnishing, hauling, preparation and placement and compaction of type B base materials and prime coat for permanent asphalt paving.

2. Payment under this item shall also include all costs for maintaining dust control prior to installation of pavement.

3. Any pavement damaged outside the pavement payment width will be repaired as specified in Section 02700 and no additional payment will be made for such work outside the pavement payment width.

4. No additional payment will be made for provision and maintenance of temporary roadway surfaces.

5. No additional payment will be made for any materials, equipment or labor associated with steel plate bridging.

6. No additional payment will be made for saw cutting of pavement due to pavement

thickness or material changes.

1.16 ITEM 8B AND 8C – TYPE E TOPPING AND SUPERPAVE TOPPING FOR PERMANENT ASPHALT PAVEMENT

A. Measurement for payment for type E topping and Superpave topping for permanent asphalt pavement replacement will be on a per square yard basis, determined by multiplying the longitudinal length of the pavement to be replaced by the specified pavement payment width as shown on the Drawings or as directed by the Engineer. Pavement thickness will be as shown on the Drawings.

B. Payment

1. Payment for Type E topping and Superpave topping for permanent asphalt pavement will be made at the unit prices established in the Bid Schedule and will be full compensation for furnishing all labor, materials, tools, and equipment necessary to install type E and Superpave topping for permanent asphalt pavement and will include cutting edge of existing pavement, furnishing, hauling, surface preparation and placement and compaction of type E and Superpave topping and tack coat for permanent asphalt paving.

2. Payment under this item shall also include all costs for maintaining dust control prior to installation of pavement.

3. Any pavement damaged outside the pavement payment width will be repaired as specified in Section 02700 and no additional payment will be made for such work outside the pavement payment width.

4. Payment under this item shall also include adjusting all existing and new manhole frames and covers and valve boxes, within the limits of new pavement, to finished grade elevation as necessary.

5. Payment under this item shall also include demolition, removal and reconstruction of existing speed bumps as shown on the Drawings.

6. Any installation, maintenance and removal of temporary asphalt or crushed stone paving will be considered incidental to the permanent paving work and no additional payment will be made under this item.

7. No additional payment will be made for any materials, equipment or labor associated with steel plate bridging.

8. No additional payment will be made for saw cutting of pavement due to pavement thickness or material changes.

1.17 ITEM 8D – PAVEMENT MILLING

A. Measurement for payment for pavement milling will be on a per square yard basis based

upon limits as directed by the Engineer.

B. Payment for pavement milling will be made at the unit price established in the Bid Schedule and will be full compensation for furnishing all labor, tools, and equipment necessary for pavement milling, including, removal and disposal of pavement, dust control during milling and adjusting existing and new manhole frames and covers and valve vaults as necessary to allow for milling as specified in Section 02700.

1.18 ITEM 8E – CONCRETE PAVEMENT REPLACEMENT

A. Measurement for payment of concrete pavement replacement (i.e, concrete over the trench) will be on a per square yard basis determined by multiplying the longitudinal length of pavement to be replaced by the specified pavement payment width as shown on the Drawings. Concrete pavement thickness shall be 8-inches.

B. Payment

1. Payment for concrete pavement replacement will be made at the unit price established in the Bid Schedule and will be full compensation for all work necessary to install the 8-inch thick concrete pavement, including but not limited to, purchase of concrete, delivery to the work site, surface preparation (including saw cutting existing pavement and reforming the graded aggregate base), concrete placement and cleanup.

2. If a greater or lesser thickness of concrete is placed, as directed by the Engineer, payment shall be prorated on the basis of the thickness actually placed.

3. Payment under this item will also include adjusting all existing and new manhole frames and covers and valve boxes, within the limits of new pavement, to finished grade elevation, as necessary.

4. No additional payment will be made for provision and maintenance of temporary paving.

5. No additional payment will be made for any materials, equipment or labor associated with steel plate bridging.

6. No additional payment will be made for saw cutting of pavement due to pavement thickness or material changes.

1.19 ITEMS 9A THROUGH 9C – CONCRETE CURB AND GUTTER, CONCRETE CURB AND CONCRETE VALLEY GUTTER

A. Measurement for payment of concrete curb and gutter, concrete curb and concrete valley gutter will be made on a per linear foot basis in place and accepted by the Engineer.

B. Payment

1. Payment of the applicable unit prices established in the Bid Schedule for concrete curb and gutter, concrete curb and concrete valley gutter will be full compensation

for all work necessary to install the curb and gutter, including, but not limited to, the purchase, delivery to the work site, on-site storage, delivery to the work areas, excavation, backfilling, compaction, placement, disposal of existing materials, all joints, all special construction at driveways and other entrances or points, and cleanup.

2. Payment under this item will also include all approaches through curb and gutter indicated on the Drawings.

1.20 ITEM 10A – BRICK PAVER SIDEWALK REPLACEMENT

A. Measurement for payment for brick paver sidewalk replacement shall be on a per square yard basis in place and accepted by the Engineer.

B. Payment

1. Payment f the unit price established in the Bid Schedule for brick paver sidewalk replacement will be full compensation for furnishing all labor, materials, tools, and equipment necessary to install specialty brick paver sidewalk including, but not limited to, excavation, backfilling, compaction, disposal of existing materials, all joints, all special construction at driveways or other entrances and points, hauling and placing materials; and cleanup.

2. Payment under this item will also include all approaches through curb and gutter indicated on the Drawings.

1.21 ITEM 10B – CONCRETE SIDEWALK REPLACEMENT

A. Measurement for payment for concrete sidewalk replacement shall be on a per square yard basis in place and accepted by the Engineer.

B. Payment

1. Payment of the unit price established in the Bid Schedule for concrete sidewalk replacement will be full compensation for furnishing all labor, materials, tools, and equipment necessary to install concrete sidewalk and shall include: excavation; backfilling; compaction; disposal of existing materials; all joints; all special construction at driveways or other entrances and points; hauling and placing materials; and incidentals necessary to complete the work.

2. Payment under this item will also include all approaches through curb and gutter indicated on the Drawings.

1.22 ITEM 10C – SPECIALTY STAMPED CONCRETE (PAVER) SIDEWALK

A. Measurement for payment for specialty stamped concrete (paver) sidewalk shall be on a per square yard basis in place and accepted by the Engineer.

B. Payment

1. Payment of the unit price established in the Bid Schedule for specialty stamped concrete sidewalk replacement will be full compensation for furnishing all labor, materials, tools, and equipment necessary to install specialty concrete (paver)

sidewalk including, but not limited to, excavation, hauling and placing materials, backfilling, compaction, disposal of existing materials, all joints, all special construction at driveways or other entrances and points and cleanup.

2. Payment under this item will include all approaches through curb and gutter indicated on the Drawings.

1.23 ITEM 10D – WHEELCHAIR RAMPS

A. Measurement for payment for wheelchair ramps will be on a per square yard basis in place and accepted by the Engineer.

B. Payment

1. Payment of the unit price established in the Bid Schedule for wheelchair ramps will be full compensation for furnishing all labor, materials, tools, and equipment necessary to install wheelchair ramps including, but not limited to, saw cutting sidewalk, removal and disposal of existing concrete, site preparation, hauling and placing materials, joint installation and cleanup.

2. Payment under this item shall also include furnishing and installing tactile surface warning tiles.

1.24 ITEM 11A - NEW GRANITE CURB

A. Measurement for payment of new granite curb will be on a per linear foot basis in place and accepted by the Engineer.

B. Payment of the unit price established in the Bid Schedule for new granite curb will be full compensation for all work necessary to install the new granite curb, including, but not limited to, purchase of granite curb, delivery to the work site, on-site storage, removal and disposal of the existing granite curb, site preparation, concrete for curb foundation, and the installation of new granite curb, placement of joints and cleanup.

1.25 ITEM 11B - REUSED GRANITE CURB

A. Measurement for payment of reused granite curb will be on a per linear foot basis in place and accepted by the Engineer.

B. Payment of the unit price established in the Bid Schedule for reused granite curb will be full compensation for all work necessary to install the reused granite curb, including, but not limited to, the removal, storage and reinstallation of existing granite curb, cleaning of the curb, delivery to the work areas, site preparation, concrete for curb foundation, reinstallation of existing granite curb, placement of joints and cleanup.

1.26 ITEMS 12A AND 12B – RESIDENTIAL AND COMMERCIAL DRIVEWAYS

A. Measurement for payment for new concrete driveway, residential and commercial will be on a per square yard basis determined by multiplying the longitudinal length of pavement actually replaced and accepted by the Engineer by the specified pavement payment width as shown on the Drawings..

B. Payment

1. Payment of the applicable unit prices established in the Bid Schedule for residential and commercial driveways will be full compensation for furnishing all labor, materials, tools, and equipment necessary to install driveways including saw cut, removal and disposal of existing concrete driveway sections, forming, delivering to the worksite, placing and finishing concrete for new driveway sections and clean up.

2. No separate measurement and payment will be made for any materials equipment or labor associated with steel plate bridging.

3. No separate measurement and payment will be made for items associated with temporary patch paving.

. 4. No additional payment will be made for saw-cutting of pavement due to pavement thickness or material changes.

1.27 ITEMS 13A AND 13B - PAVEMENT MARKINGS

A Measurement for payment for pavement markings of the type specified in the Bid Schedule will be on a per linear foot basis as determined along the centerline of the pavement markings in place and accepted by the Engineer.

B. Payment

1. Payment of the unit price established in the Bid Schedule for pavement markings will be full compensation for furnishing all labor, tools, and equipment necessary to restore the street pavement markings to the lengths, and extents and in accordance with the appropriate municipal regulations and industry standards contained Section 02700 of these specifications and as shown in the Drawings.

2. Location and quantities of existing pavement markings, to be restored, will be verified with the engineer prior to disturbing the existing pavement markings.

3. Any pavement markings installed or damaged outside the pay line limits will be remedied in accordance with City regulations and standards and as directed by the Engineer. No additional payment will be allowed for such work outside the pay line width.

1.28 ITEM 14 - TRAFFIC REGULATION

A. Measurement for payment for traffic regulation as specified in Section 01550, Traffic Regulation and as shown on the Drawings will be at the lump sum price established in the Bid Schedule.

B. Payment

1. Payment of the lump sum price established in the Bid Schedule for traffic regulation will be full compensation for all labor, materials, equipment and incidentals necessary to provide and implement traffic regulation during construction in accordance with the Drawings and Specifications, the City of Atlanta and the Georgia Department of Transportation.

2. Payment under this item shall also include furnishing off duty City of Atlanta police officers and certified flaggers for traffic control and the installation, maintenance and removal of traffic control devices..

3. Payment of the lump sum price will be based upon the breakdown of the item as required by Special Condition SC-16.7.

1.29 ITEM 15A – FURNISH AND INSTALL SOD

A. Measurement for payment for furnishing and installing sod will be on a per square yard basis, in place and accepted by the Engineer.

B. Payment for furnishing and installing sod will be made at the unit price established in the Bid Schedule and will be full compensation for all labor, materials, and equipment necessary to complete the work, including ground preparation, furnishing and placing all topsoil, mulch, sod, fertilizer and water to create a satisfactory stand, all as specified in Section 02933, Seeding.

1.30 ITEM 15B – FURNISH AND INSTALL SEED

A. Measurement for payment for furnishing and installing seed will be on a per square yard basis, in place, and accepted by the Engineer.

B. Payment for furnishing and installing seed will be made at the unit price established in the Bid Schedule and will be full compensation for all labor, materials and equipment necessary to complete seeding, including ground preparation, furnishing and placing all topsoil, mulch, seed, fertilizer and water to create a satisfactory stand, all as specified in Section 02933, Seeding.

1.31 ITEM 16 - FURNISH AND INSTALL CLASS A REINFORCED CONCRETE

A. Measurement for payment of 4000 psi reinforced concrete will be made on a cubic yard basis. Concrete will not be measured and paid for separately when included in another item of work for which payment is based on units of length or area.

B. Payment for furnishing and installing class A reinforced concrete will be made at the unit price established in the Bid Schedule and will be full compensation for all work necessary to install the reinforced concrete, including, but not limited to: the purchase, delivery to the work site, on-site storage, and delivery to the work areas of materials, site preparation;

placement of formwork, reinforcing steel and concrete and cleanup.

1.32 ITEM 17 – FURNISH AND INSTALL CLASS B UNREINFORCED CONCRETE

A. Measurement for payment of 3000 psi unreinforced concrete will be made on a cubic yard basis. Concrete will not be measured and paid for separately when included in another item of work for which payment is based on units of length or area.

B. Payment

1. Payment for furnishing and installing class B unreinforced concrete will be made at the unit price established in the Bid Schedule and will be full compensation for all work necessary to install the unreinforced concrete, including, but not limited to: the purchase, delivery to the work site, on-site storage, and delivery to the work areas; site preparation; placement of formwork and concrete; and cleanup.

2. Payment for concrete encasement of water and sewer lines shall be calculated by multiplying the longitudinal length of the encasement measured along the center line of the pipe, as accepted by the Engineer, times the cross sectional area of the encasement as shown on the Standard Detail. Deduction shall be made for the volume occupied by the pipe

1.33 ITEM 18 – GROUT-IN-PLACE AND ABANDON EXISTING SEWERS

A. Measurement for payment for the grouting in place and abandonment of existing sanitary sewer lines shall be on a per cubic yard basis of grout in place and accepted by the Engineer..

B. Payment for grout for abandoning existing sewers will be made at the unit price established in the Bid Schedule and will be full compensation for all work necessary for abandonment of existing sewer lines, including all labor, material, equipment and incidentals required to furnish and install grout in the existing sewer within the limits as shown on the Drawings or as directed by the Engineer.

1.34 ITEM 19 – BACKFILL AND ABANDON EXISTING MANHOLES

A. Measurement for payment for the backfilling and abandonment of existing manholes shall be on a per cubic yard basis of earth backfill in place and accepted by the Engineer.

B. Payment for backfill and abandoning existing sewers will be made at the unit price established in the Bid Schedule and will be full compensation for all work necessary for abandonment of existing manholes, including all labor, material, equipment and incidentals required to remove manhole to below grade as specified and to backfill the manhole with earth backfill.

1.35 ITEMS 20 THROUGH 22 – CCTV INSPECTION, SMOKE TESTING AND DYE TESTING

A. Measurement for payment for existing sewer evaluation shall be on a per linear foot basis for CCTV inspection and smoke testing and on a per each basis for dye testing.

B. Payment for evaluation of existing sewers will be made at the applicable unit prices established in the Bid Schedule and will be full compensation for all labor, materials, equipment, supplies and incidentals required for furnishing required pre-cleaning of pipe prior to CCTV inspection, video equipment for inspection of existing lines of all sizes to locate existing laterals and side lines as required to tie into new gravity sewers, all as specified in Sections 02650 and 02655.

SECTION 2 – ALLOWANCES

2.01 ALLOWANCES

A. The allowances specified in the Bid Schedule are to establish a fund to pay the cost of items for which the City could not establish accurate quantities and/or detailed scope of work. This work shall be completed only at the written direction of the Engineer, and the cost of such work shall be approved prior to performance of the work.

B. The Contractor shall be responsible for the payment for these services to the appropriate payee providing such service, and shall submit evidence of payments to the Engineer prior to its inclusion in the progress payments.

C. Payment will be made for invoices submitted by the Contractor subject to the Contract Documents. Contractor will not receive any additional compensation for bond or insurance costs for work executed using allowance funding.

D. Allowance allocations shall only be paid to the Contractor for completed work authorized by the Engineer. All allowance dollar amounts not expended shall revert to the City at the completion of the project. Should the final allowance costs be less than the specified amount of the allowance the Contract will be adjusted accordingly by a change order. The amount of the change order will not recognize any changes in handling costs at the site, labor, overhead, profit and other expenses caused by the adjustment to the allowance item.

2.02 ITEM XX - TREE REPLACEMENT

A. An allowance has been established as the value of this item. This allowance shall be used to pay the costs, where the amounts are determined as specified in General Condition Article GC-41.2.4 Force Account, for tree replacement on public or private property. This allowance will also be used to reimburse the Contractor for payments made into the tree recompense fund for the replacement of trees within easements that are not shown on the Drawings.

2.03 ITEM XX – SPECIAL RAILROAD FLAGGING AND DOT PERMIT REQUIREMENTS

A. An allowance has been established as the value of this item. This allowance shall be used to pay the costs, where the amounts are determined as specified in General Condition Article GC-41.2.4 Force Account, for any special railroad flagging or DOT permit requirements beyond those identified in the MUTCD.

2.04 ITEM XX - REPLACEMENT AND REPAIR OF TRAFFIC CONTROL DEVICES

A. An allowance has been established as the value of this item. This allowance shall be used to pay the costs, where the amounts are determined as specified in General Condition Article GC-41.2.4 Force Account, for replacement and repair of traffic control devices as directed by the Engineer.

2.05 ITEM XX – CITY DIRECTED COMPLIANCE TESTING

A. An allowance has been established as the value of this item. This allowance shall be used to pay the costs, where the amounts are determined as specified in General Condition Article GC-41.2.4 Force Account, for supplemental confirmation testing where directed by the Engineer not covered in Section 01400, Quality Assurance/Quality Control.

2.06 ITEM XX - UNFORESEEN UTILITY CONFLICTS

A. An allowance has been established as the value of this item. This allowance shall be used to pay the costs, where the amounts are determined as specified in General Condition Article GC-41.2.4 Force Account, for unforeseen utility conflicts as directed by the Engineer. This work may be required in the event utilities not shown on the Drawings are encountered and impact the contract related work.

B. If the Contractor, during the course of construction, believes an underground utility conflict exists, the conflicting condition shall be exposed and the Engineer notified. The Engineer will then determine whether an underground conflict actually exists. The Engineer’s determination shall be final.

C. If the Engineer determines that an underground utility conflict actually exists, the Contractor shall submit a plan to the Engineer detailing how the conflict is to be resolved. The plan shall include a detailed layout of existing and proposed piping. The plan shall be approved by the Engineer prior to the Contractor initiating any work.

PART 2 PRODUCTS

(NOT USED)

PART 3 EXECUTION

(NOT USED)

+ + + END OF SECTION 01200 + + +

SECTION 01260
CONTRACT MODIFICATION PROCEDURES

PART 1 GENERAL

1.01 SCOPE

A. Without invalidating the Contract and without notice to any surety, Owner may, at any time or from time to time, order additions, deletions, or revisions in the Work by a Change Order, or a Work Change Directive. Upon receipt of any such document, Contractor shall promptly proceed with the Work involved which will be performed under the applicable conditions of the Contract Documents (except as otherwise specifically provided).

1. Owner may, in anticipation of possibly ordering an addition, deletion or revision to the Work, request Contractor to prepare a proposal of cost and times to perform Owner's contemplated changes in the Work. Contractor's written proposal shall be transmitted to the City's Authorized Representative promptly, but not later than fourteen calendar days after Contractor's receipt of Owner's written request and shall remain a firm offer for a period not less than sixty days after receipt by Engineer.
2. Contractor is not authorized to proceed on an Owner contemplated change in the Work prior to Contractor's receipt of a Change Order (or Work Change Directive) incorporating such change into the Work.
3. Owner's request for proposal or Contractor's failure to submit such proposal within the required time period will not justify a claim for an adjustment in Contract Price or Contract Time (or Milestones).
4. The Owner shall not be liable to the Contractor for any costs associated with the preparation of proposal associated with the Owner's contemplated changes in the Work.

B. If Owner and Contractor are unable to agree on entitlement to, or on the amount or extent, if any, of an adjustment in the Contract Price or Contract Times, or both, that should be allowed as a result of a Work Change Directive, a Claim may be made.

C. Contractor shall not be entitled to an increase in the Contract Price or an extension of the Contract Times with respect to any work performed that is not required by the Contract Documents as amended, modified, or supplemented, except in the case of an emergency or in the case of uncovering Work.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 EXECUTION OF CHANGE ORDERS

A. Owner and Contractor shall execute appropriate Change Orders recommended by the City's Authorized Representative covering:

1. changes in the Work which are: (i) ordered by Owner, (ii) required because of acceptance of defective Work or Owner's correction of defective Work, or (iii) agreed to by the parties;
2. changes in the Contract Price or Contract Times which are agreed to by the parties, including any undisputed sum or amount of time for Work actually performed in accordance with a Work Change Directive; and
3. changes in the Contract Price or Contract Times which embody the substance of any written
4. decision rendered by Engineer; provided that, in lieu of executing any such Change Order, an appeal may be taken from any such decision in accordance with the provisions of the Contract Documents and applicable Laws and
5. Regulations, but during any such appeal, Contractor shall carry on the Work and adhere to the Progress Schedule.

B. In signing a Change Order, the Owner and Contractor acknowledge and agree that:

1. The stipulated compensation (Contract Price or Contract Time, or both) set forth in the Change Order includes payment for:
   a. the Cost of the Work covered by the Change Order,
   b. Contractor's fee for overhead and profit,
   c. interruption of Progress Schedules,
   d. delay and impact, including cumulative impact, on other work under the Contract Documents, and
   e. extended home office and jobsite overhead;
2. the Change Order constitutes full mutual accord and satisfaction for the change to the Work;
3. No reservation of rights to pursue subsequent claims on the Change Order will be made by either party; and
4. No subsequent claim or amendment of the Contract Documents will arise out of or as a result of the Change Order.

C. Notification of Surety:

If the provisions of any bond require notice to be given to a surety of any change affecting the general scope of the Work or the provisions of the Contract Documents (including, but not limited to, Contract Price or Contract Times), the giving of any such notice will be Contractor's responsibility. The amount of each applicable bond will be adjusted to reflect the effect of any such change.

D. Claims and Disputes:

1. City's Authorized Representative's Decision Required: All Claims shall be referred to the City's Authorized Representative for decision. A decision by the City's Authorized Representative shall be required as a condition precedent to any exercise by the Contractor of any rights or remedies they may otherwise have under the Contract Documents or by Laws and Regulations in respect of such Claims.
2. Notice: Written notice stating the general nature of each Claim shall be delivered by the claimant to City's Authorized Representative to the Contract promptly (but in no event later than 30 calendar days after the start of the event giving rise thereto). The responsibility to substantiate a Claim shall rest with the party making the Claim. Notice of the amount or extent of the Claim, with written supporting data shall be delivered to the City's Authorized Representative within 60 calendar days (and monthly thereafter for continuing events) after the start of such event.

   City's Authorized Representative may allow additional time for claimant to submit additional or more accurate data in support of such Claim. A Claim for an adjustment in Contract Price shall be prepared in accordance with the provisions of Paragraph 3.02.A.2. A Claim for an adjustment in Contract Times shall be prepared in accordance with the provisions of Paragraph 3.02.B.2. Each Claim shall be accompanied by claimant's written statement that the adjustment claimed is the entire adjustment to which the claimant believes it is entitled as a result of said event. The opposing party shall submit any response to the City's Authorized Representative and the claimant within 30 days after receipt of the claimant's last submittal (unless City's Authorized Representative allows additional time).
3. City's Authorized Representative Action: City's Authorized Representative will review each Claim and, within 30 calendar days after receipt of the last submittal of the claimant, if any, and take one of the following actions in writing:

a. deny the Claim in whole or in part;
b. approve the Claim; or
c. notify the party that the City's Authorized Representative is unable to resolve the Claim if, in the City Authorized Representative's sole discretion, it would be inappropriate for the City's Authorized Representative to do so. For purposes of further resolution of the Claim, such notice shall be deemed a denial.

4. In the event that the City's Authorized Representative does not take action on a Claim within said 30 days, the Claim shall be deemed denied.
5. City's Authorized Representative's written action will be final and binding.
6. No Claim for an adjustment in Contract Price or Contract Times will be valid if not submitted in accordance with this specification.

3.02 CHANGE OF CONTRACT PRICE

A. Change of Contract Price:

1. The Contract Price may only be changed by a Change Order. Any Claim for an adjustment in the Contract Price shall be based on written notice submitted by the party making the Claim to the City's Authorized Representative.
2. The value of any Work covered by a Change Order or of any Claim for an adjustment in the Contract Price will be determined as follows:
    a. where the Work involved is covered by unit prices contained in the Contract Documents, by application of such unit prices to the quantities of the items involved; or
    b. where the Work involved is not covered by unit prices contained in the Contract Documents, by a mutually agreed lump sum value fixed by the Owner or by unit price values fixed by the Owner (which may include an allowance for overhead and profit); or
    c. where the Work involved is not covered by unit prices contained in the Contract Documents and agreement to a lump sum is not reached on the basis of the Cost of the Work plus a Contractor's fee for overhead and profit.
3. Contractor's Fee: The Contractor's fee for overhead and profit shall be determined as follows:
    a. a mutually acceptable fixed fee; or
    b. if a fixed fee is not agreed upon, then a fee based on the Section 01200 Measurement and Payment, Item - Time and Materials.

B. Change of Contract Times:

1. The Contract Times may only be changed by a Change Order. Any Claim for an adjustment in the Contract Times shall be based on written notice submitted by the party making the Claim to the Engineer and the other party to the Contract.
2. Any adjustment of the Contract Times covered by a Change Order or any Claim for an adjustment in the Contract Times will be determined in accordance with the provisions of this specification.

C. Delays:

1. Where Contractor is prevented from completing any part of the Work within the Contract Times due to delay beyond the control of Contractor, the Contract Times will may be extended in an amount equal to the time lost due to such delay if a Claim is made therefor. Delays beyond the control of Contractor shall include, but not be limited to, acts or neglect by Owner, acts or neglect of utility owners or other contractors performing other work as contemplated, fires, floods, epidemics, abnormal weather conditions, quarantine restrictions, strikes, freight embargoes, acts of war (declared or not declared), or acts of God.
2. If Owner or other contractors or utility owners performing other work for Owner, or anyone for whom Owner is responsible, delays, disrupts, or interferes with the performance or progress of the Work, then Contractor shall be entitled to an equitable adjustment in the Contract Price or the Contract Times, or both. Contractor's entitlement to an adjustment of the Contract Times is conditioned on

such adjustment being essential to Contractor's ability to complete the Work within the Contract Times.

3. If Contractor is delayed in the performance or progress of the Work by fire, flood, epidemic, abnormal weather conditions, acts of God, acts or failures to act of utility owners not under the control of Owner, or other causes not the fault of and beyond control of Owner and Contractor, then Contractor may be entitled to an equitable adjustment in Contract Times, if such adjustment is essential to Contractor's ability to complete the Work within the Contract Times. Such an adjustment shall be Contractor's sole and exclusive remedy for the delays.
4. Owner, Engineer, and their officers, directors, members, partners, employees, agents, consultants, or subcontractors shall not be liable to Contractor for any claims, costs, losses, or damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) sustained by Contractor on or in connection with any other project or anticipated project.
5. Contractor shall not be entitled to an adjustment in Contract Price or Contract Times for delays within the control of Contractor. Delays attributable to and within the control of a Subcontractor or Supplier shall be deemed to be delays within the control of Contractor.

+ + + END OF SECTION 01260 + + +

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SECTION 01297
APPLICATIONS FOR PAYMENT

PART 1 GENERAL

1.01 REQUIREMENTS INCLUDED

Submit Applications for Payment to the City's Authorized Representative in accordance with the schedule established by Conditions of the Contract and Agreement Between City and Contractor.

1.02 RELATED REQUIREMENTS

A. Agreement Between City and Contractor.

B. Conditions of the Contract: Progress Payments, Retainages and Final Payment.

C. Section 01350 Project Document Tracking and Control System

D.. Section 01720: Project Record Documents.

1.03 FORMAT AND DATA REQUIRED

A. Submit applications in E-builder software.

B. Provide itemized data on continuation sheet:

Format, schedules, line items and values: Those of the Schedule of Values accepted by the City's Authorized Representative.

1.04 PREPARATION OF APPLICATION FOR EACH PROGRESS PAYMENT

A. Application Form:

1. Fill in required information, including that for Change Orders executed prior to date of submittal of application.
2. Fill in summary of dollar values to agree with respective totals indicated on continuation sheets.
3. Execute certification with signature of a responsible officer of Contract firm.
4. Application shall be incorporated into the latest version of E-builder software.

B. Continuation Sheets:

1. Fill in total list of all scheduled component items of Work, with item number and scheduled dollar value for each item.
2. Fill in dollar value in each column for each scheduled line item when work has been performed or products stored.
   Round off values to nearest dollar, or as specified for Schedule of Values.
3. List each Change Order executed prior to date of submission, at the end of the continuation sheets.
   List by Change Order Number, and description, as for an original component item of work.
4. To receive approval for payment on component material stored on site, submit copies of the original invoices with the application for payment first made for these materials. Copies of paid invoices must be submitted for all materials stored longer than sixty (60) days to continue to receive approval for payment on the materials. If paid invoices are not submitted for materials in storage longer than sixty (60) days, those materials shall not be considered in the Application for Payment.

1.05 SUBSTANTIATING DATA FOR PROGRESS PAYMENTS

A. When the City's Authorized Representative requires substantiating data; Contractor shall submit suitable information, with a cover letter identifying:

   1. Project.
   2. Application number and date.
   3. Detailed list of enclosures.
   4. For stored products:
      a. Item number and identification as shown on application.
      b. Description of specific material.

B. Submit one copy of data and cover letter for each copy of application.

C. As a prerequisite for payment, Contractor is to submit a "Surety Acknowledgment of Payment" letter showing amount of progress payment, which the Contractor is requesting.

D. The Contractor is to maintain an updated set of drawings to be used as record drawings in accordance with Section 01720. As a prerequisite for monthly progress payments, the Contractor is to exhibit the updated Record Drawings for review by the City's Authorized Representative.

E. The Contractor shall submit all applicable test reports of installed products in order to request payment for that product.

F. The Contractor shall maintain an updated construction schedule. As a prerequisite for monthly progress payments, Contractor shall submit the updated

construction schedule with the applications for progress payments. If the Contractor fails to submit the required updated schedule within the time prescribed, the City's Authorized Representative may withhold approval of progress payment estimates until such time as the Contractor submits the required updated schedule. Submit one copy for each copy of the application.

G. The Contractor shall demonstrate, as a prerequisite for monthly progress payments, compliance with all requirements specified in Erosion and Sedimentation Control requirements of this project to the City. If the Contractor fails to demonstrate compliance with the applicable Erosion and Sedimentation Control requirements, the City may withhold approval of progress payment estimates until such time as the Contractor demonstrates to the City's Authorized Representative full compliance with the approved erosion and sedimentation control permit.

H. The Contractor shall provide, as a prerequisite for monthly progress payments, an accumulating cost curve (tabular and diagram), indicating schedule, forecast and actual progress.

1.06 PREPARATION OF APPLICATION FOR FINAL PAYMENT

A. Fill in Application form as specified for progress payments.

B. Use continuation sheet for presenting the final statement of accounting.

1.07 SUBMITTAL PROCEDURE

A. Submit Applications for Payment to the City at the times stipulated in the Agreement. Application for Payment request shall be submitted through eBuilder.

B. Number: Five copies of each Application.

C. When the City's Authorized Representative finds Application properly completed and correct, he/she will transmit certificate for payment to City for approval and processing.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

+ + + END OF SECTION 01297 + + +

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SECTION 01300
SUBMITTAL PROCEDURES

PART 1 GENERAL

1.01 DESCRIPTION

This Section specifies the general methods and requirements of submissions applicable to the following work-related Submittals: Shop Drawings, Product Data, Samples, Requests For Information, Construction Schedules, Work Plan, and Submittal Schedules as defined in 01020 Definitions. Detailed submittal requirements are specified in the technical specifications sections. All submittals shall be clearly identified by reference to Specification Section, Paragraph, Drawing No. or Detail as applicable. Submittals shall be clear and legible and of sufficient size for sufficient presentation of data.

1.02 GENERAL PROCEDURES FOR SUBMITTALS

Coordination of Submittal Times: Prepare and transmit each submittal sufficiently in advance of performing the related work or other applicable activities, or within the time specified in the individual work sections of the Specifications, so that the installation will not be delayed by processing times including disapproval and resubmittal (if required), coordination with other submittals, testing, purchasing, fabrication, delivery and similar sequenced activities. No extension of time will be authorized because of the Contractor's failure to transmit submittals sufficiently in advance of the Work. Submittal entries to be input into E-builder or as directed by the City's Authorized Representative.

1.03 SHOP DRAWINGS, WORKING DRAWINGS, PRODUCT DATA, SAMPLES, PRECONSTRUCTION VIDEO

A. Shop Drawings:

1. Shop drawings, as defined above, and as specified in individual work Sections include, but are not necessarily limited to, custom-prepared data such as fabrication and erection/installation (working) drawings, scheduled information, setting diagrams, actual shop work manufacturing instructions, custom templates, special wiring diagrams, coordination drawings, individual system or equipment inspection and test reports including performance curves and certifications, as applicable to the Work.
2. All shop drawings submitted by subcontractors for approval shall be sent directly to the Contractor for checking. The Contractor shall be responsible for their submission at the proper time so as to prevent delays in delivery of materials.
3. The Contractor shall check all subcontractors' shop drawings regarding measurements, size of members, materials, and details to satisfy himself/herself that they conform to the intent of the Drawings and Specifications. Shop drawings found

to be inaccurate or otherwise in error shall be returned to the subcontractors for correction before submission thereof.

4. All details on shop drawings submitted for approval shall show clearly the relation of the various parts to the main members and lines of the structure, and where correct fabrication of the work depends upon field measurements, such measurements shall be made and noted on the drawings before being submitted for approval.
5. For electronic submittals, drawings and the necessary data shall be submitted electronically to the Owner or Owner's Representative as specified below.
   a. Submittal documents shall be in color to facilitate use of red line markups. All electronic files shall be in Portable Document Format (PDF) as generated by Adobe Acrobat Professional Version 7.0 or higher. The PDF file(s) shall be fully indexed using the Table of Contents, searchable with thumbnails generated. PDF images must be at a readable resolution. For most documents, they should be scanned or generated at 300 dots per inch (dpi). Use of higher resolution is acceptable with the Owner or Owner's Representative approval.
   b. Optical Character Recognition (OCR) capture must be performed on these images so that text can be searched, selected and copied from the generated PDF file.
   c. The PDF documents shall have a bookmark created in the navigation frame for each major entry ("Section" or "Chapter") in the Table of Contents. Thumbnails shall be generated for each page or graphic in the PDF file.
6. The opening view for each PDF document shall be as follows:
   a. Initial View: Bookmarks and Page
   b. Magnification: Fit In Window
   c. The file shall open to Contractor's transmittal letter, with bookmarks to the left. The first bookmark shall be linked to the Table of Contents.
   d. PDF document properties shall include the submittal number for the document title and Contractor's name for the author.
   e. Electronic submittal file sizes shall be limited to 10 MB. When multiple files are required for a submittal the least number of files possible shall be created.
   f. Contractor shall post submittals and retrieve the Owner or Owner's Representative's submittal review comments through the Project website accessible through the Internet. Instruction on procedures for posting and retrieving submittals will be provided after award of the Contract.

B. Product Data:

Product data as defined above, and as specified in individual Sections, include, but are not necessarily limited to, standard prepared data for manufactured products (sometimes referred to as catalog data), such as the manufacturer's product specification and installation instructions, availability of colors and patterns, manufacturer's printed statements of compliances and applicability, roughing-in diagrams and templates, catalog cuts, product photographs, standard wiring diagrams, printed performance curves and operational-range diagrams, production or quality control inspection and test reports and certifications, mill reports, product operating

and maintenance instructions and recommended spare-parts listing and printed product warranties, as applicable to the Work.

C. Working Drawings:

1. When used in the Contract Documents, the term "working drawings" shall be considered to mean the Contractor's plans for temporary structures such as temporary bulkheads, support of open cut excavation, support of utilities, ground water control systems, pedestrian bridges, temporary traffic and signage plans, forming and false work; and for such other work as may be required for construction but does not become an integral part of the Project.
2. Working drawings shall be prepared and sealed by a registered Professional Engineer, currently licensed to practice in the State of Georgia. The Contractor shall submit a letter of certification from the Professional Engineer stating that he/she has prepared the designs and has verified that the materials/ equipment have been installed as designed. No working drawings or calculations/computations relating to the working drawings shall be submitted to the City's Authorized Representative unless specifically requested in writing.

D. Samples:

Samples as defined above and as specified in individual Sections, include, but are not necessarily limited to, physical examples of the work such as sections of manufactured or fabricated work, small cuts or containers of materials, complete units of repetitively used products, color/texture/pattern swatches and range sets, specimens for coordination of visual effect, graphic symbols and units of work to be used by the City's Authorized Representative or Owner for independent inspection and testing, as applicable to the Work.

E. Colors:

1. Unless the precise color and pattern is specifically described in the Contract Documents, wherever a choice of color or pattern is available in a specified product, submit accurate color charts and pattern charts to the Engineer for review and selection by the Owner.
2. Submit the number of color and pattern charts that are desired by the Contractor to be returned plus three color and pattern charts to be retained by the Engineer. Submittal of black and white copies will not be acceptable. Charts shall be furnished to the Contractor by the vendor or supplier. Charts printed from the vendor or supplier's web-site will not be acceptable.
3. Unless all available colors and patterns have identical costs and identical wearing capabilities, and are identically suited to the installation, completely describe the relative costs and capabilities of each.

F. Pre-Construction Photos/Video Recording:

Submit Pre-Construction Photos/Video Recording per Section 01320.

G. Test Reports:

Submit test reports to City's Authorized Representative and follow all requirements per Section 01410.

H. Record Drawings:

Submit Record Drawings per Section 01720.

1.04 CONTRACTOR'S RESPONSIBILITIES

A. The Contractor shall review shop drawings, product data and samples, including those by subcontractors, prior to submission to determine and verify the following:

1. Field measurements
2. Field construction criteria
3. Catalog numbers and similar data
4. Conformance with the Specifications

B. Each shop drawing, sample and product data submitted by the Contractor shall have affixed to it the following Certification Statement including the Contractor's Company name and signed by the Contractor: "Certification Statement: By this submittal, I hereby represent that I have determined and verified all field measurements, field construction criteria, materials, dimensions, catalog numbers and similar data and I have checked and coordinated each item with other applicable approved shop drawings and all Contract requirements." Shop drawings and product data sheets 11-in x 17-in and smaller shall be bound together in an orderly fashion and bear the above Certification Statement on the cover sheet. The cover sheet shall fully describe the packaged data and include a listing of all items within the package. Provide to the City's Authorized Representative a copy of each submittal transmittal sheet for shop drawings, product data and samples at the time of submittal of said drawings, product data and samples to the City and/or City's Authorized Representative.

C. Each submittal shall be transmitted by a standard transmittal sheet which shall fully describe the transmitted data and include a listing of all items within the submittal.

D. The Contractor shall utilize a 10-character submittal identification numbering system in the following manner:

1. The first character shall be a D, S, P, M, or R, which represents Shop/Working Drawing and other Product Data (D), Sample (S), Preliminary Submittal (P), Operating/Maintenance Manual (M), or Request for Information (R).
2. The next five digits shall be the applicable Specification Section Number.
3. The next three digits shall be the numbers 001-999 to sequentially number each initial separate item or drawing submitted under each specific Section number.
4. The last character shall be a letter, A-Z, indicating the submission, or resubmission of the same Drawing, i.e., "A=1st submission, B=2nd submission, C=3d submission, etc. A typical submittal number would be as follows:

   D-03300-008-B

D	=	Shop Drawing
03300	=	Specification Section for Concrete
008	=	The eighth initial submittal under this specification section
B	=	The second submission (first resubmission) of that particular shop drawing

E. Notify the City and/or City's Authorized Representative in writing, at the time of submittal, of any deviations in the submittals from the requirements of the Contract Documents.

F. The review and approval of shop drawings, samples or product data by the City and/or City's Authorized Representative shall not relieve the Contractor from his/her responsibility with regard to the fulfillment of the terms of the Contract. All risks of error and omission are assumed by the Contractor and the City's Authorized Representative will have no responsibility therefore.

G. No portion of the work requiring a shop drawing, sample, or product data shall be started nor shall any materials be fabricated or installed prior to the approval or qualified approval of such item. Fabrication performed, materials purchased or on-site construction accomplished which does not conform to approved shop drawings and data shall be at the Contractor's risk. The City will not be liable for any expense or delay due to corrections or remedies required to accomplish conformity.

H. Project work, materials, fabrication, and installation shall conform with approved shop drawings, applicable samples, and product data.

1.05 SUBMISSION REQUIREMENTS

A. Make submittals promptly in accordance with approved schedule, and in such sequence as to cause no delay in the Work or in the work of any other contractor.

B. Each submittal, appropriately coded, will be returned within 30 calendar days following receipt of submittal by the City and/or City's Authorized Representative.

C. Number of submittals required:

1. Shop Drawings as defined in Paragraph 1.02 A: Five copies.
2. Product Data as defined in Paragraph 1.02 B: Five copies.
3. Samples: Submit the number stated in the respective Specification Sections.

D. Submittals shall contain:

1. The date of submission and the dates of any previous submissions.
2. The Project title and number.
3. Contractor identification.
4. The names of:
   a. Contractor
   b. Supplier
   c. Manufacturer
5. Identification of the product, with the specification section number, page and paragraph(s).
6. Field dimensions, clearly identified as such.
7. Relation to adjacent or critical features of the Work or materials.
8. Applicable standards, such as ASTM or Federal Specification numbers.
9. Contractor certification statement and identification of deviations from Contract Documents.
10. Identification of revisions on resubmittals.
11. An 8-in x 3-in blank space for Contractor and City stamps.

E. Facsimiles or copies of facsimiles will not be accepted as submittals.

F. After review of shop and working drawings, City and/or City's Authorized Representative will return four copies of the submittal to the Contractor.

1.06 REVIEW OF SHOP DRAWINGS, PRODUCT DATA, WORKING DRAWINGS AND SAMPLES

A. The review of shop drawings, data, and samples will be for general conformance with the design concept and Contract Documents. They shall not be construed:

1. As permitting any departure from the Contract requirements;
2. As relieving the Contractor of responsibility for any errors, including details, dimensions, and materials;
3. As approving departures from details furnished by the City and/or City's Authorized Representative, except as otherwise provided herein.

B. The Contractor remains responsible for details and accuracy, for coordinating the work with all other associated work and trades, for selecting fabrication processes, for techniques of assembly, and for performing work in a safe manner.

C. If the shop drawings, data or samples as submitted describe variations and show a departure from the Contract requirements which City and/or City's Authorized Representative finds to be in the interest of the City and to be so minor as not to involve a change in Contract Price or time for performance, the City and/or City's Authorized Representative may return the reviewed drawings without noting an exception.

D. Submittals will be returned to the Contractor under one of the following codes.

Code 1 -"APPROVED" is assigned when there are no notations or comments on the submittal. When returned under this code the Contractor may release the equipment and/or material for manufacture.

Code 2 -"APPROVED AS NOTED". This code is assigned when a confirmation of the notations and comments IS NOT required by the Contractor. The Contractor may release the equipment or material for manufacture; however, all notations and comments must be incorporated into the final product.

Code 3 -"APPROVED AS NOTED/CONFIRM". This combination of codes is assigned when a confirmation of the notations and comments IS required by the Contractor. The Contractor may release the equipment or material for manufacture; however, all notations and comments must be incorporated into the final product. This confirmation shall specifically address each omission and nonconforming item that was noted. Confirmation is to be received by the City's Authorized Representative within 15 calendar days of the date of the City's Authorized Representative's transmittal requiring the confirmation.

Code 4 -"APPROVED AS NOTED/RESUBMIT". This combination of codes is assigned when notations and comments are extensive enough to require a resubmittal of the package. This resubmittal is to address all comments, omissions and non-conforming items that were noted. Resubmittal is to be received by the City's Authorized Representative within 15 calendar days of the date of the City's Authorized Representative's transmittal requiring the resubmittal.

Code 5 -"NOT APPROVED" is assigned when the submittal does not meet the intent of the Contract Documents. The Contractor must resubmit the entire package revised to bring the submittal into conformance. It may be necessary to resubmit using a different manufacturer/vendor to meet the Contract Documents.

Code 6 -"COMMENTS ATTACHED" is assigned where there are comments attached to the returned submittal which provide additional data to aid the Contractor.

Code 7 - "RECEIPT ACKNOWLEDGED" is assigned to acknowledge receipt of a submittal that is not subject to the City's Authorized Representative's review and approval, and is being filed for informational purposes only. This code is generally used in acknowledging receipt of means and methods of construction work plans, field conformance test reports, and health and safety plans.

Codes 1 through 5 designate the status of the reviewed submittal with Code 6 showing there has been an attachment of additional data. Code 7 will be used as may be necessary.

E. Resubmittals will be handled in the same manner as the initial submittals. On resubmittals, the Contractor shall direct specific attention, in writing on the letter of transmittal and on resubmitted shop drawings by use of revision triangles or other similar methods, to revisions other than the corrections requested by the City's Authorized Representative, on previous submissions. Any such revisions which are not clearly identified shall be made at the risk of the Contractor. The Contractor shall make corrections to any work done because of this type of revision that is not in accordance to the Contract Documents as may be required by the City's Authorized Representative.

F. Partial submittals will not be reviewed. The City's Authorized Representative will be the only judge as to the completeness of a submittal. Submittals not complete will be returned to the Contractor, and will be considered "Not Approved" until resubmitted. The City's Authorized Representative may, at his/her option, provide a list or mark the submittal directing the Contractor to the areas that are incomplete.

G. Repetitive Review:

1. Shop drawings and other submittals will be reviewed no more than twice at the City's expense. All subsequent reviews will be performed at times convenient to the City's Authorized Representative and at the Contractor's expense, based on the City and/or City's Authorized Representatives then prevailing rates. The Contractor shall reimburse the City for all such fees invoiced to the City by the City's Authorized Representative. Submittals are required until approved.
2. Any need for more than one resubmission, or any other delay in obtaining City's Authorized Representative's review of submittals, will not entitle Contractor to extension of the Contract Time.

H. If the Contractor considers any correction indicated on the shop drawings to constitute a change to the Contract Documents, the Contractor shall give written notice thereof to the City's Authorized Representative at least seven working days prior to release for manufacture.

I. When the shop drawings have been completed to the satisfaction of the City's Authorized Representative, the Contractor shall carry out the construction in accordance therewith and shall make no further changes therein except upon written instructions from the City's Authorized Representative.

J. Request for Information (RFI) shall be submitted on a standard form provided by the City's Authorized Representative. RFI's shall indicate their importance to the timely completion of the project. RFI's will be processed as a shop drawing with 7 days allowed for review time.

1.07 DISTRIBUTION

Distribute reproductions of approved shop drawings and copies of approved product data and samples, where required, to the job site file and elsewhere as directed by the City's Authorized Representative. Number of copies shall be as directed by the City's Authorized Representative but shall not exceed six (6).

1.08 SCHEDULES

Provide all schedules required in 01310 Construction Progress Schedule

1.09 PROFESSIONAL ENGINEER (P.E.) CERTIFICATION FORM

If specifically required in other Sections of these Specifications, the Contractor shall submit an Engineering Certification issued by a Professional Engineer licensed in the State of Georgia for each item required, in the form attached to this Section, completely filled in and stamped.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

(P.E. CERTIFICATION FORM ATTACHED)

+ + + END OF SECTION 01300 + + +

P.E. CERTIFICATION FORM

The undersigned hereby certifies that he/she is a Professional Engineer registered in the State of Georgia and that he/she has been employed by (Name of Contractor) _____

_____ to design_____ _____

in accordance with Specification Section _____ for the (Name of Project) _____

_____. The undersigned further certifies that

he/she has performed the design of the _____

_____, that said design is in conformance with all applicable local, state and federal codes, rules, and regulations, and that his/her signature and P.E. stamp have been affixed to all calculations and drawings used in, and resulting from, the design.

The undersigned hereby agrees to make all original design drawings and calculations available to the

(Insert Name of City) _____

_____
or City's representative within the immediate five working days following written request by the City.

_____ _____
P.E. Name Signature

_____
Address

_____ _____
Contractor's Name Signature

_____
Title

_____
Address

SECTION 01310
CONSTRUCTION PROGRESS SCHEDULE

PART 1 GENERAL

1.01 SCOPE

The work under this Section includes preparing, furnishing, distributing, and periodic updating of the construction program/schedules as specified herein. Based on the type, scope and planned duration of the work order, the City may waive or modify the schedule requirements if requested by the Contractor in writing.

1.02 SUBMITTALS

A. Overall Project Schedule (OPS):

1. Submit the schedule within sixty (60) days after date of the Notice to Proceed.
2. The Engineer will review the OPS and return it within twenty (20) days after receipt.
3. If required, resubmit, incorporating all revisions, within ten (10) days after receipt of a returned copy.
4. Failure of the Contractor to meet the schedule submission milestones will result in withholding of monthly payments until deliverables associated with the milestones are received. Payments will be withheld should the Contractor fail to deliver an acceptable schedule within ninety (90) days after date of the Notice to Proceed.

B. Near Term Schedule (NTS):

1. Submit the first NTS within ten (10) days of the Notice to Proceed.
2. The Engineer will review the NTS and return it within ten (10) days after receipt.

C. Facility Shutdowns:

1. As part of the Project Schedules, include all anticipated facility shutdowns, including but not limited to the following:
   a. Temporary relocations.
   b. Temporary bypasses.
   c. Transitions from existing to temporary, temporary to new, and the like.
2. For each anticipated shutdown included in the schedule, submit within ninety (90) days of the Notice to Proceed, a description of the shutdown, extent, anticipated start date, anticipated duration or completion date, related preparation work, and related temporary facilities to be provided.

D. Updating: Submit a monthly update of the OPS and NTS with each request for payment. Provide each update on a CD/DVD. Include with the monthly update a complete report indicating all comparisons between the previous schedule and the current update.

1.03 QUALITY CONTROL

Microsoft® Office Project (or equivalent), current version at NTP date shall be used to develop the Project schedules.

1.04 INITIAL DEVELOPMENT REVIEW

A. Prior to development of the schedule, the Contractor and approved scheduling consultant shall meet with the Engineer as required to discuss and agree on how activity codes will be set up, activity identification, and the basic structure of the schedule.

B. Acceptance of the Contractor's PPS, SOV, OPS, and NTS and revisions thereto, shall in no way relieve the Contractor of any duties and obligations under the Contract. Such approval is limited to the format of the schedule and does not in any way indicate approval of, or concurrence with, the Contractor's means, methods, and ability to carry out the Work.

PART 2 PRODUCTS

2.01 OVERALL PROJECT SCHEDULE (OPS)

A. The Contractor shall submit to the Engineer for approval a detailed construction schedule detailing the proposed operations for the duration of the Project.

1. A Critical Path Method (CPM) schedule covering the entire Project and completely detailing the Contractor's proposed operations for the construction of the current work. The CPM schedule shall be sufficiently detailed, with tasks limited in duration to twenty-one (21) days.
2. A mathematical analysis of the CPM network diagram.
3. A trend chart showing early, on-time, and late completion envelopes, and actual progress trend since the start of the Project.
4. A narrative report that describes the Contractor's planned actions of carrying out each phase and portion of the Work and summarizes the current status and progress of the Work. The report shall include descriptions of temporary construction, facility disruptions, and Owner's staff interface and coordination needs. The number of workers, including subcontractors, currently on-site (separated by trade) and shift shall be indicated, as well as the type and size of each major piece of equipment required for the Work.

B. In preparing the OPS, the Contractor shall meet individually with each subcontractor. Each subcontractor shall provide the Contractor and the Consultant with detailed activity information, including manpower requirements and appropriate durations, to complete each element of the Project. Each subcontractor shall also provide the Contractor with anticipated shop drawing and submittal dates and fabrication and delivery durations for key construction materials, systems, and equipment. For subcontractors and vendors not selected at the time of this data collection, the Contractor shall provide provisional data. Such provisional data shall later be reviewed with those subcontractors and vendors as they are selected and the OPS adjusted as necessary.

C. The CPM Network Diagram shall:

1. Be prepared in the form of a time-scaled CPM network.
2. Group activities by building, structure, facility, and major exterior area of work, such as yard piping and electrical underground distribution. The identification number of the individual activities shall be coded such to provide the grouping.
3. Be prepared in the chronological order of the beginning of each item of work.
4. Identify each column or path by:
   a. Distinct graphic delineation.
   b. Major structures.
5. Have a horizontal time scale based on calendar days and identify the Monday of each week.
6. Show the order and interdependence of the activities and the sequence in which the work is to be accomplished as planned by the Contractor. The diagram shall show how the start of a given activity is dependent upon the completion of the preceding activities and how its completion restricts the start of following activities. Float need not be shown on the network diagram.
7. Be prepared in such a manner that sub-networks relating to particular phases or portions of the work can be readily extracted or revised. Such sub-networks shall include, but may not be limited to, the following portions of the Work:
   a. Each major piece of equipment.
   b. Each primary system.
   c. Activities to be performed in limited access areas or requiring interface with other Contractors.
   d. Structures.
8. Show the following information related to the activities:
   a. Activity number.
   b. Activity description.
   c. Estimated duration, in working days, of each activity.
   d. Value of each activity, including profit, overhead, and taxes.
   e. Manpower requirement, manhours.
   f. If the precedence method of diagramming is being used, lags or lag factors may be used at the Contractor's option.

9. Show all activities relating to the construction of the work. Activities that are interdependent due to restrictions to available manpower, construction equipment, or site restraints shall also be shown.
10. Show all temporary construction activities required for permanent work.

11. Show where existing facilities will be taken out of service.
12. Show the following events and milestones in addition to construction activities:
    a. Notice to Proceed.
    b. Operating Test Period prior to the completion date.
    c. Milestone dates.
    d. Owner coordination.
    e. Notification periods.
    f. Coordination with separate contracts.
    g. Owner activities impacting the Work.
13. Provide the network information detail such that the duration of activities will generally range from three (3) to twenty (20) days, with not more than one percent of those activities outside those limits. The activities which comprise separate portions of the work shall be separately identifiable by coding.
14. Be plotted on 22-inch by 34-inch size sheets with the flow of activities from left to right. Printing shall be in color and suitable for half-size reproduction. No lettering or numbering shall be less than 1/8-inch in height for capitals and numbers. The critical path shall be clearly marked and readily identifiable. Wherever possible, the activities relating to a particular sub-network shall be grouped together on a single sheet.
15. Show the following for shop drawings, product data, and samples of major equipment and materials:
    a. Submittal date.
    b. Review period, based on thirty (30) calendar day review period by the Engineer.
    c. Fabrication duration.
    d. Delivery dates.
16. Show decision dates for selection of finishes or products.
17. Show Adverse Weather Days:
    a. Show adverse weather days on the critical path at the end of the Project. The number of adverse weather days per month shown on the critical path of the schedule shall not be less than the mean number of days for that particular month in which precipitation meets or exceeds 1/10-inch.
    b. The mean number of days in which the precipitation meets or exceeds 1/10-inch will be based upon a thirty (30) year average of precipitation recorded by the closest reporting weather station and described in the National Oceanic and Atmospheric Administration (NOAA) publication “Climatography of the United States No. 20”, phone number (704) 259-0871(www.noaa.org.).
    c. The total number of adverse weather days shall be monitored and agreed to monthly. The OPS shall be updated to reflect the accrual of the normal number of adverse weather days and the accrual of days beyond the norm.

D. Mathematical Analysis:

1. The mathematical analysis of the network diagram shall be based on the network diagram and shall be a computer printout tabulating each activity and showing the following information for each activity:
   a. Activity number or label if the precedence method of diagramming is being used, or the preceding and following event numbers if the arrow method of diagramming is being used.
   b. Activity description.
   c. Estimated duration, in working days of each activity.
   d. Earliest start date, by calendar date.
   e. Earliest finish date, be calendar date.
   f. Latest start date, by calendar date.
   g. Latest finish date, by calendar date.
   h. Total float.
   i. Critical activities and activities on the critical path shall be marked.
2. The earliest start and finish dates shall be regarded as the Contractor's intended start and finish dates.
3. In addition, the Contractor shall provide the Engineer with the following:
   a. The Microsoft Project or Excel generated calendar used for computation of the dates specified, showing the calendar dates of each working day, and shall incorporate the Contractor's assumptions of working days, with due consideration being given to discretionary, legal and statutory holidays, Saturdays and Sundays, and weather shutdowns.
   b. A list of symbols and codes used in the preparation of the network diagram.
4. All standard Project generated reports.

2.02 NEAR TERM SCHEDULE (NTS)

The Contractor shall develop and refine a detailed Near Term Schedule showing the day to day activities with committed completion dates which must be performed during the upcoming two (2) to four (4) week period. The detailed schedule shall represent the Contractor's best approach to the Work which must be accomplished to maintain progress consistent with the Overall Project Schedule. The NTS must show proposed plant disruptions, the length of the disruption and key Owner interface activities.

PART 3 EXECUTION

3.01 UPDATING

A. Update Submittals: The NTS update shall coincide with the end of the pay period. The update shall be used to create the monthly payment requisition. No monthly payment requisition will be processed unless the NTS is updated and submitted to the Engineer.

B. Written Narrative Report: Provide a written narrative report with each update including:

1. A status review of the Project.
2. A discussion of problem areas including current and anticipated delay factors and their impact.
3. Direct action taken, or proposed, and its effect.
4. A description of revisions including:
   a. Their effect on the schedule due to the change of scope.
   b. Revisions in duration of activities.
   c. Other changes that may affect the schedule.
5. A listing of behind-schedule materials and equipment procurement activities. This list is an update of the submittal, manpower and key monthly completion and delivery dates, showing the OPS task number.
6. Job progress relative to the OPS, including an Early/Late Start, Early/Late Finish and Total Float Report.
7. A listing of any significant changes in the activities and restraints occurring since the last update and why the changes were made.

C. CPM Network Diagram:

1. An updated diagram with all activities and restraints shall be furnished. This includes providing an "As-Built" Schedule with completion dates to the OPS for all key monthly completion and delivery dates. All approved change orders should be listed and the effects of change orders on the OPS shown.
2. Provide updated OPS graphics in color showing progress-to-date and completion schedule. The critical path or paths shall be clearly identified.
3. OPS graphics shall include a histogram showing labor manpower loading.

D. Trend Chart: Provide a trend chart showing Project completion dates of significant areas of the Project.

E. Critical Work List: Provide a listing of critical work to be performed prior to the next Project Coordination Meeting, specifically listing what must be done during the next thirty (30) days to stay on the OPS critical path schedule and its task number.

F. At each Project Coordination Meeting, the Contractor shall present for discussion the most current update of the OPS and NTS.

+ + + END OF SECTION 01310 + + +

SECTION 01320
CONSTRUCTION PHOTOGRAPHY

PART 1 GENERAL

1.01 SCOPE

A. The Contractor shall furnish all labor, equipment and materials required to provide the Owner with electronic construction photography of the Project as specified herein.

B. The Contractor shall provide for professional videos and photographs to be made prior to and after construction to provide documentation of conditions and aid in any damage claims assessment. All conditions which might later be subject to disagreement shall be shown in sufficient detail to provide a basis for decisions.

C. Video and photo files shall become the property of the Owner and none of the video or photographs herein shall be published without express permission of the Owner.

D. Refer to Section 01350 for Project Document Tracking and Control System.

1.02 PRE AND POST CONSTRUCTION PHOTOGRAPHY

A. Prior to the beginning of any work, the Contractor shall provide for professional videos for main line construction and photographs of the work area associated with the Work Order to record existing conditions.

1. The Contractor shall furnish a complete videotaped record of the pipeline route or work area. The video shall include the date of taping and shall contain audio commentary to emphasize existing conditions along the entire route or work area.
2. The work area or route shall be videotaped prior to beginning of construction. The Contractor shall furnish the file video data to the City's Authorized Representative in a medium and manner acceptable to the Owner.
3. The work area or route shall also be videotaped at the completion of construction when directed by the City's Authorized Representative. The video shall show the same areas and features as in the preconstruction videos.

B. The pre-construction videos shall be submitted to the City's Authorized Representative within 15 calendar days after receipt of construction Notice to Proceed by the Contractor. Post construction videos and photographs shall be provided prior to final acceptance of the project.

C. All conditions which might later be subject to disagreement shall be shown in sufficient detail to provide a basis for decisions.

1.03 PROGRESS PHOTOGRAPHS

A. Photographs shall be taken to record the general progress of the Project during each pay period. Photographs shall be representative of the primary work being performed at the time.

B. All photographs shall be taken with a digital camera. The photographs shall include the date and time marking in the digital record. All photographs shall be labeled on a tab connected to the bottom of the photo to indicate date and description of work shown.

PART 2 PRODUCTS

2.01 PHOTOGRAPHS

A. Photography and video files shall be provided in electronic format.

B. Photographs shall also be provided in hard copy format. The photographs shall include the date and time marking on the photograph. All photographs shall be labeled on a tab connected to the bottom of the photograph. Tab label shall contain:

1. Project name.
2. Orientation of view.
3. Description of work shown.

C. All electronic formats furnished under this section shall be suitable for viewing with Windows Media Player.

PART 3 EXECUTION

3.01 SUBMITTALS

A. No construction shall start until pre-construction photography has been completed and accepted by the City's Authorized Representative with the exception of Emergency Work.

B. Construction photographs shall be submitted with each payment request. Failure to include photographs may be cause for rejection of the payment request.

C. The Contractor shall be responsible for all discrepancies not documented in the pre-construction videos and photography.

+ + + END OF SECTION 01320 + + +

SECTION 01350
PROJECT DOCUMENT TRACKING AND CONTROL SYSTEM

1.01 SCOPE

A. The Contractor shall utilize the City of Atlanta's Project Document Tracking and Control System (DTCS). The primary function of the system is to facilitate timely processing and approval of all contract documentation in coordination with the overall Project Schedule established by these Specifications and the Contractor. This system will utilize Oracle Unifier for document tracking and control and Lynx Photo Management software. The Oracle Unifier software will:

1. Facilitate communication among the Owner, Engineer and Contractor;
2. Facilitate turn-around time with regard to responses and approvals;
3. Provide a central location for all Project information to facilitate all Project participants in performing their tasks based on the latest Project data;
4. Provide a standard system of project administration with accountability.

B. The Contractor shall be required to utilize the web-based DTCS system that resides on the Department of Watershed Management server to generate documents in the proper format for submission to the City. The Contractor shall access the system through the internet using a compatible web browser from the Contractor's administrative field office location, and/or other locations where work associated with the Project is being performed.

C. The Contractor shall be required to generate Project documents and records utilizing the aforementioned system. The Contractor shall be required to transmit and submit the Project documents within the system to the City.

D. The Contractor shall utilize a high capacity scanner capable of scanning 11 x 17 documents, double sided, on site for the entire duration of the Project. All documents must be scanned in and attached to the appropriate Contract Manager document, including submittals, shop drawings, O&M's and all other documents requested by the Engineer.

E. The Contractor shall utilize the DTCS to create and maintain Project documents, including, but not limited to the following:

1. Company Directory: Addresses, Phone Numbers, Personnel Contacts, etc.;
2. Drawings Log: Current Drawing revision log;
3. Submittals (Integrated with Project Schedule through Activity codes);
4. Transmittals;
5. Requests for Information and Answers (RFIs) ;

6. Change Documents, Including:
    a. Work Authorizations (WAs);
    b. Change Order Requests (CORs);
    c. Change Orders (CO).
7. Daily Reports (Daily Diaries);
8. Field Decisions & Clarification Memos;
9. Notice of Non-Compliance;
10. Construction Issue Memos;
11. Punch lists;
12. Meeting Minutes & Agendas;
13. Correspondence;
14. Work Plans;
15. Start-up Plans;
16. Equipment Operation and Maintenance Training; and
17. Spare Parts.

F. The Contractor shall utilize the complete capabilities of the DTCS to meet the requirements of this Section. The Contractor shall provide a highly trained and experienced construction project controls person knowledgeable in construction work sequencing, productivity, scheduling and application of the Skire Unifier Manager Software system. This person, along with the Contractor's management team, shall work closely with the City to deliver the documents outlined in this Section.

G. Software Support

1. The Contractor is to provide for a one day training class in the base bid for the Lynx PM software for ten (10) personnel, seven (7) for City of Atlanta and three (3) for the Contractor. Type of class to be determined by the City. The Contractor may contact Lynx PM Representative at 1-877-955-7711.
2. The contractor shall purchase five (5) additional licenses of the Skire Unifier software on behalf of the City for use during the project. At project close, the licenses will remain City property.
3. The Contractor shall be required to establish an internet connection using DSL or better to connect to the DTCS to permit the forwarding and receipt of documents.
    a. The Skire Unifier Manager software supports the following Email programs, and the Contractor is to utilize:
        (1) Microsoft Outlook 2003
        (2) Microsoft Outlook 2007

b. The Contractor shall also provide two (2) days of consulting services in the base bid for troubleshooting and maintenance of the DTCS at any location designated by the City or at the Contractor's administrative field office (if authorized by the City). Troubleshooting, maintenance, upgrade, configuration, and set up shall be performed by DWM contractor or other contractor approved by DWM in writing, based on a scope pre-defined by the City of Atlanta. The Contractor shall utilize the custom data fields, dictionaries, and coding systems as required by the City of Atlanta.

H. The Contractor shall be required to attend a two (2)-day training session on the operation of the City's DTCS, provided by a Skire Authorized Trainer. The Contractor shall provide the training session for ten (10) participants (fee for the Skire Authorized Trainer). The training session shall be attended by the Contractor (limited to three (3) participants) as well as representatives of the Owner (seven (7) participants). The Contractor shall be responsible for the cost of training for additional members of their firm or future retraining, as may be deemed necessary by the Contractor.

I. The Contractor shall meet with the City within fifteen (15) days after the Contract is awarded to discuss access requirements and the Contractor's plan to utilize DTCS and execute the document control functions herein.

J. Access through the internet to the DTCS shall be operational within thirty (30) days following the pre-construction meeting date. This must be operational from the Contractor's administrative field office location.

1.02 COMPANY DIRECTORY

The Contractor and the City will monitor and manage the company directory. The directory must include company name, company abbreviation, contact names, address, phone numbers and e-mail addresses.

1.03 DRAWING LOG

The City will maintain a log of initial "issued for construction" drawings in the DTCS. Information shall include drawing number, title and revision number. In addition to logging the initial project drawing list, the City will maintain a log on the DTCS of all subsequent revisions to these drawings and any sketches resulting from clarification memos, RFIs, field orders and Change Orders. It is the Contractor's responsibility to utilize the latest drawings and sketches in the performance of the Work.

1.04 SUBMITTALS/SHOP DRAWINGS

A. Requirements: This section specifies supplemental requirements related to the processing of submittals and shop drawings. The Contractor will utilize the DTCS to log and track submittals, as well as generate associated transmittal letters.

B. Submittals & Product Data: A list of all required submittals will be entered into the DTCS by the Contractor. Submittals shall be incorporated into packages, with numbering to be provided by the COA's engineer. The Contractor will log and track all submittals utilizing the DTCS. Each review cycle shall be entered into the DTCS. The Contractor shall identify as activities in the CPM schedule, specified in SC-16, to include all data submittals, as well as those involving complex reviews and long lead deliveries, and all procurement items required for construction activities Submittal schedule information shall be updated monthly with the Contractor's updated project CPM schedule, as specified in SC-16.

C. Samples: A list of all required sample submittals will be entered into the DTCS by the Contractor. Sample submittals shall be identified as individual submittals within the submittal packages with numbering as specified above.

D. Guarantees/Warranties: A list of all required Guarantee/Warranty submittals will be entered into the DTCS by the Contractor. These submittals shall be identified as individual submittals within the submittal packages with numbering as specified above.

E. Work Plans, Start-up Plans, O&M Submittals and Spare Parts: All testing, Start-up and O&M submittals will be entered into the DTCS by the Contractor. These submittals shall be identified as individual submittals within the submittal packages identified with numbering as specified above.

F. Submittal Procedures: The Contractor shall prepare all submittal packages utilizing the submittal numbering system, description and packaging conventions described above. Submittals prepared by the Contractor, which fail to follow the conventions described above, will be returned "amend and resubmit". Should the Contractor determine that a submittal is required and is not covered by the listing within the DTCS, consultation with the City to determine the submittal number, description and packaging will be required.

1.05 CORRESPONDENCE

The City shall monitor and manage the correspondence, Non-Compliance Notices, Field Decisions & Clarification Memos and Construction Issue Memo logs. The Contractor is responsible for generating Project correspondence within the DTCS, and forwarding the correspondence to the City.

1.06 TRANSMITTAL LOG

The Contractor and the City will monitor and manage the transmittal log. All Project transmittals shall be created electronically, automatically sequentially numbered and logged into the DTCS system as they are created. The Contractor is responsible for utilizing the system to create

transmittals for items transmitted to the Owner, Engineer, Resident Inspection Staff and other Contractors.

1.07 REQUEST FOR INFORMATION & ANSWERS

The Contractor shall be responsible for generating RFIs on the DTCS system. The Contractor shall notify the City when an RFI is submitted. The City will monitor and manage the RFI log. The City will generate an Answer document in response to each RFI and forward them to the Contractor. The DTCS will track "Ball in Court" for all RFIs and Answers, as well as date of original generation and response date. In addition the RFIs will reference the relative Specification Section and Drawings. The DTCS will identify the date of the request and the originator, responsible party for a response and the date of the response.

1.08 CHANGE DOCUMENTS

NOT USED

1.09 DAILY REPORTS

The Contractor is responsible for creating daily reports (daily diaries) utilizing the DTCS. The Contractor is required to enter the Daily Reports into the DTCS by 10:00 a.m. of the subsequent day that the Contractor or any subcontractor performs work. All daily reports shall be logged into the DTCS by the Contractor. The Contractor shall also provide one (1) signed hard copy of all daily reports on a weekly basis. Required information shall include Contractor, Date, Day, Temperature, Precipitation, Sky, Wind, Work Activity, Equipment, Field Force, Visitors, Materials, and Scheduled Activities utilizing the schedule activity codes. Daily reports which fail to link work activities to the active schedule will not be acceptable.

1.10 PUNCHLISTS

The City will monitor and manage punch lists, and will create Punch lists to be forwarded to the Contractor. The Contractor shall address the Punch list items that have been assigned to the Contractor and forward updates to the City. Once accepted as complete, the City will access the punch list in the DTCS and close it out.

1.11 MEETING MINUTES AND AGENDA

The City shall monitor and manage the meeting minute process. The City will forward meeting minutes to the Contractor electronically. The City will log the meeting minute items into the DTCS within three (3) days of the meeting date.

1.12 PROGRESS PAYMENTS /REQUISITIONS FOR PAYMENT

The Contractor is responsible for creating progress payment applications directly from the Skire Unifier software and then forwarding them to the City electronically along with hard copies by

4:00 p.m. at the end of each update/billing period. The Contractor shall also simultaneously provide a separate submittal of the updated progress schedule (P6 or latest version at the time of purchase), as specified in SC-16. All Progress Payments and schedule of values shall be developed as defined in the Special Conditions. Required information within the Pay Application shall be coordinated with the City's Project Manager. Maintenance of the "As Built" record documents by the Contractor shall be verified before processing will be approved. Failure of a Contractor to maintain project record documents, maintain current and properly prepared daily reports or to submit the project schedule update per SC-16 will be just cause for withholding of the monthly or final payment.

1.13 LYNX PHOTO MANAGEMENT SOFTWARE

The Lynx PM software shall be utilized by the City and the Contractor for the duration of the project. The daily construction photographs will be the permanent visual record of the pre-construction conditions, daily construction site activities, and the completion of construction work. The Contractor must submit to the City no less than four (4) record photos for each activity ID listed in the project schedule per the last schedule update. Applicable photos must accompany each Pay Application.

+++ END OF SECTION 01350 +++

SECTION 01351
PUBLIC RELATIONS AND COMMUNICATIONS

PART 1 GENERAL

1.01 SCOPE

The Contractor shall provide all labor, materials, equipment and incidentals required to meet the requirements and responsibilities related to public relations and communications as specified.

1.02 REFERENCES

Related Sections include:

Section 01050 Project Meetings
Section 01310 Construction Progress Schedule
Section 01350 Project Documents Tracking and Communication
Section 01550 Traffic Regulation

1.03 STAFFING

A. The Contractor shall employ a Public Information Officer (PIO) whose specific duties and job shall be to perform customer service related functions and to continuously coordinate and provide information and services as required by the City's Office of Public Relations and Communications and other City staff as necessary.

B. The City shall provide a Public Information Manager (PIM) whose specific duties and job shall be to perform customer service related functions and to continuously coordinate and provide information and services as required by the City's Office of Public Relations and Communications and other City staff as necessary.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 RESPONSIBILITIES OF THE PUBLIC INFORMATION OFFICER

Responsibilities of the Public Information Officer (PIO) shall include, but not be limited to the following elements:

1. Attendance and participation at Public Relations Planning Meetings to outline the methods and means to be used to implement the requirements associated with Public Relations and Communications required to perform the Work. Refer to Section 01050, Project Meetings.

2. Receiving, logging, tracking and resolving customer/citizen complaints and claims; including complaints and claims received from jurisdiction and organizations affected by the Work; whether such complaints and claims are received directly, or by the PIM.
3. Providing notice to affected customers/citizens in the event there are scheduled service outages or other work elements required for the performance of Work that are scheduled which will have an impact on the neighborhood or property owners.
4. Attendance and participation in scheduled project progress meetings for discussion, updates and resolution of customer/citizen complaints, claims, review of schedules and other matters as required.
5. Providing reports and updates as specified.
6. In the event Work is required on private property where an easement has been acquired, the PIO shall notify the property owner at least fourteen (14) days in advance of commencement of the Work in writing.
7. Prior to commencement of work in any neighborhood, the PIO shall provide notice to the customers/citizens thirty (30) days in advance. In addition, twenty-four (24) hours prior to actual commencement of the work, the PIO shall notify the customers/citizens via door or mailbox hanger as hereinafter provided for in this Section.
8. The PIO shall be on twenty-four (24) hour call, seven (7) days a week and be equipped with a mobile phone. In the event of the PIO being unavailable, the Contractor shall designate a second individual to handle the responsibilities and functions who shall be fully familiar and aware of the duties and prosecution of the work
9. The Contractor/PIO must report all complaints to the Customer Care Call Center (404-658-6500) and to the PIM within six (6) hours of receipt. Conversely, all calls received by the Customer Care Call center will be transmitted to the PIM within forty-eight (48) hours of receipt and the PIO must perform follow-up within twenty-four (24) hours with resolution after receipt of the notice.
10. The PIO shall assist the Contractor's Traffic Control Officer with the coordination of all street closures, detours and traffic pattern changes, including coordination with the PIM, the Department of Public Works, GDOT, and all jurisdictions and organizations for which notifications apply. As required above, the PIO must provide notice to the affected areas in advance of the scheduled closures, detours and traffic pattern changes.
11. In the event there is an emergency involving the public or a situation where media inquiries and responses are possible, the PIM shall be notified immediately. The PIM will then coordinate with the City's Media Relations Manager for appropriate action. **Under no circumstance shall any employee, Subcontractor or vendor of the Contractor make any comments to the media regarding the project at any time.**

3.03 CUSTOMER SERVICE TRACKING SOFTWARE

A. The Contractor shall use the City's Document Tracking and Control System (DTCS), as specified in Section 01350, to track and enter information from customers/citizens regarding complaints, claims and inquiries. All related information shall be updated daily by the PIO. Tracking information and responses shall be coordinated with the PIM.

B. Reports for all open customer/citizen complaints and claims shall be provided on a weekly basis and, for specific cases, within twenty-four (24) hours when requested.

C. Information recorded shall include but not be limited to the following:

1. Date complaint/claim/inquiry received.
2. Name, address and telephone number of individual filing complaint/claim/inquiry.
3. Nature of complaint/claim/inquiry.
4. Address where problem is located if different than above.
5. Action required, date, action taken, date action completed.
6. Follow-up with person who filed under 2 above to verify satisfaction or status.
7. Documents associated with actions taken.
8. Any information regarding resolution with the Contractor's, Subcontractor's or vendor's insurance company shall be fully documented.

3.04 DOOR HANGERS

The Contractor shall produce door hangers required for notice to customers/citizens and residents from the template provided by the PIM (SEE EXAMPLE AT END OF THIS SECTION) as specified hereinabove in paragraph 3.02. Door hangers shall be utilized for notification in the event of, but not limited to, the following events:

1. Planned service disruption/outages
2. Road closures/detours/traffic pattern changes
3. Access/entrance to property
4. Work start-up
5. Blasting

3.05 IMPACTED AREA ADDRESS DATABASE

A. The Contractor shall provide the Office of Communications and Public Outreach with a database of addresses and phone numbers (and names if available) of all project impacted residences, businesses and facilities at least three (3) weeks prior to project start-up. The database will be used by the PIM for regular citizen communications and notifications.

B. The Contractor and City's Authorized Representative shall copy the PIM on all correspondence and Right of Entry Agreements with citizens and property owners.

3.06 SCHEDULE

A. The PIO and PIM shall be provided copies of the detailed CPM project construction schedule and the Near-Term Schedule, including all updates. The PIO will provide notification to the impacted area at least two (2) weeks prior to project start-up.

B. The Contractor shall inform the PIM through the weekly progress meetings of any project schedule changes or changes in "disruptive work" such as blasting, road closures, etc., that would have significant impact on citizens or require prior citizen notification.

3.07 MEDIA RELATIONS AND JOB SITE INQUIRIES

A. As specified above in paragraph 3.02, only authorized persons shall release any information to media inquiries. The Contractor's field personnel shall at all times have project information cards available that will be provided to media and citizens if inquiries are made on-site. All inquiries shall be directed to the person referred to on the card and citizens shall be referred to the PIO and/or PIM.

B. Project information cards shall be produced by the Contractor from the template provided by the PIM. (SEE EXAMPLE AT END OF THIS SECTION)

3.08 TRAINING

All the Contractor's staff at or below the level of superintendent shall attend a mandatory Public Relations Training and Protocol Procedures Training. The purpose of this training is to teach construction crews on how to deal with citizens, the media, etc. and how to conduct themselves on the jobsite. This training is approximately one (1) hour in length and will be facilitated by City staff at a designated City facility. Training will be provided at no cost to the Contractor.

3.09 VEHICLE SIGNS AND PROJECT SITE SIGNAGE

A. The Contractor shall place pre-approved magnetic signs on all job-site project vehicles. The signage template will be provided by the PIM with the signs to be produced by the Contractor.

B. All project sites shall have pre-approved project signs in accordance with the template provided by the PIM and signs produced by the Contractor. Some of the signs shall be mounted on moveable skids so they can be relocated as the project progresses on various streets in project area.

3.10 NOTIFICATIONS

A. The Contractor shall provide the following notifications:

1. Anticipated Work Order Start Date - notify City three (3) weeks in advance so the PIM may send out two (2) week notice mailer.
2. Notice to Impacted Area - notify citizens/customers who will be impacted by a Work Order at least two weeks prior to Project start-up.
3. Service Disruptions - notify PIM and Call Center at least seventy-two (72) hours in advance so that 48-hour notice may be issued. Notify citizens via door hangers and/or automated phone message 24 hours prior to disruption.
4. Street Closure or Partial Closure - notify PIM and Call Center at least seventy-two (72) hours in advance to permit 48-hour automated phone message; notify fire, police other emergency services and other authorities twenty-four (24) hours prior to street closure.
5. Significant Work in Neighborhood - blasting, directional drilling, trenchless installation, open cut, etc.-door hangers or automated phone messages are required to notify the PIM and Call Center at least seventy-two (72) hours in advance to permit 48-hour automated phone message; notification to citizens via door hangers and/or automated phone messages twenty-four (24) hours in advance.
6. Miscellaneous Notifications - notify citizens/customers as necessary to identify the outcome of work, the need for ongoing work, etc. as necessary to avoid customer complaints regarding lack of communication and as directed by the City's Authorized Representative who will be impacted by a Work Order at least two weeks prior to Project start-up.

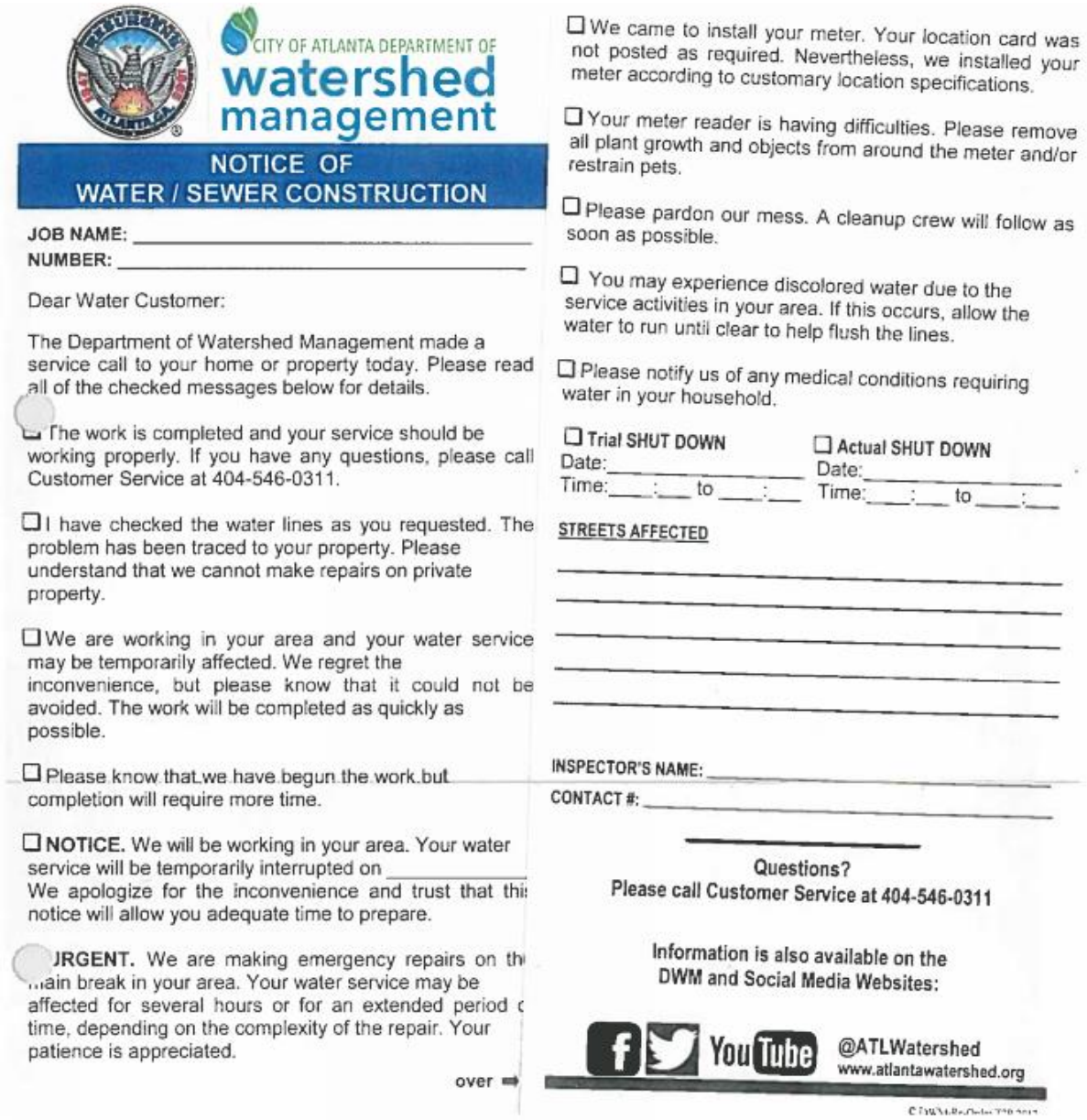
B. The Contractor shall be fully responsible for notification to all emergency related services for detours, closures (partial or full) or traffic pattern changes. Such notifications must be detailed in their traffic control plan and implemented through the Contractor's Traffic Control Manager and per all permitting requirements. Refer to Section 01550, Traffic Regulation.

C. The Contractor shall be fully responsible for distributing all notifications a minimum of forty-eight (48) hours in advance of service outages for schools, nursing homes hospitals, medical clinics, assisted living facilities or other types of facilities and shall also make personal contact with facility representatives no later than sixty (60) minutes prior to the outage.

D. The Contractor shall at all times coordinate with the PIM and Call Center to provide detailed schedules and street locations for service disruptions or street closures to ensure that Call Center is well equipped to provide adequate response to citizen inquiries.

+ + + END OF SECTION 01351 + + +

Sample Door Hanger
(Two Sided)



CITY OF ATLANTA DEPARTMENT OF
watershed management

NOTICE OF
WATER / SEWER CONSTRUCTION

JOB NAME: _____
NUMBER: _____

Dear Water Customer:

The Department of Watershed Management made a service call to your home or property today. Please read all of the checked messages below for details.

☐ The work is completed and your service should be working properly. If you have any questions, please call Customer Service at 404-546-0311.

☐ I have checked the water lines as you requested. The problem has been traced to your property. Please understand that we cannot make repairs on private property.

☐ We are working in your area and your water service may be temporarily affected. We regret the inconvenience, but please know that it could not be avoided. The work will be completed as quickly as possible.

☐ Please know that we have begun the work but completion will require more time.

☐ **NOTICE.** We will be working in your area. Your water service will be temporarily interrupted on _____. We apologize for the inconvenience and trust that this notice will allow you adequate time to prepare.

☐ **URGENT.** We are making emergency repairs on the main break in your area. Your water service may be affected for several hours or for an extended period of time, depending on the complexity of the repair. Your patience is appreciated.

over ➡

☐ We came to install your meter. Your location card was not posted as required. Nevertheless, we installed your meter according to customary location specifications.

☐ Your meter reader is having difficulties. Please remove all plant growth and objects from around the meter and/or restrain pets.

☐ Please pardon our mess. A cleanup crew will follow as soon as possible.

☐ You may experience discolored water due to the service activities in your area. If this occurs, allow the water to run until clear to help flush the lines.

☐ Please notify us of any medical conditions requiring water in your household.

☐ **Trial SHUT DOWN**
Date: _____
Time: ___:___ to ___:___

☐ **Actual SHUT DOWN**
Date: _____
Time: ___:___ to ___:___

STREETS AFFECTED

_____
_____
_____
_____
_____

INSPECTOR'S NAME: _____
CONTACT #: _____

Questions?
Please call Customer Service at 404-546-0311

Information is also available on the DWM and Social Media Websites:

YouTube @ATLWatershed
www.atlantawatershed.org

SECTION 01400
QUALITY ASSURANCE/QUALITY CONTROL

PART 1 GENERAL

1.01 SCOPE

This section includes requirements for the implementation of the Contractor's quality assurance and quality control program.

1.02 SITE INVESTIGATION AND CONTROL

A. Contractor shall check and verify all dimensions and conditions in the field continuously during construction. Contractor shall be solely responsible for any inaccuracies built into the Work due to Contractor's and subcontractor's failure to comply with this requirement.

B. Contractor shall inspect related and appurtenant Work and report in writing to the Engineer any conditions that will prevent proper completion of the Work. Failure to report any such conditions shall constitute acceptance of all Site conditions, and any required removal, repair, or replacement caused by unsuitable conditions shall be performed by the Contractor solely and entirely at Contractor's expense.

1.03 INSPECTION OF THE WORK

A. All work performed by the Contractor and subcontractors shall be inspected by the Contractor and non-conforming Work and any safety hazards in the work area shall be noted and promptly corrected. The Contractor is responsible for the Work to be performed safely and in conformance to the Contract Documents.

B. The Work shall be conducted under the general observation of the Engineer and is subject to inspection by representatives of the City acting on behalf of the City to ensure strict compliance with the requirements of the Contract Documents. Such inspection may include mill, plant, shop, or field inspection, as required. The Engineer or any inspector(s) shall be permitted access to all parts of the Work, including plants where materials or equipment are manufactured or fabricated.

C. The presence of the Engineer, or any inspector(s), however, shall not relieve the Contractor of the responsibility for the proper execution of the Work in accordance with all requirements of the Contract Documents. Compliance is the responsibility of the Contractor. No act or omission on the part of the Engineer, or any inspector(s) shall be construed as relieving Contractor of this responsibility. Inspection of Work later determined to be non-conforming shall not be cause or excuse for acceptance of the non-conforming Work. The City may accept non-conforming Work when adequate compensation is offered and it is in the City's best interest as determined by the City.

D. All materials and articles furnished by the Contractor or subcontractors shall be subject to rigid documented inspection, by qualified personnel, and no materials or articles shall be used in the Work until they have been inspected and accepted by the Contractor's Quality Control representative and the Engineer or other designated representative. No Work shall be backfilled, buried, cast in concrete, covered, or otherwise hidden until it has been inspected. Any Work covered in the absence of inspection shall be subject to uncovering. Where uninspected Work cannot be easily uncovered, such as in concrete cast over reinforcing steel, all such Work shall be subject to demolition, removal, and reconstruction under proper inspection at the Contractor's expense.

E. All materials, equipment and/or articles furnished to the Contractor by the City shall be subject to rigid inspection by the Contractor's Quality Control representative before being used or placed by the Contractor. The Contractor shall inform the Engineer, in writing, of the results of said inspections within one working day after completion of inspection. In the event the Contractor believes any material or articles provided by the City to be of insufficient quality for use in the Work, the Contractor shall immediately notify the Engineer.

1.04 TIME OF INSPECTION AND TESTS

A. Samples and test specimens required under these Specifications shall be furnished and prepared for testing in ample time for the completion of the necessary tests and analyses before said articles or materials are to be used. The Contractor shall furnish and prepare all required test specimens at Contractor's own expense.

B. Whenever the Contractor is ready to backfill, bury, cast in concrete, hide, or otherwise cover any Work under this Contract, the Engineer shall be notified not less than three work days in advance to request inspection before beginning any such Work of covering. Failure of the Contractor to notify the Engineer at least three work days in advance of any such inspections shall be reasonable cause for the Engineer to order a sufficient delay in the Contractor's schedule to allow time for such inspection. The costs of any remedial or corrective work required, and all costs of such delays, including its impact on other portions of the Work, shall be borne by the Contractor.

1.05 SAMPLING AND TESTING

A. The Contractor shall retain and pay for an independent materials testing agency approved by the Engineer and the City of Atlanta as required by the General Conditions. This independent testing agency will develop and submit a testing plan for quality assurance on each type of work activity. The testing agency will document the processes and procedures utilized to verify and maintain quality work. When not otherwise specified, all sampling and testing shall be in accordance with the methods prescribed in the most current standards, as applicable to the class and nature of the article or materials considered. However, the Engineer reserves the right to use any generally accepted system of inspection which, in the opinion of the Engineer, will ensure the Engineer that the quality of the workmanship is in full accord with the Contract Documents.

B. The City reserves the right to abbreviate, modify the frequency of or waive tests or quality assurance measures, but waiver of any specific testing or other quality assurance measure, whether or not such waiver is accompanied by a guarantee of substantial performance as a relief from the specified testing or other quality assurance requirements as originally specified, and whether or not such guarantee is accompanied by a performance bond to assure execution of any necessary corrective or remedial work, shall not be construed as a waiver of any technical or qualitative requirements of the Contract Documents.

C. Notwithstanding the existence of such waiver, the City shall reserve the right to make independent investigations and tests as specified in the following paragraph and failure of any portion of the Work to meet any of the qualitative requirements of the Contract Documents, shall be reasonable cause for the City to require the removal or correction and reconstruction of any such Work.

D. In addition to any other inspection or quality assurance provisions that may be specified, the City shall have the right to independently select, test, and analyze, at the expense of the City, additional test specimens of any or all of the materials to be used. Results of such tests and analyses shall be considered along with the tests or analyses made by the Contractor to determine compliance with the applicable specifications for the materials so tested or analyzed provided that wherever any portion of the Work is discovered, as a result of such independent testing or investigation by the Engineer, which fails to meet the requirements of the Contract Documents, all costs of such independent inspection and investigation and all costs of removal, correction, reconstruction, or repair of any such Work shall be borne by the Contractor.

1.06 CONTRACTOR'S QUALITY ASSURANCE/QUALITY CONTROL REQUIREMENTS

A. The Contractor shall establish and execute a Quality Assurance/Quality Control (QA/QC) program for the services that are being procured from the Contractor. The program shall provide the Contractor with adequate measures for verification and conformance to defined requirements by the Contractor's personnel and subcontractors (including fabricators and suppliers). This program shall be described in a Plan responsive to this Section. It shall utilize the services of an independent testing agency/company that is industry certified to provide quality assurance and compliance with the standards specified.

B. The Contractor shall furnish the Engineer a project specific QA/QC Plan. The Plan shall contain a comprehensive account of Contractor's QA/QC procedures as applicable to this job. The Contractor shall furnish for review by the Engineer, no later than 14 days after receipt of notice to proceed, the QA/QC plan proposed to be implemented. The plan shall identify personnel, procedures, control, instructions, tests, records, and forms to be used. Construction will be permitted to begin only after acceptance of the QA/QC Plan. The detailed requirements for this Plan are delineated in the following paragraphs. No payments will be made to the Contractor until the QA/QC Plan is fully accepted by the

Engineer.

C. The QA/QC Plan shall describe and define the personnel requirements described herein. The Contractor shall employ a full time on-site QA/QC Manager to manage, address and resolve all quality control issues.

1. The QA/QC Manager shall be as identified by the Contractor and approved by the City. The QA/QC Manager shall have a minimum of five (5) years of construction experience in pipe line installation. The QA/QC Manager shall be onsite at all times while work is being performed by the contractor, to remedy and demonstrate that work is being performed properly and to make multiple observations of all Work in progress. This individual shall be dedicated solely to QA/QC activities and shall have no supervisory or managerial responsibility over the work force. The QA/QC Manager shall not be assigned any other duties or roles by the Contractor.

2. The Contractor shall provide additional personnel who are assigned to assist the QA/QC Manager as required to fulfill the requirements of the QA/QC Plan. The Contractor shall provide a copy of the letter to the QA/QC Manager signed by an authorized official of the firm which describes the responsibilities and delegates sufficient authorities to adequately perform the functions of the QA/QC Manager, including authority to stop work which is not in compliance with the contract. The QA/QC Manager shall issue letters of direction to all other various quality control representatives outlining duties, authorities, and responsibilities. Copies of these letters shall also be furnished to the Engineer.

D. The Contractor's QA/QC program shall ensure the achievement of adequate quality throughout all applicable areas of the Project. A customized QA/QC Plan shall be developed that discusses each type of work that the Contractor is responsible for within the Project. The QA/QC Plan shall describe the program and include procedures, work instructions and records and a description of the quality control organization.

1. The description of the quality control organization shall include a chart showing lines of authority staffing plan and acknowledgment that the QA/QC staff shall implement the system for all aspects of the work specified. The staffing plan shall identify the name, qualifications (in resume format), duties, responsibilities, and authorities of each person assigned a QA/QC function including the QA/QC Manager.

2. In addition, the Plan shall describe methods relating to areas that require special testing and procedures as noted in the specifications.

E. Identification and Control of Items and Materials: Procedures to ensure that items or materials that have been accepted at the site are properly used and installed shall be described in the QA/QC Plan.

F. The procedures shall provide for proper identification and storage, and prevent the use of

incorrect or defective materials.

G. Inspection and Tests: The Contractor shall have written procedures defining a program for control of inspections performed and these procedures shall be described in the QA/QC Plan.

1. Inspections and tests shall be performed and documented by qualified individuals. At a minimum, "qualified" shall mean having performed similar QA/QC functions on similar type projects for a minimum of five (5) years and possession of industry standards certification and license. Records of personnel experience, training and qualifications shall be submitted to the Engineer for review and approval.

2. The Contractor shall maintain and provide to the Engineer, within two working days of completion of each inspection and test, adequate records of all such inspections and tests. Inspection and test results shall be documented and evaluated to ensure that requirements have been satisfied.

3. Procedures shall include:

   a. Specific instructions defining procedures for observing all Work in process and comparing this Work with the Contract requirements (organized by specification section).
   b. Maintaining and providing daily QA/QC inspection reports. Such reports shall, at a minimum, include the following:
      i. Dated list of Item(s) inspected
      ii. Location of the test sample(s)
      iii. Logs, detailed locational drawings and confirmation reports
      iv. Quality characteristics in compliance
      v. Quality characteristics not in compliance
      vi. Corrective/remedial actions taken
      vii. Statement of certification
      viii. QC Manager’s signature
   c. Specific instructions for recording all observations and requirements for demonstrating through the reports that the Work observed was in compliance or a deficiency was noted and action to be taken.
   d. Procedures to preclude the covering of deficient or rejected Work.
   e. Procedures for halting or rejecting Work.
   f. Procedures for resolution of differences between the QA/QC representative(s) and the production representative(s).
   g. Method of documenting QA/QC process and results including:
      i. Automatic exception reporting
      ii. Resolution tracking
      iii. Quality Confirmation Test reports
      iv. Sample retention index and storage

4. The QA/QC Plan shall identify all contractual hold/inspection points as well as any

Contractor imposed hold/inspections points.

5. The QA/QC Plan shall include procedures to provide verification and control of all testing provided by the Contractor including:

    a. Individual test records containing the following information:
        i. Item tested –item number and description
        ii. Test results
        iii. Test designation
        iv. Test work sheet including location sample was obtained
        v. Acceptance or rejection
        vi. Date sample was obtained
        vii. Retest information, if applicable
        viii. Control requirements
        ix. Tester signature
        x. Testing QC staff initials
    b. Maintaining and providing to the Engineer daily testing records. Such records shall, at a minimum, contain the following:
        i. Dated list of Item(s) inspected
        ii. Location of the test sample(s)
        iii. Logs, detailed location drawings and confirmation reports
        iv. Quality characteristics in compliance
        v. Quality characteristics not in compliance
        vi. Corrective/remedial actions taken
        vii. Statement of certification
    c. QC Manager's signature providing for location maps/drawings (i.e. lift drawings, laying schedules, etc.) for all tests performed or location of Work covered by the tests.
    d. Maintaining copies of all test results.
    e. Ensuring Engineer receives independent copy of all tests.
    f. Ensuring testing lab(s) are functioning independently and in accordance with the specifications.
    g. Ensuring re-tests are properly taken and documented.

H. Control of Measuring and Test Equipment: Measuring and/or testing instruments shall be adequately maintained, calibrated, certified and adjusted to maintain accuracy within prescribed limits. Calibration shall be performed at specified periods against valid standards traceable to nationally recognized standards and documented.

I. Supplier Quality Assurance: The QA/QC Plan shall include procedures to ensure that procured products and services conform to the requirements of the Specifications. Requirements of these procedures shall be applied, as appropriate, to subcontractors and suppliers. QA/QC inspections and certifications shall not be deferred to the Contractor's subcontractors or suppliers.

J. Deficient, Defective and Non-conforming Work and Corrective Action

The QA/QC Plan shall include procedures for handling of deficiencies and non-conformances. Deficiencies and non-conformances are defined as documentation, drawings, material, and equipment or Work not conforming to the specified requirements or procedures. The procedures shall prevent non-conformances by identification, documentation, evaluation, separation, disposition and corrective action to prevent recurrence. Conditions having adverse effects on quality shall be promptly identified and reported to the senior level management. The cause of conditions adverse to quality shall be determined and documented and measures implemented to prevent recurrence. In addition, at a minimum, this procedure shall address:

a. Personnel responsible for identifying deficient and non-complying items within the work.
b. How and by whom deficient and non-compliant items are documented "in the field".
c. The personnel and process utilized for logging deficient and non-compliant work at the end of each day onto a Deficiency Log.
d. Tracking processes and tracking documentation for Deficient and Non-Compliant items.
e. Personnel responsible for achieving resolution of outstanding deficiencies.
f. Once resolved, how are the resolutions documented and by whom.

K. Special Processes And Personnel Qualifications

1. The QA/QC Plan shall include detailed procedures for the performance and control of special process (e.g. welding, soldering, heat treating, cleaning, plating, nondestructive examination, etc.).

2. Personnel performing special process tasks shall have the experience, training and certifications commensurate with the scope, complexity, or nature of the activity. They shall be approved by the Engineer before the start of Work on the Project.

L. Audits

1. The Contractor's QA/QC program shall provide for documented audits to verify that QA/QC procedures are being fully implemented by the Contractor as well as its subcontractors. Audit records shall be made available to the Engineer upon request.

2. The Contractor shall provide to the City, a quarterly report indicating any outstanding and unresolved exceptions to the QA/QC program or contract documents. The report will include documentation on any standards modifications, corrections, failed tests and a review of field procedures and checks and balances effectiveness.

M. Documented Control/Quality Records

1. The Contractor shall establish methods for control of Contract Documents that describe how Drawings and Specifications are received and distributed to assure the correct issue of the document being used. The methods shall also describe how as-built data are documented and furnished to the Engineer.

2. The Contractor shall maintain evidence of activities affecting quality, including operating logs, records of inspections and tests, audit reports, material analyses, personnel qualification and certification records, procedures, and document review records.

3. Quality records shall be maintained in a manner that provides for timely retrieval, and traceability. Quality records shall be protected from deterioration, damage, and destruction. The Contractor shall maintain an automated exceptions list of any non-conforming or defective or substandard work.

4. The Contractor shall provide a list with specific records as specified in the Contract Documents which will be furnished to the Engineer at the completion of activities and in conjunction with logs and location drawings.

N. Acceptance of QA/QC Plan: The Engineer's review and acceptance of the Contractor's QA/QC Plan shall not relieve the Contractor from any of its obligations for the performance of the Work. The Contractor's QA/QC staffing is subject to the Engineer's review and continued acceptance. The City, at its sole option, without cause, may direct the Contractor to remove and replace the QA/QC representative. No Work covered by the QA/QC Plan shall start until the Engineer's acceptance of Contractor's QA/QC plan has been obtained.

O. The Engineer may perform independent quality assurance audits to verify that actions specified in Contractor's QA/QC Plan have been implemented. No Engineer audit finding or report shall in any way relieve Contractor from any requirements of this Contract.

1.07 TESTING SERVICES

A. All tests which require the services of a laboratory to determine compliance with the Contract Documents shall be performed by an independent commercial testing firm acceptable to Engineer. The testing firm's laboratory shall be staffed with experienced technicians, properly equipped and fully qualified to perform the tests in accordance with the specified standards. All standard quality assurance testing and installation verification testing will be at the expense of the Contractor.

B. Testing, when required, will be in accordance with all pertinent codes and regulations and with procedures and requirements of the American Society for Testing and Materials (ASTM).

C. The Engineer shall have the right to inspect work performed by the independent testing laboratory both at the project and at the laboratory. This shall include inspection of the

manual, equipment calibrations, proficiency sample performance, etc.).

D. Testing services provided by the City, if any, are for the sole benefit of the City; however, test results shall be available to the Contractor. Testing necessary to satisfy Contractor's internal quality control procedures shall be the sole responsibility of Contractor.

E. Testing Services Provided by the Contractor

1. Unless otherwise specified, and in conjunction with, all other specified testing requirements, the Contractor shall provide the following testing services, and submit a detailed testing plan for each along with proposed forms for Engineer's review:

2. Moisture-density and relative density tests on embankment, fill, and backfill materials.

3. In-place field density test on embankments, fills and backfill.

4. QC testing of all precast and/or pre-stressed concrete

5. All other tests and engineering data required for the Engineer's review of materials and equipment proposed to be used in the Work

6. In addition, the following QC tests shall be performed by the Contractor:

    a. Holiday testing of pipeline and all other coatings systems applied to surfaces as required by the Engineer
    b. Slumps, air bucket tests, compression tests and other confirmation tests
    c. Air testing of field-welded joints for steel pipe or pipe cylinders and fabricated specials.
    d. All testing and inspection of welding work including, but not limited to, welding procedure qualifications, welder operator qualifications, all work performed by the certified welding inspector, all appropriate nondestructive testing of welds and all repair and retest of weld defects.

7. Testing, including sampling, shall be performed by the Contractor's testing firm's laboratory personnel, in the manner and frequency indicated in the Specifications. The Engineer shall have the right to stipulate the location of the confirmation tests. The Contractor shall provide preliminary representative samples of materials to be tested, to the testing firm's laboratory, in required quantities.

8. The testing firm's laboratory shall perform all laboratory tests within a reasonable time consistent with the specified standards and will furnish a written report of each test.

9. Where such inspection and testing are to be conducted by an independent laboratory

agency, the sample or samples shall be selected by such laboratory or agency or the Engineer and shipped to the laboratory by the Contractor at Contractor's expense.

10. Notify laboratory sufficiently in advance of operation to allow for the assignment of personnel and schedules of tests.

F. Transmittal of Test Reports:

1. Written reports of tests and engineering data furnished by Contractor for Engineer's review of materials and equipment proposed to be used in the Work shall be submitted as specified for Shop Drawings. Final transmittal of all Project testing records will be required as a final close-out submittal for the release of retainage.

2. Promptly process and distribute all required copies of test reports and related instructions to insure all necessary retesting or replacement of materials with the least possible delay in progress of the Work.

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+ + + END OF SECTION 01400 + + +

SECTION 01410
TESTING LABORATORY SERVICES

PART 1 GENERAL

1.01 SCOPE

A. This Section includes testing which the Engineer may require, beyond that testing required of the manufacturer, to determine if materials provided for the Project meet the requirements of these Specifications.

B. This section also includes all testing required by the Owner to verify if work performed by the Contractor is in accordance with the requirements of these specifications, i.e., concrete strength and slump testing, soil compaction, etc.

C. This section does not include testing required in various sections of these specifications to be performed by the manufacturer, i.e., testing of pipe. Where no testing requirements are described in various sections of these specifications, but the Engineer decides that testing is required to demonstrate compliance with material or performance standards, the Engineer may require testing to be performed under current pertinent standards for testing.

D. An independent testing laboratory shall be selected by the Contractor approved by the Engineer and paid by the Contractor. The laboratory must be approved in writing by the Engineer before any testing services are performed.

E. The Contractor shall pay directly for the services of the independent testing laboratory for all testing required under this Contract.

F. Employment of the testing laboratory shall in no way relieve the Contractor of Contractor's obligation to perform work meeting the requirements of the Contract.

G. Testing laboratory services will be required for, but not be limited to:

1. Cement
2. Aggregate
3. Concrete
4. Steel and Metals
5. Welding
6. Backfill and Compaction

7. Bituminous Pavement

1.02 LABORATORY DUTIES

A. Cooperate with the Owner, Engineer and Contractor.

B. Provide qualified personnel promptly on notice.

C. Perform specified inspections, sampling and testing of materials.

1. Comply with specified standards, ASTM, other recognized authorities, and as specified.

2. Ascertain compliance with requirements of the Contract Documents.

D. Promptly notify the Engineer and Contractor of irregularity or deficiency of work which are observed during performance of services.

E. Promptly submit three copies (two copies to the Engineer and one copy to the Contractor) of report of inspections and tests in addition to those additional copies required by the Contractor with the following information included:

1. Date issued

2. Project title and number

3. Testing laboratory name and address

4. Name and signature of inspector

5. Date of inspection or sampling

6. Record of temperature and weather

7. Date of test

8. Identification of product and Specification section

9. Location of sample or test in the Project

10. Type of inspection or test

11. Results of test and observations regarding compliance with the Contract Documents

12. Interpretation of test results, when requested by the Engineer

F. Perform additional services as required.

G. The laboratory is not authorized to:

1. Release, revoke, alter or enlarge on requirements of the Contract Documents

2. Approve or accept any portion of the Work

3. Perform any duties of the Contractor.

1.03 CONTRACTOR RESPONSIBILITIES

A. Cooperate with laboratory personnel; provide access to Work and/or manufacturer's requirements.

B. Provide to the laboratory, representative samples, in required quantities, of materials to be tested.

C. Furnish copies of mill test reports.

D. Furnish required labor and facilities to:

1. Provide access to Work to be tested;

2. Obtain and handle samples at the site;

3. Facilitate inspections and tests;

4. Build or furnish a holding box for concrete cylinders or other samples as required by the laboratory.

E. Notify the laboratory sufficiently in advance of operation to allow for the assignment of personnel and schedules of tests.

F. Laboratory Tests: Where such inspection and testing are to be conducted by an independent laboratory agency, the sample(s) shall be selected by such laboratory or agency, or the Engineer, and shipped to the laboratory by the Contractor at Contractor's expense.

G. Copies of all correspondence between the Contractor and testing agencies shall be provided to the Engineer.

1.04 QUALITY ASSURANCE

Testing shall be in accordance with all pertinent codes and regulations and with procedures and requirements of the American Society for Testing and Materials

(ASTM).

1.05 PRODUCT HANDLING

Promptly process and distribute all required copies of test reports and related instructions to insure all necessary retesting or replacement of materials with the least possible delay in the progress of the Work.

1.06 FURNISHING MATERIALS

The Contractor shall be responsible for furnishing all materials necessary for testing.

1.07 CODE COMPLIANCE TESTING

Inspections and tests required by codes or ordinances or by a plan approval authority, and made by a legally constituted authority, shall be the responsibility of, and shall be paid for by the Contractor, unless otherwise provided in the Contract Documents.

1.08 CONTRACTOR'S CONVENIENCE TESTING

Inspection or testing performed exclusively for the Contractor's convenience shall be the sole responsibility of the Contractor.

1.09 SCHEDULES FOR TESTING

A. Establishing Schedule

1. The Contractor shall, by advance discussion with the testing laboratory selected by the Owner, determine the time required for the laboratory to perform its tests and to issue each of its findings, and make all arrangements for the testing laboratory to be on site to provide the required testing.

2. Provide all required time within the construction schedule.

B. When changes of construction schedule are necessary during construction, coordinate all such changes of schedule with the testing laboratory as required.

C. When the testing laboratory is ready to test according to the determined schedule, but is prevented from testing or taking specimens due to incompleteness of the Work, all extra costs for testing attributable to the delay will be back charged to the Contractor and shall not be borne by the Owner.

1.10 TAKING SPECIMENS

Unless otherwise provided in the Contract Documents, all specimens and samples for tests will be taken by the testing laboratory or the Engineer.

1.11 TRANSPORTING SAMPLES

The Contractor shall be responsible for transporting all samples, except those taken by testing laboratory personnel, to the testing laboratory.

PART 2 PRODUCTS

(NOT USED)

PART 3 EXECUTION

3.01 TESTS AND CERTIFICATIONS

A. As a minimum, the following tests shall be performed and the following certification provided:

1. Cement: Certified test results by cement manufacture or by independent laboratory shall be furnished as required by the Engineer.

2. Aggregate and Mortar Sand: Certified test results by aggregate producer or by independent laboratory shall be furnished as required by the Engineer.

3. Concrete:

   a. Certified test results of all concrete in accordance with ASTM C31, C39 and C172.
   b. Slump tests:
      (1) Perform slump tests on the job in accordance with ASTM standards.
      (2) One (1) slump test shall be performed for each 25 cubic yards of concrete.

B. Steel and Miscellaneous Metal: Reinforcing steel, structural steel and miscellaneous metal may be inspected visually on site by the Engineer.

C. Welding: 1 percent of all structural welds during construction shall be inspected either visually or by an independent laboratory as required by the Engineer.

D. Laboratory tests of compacted backfill shall be made in accordance with ASTM D698. In-place density tests shall be made in accordance with ASTM D1556 or D2922. Compaction testing shall be required as specified in paragraph 3.16 of Section 02225.

E. Bituminous Concrete Pavement: Material testing for bituminous concrete shall be performed as directed by the Engineer, GDOT and the City of Atlanta Department of Public Works. Refer to paragraph 3.11 of Section 02700.

+ + + END OF SECTION 01410 + + +

SECTION 01500
FIELD OFFICES AND SHEDS

PART 1 GENERAL

1.01 DESCRIPTION

A. The Contractor shall provide all field offices and sheds as necessary for completion of the Work as specified herein

B. The Contractor shall maintain offices and sheds in proper and safe condition through the progress of the Work. In the event of loss or damage, the Contractor shall immediately make all repairs and replacements necessary subject to approval of the Engineer and at no additional cost to City. At completion of the Work, the Contractor shall remove all offices and sheds as directed by the Engineer.

C. The ownership of the trailers for Engineer's facilities shall remain with the Contractor. All office furnishings and equipment provided by Contractor under this section of specifications shall remain as City property. At completion of the Work, the Contractor move all office furnishings and equipment to a location designated by the Engineer.

1.02 SUBMITTALS

A. Submittals shall be made in accordance with the requirements of the General Conditions of the Contract Documents.

B. Engineer's Field Office: Submit a plan of the office layout to Engineer for mark-up and approval within 10 days after the Notice to Proceed.

C. Telephone System: Schematic drawings, showing the complete telephone system to be installed shall be provided for review by the Engineer before installation of the service.

1.03 REQUIREMENTS

A. General

1. The materials, equipment, and furnishings provided under this Section shall be new and shall meet all the applicable codes and regulations.

2. Make all provisions, and pay all costs of furnishing, installation, maintenance, professional services, permit fees, and site work for the temporary facilities.

B. Construction

1. Temporary buildings shall be structurally sound, weather tight, with floors raised above ground. All mobile/modular buildings shall comply with GA-DCA/SBCC/ADA requirements and shall be Williams-Scottsman or equal.

2. Temporary buildings shall have temperature transmission resistance compatible with occupancy and storage requirements.

PART 2 PRODUCTS

2.01 CONTRACTOR'S FACILITIES

A. Contractor's Plant: Contractor's plant, for purposes of this Section, is defined to include but not limited to Contractor's field offices, first aid station, storage facilities, shops, and major equipment. Sufficient construction plant shall be provided and maintained at all points where work is in progress to meet adequately demands of the Work and with ample margin for emergencies or overload.

B. The plant shall be of sufficient capacity and reliability to permit a rate of progress, which will insure completion of the Work within the time stipulated in the Contract. Insufficient, inadequate and improper plant or equipment shall be brought to acceptable condition or shall be removed from the site.

C. The location of stationary and mobile equipment shall be subject to the Engineer's approval.

D. First Aid Station: Contractor shall provide a suitable first aid station at the work site. The station shall be equipped with all facilities and medical supplies necessary to administer emergency first aid treatment. Contractor shall have standing arrangements for the removal and hospital treatment of any injured person. The information reflecting this arrangement shall be clearly posted for easy visibility. All first aid facilities and emergency ambulance service shall be made available by the Contractor to the City's and Engineer's personnel.

2.02 ENGINEER'S FACILITIES (SPECIFIER SHALL MODIFY BASED ON PROJECT REQUIREMENTS)

A. General

1. The Contractor shall be responsible for all office setup and removal costs, furnishing and installing all furniture and equipment as specified herein, and all maintenance costs for the Engineer's field office. The facilities for the field staff shall be in place within 30 days following issuance of the Notice to Proceed.

2. All facilities and equipment listed below are to be provided as specified for exclusive use by the City's project staff during the entire duration of the contract plus six additional months after completion of all punch list items or total project closeout whichever occurs last. The Contractor shall maintain ownership of the office trailer, but all office furniture, equipment and supplies and computer systems and hardware supplied by the Contractor shall remain in the possession of the City of Atlanta after closeout of the project.

B. Engineer’s Field Office

1. The Contractor shall furnish one new (single) (double) wide trailer to serve as the Engineer’s field office for the City's field staff. The interior of the trailer shall be divided by partitions with doors and have a minimum of two offices, conference room, men’s restroom, women’s restroom, communications equipment closet, break area, janitor’s closet and storage closet. The floor plan shall be submitted to the Engineer for approval as specified in Paragraph 1.02B of this Section. The final dimensions and number of rooms/areas shall be as directed by the Engineer.

2. The field office shall have a minimum of two exterior entrances with solid core doors with deadbolts. The trailer shall be furnished with a white, fiberglass shingle, 20-year warranty roof, color coordinated plastic or PVC skirting with access door and porch with landing, steps and full aluminum canopy at each exterior door. Porch shall be 8-foot wide by 6-foot deep, minimum. Aluminum canopy shall be as manufactured by Ray-O-Lite South East, Inc. or approved equal.

3. The field office shall be equipped with approximately, 1-foot wide, perforated aluminum soffits on all four sides and continuous ridge vent.

4. The Engineer will indicate the locations of telephone/computer outlets and certain electrical outlets on the shop drawing. However, there shall be a minimum of one combination telephone/computer outlet per office and two combination telephone/computer outlets in the conference room. All combination telephone/computer outlets shall be wired to the communications equipment closet.

5. Electrical outlets shall be no more than 6 feet apart, with a minimum two outlets per wall. All outlets shall be surge protected. Provide four duplex surge protected outlets at 42-inches above finished floor (AFF) in the communications equipment closet.

6. All walls shall be vinyl covered sheetrock. All exterior and all interior walls shall be fully insulated.

7. Floors shall be double 3/4-inch CDX plywood minimum with vinyl tile floor covering and color coordinated vinyl base cove throughout.

8. Provide a minimum of twelve 48-inch by 30-inch minimum sliding, lockable, double pane insulated windows with insect screens and metal mini-blinds.

9. Provide 4-foot fluorescent lighting fixtures with diffuser covers to provide 100-foot candles of illumination for all areas. Provide 18-inch fluorescent lighting fixture in bathrooms.

10. Each restroom shall be furnished with:

a. An elongated ceramic commode.
b. Ceramic sink with faucets
c. Vinyl coated wire shelf for supplies, 12-inches deep by 24-inches wide, minimum.
d. Medicine cabinet with mirror doors.
e. Paper towel dispenser.
f. Toilet paper holder.
g. Liquid soap dispenser.

11. Break area shall be furnished with:

    a. Wall cabinets with shelves
    b. Laminated counter with stainless steel sink and faucet
    c. Base cabinet with shelves

12. Provide 40-gallon hot water heater (to serve both restrooms and break area).

13. Exterior doors shall be insulated heavy-duty steel with pneumatic/hydraulic closures and Best lock sets and double cylinder deadbolts. Locksets on all interior doors except restrooms shall be keyed privacy type, Kwikset, or approved equal.

14. Interior doors shall be prehung stained solid core wood with wood trim and shall be furnished with integral locks. Provide chrome coat hook on the back of all interior doors.

15. Sound attenuation/insulation in all interior walls shall be required.

16. Communication equipment closet with door shall have painted plywood walls. Provide up to 24 J-boxes with conduit stubbed to under trailer for use in communications installation. Provide stainless steel switch plates and outlet covers. Include master circuit surge protector. Lights and receptacles shall be on separate circuits. Provide 10 dedicated circuits for computers, copiers, etc. and emergency lights and lighted exit signs.

17. Provide a 10-pound Type A-B-C fire extinguisher at each exit and in break area.

18. Provide a high-pressure sodium photocell controlled light at each exterior entrance.

19. Provide freeze protection for all water system piping.

20. Provide a HVAC system. HVAC system shall include:

    a. Dual heat pump units.
    b. In duct heat strips as required; piped condensate drains to eliminate surface evaporation, including dry well if needed; single programmable thermostat to

control both units simultaneously; accessible filter locations; individual returns and supplies for all rooms and spaces including hallways.

c. Locate units at center of each side of trailer for optimum and equal air distribution.

d. Two vertical chases to be s located on interior walls, behind doors.

e. HEPA air filtration system including manufacturer's recommended maintenance instructions.

. 21. Furnish and install the following office furniture:

a. Desks, 36-inches by 60-inches, double pedestal with mahogany colored laminated top

. b. Credenzas, mahogany colored laminate, with kneehole and keyboard drawer.

c. Hutch, mahogany colored laminate.

d. Conference table, 48-inches by 168-inches with mahogany colored laminated top.

e. Swivel chairs with black frame.

f. Guest chairs with black frame.

g. Work tables, 30-inches x 60-inches with mahogany colored laminated tops.

h. 4-drawer, legal size locking fireproof file cabinets.

i. 36-inches x72-inches bookcases.

j. 48-inch x 96-inch marker board with aluminum frame, installed in conference room.

k. 24-inch by 36-inch marker board with aluminum frames, installed.

l. 24-inch by 36-inch gray fabric covered bulletin board, installed.

m. Plastic trash receptacles

22. Furnish and install a water filtration system as provided by a standard coffee service for the duration of the Contract. In addition furnish the following:

a. One drinking water appliance (to include plastic cups and dispenser and bottled water supply) or bottled water for the duration of the Contract.

. b. One 12-cup commercial metal coffee maker with two decanters, filters, 12-ounce styrofoam cups, stirrers and supplies, including regular coffee, decaffeinated coffee, tea bags, sugar, nondairy creamer and artificial sweetener for the duration of the Contract.

23. Furnish and install the following office equipment and supplies:

a. One plain paper color facsimile machine with automatic document feed and automatic single sided faxing.

b. One plain paper copier machine, (Owner’s choice) with automatic document feeder, multi sheet and single sheet feeder, 8-1/2 x 11 to 11 x 17; zoom reduction/enlargement in 1 percent increments; 3 paper supply trays with 250 sheet capacity each (8-1/2 x 11, 8-1/2 x 14 and 11 x 17); and with a finisher with multi-position stapling and optional hole punching.

c. The Contractor shall provide a maintenance service contract and copy paper, toner/ink cartridges, etc., for both machines during the Contract period.

24. Provide computer system hardware, software and local area network as follows:

(SPECIFIER SHALL MODIFY COMPUTER SYSTEM HARDWARE AND OPERATING REQUIREMENTS AS NECESSARY)

a. Furnish and install Dell Latitude Laptop Computer Systems, each equipped as follows:
   i. 15.6-inch HD Screen
   ii. 6GB SDRAM and 750GB, 7200 rpm Hard Drive
   iii. 8X DVD +/- RW w/Roxio and Cyberlink Power DVD
   iv. Optical USB mouse.
   v. Docking Station with 20-inch Wide Screen Flat Panel Monitor and Dell USB Keyboard
   vi. 9 cell Lithium Battery
   vii. Integrated Ethernet Network Card
   viii.. Nylon Zippered Carrying Case with Hand Grips and Shoulder Strap
   ix. Color Laser Printer

b. Maintenance service agreements for all hardware for duration of contract.

c. Computer Software, Latest Versions, for each computer system. (Note: This software shall be supplied in addition to the software specified in Specification 01350, Project Document Tracking and Control System);
   i. Microsoft Windows 7, Professional Edition.
   ii. Microsoft Office, Professional Edition (w/Adobe Acrobat).
   iii. McAfee Anti-Virus
   iv. Provide 200 blank CD-Rs
   v. Provide 50 blank DVD-Rs

d. Local Area Network: Furnish and install cable, terminations and connectors to connect the computer system Ethernet cards, the printer Ethernet cards and copiers and facsimile machine as a local area network. Cable shall be installed inside the walls or under the floor. Furnish the services of a qualified field technician to set up the software as a local area network as directed by the Engineer.

2.03 TELEPHONE SYSTEM

Provide telephone system as follows, complete for the duration of the project, plus six additional months:

1. Make all necessary arrangements for outside telephone service to Contractor's office and Engineer's field office. The connection to Engineer's Facilities shall be consistent with the specified hardware requirements for such facilities

2. Provide Computerized Modular Telephone System: Telephone system shall be comprised of Cisco IP Phones, Series 7962G. Each phone shall be equipped with,

but not be limited to, the following features:

a. Capability to support up to 6 lines
b. Voicemail; call on hold; hold reminder tone; call forwarding; conference calling; intercom call-ring/voice signal; last number redial; on-hook, headset and speakerphone dialing; speed dialing; ringing line preferences; call transfer, volume and mute control; incoming call rollover.

3. Telephone system shall be installed complete including UPS backup.

4. Wall outlet jacks for the telephone system shall be provided. The system shall not be hard wired.

5. Provide one central line for office and a separate line for fax use.

6. All costs for purchase and installation of hardware, lines, line extensions, service changes and recurring monthly charges for telephone service shall be paid by the Contractor.

7. The Engineer shall reimburse the Contractor for long distance charges made by the Engineer.

2.04 SECURITY SYSTEM

A. During other than normal daytime office working hours provide a totally separate electronic security system monitored by a security agency for the Engineer's facilities. All offices shall be equipped with exterior security flood lights automatically activated by darkness and in sufficient number and placement to provide adequate lighting of the office and the parking areas

B. Arrange for installation and provide security system for Engineer’s field office during construction. Pay for purchase and installation and all monthly charges.

2.05 TEMPORARY UTILITIES

A. Determine the need for temporary utility services, including utility services for Engineer's facilities and first aid stations, and make all arrangements with utility companies and governmental agencies to secure such services. Such services shall be provided at no additional cost to the City. Temporary utility services shall be furnished, installed, connected, and maintained by Contractor in a manner satisfactory to the Engineer, and shall be removed in like manner prior to final acceptance.

B. Power

1. The Contractor shall determine the type and capacity required and shall make the necessary arrangements for obtaining temporary power metering equipment, pay for all installation costs and usage costs.

2. All temporary electric power installations shall meet the safety requirements of all federal, state, and local codes and regulations.
3. Cost of electric power used in testing will be borne by the Contractor.

C. Lighting: Provide temporary site lighting to meet all applicable safety requirements to allow erection, application or installation of materials and equipment, and observation or inspection of the Work.

D. Heating, Cooling, and Ventilating

1. Provide as required to maintain adequate environmental conditions to facilitate progress of the Work, to meet specified minimum conditions for the installation of materials, and to protect materials, equipment, and finishes from damage due to temperature or humidity. Costs for temporary heat shall be borne by the Contractor.

2. Provide adequate forced air ventilation of enclosed areas to cure installed materials, to dispense humidity, and to prevent hazardous accumulations of dust, fumes, vapors, or gases.

3. Pay all costs of installation, maintenance, operation, removal, and fuel consumed.

4. Provide portable unit heaters, complete with controls, oil or gas-fired, and vented to the outside as required for protection of health and property.

5. If permanent natural gas piping is used for temporary heating units, do not modify or reroute gas piping without approval of utility company. Provide separate gas metering as required by utility.

E. Water

1. The Contractor shall be allowed to connect to the existing City water system at a point approved by the Engineer. The connection point shall serve as a source for water for construction purposes. The Contractor shall provide temporary facilities and piping required to bring water to the point of use at each site, and remove them when no longer needed.

2. Refer to Section 01040 for requirements related to utilization of water for construction purposes.

F. Sanitary and Personnel Facilities

1. Provide and maintain facilities for Contractor's employees, Subcontractors, and all other onsite employer's employees. Service, clean, and maintain facilities and enclosures.

2. Use of City's existing sanitary facilities by construction personnel will not be allowed.

G. Fire Protection: Furnish and maintain on the site adequate firefighting equipment capable of extinguishing incipient fires. Comply with applicable parts of the National Fire Prevention Standard for Safeguarding Building Construction Operations (NFPA No. 241).

2.06 PARKING FACILITIES

Provide parking adjacent to Engineer's field office for a minimum of 5 cars. The parking surface shall be promptly and adequately maintained by the Contractor for the duration of the Contract.

PART 3 EXECUTION

3.01PREPARATION

Fill and grade sites for temporary structures to provide surface drainage.

3.02 INSTALLATION

A. Locate offices at locations designated by the Engineer.

B. Construct temporary field offices, first aid stations, and storage facilities on proper foundations and provide connections for utility all services.

1. Secure portable or mobile buildings when used.

2. Provide tie-downs for 100 mile per hour gusts and winds

C. Mount thermometer at convenient outside location, not in direct sunlight.

D. Mount rain gauge in accessible open area.

3.03 MAINTENANCE AND CLEANING

A. Repair and clean the offices, parking areas and access routes and provide complete professional janitorial services in the Engineer's facilities for the duration of the project. Cleaning shall be done on a daily basis, to the satisfaction of the Engineer, during other than normal daytime office working hours. These daily services shall include sweeping, vacuuming, dusting, emptying of trash, cleaning of washbasins, bathroom facilities and mopping of all vinyl floors.

B. Provide approved containers for collection and disposal of waste materials, debris and rubbish. Dispose of such waste materials, debris, and rubbish offsite. Trash containers shall be lined with trash bags.

C. Contractor shall provide for monthly waxing of all vinyl floors.

D. Contractor shall provide for monthly exterminating services of the offices.

E. The Contractor shall provide floor mats at exterior entrances (inside and outside of door) and all cleaning supplies, toilet tissue and paper towels, liquid soap, air fresheners, etc.

3.04 REMOVAL

A. Remove temporary field offices, contents, temporary utilities and services at a time when no longer needed. The office contents shall be packed and moved by the Contractor to a location designated by the Engineer.

B. Remove foundations and debris; grade site to required elevations; clean and restore areas as specified in Section 02920, Site Restoration.

+ + + END OF SECTION 01500 + + +

SECTION 01510
TEMPORARY FACILITIES (PIPELINE PROJECTS)

PART 1 GENERAL

1.01 SCOPE

Temporary facilities required for this work include, but are not necessarily limited to:

1. Temporary utilities such as water and electricity.

2. Sanitary facilities.

3. Potable water.

4. Temporary heat and ventilation.

5. Parking facilities

1.02 GENERAL

A. Installation: Furnish and install temporary facilities as required for the performance of the Work.

B. Maintenance: Maintain temporary facilities in proper and safe condition throughout progress of the Work. In the event of loss or damage, immediately make all repairs and replacements necessary, at no additional cost to the Owner.

C. Removal: Remove temporary facilities as rapidly as progress of the Work will permit. Clean and repair damage caused by temporary installations or use of temporary facilities.

1.03 TEMPORARY UTILITIES

A. General:

1. Pay all costs for temporary utilities until Project completion.

2. Costs for temporary utilities shall include all power for testing equipment as required by the Contract Documents.

B. Temporary Water:

1. Refer to Section 01040 for requirements related to utilization of water for construction purposes.

2. Provide all necessary temporary piping, and upon completion of the Work, remove all temporary piping and water meters.

C. Temporary Electricity:

1. Provide all necessary wiring for the Contractor's use.

2. Furnish, locate and install area distribution boxes such that the individual trades may use their own construction type extension cords to obtain adequate power and artificial lighting at all points where required and for safety.

1.04 SANITARY FACILITIES

Prior to starting the Work, the Contractor shall furnish, for use of Contractor's personnel on the job, all necessary toilet facilities which shall be secluded from public observation. Toilet facilities shall be either chemical toilets or shall be connected to the Owner's sanitary sewer system. All facilities, regardless of type, shall be kept in a clean and sanitary condition and shall comply with the requirements and regulations of the area in which the Work is performed. Adequacy of these facilities will be subject to the Engineer's review and maintenance of facilities must be satisfactory to the Engineer at all times.

1.05 POTABLE WATER

The Contractor shall be responsible for furnishing a supply of potable drinking water for employees, subcontractors, inspectors, engineers and the Owner who are associated with the Work.

1.06 TEMPORARY HEAT AND VENTILATION

Provide temporary heat and ventilation as required to maintain adequate environmental conditions to facilitate progress of the work, to meet specified minimum conditions for the installation of materials and to protect materials and finishes from damage due to temperature or humidity.

1.07 PARKING FACILITIES

Parking facilities for the Contractor's and Contractor's subcontractors' personnel shall be the Contractor's responsibility.

PART 2 PRODUCTS

(NOT USED)

PART 3 EXECUTION

(NOT USED)

+ + + END OF SECTION 01510 + + +

SECTION 01540
SECURITY AND SAFETY

PART 1 GENERAL

1.01 SECURITY PROGRAM

A. The Contractor shall protect the Work, including all field offices and temporary facilities and their contents from theft, vandalism and unauthorized entry.

B. The Contractor shall initiate a site security program at the time of mobilization onto the worksite, which provides adequate security for site stored and installed material.

C. The Contractor shall maintain the security program throughout the Contract duration.

D. The Contractor shall be wholly responsible for the security of their storage and lay down areas and for all their plant, material, equipment and tools at all times.

E. The Contractor shall provide the Engineer with a list of 24 hour emergency phone numbers including chain of command.

1.02 ENTRY CONTROL

A. The Contractor shall restrict entry of unauthorized personnel and vehicles onto the Project site.

B. The Contractor shall allow entry only to authorized persons with proper identification.

C. The Contractor shall maintain an Employee Log and Visitor Log and make the log available to the City upon request. The log shall be submitted to the Engineer bi-weekly or as necessary. Sample logs are included at the end of this section.

D. The Contractor shall require all visitors to sign the Visitor Acknowledgment of the Program Site Rules/Visitor Log, which includes a release form. Copies of these forms shall be submitted to the Engineer bi-weekly and maintained in the Contractor's security files on-site.

E. The Contractor shall require all employees to sign the Employee Acknowledgment of Project Site Rules Log included at the end of this Section. All employees, subcontractor employees and lower tier contractor employees will receive a new employee orientation. Signing the Employee Log by the employee is certifying that the orientation training has been received.

F. The Engineer has the right to refuse access to the site or request that a person or vehicle be removed from the site if found violating any of the Project safety, security conduct rules.

1.03 BARRICADES, LIGHTS AND SIGNALS

A. The Contractor shall furnish and erect such barricades, fences, lights and danger signals and shall provide such other precautionary measures for the protection of persons or property and of the work as necessary. Barricades shall be painted in a color that will be visible at night. From sunset to sunrise, the Contractor shall furnish and maintain at least one light at each barricade and sufficient numbers of barricades shall be erected to keep vehicles from being driven on or into any work under construction.

B. The Contractor will be held responsible for all damage to the work and any resulting injuries due to failure of barricades, signs and lights and whenever evidence is found of such damage, the Contractor shall immediately remove the damaged portion and replace it at Contractor's cost and expense. The Contractor's responsibility for the maintenance of barricades, signs and lights shall not cease until the Project has been accepted by the City.

1.04 RESTRICTIONS

The Contractor shall not allow cameras on site or photographs taken except with approval of the City or the Engineer.

1.05 CONTRACTOR SAFETY/HEALTH AND SECURITY PLAN

A. Prior to the performance of any work the Contractor will prepare a contract specific Safety/Health and Security Plan signed by an officer of the Contractor's organization. Adequacy of the plan shall be the responsibility of the Contractor.

B. The Engineer will not review the Contractor's safety plan for the adequacy of the plan. The plan shall:

1. Identify the person(s) responsible for implementation and enforcement of Safety/Health and Security rules and regulations for this Project.

2. Generally address safe work procedures for the activities within the Contractor's scope of work.

3. Included a new employee orientation program, which addresses job and site specific rules, regulations and hazards.

4. Include the Contractor's Drug Free Work Place Policy including substance abuse prevention and testing program.

5. Include provisions to protect all of the Contractor's employees, other persons and organizations who may be affected by the work from injury, damage or loss.

6. Comply with current Fed/OSHA, Safety/Health and Security Plan, facility safety program (when applicable), and locally accepted safety codes, regulations and practices.

7. Include a site specific emergency action and evacuation plan.

8. Include Hazard Communication/Right To Know Program.

9. Include security procedures for the Contractor's work, tools, and equipment.

10. Include the capability of providing the Engineer with documentation to show compliance with their plan, plus accidents and investigation reports.

11. Address any other specific contract requirements.

C. Provide a Job Safety Analysis (JSA) for the scope of work, prior to the start of work.

D. Review of the Contractor's Safety Plan by the Engineer shall not impose any duty or responsibility upon the Engineer for the Contractor's performance of the work in a safe manner.

E. The Contractor shall be fully responsible for the safety and health of its employees, its subcontractors and lower tier contractors during performance of its work.

F. The Contractor shall provide the Engineer with all safety reports, training records, competent person list, and accident reports prepared in compliance with Fed/OSHA and the Project Safety/Health and Security Plan.

1.06 PROJECT SAFETY COORDINATOR

A. The Contractor shall be responsible for the safety of the Contractor’s and the City’s personnel and all other personnel at the site of the Work. The Contractor shall have a Project Safety Coordinator, as required by the General Conditions, on the job site. The Project Safety Coordinator shall maintain and keep available safety records and up-to-date copies of all pertinent safety rules and regulations.

B. The Project Safety Coordinator shall:

1. Ensure compliance with all applicable health and safety requirements of all governing legislation.

2. Schedule and conduct safety meetings and safety training programs as required by law for all personnel engaged in the work.

3. Post all appropriate notices regarding safety and health regulations at locations that afford maximum exposure to all personnel at the job site.

4. Post the name, address and hours of the nearest medical doctor; names and addresses of nearby clinics and hospitals; and the telephone numbers of the fire and police departments.

5. Post appropriate instructions and warning signs with regard to all hazardous areas or conditions.

6. Have proper safety and rescue equipment adequately maintained and readily available for any contingency. This equipment shall include such applicable items as: proper fire extinguishers, first aid kits, safety ropes and harnesses, stretcher, life savers, oxygen breathing apparatus, resuscitators, gas detectors, oxygen deficiency indicators, explosion meters, and any other equipment mandated by law.

7. Make inspections at least once daily in accordance with an inspection checklist report form to ensure that all machines, tools and equipment are in safe operating condition; that all work methods are not dangerous; and that all work methods are free of hazards.

8. Submit to the Engineer upon request copies of all inspection checklist report forms, safety records and all safety inspection reports and certifications from regulating agencies and insurance companies.

9. Notify the Engineer of a serious accident immediately, followed by a detailed written report within twenty-four (24) hours. A "serious accident" is defined as an accident requiring an absence from work of more than 2 days and/or hospitalization.

10. Notify the Engineer immediately in the event of a fatal accident.

11. Notify Engineer of any accident claim against the Contractor or any sub-contractor immediately, followed up by a detailed written report on the claim and its resolution.

12. Review safety aspects of the Contractor's submittals as applicable.

VISITOR ACKNOWLEDGMENT OF THE PROJECT SITE RULES

By signing this Visitor's Log, I acknowledge that I understand and agree to abide by the project rules outlined below.

In consideration of my receipt of a visitor's pass as issued by the Engineer directly or indirectly for the City of Atlanta, I waive on behalf of myself, my heirs, employer, legal representatives and assigns and hereby release and discharge the City, Engineer, Designer, and their subcontractors and consultants and each of their directors, officers, employees, representatives and agents from any and all claims, actions, causes of action or any charge of any kind whatsoever which may arise or could arise in the future as a result of my being present at the

facility including injury, death or property damage whether or not caused by the fault or negligence of any of the parties released hereunder.

I further acknowledge that I have been briefed on specific hazards, hazardous substances that are on site and the site emergency action procedure.

PROHIBITED ACTIVITIES

- Unauthorized removal or theft of City's property
- Violation of safety or security rules or procedures
- Possession of firearms or lethal weapons on jobsite
- Acts of sabotage
- Destruction or defacing City's property
- Failure to use sanitary facilities
- Failure to report accidents or job related injuries
- Being under the apparent influence of drugs, alcohol or other intoxicants or in possession of drugs, alcohol or other intoxicants on the property
- Wearing shorts or tennis shoes on the jobsite
- Failure to wear a hardhat/safety glasses.
- Gambling at any time on the project
- Fighting, threatening behavior, or engaging in horseplay on the project
- Smoking in unauthorized areas on the project
- Open fire cooking or making unauthorized fires on project property
- Selling items or raffles without authorization
- Use of unauthorized cameras on the project
- Use of radio or television in the construction area
- Failure to park personal vehicle in authorized parking area
- Failure to wear designated identification [Site Specific]
- Failure to use designated gates

I have read, understand and agree to abide by the PROJECT SITE RULES. Furthermore, I understand failure to abide by these rules is grounds for being denied access to the project site. I have received a personal copy for my use and reference.

VISITOR LOG

THE SIGNING OF THIS LOG ACKNOWLEDGES I HAVE READ AND UNDERSTAND AND AGREE TO ABIDE BE THE PROJECT RULES OUTLINE ABOVE. THIS IS NOT A VEHICLE ACCESS PERMIT.

VISITOR'S NAME PRINT	SIGNATURE	COMPANY VISITED	DATE	IN	OUT

EMPLOYEE ACKNOWLEDGMENT OF THE PROJECT SITE RULES

By signing this Employee Log, I acknowledge that I understand and agree to abide by the project rules outlined below.

PROHIBITED ACTIVITIES

- Unauthorized removal or theft of City's property
- Violation of safety or security rules or procedures
- Possession of firearms or lethal weapons on jobsite
- Acts of sabotage
- Destruction or defacing City's property
- Failure to use sanitary facilities
- Failure to report accidents or job related injuries
- Under the apparent influence of drugs, alcohol or other intoxicants or in possession of drugs, alcohol or other intoxicants on the property
- Wearing shorts or tennis shoes on the jobsite
- Failure to wear a hardhat
- Gambling at any time on the project
- Fighting, threatening behavior, or engaging in horseplay on the project
- Smoking in unauthorized areas on the project
- Open fire cooking or making unauthorized fires on project property
- Selling items or raffles without authorization
- Use of unauthorized cameras on the project
- Use of radio or television in the construction area
- Failure to park personal vehicle in authorized parking area
- Failure to wear designated identification [Site Specific]
- Failure to use designated gates

I have read, understand and agree to abide by the PROJECT SITE RULES. Furthermore, I understand failure to abide by these rules is grounds for being denied access to the project site. I have received a personal copy for my use and reference.

EMPLOYEE LOG

BY SIGNING THIS LOG ACKNOWLEDGMENT I HAVE READ AND UNDERSTAND AND AGREE TO ABIDE BY THE PROJECT RULES OUTLINED ABOVE AND ALL STATE, FEDERAL, LOCAL OR ANY OTHER CONTRACT OBLIGATIONS THAT MAY APPLY. I FURTHER ACKNOWLEDGE THAT I HAVE BEEN ORIENTATED AS TO THE SITE SPECIFIC HAZARDS, ANY HAZARDOUS SUBSTANCES I MAY BE EXPOSED TO WHILE ON THE SITE AND THE SITE/COMPANY EMERGENCY ACTION PROCEDURES, BY A REPRESENTATIVE OF THE COMPANY.

EMPLOYEE NAME (PRINT)	SIGNATURE	COMPANY NAME	DATE
Signature of Company Representative		Date Signed	

+ + + END OF SECTION 01540 + + +

SECTION 01550
TRAFFIC REGULATION

PART 1 GENERAL

1.01 SCOPE

The work specified in this section includes the provision of products, permits, services, procedures and personnel by the Contractor to effect traffic control during the Work.

1.02 TRAFFIC CONTROL MANAGER

A. The Contractor shall designate a qualified individual as the Traffic Control Manager (TCM) who shall be responsible for selecting, installing and maintaining all traffic control devices in accordance with the Drawings and Specifications and the Manual of Uniform Traffic Control Devices (MUTCD).

B. A written resume documenting the experience and credentials of the TCM shall be submitted and accepted by the Engineer prior to beginning any work that involves traffic control.

C. The TCM shall be available on a twenty-four (24) hour basis to perform his duties. If the work requires traffic control activities to be performed during the daylight and nighttime hours it may be necessary for the Contractor to designate alternate TCMs. An alternate TCM must meet the same requirements and qualifications as the primary TCM and be accepted by the Engineer prior to beginning any traffic control duties.

D. The Traffic Control Manager's traffic control responsibilities shall have priority over all other assigned duties.

E. As the representative of the Contractor, the TCM shall have full authority to act on behalf of the Contractor in administering the Traffic Control Plan. The TCM shall have appropriate training in safe traffic control practices in accordance with Part VI of the MUTCD. In addition to the TCM all other individuals making decisions regarding traffic control shall meet the training requirements of the Part VI of the MUTCD.

F. The TCMs shall supervise the initial installation of traffic control devices. The Engineer prior to the beginning of construction will review the initial installation. Modifications to traffic control devices as required by sequence of operations or staged construction shall be reviewed by the TCMs.

PART 2 PRODUCTS

2.01 SIGNS, SIGNALS, AND DEVICES

A. The Contractor shall provide post-mounted and wall-mounted traffic control and informational signs as specified and required by local jurisdictions.

B. The Contractor shall provide automatic traffic control signals as approved by local jurisdictions.

C. The Contractor shall provide traffic cones, drums and flashing lights as approved by local jurisdictions.

D. The Contractor shall provide City of Atlanta police officers and certified flaggers and flagger's equipment as required by GDOT.

PART 3 EXECUTION

3.01 PERMITS

A. The Contractor shall obtain permits from authorities having jurisdiction over road closures before closing any road. The Contractor shall use forms provided by authorities having jurisdiction (City of Atlanta Division of Traffic and Transportation, GDOT, etc). Refer to Section 01060, Regulatory Requirements.

B. Permit applications shall indicate the time (in days), length (in feet), the number of lanes, and the purpose of the closure.

C. All permits are approved for operations during off-peak hours 9:00 a.m. to 4:00 p.m. unless special approval is received.

D. Operations between the hours of 6:00 p.m. and 10:00 p.m. and Saturdays and Sundays must be approved by the City

E. Full street closure permits require ninety-six (96) hours advance notice prior to street closure. The following additional information is required prior to approval:

1. The recommended detour route with signage and Traffic Management Plan as per the Manual of Uniform Traffic Control Devices (MUTCD).

2. A copy of the resident and/or business notification letters about the closure. The residents/businesses located between the detour route must be notified about the closure at least five (5) business days prior to the proposed closure.

F. The City of Atlanta Division of Traffic and Transportation will return full street closure permit applications to the Contractor with a cover letter to the Fire Chief, Chief of Police, Grady Memorial Hospital, MARTA and the Atlanta Board of Education. The Contractor shall have received the permit application and cover letter at least seventy-two (72) hours before commencing street closure activities.

G. Lane closure permits require a minimum of forty-eight (48) hour notice prior to lane closure. The Contractor shall continuously maintain the safety of the traveling public during lane closures in accordance with the requirements of the MUTCD and as stipulated by public officers.

H. The City of Atlanta Division of Traffic and Transportation will return the lane closure applications to the Contractor with a cover letter with copies to the Fire Chief, Chief of Police, Grady Memorial Hospital, MARTA and the Atlanta Board of Education. The Contractor shall have received the permit application and cover letter at least seventy-two (72) hours before commencing lane closure activities.

3.02 PREPARATION OF TRAFFIC CONTROL PLANS

The Maintenance of Traffic drawings included with the Contract Documents shall only be considered as a guide and are not intended to contain all the traffic regulation details that may be required by the specifications, permitting agencies and the MUTCD. The Contractor shall develop detailed staging and traffic control plans for performing specific areas of the Work including but not limited to all requirements for certified flaggers, additional traffic control devices, traffic shifts, detours, paces, lane closures or other activities that disrupt traffic flow. The Contractor shall submit these plans in accordance with the Specifications to receive final approvals from permitting agencies and provide any and all required traffic control devices as required by both the permitting agencies and these specifications at no additional cost to the City.

3.03 CONSTRUCTION PARKING CONTROL

A. The Contractor shall control vehicular parking to prevent interference with public traffic and parking, access by emergency vehicles and City's operations.

B. The Contractor shall monitor parking of construction personnel's vehicles in existing facilities and maintain vehicular access to and through parking areas.

C. The Contractor shall prevent parking on or adjacent to access roads or in non designated areas.

3.04 MAINTENANCE OF TRAFFIC

A. Whenever and wherever, in the Engineer's opinion, traffic is sufficiently congested or public safety is endangered, the Contractor shall furnish uniformed officers to direct traffic and to keep traffic off the highway area affected by construction operations.

B. When the Contract requires the maintenance of vehicular traffic on an existing road, street, or highway during the Contractor's performance of Work that is otherwise provided for on the Drawings and these Specifications, the Contractor shall keep such road, street, or highway open to all traffic and shall provide such maintenance as may be required to safely accommodate traffic. The Contractor shall furnish, erect and maintain

barricades, warning signs, flaggers, and other traffic control devices in conformity with the requirements of the Georgia Department of Transportation and other local jurisdictions.

C. The Contractor shall also construct and maintain in a safe condition any temporary connections necessary to ingress into and egress from abutting property or intersecting roads, streets, or highways. The Contractor shall maintain traffic in accordance with any traffic control plans furnished with and made a part of the plan assembly.

D. The Contractor shall make his own estimate of all labor, materials, equipment, and incidentals necessary for providing the maintenance of traffic as specified in this section.

E. Unless specified on the Drawings or in these Specifications and subject to the approval of the City, the cost of maintaining traffic specified in this section shall be included under Bid Item, Traffic Regulation.

3.05 UNIFORMED POLICE OFFICER FOR TRAFFIC CONTROL

A. The Contractor shall provide uniformed City of Atlanta police officers to regulate traffic when construction operations are ongoing:

1. In all signalized intersections

2. In streets designated as “collector” streets

3. In all full street closings

4. In GDOT right of ways

B. Officers will be currently employed by the City of Atlanta, be in full uniform and have full arrest power while working.

C. Officers will be employed and paid by the Contractor.

D. It is the officers’ responsibility to assist in the direction of traffic within the construction site.

3.06 FLAGGERS FOR TRAFFIC CONTROL

The Contractor shall provide Georgia Department of Transportation (GDOT) certified trained and equipped flaggers to regulate traffic when construction operations or traffic encroach on public traffic lanes.

3.07 FLASHING LIGHTS

The Contractor shall use flashing lights during hours of low visibility to delineate traffic

lanes and to guide traffic.

3.08 HAUL ROUTES

A. The Contractor shall consult with authorities and establish public thoroughfares to be used for haul routes and site access and obtain a haul route permit as specified in Section 01060, Regulatory Requirements.

B. The Contractor shall confine construction traffic to designated haul routes.

C. The Contractor shall provide traffic control at critical areas of haul routes to regulate traffic and minimize interference with public traffic.

3.09 ROAD CLOSURES ON CITY STREETS AND ROADS

A. No street or road shall be closed without the permission of the Owner of any street or road and the fire department having jurisdiction. Prior to closing a street, road or highway, signs shall be posted for a minimum of seven (7) days prior to actual closing, forewarning of the imminent closing. The City shall determine the information to be placed upon the signs by the Contractor. Where traffic is diverted from the Work, the Contractor shall provide all materials and perform all work for the construction and maintenance of all required temporary roadways, structures, barricades, signs and signalization.

B. To obtain approval to close a road or street maintained by the City, the Contractor shall proceed as follows:

1. The Contractor shall obtain approval of his traffic plan from the Engineer unless a traffic plan approved by the Engineer is included in the Drawings. The traffic plan must be in accordance with the requirements of the Georgia Department of Transportation and the City of Atlanta.

2. The Contractor shall obtain a utility permit.

3. The Contractor shall apply in writing to the City and obtain a permit to close the road on a specific date. Routine permit approval by the City requires from one (1) to two (2) weeks depending on when the application is received.

4. The Contractor shall obtain a permit from the City before posting closure signs. Signs must be posted for seven (7) days prior to the first day of closure. Signs shall be acceptable to the Engineer.

5. Emergency road closures will be handled by the Engineer.

3.10 PROCEDURES FOR TRAFFIC DETOUR ROUTE PLAN

A. The Contractor shall provide a sketch map showing his traffic detour route plan to the Engineer. The sketch map need not be drawn to scale but should resemble, as closely as possible, the actual location. The sketch map shall be drawn in a manner so as to provide emergency agencies a better understanding of the detour for quick response. The sketch map shall include directional arrows showing the flow of traffic.

B. "Road Closed Ahead" signs shall be erected before the start point of the detour indicating the name of the street closed.

C. Detour signs with appropriate directional arrows shall be erected at every intersection along the detour route until the end of the detour, when the traffic is back to the original street.

D. The Contractor shall erect an "End Detour" sign at the end of the detour.

E. Each detour and "End Detour" sign shall be accompanied by an accessory plate indicating the name of the street being detoured.

F. The Contractor shall apply appropriate traffic control measures in accordance with the requirements of the MUTCD and the City of Atlanta Department of Public Works.

3.11 BARRICADES AND WARNING SIGNS

A. The Contractor shall furnish, erect, and maintain all barricades and warning signs for hazards necessary to protect the public and the Work. When used during periods of darkness, such barricades, warning signs and hazard markings shall be suitably illuminated or reflectorized.

B. For vehicular and pedestrian traffic, the Contractor shall furnish, erect, and maintain barricades, warning signs, lights, and other traffic control devices in conformity with the requirements of the Georgia Department of Transportation and the City of Atlanta Department of Public Works.

C. The Contractor shall furnish and erect all barricades and warning signs for hazards prior to commencing Work which requires such erection and shall maintain the barricades and warning signs for hazards until their dismantling is directed by the Engineer.

3.12 REMOVAL

The Contractor shall remove equipment and devices when no longer required and repair damage caused by installation.

3.13.1 RIGHT OF WAY MANUAL

Included at the end of this Section are copies of the title page and pages 42 through and including page 52 from the City's Right-of Way Manual. These pages include Appendices A, B and C which indicate street designations and Appendix D which covers restrictions for working within the City's right of way. These restrictions shall also apply to GDOT right of ways.

+ + + END OF SECTION 01550 + + +

SECTION 01610
TRANSPORTATION AND HANDLING

PART 1 GENERAL

1.01 SCOPE

A. The Contractor shall provide transportation of all equipment, materials and products furnished under these Contract Documents to the Work site. In addition, the Contractor shall provide preparation for shipment, loading, unloading, handling and preparation for installation and all other work and incidental items necessary or convenient to the Contractor for the satisfactory prosecution and completion of the Work.

B. All equipment, materials and products damaged during transportation or handling shall be repaired or replaced by the Contractor at no additional cost to the City prior to being incorporated into the Work.

1.02 TRANSPORTATION

A. All equipment shall be suitably boxed, crated or otherwise protected during transportation.

B. Where equipment will be installed using existing cranes or hoisting equipment, the Contractor shall ensure that the weights of the assembled sections do not exceed the capacity of the cranes or hoisting equipment.

C. Small items and appurtenances such as gauges, valves, switches, instruments and probes which could be damaged during shipment shall be removed from the equipment prior to shipment, packaged and shipped separately. All openings shall be plugged or sealed to prevent the entrance of water or dirt.

1.03 HANDLING

A. All equipment, materials and products shall be carefully handled to prevent damage or excessive deflections during unloading or transportation.

B. Lifting and handling drawings and instructions furnished by the manufacturer or supplier shall be strictly followed. Eyebolts or lifting lugs furnished on the equipment shall be used in handling the equipment. Shafts and operating mechanisms shall not be used as lifting points. Spreader bars or lifting beams shall be used when the distance between lifting points exceeds that permitted by standard industry practice.

C. Under no circumstances shall equipment or products such as pipe, structural steel,

castings, reinforcement, lumber, piles, poles, etc., be thrown or rolled off of trucks onto the ground.

D. Slings and chains shall be padded as required to prevent damage to protective coatings and finishes.

1.04 STORAGE

A. Upon delivery, all equipment and materials shall immediately be stored and protected until installed in the Work.

B. Stacked items shall be suitably protected from damage by spacers or load distributing supports that are safely arranged. No metalwork (miscellaneous steel shapes and reinforcing steel) shall be stored directly on the ground. Masonry products shall be handled and stored in a manner to hold breakage, chipping, cracking, and spalling to a minimum. Cement, lime, and similar products shall be stored off the ground on pallets and shall be covered and kept completely dry at all times. Pipe, fittings, and valves may be stored out of doors, but must be placed on wooden blocking. PVC pipe, geomembranes, plastic liner, and other plastic materials shall be stored off the ground on pallets and protected from direct sunlight.

C. Pumps, motors, electrical equipment, and all equipment with antifriction or sleeve bearings shall be stored in weathertight structures maintained at a temperature above 60°F. Electrical equipment, controls, and insulation shall be protected against moisture and water damage. All space heaters furnished in equipment shall be connected and operated continuously.

D. Equipment having moving parts, such as gears, bearings, and seals, shall be stored fully lubricated with oil, grease, etc., unless otherwise instructed by the manufacturer. Manufacturer's storage instructions shall be carefully followed by Contractor.

E. When required by the equipment manufacturer, moving parts shall be rotated a minimum of twice a month to ensure proper lubrication and to avoid metal to metal "welding". Upon installation of the equipment, Contractor shall, at the discretion of the City’s Authorized Representative, start the equipment at one-half load for an adequate period of time to ensure that the equipment does not deteriorate from lack of use.

F. When required by the equipment manufacturer, lubricants shall be changed upon completion of installation and as frequently as required thereafter during the period between installation and acceptance. New lubricants shall be put into the equipment by Contractor at the time of acceptance.

G. Equipment and materials shall not show any pitting, rust, decay, or other deleterious effects of storage when installed in the Work.

H. In addition to the protection specified for prolonged storage, the packaging of spare units and spare parts shall be for export packing and shall be suitable for long-term storage in a damp location. Each spare item shall be packed separately and shall be completely identified on the outside of the container.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

+ + + END OF SECTION 01610 + + +

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SECTION 01650
WARRANTIES

PART 1 GENERAL

PROJECT MAINTENANCE AND WARRANTY

A. Maintain and keep in good repair the Work covered by these Drawings and Specifications until acceptance by the Owner.

B. The Contractor shall warrant for a period of one year from the date of Owner's written acceptance of the Work and/or Owner's written final acceptance of the Project, as defined in the Contract Documents, that the completed Work is free from all defects due to faulty products or workmanship and the Contractor shall promptly make such corrections as may be necessary by reason of such defects. The Owner will give notice of observed defects with reasonable promptness. In the event that the Contractor should fail to make such repairs, adjustments or other work that may be made necessary by such defects, the Owner may do so and charge the Contractor the cost thereby incurred. The Performance Bond shall remain in full force and effect throughout the warranty period.

C. The Contractor shall not be obligated to make replacements which become necessary because of ordinary wear and tear, or as a result of improper operation or maintenance, or as a result of improper work or damage by another Contractor or the Owner, or to perform any work which is normally performed by a maintenance crew during operation.

D. In the event of multiple failures of major consequences prior to the expiration of the one year warranty described above, the affected unit shall be disassembled, inspected and modified or replaced as necessary to prevent further occurrences. All related components which may have been damaged or rendered non-serviceable as a consequence of the failure shall be replaced. A new warranty period equal to the original warranty period shall be provided against defective or deficient design, workmanship, and materials and shall commence on the day that the item is reassembled and placed back into operation. As used herein, multiple failure shall be interpreted to mean two (2) or more successive failures of the same kind in the same item or failures of the same kind in two or more items. Major failures may include, but are not limited to, cracked or broken housings, piping, or vessels, excessive deflections, bent or broken shafts, broken or chipped gear teeth, premature bearing failure, excessive wear or excessive leakage around seals. Failures which are directly and clearly traceable to operator abuse, such as operations in conflict with published operating procedures or improper maintenance, such as substitution of unauthorized replacement parts, use of incorrect lubricants or chemicals, flagrant over-or under-lubrication and using maintenance procedures not conforming with published maintenance instructions, shall be exempted from the scope of the one year warranty.

Should multiple failures occur in a given item, all products of the same size and type shall be disassembled, inspected, modified or replaced as necessary and re-warranted for the original full warranty period.

E. The Contractor shall, at Contractor's own expense, furnish all labor, materials, tools and equipment required and shall make such repairs and removals and shall perform such work or reconstruction as may be made necessary by any structural or functional defect or failure resulting from neglect, faulty workmanship or faulty materials, in any part of the Work performed by the Contractor. Such repair shall also include refilling of trenches, excavations or embankments which show settlement or erosion after backfilling or placement.

F. Except as noted on the Drawings or as specified, all structures such as embankments and fences shall be returned to their original condition prior to the completion of the Contract. Any and all damage to any facility not designated for removal, resulting from the Contractor's operations, shall be promptly repaired by the Contractor at no cost to the Owner.

G. The Contractor shall be responsible for all road and entrance reconstruction and repairs and maintenance of same for a period of one (1) year from the date of final acceptance. In the event the repairs and maintenance are not made immediately and it becomes necessary for the Owner of the road to make such repairs, the Contractor shall reimburse the owner of the road for the cost of such repairs.

H. In the event the Contractor fails to proceed to remedy the defects upon notification within ten (10) days of the date of such notice, the Owner reserves the right to cause the required materials to be procured and the work to be done, as described in the Drawings and Specifications, and to hold the Contractor and the sureties on Contractor's bond liable for the cost and expense thereof.

I. Notice to Contractor for repairs and reconstruction will be made in the form of a registered letter addressed to the Contractor at Contractor's home office.

J. Neither the foregoing paragraphs nor any provision in the Contract Documents, nor any special guarantee time limit implies any limitation of the Contractor's liability within the law of the place of construction.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

+ + + END OF SECTION 01650 + + +

SECTION 01720
RECORD DOCUMENTS

PART 1 GENERAL

1.01 SCOPE

A. The work under this Section includes, but is not necessarily limited to, the compiling, maintaining, recording, and submitting of project record documents as herein specified.

B. Record documents include, but are not limited to:

1. Record Drawings
2. Specifications
3. Change orders and other modifications to the Contract
4. Field orders or written instructions, including Requests for Information (RFI) and Design Clarification Memorandums
5. Requests for Information and Design Clarification Memoranda
6. Approved Shop Drawings and samples
7. Field Test Records
8. Coordinates for centerline of Water Main at 100 foot stationing
9. Original copies of all Warranties
10. Final Operation and Maintenance Manuals

C. The Contractor shall maintain a current set of Record Drawings and GIS data at the project locations or at a location as agreed to by the City's Authorized Representative throughout the Contract Time. These drawings must be the latest revision and match that of the City's Authorized Representative.

1.02 MAINTENANCE OF DOCUMENTS AND SAMPLES

A. Storage:

1. Store documents and samples in the Contractor's office, apart from documents used for construction
2. Provide files and racks for storage of documents
3. Provide locked cabinet or secure storage space for storage of samples

B. File documents and samples in accordance with format of these Specifications

C. Maintenance:

1. Maintain documents in a clean, dry, legible condition and in good order.
2. Do not use Record documents for construction purposes.

D. Make documents and samples available at all times for inspection by City's Authorized Representative.

E. Failure to maintain the Record Documents in a satisfactory manner may be cause for withholding payment.

1.03 QUALITY CONTROL

A. Unless noted otherwise, Record Drawings and corresponding GIS data shall provide dimensions, distances, coordinates to the nearest 0.1 foot in North American Datum of 1983 (1986 adjustment) Georgia State Plane West 1002 System format. All coordinate values shall be provided as grid coordinates in US Survey Feet.

B. Unless noted otherwise, Record Drawings and corresponding GIS data shall provide elevations to the nearest 0.01 foot referenced to the North American Vertical Datum of 1988 (NAVD88) format. All coordinate values shall be provided as grid coordinates in US Survey Feet.

C. Any transformation or adjustment necessary to project surveyed coordinates to the Reference Coordinate System will be the responsibility of the Contractor.

D. The Contractor shall employ a Professional Land Surveyor (PLS) licensed in the State of Georgia to certify the Record Drawings from the collected GIS data or a post-construction, field survey of all water line and appurtenances newly constructed, replaced or otherwise adjusted in position or elevation. Additionally, the contractor shall submit the corresponding GIS data to indicate the as-built condition and GIS data attributes of these structures and pipelines. A post construction survey is not required for rehabilitation projects where lines or appurtenances are not adjusted; however, the GIS data attributes shall be updated to indicate the physical as-built condition.

1.04 DATA ACCURACY

A. High Resolution: For all water line appurtenances including but not limited to valves, hydrants, and meters, the equipment and means used by Contractor must generate the position of points with a minimum accuracy of three (3) centimeters horizontal and three (3) centimeters vertical. To determine the accuracy obtained, Contractor's GPS system will be calibrated daily against a known point (monuments) prior to beginning work and when the work is completed. The Contractor shall submit a report to the City's Authorized Representative certifying calibration was accomplished and indicating the reference system. Data delivered to the City's Authorized Representative arising from the GPS survey shall be certified by a Professional Land Surveyor. When the GPS equipment cannot be set directly on the point, conventional surveying methods will be used to establish the position to the stated level of accuracy.

B. Calibration shall be carried out at least on a daily basis in accordance with the GPS equipment manufacturer's instructions. Additional calibrations may be required during the course of the working day for large fluctuations of temperature and/or humidity, also in accordance with the manufacturer's instructions and tolerances. The Contractor shall submit a report to the City's Authorized Representative certifying calibration was accomplished and indicating the reference system.

1.05 INTERFERENCE

A GPS position is required for all newly constructed, replaced or adjusted water line structures regardless of the overhead conditions or other nearby obstructions which may interfere with satellite signals, at no additional cost. In the event coverage conditions do not allow all positions to be obtained by setting directly over the point, rangefinders or other conventional surveying methods may be used to obtain the position of the point(s).

1.06 RECORDING

A. Label each document "PROJECT RECORD" in neat, large printed letters.

B. Recording:

1. Record information concurrently with construction progress.
2. Do not conceal any work until required information is recorded.

1.07 RECORD DRAWINGS

A. The Contractor must maintain an up-to-date field record set of Record drawings by marking changes and other information directly on a clean set of full-size contract drawings. The Contractor shall submit up-to-date Record drawings with monthly pay applications and have them available for review at monthly progress meetings. Approval of monthly pay applications will not occur until the updated Record drawings are approved. The City's Authorized Representative will review the working drawings to confirm that the recorded information is current.

B. Record Drawings are a final deliverable and shall be reproducible, shall have a title block indicating that the drawings are Record Drawings, the name of the company preparing the Record Drawings, and the date the Record Drawings were prepared. The Contractor shall provide record drawings in both PDF form as well as the native format (for platcard and GIS update).

C. Legibly mark Record drawings to record actual construction, including:

1. All Construction:
   a. Changes of dimension, diameter, or material and detail.

b. Location (address, intersections, other) and type of work performed on each manhole or water line (indicate asset ID numbers)
c. Changes made by Requests for Information (RFI), field order, clarification memorandums or by change order
d. Details not on original Drawings
e. The distance (length) between valves on pipe segments where work was performed.

2. Structures:

   Position coordinates, as well as elevations of all water line appurtenances where they have been newly constructed, replaced or adjusted.

3. Mains:

   Class, Date of Installation, Failure type (corrosion, bell split, circumferential cracking, longitudinal cracking, etc.), GPS coordinates (repair location), Lining type, Manufacturer, Material, Size.

4. Hydrants:

   Barrel Size, Date of installation, GPS coordinates, Height, Manufacturer, Number/size of nozzle.

5. Valves:

   Date of installation, Depth to operating nut, Direction to open, GPS coordinates, Manufacturer, Number of turns, Pressure rating, Size, Stem length (when applicable), Type, Vertical or horizontal.

6. Meters:

   Date of Installation, GPS Coordinates, Location Notes, Serial Number, Size, Manufacturer, Type, Model, As-built Register Information for high and low registers. See Section 02668 for additional as-built information.

7. Registers:

   Date of Installation, Serial Number, Size, Type, Register Readings at timeof vault delivery/customer connection /meter removal, AMR Readings obtained from drive-by AMR reading location. See Section 02668 for additional as-built information.

8. Detector Checks:

   Date of Installation, GPS Coordinates, Serial Number, Size, Manufacturer, Type, Detector Check Bypass Assembly Size, Detector Check Bypass Assembly Meter Information (see above). See Section 02668 for additional as-built information.

9. Meter Boxes, Meter Vaults and Detector Check Vaults:

Date of Installation, GPS Coordinates, Schematic of piping and equipment within vaults, Internal dimensions of vault and hatch (L x W x D), Design loading. See Section 02668 for additional as-built information.

10. Water Service Lines

Date of Installation, GPS Coordinates for tapping and abandonment locations. See Section 02668 for additional as-built information.

11. Other:

GPS coordinates for fittings (tees, elbows, sleeves, taps), Type of fittings.

1.08 SPECIFICATIONS

Legibly mark each Record drawing to record:

A. Manufacturer, trade name, catalog number, and supplier of each product and item of equipment actually installed.

B. Changes made by Requests for Information (RFI), field order, clarification memorandums, or by change order.

1.09 GIS DATA

A. Contractor shall provide a GIS data file containing both electronic and hard copy format at the completion of each newly installed or relocated water line (includes fire hydrants, valves, vaults, deadmen, dead ends etc.). The hard copy data must be submitted for approval by the City's Authorized Representative. Electronic data will not be accepted without hard copy data. Data shall be submitted in an ESRI shapefile format. Shapefile shall include data pertaining to all associated appurtenances, elevations, pipe diameters, material composition, install date. Each submittal must be numbered according to the numbering system outlined in Specification Section 01350.

B. The hard copy data shall include a cover letter and printed spreadsheet that corresponds to the electronic data submitted. If the survey work is performed by a subcontractor, the cover letter shall provide certification of data accuracy by a Professional Land Surveyor (PLS) licensed in the State of Georgia. If the survey work is performed by the prime Contractor, the cover letter shall provide certification of data accuracy by a Professional Land Surveyor (PLS) licensed in any State in the United States of America. The hard copy data must be bound, with the PLS seal placed on the cover letter; OR, the hard copy data may be submitted unbound, with the PLS seal placed on each and every sheet of unbound data submitted.

C. The attached GPS Certification Form shall be signed and sealed by a Registered Land Surveyor in Georgia and submitted for each identifiable water distribution feature.

D. Numerical value measurement data precision shall be 1/1000 or three decimal places. Each data worksheet shall include individual data records arranged in template formats and header values conforming to examples provided below;

1.08 SUBMITTAL

A. At work assignment or contract closeout (whichever comes first), the Contractor shall submit two copies of Record Documents to the City's Authorized Representative.

B. The submittal shall include a transmittal letter, in duplicate, containing;

1. date
2. project title and number
3. contractor's name and address
4. title and number of each record document and
5. Signature of Contractor or Contractor's authorized representative.

C. Additionally, the Contractor shall edit the digital PDF(s) files furnished for each Project to include all changes based upon actual field conditions. The Contractor shall submit marked up map(s) showing the position of unmapped and incorrectly positioned structure(s) and/or pipelines discovered during the work. All map(s) shall be marked up with red text and delivered to the City's Authorized Representative upon the completion of each watershed. Supplemental sketches shall also be provided in red text, as necessary to clearly depict the actual site conditions including, but not limited to congested areas and established access roads. A legend shall be added to the title block indicating the symbology, color coding and descriptions. The date, the words "As-Built" and company name shall also be included in the title block.

+ + + END OF SECTION 01720 + + +

Information to be Inserted in other sections
Mains:
Add Tapping location

Registers:

ATTACHMENT A

CLEAN WATER ATLANTA

GPS CERTIFICATION FORM

The purpose of this form is to provide the City of Atlanta with additional GPS/Survey information necessary to maintain the GIS system. This form should be completed for each sewershed and submitted with the Certified GPS.

Name of Sewershed:	Contractor Name: Contact Number:	Surveyor Name: Contact Number:
Brief description of survey equipment used: (Manufacturer, Model No., Age)		

Reference Coordinate System used

a. Horizontal

- Datum _____
- Adjustment _____
- Coordinate System _____
- Unit of Measure _____

b. Vertical

- Datum _____
- Geoid Model _____
- Unit of Measure _____

c. Geodetic monuments used or name of network RTK service _____

d. Scale factors for Conventional Survey _____

e. If calibration or transformation was applied, list parameters _____

f. Are coordinates Grid or Ground? _____

_____ _____

Signature and Seal of Surveyor Date

+ + + END OF SECTION 01720 + + +

SECTION 01740
CLEANING AND DISPOSAL

PART 1 GENERAL

1.01 SCOPE OF WORK

During the progress of the Work Contractor shall keep the Project work area and other immediate impacted areas free from accumulations of waste materials, rubbish, and other debris. Removal and disposal of such waste materials, rubbish, and other debris shall conform to applicable Laws and Regulations. At the completion of the Work, the Contractor shall remove from the Project work area, all waste materials, rubbish, debris, tools, appliances, construction equipment and machinery, and surplus materials and shall restore to original condition all property not designated for alteration by the Contract Documents.

1.02 RELATED WORK

Each Section: Cleaning for specific products or work.

1.03 DISPOSAL AND CLEANING

Conduct cleaning and disposal operations to comply with codes, ordinances, regulations and anti-pollution laws.

PART 2 PRODUCTS

2.01 MATERIALS

A. Use only those cleaning materials which will not create hazards to health or property and which will not damage surfaces.

B. Use only those cleaning materials and methods recommended by manufacturer of the surface material to be cleaned.

C. Use cleaning materials only on surfaces recommended by cleaning material manufacturer.

PART 3 EXECUTION

3.01 DURING CONSTRUCTION

A. Execute periodic cleaning to keep the work, the site and adjacent properties free from accumulations of waste materials, rubbish and windblown debris, resulting from construction operations.

B. Provide on-site containers for the collection of waste materials, debris and rubbish.

C. Remove waste materials, debris and rubbish from the site periodically and dispose of at legal disposal areas away from the site.

D. Refer to Section 01060 for Stormwater discharges

3.02 DUST CONTROL

A. Clean interior spaces prior to the start of finish painting and continue cleaning on an as-needed basis until painting is finished.

B. Schedule operations so that dust and other contaminants resulting from cleaning process will not fall on wet or newly-coated surfaces.

3.03 FINAL CLEANING

A. Employ skilled workmen for final cleaning.

B. Remove grease, mastic, adhesives, dust, dirt, stains, fingerprints, labels and other foreign materials from sight-exposed interior and exterior surfaces.

C. Wash and shine glazing and mirrors.

D. Polish glossy surfaces to a clear shine.

E. Ventilating Systems:

1. Clean permanent filters and replace disposable filters if units were operated during construction.
2. Clean ducts, blowers and coils if units were operated without filters during construction.

F. Broom clean exterior paved surfaces; rake clean other surfaces of the grounds.

G. Prior to final completion, or Owner occupancy, conduct an inspection of sight-exposed interior and exterior surfaces and all work areas, to verify that the entire work is clean.

+ + + END OF SECTION 01740 + + +

SECTION 01770
CLOSEOUT PROCEDURES

PART 1 SCOPE

1.01 SUBMITTALS

A. Quality Control Submittals: Written procedures for maintaining and markup of Record Documents.

B. Contract Closeout Submittals: Submit prior to processing of application for final payment.

1. Record Documents
2. Complete set of Approved Shop Drawings and Samples
3. Two (2) copies of all Special Bonds, Special Warranties, and Service Agreements.
4. Consent of Surety to Final Payment
5. Releases or Waivers of Liens and Claims
6. Release from Agreements.
7. Certificates of Inspection and Occupancy if required by local jurisdiction.
8. Registry of training sessions conducted and list of attendees for all manufacturer's operation and maintenance training session.
9. Registry of final maintenance and lubrication of filter and/or oil lube protected equipment.
10. Registry of all Spare Parts and Special Tools provided to the Owner as required by individual specification sections organized by specification section inclusive of documentation depicting receipt by Owner.
11. Final Application for Payment: Submit in accordance with procedures and requirements stated in paragraph 14.07 of the General Conditions.
12. A final written tabulation, plus other documentation as may be required, of all taxes, including sales tax, paid by the CONTRACTOR to assist the OWNER in obtaining sales and/or use tax refunds for eligible machinery and equipment used for the primary purpose of reducing or eliminating air or water pollution as provided for in Chapter 48-8-3 (36) and (37) of the Official Code of Georgia.

1.02 FINAL PAYMENT

A. Neither the Final Payment nor the retainage shall become due until Contractor submits to the Engineer:

1. An affidavit that all payrolls, bills for Materials and Equipment, and other indebtedness connected with the Work have been paid or otherwise satisfied;
2. Consent of surety, if any, to Final Payment;
3. Clear title for all vehicles and/or trailers, if any, to remain as City property;
4. Complete set of as-built record Drawings;

5. Documentation for all state sales taxes paid by Contractor including completed State Department of Revenue Refund forms and all necessary back up documentation required by the Department of Revenue;
6. If required by the Engineer or City, other data establishing payment or satisfaction of all such obligations, such as receipts, releases, and waivers of liens arising out of the Agreement, to the extent and in such form as may be designated by the Engineer or City. If any Subcontractor refuses to furnish a release or waiver required by the Engineer or City, Contractor may furnish a bond satisfactory to the City to indemnify the City against any such loss. If any lien or indebtedness remains unsatisfied after all payments are made, Contractor shall refund to the City all monies that the latter may be compelled to pay in discharging such lien or other indebtedness, including, without limitation, all costs, expenses, arbitration fees, reasonable attorneys' fees, expert fees, or consultant fees incurred in connection with same; and
7. As a condition of Final Payment on the Project, Contractor shall, prior to final payment, complete and submit to the City, all of the invoice documentation and the State of Georgia Revenue Department forms required to obtain the sales tax refund on all applicable equipment expenditures. This submittal shall include the certified forms and auditable back-up necessary to substantiate the expenditures for State refund.

1.03 PROJECT RECORD DOCUMENTS

See Section 01720 .

1.04 RELEASES FROM AGREEMENTS

A. Furnish Owner written releases from property owners or public agencies where side agreements or special easements have been made, or where Contractor's operations have not been kept within the Owner's construction right-of-way.

B. In the event Contractor is unable to secure written releases, inform the Owner of the reasons:

1. Inform Owner of the reasons.
2. Owner or its representatives will examine the site, and Owner will direct Contractor to complete Work that may be necessary to satisfy terms of the side agreement or special easement.
3. Should Contractor refuse to perform this Work, Owner reserves the right to have it done by separate contract and deduct the cost of same from the Contract Price, or require the Contractor to furnish a satisfactory Bond in a sum to cover legal claims for damages.
4. When Owner is satisfied that Work has been completed in agreement with the Contract Documents and terms of side agreement or special easement, the right is reserved to waive the requirement for written release if:

a. Contractor's failure to obtain such statement is due to the grantor's refusal to sign, and this refusal is not based upon any legitimate claims that Contractor has failed to fulfill the terms of the side agreement or special easement, or
b. Contractor is unable to contact or has had undue hardship in contacting the grantor.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

+ + + END OF SECTION 01770 + + +

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CERTIFICATE OF DESIGN

The undersigned hereby certifies that he/she is a Professional Engineer registered in the state of _____ and that he/she has been employed by (Name of Contractor) _____ to design _____ in accordance with Specifications Section _____ for the (Name of Project) _____ The undersigned further certifies that he/she has performed similar designs previously and has performed the design of the _____; that said design is in conformance with all applicable local, state, and federal codes, rules, and regulations and professional practice standards; that his/her signature and Professional Engineer (P.E.) Stamp have been affixed to all calculations and drawings used in, and resulting from, the design; and that the use of that stamp signifies the responsibility of the undersigned for that design.

The undersigned hereby certifies that he/she has Professional Liability Insurance with limits of $1,000,000.00 and a Certificate of Insurance is attached.

The undersigned hereby agrees to make all original design drawings and calculations available to the Town/City of _____ or Owner's representative within seven (7) days following written request therefore by the Owner.

P.E. Name	Contractor's Name
Signature	Signature
Title	Title
Address	Address

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CERTIFICATE OF UNIT RESPONSIBILITY

For Specification Section _____

_____

In accordance with Section 01 61 16, paragraph 4 of the contract documents, the undersigned manufacturer accepts unit responsibility for all components of equipment furnished under specification Section _____. Equipment supplied by the manufacturer is covered and the equipment will be operated according to the O&M manual. We hereby certify that these components are compatible and comprise a functional unit suitable for the specified and indicated performance and design requirements.

_____ _____

Notary Public Name of Corporation

_____ _____

Commission expiration date Address

Seal By: _____

Duly Authorized Official

_____

Legal Title of Official

Date: _____

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SECTION 01900
SEISMIC REQUIREMENTS

PART 1 GENERAL

1.01 SCOPE

A. This section establishes the minimum seismic design requirements for mechanical and non-structural components required to complete the Work.

B. The Contractor shall be responsible for the seismic requirements specified including the conformance of work for all subcontractors, manufacturers and suppliers with regard to the indicated and specified seismic requirements.

1.02 REFERENCES

A. American Society of Civil Engineers:

ASCE 7: Minimum Design Loads for Buildings and Other Structures.

B. American Petroleum Institute:

STD 650: Welded Steel Tanks for Oil Storage

C. American Society of Mechanical Engineers:

1. B 31: Code for Pressure Piping

2. Boiler and Pressure Vessel Code

D. International Code Council (ICC):

International Building Code

E. Manufacturers Standardization Society of the Valve and Fitting Industry:

SP-58: Pipe Hangers and Supports - Materials, Design and Manufacture

1.03 DEFINITIONS

A. Components are defined as systems, equipment, parts, or other elements, including supporting structures and attachments.

B. The reference building code is defined as the building code cited on the structural drawings or specified herein for the design of the basic structure.

C. The specified seismic criteria is defined as the seismic criteria cited on the structural

drawings or specified herein for the design of the basic structure.

1.04 SEISMIC DESIGN REQUIREMENTS

A. Refer to structural drawings for seismic requirements and also conform to the requirements specified herein.

B. Non-structural components shall be designed and constructed to resist the seismic forces and displacements based upon ASCE 7, the reference building code, and the specified seismic criteria. In the case of conflict the more stringent requirements shall govern.

C. The interrelationship of components and their effect on each other shall be such that the failure of one component shall not cause the failure of any other component.

D. Components shall be anchored to the building structure to transfer seismic forces. Connections shall be bolted, welded or otherwise positively anchored to the structure. Anchorage shall not rely on friction for force transfer.

E. Exceptions: Exemption from the requirements for seismic analysis and design are permitted only to the extent permitted in the reference code.

1.05 SUBMITTALS

Submittals shall be made in accordance with the requirements of the General Condition of the Contract Documents. In addition, the following specific information shall be provided:

1. Certification signed and sealed by a Professional Structural Engineer holding current registration in the State of Georgia stating that all systems, equipment and other elements, including supporting structures, attachments and connections are designed to withstand the required seismic forces and displacements.

2. Codes and specifications to which structural design conforms.

1.06 SPECIFIC COMPONENTS

A. Piping Systems: Support and bracing of piping systems shall account for the weight and hydrodynamic effects of the contents.

B. Pressure Piping: Pressure piping support and bracing shall conform to ASME B 31 in addition to the force and displacement requirements of the reference code.

PART 2 PRODUCTS

(NOT USED)

PART 3 EXECUTION

(NOT USED)

+ + + END OF SECTION 01900 + + +

SECTION 02000
SITE WORK

PART 1 - GENERAL

1.01 DESCRIPTION

These general site work requirements apply to all site work operations. Refer to specification sections for specific product and execution requirements.

1.02 QUALITY CONTROL

A. Comply with all applicable local, state, and federal requirements regarding materials, methods of work, and disposal of excess and waste materials.

B. Obtain and pay for all required inspections and permits, including all applicable NPDES permits, GDOT permits, City of Atlanta Public Works permits, and fees. Provide notices required by governmental authorities.

C. Quality Testing of materials to certify conformance with the Specifications shall be performed by an independent testing laboratory.

1.03 PROJECT CONDITIONS

A. Locate and identify existing underground and overhead services and utilities within contract limit work areas. Provide adequate means of protection of utilities and services designated to remain. Repair utilities damaged during site work operations at Contractor's expense.

B. Arrange for disconnection and seal or cap all utilities and services designated to be removed before start of site work operations. Perform all work in accordance with the requirements of the applicable utility company or agency involved.

C. When uncharted or incorrectly charted underground piping or other utilities and services are encountered during site work operations, notify the City's Authorized Representative and the applicable utility company immediately to obtain procedure directions. Cooperate with the applicable utility company in maintaining active services in operation.

D. Locate, protect, and maintain bench marks, monuments, control points and project engineering reference points. Reestablish disturbed or destroyed items at no additional expense to the owner.

E. Perform site work operations and the removal of debris and waste materials to assure

minimum interference with streets, sidewalks, and other adjacent facilities. If interference with streets is anticipated, a lane closure plan and road closure plan shall be submitted and Contractor shall supply signage, flagmen, etc. These plans should also account for commercial/residential entrances, sidewalks, bike lanes and other avenues of public egress.

F. Obtain governing authorities' written permission when required to close or obstruct street, walks and adjacent facilities. Provide alternate routes around closed or obstructed traffic ways when required by governing authorities having jurisdiction.

G. Control dust caused by work. Dampen surfaces as required. Comply with pollution control regulations of governing authorities.

H. Protect existing buildings, paving, and other services or facilities on site and adjacent to the site from damage caused by site work operations. Cost of repair and restoration of damaged items at no additional expense to the owner.

I. Protect and maintain street lights, utility poles and services, traffic signal control boxes, curb boxes, valves and other services, except items designated for removal. Remove or coordinate the removal of traffic signs, parking meters and postal mail boxes with the applicable governmental agency. Provide for temporary relocation when required to maintain facilities and services in operation during construction work.

J. Preserve from injury or defacement all vegetation and objects designated to remain.

PART 2 - PRODUCTS

MATERIALS AND EQUIPMENT

Materials and equipment: As selected by Contractor, except as indicated in contract documents.

PART 3 - EXECUTION

3.01 PREPARATION

A. Examine the areas and conditions under which site work is performed. Do not proceed with the work until unsatisfactory conditions are corrected.

B. Consult the records and drawings of adjacent work and of existing services and utilities which may affect site work operations.

+ + + END OF SECTION 02000 + + +

SECTION 02010
GEOTECHNICAL DATA

PART 1 - GENERAL

1.1 DESCRIPTION

This Section includes subsurface investigation data to be used in the design and construction of the City of Atlanta Woodward Way Pump Station #1 Improvements Modifications. For information on existing soil conditions, investigations, evaluation and recommendations refer to Geotechnical Engineering Report, Northside Drive at Peachtree Creek – New Pump Station, Prepared by MC Squared dated August 2018; which is considered incorporated into these documents as referenced herein and as attached as Appendix A.

END OF SECTION

SECTION 02010 – GEOTECHNICAL DATA

APPENDIX A

GEOTECHNICAL ENGINEERING REPORT

NORTHSIDE DRIVE AT PEACHTREE CREEK – NEW PUMP STATION

CITY OF ATLANTA, GEORGIA

AUGUST 2018

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Geotechnical Engineering Report

Northside Drive at Peachtree Creek – New Pump Station
City of Atlanta, Fulton County, Georgia

Prepared for: ***WSP USA***
3340 Peachtree Road, N.E., Suite 2400
Atlanta, Georgia 30326-1087

Prepared by: ***MC Squared, Inc.***
1275 Shiloh Road NW, Suite 2620
Kennesaw, Georgia 30144

MC² Project No. A041707.047
August 2018

1275 Shiloh Road NW, Suite 2620, Kennesaw, Georgia 30144
Phone (770) 650-0873, Fax (770) 650-7825
www.mc2engineers.com

August 6, 2018

Ms. Ankita Patel, P.E.
WSP USA
3340 Peachtree Road, N.E., Suite 2400
Atlanta, Georgia 30326-1087

Subject: Geotechnical Engineering Report
Northside Drive at Peachtree Creek – New Pump Station
Atlanta, Fulton County, Georgia
MC² Project No. A041707.047

Dear Ms. Patel:

MC Squared, Inc. (**MC²**) has completed geotechnical engineering services for the proposed Pump Station (PS) located at Woodward Way NW, in Atlanta, Fulton County, Georgia. This report outlines our geotechnical engineering recommendations for the proposed pump station and associated access driveway.

We trust that this report will assist you in the design and construction of the proposed project and we appreciate the opportunity to be of service to you. Should you have any questions, please do not hesitate to contact us.

Respectfully submitted,
MC²

Lucas Caliari de Lima, Ph.D.
Geotechnical Project Engineer

Jodonna J. Jimenez, P.E.
Project Engineer

Prashanth Vaddu, P.E.
Project Manager
Georgia P.E. No. 039820

1275 Shiloh Road NW, Suite 2620, Kennesaw, Georgia 30144
Phone (770) 650-0873, Fax (770) 650-7825
www.mc2engineers.com

Table of Contents

1 PROJECT INFORMATION 1
1.1 Project Authorization 1
1.2 Project Description 1
2 SCOPE OF WORK AND SERVICES 1
3 SITE CONDITIONS 3
3.1 Site Features 3
3.2 USDA Soil Survey 3
3.3 Topographic Map and Site History 4
3.4 Readily Available Geotechnical Information 4
4 FIELD EXPLORATION PROGRAM 4
4.1 Standard Penetration Test (SPT) Borings 4
4.2 Rock Coring 5
5 GEOTECHNICAL LABORATORY TESTING 5
6 SUBSURFACE CONDITIONS 6
6.1 Subsurface Soil and Rock Conditions 6
6.2 Groundwater Conditions 8
7 EVALUATIONS AND CONCLUSIONS 9
8 RECOMMENDATIONS 11
8.1 Foundation Recommendations 11
8.2 Uplift Resistance 13
8.3 Lateral Earth Pressures 13
8.4 Temporary Structure Excavations 14
8.5 Federal Excavation Regulations 15
8.6 Access Driveway 15
8.7 Construction Recommendations 17
8.8 Drainage and Groundwater Considerations 20
9 REPORT LIMITATIONS 21

FIGURES

Project Location Map – Sheet 1
USDA Soil Survey Map and USGS Topographic Map – Sheet 2
Boring Location Map – Sheets 3 and 4
Subsurface Boring Profiles – Sheet 5
Subsurface Boring Profile Legend – Sheet 6

APPENDIX

Individual Boring Profiles – gINT (5 Pages)
Summary of Soil Parameters – Table No. 5 (1 Page)
Summary of Soil Laboratory Testing Results (1 Page)
Standard Proctor Result (1 Page)
Grain-Size distribution Curves of Soils (6 Pages)
Rock Core and Rock Testing Photographs (6 Pages)
Test Procedures (4 Pages)

1 PROJECT INFORMATION

1.1 Project Authorization

Authorization to proceed with this project was issued by **Ms. Ankita Patel, PE** of **WSP** through e-mail on July 3, 2018 and in general accordance with our proposal dated May 22, 2018.

1.2 Project Description

The proposed project site is located near the southeast corner of the intersection of Woodward Way NW and Northside Drive NW in Atlanta, Fulton County, Georgia (refer to Sheet 1 – Project Location Map). Project information was provided by **Ms. Ankita Patel, P.E.** of **WSP** through e-mail and verbal communications. Based on our understanding, geotechnical engineering services are required to support the design of a new pump station and appurtenant access driveway, new transformer and new genset pad.

Ms. Patel provided a one-page PDF entitled "New PS Site Plan" (refer to Sheet 3 – Boring Location Plan) indicating plan and section views of the proposed pump station. Additionally, we were provided with the boring locations and specific directions for geotechnical drilling by **WSP**. The pump station and associated structures are described as follows:

- A new 28-ft 11-in x 28-ft 8-in foundation for the proposed Pump Station #1 at a depth of 35-ft. below the ground surface (bgs).
- A new access driveway.

Structure specific loads and foundation details were not available as of this report writing. If any of the project description information is incorrect or changes, please inform **MC^2** so that we may amend, the recommendations presented in this report, as appropriate.

2 SCOPE OF WORK AND SERVICES

The purpose of this report is to describe, in general terms, soil and groundwater conditions encountered at the site and to provide evaluations and recommendations to aid in the design and construction of the new pump station and access driveway. To achieve the aforementioned objective, our scope of services included the following:

1. Conducting a visual reconnaissance of the project site. Reviewing the readily available information including USDA Soil Survey, Fulton County, Georgia, the USGS topographic maps for the site and geotechnical information from a nearby bridge project.

2. Marking boring locations by measuring from existing site features.

3. Clearing utilities with local authorities through Georgia 811 service only.

4. Attending a site meeting with City of Atlanta representatives upon **WSP**'s request.

5. Performing geotechnical explorations at accessible locations as follows:

    - Advancing one (1) Standard Penetration Test (SPT) boring to a depth of 54 feet bgs (including 15 feet of rock coring) within the proposed pump station footprint.

    - Advancing one (1) SPT boring to a depth of 35 feet bgs within the proposed access driveway footprint.

    - Collecting a soil bulk sample within the access driveway footprint for performing a standard Proctor compaction test.

6. Visually examining all recovered soil and rock samples in the laboratory. Performing laboratory tests on selected representative samples to develop the soil and rock profile for the project using the Unified Soil Classification System.

We present the following data and recommendations in this report:

1. General assessment of area geology based on our experience, study of geological literature, readily available geotechnical data and our current boring information.

2. General location and description of potentially deleterious materials encountered in the borings, which may interfere with the proposed design, construction or performance, including considerations regarding groundwater.

3. General construction recommendations along with recommendations for conventional shallow foundations for the pump station structure and general pavement recommendations. Pavement design is not a part of our services.

The scope of our services did not include an environmental assessment for determining the presence or absence of wetlands or hazardous or toxic materials in the soil, bedrock, groundwater, or air, on or below or around this site. Any statements in this report or on the boring logs regarding odors, colors, unusual or suspicious items or conditions are strictly for completeness of information.

3 SITE CONDITIONS

3.1 Site Features

The project site is located near the southeast corner of the intersection of Woodward Way NW and Northside Drive NW in Atlanta, Fulton County, Georgia (Sheet 1). The project site is bound by Woodward Way NW to the north, Peachtree Creek to the south, and Northside Drive NW to the east. The site is generally level within the proposed PS footprint with a general slope to the south (towards Peachtree Creek). A portion of the project site is an active pump station.

Based upon our review of the site plans provided by **WSP**, meeting with City of Atlanta personnel and our site reconnaissance, a storm water pipe appears to traverse north-south within the proposed access driveway footprint at an unknown depth. During the period of our field activities (July 2018), we observed that a new curb and gutter as well as sidewalk were installed along Woodward Way NW in the immediate vicinity of the project site.

Following our site reconnaissance we reviewed readily available geological and geotechnical information as detailed in the following sections.

3.2 USDA Soil Survey

Our review of the U.S. Department of Agriculture (USDA) - Soil Conservation Service (SCS) maps for the project site indicates the improvements are located within the CpA mapping unit – Congaree sandy loam, with 0% to 2% slopes, and occasionally flooded.

The parent material is fine-loamy alluvium, and the depth to restrictive features is over 80 inches. The natural drainage class is generally well drained with low runoff class. The depth to water table is described as about 30 to 48 inches.

This information was published in a report titled *Custom Soil Resource Report for Fulton County, Georgia* using Version 12, dated October 5, 2017. The aerial images were photographed from May 4, 2014 to June 18, 2014. A portion of the **USDA Soil Survey Map** of the project area is included in the **Figures** (Sheet 2 - USDA Soil Survey Map).

The USDA Soil Survey is not an exact representation of the soils and conditions on the site. The mapping by USGS is based on interpretation of aerial maps with scattered shallow borings for confirmation. Accordingly, borders between mapping units are approximate and the change may be transitional. Differences may also occur from the typical stratigraphy, and small areas of other similar and dissimilar soils may occur within the soil mapping unit. As such, there may be differences in the mapped description and the boring descriptions obtained for this report. Development/urbanization can also cause differences in the typical stratigraphy. The survey is, however, a good basis for evaluating the shallow soil conditions of the area.

3.3 Topographic Map and Site History

Based on our review of the USGS topographic quadrangles titled "Northwest Atlanta Quadrangle", the existing site is at an approximate elevation range of 770 to 780 feet (NAVD 1988 datum) (refer to the **USGS Topographic Map** in the **Figures** – Sheet 2). The elevation at the site does not appear to have changed drastically since 1954, date of the oldest historical topographic map readily available at USGS.

3.4 Readily Available Geotechnical Information

We reviewed a Bridge Foundation Investigation (BFI) Report prepared by others for the bridge on Northside Drive NW over Peachtree Creek. The bridge is located due west of the project site within approximately 130 feet. Based upon the five SPTs reported in the BFI, top of rock appears to vary between approximately 756 feet to 765 feet. The overburden soils reported consisted of loose silty SAND (SM) and very loose to very dense SAND (SP). In one of the borings, a shallow layer of very loose clayey SAND (SC) was reported. The rock quality ranged from very poor (RQD = 0%) to excellent (RQD = 90%).

4 FIELD EXPLORATION PROGRAM

Our field exploration program consisted of two (2) SPT borings including rock coring. The SPT borings were performed on July 18 and July 19, 2018. Rock coring was only performed in the boring within the new pump station footprint (B-1). The field exploration services were performed by **MC^2's** subcontractor under the direct supervision of **MC^2's** qualified staff engineer and overseen by a Georgia licensed professional engineer. A bulk sample (P-1) was collected within the access driveway footprint to perform a standard Proctor compaction test.

4.1 Standard Penetration Test (SPT) Borings

A total of two (2) SPT borings were completed at the site in general accordance with ASTM D1586 (Standard Test Method for Penetration Test and Split Barrel Sampling of Soils) using a truck-mounted, CME 55 drill rig. Hollow-stem auger and NQ rock coring drilling methods were used at this site. Representative soil samples were obtained using the split-barrel sampling procedure discussed below. In this procedure, a 2-in. outer-diameter, split-barrel sampler is driven into the soil by a 140-lb hammer with a free-fall of 30-in. The number of blows required to drive the sampler through a 12-in. interval, after the initial 6-in. seating interval, is termed the Standard Penetration Resistance, or "N" value, and is indicated for each sample on the boring log. The "N" value may be taken as an indication of the relative density of in-situ soils.

Soil samples, recovered during the field exploration program, were placed into air-tight containers, labeled with the project number, boring number and corresponding depth bgs, and

returned to our office to confirm field classification and perform laboratory testing, as required.

4.2 Rock Coring

Rock coring was performed at boring B-1, between approximately 39 feet bgs (auger refusal) and 54 feet bgs. Three runs of 5 feet each were performed using an NQ core barrel. The rock cores were photographed (refer to **Appendix**) and visually described in our laboratory.

All soil and rock samples collected will be retained in house for 60 days from the date of release of this report and will be subsequently discarded without further notice unless requested otherwise in writing.

5 GEOTECHNICAL LABORATORY TESTING

A representative set of soil and rock samples was tested in the laboratory to assist in the classification and determination of engineering characteristics of the soil and rock based on their mechanical and physical behavior. Laboratory testing was accomplished in general accordance with applicable ASTM standards. Laboratory tests completed on soil and rock samples retrieved for this project include:

- six (6) natural moisture content determinations;
- six (6) grain size analysis, including hydrometer testing;
- two (2) Atterberg limit determination tests;
- one (1) standard Proctor test;
- two (2) unconfined compressive strength tests of rock cores; and
- visual classification.

Results for each of these laboratory tests are summarized in the following tables and are also presented on the individual **Soil Profile** logs provided in the **Appendix** and **Figures** (refer to Sheets 5 and 6).

Table 1: Summary of Laboratory Testing of Soils

Boring No. (Depth) (ft.)	Moisture Content (%)	Percent Passing No. 200 Sieve (%)	Maximum Dry Density (%)	Optimum Moisture Content (%)	Liquid Limit (%)	Plasticity Index (%)	USCS Classification
P-1 (0-1.0)	18.9	57	105.0	17.2	28	4	ML
B-1 (6-8)	22.1	35	-	-	NL	NP	SM
B-1 (13.5-15)	24.1	5	-	-	-	-	SP-SM
B-1 (23.5-25)	14.8	51	-	-	-	-	ML
B-1 (33.5-35)	6.6	35	-	-	-	-	SM
B-2 (4-6)	12.6	51	-	-	-	-	ML

Table 2: Summary of Laboratory Testing of Rock

Boring No.	Run No.	Approx. Run Depths (bgs)	Bulk Density (pcf)	Unconfined Compressive Strength (psi)
B-1	3	50.7' – 51.0'	168	12,080*
B-1	3	52.1' – 52.4'	170	14,320

* Specimen failed along pre-existing fracture.

6 SUBSURFACE CONDITIONS

6.1 Subsurface Soil and Rock Conditions

The subsurface conditions at the project site were explored using two (2) SPT borings, as detailed in **Section 4** of this report. The approximate boring locations are presented on Sheets 3 and 4 – Boring Location Plan.

Pump Station (Boring B-1)

The boring performed within the PS footprint (B-1) revealed a layer of soft to firm sandy SILT (ML) to approximately 6 feet bgs, underlain by loose, micaceous silty SAND (SM) to about 13 feet bgs. Between 13 and 20 feet bgs, loose to medium dense, fine to coarse SAND with silt (SP-SM), micaceous, with rounded quartz fragments and trace of roots were observed (alluvium characteristics). Below 20 feet, the existing soils transition to residuum and preserve some of the original rock fabric / foliations, as can be observed in Figure 1. Such soils are hard to very hard sandy SILT (ML), micaceous, to 25 feet bgs, and very dense silty fine SAND (SM), micaceous, with rock fragments, as illustrated in Figure 2 (partially weathered rock – PWR). The top of rock was encountered at an approximate depth of 39 feet bgs (auger refusal depth).

The top ten (10) feet of rock (39-ft to 49-ft bgs) observed in B-1 is competent to fairly continuous, is of very poor quality (recovery of 78% and 58% in runs 1 and 2, respectively, and RQD of 0%), soft to hard schist, highly to slightly weathered, with horizontal to 25 degree foliation, intensely to very intensely fractured. The five (5) feet (49-ft to 54-ft bgs) is continuous (recovery of 97%), excellent quality (RQD of 97%), very hard schist, fresh to slightly weathered, with approximately 10 degree foliation, very slightly fractured. Photographs of the retrieved rock cores in each run are shown in the **Appendix**.

Access Driveway (Boring B-2)

Boring B-2, performed within the access driveway footprint, revealed relatively similar subsurface conditions as recorded in B-1. Subsurface soil conditions in B-2 generally consisted of soft to firm sandy SILT (ML) to approximately 6 feet bgs underlain by very loose to medium dense silty SAND (SM), micaceous, to 20 feet bgs. This SM layer was observed to have rounded quartz fragments between approximately 13.5 and 20 feet, with trace organics between 13.5 and 15 feet bgs. This SM layer is underlain by hard micaceous sandy SILT (ML) and very dense micaceous silty fine SAND (SM) with rock fragments, to a depth of 30 feet bgs. Between 30 and 35 feet bgs, the ML layer appears to transition into parent rock prior to boring termination depth of 35 feet bgs.

During our field exploration program, we performed Pocket Penetrometer tests on soil samples to get a general estimate of unconfined compressive strength for cohesive undrained soils. Results from the pocket penetrometer tests are summarized in Table 3.

Table 3: Summary of Pocket Penetrometer Tests in the Field

Boring	Depth bgs (ft)	Estimated Undrained Shear Strength (psf)
B-1	0	750
	1	1000
	7	1000
	9	750
	24	1750
B-2	0	750
	7	500
	9	750
	14	500
	24	1500

Figure 1. Sample retrieved from 23.5 to 25-ft bgs, B-1.

Figure 2. Sample retrieved from 38.5 to 38.6-ft bgs, B-1 (PWR).

The subsurface description discussed above is of a generalized nature to highlight the major subsurface stratification features and material characteristics. The **Subsurface Boring Profiles** (refer to Sheets 5 and 6) and **individual Boring Profiles** (refer to the **Appendix**)**,** should be reviewed for specific information at individual boring locations. These profiles include soil description, stratification, penetration resistances, laboratory test results and rock description, including percent recovery and RQD. The stratification shown on the boring profiles represents the conditions only at the actual boring location. Variations may exist between borings and project area.

6.2 Groundwater Conditions

Groundwater table was measured during the advancement of our borings. At boring B-1, groundwater table was determined by visually examining the retrieved samples as the borehole was advanced. After rock coring was completed, measurements of groundwater table would be misleading due to the water added to the borehole during coring activities. At boring B-2, the groundwater table was measured immediately after completion of drilling.

The groundwater depth was recorded at 19.0 and 21.5 feet bgs in borings B-1 and B-2, respectively, at the time of drilling. In B-1, the groundwater table was recorded before starting rock coring. Depth to the groundwater table appeared to be close to the depth of water in Peachtree Creek.

In general, groundwater levels tend to fluctuate during periods of prolonged drought and extended rainfall or storm events. The groundwater table at this site may specifically be affected by the water level in Peachtree Creek. If the groundwater level is critical to design or construction, multiple temporary observation wells should be installed at the site to monitor groundwater fluctuations over a period of time. This will permit more accurate determination of wet and dry water levels. Fluctuation of the groundwater levels should be anticipated. We recommend that the Contractor determine the actual groundwater levels at the time of the construction to determine

groundwater impact on the construction procedure. During operation of the new pump station, high groundwater level may subject the PS foundations to uplift loads.

7 EVALUATIONS AND CONCLUSIONS

The following evaluations and conclusions have been developed by us on the basis of the previously described project characteristics, our review of published data, information provided by the project team members, our site exploration and subsurface conditions encountered.

Once final design plans and specifications are available, a general review by **MC^2** is strongly recommended as a means to check that the evaluations made in preparation of this report are correct and that earthwork and foundation recommendations are properly interpreted and implemented.

- We compared the published USDA soil survey information with the subsoil conditions we encountered in our test borings. The data provided in the soil survey generally indicates sandy loam from 0 to 80 inches. Our test borings encountered shallow (approximately 0 to 6 feet bgs) sandy SILT soils near the ground surface. There were no conditions noted on the soil survey in the area of the project improvements that are detrimental to this project. As detailed in **Section 3.2** of this report, urbanization around the site (current developmental activities) may have impacted shallow subgrade conditions at the site.

- Our review of the USGS Topographic Map did not indicate any unusual features at the project site. As noted in **Section 3.3** of this report, the elevation at the site does not appear to have changed drastically since 1954. However, due to the proximity of the test site to Peachtree Creek, potential erosion of the banks and consequential impact to the PS should be considered in design.

- Careful analyses and the laboratory tests performed in the retrieved samples revealed that both borings B-1 and B-2 consisted of non-cohesive soils, and therefore, the values presented in **Table 3** are for information only, and should not be used as reference values for design.

- We observed two proposed pipes on the plans (8-in and 18-in diameter sanitary forcemain) tying into the proposed pump station. However, pipe invert elevation information was not available at the time of preparation of this report. Depending on the elevation of installation of the pipes, PWR (partially weathered rock) or rock may be encountered, and the design should provide specific methods for the installation of the pipes.

- Subsurface soil conditions at the proposed pump station were evaluated using soils encountered in Boring B-1. It is being assumed that a mat foundation covering the entire

plan area of the new pump station will be utilized. The soils at the foundation bearing depth transition between very dense silty SAND and residuum of partially weathered rock (PWR). Rock surface was encountered at a depth of 39 feet bgs (4 feet below the proposed bearing depth of the pump station). While no structural details are available at this time, we assume that the proposed pump station will be supported on a mat foundation at a depth of 35 feet bgs.

- The rock surface elevation reported in the BFI provided to us by **WSP** indicates 10 feet of variation between the five borings. The subsurface conditions (both soil and rock) encountered in our borings in general match the subsurface conditions reported in the BFI. Variations in the depth to top of rock should be expected at the PS project site. Accordingly, excavation of hard rock should be accounted for by the contractor (refer to **Section 8.7.3** of this report for details).

- Based upon the existing soil conditions and depth of installation of the PS, we anticipate a net relief in the overburden pressure post-construction. The subsurface conditions encountered at the proposed bearing elevation are predominantly non-cohesive and suitable for support of the proposed PS. Refer to **Section 8** of this report for detailed foundation recommendations.

- The general site plan provided to us by **WSP** shows a new transformer and a new genset pad just east of the access driveway. The soils near the ground surface (0 to 6 feet bgs) are soft to firm sandy SILT (ML), underlain by very loose to loose silty SAND (SM). These soils may require improvement (such as strict moisture control and lowering of groundwater table) in order to support the anticipated shallow foundations. Excavations to a depth below the sandy SILT layer (4-ft to 6-ft) and placement of a compacted GAB base wrapped in filter fabric (Mirafi N 140 or equivalent) can generally improve the suitability of shallow foundations for such structures.

- Due to the proximity of the proposed PS to the creek and fluctuations in water table depths, uplift of the new pump station and associated structures should be considered during design. Structures placed below the groundwater table will need to be evaluated for buoyancy, and if required, counteractive measures will need to be part of the design. The bottom of excavations may also experience uplift forces thus causing potential for blowouts during construction. Groundwater will need to be lowered below the excavation bottom to prevent unstable conditions during construction. For the uplift design we recommend using the 100-year design storm event.

- Groundwater control will most likely be required during construction of the new pump station and appurtenant structures. Dewatering at this project may range from simple sump pumps to well points to cutoff walls, etc., depending on the time of the year, depth

of excavations and groundwater table by the time of construction. A qualified dewatering contractor should design the dewatering system.

- It is our understanding that the existing pump station / wet well structure will remain operational until the new PS addressed in this report is completed. Accordingly, due consideration must be given towards the stability of the existing structures during construction of the proposed PS. Refer to **Section 8.3** of this report for our recommended lateral earth pressure geotechnical design parameters.

- A bulk soil sample was tested in the laboratory utilizing standard Proctor compaction effort. Our soil classification indicates that it is an ML type soil. These soils are moisture sensitive and difficult to handle during construction. Accordingly, soil modification including potential replacement with granular material may be required. The silty SANDS from the proposed PS excavation may be utilized to replace the shallow soils within the access driveway footprint. Refer to **Section 8.6** for general pavement recommendations.

Based on our evaluations and conclusions, the following are our recommendations for the pump station structure, access driveway and appurtenant structures planned for this project.

8 RECOMMENDATIONS

8.1 Foundation Recommendations

Pump Station Structure (B-1)

Our analysis and recommendations for the pump station structure are based on the PS footprint of 28-ft. 11-in. x 24-ft. 8-in. at a depth of 35 feet bgs. Where appropriate, the use of shallow foundations is typically the most cost effective, provided that the structure can be designed to accommodate the magnitude of anticipated total and differential settlements. With this foundation system, the structure loads are transmitted to the subsoil at a pressure suited for the properties of the soil. These properties are typically governed by the allowable soil bearing pressure and the total and differential settlement criteria.

Subsurface conditions encountered within the proposed pump station footprint are generally suitable for development of the proposed structure utilizing the assumed mat foundation, provided the site preparation recommendations outlined in **Section 8.7.1** are followed and the estimated magnitude of total and differential settlement are tolerable. For this structure founded at a depth of 35-ft, there will be a net decrease in contact pressure due to the over-excavation and replacement of the existing soils. Therefore, settlement of the structure should be minimal. Based on our SPT boring performed, the material encountered at a depth of 35 feet is expected to be very dense silty SAND, likely partially weathered rock. This material should be over excavated

if soft soils are encountered at the foundation elevation and backfilled with mechanically densified and/or compacted structural fill. To provide a level pad for foundation support, No. 57 stone wrapped in a geo-fabric should be placed below the assumed mat foundation.

The increase in net allowable soil bearing pressure for support of the pump station structure on the existing soils should not exceed 3,000 psf. Should the footprint, elevation or assumed foundation type be different, and when the loads are available, **MC^2** must be contacted to reevaluate our recommendations. The mat design may be conducted using a modulus of subgrade reaction (ks) which is a function of the applied load and expected settlement and size of the foundation. The modulus of subgrade reaction also depends on the foundation stiffness and size. We recommend a modulus of subgrade reaction in the range of 35 to 40 pci to be used for design of the mat foundations. A coefficient of friction between concrete and soil of 0.35 is recommended to calculate sliding resistance.

Structural loading and configuration information is not available at this time and should be forwarded to us to evaluate potential changes to our recommendations.

New Transformer & New Genset Pad (B-2)

As of this writing, no dimensions were provided for the new transformer and the new genset pad. We anticipate that the equipment will be supported on concrete slabs. The soils within these structure footprints consist of soft to firm sandy SILT (ML), underlain by very loose to loose silty SAND (SM) and may require over excavation to be suitable for support of the proposed structures. A separation geotextile may be required between the over excavated subgrade soils and replaced granular soils for separation purposes. The soils excavated from the PS structure classified as SM are suitable as structural fill. The foundation soils should be prepared in accordance with our recommendations in **Section 8.7** of this report. For general calculations, it is being assumed that the shallow foundations will be 12-ft x 12-ft concrete slabs for each structure, and that the net contact pressure transmitted by the foundations will not exceed 1,500 psf.

Total settlement is estimated to be a maximum of ¾ of an inch, and the maximum differential settlement of less than ½-in based on a contact pressure of 1,500 psf. Variations of the footing sizes will also result in different settlement values.

The modulus of subgrade reaction for the mat foundations for the new transformer and the new genset pad slab was calculated using empirical data and is estimated to range from 15 to 20 pci. A coefficient of friction between concrete and soil of 0.35 is recommended to be used for sliding resistance calculations.

8.2 Uplift Resistance

The groundwater depth at B-1 and B-2 ranged between 19.0 to 21.5-ft. bgs at the time of drilling. Due to the potential for seasonal fluctuation of the groundwater table and the influence of the creek on the structures, all structures should be designed for hydrostatic pressure and uplift. As indicated previously, we recommend uplift or buoyancy be based on the 100-year flood level. Dewatering for the pipes and pump station construction should be continuous until enough fill is placed over the pipe to counteract uplift hydrostatic pressure. For the pump station structure, uplift resistance can be created by both the dead weight of the structure as well as the buoyant weight of the backfill above the pipe or projecting parts of the base slab. A factor of safety of 1.2 should be used in design calculations for uplift resistance.

For the pump station structure, the buoyant weight of a wedge of soil from the outside upper edge of the base of the extended slab upward at a 30-degree angle to the ground surface can be added to the resistance forces. The resistance force for the pipe will be the buoyant weight of the soil from the outer diameter of the pipe upwards. The backfill soil buoyant weight should be used in calculating the weight of soil below the high water level. We estimate the buoyant weight of the silty sands is approximately 42.6 pcf.

Depending on the magnitude of the net uplift load, it may be necessary to anchor the pump station foundation into sound rock. Rock core runs 1 and 2 revealed poor quality rock; thus we recommend anchoring the foundations into sound rock (between 10-ft to 15-ft below top of rock, or between 49-ft and 54-ft below ground surface). The length of the third run (5-ft) shall be considered in design as the layer providing side resistance for the anchors, if required. The reported unconfined compressive strength values for the two (2) rock cores tested are ultimate values and the appropriate resistance factors must be applied by the rock anchor specialty contractor.

8.3 Lateral Earth Pressures

Below grade walls, where required, will be subject to lateral earth pressures. For walls which are restrained (braced) and adjacent to moderately compacted backfill, design is usually based on “at-rest” earth pressures. Active pressures are usually employed for unrestrained retaining wall design. Several earth pressure theories could be utilized. We used the equivalent fluid pressure or Rankine Theory.

Table 4: Earth Pressure Information

Earth Pressure Condition	Coefficient of Earth Pressure (K)	Unsubmerged Fluid Density (1) (pcf)	Submerged Fluid Density (2) (pcf)
At-Rest (K_o)	0.515	54	22
Active (K_a)	0.347	36	15
Passive (K_p)	2.882	303	123
(1) Fluid densities shown above are based on a clean sand backfill with an average internal friction angle of 29 degrees and a moist unit weight of 105 pcf. (2) Hydrostatic and seepage forces should be added to the submerged fluid densities when calculating total forces acting on retaining walls.			

It is our understanding that the existing pump station / wet well structure will remain operational until the new PS addressed in this report is completed. Accordingly, due consideration must be given towards the stability of the existing structures during construction of the proposed PS.

The above pressures do not include any surcharge effects for sloped backfill, point or area loads behind the walls and assume that adequate drainage provisions have been incorporated. The lateral earth pressures acting on below grade walls will be resisted by the sliding resistance forces along the base of the wall footing and the passive resistance resulting from footing embedment at the wall toe. Passive resistance could be neglected for a safer design (due to possible excavation or erosion in front of the wall at a future time). Should the backfill material have different densities and/or effective friction angle, the values shown in **Table 4** must be re-evaluated.

8.4 Temporary Structure Excavations

Side slopes for temporary excavations may stand near one and a half (1.5) horizontal to one (1) vertical (1.5H:1V) for short dry periods of time and a maximum excavation depth of four (4) feet. Where restrictions do not permit slopes to be constructed as recommended above, the excavation should be shored in accordance with current OSHA requirements. In addition, any open cut excavations adjacent to existing structures should be evaluated by a geotechnical engineer on a case by case basis. During construction, excavated materials should not be stockpiled at the top of the slope within a horizontal distance equal to 1.5 times the excavation depth.

Excavation slopes should conform to OSHA, State of Georgia and any other local regulations. The dewatering system chosen for use on this project should consider the nature of the relatively permeable soils and fractured rocks encountered at the project site. The contractor should also assess equipment loads and vibrations when considering slopes or excavation bracing.

8.5 Federal Excavation Regulations

In Federal Register Volume 54, No. 209 (October 1989), the United States Department of Labor, Occupational Safety and Health Administration (OSHA) amended its "Construction Standards for Excavations, 29 CFR, Part 1926, Subpart P". This document was issued to better insure the safety of workmen entering trenches or excavations. It is mandated by this federal regulation that all excavations, whether they be utility trenches, basement excavations, or footing excavations, be constructed in accordance with the revised OSHA guidelines. It is our understanding that these regulations are being strictly enforced and if they are not closely followed, the owner and the contractor could be liable for substantial penalties.

The contractor is solely responsible for designing and constructing stable, temporary excavations and should shore, slope, or bench the sides of the excavations as required to maintain stability of both the excavation sides and bottom. The contractor's responsible person, as defined in 29 CFR Part 1926, should evaluate the soil exposed in the excavations as part of the contractor's safety procedures. In no case should slope height, slope inclination, or excavation depth, including utility trench excavation depth, exceed those specified in local, state, and federal safety regulations.

We are providing this information solely as a service to our client. **MC^2** is not assuming responsibility for construction site safety or the contractor’s activities; such responsibility is not being implied and should not be inferred.

8.6 Access Driveway

The planned improvements require the construction of a new access driveway to the proposed PS structure.

The areas that require fill or construction at the existing grade should be prepared in accordance with **Section 8.7** of this report.

For a typical minimum flexible pavement section for similar type facilities, we recommend the following minimum flexible pavement sections for this project site:

Standard Duty Pavement Areas:

Material	Thickness
Asphaltic Concrete Surface	1 1/2 inches
Asphaltic Concrete Base	1 1/2 inches
GAB / Crushed Concrete	6 inches

Heavy Duty Pavement Areas:

Material	Thickness
Asphaltic Concrete Surface	2 inches
Asphaltic Concrete Base	2 inches
GAB / Crushed Concrete	8 inches

Rigid pavement sections merit consideration for areas to receive relatively high concentrated sustained loads such as loading areas, storage bins and areas having tight turning radii. The rigid pavement section should be sized to hold the full length and width of the truck utilizing the area, and should extend outwards to include the turning areas that would be affected by trucks during ingress and egress.

A corresponding value of 100 pci may be used for the modulus of subgrade reaction in the rigid pavement design. We recommend a welded wire-reinforced 6-inch concrete section underlain by 4 to 6 inches of graded aggregate base (GAB) or crushed concrete be used in these areas. This recommended section will distribute concentrated loads over a greater area, hence reducing the possibility of high stress concentrations to the subgrade.

The concrete used for rigid pavement should have a minimum 28-day compressive strength of 5000 psi, a maximum slump of 4 inches and air entrainment of 5 percent ± 1 percent. The GAB or crushed concrete under concrete pavements should be compacted to at least 100 percent of the standard Proctor maximum dry density (ASTM D-698). The soil subbase should consist of a near uniform soil of equivalent moisture content, and density. Pavement joints, reinforcing and details should be designed in accordance with the applicable American Concrete Institute (ACI) standards.

All pavements should be sloped a minimum of one percent to provide rapid surface drainage. Water allowed to pond on or adjacent to the pavement could saturate the subgrade and cause premature pavement deterioration.

We recommend that the pavement subgrade be evaluated by a representative of **MC^2** immediately prior to placing GAB / Crushed Concrete. If low consistency soils are encountered which cannot be adequately densified in place, such soils should be removed and replaced with well-compacted soil fill or crushed stone materials. We note that the subgrade surface should be recompacted prior to pavement construction in accordance with the site work and fill placement recommendations sections of this report.

Actual pavement section thicknesses should be provided by the design civil engineer based upon traffic loads, volume, and the owner's design life requirements. The above sections represent minimum thicknesses representative of typical, local construction practices, and as such periodic maintenance should be anticipated. All pavement materials should conform to Georgia DOT, ACI, and/or appropriate city or county requirements.

8.7 Construction Recommendations

8.7.1 Site Preparation

Site preparation for each structure should include stripping/removal of surface (topsoil) and shallow roots where present prior to replacing with properly compacted structural fill. The onsite soils classified as silty SANDS (SM) encountered in our borings generally appear suitable for use as structural fill. Organic soils were not observed in boring B-1. Trace organics were encountered in the soil sample between 13.5 and 15 feet at boring B-2; these soils are not anticipated to be excavated. However, if such soils are encountered during excavation operations, they must be tested prior to wasting.

We recommend that any proposed construction areas to receive fill be evaluated by proof-rolling prior to fill placement. Proof-rolling should be performed by traversing the construction areas with a loaded dump truck or similar compaction equipment weighing at least 20 tons. Proof-rolling operations should be observed by a representative of **MC^2**. Unstable soils which are revealed by proof-rolling and which cannot be adequately densified in place should be removed and replaced under the recommendations of the **MC^2** representative. The contractor should exercise caution during construction, proof-rolling and compaction of soils so as not to cause settlement of the existing structures induced by vibrations. The Contractor must control and adjust the vibration so as to not disturb existing structures and/or subsurface utilities that may be in the vicinity of the project. The contractor is solely responsible for any settlement caused by his actions.

After clearing, grubbing and proof-rolling, if softening of the exposed subgrade is noted, we recommend that the upper 12-in. of the subgrade in the concrete slabs / mat foundations, as assumed, should be compacted to a minimum of 98% of the soil's modified Proctor maximum dry density +/-3% of the optimum moisture content as determined by ASTM designation D-698. If fill is needed, the fill should be placed in level lifts not to exceed 12-in. loose thickness. The fill should be compacted to a minimum of 98% of the soil's modified Proctor maximum dry density +/-2% of the optimum moisture content as determined by the current version of ASTM designation D-698.

It is possible that some soft or loose soils will not be identified and properly remediated during site preparation. We recommend that the bearing soils beneath slab-on-grade areas and below the pump station mat foundation excavation be checked by an engineering representative to assess the suitability of the soils. Evaluations should be performed prior to reinforcement and concrete placement. If unsuitable bearing soils are encountered, these soils will need to be re-compacted in place, or removed and replaced with properly compacted fill, or foundations deepened, to achieve suitable bearing. We noted that the rock surface is at 39-ft below ground surface (4-ft below the depth of the proposed pump station slab). The backfilling, as required, may be done with a very lean concrete or with a well-compacted, suitable structural fill or crushed No.57 stone.

Foundation bearing surface evaluations should be performed and concrete placed as quickly as possible to avoid exposure of the footing bottoms to changes in moisture content or loosening due to construction operations. If it is required that foundation excavations be left open for more than one day, they should be protected to reduce evaporation or entry of moisture.

8.7.2 Selection and Placement of Fill

Structural fill should be free of organic material, have a plasticity index (PI) less than 20 and contain rock sizes no larger than 4 inches. The moisture content of fill soils at the time of placement and compaction should generally be within +/-3% percentage points of their optimum moisture content. A representative of **MC^2** should observe fill placement operations and perform density tests concurrently to indicate if the specified compaction is being achieved. The upper two (2) feet of fill which will support pavements should be compacted to at least 98 percent of the soil's standard Proctor maximum dry density within +/-3% of the optimum moisture content for improved support. In areas which are at or above the finished grade, and which will support pavements or slabs, the upper 8 inches immediately below these systems should be scarified and recompacted to the 98 percent criteria of standard Proctor within +/-3% of the optimum moisture content.

Density testing should be performed by a soils technician to determine the degree of compaction and verify compliance with the project specifications. We suggest the following minimum testing frequency one (1) test per 1,500 square feet of building/structure area and one (1) test per 2,500 square feet of pavement area per layer of fill placed. Testing frequency should be increased in confined areas. Areas which do not meet the compaction specifications should be recompacted to the specified compaction. If fill has to be placed near existing structures, it should be placed in 6 to 8 inch loose lifts and compacted using a static roller. Within small excavations such as in utility trenches, around manholes, or within 5 feet of any of the structure walls, we recommend the use of smaller, hand or remote-guided equipment. Placement of loose lift thickness of 4 inches is recommended when using such equipment.

8.7.3 Excavation Considerations

Soil excavation may be required throughout the project. If dewatering is required, the dewatering system should be in place and functioning prior to any excavation taking place. Refer to **Section 8.8** of this report for general dewatering recommendations.

The existing soils most likely to be excavated within the footprint of the proposed structure generally consisted of layers of soft to firm sandy SILT (ML), loose silty SAND (SM), loose to medium dense SAND with silt (SP-SM) from the ground surface to a depth of approximately 20 feet below ground surface. These materials may be excavated by a qualified contractor using conventional earth moving equipment without difficulties.

Between 20 and 39 feet below ground surface the materials to be excavated transition from very hard sandy SILT (ML) to very dense silty SAND (SM), underlain by very dense PWR. Rock surface was encountered at a depth of 39 feet bgs.

For soils of the type present at the site we recommend that all temporary excavations be sloped no steeper than 1.5H:1V. Please refer to the **Federal Temporary Excavation Regulations** reported in **Section 8.5**. The use of any bracing system during the temporary excavation is the sole responsibility of the contractor.

8.7.3.1 Partially Weather Rock

Partially weathered rock (PWR) was encountered in boring B-1 at a depth of about 35 feet bgs. While PWR was encountered near the proposed bearing depth at the PS, fluctuations in the top of PWR and very hard to very dense soils should be anticipated during construction / excavations. Accordingly, the contractor should be prepared to excavate PWR and very dense soils past 20 feet bgs. Removal of PWR generally requires loosening using a large single-tooth ripper pulled by a Caterpillar D 8K dozer, or similar equipment prior to removal using conventional earth moving equipment. Most partially weathered rock may be considered rippable. However, some PWR would likely require localized blasting to aid in removal.

The rippability of PWR is dependent upon several factors including the penetration resistance and continuity of the material encountered; the type and condition of the equipment utilized; and the skill, effort, and diligence of the grading contractor. Sometimes PWR can be ripped in one direction due to existing joints and fractures but ripping in other directions may be unsuccessful. The project specifications should clearly state that the contractor should attempt to rip in several directions using appropriate equipment before any claims of rock excavation is considered valid. Any claims of rock excavation should be verified by the geotechnical engineer or his representative. If excavation of deep layers and/or large quantities of PWR is anticipated, it may be more expeditious and economical for the contractor to loosen the PWR by blasting. Removal of PWR in confined excavations, such as excavations for utility lines and shallow foundations, would likely require the use of large backhoes, hoe ram, or blasting.

8.7.3.2 Rock

Auger refusal material was encountered at a depth of 39 feet bgs in boring B-1. Boring B-2 was terminated at 35 feet bgs in a very dense sandy SILT. Based on the available project details, we do not anticipate that excavation into rock will be required for this project.

If rock is encountered, the contractor may be able to rip the upper few feet of the poor quality, fractured rock. However, for planning purposes, we anticipate that all material below auger refusal depths will require blasting prior to removal using conventional earth moving equipment.

When blasting near proposed finished grades or within foundation excavations, the contractor should exercise caution to avoid damaging the underlying material. Any material that is damaged during blasting should be removed prior to commencing construction.

The contractor should take appropriate precautionary measures prior to commencing blasting to ensure that the nearby facilities, structures, and utility lines are not adversely impacted. We recommend that a pre-blast survey be performed to record the condition of the existing structures prior to blasting and blast monitoring devices be installed at critical locations to monitor vibrations caused by blasting. The blasting and all associated tasks including precautionary measures related to blasting should be the sole responsibility of the contractor.

8.7.3.3 Definitions for Rock Payment

On many projects conflicts arise over the definition of rock. We suggest that the following definitions be incorporated into specifications to avoid such conflicts. These definitions have been used on other projects successfully and are included herein for your guidance.

Mass Excavation Rip Rock: Any material that cannot be removed by scrapers, loaders, pans, dozers, or graders; and requires loosening by using a single tooth ripper mounted on a crawler tractor having a minimum draw bar pull rated at not less than 56,000 pounds.

Mass Excavation Blast Rock: Any material which cannot be excavated after loosening with a single-tooth ripper mounted on a crawler tractor having a minimum draw bar pull rated at not less than 56,000 pounds (Caterpillar D 8K or equivalent) or by a Caterpillar 973 front end loader or equivalent; and occupying an original volume of at least one (1) cubic yard.

Trench Excavation Blast Rock: Any material which cannot be excavated with a backhoe having a bucket curling force rated at not less than 25,700 pounds (Caterpillar Model 225 or equivalent) and occupying an original volume of at least one half (1/2) cubic yard.

8.8 Drainage and Groundwater Considerations

Groundwater will likely be a concern during the installation of the pump station and pipe lines, depending on final grades and the time of year construction is performed. We recommend that the Contractor determine the groundwater table prior to construction to determine the need for dewatering. For limited, relatively shallow excavations below the groundwater level, pumping from the excavation or sumps should be sufficient to control groundwater seepage. Deeper and larger excavations may require more extensive dewatering measures such as well points or cut-off walls. Recharge of groundwater a short distance from the dewatering location is recommended to avoid significant drawdowns which may trigger undue subsidence/settlement of existing structures in the vicinity.

We recommend designing the walls to resist the earth and the hydrostatic pressures applied by the groundwater considering the elevations resulting from the 100-year design storm.

If temporary sheet pile walls are required for excavation support during construction of the pump station, piping and/or other structures, the sheet pile walls should be designed by others using the soil parameters presented in this report.

Excavated areas should be sloped toward one corner to facilitate removal of any collected rainwater, groundwater or surface water runoff. Positive site drainage should be provided to reduce infiltration of surface water around the perimeter of any above-ground structures and beneath slabs. All grades should be sloped away from the structures and surface drainage should be collected and discharged such that water is not permitted to infiltrate the immediate area surrounding structures.

Depending on groundwater levels and the effectiveness of dewatering at the time of construction, seepage may enter the excavated areas from the bottom and sides. Such seepage will act to loosen soils and create difficult working conditions. Groundwater levels should be determined immediately prior to construction. Groundwater should be kept at least 18 in. below the working area to facilitate proper material placing and compaction. Some contractors like to place a gravel working bed in wet areas. Fine gravel, such as No. 57, and No. 67 stone may be used as long as the gravel is wrapped in a filter fabric (Mirafi N 140 or equivalent) to reduce the risk of fines filtering into the open voids in the gravel. The gravel, where used, should be compacted and the compaction confirmed by visual observation.

9 REPORT LIMITATIONS

The recommendations detailed herein are based on the available limited soil information obtained by **MC^2** and information provided by **WSP** for the proposed project. If there are any revisions to the plans for this project or if deviations from the subsurface conditions noted in this report are encountered during construction, **MC^2** should be notified immediately to determine if changes of recommendations are required. In the event that **MC^2** is not retained to perform these functions, **MC^2** cannot be responsible for the impact of those conditions on the performance of the project during construction and operation.

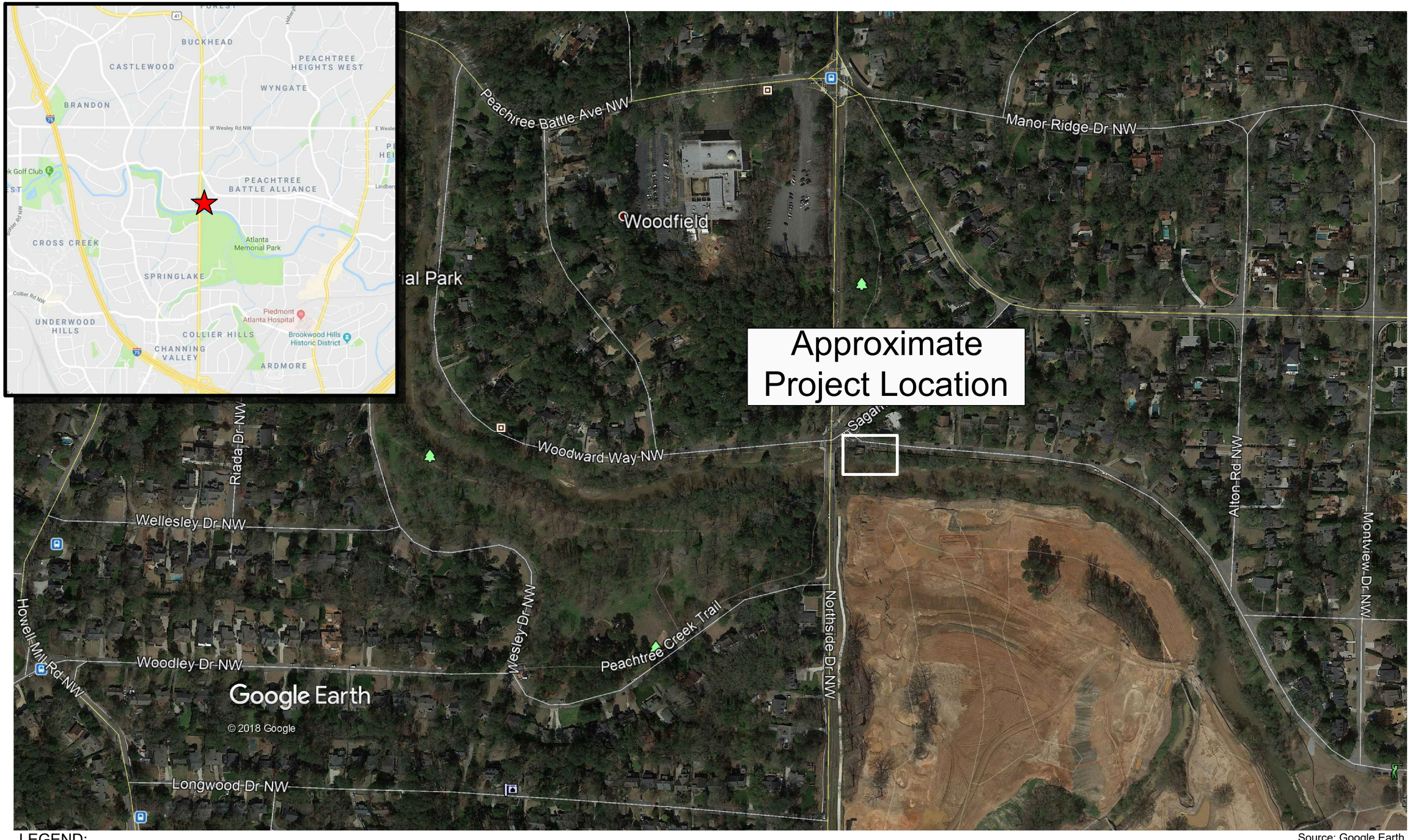
The Geotechnical Engineer warrants that the findings, recommendations, specifications, or professional advice contained herein have been made in accordance with generally accepted professional geotechnical engineering practices in the local area. No other warranties are implied or expressed.

After the plans and specifications are more complete, the Geotechnical Engineer should be provided the opportunity to review the final design plans and specifications to assess that our

engineering recommendations have been properly incorporated into the design documents. At that time, it may be necessary to submit supplementary recommendations. This report has been prepared for the exclusive use of **WSP and their client**.

FIGURES

Project Location Map – Sheet 1
USDA Soil Survey Map and USGS Topographic Map – Sheet 2
Boring Location Map – Sheets 3 and 4
Subsurface Boring Profiles – Sheet 5
Subsurface Boring Profile Legend – Sheet 6



Approximate Project Location

LEGEND:

★ Project Location

Source: Google Earth
Image Date: 3/14/2018

0′ 250′ 500′

Graphic Scale (feet)

DATE	NAME	REVISION	APPROVED BY:

MC SQUARED, INC.
Geotechnical Consultants
1275 Shiloh Road NW
Suite 2620
Kennesaw, GA 30144
Ph:770-650-0873 Fax:770-650-7825

GEORGIA ENGINEERING CERTIFICATE OF AUTHORIZATION No. PEF004822
Prashanth Vaddu, P.E.
GEORGIA LICENSE No. PE039820

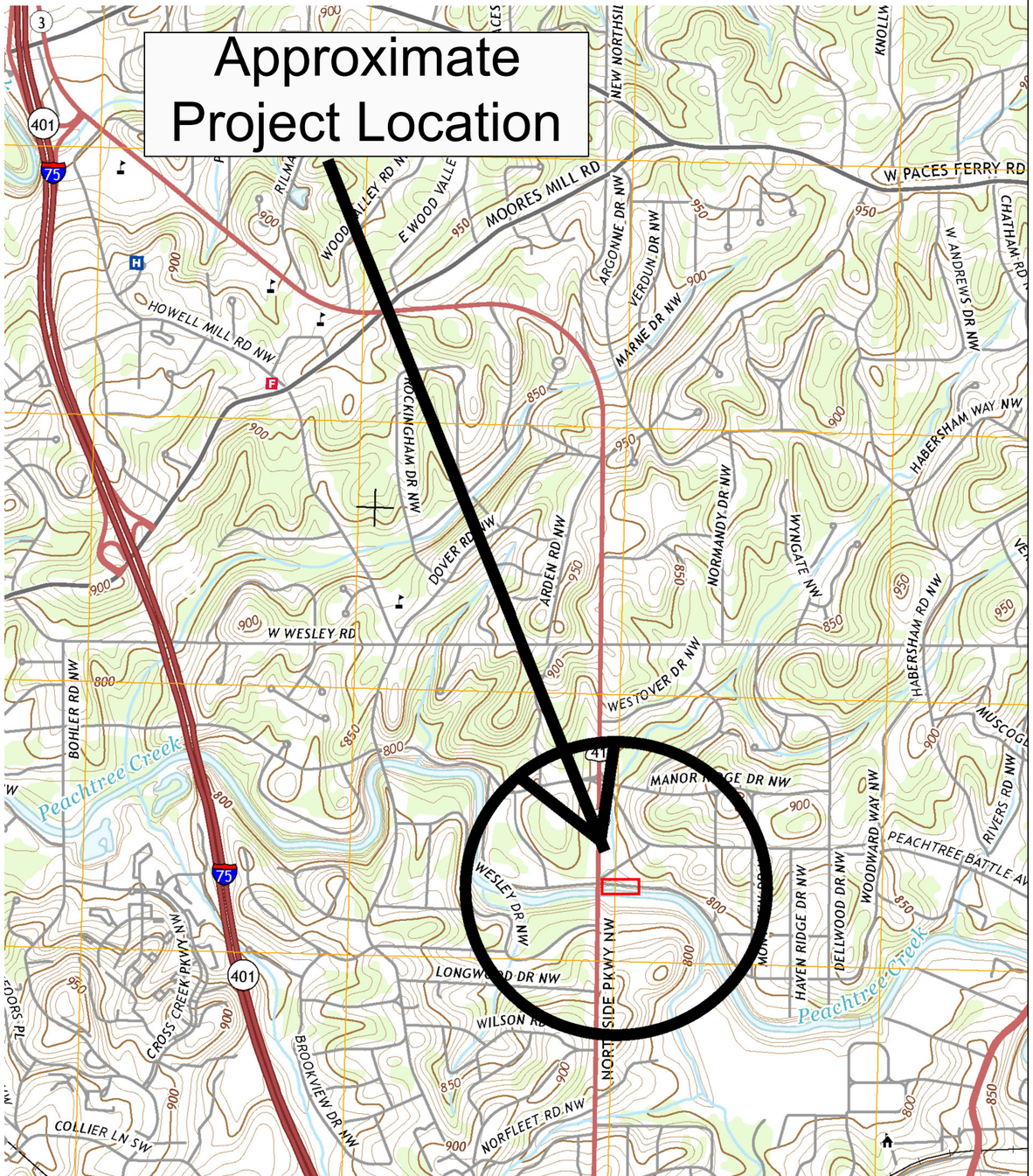
	NAME	DATE
DESIGNED BY:	TC	7/30/2018
DRAWN BY:	KH	7/30/2018
CHECKED BY:	LC	7/30/2018
SUPERVISED BY:	PV	

Project Location Map

Northside Drive at Peachtree Creek - New Pump Station
City of Atlanta, Fulton County, Georgia

MC² PROJ. NO.: A041707.047

SHEET NO.: 1



Fulton County, GA

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
CpA	Congaree sandy loam, 0 to 2 percent slopes, occasionally flooded	0.9	88.4%
Ub	Urban land	0.1	5.7%
W	Water	0.1	5.9%
Totals for Area of Interest		1.0	100.0%

Source: United States Department of Agriculture

NORTHWEST ATLANTA QUADRANGLE
GEORGIA
7.5 MINUTE SERIES TOPOGRAPHIC
NGVD: 1988 - DATE: 2017

DATE	NAME	REVISION	APPROVED BY:

MC SQUARED, INC.
Geotechnical Consultants
1275 Shiloh Road NW
Suite 2620
Kennesaw, GA 30144
Ph:770-650-0873 Fax:770-650-7825

GEOTECHNICAL • ENVIRONMENTAL MATERIALS TESTING

GEORGIA ENGINEERING CERTIFICATE OF AUTHORIZATION No. PEF004822
Prashanth Vaddu, P.E.
GEORGIA LICENSE No. PE030820

	NAME	DATE
DESIGNED BY:	TC	7/30/2018
DRAWN BY:	KH	7/30/2018
CHECKED BY:	LC	7/30/2018
SUPERVISED BY:	PV	

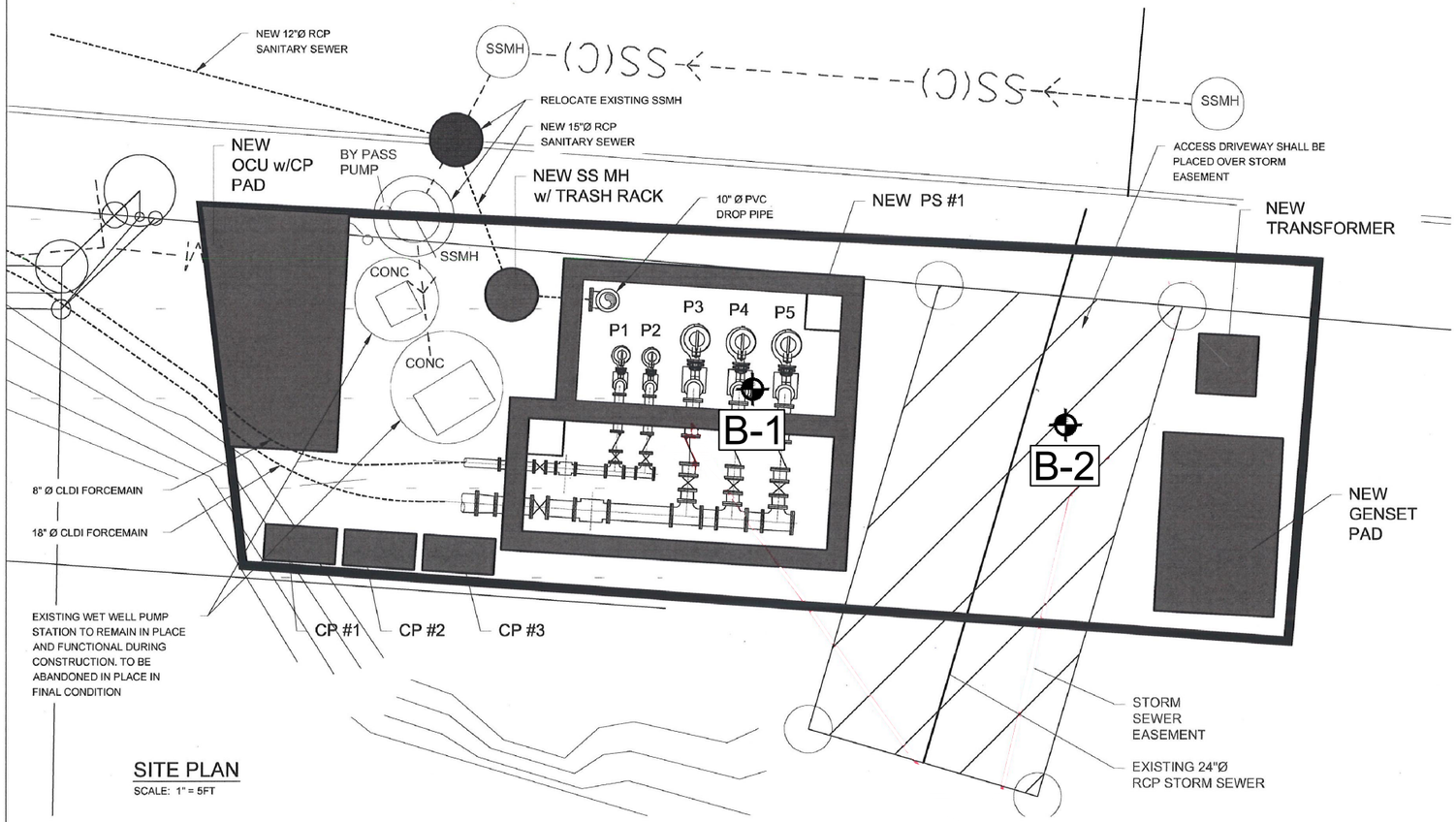
USDA Soil Survey and USGS Topographic Map

Northside Drive at Peachtree Creek - New Pump Station
City of Atlanta, Fulton County, Georgia

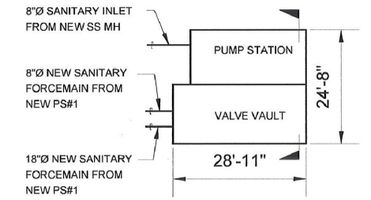
MC² PROJ. NO.: A041707.047

SHEET NO.: 2

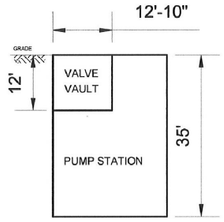
P.I. No.
pinumber



SITE PLAN
SCALE: 1" = 5FT



PS#1 PLAN
SCALE: 1"=10FT



PS#1 SECTION
SCALE: 1"= 10FT

PUMP SCHEDULE

PUMP	MAKE AND MODEL
P1	FLYGT, NP 3127 LT 3~ ADAPTIVE 425; 1014 GPM @ 30.2 FT
P2	FLYGT, NP 3127 LT 3~ ADAPTIVE 425; 1014 GPM @ 30.2 FT
P3	FLYGT, CP 3306/605 3~ 831; 3020 GPM @ 35.1 FT
P4	FLYGT, CP 3306/605 3~ 831; 3020 GPM @ 35.1 FT
P5	FLYGT, CP 3306/605 3~ 831; 3020 GPM @ 35.1 FT

wsp

SCALE IN FEET
0 5 10 20

REVISION DATES

NEW PS SITE PLAN
SR 3 BRIDGE REPLACEMENT
OVER PEACHTREE CREEK

CHECKED:		DATE:		DRAWING No.
BACKCHECKED:		DATE:		C-01
CORRECTED:		DATE:		
VERIFIED:		DATE:		

LEGEND:

Approximate Boring Locations

Source: WSP USA, Inc.

DATE	NAME	REVISION	APPROVED BY:

MC SQUARED, INC.
Geotechnical Consultants
1275 Shiloh Road NW
Suite 2620
Kennesaw, GA 30144
Ph:770-650-0873 Fax:770-650-7825

GEORGIA ENGINEERING CERTIFICATE OF AUTHORIZATION No. PEF004822
Prashanth Vaddu, P.E.
GEORGIA LICENSE No. PE030820

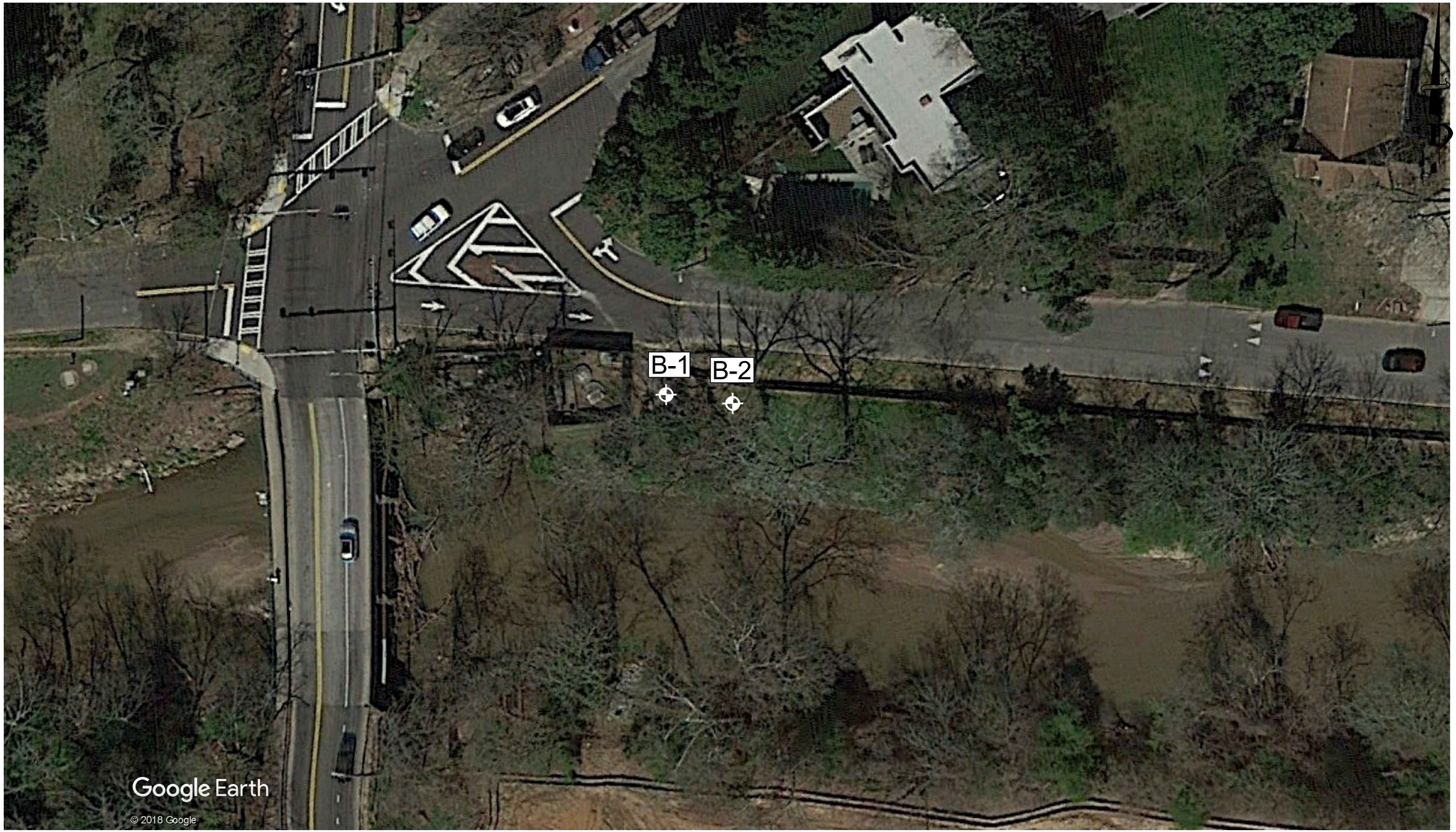
	NAME	DATE
DESIGNED BY:	TC	7/30/2018
DRAWN BY:	KH	7/30/2018
CHECKED BY:	LC	7/30/2018
SUPERVISED BY:	PV	

Boring Location Plan

Northside Drive at Peachtree Creek - New Pump Station
City of Atlanta, Fulton County, Georgia

MC² PROJ. NO.: A041707.047

SHEET NO.: 3



LEGEND:

Approximate Boring Locations

Source: Google Earth
Image Date: 3/14/2018

0′ 50′ 100′

Graphic Scale (feet)

DATE	NAME	REVISION	APPROVED BY:

MC² Geotechnical • Environmental Materials Testing

MC SQUARED, INC.
Geotechnical Consultants
1275 Shiloh Road NW
Suite 2620
Kennesaw, GA 30144
Ph:770-650-0873 Fax:770-650-7825

GEORGIA ENGINEERING CERTIFICATE OF AUTHORIZATION No. PEF004822
Prashanth Vaddu, P.E.
GEORGIA LICENSE No. PE030820

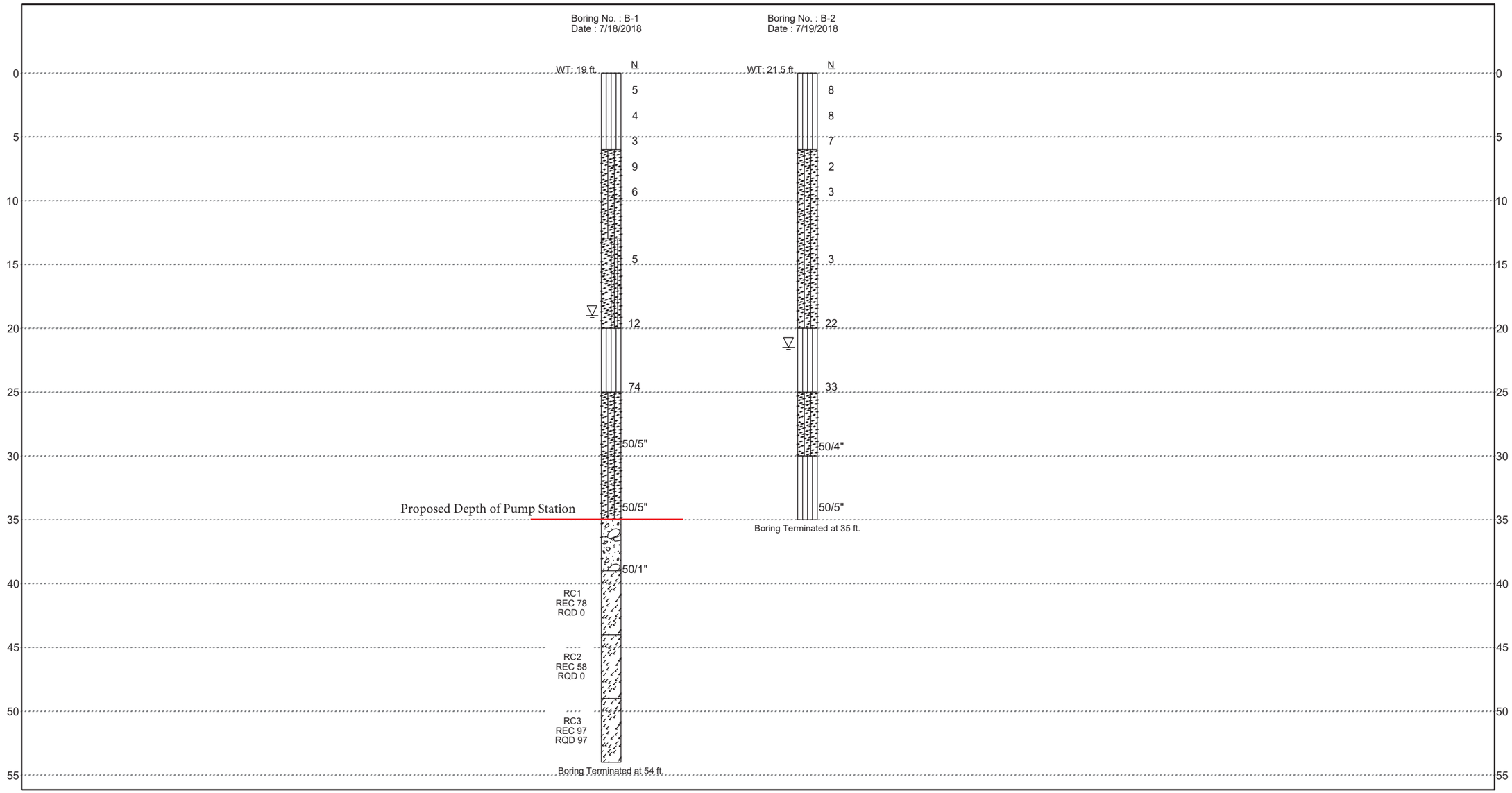
	NAME	DATE
DESIGNED BY:	TC	7/30/2018
DRAWN BY:	KH	7/30/2018
CHECKED BY:	LC	7/30/2018
SUPERVISED BY:	PV	

Boring Location Plan

Northside Drive at Peachtree Creek - New Pump Station
City of Atlanta, Fulton County, Georgia

MC² PROJ. NO.: A041707.047

SHEET NO.: 4



*N Values Drawn At Middle Of Interval

DATE	NAME	REVISION	APPROVED BY

MC SQUARED INC.
Geotechnical Consultants
1275 Shiloh Road, Suite 2620
Kennesaw, Georgia 30144
P - (770) 650 0873
F - (770) 650 7825

GEOTECHNICAL • ENVIRONMENTAL MATERIALS TESTING

GEORGIA ENGINEERING CERTIFICATE OF AUTHORIZATION No. PEF004822
Prashanth Vaddu, P.E.
GEORGIA LICENSE No. 039820

	NAME	DATE
DESIGNED BY:	TC	7/30/2018
DRAWN BY:	KH	7/30/2018
CHECKED BY:	LC	7/30/2018
SUPERVISED BY:	PV	

SUBSURFACE BORING PROFILES

Northside Drive at Peachtree Creek - New Pump Station
City of Atlanta, Fulton County, Georgia

MC² PROJ. NO.: A041707.047

SHEET NO.: 5

LEGEND

- Top Soil
- Asphalt
- Concrete
- (GAB) Graded Aggregate Base
- Limerock Base
- No. 57 Stone
- Soil Cement
- (SP) Poorly Graded Sand
- (SP-SM) Poorly Graded Sand With Silt
- (SP-SC) Poorly Graded Sand With Clay
- (SM) Silty Sand
- (SC) Clayey Sand
- (MH) Elastic Silt
- (ML) Silt
- (CL-ML) Silty Clay
- (CH) Fat Clay
- (CL) Lean Clay
- (OH) Organic Clay
- (OL) Organic Silt
- Peat
- Fill
- Bedrock
- Limestone
- (WLS) Weathered Limestone
- (PWR) Partially Weathered Rock
- Granite
- Gneiss
- Schist

NOTES:

▽	Water Table At Time Of Drilling
▼	Water Table After 24 Hours
GNE	Groundwater Not Encountered
GNA	Groundwater Not Apparent
GNM	Groundwater Not Measured
CL	Center Line
RT	Right Of Center Line
LT	Left of Center Line
BGS	Below Ground Surface
HA	Hand Auger
PA	Power Auger
NMC	Natural Moisture Content (%)
-200	Fines Passing A No. 200 Sieve (%)
PI	Plasticity Index
NP	Non Plastic
LL	Liquid Limit
OC	Organic Content (%)

N	SPT N-Value
WOH	Weight-Of-Hammer
WOR	Weight-Of-Rod
CPT	Cone Penetrometer Test
SPT	Standard Penetration Test
DT	Dilatometer Test
LOC	Loss Of Circulation
ROC	Regain Of Circulation
REC	Rock Core Recovery(%)
RQD	Rock Quality Designation
ST	Shelby Tube Sample
q_u	Unconfined Compressive Strength From Pocket Penetrometer In tsf

GRANULAR MATERIALS- RELATIVE DENSITY	SPT (BLOWS/FT)
VERY LOOSE	≤ 4
LOOSE	5-10
MEDIUM	11-30
DENSE	31-50
VERY DENSE	GREATER THAN 50
SILTS AND CLAYS CONSISTENCY	**SPT (BLOWS/FT)**
VERY SOFT	≤ 2
SOFT	3-4
FIRM	5-8
STIFF	9-15
VERY STIFF	16-30
HARD	30-50
VERY HARD	GREATER THAN 50

SPT Spoon Inside Diameter 1 3/8"
SPT Spoon Outside Diameter 2"

ASTM Standard Drop Safety Hammer
Average Hammer Drop Height 30"
Hammer Weight 140 lbs

DATE	NAME	REVISION	APPROVED BY:

MC² Geotechnical • Environmental Materials Testing

MC SQUARED, INC.
Geotechnical Consultants
1275 Shiloh Road NW
Suite 2620
Kennesaw, GA 30144
Ph:770-650-0873 Fax:770-650-7825

GEORGIA ENGINEERING CERTIFICATE OF AUTHORIZATION No. PEF004822
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	NAME	DATE
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DRAWN BY:	KH	7/30/2018
CHECKED BY:	LC	7/30/2018
SUPERVISED BY:	PV	

Legend

New Pump Station - Northside Drive at Peachtree Creek
City of Atlanta, Fulton County, Georgia

MC² PROJ. NO.: A041707.047

SHEET NO.: 6

APPENDIX

Individual Boring Profiles – gINT (5 Pages)
Summary of Soil Parameters – Table No. 5 (1 Page)
Summary of Soil Laboratory Testing Results (1 Page)
Standard Proctor Result (1 Page)
Grain-Size distribution Curves of Soils (6 Pages)
Rock Core and Rock Testing Photographs (6 Pages)
Test Procedures (4 Pages)

Soil Profile

BORING ID: B-1

MC² Geotechnical • Environmental Materials Testing

CLIENT WSP USA
PROJECT NAME Northside Drive at Peachtree Creek - New Pump Station
PROJECT NUMBER A041707.047
PROJECT LOCATION City of Atlanta, Fulton County, GA
DATE STARTED 7/18/18 **COMPLETED** 7/18/18
GROUND ELEVATION _____ **HOLE SIZE** 6 inches
DRILLING CONTRACTOR Tri-State Drilling
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger
▽ **AT TIME OF DRILLING** 19.0 ft
LOGGED BY L. Caliari **CHECKED BY** P. Vaddu
AT END OF DRILLING ---
NOTES _____
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	USCS Group Symbol	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY % (RQD)
0		ML	Soft to firm, reddish brown to brown, sandy SILT, slightly micaceous	SS 1	3-2-3-2 (5)	
				SS 2	1-2-2-3 (4)	
5				SS 3	1-1-2-3 (3)	
		SM	Loose, reddish brown to brown, silty fine SAND, micaceous Drilling through roots (6'-8')	SS 4	1-5-4-5 (9)	
				SS 5	3-3-3-2 (6)	
10						
		SP-SM	Loose to medium dense, gray, brown to tan, poorly-graded fine SAND with silt, micaceous, with roots	SS 6	12-2-3 (5)	
15						
			▽ Quartz fragments (alluvium) (18.5'-20')	SS 7	2-6-6 (12)	
20						

● SPT N VALUE ●
⊕ ORGANIC CONTENT % ⊕
PL MC LL
□ FINES CONTENT (%) □
20 40 60 80

(Continued Next Page)

Soil Profile

BORING ID: B-1

MC² Geotechnical • Environmental Materials Testing

CLIENT WSP USA

PROJECT NAME Northside Drive at Peachtree Creek - New Pump Station

PROJECT NUMBER A041707.047

PROJECT LOCATION City of Atlanta, Fulton County, GA

DEPTH (ft)	GRAPHIC LOG	USCS Group Symbol	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY % (RQD)
20		ML	Hard to very hard, yellowish brown to tan, sandy SILT, micaceous			
25			Original rock fabric observed	SS 8	19-27-47 (74)	
		SM	Very dense, brown to light gray, silty fine SAND, micaceous, with rock fragments	SS 9	50/5"	
30				SS 10	50/5"	
35			Proposed Depth of Pump Station			
		PWR	Partially-weathered rock	SS 11	50/1"	
			Auger Refusal at 39 feet.			
40			(39'-44') SCHIST (feldspar, quartz, muscovite) gray, white, black, soft to hard, slightly weathered to highly weathered, horizontal to 25 degree foliation, fine to coarse-grained, instensely to very intensely fractured, planar, FeOx staining present throughout.	RC 1		78 (0)

● SPT N VALUE ●
⊕ ORGANIC CONTENT % ⊕
PL MC LL
□ FINES CONTENT (%) □
20 40 60 80

(Continued Next Page)

Soil Profile

BORING ID: B-1

MC² Geotechnical • Environmental Materials Testing

CLIENT WSP USA

PROJECT NAME Northside Drive at Peachtree Creek - New Pump Station

PROJECT NUMBER A041707.047

PROJECT LOCATION City of Atlanta, Fulton County, GA

DEPTH (ft)	GRAPHIC LOG	USCS Group Symbol	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY % (RQD)
45			(44'-49') SCHIST (feldspar, quartz, muscovite) gray, white, black, soft to hard, slightly weathered to highly weathered, horizontal to 25 degree foliation, fine to coarse-grained, instensely to very intensely fractured, planar, FeOx staining present throughout.	RC 2		58 (0)
50			(49'-54') SCHIST (feldspar, quartz, muscovite) gray, white, black, very hard, fresh to slightly weathered, 10 degree foliation, fine to coarse-grained, very slightly fractured, planar, little FeOx staining present observed.	RC 3		97 (97)
			Bottom of hole at 54.0 feet.			

● SPT N VALUE ●

⊕ ORGANIC CONTENT % ⊕

PL MC LL

☐ FINES CONTENT (%) ☐

20 40 60 80

Soil Profile

BORING ID: B-2

MC² Geotechnical • Environmental Materials Testing

CLIENT WSP USA
PROJECT NAME Northside Drive at Peachtree Creek - New Pump Station
PROJECT NUMBER A041707.047
PROJECT LOCATION City of Atlanta, Fulton County, GA
DATE STARTED 7/19/18 **COMPLETED** 7/19/18
GROUND ELEVATION _____ **HOLE SIZE** 6 inches
DRILLING CONTRACTOR Tri-State Drilling
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger
AT TIME OF DRILLING 21.5 ft
LOGGED BY L. Caliari **CHECKED BY** P. Vaddu
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	USCS Group Symbol	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY % (RQD)
0		ML	Firm, reddish brown to brown, sandy SILT	SS 1	2-4-4-4 (8)	
				SS 2	3-4-4-4 (8)	
5			Micaceous (4'-6')	SS 3	2-3-4-3 (7)	
		SM	Very loose to medium dense, light brown to dark brown, reddish to yellowish brown, gray, tan, silty SAND, micaceous, with rock fragments and partially-weathered rock	SS 4	1-1-1-1 (2)	
				SS 5	2-1-2-1 (3)	
10						
				SS 6	2-1-2 (3)	
15			Silty coarse SAND, trace organics (13.5'-15')			
				SS 7	4-10-12 (22)	
20			Silty coarse SAND with quartz (alluvium) (18.5'-20')			

● SPT N VALUE ●
⊕ ORGANIC CONTENT % ⊕
PL MC LL
□ FINES CONTENT (%) □
20 40 60 80

(Continued Next Page)

Soil Profile

BORING ID: B-2

MC² Geotechnical • Environmental Materials Testing

CLIENT WSP USA

PROJECT NAME Northside Drive at Peachtree Creek - New Pump Station

PROJECT NUMBER A041707.047

PROJECT LOCATION City of Atlanta, Fulton County, GA

DEPTH (ft)	GRAPHIC LOG	USCS Group Symbol	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	RECOVERY % (RQD)
20		ML	Hard, yellowish brown to brown, sandy SILT, micaceous ▽ Hard drilling at 21.5' Original rock fabric observed.			
25				SS 8	9-15-18 (33)	
		SM	Very dense, light brown, silty fine SAND, micaceous with rock fragments			
30				SS 9	40-50/4"	
		ML	Very hard, reddish to light brown, sandy SILT, micaceous			
35				SS 10	50/5"	
			Bottom of hole at 35.0 feet.			

● SPT N VALUE ●
⊕ ORGANIC CONTENT % ⊕
PL MC LL
☐ FINES CONTENT (%) ☐
20 40 60 80

>>

>>

MC2 REPORT A17.047 COA NORTHSIDE PEACHTREE.GPJ MC2.GDT 8/3/18

Table No. 5
Summary of Soil Parameters
Northside Drive at Peachtree Creek – New Pump Station
City of Atlanta, Fulton County, Georgia
MC² Project No. A041707.047

Boring ID	Depth (ft)	N Value Range	USCS Soil Classification	Average Unit Weight (γ)**		Angle of Internal Friction Ø ** (degrees)	Earth Pressure Coefficients*			Average Undrained Cohesion C_u ** (psf)
				Saturated (pcf)	Submerged (pcf)		At Rest (K_o)	Active (K_a)	Passive (K_p)	
Proposed Pump Station Structures										
B-1	0-6	3-5	ML	105	42.6	26	0.562	0.390	2.561	0
	6-13	6-9***	SM	105	42.6	29	0.515	0.347	2.882	0
	13-20	5-12	SP-SM	105	42.6	29	0.515	0.347	2.882	0
	20-25	> 50	ML	125	62.6	34	0.441	0.283	3.537	0
	25-39	> 50	SM	125	62.6	34	0.441	0.283	3.537	0
B-2	0-6	7-8	ML	105	42.6	29	0.515	0.347	2.882	0
	6-10	2-3	SM	100	37.6	27	0.546	0.376	2.663	0
	10-15	3	SM	100	37.6	27	0.546	0.376	2.663	0
	15-20	22	SM	115	52.6	32	0.470	0.307	3.255	0
	20-25	33	ML	120	57.6	33	0.455	0.295	3.392	0
	25-30	> 50	SM	125	62.6	34	0.441	0.283	3.537	0
	30-35	> 50	ML	125	62.6	34	0.441	0.283	3.537	0

*Values are for level (non-sloping) backfill; no surcharge loads on backfill

**Based on empirical correlations for drained, non-cohesive behavior

***Between 6 and 8 feet bgs the presence of roots caused the N value to be 9

MC Squared, Inc.
1275 Shiloh Road, Suite 2620
Kennesaw, GA 30144

SUMMARY OF LABORATORY RESULTS

CLIENT WSP USA

PROJECT NUMBER A041707.047

PROJECT NAME Northside Drive at Peachtree Creek - New Pump Station

PROJECT LOCATION City of Atlanta, Fulton County, Georgia

Sample No.	Depth (ft)	Soil Description	USCS Class.	%< Finer Sieve								NMC (%)	LL %	PL %	PI %
				3/4"	#4	#10	#20	#40	#60	#100	#200				
P-1	(0-1 ft.)	Brown sandy SILT	ML			98	91	84	78	70	57	18.9	28	24	4
B-1	(6-8 ft.)	Reddish brown to brown silty fine SAND	SM				99	95	85	60	35	22.1	NP	NP	NP
B-1	(13.5-15 ft.)	Gray, brown to tan, poorly-graded fine SAND with silt	SP-SM				91	63	33	14	5	24.1	-	-	-
B-1	(23.5-25 ft.)	Yellowish brown to tan, sandy SILT	ML				99	95	87	74	51	14.8	-	-	-
B-1	(33.5-35 ft.)	Brown to light gray, silty fine SAND	SM		86	71	66	60	54	47	35	6.6	-	-	-
B-2	(4-6 ft.)	Reddish brown to brown, sandy SILT	ML				90	86	81	70	51	12.6	-	-	-

GENERAL SUMMARY - GINT STD US LAB.GDT - 8/2/18 14:05 - Z:\PROP AND RPTS\ATL\ATL 17\A041707.047 COA NORTHSIDE DR PEACHTREE CREEK\LABORATORY\LAB TESTING.GPJ

MOISTURE-DENSITY RELATIONSHIP

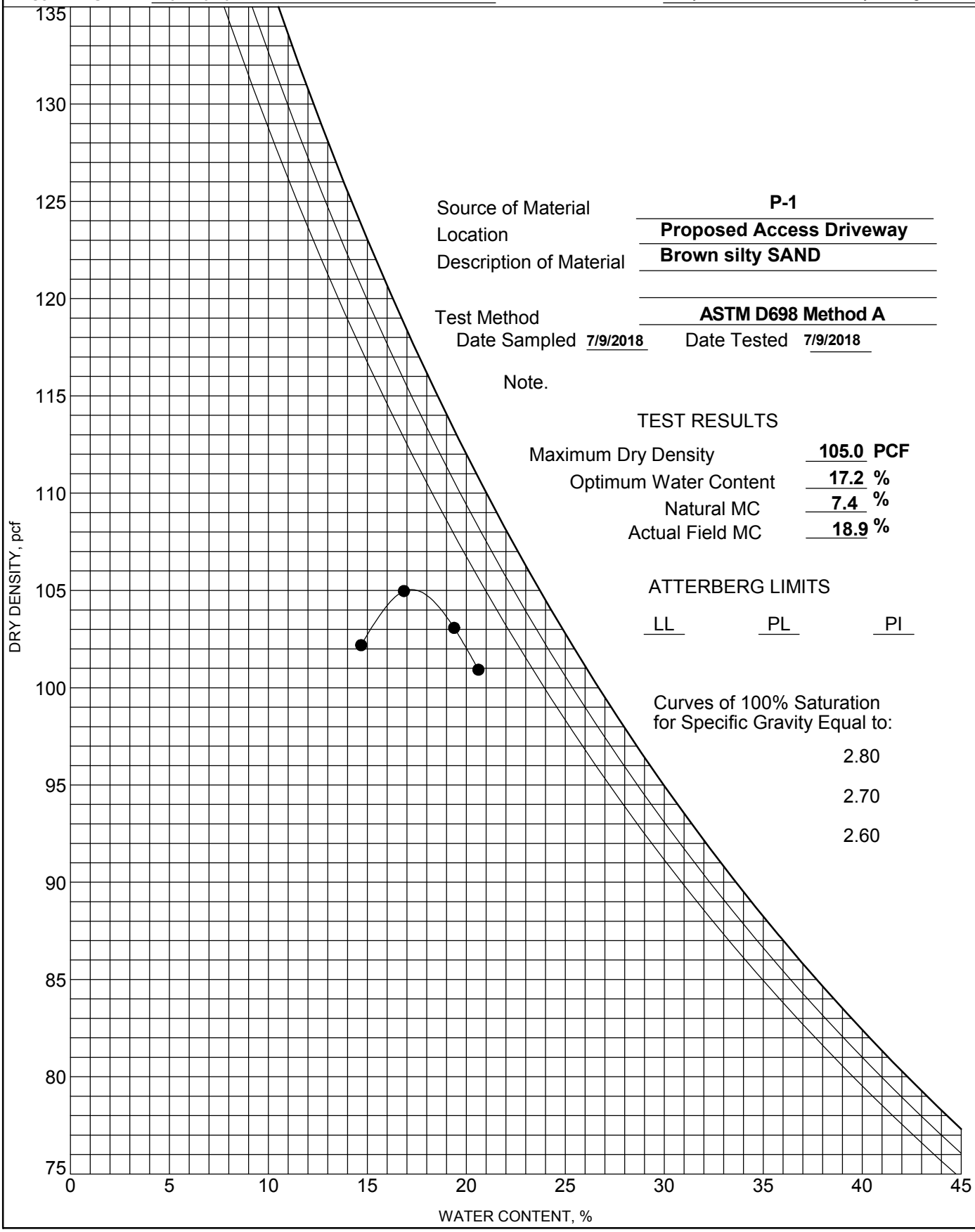
MC Squared
1275 Shiloh Road,Suite 2620
Kennesaw, GA 30144

CLIENT WSP USA

PROJECT NAME Northside Drive at Peachtree Creek - New Pump Station

PROJECT NUMBER A041707.047

PROJECT LOCATION City of Atlanta, Fulton County, Georgia



Source of Material **P-1**

Location **Proposed Access Driveway**

Description of Material **Brown silty SAND**

Test Method **ASTM D698 Method A**

Date Sampled **7/9/2018** Date Tested **7/9/2018**

Note.

TEST RESULTS

Maximum Dry Density	**105.0**	**PCF**
Optimum Water Content	**17.2**	**%**
Natural MC	**7.4**	**%**
Actual Field MC	**18.9**	**%**

ATTERBERG LIMITS

LL	PL	PI

Curves of 100% Saturation for Specific Gravity Equal to:

2.80

2.70

2.60

PROCTOR WITH MC - GINT STD US LAB.GDT - 7/9/18 15:41 - Z:\PROP AND RPTS\ATL\ATL 17\A041707.047 COA NORTHSIDE DR PEACHTREE CREEK\LABORATORY\LAB TESTING.GPJ

GRAIN SIZE DISTRIBUTION

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Kennesaw, GA 30144

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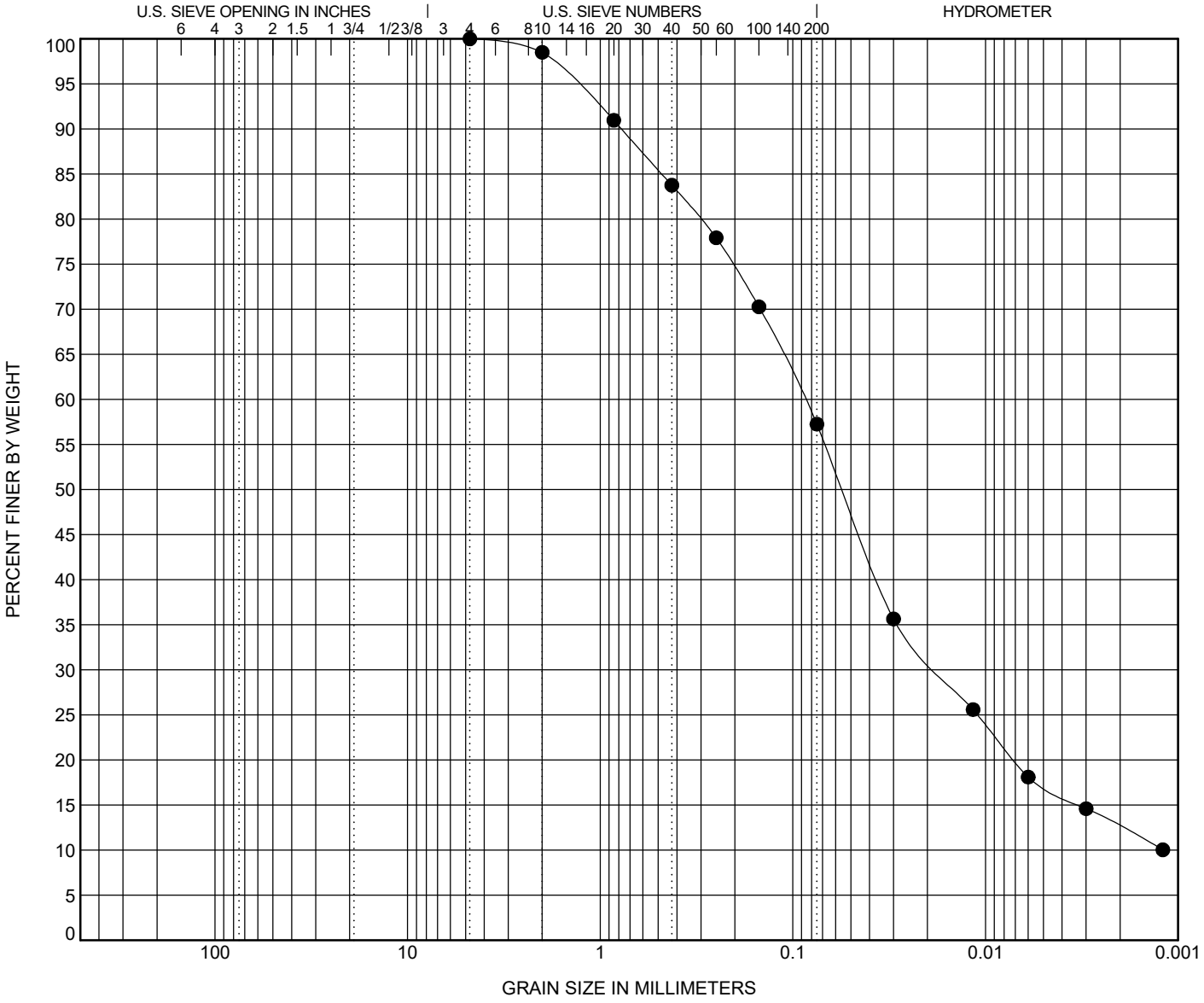


COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	Classification	LL	PL	PI	Cc	Cu
● **P-1 (0-1)**	**Brown sandy SILT**	**28**	**24**	**4**		

Specimen Identification	D100	D60	D30	D10	%NMC	%Gravel	%Sand	%Silt	%Clay
● **P-1 (0-1)**	**4.75**	**0.087**	**0.018**				**42.8**	**40.1**	**17.2**

Note-Sample soaked for 16 hrs (+/- 10 min)

GRAIN SIZE SINGLE WITH M.C. - GINT STD US LAB.GDT - 8/3/18 13:19 - Z:\PROP AND RPTS\ATL\ATL 17\A041707.047 COA NORTHSIDE DR PEACHTREE CREEK\LABORATORY\LAB TESTING.GPJ

GRAIN SIZE DISTRIBUTION

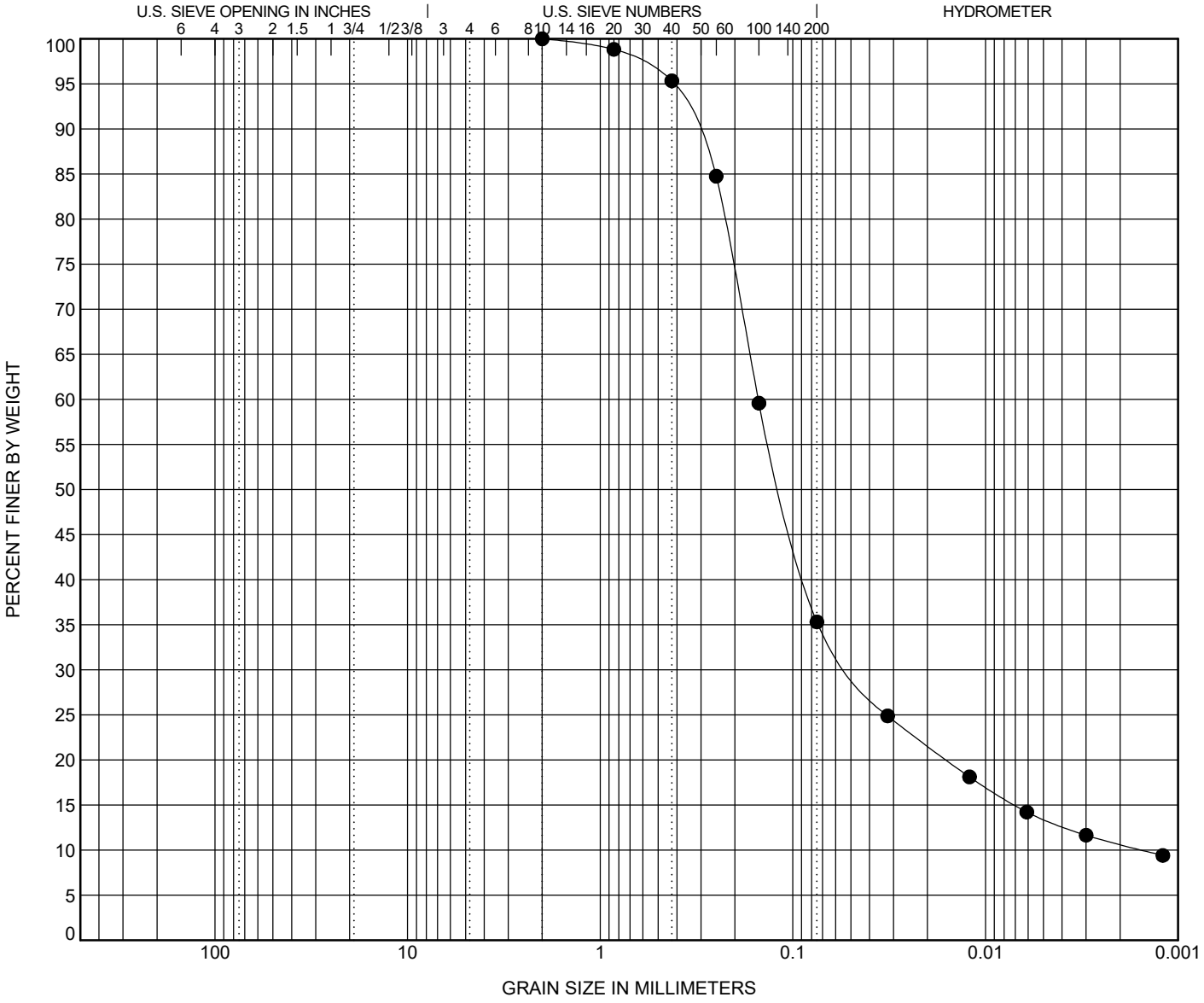
MC Squared, Inc.
1275 Shiloh Road,Suite 2620
Kennesaw, GA 30144

CLIENT WSP USA

PROJECT NAME Northside Drive at Peachtree Creek - New Pump Station

PROJECT NUMBER A041707.047

PROJECT LOCATION City of Atlanta, Fulton County, Georgia



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification	Classification	LL	PL	PI	Cc	Cu
●	**B-1 (6-8)**	**Reddish brown to brown silty fine SAND**			**NP**	**10.27**	**98.90**

	Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**B-1 (6-8)**	**2**	**0.151**	**0.049**	**0.002**		**64.7**	**21.8**	**13.5**

Note-Sample soaked for 16 hrs (+/- 10 min)

GRAIN SIZE SINGLE - GINT STD US LAB.GDT - 8/2/18 16:42 - Z:\PROP AND RPTSVATL\ATL 17\A041707.047 COA NORTHSIDE DR PEACHTREE CREEK\LABORATORY\LAB TESTING.GPJ

GRAIN SIZE DISTRIBUTION

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CLIENT WSP USA

PROJECT NAME Northside Drive at Peachtree Creek - New Pump Station

PROJECT NUMBER A041707.047

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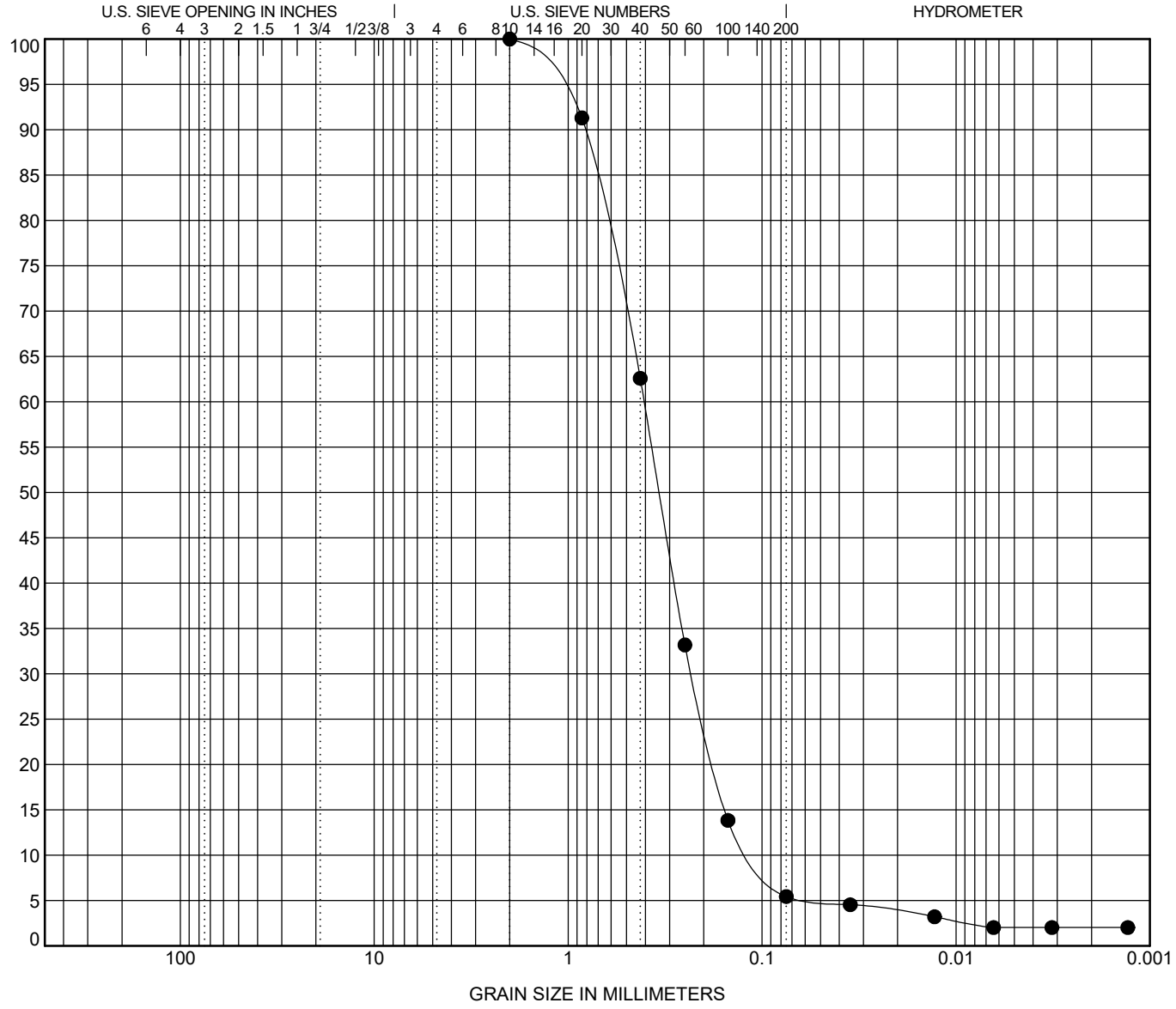

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	Classification	LL	PL	PI	Cc	Cu
● **B-1 (13.5-15)**	**Gray, brown to tan, poorly-graded fine SAND with silt**				**1.19**	**3.71**

Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● **B-1 (13.5-15)**	**2**	**0.406**	**0.23**	**0.109**		**94.6**	**3.4**	**2.0**

Note-Sample soaked for 16 hrs (+/- 10 min)

GRAIN SIZE SINGLE - GINT STD US LAB.GDT - 8/2/18 16:42 - Z:\PROP AND RPTSVATL\ATL 17\A041707.047 COA NORTHSIDE DR PEACHTREE CREEK\LABORATORY\LAB TESTING.GPJ

GRAIN SIZE DISTRIBUTION

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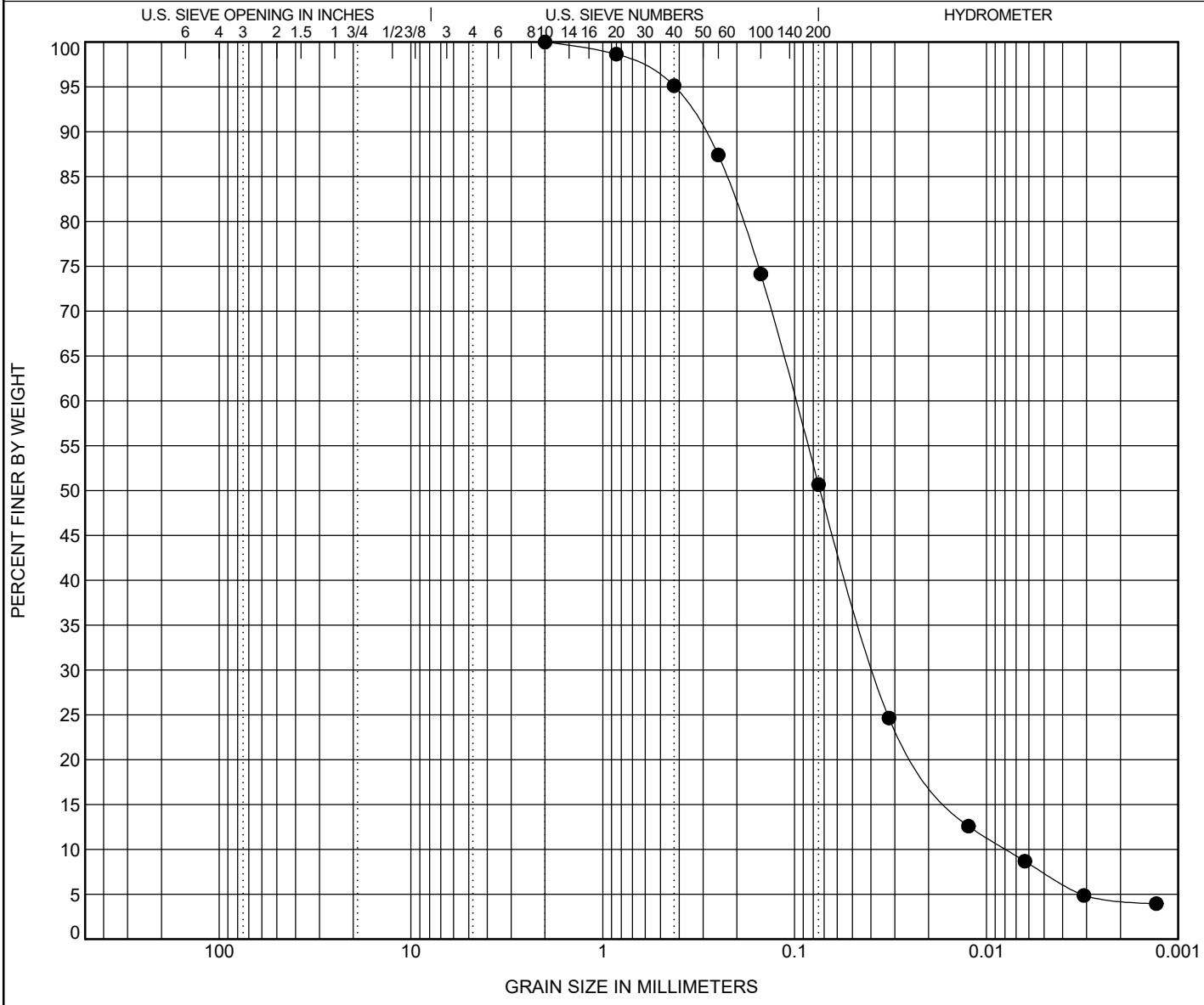

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	Classification	LL	PL	PI	Cc	Cu
● **B-1 (23.5-25)**	**Yellowish brown to tan, sandy SILT**				**1.88**	**12.50**

Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● **B-1 (23.5-25)**	**2**	**0.099**	**0.038**	**0.008**		**49.3**	**43.2**	**7.4**

Note-Sample soaked for 16 hrs (+/- 10 min)

GRAIN SIZE SINGLE - GINT STD US LAB.GDT - 8/2/18 16:43 - Z:\PROP AND RPTSVATL\ATL 17\A041707.047 COA NORTHSIDE DR PEACHTREE CREEK\LABORATORY\LAB TESTING.GPJ

GRAIN SIZE DISTRIBUTION

MC Squared, Inc.
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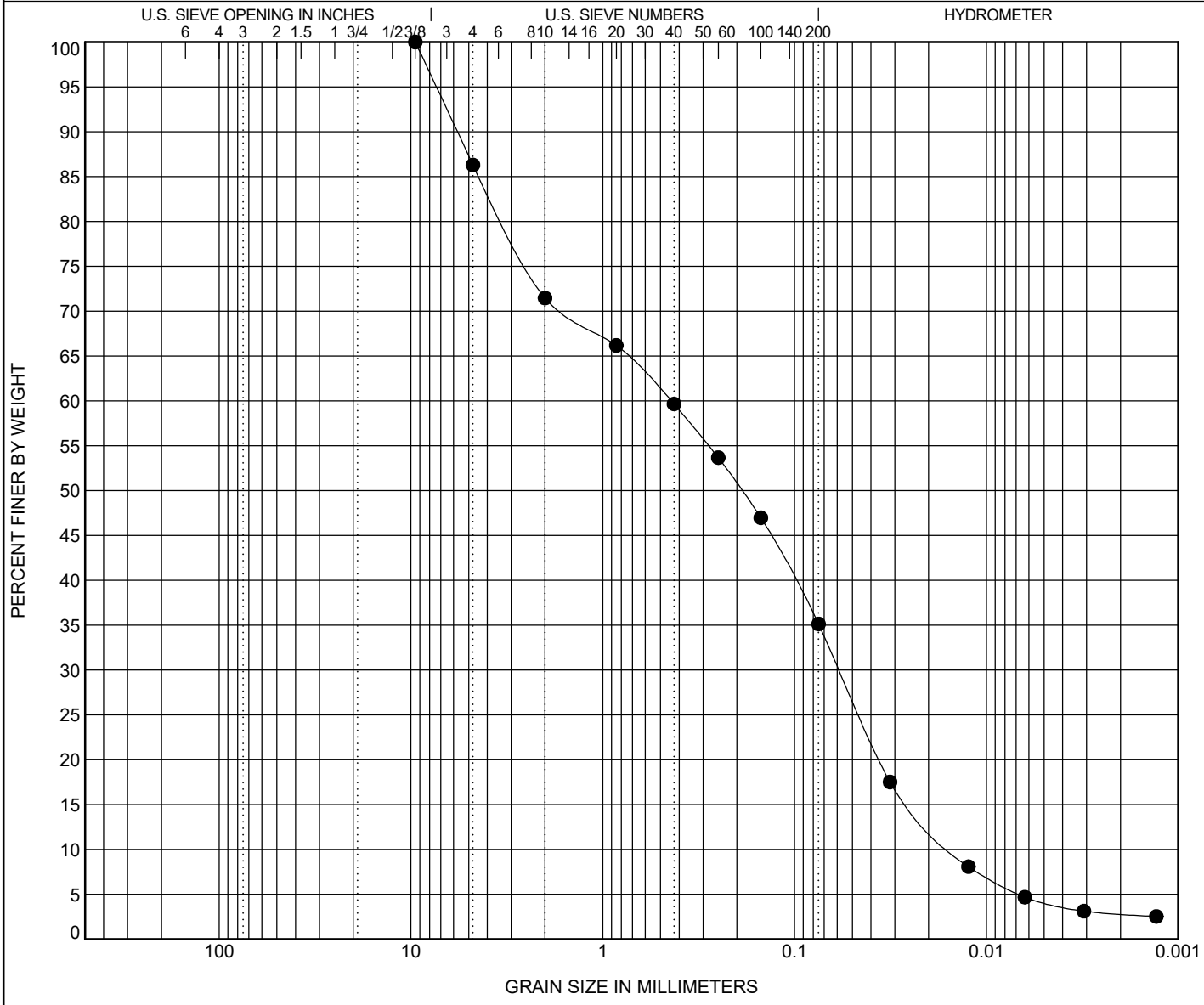
Kennesaw, GA 30144

CLIENT WSP USA

PROJECT NAME Northside Drive at Peachtree Creek - New Pump Station

PROJECT NUMBER A041707.047

PROJECT LOCATION City of Atlanta, Fulton County, Georgia



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification	Classification	LL	PL	PI	Cc	Cu
●	**B-1 (33.5-35)**	**Brown to light gray, silty fine SAND**				**0.52**	**29.35**

	Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**B-1 (33.5-35)**	**9.5**	**0.441**	**0.058**	**0.015**	**13.7**	**51.2**	**31.0**	**4.2**

Note-Sample soaked for 16 hrs (+/- 10 min)

GRAIN SIZE SINGLE - GINT STD US LAB.GDT - 8/2/18 16:43 - Z:\PROP AND RPTSVATL\ATL 17\A041707.047 COA NORTHSIDE DR PEACHTREE CREEK\LABORATORY\LAB TESTING.GPJ

GRAIN SIZE DISTRIBUTION

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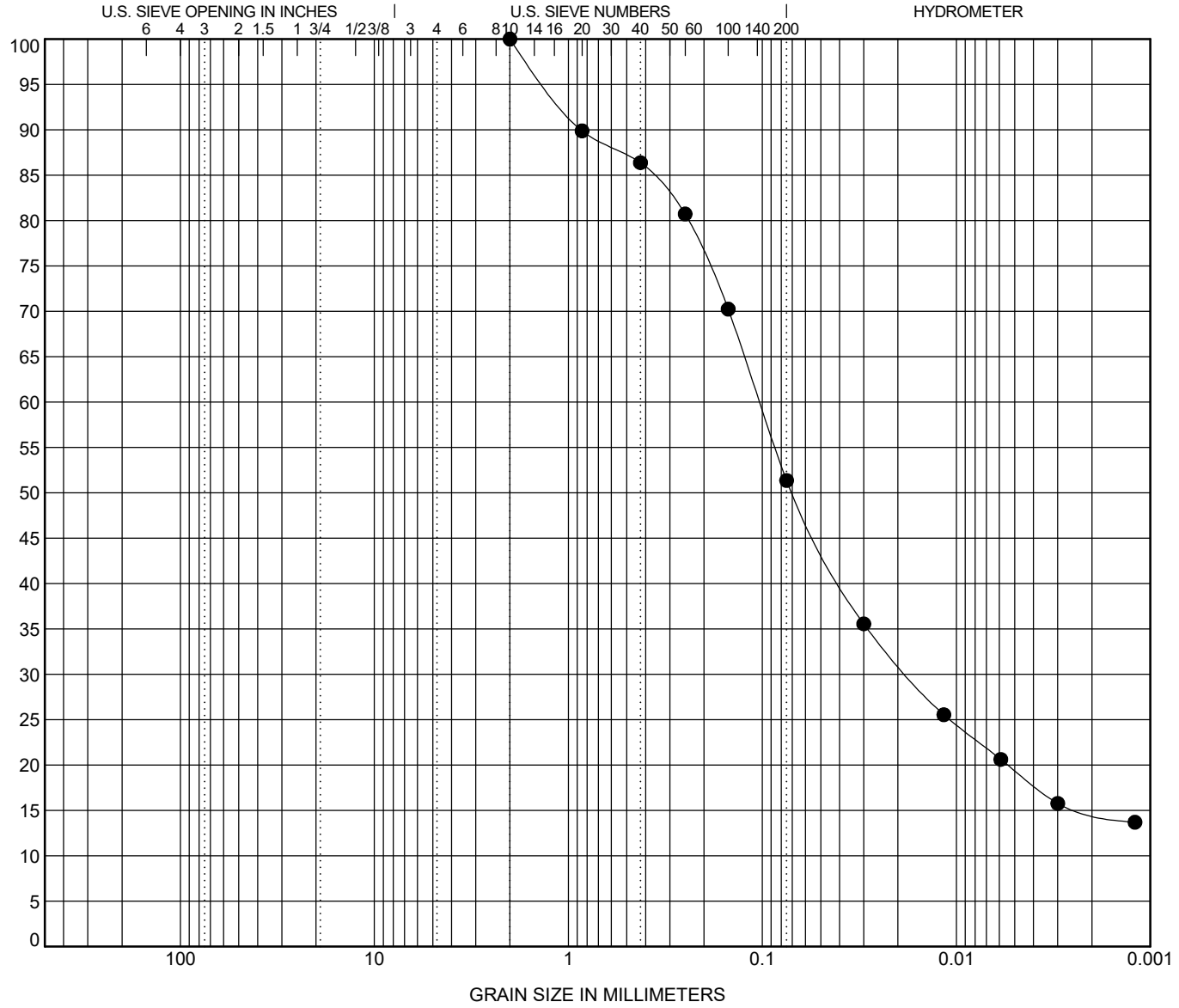


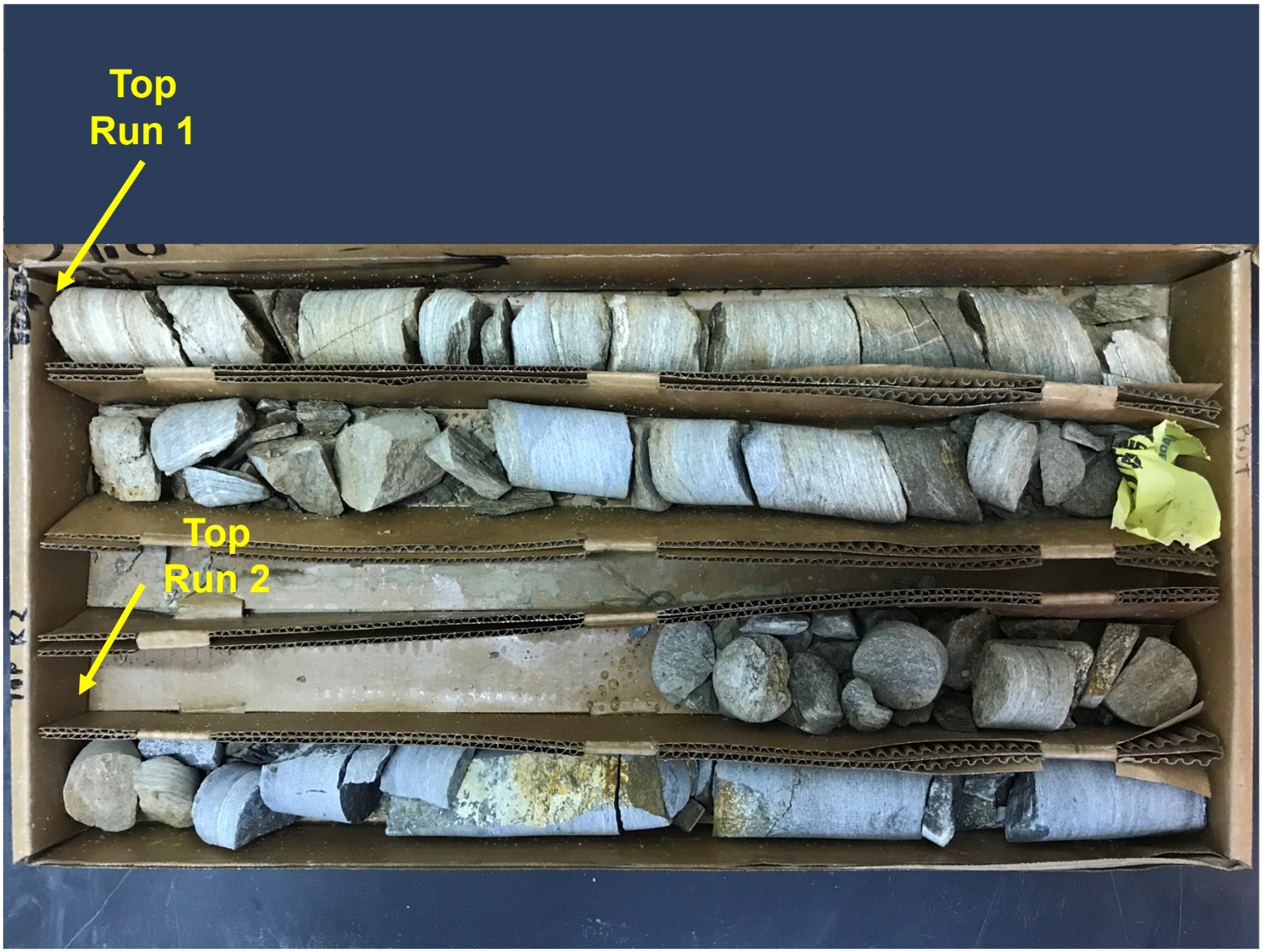
COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification	Classification	LL	PL	PI	Cc	Cu
●	**B-2 (4-6)**	**Reddish brown to brown, sandy SILT**					

	Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**B-2 (4-6)**	**2**	**0.103**	**0.018**			**48.6**	**31.9**	**19.4**

Note-Sample soaked for 16 hrs (+/- 10 min)

GRAIN SIZE SINGLE - GINT STD US LAB.GDT - 8/2/18 16:44 - Z:\PROP AND RPTSVATL\ATL 17\A041707.047 COA NORTHSIDE DR PEACHTREE CREEK\LABORATORY\LAB TESTING.GPJ



Boring No. B-1 Runs 1 and 2
Run 1: 39.0 ft. – 44.0 ft., REC = 78%, RQD = 0%
Run 2: 44.0 ft. – 49.0 ft., REC = 58%, RQD = 0%

MC² Geotechnical • Environmental Materials Testing	**Geotechnical Engineering Report** **Northside Drive at Peachtree Creek** **New Pump Station** **City of Atlanta, Fulton County, Georgia**	**Prepared For:** WSP USA, Inc. 3340 Peachtree Road, N.E., Suite 2400 Atlanta, Georgia 30326
		MC² Project No. A041707.047
	ROCK CORE PHOTOGRAPHS	**Date:** 7/24/18

Boring No. B-1 Runs 1 and 2
Run 1: 39.0 ft. – 44.0 ft., REC = 78%, RQD = 0%
Run 2: 44.0 ft. – 49.0 ft., REC = 58%, RQD = 0%

MC² Geotechnical • Environmental Materials Testing	**Geotechnical Engineering Report** **Northside Drive at Peachtree Creek** **New Pump Station** **City of Atlanta, Fulton County, Georgia**	**Prepared For:** WSP USA, Inc. 3340 Peachtree Road, N.E., Suite 2400 Atlanta, Georgia 30326
		MC² Project No. A041707.047
	ROCK CORE PHOTOGRAPHS	**Date:** 7/24/18

Boring No. B-1 Run 3
Run 3: 49.0 ft. – 54.0 ft., REC = 97%, RQD = 97%

MC² Geotechnical • Environmental Materials Testing	**Geotechnical Engineering Report** **Northside Drive at Peachtree Creek** **New Pump Station** **City of Atlanta, Fulton County, Georgia**	**Prepared For:** WSP USA, Inc. 3340 Peachtree Road, N.E., Suite 2400 Atlanta, Georgia 30326
		MC² Project No. A041707.047
	ROCK CORE PHOTOGRAPHS	**Date:** 7/24/18

Boring No. B-1 Run 3
Run 3: 49.0 ft. – 54.0 ft., REC = 97%, RQD = 97%

MC² Geotechnical • Environmental Materials Testing	**Geotechnical Engineering Report** **Northside Drive at Peachtree Creek** **New Pump Station** **City of Atlanta, Fulton County, Georgia**	**Prepared For:** WSP USA, Inc. 3340 Peachtree Road, N.E., Suite 2400 Atlanta, Georgia 30326
		MC² Project No. A041707.047
	ROCK CORE PHOTOGRAPHS	**Date:** 7/24/18

B-1, Run 3, Depth 50.7’ – 51.0’
Before Test

B-1, Run 3, Depth 50.7’ – 51.0’
After Test

MC² Geotechnical • Environmental Materials Testing	**Geotechnical Engineering Report** **Northside Drive at Peachtree Creek** **New Pump Station** **City of Atlanta, Fulton County, Georgia**	**Prepared For:** WSP USA, Inc. 3340 Peachtree Road, N.E., Suite 2400 Atlanta, Georgia 30326
		MC² Project No. A041707.047
	ROCK CORE TESTING PHOTOGRAPHS	**Date:** 7/25/18

B-1, Run 3, Depth 52.1’ – 52.4’
Before Test

B-1, Run 3, Depth 52.1’ – 52.4’
After Test

MC² Geotechnical • Environmental Materials Testing	**Geotechnical Engineering Report** **Northside Drive at Peachtree Creek** **New Pump Station** **City of Atlanta, Fulton County, Georgia**	**Prepared For:** WSP USA, Inc. 3340 Peachtree Road, N.E., Suite 2400 Atlanta, Georgia 30326
		MC² Project No. A041707.047
	ROCK CORE TESTING PHOTOGRAPHS	**Date:** 7/25/18

TEST PROCEDURES

The general field procedures employed by **MC Squared, Inc.** (**MC^2**) are summarized in the American Society for Testing and Materials (ASTM) Standard D420 which is entitled "Investigating and Sampling Soil and Rock". This recommended practice lists recognized methods for determining soil and rock distribution and groundwater conditions. These methods include geophysical and in-situ methods as well as borings.

STANDARD DRILLING TECHNIQUES

To obtain subsurface samples, borings are drilled using one of several alternate techniques depending upon the subsurface conditions. Some of these techniques are:

In Soils:

a) Continuous hollow stem augers.
b) Rotary borings using roller cone bits or drag bits, and water or drilling mud to flush the hole.
c) "Hand" augers.

In Rock:

a) Core drilling with diamond-faced, double or triple tube core barrels.
b) Core boring with roller cone bits.

The drilling method used during this exploration is presented in the following paragraph.

Hollow Stem Augering: A hollow stem auger consists of a hollow steel tube with a continuous exterior spiral flange termed a flight. The auger is turned into the ground, returning the cuttings along the flights. The hollow center permits a variety of sampling and testing tools to be used without removing the auger.

Core Drilling: Soil drilling methods are not normally capable of penetrating through hard cemented soil, weathered rock, coarse gravel or boulders, thin rock seams, or the upper surface of sound, continuous rock. Material which cannot be penetrated by auger or rotary soil-drilling methods at a reasonable rate is designated as “refusal material”. Core drilling procedures are required to penetrate and sample refusal materials.

Prior to coring, casing may be set in the drilled hole through the overburden soils, to keep the hole from caving and to prevent excessive water loss. The refusal materials are then cored according to ASTM D-2113 using a diamond-studded bit fastened to the end of a hollow, double or triple tube core barrel. This device is rotated at high speeds, and the cuttings are brought to the surface by circulating water. Core samples of the material penetrated are protected and retained in the swivel-mounted inner tube. Upon completion of each drill run, the core barrel is brought to the surface, the core recovery is measured, and the core is placed, in sequence, in boxes for storage and transported to our laboratory.

SAMPLING AND TESTING IN BOREHOLES

Several techniques are used to obtain samples and data in soils in the field, however the most common methods in this area are:

a) Standard Penetration Testing
b) Undisturbed Sampling
c) Dynamic Cone Penetrometer Testing
d) Water Level Readings

The procedures utilized for this project are presented below.

Standard Penetration Testing: At regular intervals, the drilling tools are removed and soil samples obtained with a standard 2-inch diameter split tube sampler connected to an A or N-size rod. The sampler is first seated 6 inches to penetrate any loose cuttings, then driven an additional 12 inches with blows of a 140-pound safety hammer falling 30 inches. Generally, the number of hammer blows required to drive the sampler the final 12 inches is designated the "penetration resistance" or "N" value, in blows per foot (bpf). The split barrel sampler is designed to retain the soil penetrated, so that it may be returned to the surface for observation. Representative portions of the soil samples obtained from each split barrel sample are placed in jars, sealed and transported to our laboratory.

The standard penetration test, when properly evaluated, provides an indication of the soil strength and compressibility. The tests are conducted according to ASTM Standard D698 / D1586. The depths and N-values of standard penetration tests are shown on the Boring Logs. Split barrel samples are suitable for visual observation and classification tests but are not sufficiently intact for quantitative laboratory testing.

Water Level Readings: Water level readings are normally taken in the borings and are recorded on the Boring Records. In sandy soils, these readings indicate the approximate location of the hydrostatic water level at the time of our field exploration. In clayey soils, the rate of water seepage into the borings is low and it is generally not possible to establish the location of the hydrostatic water level through short-term water level readings. Also, fluctuation in the water level should be expected with variations in precipitation, surface run-off, evaporation, and other factors. For long-term monitoring of water levels, it is necessary to install piezometers.

The water levels reported on the Boring Logs are determined by field crews immediately after the drilling tools are removed, and several hours after the borings are completed, if possible. The time lag is intended to permit stabilization of the groundwater level that may have been disrupted by the drilling operation.

Occasionally the borings will cave-in, preventing water level readings from being obtained or trapping drilling water above the cave-in zone.

BORING LOGS

The subsurface conditions encountered during drilling are reported on a field boring log prepared by the Driller. The log contains information concerning the boring method, samples attempted and recovered, indications of the presence of coarse gravel, cobbles, etc., and observations of groundwater. It also contains the driller's interpretation of the soil conditions between samples. Therefore, these boring records contain both factual and interpretive information. The field boring records are kept on file in our office.

After the drilling is completed a geotechnical professional classifies the soil samples and prepares the final Boring Logs, which are the basis for our evaluations and recommendations.

SOIL CLASSIFICATION

Soil classifications provide a general guide to the engineering properties of various soil types and enable the engineer to apply his past experience to current problems. In our investigations, samples obtained during drilling operations are examined in our laboratory and visually classified by an engineer. The soils are classified according to consistency (based on number of blows from standard penetration tests), color and texture. These classification descriptions are included on our Boring Logs.

The classification system discussed above is primarily qualitative and for detailed soil classification two geotechnical laboratory tests are necessary; grain size tests and plasticity tests. Using these test results the soil can be classified according to the AASHTO or Unified Classification Systems (ASTM D-2487). Each of these classification systems and the in-place physical soil properties provides an index for estimating the soil's behavior. The soil classification and physical properties are presented in this report.

The following table presents criteria that are typically utilized in the classification and description of soil and rock samples for preparation of the Boring Logs.

Relative Density of Cohesionless Soils From Standard Penetration Test		**Consistency of Cohesive Soils**	
Very Loose	≤ 4 bpf	Very Soft	≤ 2 bpf
Loose	5 - 10 bpf	Soft	3 - 4 bpf
Medium Dense	11 - 30 bpf	Firm	5 - 8 bpf
Dense	31 - 50 bpf	Stiff	9 - 15 bpf
Very Dense	> 50 bpf	Very Stiff	16 - 30 bpf
		Hard	31 – 50 bpf
(bpf = blows per foot, ASTM D 1586)		Very Hard	> 50 bpf

Relative Hardness of Rock		**Particle Size Identification**	
Very Soft	disintegrates or easily compresses to touch; can be hard to very hard soil.	Boulders	Larger than 12"
Soft	May be broken with fingers.	Cobbles	3" - 12"
Moderately Soft	May be scratched with a nail, corners and edges may be broken with fingers.	Gravel	
		Coarse	3/4" - 3"
		Fine	4.76mm - 3/4"
Moderately Hard	Light blow of hammer required to break samples.	Sand	
		Coarse	2.0 - 4.76 mm
		Medium	0.42 - 2.00 mm
		Fine	0.42 - 0.074 mm
Hard	Hard blow of hammer required to break sample.	Fines (Silt or Clay)	Smaller than 0.074 mm

Rock Continuity		**Relative Quality of Rocks**	
RECOVERY = $\frac{\text{Total Length of Core}}{\text{Length of Core Run}}$ x 100 %		**RQD** = $\frac{\text{Cumulative length of all pieces} \geq 4"}{\text{Length of Core Run}}$ x 100 %	
Description	Core Recovery %	Description	RQD %
Incompetent	Less than 40	Very Poor	0 - 25 %
Competent	40 - 70	Poor	25 - 50 %
Fairly Continuous	71 - 90	Fair	50 - 75 %
Continuous	91 - 100	Good	75 - 90 %
		Excellent	90 - 100 %

SECTION 02050
DEMOLITION AND MODIFICATION

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, material, equipment and incidentals required for demolition and disposal of all materials and appurtenances to be removed.

B. This section also includes complete or partial removal and disposal of specified existing structures, piping, existing (to be abandoned) buried piping and miscellaneous appurtenances encountered during construction operations.

C. These specifications call attention to certain activities necessary to maintain operation of the City's existing water distribution system during and following construction and do not intend to cover all of the activities necessary. The Contractor shall exercise due concern for the water distribution system operation and shall direct all his activities toward maintaining continuous operation of the water distribution system.

D. Demolition includes:

1. Complete demolition of all existing structures which are encountered in the way of the new work as shown on the Drawings.
2. Temporary modification of structures, appurtenances and utilities as necessary to allow for operation of the water distribution system during construction.
3. Demolition, removal and cutting of existing masonry as required for the new construction.
4. Distribution of salvageable and excess unacceptable material as specified below.
5. Off-site disposal of excess and unacceptable materials.

1.02 SUBMITTALS

Submittals shall be made in accordance with the requirements of 01300 Submittals. In addition, the following specific information shall be provided:

The Contractor shall submit to the City's Authorized Representative, prior to beginning work, a schedule of demolition and detailed methods, to be used on each vault to be demolished or modified.

1.03 EXISTING CONDITIONS

A. Many obstructions are not shown on the Drawings. Bidders are advised to carefully inspect the existing facilities before preparing their bid.

B. The Owner and the City's Authorized Representative assume no responsibility of the actual condition of the structures to the demolished or modified.

C. Conditions existing at the time of inspection for bidding purposes will be maintained by the Owner to the maximum extent possible. However, variations within the structures may occur prior to the beginning of the work.

PART 2 PRODUCTS

A. The Contractor shall provide all materials and equipment in suitable and adequate quantity as required to accomplish the work shown, specified herein, and as required to complete the Work.

B. All concrete, mortar, grout, and backfill used in patching, plugging or repairing shall comply in all respects with the applicable material requirements of these Specifications.

PART 3 EXECUTION

3.01 DISPOSAL AND SALVAGE OF MATERIAL AND APPURTENANCES

A. Salvageable material shall become the property of the Owner, if the Owner requests any specific item. The Contractor shall dismantle all material to such a size that it can be readily handled, and deliver all salvageable material requested by the Owner to a location as designated by the City. These include but are not limited to:

1. City's Pipe Yard: 2750 Peyton Road, N.W. , Atlanta, GA 30318
2. City's 14th Street Facility: 651 14th Street, N.W., Atlanta, GA 30318

B. The following is a list of materials to be removed and salvaged. The City's Authorized Representative may identify other materials and appurtenances to be salvaged during the course of the Work.

1. Fire Hydrants
2. Meters
3. Valves
4. Valve Boxes and Covers
5. Frames, Grates and Manhole Covers

C. Salvaged materials and appurtenances shall be removed by the Contractor before demolition or removal work begins and shall be delivered to the City.

D. Any material that the Owner rejects shall become the Contractor's property and shall be removed from the site.

E. Concrete, concrete block and bricks may be disposed of as specified below in Part 3, Execution, or hauled to a waste disposal site.

F. All other material shall be hauled to a waste disposal site by the Contractor.

G. The storage or sale of removed items on the site will not be allowed.

3.02 TRAFFIC AND ACCESS

A. Conduct demolition, 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.

B. Special attention shall be directed towards maintaining safe and convenient access to the existing facilities by Owner's personnel and associated vehicles.

C. Do not close or obstruct streets, walks or other occupied or used facilities without permission from the City's Authorized Representative. Provide alternate routes around closed or obstructed traffic in access ways.

D. The Contractor's attention is directed to Section 01550, Traffic Regulation.

3.03 UTILITIES

A. Maintain existing utilities as directed by the City's Authorized Representative to remain in service and protect against damage during demolition operations.

B. Do not interrupt existing utilities serving occupied or used facilities, except when authorized by the City's Authorized Representative. Provide temporary services during interruptions to existing utilities as acceptable to the City's Authorized Representative.

C. The Contractor shall be solely responsible for making all necessary arrangements and for performing any necessary work involved in connection with the discontinuance or interruption of all public and private utilities or services under the jurisdiction of the utility companies.

3.04 EXTERMINATION

If required, before starting demolition, employ a certified rodent and vermin exterminator and treat the facilities in accordance with governing health laws and regulations.

3.05 POLLUTION CONTROL

A. For pollution control, use water sprinkling, temporary enclosures, and other suitable

methods as necessary to limit the amount of dust and dirt rising and scattering in the air to the lowest level of air pollution practical for the conditions of work. Comply with the governing regulations.

B. Clean adjacent structures and improvements or all dust, dirt and debris caused by demolition operations as directed by the City's Authorized Representative. Return areas to conditions existing prior to the start of work.

3.06 REMOVAL OF EXISTING EQUIPMENT AND PIPING

A. Equipment specified to be removed shall be removed completely, including all related accessories and concrete bases. Any embedded items such as anchor bolts, steel reinforcement, conduit and piping shall be cut off 1 inch below adjacent finished surfaces. The surface shall then be repaired to match adjacent surfaces in finish and appearance.

B. 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 the work and the open ends plugged or capped unless directed otherwise by the City's Authorized Representative.

3.07 DEMOLITION

A. The Task Order will define the extent of demolition. Unless otherwise directed by the City's Authorized Representative, the Contractor shall not make rough cuts or breaks that exceed the limits of the required demolition.

B. All equipment, materials and piping, except as specified in paragraph 3.01 above, within the limits of the demolition shall become the property of the Contractor.

3.08 PROTECTION OF WORK AND EXISTING FACILITIES

A. Examine the existing structures and evaluate conditions to be encountered in accomplishing the Work.

B. The Contractor shall perform the work in a manner that will not damage parts of the structure not intended to be removed. If, in the opinion of the City's Authorized Representative, the method of demolition or cutting may endanger or damage parts of the structure(s) or affect the operation of the water distribution system, promptly change the method when directed by the City's Authorized Representative. Perform all cutting required regardless whether such cutting is specifically indicated.

C. Blasting will not be permitted.

D. The Contractor shall exercise full care and shall use such methods and equipment during removal as will maintain the usefulness of the various materials and equipment

removed.

E. Any damage done to structures or equipment during removal and any patching, plugging of holes or repairs necessitated because of removal of equipment and piping shall be repaired to the satisfaction of the City's Authorized Representative at no additional cost to the City.

3.09 DISPOSAL

A. All rubble and waste material shall be removed from the work site. Removal and cleanup shall be completed upon conclusion of daily work, outage period, or a specific work period. Removal of waste material from the work areas shall constitute physical removal of all debris, rubble, or waste from the work site to a proper storage container.

B. Waste containers shall be located as approved by the City's Authorized Representative. Waste material shall be considered to be any existing item or material that is removed and is not intended for reinstallation or salvage to the City.

C. The Contractor shall be fully responsible for proper disposal of waste materials in accordance with all federal, state and local laws at no additional cost to the City.

3.10 DAMAGE

The Contractor shall promptly repair damage caused to adjacent facilities as directed by the City's Authorized Representative and at no cost to the Owner.

+ + + END OF SECTION 02050 + + +

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SECTION 02060
CRUSHED STONE AGGREGATE

PART 1 - GENERAL

1.01 SCOPE

A. This section includes installation of crushed stone aggregate; and any other similar, incidental or appurtenant operation which may be necessary to properly complete the Work.

B. The Contractor shall provide all services, labor, materials, and equipment required for all installation of crushed stone aggregate and related operations necessary or convenient to the Contractor for furnishing complete Work as shown on the Plans or specified in these Contract Documents.

1.02 SUBMITTALS

Submittals shall be made in accordance with the requirements of 01300 Submittals.

1.03 QUALITY CONTROL

Reference Standards: The Contractor shall comply with the applicable provisions and recommendations of the latest editions of the following standards, except as otherwise shown on the Plans or specified in these specifications.

1. American Association of State Highway and Transportation Officials (AASHTO) M147 - Standard Specification for Materials for Aggregate and Soil-Aggregate Subbase, Base, and Surface Courses.
2. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Hammer and a 457-mm (18-in) Drop.
3. ASTM C136 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
4. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3 (600 kN-m/m^3)).
5. ASTM D1557 - Standard Test Method for Laboratory Compaction Characteristics of Soils Using Modified Effort (56,000 ft-lbf/ft^3 (2,700 kN-m/m^3)).
6. ASTM D2487 - Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System).
7. ASTM D4318 - Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Coarse aggregate shall be crushed stone per GDOT Standards, of solid composition, free from dirt and adherent coatings, and suited for the class of its intended usage.

B. Unless otherwise specified elsewhere in these Specifications or directed by the City's Authorized Representative, gradation of coarse aggregate shall conform with size Number 467, Number 57, or Number 67 as described in ASTM C33.

C. The nominal maximum size of coarse aggregate used in concrete shall not be larger than one-fifth 1/5 of the narrowest dimension between sides of the forms, one-third 1/3 of the depth of slabs, or three-fourths ¾ of the minimum clear spacing between reinforcing bars as described in ACI 68-50.

D. Sand shall be clean and sharp, free from all deleterious substances, and shall conform to the requirements of ASTM C33.

PART 3 - EXECUTION

3.01 EXAMINATION

The Contractor shall verify that subgrade has been inspected and that gradients and elevations are correct and dry.

3.02 AGGREGATE PLACEMENT

A. The Contractor shall place coarse aggregates in areas shown on the Plans or directed by the City's Authorized Representative.

B. The Contractor shall place and compact coarse aggregate in accordance with the requirements of Section 02225 – Trench Excavation and Backfill.

C. The Contractor shall level and contour surfaces to elevations and gradients indicated on the Plans.

D. The Contractor shall add small quantities of fine aggregate to coarse aggregate as appropriate to assist compaction.

E. The Contractor shall add water to assist compaction. If excess water is apparent, the Contractor shall remove aggregate and aerate to reduce moisture content.

F. The Contractor shall use mechanical vibrating tamping in areas inaccessible to compaction equipment. Place material in uniform layers, compacting each layer

thoroughly as follows:

1. In 6-inch layers, if using light power tamping equipment, such as “jumping jack”.
2. In 12-inch layers, if using heavy tamping equipment, such as hammer with tamping feet.

3.03 TOLERANCES

A. Flatness: Maximum variation of 0.2 feet measured with a ten (10) foot straight edge.

B. Variation from True Elevation: Within 0.2 feet.

C. Base: Compacted to ninety-eight percent (98%) standard proctor density as determined by ASTM D-698.

+ + + END OF SECTION 02060 + + +

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SECTION 02100
SITE PREPARATION

PART 1 – GENERAL

1.01 SCOPE

A. This section covers the work necessary to remove all interfering or objectionable material from the areas shown on the Drawings, designated in these Specifications, as directed by the City's Authorized Representative, or as necessary to complete the Work. Site preparation required in temporary easement areas shall be approved by the City's Authorized Representative before commencing Work, unless specified otherwise in these Specifications.

B. Site preparation includes, but is not limited to, removing from the site of the Work, trees, stumps, roots, brush, structures, abandoned utilities, trash, debris, and all other materials found on or near the surface of the ground in the site of the Work and understood by generally accepted engineering practice not to be suitable for construction of the type contemplated. Precautionary measures that prevent damage to existing features to remain are part of the Work.

C. Site preparation activities shall be coordinated with temporary and permanent erosion and sediment control procedures.

1.03 SUBMITTALS

Submittals shall be made in accordance with the requirements of 01300 Submittals. In addition, the following specific information shall be provided:

The Contractor shall submit disposal agreement and release to the City's Authorized Representative.

1.02 QUALITY CONTROL

A. The Contractor shall comply with all applicable local, state, and federal requirements regarding materials, methods of work, and disposal of excess and waste materials.

B. The Contractor shall obtain and pay for all required inspections, permits, and fees. Provide notices required by governmental authorities.

1.04 REGULATORY REQUIREMENTS

A. The Contractor shall comply with applicable codes; ordinances; rules; and regulations and laws of local, municipal, state, or federal authorities having jurisdiction over the Work. All required permits of a temporary nature shall be obtained for construction operations by the Contractor.

B. Open burning shall not be allowed.

PART 2 - PRODUCTS

EQUIPMENT

The Contractor shall furnish equipment of the type normally used in site preparation activities including, but not limited to, tractors, trucks, loaders, and root rakes.

PART 3 - EXECUTION

3.01 SITE INVESTIGATION

A. The Contractor shall verify that existing plant life designated to remain is tagged or identified prior to construction activities.

B. The Contractor shall identify an area for placing removed material and inform the City's Authorized Representative for his approval.

C. The Contractor shall make test holes when necessary for locating underground obstructions. The Contractor shall notify the Georgia Utilities Protection Center (by calling 811) in accordance with applicable Georgia law.

3.02 PROTECTION

A. Locate and identify existing underground and overhead services and utilities within contract limit work areas. Provide adequate means of protection of utilities and services designated to remain. Repair utilities damaged during site work operations at Contractor's expense.

B. Where utilities are to be crossed, they shall be uncovered by hand excavation methods before other excavation near them is started. The Contractor shall coordinate all utility locations with the utility owner and the Georgia Utilities Protection Center. Every pipe for water, gas, drainage, or other use, and every

conduit, foundation, or other underground structure encountered shall be carefully protected from damage or displacement.

C. Arrange for disconnection disconnect and seal or cap all utilities and services designated to be removed before start of site work operations. Perform all work in accordance with the requirements of the applicable utility company or agency involved.

D. When uncharted or incorrectly charted underground piping or other utilities and services are encountered during site work operations, notify the City's Authorized Representative and the applicable utility company immediately to obtain procedure directions. Cooperate with the applicable utility company in maintaining active services in operation.

E. The Contractor shall not remove vegetation which has been marked or identified to be saved by the City's Authorized Representative. If any vegetation so marked appears to be in conflict with areas to be cleared, the Contractor shall inform the City's Authorized Representative for his decision.

F. Locate, protect, and maintain bench marks, monuments, control points, and project engineering reference points around the site of the Work. Reestablish disturbed or destroyed items at Contractor's expense.

G. When directed by the City's Authorized Representative, the Contractor shall provide orange barrier fencing to protect trees to remain at the site of the Work.

H. Prior to clearing and grubbing operations, the Contractor shall protect slopes and control erosion in accordance with the requirements of Section 02125, Temporary and Permanent Erosion and Sediment Control. The Contractor shall be responsible for the prevention and control of soil erosion and gullying as a result of the construction. The Contractor shall prevent excessive erosion within the easements, right-of-way, and property immediately adjacent thereto. Ground where the soil has been exposed shall be revegetated with grass. Slopes in channel relocations shall be seeded and fertilized above the water line. Fill slopes shall be provided with adequate slope protection as detailed on the Plans or as directed by the City's Authorized Representative. All soil left within the easement areas and right-of-way shall be leveled off, dressed out, and seeded in a manner that will permit the ground surface to return to a natural state where approved by the City's Authorized Representative.

I. Construction operations shall be planned and conducted in such a manner so as to prevent adverse impact on streams, lakes, and reservoirs with sediment or other harmful material used in the construction of the project. The

Contractor shall comply with all regulations of the Environmental Protection Agency and the Georgia Department of Natural Resources, Environmental Protection Division (EPD).

J. The discharge ends of all channel relocations shall be aligned to provide direct flow into existing stream beds without an abrupt direction change.

K. The Contractor shall assume full responsibility for the protection of all buildings, structures, paving, and other services or facilities on site and adjacent to the site from damage caused by site work operations. Cost of repair and restoration of damaged items shall be at Contractor's expense.

L The Contractor shall assume full responsibility for the protection of all utilities, public or private, including street lights, utility poles, traffic signal control boxes, signs, services to buildings, other utilities in the street, on site and adjacent to the site from damage caused by site work operations whether or not they are shown in the Drawings. The Contractor shall carefully support and protect all such structures and utilities from injury of any kind. Any damage resulting from the Contractor's operations shall be repaired and restored by the Contractor at the Contractor's own expense. The Contractor is also required to conduct onsite utility investigations and become very familiar with the onsite conditions prior to excavation.

M. Obtain governing authorities' written permission when required to close or obstruct street, walks and adjacent facilities. Provide alternate routes around closed or obstructed traffic ways when required by governing authorities.

3.03 DUST CONTROL

Limit blowing dust caused by construction by applying water or employing other appropriate means or methods to maintain dust control subject to the approval of the City's Authorized Representative. As a minimum, the Contractor shall comply with pollution control regulations of governing authorities. This may require the use of a water wagon twice a day to suppress dusty conditions. The Contractor shall make adequate provision to fully protect the surrounding area and will be held fully responsible for all damages resulting from Contractor's operations.

3.04 SCHEDULE OF CLEARING

A. The Contractor shall clear at each construction area only that length of the right-of-way, permanent or temporary easement, which would be the equivalent of one (1) month's pipe laying.

B. The City's Authorized Representative may permit clearing for additional lengths of the pipeline, if temporary erosion and sediment controls are in place and a satisfactory stand of temporary grass is established. Should a satisfactory stand of grass not be possible, no additional clearing shall be permitted beyond that specified above.

C. A satisfactory stand of grass shall have no bare spots larger than 1 square yard. Bare spots shall be scattered and the bare area shall not comprise more than 1 percent of any given area.

3.05 SITE CLEARING AND GRUBBING

A. Prior to starting construction operations, the Contractor shall remove all vegetative growth, debris, and other objectionable matter standing or lying on the surface within the limits of the areas to be excavated or filled; and shall demolish and remove such buildings and other structures as are specifically designated on the Drawings for removal.

B. Clearing shall be performed to provide access and to ensure the safety of employees working at the site of the Work.

C. The Contractor shall remove trees and plants in a manner so as to prevent injury to remaining trees, plants, and structures, which are to be preserved. All stumps shall be completely removed and disposed of in accordance with the requirements of this section.

D. The Contractor shall remove undergrowth and deadwood without disturbing sub soil. The Contractor shall not bury any vegetation or debris.

E. The Contractor shall saw cut along neat lines for removal of paving, curbs and gutters as required to perform the Work.

F. Unless directed otherwise by the City's Authorized Representative, the Contractor shall clear and grub the permanent easement or ten (10) feet, whichever is greater on each side of the pipeline before excavating. The Contractor shall remove all trees, growth, debris, stumps, and other objectionable matter. The Contractor shall clear the temporary easement only if necessary.

G. Materials to be cleared, grubbed, and removed from the site of the Work include, but are not limited to, all trees, stumps, roots, brush, trash, organic matter, paving, miscellaneous structures, debris, boulders, abandoned utilities and any other unsuitable material.

H. Grubbing shall consist of completely removing roots, stumps, trash, and other debris from all graded areas so that topsoil is free of roots and debris. Topsoil is to be left sufficiently clean so that further picking and raking will not be required.

I. All stumps, roots, foundations, and planking embedded in the ground shall be removed and disposed of. Piling and butts of utility poles shall be removed to a minimum depth of two (2) feet below the limits of excavation for structures, trenches, and roadways or two (2) feet below finish grade, whichever is lower.

J. Landscaping features shall include, but are not necessarily limited to, fences, cultivated, trees, cultivated shrubbery, property comers, man-made improvements, and subdivision and other signs within the right-of-way and easement. The Contractor shall take extreme care in moving landscape features and promptly re-establishing these features.

K. Surface rocks and boulders shall be grubbed from the soil and removed from the site of the Work if not suitable or required as riprap.

L. Where tree limbs interfere with utility wires, or where the trees to be felled are in close proximity to utility wires, the tree shall be taken down in sections to eliminate the possibility of damage to the utility.

M. Any work pertaining to utility poles shall comply with the requirements of the appropriate utility.

N. All fences adjoining any excavation or embankment that, in the Contractor's opinion, may be damaged or buried, shall be carefully removed, stored, and replaced. Any fencing that, in the City’s Authorized Representative’s opinion, is significantly damaged shall be replaced with new fence material to match the existing fence.

O. The Contractor shall exercise special precautions for the protection and preservation of trees, cultivated shrubs, sod, fences, etc. situated within the limits of the construction area but not directly within excavation and/or fill limits. The Contractor shall be held liable for any public or private property damage caused by the Contractor's operations.

P. Contractor to exercise extreme care to avoid causing any unnecessary disturbance to private property bordering the Site. The Contractor shall be responsible for all damages to existing structures, infrastructure, and adjacent properties resulting from the Contractor's operations.

3.06 REMOVAL OF EXISTING STRUCTURES AND MATERIALS

A. All existing structures encountered within the established lines, grades, or trenching sections shall be removed by the Contractor, unless such existing structures are otherwise specified to be relocated, adjusted up or down, salvaged, abandoned in place, reused in the Work, or to remain in place.

B. Should the Contractor encounter an existing structure (above or below ground) in the site of the Work for which the disposition is not indicated on the Drawings, the City's Authorized Representative shall be notified prior to disturbing such structure. The disposition of existing structures so encountered will be determined by the City's Authorized Representative in accordance with the provisions of the Contract

C. It is intended that all existing materials or structures that may be encountered (within the lines, grades, or trenching sections established for completion of the Work) be utilized in the Work if they are suitable and acceptable to the City's Authorized Representative. Such existing materials or structures which are not suitable or acceptable for use in the Work shall be disposed of as specified in this section.

3.07 TOPSOIL STRIPPING

A. The Contractor shall remove topsoil from areas to be further excavated or graded.

B. Excavated soil shall be stockpiled at an area approved by the City's Authorized Representative to a depth not exceeding 8 feet. Stockpiled soil shall be protected from erosion.

C. The Contractor shall not excavate wet soil.

3.08 BURNING OF MATERIAL ON THE SITE OF THE WORK

Burning of material on the site of the Work shall not be allowed.

3.09 MATERIAL STORAGE AND DISPOSAL

A. The Contractor shall stockpile excavated material off site within five (5) days of its removal from the excavation, to the satisfaction of the City's Authorized Representative, until required for backfill or fill. The Contractor shall place, grade, and shape stockpiles for proper drainage and erosion control.

B. All materials removed during site preparation and by excavation which are suitable for the purpose shall be used whenever practical for backfilling and

for such other purposes as may be shown on the Plans or directed by the City's Authorized Representative. All materials not used for such purposes shall be considered as waste materials and disposed of by the Contractor in an approved manner.

C. The toe of fill slopes will not be allowed to fall within stream or creek channels unless so noted on the Plans or directed by the City's Authorized Representative. No material shall be deposited within the flood plain of any stream.

D. The Contractor shall locate and retain soil materials away from the edge of excavations. The Contractor shall not store soil materials within drip line of trees indicated to remain.

E. Waste, loose soil, or other materials removed from the right-of-way or channel relocations shall not be deposited in streams. Depositing material along stream banks where it could be washed away by high stream flows will not be permitted. Surplus material may be deposited only in disposal areas approved by the City's Authorized Representative. All disposal areas shall be dressed and treated with erosion control items in accordance with the requirements of Section 02125, Temporary and Permanent Erosion and Sediment Control.

F. Fuels, oils, bitumen, or other greasy or chemical substances originating from construction operations shall not be allowed to enter or be placed where it may contaminate soil, groundwater, or surface water.

G. On completion of any part of the Work, proper disposal shall be made of all surplus or unused materials left within the construction limits of such work and the surface of the Work shall be left in a neat and workmanlike condition.

H. All waste material resulting from site preparation and excavation activities shall be disposed of in accordance with the regulations established by the United States Environmental Protection Agency (EPA), the Georgia Department of Natural Resources, Environmental Protection Division (EPD), and in a manner approved by the City's Authorized Representative.

3.10 REMOVAL AND MANAGEMENT OF CONTAMINATED AND HAZARDOUS MATERIALS

If contaminated material is encountered during site preparation, abandonment, excavation, trenching, or any other activities at the site of the Work, the Contractor shall immediately notify the City's Authorized Representative. Contaminated material shall be removed and managed in accordance with applicable Federal, State, and local laws and regulations.

3.11 DISPOSAL OF DEBRIS

The debris resulting from site preparation operations shall be hauled to a disposal site secured by the Contractor and shall be disposed of in accordance with all requirements of Federal, State, and local laws and regulations. No debris of any kind shall be deposited in any stream or body of water, or in any street or alley. In no case shall any material or debris be left on the site of the Work, shoved onto abutting private properties, or buried on the site of the Work.

+ + + END OF SECTION 02200 + + +

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SECTION 02110
CLEARING AND GRUBBING

PART 1 GENERAL

1.01 SCOPE

A. Work described in this Section includes furnishing all labor, equipment, tools and incidentals required for all clearing and grubbing including, but not limited to, the removal of trees, stumps, roots, brush, structures, abandoned utilities, trash, debris and all other materials found on or near the ground surface within the construction area. Precautionary measures to prevent damage to existing features to remain shall be part of the work.

B. Clearing and grubbing operations shall be coordinated with temporary and permanent erosion control procedures.

1.02 QUALITY CONTROL

A. The Contractor shall comply with applicable codes, ordinances, rules, regulations, and laws of local, municipal, state or federal authorities having jurisdiction over the Project. All required permits of a temporary nature shall be obtained for construction operations by the Contractor.

B. Burning shall not be allowed.

1.03 JOB CONDITIONS

A. Location of the Work: As show in the Drawings. The area to be cleared and grubbed shall be the minimum required to perform the Work.

B. Protection of Existing Improvements: Provide barricades, coverings, or other types of protection necessary to prevent damage to existing improvements. Protect improvements on adjoining properties as well as those on the project site. Restore improvements damaged by this work to their original condition, as acceptable to the City's Authorized Representative. Replace property line monuments (such as iron pins) removed or disturbed by clearing operations under the direction of a Land Surveyor licensed in the State of Georgia.

C. Protection of Existing Tress and Vegetation: Protect existing trees and other vegetation to avoid cutting, breaking or skinning of roots, skinning and bruising of bark, smothering of trees by stockpiling construction materials or excavated materials within drip lines, foot or vehicular traffic, and parking of vehicles or equipment within drip line. Provide temporary fences, barricades or guards as required to protect trees and vegetation to be left standing. Provide protection for tree roots over

1-1/2 inches diameter that are cut during any construction operation. Coat the cut faces with emulsified asphalt, or other acceptable coating, especially formulated for horticultural use on cut or damaged plant tissues. Temporarily cover all exposed roots of trees with wet burlap to prevent roots from drying out; provide earth cover as soon as possible. Repair or replace damaged trees and vegetation resulting from any construction operation, in a manner acceptable to the City's Authorized Representative. A qualified arborist approved by the City's Authorized Representative shall perform tree damage repair at no cost to the City. Replace damaged trees that cannot be repaired and restored to full-growth status, as determined by the City's Authorized Representative.

PART 2 PRODUCTS

EQUIPMENT

The Contractor shall furnish equipment with operators of the type normally used in clearing and grubbing operations including, but not limited to, tractors, trucks, loaders and root rakes.

PART 3 EXECUTION

3.01 SCHEDULING OF CLEARING

A. The Contractor shall clear only that length of the right-of-way, permanent or construction easement which would be the equivalent of one month's pipe laying.

B. The City's Authorized Representative may permit clearing for additional lengths of the pipeline provided that temporary erosion and sedimentation controls are in place and a satisfactory stand of grass is established. Should a satisfactory stand of grass not be possible, no additional clearing shall be permitted beyond that specified above.

C. A satisfactory stand of grass shall have no bare spots larger than one square yard. Bare spots shall be scattered and the bare area shall not comprise more than one percent of any given area.

3.02 EXISTING TREES AND VEGETATION

Avoid cutting or injuring trees and vegetation outside the construction limits. The Contractor shall be responsible for damages outside these limits.

3.03 CLEARING AND GRUBBING

A. Clear and grub the permanent easement on each side of the pipeline before excavating. Remove all trees, growth, debris, stumps and other objectionable matter. Clear the construction easement or road right-of-way only if necessary.

B. Materials to be cleared, grubbed and removed from the site include, but are not limited to, all trees, stumps, roots, large rocks, brush, trash, organic matter, paving, miscellaneous structures, houses debris and abandoned utilities.

C. Grubbing shall consist of completely removing roots, stumps, trash and other debris in the earthwork area so that topsoil is free of roots and debris. Topsoil is to be left sufficiently clean so that further picking and raking will not be required.

D. All stumps, roots, sheeting foundations and planking embedded in the ground shall be removed and disposed of. Stumps and roots larger than 1 inch shall be grubbed and removed to a depth not less than 4 feet below grade. All holes or cavities, which extend below the subgrade elevation of the proposed work shall be filled with crushed rock or other suitable material, compacted to the same density as the surrounding material.

E. Landscaping features shall include, but not necessarily limited to, fences, cultivated trees, cultivated shrubbery, property corners, man-made improvements, subdivision and other signs within the right-of-way and easement. The Contractor shall take extreme care in moving landscape features and promptly re-establishing these features.

F. Surface rocks and boulders larger than 6" on its longest side shall be grubbed from the soil and removed from the site.

G. Where the tree limbs interfere with utility wires, or where the trees to be felled are in close proximity to utility wires, the tree shall be taken down in sections to eliminate the possibility of damage to the utility.

H. Any work pertaining to utility poles shall comply with the requirements of the appropriate utility.

I. All fences adjoining any excavation or embankment that, in the Contractor's opinion, may be damaged or buried, shall be carefully removed, stored and replaced. Any fencing that, in the City's Authorized Representative's opinion, is significantly damaged shall be replaced with new fencing material at the Contractor's expense.

J. Burying of any materials and organics shall not be allowed.

K. The Contractor shall exercise special precautions for the protection and preservation of trees, cultivated shrubs, sod, fences etc. situated within the construction area but not directly within excavation and/or fill limits. The Contractor shall be held liable for any damage Contractor's operations inflict on such property. construction area

L. The Contractor shall be responsible for all damages to existing improvements resulting from Contractor's operations.

3.04 DISPOSAL OF DEBRIS

The debris resulting from the clearing and grubbing operation shall be hauled to a disposal site secured by the Contractor and shall be legally disposed of in accordance with all requirements of federal, state, county and municipal regulations. No refuse of any kind shall be deposited in any stream or body of water, or in any street or alley. In no case shall any material be left on the site, shoved onto abutting private properties, or buried on the Project Site.

3.05 KUDZU REMOVAL

A. The Contractor shall remove and eradicate all kudzu from the construction limits.

B. During the growing season, treat the emerging and existing growth with dicotyledon selective herbicide as per the manufacturer's directions and wait two weeks before starting the clearing and grubbing of the kudzu.

C. Remove the kudzu and roots by mechanical means. Hand clear the remaining roots.

D. Treat emerging growth with dicotyledon selective herbicide as per manufacturer's direction. After two weeks, remove the remaining kudzu.

E. Continue herbicide applications and removal of emerging kudzu as necessary.

F. Do not spill on slopes or other grassed areas. Keep the spray controlled so that it does not enter the waters of the State. Repair vegetated areas damaged by careless handling or overspray of the herbicide at no additional expense to the Owner.

+ + + END OF SECTION 02110 + + +

SECTION 02125
TEMPORARY AND PERMANENT EROSION AND SEDIMENTATION CONTROL

PART 1 GENERAL

1.01 SCOPE

A. Work under this section includes furnishing all labor, materials, equipment and incidentals required to install and maintain temporary and permanent erosion and sedimentation controls as shown on the Drawings and as specified herein. Work under this Section also includes the subsequent removal of temporary erosion and sedimentation controls at completion of the project.

B. Temporary and permanent erosion and sedimentation controls include mulching and grassing of disturbed areas and structural barriers at those locations which will ensure that erosion during construction will be maintained within acceptable limits. Acceptable limits are as established by the Georgia Environmental Protection Division (EPD) and applicable codes, ordinances, rules, regulations and laws of local and municipal authorities having jurisdiction.

C. The temporary and permanent erosion and sedimentation control measures shown on the Drawings are minimum requirements. The Contractor shall notify the City's Authorized Representative of any changes and/or additions to the erosion and sedimentation control measures necessary to accommodate the Contractor's means and methods of operation. Any additional erosion and sedimentation control measures required by the Contractor's means and methods of operation will be installed by the Contractor at no additional cost to the City.

D. The Contractor shall be solely responsible for the control of erosion and sediment production within the Project area. The Contractor shall install controls that will ensure that storm water and drainage from the disturbed area of the Project site will be filtered or otherwise managed to minimize impacts on receiving waters and/or existing storm drains. Discharged waters shall be free of soil particles and shall meet all applicable permit turbidity requirements.

1.02 SUBMITTALS

Submittals shall be made in accordance with the requirements of 01300 Submittals.

1.03 QUALITY CONTROL

A. The Contractor shall designate a worksite erosion control supervisor. The supervisor shall have the responsibility and authority to coordinate all equipment, personnel and materials needed to maintain project site erosion and sediment control in accordance with the management practices and standards established in the Manual for Erosion

and Sediment Control in Georgia and the Drawings and Specifications.

B. Within fifteen (15) days after receipt of the Notice to Proceed, the Contractor shall submit the name and contact data for the designated erosion control supervisor. The supervisor shall be an individual with an active minimum Level 1 certification as issued by the Georgia Soil and Water Conservation Commission.

PART 2 PRODUCTS

2.01 MATERIALS

A. Silt fence: Silt fence shall be as detailed on the Drawings and shall meet the requirements of the latest version of the Georgia Soil and Water Commission Manual for Erosion and Sediment Control.

B. Hay bales shall be clean, seed-free cereal hay type, rectangular in shape.

C. Woven wire fence backing shall be ½-inch, galvanized steel, chicken-wire mesh.

D. Filter stone shall be crushed rock conforming to Georgia Department of Transportation Table 800.01, Size Number 57.

E. Concrete block shall be hollow, non-loadbearing type.

F. Concrete shall be 3000 psi in accordance with Section 03300, Cast-in-Place Concrete.

G. Plywood shall be ¾-inch thick exterior type.

2.02 RIP RAP

A. Use only one method throughout the Project.

B. Stone Rip Rap shall consist of sound, tough, durable stones resistant to the action of air and water. Slabby or shaley pieces will not be acceptable. Specific gravity shall be 2.0 or greater. Rip rap shall have less than 66 percent wear when tested in accordance with AASHTO T-96. Unless shown on the Drawings or specified otherwise, stone rip-rap shall be type 3.

1. Type 1 Rip Rap: The largest pieces shall have a maximum approximate volume of two cubic feet. At least 35 percent of the mass shall be comprised of pieces which weigh 125 pounds or more. The remainder shall be well graded down to the finest sizes. Rock fines shall comprise a maximum of 10 percent of the total mass. Rock fines are defined as material passing a No. 4 sieve. Rip rap size shall conform to Georgia Department of Transportation Standard Specification Section 805 - Stone Dumped Rip Rap, Type 1.
2. Type 3 Rip Rap: The largest pieces shall have a maximum approximate volume of one cubic foot. At least 35 percent of the mass shall be comprised of pieces which weigh 15

pounds or more. The remainder shall be well graded down to the finest sizes. Rock fines shall comprise a maximum of 10 percent of the total mass. Rock fines are defined as material passing a No. 4 sieve. Rip rap size shall conform to Georgia Department of Transportation Standard Specification Section 805 - Stone Dumped Rip Rap, Type 3.

3. Rock Rip Rap: Refer to Section 02126

2.03 FILTER FABRIC

Filter fabric for use under rip-rap shall meet the requirements of GDOT Standard Specification Section 881.2.05 for plastic filter fabric.

2.04 CONSTRUCTION EXIT STONE

Stone shall be sound, tough, durable stone resistant to the action of air and water. Slabby or shaley pieces will not be acceptable. Aggregate size shall be in accordance with the National Stone Association Size R-2 (1.5 to 3.5-inch stone) or Type 3 Riprap as specified in paragraph 2.02 of this Section.

2.05 GRASS

Permanent grass shall be of the same type that existed prior to construction.

2.06 WATER

A. Water shall be free of excess and harmful chemicals, organisms and substances which may be harmful to plant growth or obnoxious to traffic. Salt or brackish water shall not be used.

B. Water shall be furnished by the Contractor.

2.07 EROSION CONTROL FABRIC

Erosion control fabric shall be equal to Futerra Erosion Control Blanket manufactured by Profile Products LLC. Fabric shall be a non-woven erosion control/vegetation blanket comprised of wood fiber and crimped, interlocking synthetic fibers laminated by an accelerated photodegradable polypropylene netting. Fabric shall be 100% bio-degradable and photo-degradable within 10 months of installation.

PART 3 EXECUTION

3.01 GENERAL

A. Basic Principles:

1. Conduct the earthwork and excavation activities in such a manner to fit the topography, soil type and condition.
2. Minimize the disturbed area and the duration of exposure to erosion elements.

3. Stabilize disturbed areas within 13 days of completed work.
4. Safely convey run-off from the site to a stable outlet.
5. Retain sediment on site that is generated on site.
6. Minimize encroachment upon watercourses.

B. Temporary Erosion and Sedimentation Control: Temporary erosion and sedimentation control procedures shall be directed toward:

1. Preventing soil erosion at the source.
2. Preventing silt and sediment from entering any waterway if soil erosion cannot be prevented.
3. Preventing silt and sediment from migrating downstream in the event it cannot be prevented from entering the waterway.

C. Permanent Erosion Control: Permanent erosion control measures shall be implemented to prevent sedimentation of waterways and to prevent erosion of the Project site.

3.02 SEDIMENTATION AND EROSION CONTROL MEASURES

A. Temporary and permanent erosion and sedimentation control measures shall prevent erosion and prevent sediment from exiting the site. If, in the opinion of the City's Authorized Representative, the Contractor's temporary erosion and sedimentation control measures are inadequate, the Contractor shall provide additional maintenance for existing measures or additional devices to control erosion and sedimentation on the site at no additional cost to the Owner.

B. All erosion and sedimentation control devices and structures shall be inspected by the Contractor daily and immediately prior to and after each rainfall occurrence. Any device or structure found to be damaged shall be repaired or replaced by the end of the day. Sediment ponds shall be cleaned out prior to the silt reaching the height or elevation shown on the Drawings. The contractor copy the Owner on the daily reports.

C. All erosion and sedimentation control measures and devices shall be constructed and installed as shown on the Drawings or specified herein and maintained until adequate permanent disturbed area stabilization has been provided or permanent pavement has been installed and accepted by the City's Authorized Representative. After adequate permanent stabilization has been provided or permanent pavement has been installed and accepted by the City's Authorized Representative, all temporary erosion and sedimentation control structures and devices shall be removed.

3.03 SEDIMENT CONTROL

A. Construction Exit:

1. Construction exit(s) shall be placed as shown on the Drawings and as directed by the City's Authorized Representative. A construction exit shall be located at any point traffic will be leaving a disturbed area to a public right-of-way, street, alley, sidewalk or parking area.
2. Placement of Construction Exit Material: The ground surface upon which the construction exit material is to be placed shall be prepared to a smooth condition free from obstructions, depressions or debris. The plastic filter fabric shall be placed to provide a minimum number of overlaps and a minimum width of one foot of overlap at each joint. The stone shall be placed with its top elevation conforming to the surrounding roadway elevations. The stone shall be dropped no more than three feet during construction.
3. Construction Exit Maintenance: The Contractor shall regularly maintain the exit with the top dressing of stone to prevent tracking or flow of soil onto public rights-of-way and paved surfaces as directed by the City's Authorized Representative.
4. Construction Exit Removal: Construction exit(s) shall be removed and properly disposed of when the disturbed area has been properly stabilized, the tracking or flow of soil onto public right-of-way or paved surfaces has ceased and as directed by the City's Authorized Representative.

B. Sediment Barriers:

1. Sediment barriers shall include, but are not necessarily limited to, silt fences, hay bales, rock check dams and inlet sediment traps and any device which prevents sediment from exiting the disturbed area.
2. Silt fences, hay bales and rock check dams shall not be used in any flowing stream, creek or river.
3. Sediment barriers shall be installed as shown on the Drawings and as directed by the City's Authorized Representative.
4. Sediment barriers shall be maintained to ensure the depth of impounded sediment is no more than one half of the original height of the barrier or as directed by the City's Authorized Representative. Torn, damaged, destroyed or washed out barriers shall be repaired, reinforced or replaced with new material and installed as shown on the Drawings and as directed by the City's Authorized Representative.
5. Sediment Barrier Removal:
    a. Sediment barrier shall be removed once the disturbed area has been stabilized with a permanent vegetative cover or permanent pavement has been installed and the sediment barrier is no longer required as directed by the City's Authorized Representative.
    b. Accumulated sediment shall be removed from the barrier and removed from the site.
    c. All non biodegradable parts of the barrier shall be disposed of properly. The hay bales may be spread evenly across disturbed areas as a mulching material.
    d. The disturbed area created by barrier removal shall be permanently stabilized.

1.04 EROSION CONTROL

A. Grassing:

1. Grassing shall be as specified in paragraph 3.05 of this Section
2. Temporary Stabilization: Temporary stabilization shall be provided as shown on the Drawings and conforming to these Specifications to control erosion on the site. Temporary stabilization shall be provided to any area which will not receive permanent stabilization within the next 14 calendar days. Partial payment requests may be withheld for those portions of the Project not complying with this requirement.
3. Permanent Stabilization
   a. Permanent stabilization shall be provided as shown on the Drawings and conforming to these Specifications to control erosion on the site. Permanent stabilization shall be provided to all areas of land disturbance within seven calendar days of the completion of land disturbance for any area greater than 0.25 acre. Partial payment requests may be withheld for those portions of the Project not complying with this requirement.
   b. Grass or sod removed or damaged in residential areas shall be replanted with the same variety within seven calendar days of the completion of work in any area.
   c. Where permanent stabilization cannot be immediately established because of an inappropriate season, the Contractor shall provide temporary stabilization. The Contractor shall return to the site at the appropriate season to provide permanent stabilization in areas that received only temporary stabilization.

B. Erosion Control Blanket:

1. Erosion control blankets shall be applied to sloped areas as indicated on the Drawings and where in excess of 2 to 1 slope. Blankets shall be laid on finished grades that have been seeded, insuring good contact with the soil. Soil surface shall be smooth and free of rocks, roots, debris and other obstructions.
2. Secure blankets with biodegradable staples or stakes at the top of slopes in a 6-inch deep x 6-inch wide anchoring trench. Secure blankets with staples or stakes per the manufacturer's recommendations, increasing the spacing at overlapping edges. Blankets shall be overlapped by a minimum of 8-inches. Provide a 6-inch deep x 6-inch wide anchoring trench at the toe of the slope or shoreline.

3.05 GRASSING

A. General:

1. Refer to Section 02933, Seeding for detailed specifications on permanent seeding.
2. When final grade has been established, all bare soil, unless otherwise required by the Contract Documents, shall be seeded, fertilized and mulched in an effort to

restore to a protected condition.

3. Specified permanent grassing shall be performed at the first appropriate season following establishment of final grading in each section of the site.

4. All references to grassing, unless noted otherwise, shall relate to establishing permanent vegetative cover as specified herein for seeding, fertilizing, mulching, etc.
5. Permanent grassing shall be of a perennial species.

B. Grassing activities shall comply with Section 02933, Seeding and the Georgia Soil and Water Commission Manual for Erosion and Sediment Control, 2016 Edition, specifically for the selection of species, planting dates and application rates for seeding, fertilizer and mulching. Where permanent vegetative cover (grassing) cannot be immediately established (due to season or other circumstances) the Contractor shall provide temporary vegetative or mulch cover.

3.06 RIP-RAP

A. Unless shown otherwise on the Drawings, rip-rap shall be placed at all points where banks of streams or drainage ditches are disturbed by excavation, or at all points where their natural vegetation is removed. Carefully compact backfill and place rip rap to prevent subsequent settlement and erosion. This requirement applies equally to construction alongside a stream or drainage ditch as well as crossing a stream or drainage ditch.

B. When trenching across a creek, place rip-rap a distance of 10 feet upstream and 10 feet downstream from the top of the trench excavation. Place rip rap across creek bottom, across creek banks and extend rip-rap placement five feet beyond the top of each creek bank.

C. Preparation of Foundations

1. The ground surface upon which the rip rap is to be placed shall be brought in close conformity to the correct lines and grades before placement is commenced. Where filling of depressions is required, the new material shall be compacted with hand or mechanical tampers.
2. Unless at creek banks or otherwise shown or specified, rip-rap shall begin in a toe ditch constructed in original ground around the toe of the fill or the cut slope. The toe ditch shall be two feet deep in original ground, and the side next to the fill or cut shall have that same slope. After the rip-rap is placed, the toe ditch shall be backfilled.

D. Placement of Filter Fabric

1. The surface to receive fabric shall be prepared to a relatively smooth condition free from obstructions, depressions and debris. The fabric shall be placed with the

long dimension running up the slope and shall be placed to provide a minimum number of overlaps. The strips shall be placed to provide a minimum width of one foot of overlap for each joint. The filter fabric shall be anchored in place with securing pins of the type recommended by the fabric manufacturer. Pins shall be placed on or within 3-inches of the centerline of the overlap. The fabric shall be placed so that the upstream strip overlaps the downstream strip. The fabric shall be placed loosely so as to give and therefore avoid stretching and tearing during placement of the stones.

2. The fabric shall be protected at all times during construction from clogging due to clay, silts, chemicals or other contaminants. Any contaminated fabric or any fabric damaged during its installation or during placement of rip-rap shall be removed and replaced with uncontaminated and undamaged fabric at no expense to the City.

E. Placement of Rip-Rap:

1. The rip-rap shall be placed on a 6-inch layer of soil, crushed stone or sand overlaying the filter fabric. This 6-inch layer shall be placed to maximize the contact between the soil beneath the filter fabric and the filter fabric. Rip-rap shall be placed with its top elevation conforming to the finished grades or the natural slope of the stream bank and stream bottom.
2. The stones shall be dropped no more than 3 feet during construction.
3. Stone rip-rap shall be dumped into place to form a uniform surface and to the thickness specified on the Drawings. The thickness tolerance for the course shall be -6-inches and +12-inches. If the Drawings do not specify a thickness, the course shall be placed to a thickness of not less than 18-inches.

3.07 CLEAN-UP

Remove and dispose of all excess erosion and sedimentation control devices and materials when no longer needed or at the completion of construction as directed by the City's Authorized Representative.

+ + + END OF SECTION 02125 + + +

SECTION 02150
SHEETING, SHORING AND BRACING

PART I GENERAL

1.01 SCOPE

A. This section specifies requirements for sheeting, shoring, and bracing of trenches and excavations. Where shoring, sheeting, bracing or other supports are necessary, they shall be furnished, placed, maintained, and except as specified otherwise, removed by the Contractor.

B. Design Requirements:

1. The design, planning, installation and removal, if required, of all sheeting, shoring, lagging, and bracing shall be accomplished in such a manner as to maintain the required excavation or trench section and to maintain the undisturbed state of the soils below and adjacent to the excavation.
2. The Contractor shall design sheeting, shoring, and bracing in accordance with the OSHA Safety and Health Standards as well as state and local requirements.
3. Horizontal strutting below the barrel of a pipe and the use of pipe as support are not acceptable.
4. When the construction sequence of structures requires the transfer of bracing to the completed portions of any new structure or to any existing structure, the Contractor shall provide the City's Authorized Representative with a complete design analysis of the expected impact of that bracing on the structure. This action shall in no way absolve the Contractor of responsibility of damage resulting from said bracing.

1.02 REFERENCES

This section contains references to the following documents. They are a part of this section as specified and modified. In case of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Reference	Title
OSHA 2226-10R 2015	Trenching and Excavation Safety

1.03 SUBMITTALS

A. Prior to starting any excavation work requiring sheeting, shoring, and bracing, the Contractor shall submit his plans for trench and excavation support systems to the City's Authorized Representative as working drawings in accordance with the requirements of 01300 Submittals. No provisions of the above requirements shall be construed as relieving the Contractor of his overall responsibility and liability for the work.
B. The Contractor shall submit a Certification of Compliance properly identified with the project name and project location. The Certification shall state that the sheeting, shoring and bracing have been designed in accordance with the prevailing codes and standards by a Professional Engineer registered in the State of Georgia with the Professional Engineer's seal and signature appearing on the certification. Calculations shall not be submitted unless specifically requested by the City's Authorized Representative.
C. If the work is to be 20 feet or deeper, the support of excavation plan shall be sealed by a Professional Engineer registered in the State of Georgia and submitted for approval prior to excavation being performed.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

GENERAL

A. The construction of sheeting, shoring and bracing shall not disturb the state of soil adjacent to the trench and below the excavation bottom.

B. Trench sheeting below the top of a pipe shall be left in place.

C. Excavation shall not be started until the design for support systems has been accepted by the City's Authorized Representative.

+ + + END OF SECTION 02150 + + +

SECTION 02200
EARTHWORK

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. The work covered by this Section consists of furnishing all labor, equipment, and material and performing all operations in connection with excavation, filling and grading, to the lines and grades shown on the drawings and as specified herein.

B. Reference Sections

1. Section 02010 – Geotechnical Data
2. Section 02290 – Dewatering
3. Section 02295 – Excavation Support

1.02 REFERENCE STANDARDS

A. Definitions and Reference Standards:

1. ASTM: Specifications of the American Society for Testing and Materials.

2. ACI: American Concrete Institute.

3. EPA: Environmental Protection Agency.

4. Standard Specifications for Highways and Bridges, Commonwealth of Massachusetts, dated 1988 shall be referred to hereinafter as the "Standard Specifications".

1.05 SUBMITTALS

A. General: Submittals shall be made in compliance with the requirements of Special Provisions. The Contractor shall submit the information specified herein to the Engineer for review.

B. Backfill Samples:

1. Deliver to the Engineer (on site) at least five working days prior to use, a representative bag sample for each proposed backfill material. Each sample shall be clearly labeled as to source of material, proposed use, sieve analysis, date of delivery, and shall weigh approximately 25 lbs.

C. Site Characterization of All Off-site Borrow Sources:

1. The following information shall be submitted to the Engineer for review at least three weeks prior to use as an off-site borrow source. No soil materials shall be brought to the site without approval by the Engineer.

2 Site Data: Information regarding the off-site borrow source and material, as follows:

a. location of the site;
b. present and past usage of the source site and material;
c. any previously existing report(s) associated with an assessment of the source site as relates to the presence of oil or hazardous materials;
d. location within the site from which the material will be obtained.

D. Temporary Excavation Support:

1. Where excavations are greater than twelve feet deep or require more than one level of bracing, the Contractor shall prepare calculations and working drawings for the temporary excavation support system. The design calculations and drawings shall be prepared, stamped, and signed by a professional Engineer registered in the State of Georgia, who is experienced in designing excavation support systems.

1.06 QUALITY ASSURANCE

A. Comply with all rules, regulations, laws and ordinances of the State of Georgia and of all other authorities having jurisdiction. All labor, materials, equipment and services necessary to make work comply with such requirements shall be provided without additional cost to the Owner.

B. Field Monitoring and Testing:

1. The Contractor shall employ and pay an independent testing agency to test, observe and document the Contractor's on-site earthwork activities related to material gradation and compaction to determine if the work is completed in accordance with the Project Specifications.

2. All fill materials and their placement will be subject to quality control testing. The Contractor will bear the cost of any tests which are needed to correct previously unacceptable work.

3. Approvals given by the Engineer will not relieve the Contractor of his responsibility for performing the work in accordance with the Contract Documents.

1.07 JOB CONDITIONS

A. Site and Subsurface Conditions:

1. The Contractor is advised that remains of foundations and slabs of structures, and other miscellaneous rubble may be present below grade. The extent and locations of all these structures have not been determined.

1.08 LINES AND GRADES

A. Lay out all lines and grade work not presently established at the site in accordance with Drawings and Specifications. Survey control shall be established by a Registered Land Surveyor. Maintain all established bounds and bench marks and replace as directed any which are destroyed or disturbed.

B. The words "finished grades" as used herein shall mean the required final grade elevations indicated on the Drawings. Spot elevations shall govern over proposed contours.

C. The word "subgrade" as used herein, means the required surface of subsoil, borrow fill or compacted fill. This surface is immediately beneath site improvements, specially dimensioned fill, paving, topsoil or other surfacing material.

1.09 PROTECTION OF UNDERGROUND FACILITIES

A. The Contractor's attention is directed to the necessity of making her/his own investigation in order to assure that no damage to existing structures, drainage lines, utilities or conduits, will occur.

PART 2 PRODUCTS

2.01 MATERIALS

A. Subbase Material: Compacted Granular Fill or Structural Fill: Compacted Granular Fill or Structural Fill shall be sandy gravel or gravely sand, free of organic material, loam, snow, ice, frozen soil and other objectionable materials, well-graded within the following limits:

U.S. Standard Sieve Size	Percent Finer Maximum	Percent Passing Minimum
4 in.	---	100
1/2 in.	85	50
#4	75	40
#10	35	10
#100	20	5
#200	10	2

B. Pipe Bedding Material and Drainage Layer: Bedding/Drainage Material under loam and around utilities shall be natural mineral sand within the following limits:

U.S. Standard Sieve Size	Percent Finer Maximum	Percent Passing Minimum
1/2 in.	---	100
3/8 in.	100	85
#4	100	60
#16	80	35
#50	55	10
#200	10	2

C. Gravel Borrow (Aggregate):

1. Gravel borrow shall be processed fill material consisting of inert material that is hard durable stone and coarse sand, free from loam and clay, surface coatings, and deleterious materials. Gradation requirements shall be determined by AASHTO T11 and T27 and shall conform to Section M1.03.0, Type b of the Massachusetts Highway Department Standard Specifications:

U.S. Sieve No.	Percent Passing By Weight
3 in.	100

1/2”	50-85
#4	40-75
#50	8-28
#200	0-8

D. Crushed Stone: Crushed stone shall consist of clean, hard, durable natural rock, free of organic matter, rock dust and other contaminants and conforming to Massachusetts Highway Department Specification M2.01.3.

E. Ordinary Borrow: Ordinary borrow shall consist of well-graded mineral soil substantially free of organic materials, loam, wood, trash and other objectionable material which may be compressible or which cannot be compacted properly. Ordinary borrow shall be unfrozen and shall not contain snow, ice or frozen materials. Ordinary borrow shall not contain stones larger than six (6) inches in largest dimension and shall have physical properties such that it can be readily spread and compacted. Ordinary borrow shall conform to Massachusetts Highway Department Specification Section M1.01.0 .

F. All off-site soil materials to be used as fill or backfill will be evaluated, based on information submitted by the Contractor to the Engineer, in accordance with current environmental practice in the Commonwealth of Massachusetts. The evaluation will be based on site characterization data and/or, if required, chemical test results submitted by the Contractor to the Engineer. Materials may be rejected for use based on the results of the evaluation. Off-site materials which are rejected for use, if brought to the site, shall be removed by the Contractor at his own expense.

2.02 TEMPORARY STEEL PLATES

A. Temporary steel plates shall be placed over all saw cuts and trenches in roadway areas that will be subjected to traffic during installations and over any lighting and electric handholes to allow for the passage of vehicular traffic and they shall be designed to size and thickness capable of supporting HS-20 loading, but in no case shall thickness be less than one (1) inch. The Contractor shall submit for approval by the Engineer, design criteria and calculations that determine the sizes to be used. Bituminous concrete shall be placed around the edges of the steel plating to the satisfaction of the Engineer, to hold the plates in place and so that vehicles can achieve a smooth transition on and off the plates. When the steel plating is removed the temporary bituminous concrete shall also be completely removed to the satisfaction of the Engineer.

2.03 FILTRATION FABRIC

A. Filter fabric for lining pipe trenches shall be Mirafi 140N fabric as manufactured by the Nicolon Mirafi Group, Trevia 011/2550 as manufactured by Contech Construction Products Inc., GTF-150EX as manufactured by Exxon Chemical Co. or equal.

PART 3 EXECUTION

3.01 CLEARING AND PREPARATION

A. Remove and separate from excavated soil and properly dispose of all organic matter, asphalt paving, concrete and other non-soil materials encountered during excavation operations.

B. Locate existing underground utilities in the areas of work. If utilities are to remain in place, provide adequate means of protecting during excavation operations.

C. Should uncharted, or incorrectly charted, piping or other utilities be encountered during excavation, consult the Engineer immediately for directions. Cooperate with the Engineer, and public utility service companies as required to keep their respective services and facilities in operation. Repair damaged utilities to the satisfaction of the Owner.

3.02 EXCAVATION

A. The work shall consist of the excavation, reuse and, if required the off-site disposal of soils and other materials that may be encountered down to subgrade elevation as shown on the drawings, specified herein, and as may be required to provide suitable materials for firm bearing stratas for the proposed construction of pavements and structures. No structures, pavements, utilities or fill materials of any kind shall be placed in, or upon, excavated areas until such areas have been inspected and approved by the Engineer.

1. The proposed contour lines and spot grades on the grading plans are finish elevations. Excavation to subgrade shall be the distance below these elevations as may be required by the size and thickness of pavements, structures, utilities and surface treatments as shown on the plans, details and sections.

B. The work of excavation shall be conducted in such locations, at such rates of progress, and in such a manner to ensure the continued progress of the work. The sequence of all excavation operations shall ensure the most efficient utilization of excavated materials for backfill and subgrade preparation.

C. All materials encountered during excavation shall be considered unclassified excavation and shall include, but not be limited to, the removal of base courses, earth, boulders and rock less than 1/2 cubic yard, concrete foundations, unbroken pavement, abandoned utilities, and rubble. All excavated material, excluding soil, shall become the property of the Contractor and shall be removed from the site and legally disposed of. Excavated soil shall be stockpiled as directed by the Engineer. The Engineer shall designate which

materials are suitable for reuse and which must be properly disposed of. The Contractor shall cooperate or assist in material sampling operations as part of the work.

D. Excavate all materials to the elevations, dimensions, and form as shown on the drawings for the construction of underground structures, foundations, slabs, utilities and pavements necessary for the completion of work. Excavate to elevations indicated or required to allow structures to rest on firm undisturbed earth or rock, free of loose materials.

E. Foundation excavation shall be carried to the grade lines as indicated or as required to permit the surfaces to be located at proper levels and on firm bearing stratas.

1. The Contract Lump Sum Price shall include all costs associated with the excavation for the installation of the footings and shall be based on the assumed bottom of footing elevations indicated on the drawings plus or minus three (3) feet.

2. The actual depth of excavation for footing installation shall be determined and measured in the field by the Engineer. Upon completion of excavation to bottom of footings, the total excavation depth will be determined based on the summation of the depth at each footing location, complete in place, measured from grade to bottom of footing. Should the total excavation depth be greater or less than three (3) feet from which the proposed Contract Lump Sum Price is based, payment to the Contractor or credit to the Owner will be made based on a unit price of eight dollars per cubic yard ($8/cy).

F. Bottom of excavations shall be protected from frost. Work shall not be placed on frozen ground nor shall work be placed on wet unstable ground.

G. After completion of the excavation and prior to commencement of construction, the excavation will be inspected by the Engineer to ensure that foundation elevations have been reached and that the subgrade is suitable to support the structure to be placed thereon, and, if not, what additional work is required to correct the conditions. The Contractor shall perform any additional preparation work at no cost to the Owner.

H. Excavated material shall not be deposited or stockpiled at any time so as to endanger portions of any new or existing structures, either by direct pressure or indirectly by overloading banks contiguous to the operation.

I. During earthwork operations if the Engineer determines that the existing soils are unsuitable they shall be excavated and stored on-site. The new exposed subgrade shall be compacted and the area backfilled and compacted with approved material. The exact location, extent and volume of unsuitable soils will be determined in the field by the Engineer. Excavation of these materials shall be done in the presence of the Engineer who will verify the volume of material removed.

J. Excavate utility trenches to the geometric lines and grades indicated on the Drawings for the particular item to be installed. Trench walls shall be as vertical as possible and the Contractor shall provide the necessary protection to support these walls.

1. Perform excavation operations in trenches in general conformance with "OSHA Standards and Interpretations, Subpart P - Excavation, Trenching and Shoring."

2. Prepare the bottom of the trench excavation to receive bedding material and pipes in accordance with respective specifications for utilities to be placed in the trenches.

3.03 TEMPORARY EXCAVATION SUPPORT

A. It is the responsibility of the Contractor to provide safe and stable excavations in earth and rock at all times during construction until the permanent structures shown on the Drawings have been constructed/completed, achieve adequate strength, and are accepted by the Engineer as being complete.

B. The Contractor shall furnish, place and maintain such sheeting, shoring, and bracing at locations necessary to support the sides of excavations and to prevent danger to persons or damage to pavements, facilities, utilities, or structures, and to prevent injurious caving or erosion or loss of the ground, and to maintain pedestrian and vehicular traffic as directed and required.

C. Where sheeting is to be used, it shall be driven ahead of the excavation operations to the extent practicable so as to avoid the loss of material from behind the sheeting; where voids occur outside of the sheeting, they shall be filled immediately with gravel borrow, thoroughly compacted.

D. The Contractor shall leave in place all sheeting and bracing at the locations and within the limits ordered by the Engineer in writing. The Contractor shall cut off the sheeting at elevations to be determined by the Engineer.

3.04 SUBGRADE PREPARATION AND PROTECTION

A. General:

1. Complete the excavations to the specified or indicated limits and required depths.

B. Proof Rolling Subgrades:

1. Where specified herein, indicated on the Drawings or directed by the Engineer during construction, the Contractor shall proof roll subgrades prior to proceeding with work in the vicinity. Proof rolling of in-place fill shall be conducted in all paving areas following initial site clearing excavation or grading.

2. Proof rolling shall consist of at least two (2) complete coverages over the designated area(s) with approved heavy compaction equipment.

3. Soft spots detected by the Engineer shall be removed and replaced with compacted granular fill.

C. Cold Weather Protection:

1. Protect frost susceptible subgrade soils against freezing when the atmospheric temperature is less than 35 degrees F. Should protection fail, remove frozen materials and replace with Common borrow or granular fill, as directed by the Engineer, at no cost to the Owner.

3.05 PLACEMENT AND COMPACTION OF MATERIALS

A. General:

1. All fill and backfill materials brought to the site must be obtained from an Owner-approved borrow source(s).

2. All fill materials shall be placed "in-the-dry" on subgrades acceptable to the Engineer. The Contractor shall dewater excavated areas as required to perform the work, and in such a manner as to preserve the undisturbed state of the subgrade material. The Contractor shall drain away ponded areas as required to perform the placement of fill "in-the-dry."

3. During compaction operations, incidental compaction due to traffic by construction equipment other than used specifically in compaction operations will not be credited toward the required minimum coverage's specified.

4. Bulldozers, trucks, and other mechanical contrivances used in placement of fill materials are expressly prohibited from approaching within 8 feet of backfilled foundations.

5. Compaction by puddling or jetting is prohibited.

6. Control surface water runoff by ditches, sumps, sloped surfaces, to permit collection and removal efficiently and with minimal disturbance to materials being placed.

7. Fill materials of the various types specified below shall generally be used as indicated and be placed and compacted within the limits and to the thickness indicated on the Drawings, unless otherwise specified.

a. Crushed Stone: Crushed stone shall be used as water line pipe-bedding and backfill.

b. Compacted Granular Fill or Structural Fill: Compacted Granular Fill or Structural Fill shall be used as backfill as shown on the drawings.

c. Common Borrow: Common borrow shall be used as backfill beneath areas that are designated to be landscaped. It is anticipated that on-site excavated soil will be selectively re-used as Common borrow.

d. Pipe Bedding Material: Pipe Bedding Material shall be used under and around site utilities as shown on the drawings.

8. Do not place fill material on surfaces that are muddy, frozen, or contain frost or ice.

9. Refer to Sections 3.05.E, 3.05.F and 3.05.G, for placement requirements and maximum thickness of lifts for fill materials.

10. Place fill materials evenly adjacent to structures to required elevations. Take care to prevent wedging action of backfill against structures by carrying the material uniformly around the structure to approximately the same elevation in each lift.

11. Prior to placing fill materials, complete the specified ground surface and subgrade preparation for materials encountered at ground surface and at subgrade levels.

12. Fill shall not be placed when the atmospheric temperature is less than 30 degrees, unless prior approval is given by the Engineer. In addition, during freezing weather, the following shall apply:

    a. A layer of fill shall not be left in an uncompacted state at the close of a day's operations. Prior to terminating operations for the day, the final layer of fill, after compaction, shall be rolled with a smooth-wheeled roller to eliminate ridges of soil left by tractors, trucks and compaction equipment.

    b. A layer of compacted fill shall not be placed on snow, ice, or soil that was permitted to freeze prior to compaction. Removal of these unsatisfactory materials will be required as directed by the Engineer.

13. Placement of all specified fill materials shall be systematically conducted in the specified uniform layer thickness which is measured in all cases prior to compaction.

14. Compaction of fill materials shall be conducted by a minimum of four (4) complete coverages with acceptable compaction equipment to a specified density which is expressed as a percentage of maximum dry density as determined by ASTM D1557.

B. Backfill excavations as promptly as work permits, but not until completion of the following:

1. Acceptance by the Engineer of construction below finish grade including, where applicable, dampproofing, and utilities.

2. Completion of quality control testing, approval and recording locations of underground utilities.

3. Removal of concrete formwork.

4. Removal of trash and debris.

C. Compaction Equipment:

1. In all cases, the character, efficiency and acceptability of the Contractor's compaction equipment shall be subject to the approval of the Engineer based on observed or documented field performance.

2. Compaction in open areas shall be conducted with heavy equipment such as vibratory rollers with the compaction characteristics of a Bomag BW14D when operated at optimum rating or by other equipment acceptable to the Engineer.

3. Compaction in confined areas (in trenches) shall be conducted with equipment acceptable to the Engineer such as hand-guided vibratory compactors or mechanical tampers.

D. Moisture Control:

1. The amount of moisture in any one layer of fill material shall be as uniform as practicable throughout. The upper limit of water content in materials shall be that which will permit handling and placing and will permit proper compaction to exceed a value of three (3) percentage points on the wet side of optimum water content as determined by ASTM D1557. The lower limit of water content shall not be less than two (2) percentage points below optimum water content. Material which is too wet, shall be spread and permitted to dry, assisted by mechanical agitation, if necessary, until the water content is reduced to a value within the specified limits.

2. Each layer of material which is too dry shall be sprinkled with water, and the water worked into the material by mechanical methods until a uniform distribution of moisture shall be accurately controlled in amount so that free water will not appear on the surface during or subsequent to compaction. Should excess water be applied to any part of the material, such that materials are too wet to obtain the specified

compaction, the compaction operations and all work on that section of placed material shall be suspended until the water content of the material is reduced to a value within the specified limits.

E. Compacted Granular Fill, Structural Fill and Gravel Borrow:

1. Place in layers not to exceed nine inches when utilizing heavy compaction equipment and in six inch layers when utilizing light, hand-operated compaction equipment.

2. Compact to at least 95 percent of maximum dry density as determined by ASTM D1557.

F. Common Borrow:

1. Place in layers not to exceed twelve inches.

2. Compact to at least 92 percent of maximum dry density as determined by ASTM D1557.

G. Pipe Bedding:

1. Place in layers not to exceed 12 inches.

2. Compact with hand-operated compaction equipment.

3.06 GRADING

A. General: Perform all rough and finish grading required to attain the elevations shown on the Drawings.

B. Grading Tolerances: Upon completion of required backfilling, compacting and grading, the grade surfaces shall conform to the following requirements and tolerances:

1. General: Uniformly grade areas within limits of grading under this Section, including adjacent transition areas. Smooth finish surfaces within specified tolerances, compact with uniform levels or slopes between points where elevations are shown, or between such points and existing grades.

2. Grading Outside Building Lines: Finish surfaces free from irregular surface changes, and as follows:

a. Lawn Areas - Finish areas to receive topsoil to within not more than 2 in. above or below the required subgrade elevations.

3. Grading Surface of Fill Under Pavements: Grade smooth and even, free of voids, compact, and to the required elevation.

C. Treatment After Completion of Grading:

1. After grading is completed and the Engineer has finished his inspection, no further excavating, filling, or grading shall be permitted except with the approval of and inspection by the Engineer.

1. The Contractor shall use all means necessary to prevent erosion of freshly graded areas during construction and until such time as permanent drainage and erosion control measures have been installed.

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SECTION 02225
TRENCH EXCAVATION AND BACKFILL

PART I GENERAL

1.01 SCOPE

A. The Contractor shall furnish all labor, materials, equipment, and incidentals required to perform all excavation and backfill required to complete the work as shown on the Drawings and as specified herein. The work shall include, but not be necessarily limited to, excavation and backfill for pipe and appurtenances, manholes and vaults, backfill and compaction, disposal of surplus and unsuitable material and all related work such as sheeting and bracing and dewatering.

B. Work shall also include the removal and proper disposal of trees, stumps, brush, debris or other obstacles which remain after clearing and grubbing operations, which may obstruct the work, and the removal of all other materials, including rock larger than 2-inches at its largest dimension, to the extent necessary to install the pipe and appurtenances in conformance with the lines and grades shown on the Drawings, Specification 02110 Clearing and Grubbing, and as specified herein.

C. Backfill shall include the refilling and compaction of the fill in the trenches and excavations up to the surrounding ground surface.

D. The trench is divided into five specific areas:

1. Foundation: The area beneath the bedding, sometimes also referenced to as trench bottom.
2. Bedding: The area above the trench bottom (or foundation) and below the bottom of the barrel of the pipe.
3. Haunching: The area above the bottom of the barrel of the pipe up to the spring line of the pipe.
4. Initial Backfill: The area above the haunching material and below a plane 12-inches above the top of the barrel of the pipe.
5. Final Backfill: The area above a plane 12-inches above the top of the barrel of the pipe up to the subgrade of the finished surface.

E. The choice of method, means, techniques, and equipment shall rest with the Contractor. The Contractor shall select the method and equipment for trench excavation depending upon the: type of material to be excavated and backfilled, the depth of excavation, the amount of space available for operation of equipment, storage of excavated material, proximity of man-made improvements to be protected and available easement and/or public Rights-of-Way.

F. Contractor shall comply with applicable codes, ordinances, rules, regulations and laws of local, municipal, state and federal authorities having jurisdiction.

1.03 SUBMITTALS

A. The Contractor shall submit record documents in accordance with the requirements of 01300 Submittals. The Contractor shall record locations of all pipelines installed referenced to survey benchmarks. The Contractor shall also include the locations of all underground utilities encountered and/or rerouted. The Contractor shall provide dimensions, materials, elevations, inverts and direction of flow. The Contractor shall use GPS technology or conventional survey methods to locate utilities.

B. At least 30 days before starting construction on the sheeting and shoring, and in accordance with the OSHA requirements identified above, the Contractor shall ensure that the sheeting and shoring design engineer shall complete and submit to the City and/or City's Authorized Representative the Protection System Design Certificate and the Contractor shall use the sheeting and shoring design. If required by the OSHA requirements identified above or to protect existing facilities, the Contractor shall submit a separate certificate for each unique design. If required for protection of existing facilities or as required by the OSHA regulations identified above, the certificate(s) shall be signed and sealed by the Professional Engineer licensed in the State of Georgia that designed the protection system.

1.02 QUALITY CONTROL

A. Reference Standards: The Contractor shall comply with the applicable provisions and recommendations of the latest editions of the following standards, except as otherwise shown on the Drawings or specified herein.

1. ASTM C33 – Standard Specification for Concrete Aggregates
2. ASTM C136 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
3. ASTM D698 – Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3)
4. AST, D2487 – Standard Classification of Soils for Engineering Purposes
5. ASTM D4253 – Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using A Vibratory Table
6. ASTM D6938 – Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)
7. ASTM D1556 – Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method
8. ASTM D1557 - Standard Test Method for Laboratory Compaction Characteristics of Soil using Modified Effort (56,000 ft-lbf/ft^3)
9. ASTM D2937 – Standard Method for Density of Soil in Place by the Drive-Cylinder Method

B. Density: All references to "maximum dry density" shall mean the maximum dry density defined by ASTM D698, except that for cohesionless, free draining soils "maximum dry density" shall mean the maximum index density as determined by ASTM D4253. Determination of the density of foundation, bedding, haunching, or backfill materials in place shall meet with the requirements of ASTM D1556, ASTM D6938 or ASTM D2937.

C. Sources and Evaluation Testing: Testing of materials to certify conformance with the Specifications shall be performed by an independent testing laboratory.

1.04 SAFETY

Perform all trench excavation and backfilling activities in accordance with the Occupational Safety and Health Act of 1970 (PL 91-596), as amended. The Contractor shall pay particular attention to the Safety and Health Regulations Part 1926, Subpart P "Excavations" as described in OSHA publication 2226.

1.05 TESTING AND INSPECTION

A. Earthwork operations, acceptability of excavated materials for bedding or backfill, and placing and compaction of bedding and backfill shall be subject to inspection by the City and/or City's Authorized Representative.

B. Quality Assurance Testing shall be performed by an Independent 3rd Party Testing Agency approved by the City and/or City's Authorized Representative in accordance with Specification Section 01400.

C. The independent testing agency shall conduct in-place standard proctor analysis, grain size distribution analysis, moisture content tests, and field density tests in a manner acceptable to the City and/or City's Authorized Representative of all backfill materials.

1. One in-place field density test shall be performed on each lift at a frequency of not less than 200 linear feet of trench backfill or one per day of active backfill operations whichever is more frequent unless soil conditions or construction practices, in the opinion of the City and/or City's Authorized Representative, warrant the need for additional tests.
2. Moisture-density relationship testing (Standard Proctor Analysis) shall be performed in accordance with ASTM D698 on trench backfill soils at a frequency of once every 500 linear feet of trench or at each change in fill material.
3. Field density tests (compaction tests) will be performed using the sand cone method and/or a nuclear moisture/density gauge. Any backfill which does not meet the specified compaction requirements shall be removed, replaced and re-compacted as directed by the City and/or City's Authorized Representative. Compaction testing shall be performed in accordance with the requirements of ASTM D1556 or ASTM D6938.

D. Contractor's Quality Control Testing Requirements: Testing shall be performed by an Independent 3rd Party Testing Agency; the following guidelines shall be used for frequency of field tests. Additional tests shall be performed as necessary for job conditions and number of failed tests.

1. One moisture-density relationship test (Standard Proctor Analysis) shall be performed in accordance with ASTM D698 at each new trench to determine the material composition, moisture content and compaction quality of the proposed trench backfill.
2. In-place field density and moisture tests in accordance with ASTM D2922 and ASTM D3017 on backfill at intervals of 500 feet [150 m] along the trench. One (1) complete field density (compaction) test shall consist of individual tests in the same vertical plane over the installed pipe, beginning at a depth of 2-feet above the top of the pipe and at successive two feet vertical increments up to the top of the backfill.

PART 2 PRODUCTS

2.01 TRENCH FOUNDATION MATERIALS

Crushed Stone: Crushed stone shall be utilized for trench foundation (trench stabilization) and shall meet the requirements of the Georgia Department of Transportation Specification 800, Group I (limestone, marble, or dolomite) or Group II (quartzite, granite, or gneiss). Stone size shall be between No. 57 and No. 4, inclusive.

2.02 BEDDING AND HAUNCHING MATERIALS

A. Crushed stone, for bedding and haunching, shall meet the requirements of the Georgia Department of Transportation Specification 800.01, Group I (limestone, marble, or dolomite) or Group II (quartzite, granite, or gneiss). Stone size shall be between No. 57 and No. 4, inclusive.

B. Filter Fabric - Non-Woven Type:

1. Filter fabric associated with bedding shall be a UV stabilized, spunbonded, continuous filament, needle-punched, polypropylene, non-woven geotextile.
2. The fabric shall have an equivalent open size (EOS or AOS) of 120 – 70 microns. The fabric shall also conform to the minimum property values listed in the following table:

Fabric Property	Unit	Test Procedure	Average Value	
			Typical	Minimum
Weight	oz/yd^2	ASTM D 3776	8.3	
Thickness	mils	ASTM D 1777	105	
Grab Strength	lbs.	ASTM D 4632	240	210
Grab Elongation	%	ASTM D 4632	>50	50
Tear Strength	lbs.	ASTM D 4533	100	85
Mullen Burst	psi	ASTM D 3786	350	320
Puncture Resistance	lbs.	ASTM D 4833	115	100
Permittivity	sec^{-1}	ASTM D 4491	1.7	
Water Permeability	cm/sec	ASTM D 4491	0.4	
Water Flow Rate	gpm/ft^2	ASTM D 4491	120	
UV Resistance (500 hrs)	%	ASTM D 4355	>85	
pH			2 - 13	

3. If ordered by the City and/or City's Authorized Representative, the filter fabric manufacturer shall furnish the services of a competent factory representative to supervise and/or inspect the installation of pipe. This service will be furnished for a minimum of 10 days during initial pipe installation.

4. Filter fabric shall be equal to Polyfelt TS 700, Trevira 1125 or SuPac 7-MP.

2.03 INITIAL BACKFILL

A. Initial backfill material shall be earth materials excavated from the trench which conform to Common Backfill requirements as defined in this Specification Section. Should the material excavated from the trench be saturated, the saturated material may be used as backfill, should the material be capable of conforming to the common backfill specifications if allowed to dry properly and is capable of meeting the specified compaction requirements and shall not be considered unsuitable backfill material.

B. When necessary, initial backfill materials shall be moistened to facilitate compaction by tamping.

B. If materials excavated from the trench are not suitable for use as initial backfill material, provide select common backfill or graded aggregate base (GAB) material conforming to the requirements of this Section. Unless prior authorization is given by the City' Project Manager, no payment shall be given for the quantity of GAB used as backfill that is in excess of the quantity of unsuitable material excavated from the trench. Quantities shall be as determined by the City and/or City's Authorized Representative.

2.04 FINAL BACKFILL

A. Final backfill material shall be general excavated earth materials from the trench which conform to Common Backfill requirements as defined in this Section. Should the material excavated from the trench be saturated, the saturated material may be used as earth material, provided it conforms to the requirements for common backfill, is allowed to dry properly and capable of meeting the specified compaction requirements and shall not be considered unsuitable backfill material.

B. When necessary, initial backfill materials shall be moistened to facilitate compaction by tamping.

C. If materials excavated from the trench are not suitable for use as final backfill material, provide select common backfill or graded aggregate base (GAB) material conforming to the requirements of this Section. Unless prior authorization is given by the City's Project Manager, no payment shall be given for the quantity of GAB used as backfill that is in excess of the quantity of unsuitable material excavated from the trench. Quantities shall be as determined by the City and/or City's Authorized Representative.

2.05 COMMON BACKFILL

A. Common backfill shall consist of suitable mineral soil selected from materials excavated from the trench. This suitable material shall be clean, substantially free of organic materials, wood, loam, frozen earth or mud, trash, and other objectional materials which may be compressible, or which cannot be properly compacted. Common fill shall not contain stones larger than 6 inches in its largest diameter. Stone shall not exceed 10 percent of the total makeup of fill material. Common fill shall not contain granite blocks, broken concrete, masonry rubble, or other similar materials. It shall have physical properties such that it can be readily spread and compacted during filling.

B. Soft, wet, plastic soils which may be expansive, clay soils having a natural, in-place water content in excess of 30 percent, soils containing more than 5 percent by weight fibrous organic materials (as determined by ASTM D 2974, Method C), and soils having a plasticity index greater than 30 (as determined by ASTM S 4318) shall be considered unsuitable for use as backfill or fill.

C. Common fill used as initial backfill or placed within 12 inches of the trench shall be screened to contain no stones larger than 2 inches.

D. Common fill shall be within +/- 2 percent of optimum moisture content as determined by ASTM D698 for maximum compaction density prior to placement.

2.06 SELECT COMMON BACKFILL

A. Select Common Backfill shall consist of mineral soil free from organic materials, loam, wood, trash or other objectionable materials which may be compressible or which cannot be properly compacted. It shall contain no stones larger than three inches and

shall have a maximum of 50 percent passing the number 200 sieve, a maximum liquid limit of 50 percent and a maximum plasticity index of 15 percent.

B. Select Common Backfill shall be placed in maximum 8-inch thick lifts and compacted to 95% of the Standard Proctor ASTM D698 maximum dry density, or as otherwise shown in the Drawings.

C. In areas beneath roadways, the top 24-inches of Select Fill shall be compacted to 98% of the maximum dry density of ASTM D698. The soils shall be wetted or dried as necessary so that the moisture content during compaction is less than two percent above the optimum moisture content.

D. High micaeous and elastic silts shall not be used.

2.07 CONCRETE

In certain cases, concrete may be allowed for pipe bedding, haunching, backfill, and/or encasement. Concrete for bedding, haunching, initial backfill, or encasement shall have a compressive strength of not less than 3,000 psi, with not less than 5.5 bags of cement per cubic yard and a slump between 3 and 5-inches. Ready-mixed concrete shall be mixed and transported in accordance with ASTM C94. Reinforcing steel shall conform to the requirements of ASTM A615, Grade 60.

2.08 FLOWABLE FILL

A. Controlled strength flowable fill shall be used as trench backfill only when authorized, in writing, by the City and/or City's Authorized Representative.

B. Controlled low strength flowable fill shall conform to Section 600 of the Georgia Department of Transportation (GDOT) Standard Specifications for Construction of Roads and Bridges – latest edition.

C. Flowable fill design mix shall be for "excavatable" fill. Design mix shall be submitted to the City's Authorized Representative for approval in accordance with Section 600.3.03 of the GDOT Standard Specifications.

2.09 GRANULAR MATERIAL

Granular material, where required for trench backfill, shall be sand, river sand, crushed stone or aggregate, pond screenings, crusher run, recycled concrete, or other angular material. Granular material shall meet gradation requirements for Size No. 57 as described in ASTM D448 or finer.

2.10 GRADED AGGREGATE BASE

Graded aggregate base shall be Class "A" meeting the requirements of the Georgia Department of Transportation Specification Section 815.

PART 3 EXECUTION

3.01 TRENCH EXCAVATION

A. Topsoil and grass shall be stripped a minimum of 6-inches over the trench excavation site and stockpiled separately for replacement over finished graded areas. In paved areas, trench limits shall be saw cut in parallel lines or at right angles or as directed by the City and/or City's Authorized Representative to the full depth of the pavement section. The removal and proper disposal of the removed pavement section and/or the handling of topsoil shall be considered as incidental to the work.

C. Trenches shall be excavated to the lines and grades shown on the Drawings (if provided). Whether Drawings are provided or not, all trenches shall be excavated along the centerlines of the pipes and to the dimensions which provide the proper support and protection of the pipe and other structures and accessories.

D. Pavement shall be cut with a saw, wheel or pneumatic chisel along straight lines before excavating.

D. Trench Width:

1. Trench width shall be a practical minimum. The sides of all trenches shall be vertical to a minimum of one foot above the top of the pipe. Unless otherwise indicated on the Drawings, the maximum trench width shall be equal to 1.5 times the diameter. The minimum trench width shall be that which allows the proper consolidation of the haunching and initial backfill material.

2. Excavate the top portion of the trench to any width within the construction easement or right-of-way which will not cause unnecessary damage to adjoining structures, roadways, pavement, utilities, trees or private property. Where necessary to accomplish this, provide sheeting and shoring.

3. Where rock is encountered in trenches, excavate to remove boulders and stones to provide 12-inches of clearance between the rock and any part of the pipe, manhole, vault or other structure.

E. Trench Depth:

1. The trenches shall be excavated to the required depth or elevation which allow for the placement of the pipe/structure and bedding to the dimensions and elevations shown on the Drawings (if available) or to the dimensions and elevations as appropriate to match the grade of the existing piping.

2. Where rock is encountered in trenches for pipelines, excavate to the minimum depth which will provide a clearance below the pipe barrel of 8-inches for pipe 21-inches in diameter and smaller and 12-inches clearance for larger pipe, manholes and other structures. Remove boulders and stones to provide above minimum clearances between the rock and any part of the pipe, manhole, vault or other structure.

F. No more trench shall be opened in advance of pipe laying than is necessary to expedite the work. The maximum length of open trench shall be no more than 100 feet in roadways and 300 feet elsewhere unless written approval otherwise is obtained from the City and/or City's Authorized Representative. Contractor is responsible for utilizing appropriate ground support.

G. Prior to excavation, Contractor shall contact local underground alert hotlines, "Dig Safe" and/or individual utility owners for marking underground utilities. Once utilities are marked, Contractor shall hand dig or pothole to expose the existing utilities. A survey shall be made of the utility size, material, location, and elevation prior to trench excavation and information shall be recorded on the Contractor's As-Builts and/or Record Drawings maintained by the Contractor.

H. Excavated Materials:

1. Excavated materials shall be placed adjacent to the work to be used for backfilling as required. Top soil shall be carefully separated and lastly placed in its original location.

2. Excavated material shall be placed sufficiently back from the edge of the excavation to prevent caving of the trench wall, to permit safe access along the trench and not cause any drainage problems.

3. Excavated material shall be placed so as not to damage existing landscape features or man-made improvements and also allow access to valves and hydrants.

3.02 POINT EXCAVATION

A. Topsoil and grass shall be stripped a minimum of 6-inches over the point excavation site and stockpiled separately for replacement over finished graded areas. In paved areas, trench limits shall be saw cut in parallel lines or at right angles or as directed by the City and/or City's Authorized Representative to the full depth of the pavement section. The removal and proper disposal of the pavement section or handling of the topsoil shall be considered incidental to the work.

B. Point excavations shall be excavated to the lines and grades shown on the Drawings with the centerlines of the excavation on the centerlines of the pipes and to the dimensions which provide the proper support and protection of the pipe and other structures and accessories.

C. Point Excavation Width:

The sides of the point excavation shall be vertical to a minimum of one foot above the top of the pipe or trench bottom. If excavating for a pipe, unless otherwise indicated on the Drawings, the maximum width shall be equal to 1.5 times the diameter. The minimum excavation width shall be that which allows the proper consolidation of the haunching and initial backfill material. Width of the excavation shall be adequate to install the vault, manhole or other structure as indicated on the drawings.

D. Excavation Depth:

1. The excavation shall be excavated to the required depth or elevation which allow for the placement of the pipe and bedding to the dimensions and elevations shown on the Drawings.

2. Where rock is encountered in excavation for pipelines, excavate to the minimum depth which will provide a clearance below the pipe barrel of 8-inches for pipe 21-inches in diameter and smaller and 12-inches clearance for larger pipe, manholes and other structures. Remove boulders and stones to provide above minimum clearances between the rock and any part of the pipe, manhole, vault or other structure. Contractor is responsible for utilizing appropriate ground support.

E. No more excavation shall be opened in advance of pipe laying than is necessary to expedite the work.

F. Prior to excavation, Contractor shall contact local underground alert hotlines, "Dig Safe" and/or individual utility owners for marking underground utilities. Once utilities are marked, Contractor shall hand dig or pothole to expose the existing utilities. A survey shall be made of the utility size, material, location, and elevation prior to trench excavation and information shall be recorded on the record Drawings maintained by the Contractor.

G. Excavated Materials:

1. Excavated materials shall be placed adjacent to the work to be used for backfilling as required. Top soil shall be carefully separated and lastly placed in its original location.
2. Excavated material shall be placed sufficiently back from the edge of the excavation to prevent caving of the trench wall, to permit safe access along the trench and not cause any drainage problems.
3. Excavated material shall be placed so as not to damage existing landscape features or man-made improvements and also allow access to valves and hydrants.

3.03 SHEETING, SHORING AND BRACING

A. Sheeting, shoring and bracing is specified in Section 02150.

B. Protection of the excavation against caving or settling of the banks shall be the sole responsibility of the Contractor. The Contractor shall protect the sides of his excavation by sheeting and bracing as may be necessary. No actions or instructions by the City and/or City's Authorized Representative shall be regarded as the responsibility for security of the trench or the surrounding areas. The full responsibility remains with the Contractor.

D. The Contractor shall furnish, put in place and maintain sheeting and bracing required to support the side of the excavation and prevent loss of ground which could damage or delay the work or endanger adjacent structures or vehicular traffic. If the City and/or City's Authorized Representative is of the opinion that at any point sufficient or proper supports have not been provided, he may order additional supports placed at the expense of the Contractor. Compliance with such order shall not relieve the Contractor from his responsibility for the sufficiency of such supports. Care shall be taken to prevent voids outside of the sheeting, but if voids are formed, they shall be immediately filled and rammed.

D. The Contractor shall leave in place to be embedded in the backfill of the trench, all wood sheeting, bracing and other related items as shown on the Drawings, or which the City and/or City's Authorized Representative may direct him in writing to leave in place at any time during the progress of the work for the purpose of preventing injury to structures, utilities, or property, whether public or private. The City's Authorized Representative may direct that timber used for sheeting and bracing in the trench be cut off at any specified elevation, after backfilling and tamping has reached this level.

E. All sheeting and bracing not left in place shall be carefully removed in such manner as not to endanger the construction of other structures, utilities or property, whether public or private.

F. The right of the City and/or City's Authorized Representative to order sheeting and bracing left in place shall not be construed as creating any obligation on his part to issue such orders, and his failure to exercise his right to do so shall not relieve the Contractor from liability for damages to persons or property occurring from or upon the work occasioned by negligence or otherwise, growing out of a failure on the part of the Contractor to leave in place in the trench sufficient sheeting and bracing to prevent any caving or moving of the ground adjacent to the sides of the trench.

G. The Contractor shall receive no payment, other than that included in the price to be paid for pipe, for any extra timber used for sheeting, bracing and other related items. The Contractor shall receive no payment for such timber which was used for the convenience of the Contractor.

3.04 TEST PITS

A. Test pits for the purpose of locating underground utilities or structures as an aid in

establishing the precise location of new work may be excavated by the Contractor. Test pits shall be backfilled as soon as the desired information has been obtained. The backfilled surface shall be maintained in a satisfactory condition for travel until resurfaced as hereinafter specified.

B. Excavation and backfill of test pits shall be considered work incidental to the project and the cost shall be included in the appropriate bid item.

C. If, for any reason, a test pit is left open for any period of time, it shall be properly barricaded and lighted by the Contractor.

3.05 ROCK EXCAVATION

A. Rock shall be defined as any large mass of stone, bedrock or ledgerock that cannot be removed by conventional mechanical excavation equipment. This definition of rock does not include soft or weathered rock which can be removed with a hand pick or air powered spades; no loose, shaken or previously blasted rock or broken stone in rock fillings or elsewhere.

B. A boulder is defined as rock fragments exceeding 1 cubic yard in volume.

C. Rock excavation shall mean the removal of rock and/or boulders which, in the opinion of the City and/or City's Authorized Representative, cannot be removed by the following equipment or method:

1. Trench and Shafts – tracked excavator with a bucket curling force of at least 18,300 pounds or tracked excavator with a 2,000 foot-lbs impact energy class hydraulic hammer, whichever is greater.

2. Mass Excavation – Bulldozer or trackloader, drawing a single-tooth hydraulic ripper with minimum drawbar pull of 56,000 pounds.

D. Rock excavation may be performed by drilling and blasting, jack hammering, hydraulic ramming, expansive chemical splitting, or other process.

E. The following should govern the procedures for the payment of rock excavation:

1. When rock is encountered, the material shall be uncovered or its subsurface limits demonstrated by drilling and the City and/or City's Authorized Representative shall be notified immediately. The City and/or its Authorized Representative will then estimate the quantity of rock encountered based on the above observation or information. Failure to perform any of the above activities and allow ample time for measuring the undisturbed material shall not give right of claim to any classification other than that allowed by the City.

2. For pipes, measurement of rock excavation will be based on the quantity of rock removed, not exceeding 8-inches below the bottom of the pipe and 12-inches on each side of the pipe, unless otherwise approved by the City. The top of the rock will be surface elevation as determined by the City prior to or during excavation.

3. For structures and/or shafts, measurement for rock excavation will be limited to the volume of rock excavation required to install the footing or shaft as shown on the approved shop drawings or as shown on the Contract Drawings (if provided by the City), whichever is smaller.

4. No rock exterior to the minimum excavation limits, which may fall into the excavation, will be measured or allowed.

B. Blasting:

1. Exhaust other practical means of excavating prior to utilizing blasting as a means of excavation. Provide licensed, experienced workmen to perform blasting. Conduct blasting operations in accordance with all existing ordinances and regulations. Protect all buildings and structures from the effects of the blast. Repair any resulting damage. If the Contractor repeatedly uses excessive blasting charges or blasts in an unsafe or improper manner, the City and/or City's Authorized Representative may direct the Contractor to employ an independent blasting consultant to supervise the preparation for each blast and approve the quantity of each charge.

2. Refer to Section 02020, Use of Explosives

C. Disposal of Rock: Dispose of rock off site that is surplus or not suitable for use as rip rap or backfill.

D. The Contractor shall notify the City and/or City's Authorized Representative prior to any blasting. Additionally, the Contractor shall notify the City and local fire department a minimum of one hour before any charge is detonated.

E. Following review by the City and/or City's Authorized Representative regarding the proximity of permanent buildings and structures to the blasting site, the City and/or City's Authorized Representative may direct the Contractor to employ an independent, qualified specialty sub-contractor, approved by the City and/or City's Authorized Representative, to: monitor the blasting by use of a seismograph; identify the areas where light charges must be used, conduct pre-blast and post-blast inspections of structures, including photographs or videos; and maintain a detailed written log.

3.06 DEWATERING EXCAVATIONS

A. Dewater excavation continuously to maintain a water level 2 feet below the bottom of the trench.

B. Control drainage in the vicinity of excavation so the ground surface is properly pitched to prevent water running into the excavation.

C. There shall be sufficient pumping equipment, in good working order, available at all times, to remove any water that accumulates in excavations. Where the utility crosses natural drainage channels, the work shall be conducted in such a manner that unnecessary damage or delays in the prosecution of the Work will be prevented. Provision shall be made for the satisfactory disposal of surface water to prevent damage to public or private property.

D. In all cases, accumulated water in the trench shall be removed before placing bedding or haunching, laying pipe, placing concrete or backfilling.

E. Where dewatering is performed by pumping the water from a sump, crushed stone shall be used as the medium for conducting the water to the sump. Sump depth shall be at least two feet below the bottom of the trench. Pumping equipment shall be of sufficient quantity and/or capacity to maintain the water level in the sump two feet below the bottom of the trench. Pumps shall be a type such that intermittent flows can be discharged. A standby pump shall be required in the event the operating pump or pumps clog or otherwise stop operation.

F. Dewater by use of a well point system when pumping from sumps does not lower the water level two feet below the trench bottom. Where soil conditions dictate, the Contractor shall construct well points cased in sand wicks. The casing shall be jetted into the ground, followed by the installation of the well point, filling casing with sand and withdrawing the casing.

3.07 TEMPORARY STORAGE OF EXCAVATED MATERIAL

A. Excavated material deemed suitable for backfill shall be temporarily stored in the temporary or permanent right-or-ways in a manner that will not endanger the public, workers, or the work for no longer than 8 hours. Excavated material shall be stored a safe distance away from the edge of the excavation, allowing room for an adequate angle of repose.

B. Excavated materials which have been deemed “suitable for backfill” by means of testing that have been stored on-site for a period longer than 8 hours shall be hauled and stored off-site in accordance with the applicable local, state and federal regulations at locations procured and paid for by the Contractor under written agreements with the property owners (with copies thereof to the City and/or City’s Authorized Representative). Contractor may re-haul and use any excavated material that has been removed from the site which has been deemed “suitable for backfill” by means of testing for backfill of the trench. Stored excavation materials shall be protected from wetting by rainfall in

accordance with the approved Erosion and Sedimentation Control Plan as approved by GSWCC.

C. Sidewalks, driveways, hydrants, valve pit covers, valve boxes, curb stop boxes, existing manholes, fire and police call boxes, or other utility controls shall be unobstructed and accessible at all times. Gutters, catch basins, and natural water courses shall not be obstructed or silted. An emergency accessway measuring no less than 10 feet wide at any location shall be maintained at all times.

3.08 TRENCH FOUNDATION AND STABILIZATION

A. The bottom of the trench shall provide a foundation to support the pipe and its specified bedding. The trench bottom shall be graded to support the pipe and bedding uniformly throughout its length and width.

B. If, after dewatering as specified above, the trench bottom is spongy, or if the trench bottom does not provide firm, stable footing and the material at the bottom of the trench will still not adequately support the pipe, the City and/or City's Authorized Representative may determine that the trench bottom is unsuitable and the City and/or City's Authorized Representative may then order trench stabilization by directing the Contractor to over excavate trench bottom and fill with crushed stone.

C. Where the replacement of unsuitable material with crushed stone does not provide an adequate trench foundation, the trench bottom shall be excavated to a depth of at least two feet below the specified trench bottom. Place filter fabric in the bottom of the trench and support the fabric along the trench walls until the trench stabilization, bedding, haunching and pipe have been placed at the proper grade. The ends of the filter fabric shall be overlapped above the pipe.

D. Where trench stabilization is provided, the trench stabilization material shall be compacted to at least 95 percent of the maximum dry density, unless shown or specified otherwise. 98% will be required under structures like buildings, sidewalks, or roads.

3.09 BEDDING AND HAUNCHING

A. Prior to placement of bedding material, the trench bottom shall be free of any water, loose rocks, boulders, or large dirt clods.

B. Bedding material shall be placed to provide uniform support along the bottom of the pipe and to place and maintain the pipe at the proper elevation. The initial layer of bedding placed to receive the pipe shall be brought to the grade and dimensions indicated on the Drawings. Bedding and haunching materials for water mains shall be

No. 57 stone up to the pipe spring line unless otherwise shown on the drawings. All bedding shall extend the full width of the trench bottom. The pipe shall be placed and brought to grade by tamping the bedding material or by removal of the excess amount of the bedding material under the pipe. Adjustment to grade line shall be made by scraping away or filling with bedding material. Wedging or blocking up of pipe shall not be permitted. Applying pressure to the top of the pipe, such as with a backhoe bucket, to lower the pipe to the proper elevation or grade shall not be permitted. Each pipe section shall have a uniform bearing on the bedding for the length of the pipe, except immediately at the joint.

C. At each joint, excavate bell holes of ample depth and width to permit the joint to be assembled properly and to relieve the pipe bell of any load.

D. After the pipe section is properly placed, add the haunching material to the specified depth. The haunching material shall be shovel sliced, tamped, chinked or otherwise consolidated to provide uniform support for the pipe barrel and to fill completely the voids under the pipe, including the bell hole. Prior to placement of the haunching material, the bedding shall be clean and free of any water, loose rocks, boulders, or dirt clods.

E. Manholes, Vaults and Other Structures: Excavate to a minimum of 12-inches below the planned elevation of the base of the manhole, vault or structure. Place and compact crushed stone bedding material to the required grade before constructing the manhole, vault or structure.

F. Compaction:

Bedding and haunching materials under pipe, manholes, vaults, structures and accessories shall be compacted to a minimum of 95 percent of the maximum dry density for grassed or cross-country areas, or 98 percent if adjacent or under a structure or under a roadway, unless shown or specified otherwise. Backfill materials within the limits of restrained joint pipe shall be compacted to a minimum of 95 percent of the maximum dry density, or 98% if adjacent or under a structure, unless shown or specified otherwise.

3.10 INITIAL BACKFILL

A. Backfilling of pipeline trenches shall be started immediately after the construction of the same has been inspected by the City and/or City's Authorized Representative. Backfill shall be placed on both sides of the pipe simultaneously to prevent side pressures.

B. Initial backfill shall be placed to anchor the pipe, protect the pipe from damage by subsequent backfill and ensure the uniform distribution of the loads over the top of the pipe.

C. Place initial backfill material carefully around the pipe in uniform layers to a depth of at least 12-inches above the pipe barrel. Layer depths shall be a maximum of 6-inches for

pipe 18-inches in diameter and smaller and a maximum of 12-inches for pipe larger than 18-inches in diameter.

D. Compact each layer thoroughly with suitable hand tools or tamping equipment.

E. Backfill shall be brought up evenly on all sides. Each layer of backfill material shall be thoroughly compacted by rolling, tamping, or vibrating with mechanical compacting equipment.

F. Initial backfill shall be compacted to a minimum 95 percent of the maximum dry density, or 98% if adjacent or under a structure or roadway, unless shown or specified otherwise.

3.11 CONCRETE ENCASEMENT FOR PIPELINES

Where concrete encasement is shown on the Drawings for pipelines, excavate the trench to provide a minimum of 12-inches clearance from the barrel of the pipe. Lay the pipe to line and grade on solid concrete blocks or solid bricks. In lieu of bedding, haunching and initial backfill, place concrete to the full width of the trench and to a height of not less than 12-inches above the pipe bell. Do not backfill the trench for a period of at least 24 hours after concrete is placed.

3.12 FINAL BACKFILL

A. Backfill carefully to restore the ground surface to its original condition.

B. The top 8-inches of backfill shall be topsoil or graded aggregate base material, depending upon the trench location.

C. Excavated material which is unsuitable for backfilling, and excess material, shall be disposed of in a manner approved by the City and/or City's Authorized Representative. Surplus soil may be neatly distributed and spread over the site, if approved by the City and/or City's Authorized Representative, except that surplus soil shall not be distributed and spread over the site in areas under Corps of City and/or City's Authorized Representative jurisdiction. If such spreading is allowed, the site shall be left in a clean condition and shall not affect pre-construction drainage patterns. Surplus rock from the trenching operations shall be removed from the site.

E. Pipelines: After initial backfill material has been placed and compacted, backfill with final backfill material. Place backfill material in uniform layers, compacting each layer thoroughly as follows:

1. In 6-inch layers, if using light power tamping equipment, such as a "jumping jack".

2. In 12-inch layers, if using heavy tamping equipment, such as hammer with tamping feet.

F. Manholes, Vaults and other Structures:

1. Backfilling shall be carried up evenly on all walls of an individual structure simultaneously. A variation of 2-feet in elevation will be the maximum allowable. Backfill shall not be allowed against walls until they and their supporting slabs, if applicable, have attained sufficient strength. Backfill shall be subject to the approval of the City and/or City‘s Authorized Representative.
2. In locations where pipes pass through walls, the Contractor shall take the following precautions to consolidate the backfill up to an elevation of at least 2-feet above the bottom of the pipe:
   a. Place fill in such areas for a distance of not less than 3-feet either side of the centerline of the pipe in level layers not exceeding 6-inches in depth.
   b. Thoroughly compact each layer with a power tamper to the satisfaction of the City and/or City’s Authorized Representative.
3. Temporary bracing shall be provided as required during construction of all structures to protect partially completed structures against construction loads, hydraulic pressure and earth pressure. The bracing shall be capable of resisting all loads applied to the walls as a result of backfilling.
4. Backfill against structures, in tight excavations with limited access to compaction equipment, shall be structural fill (i.e. No. 57 stone, flowable fill, etc.). This fill material shall be considered incidental to the Work.

G. Final backfill shall be compacted to a minimum 95 percent of the maximum dry density, or 98% if adjacent to or under a road or structure, unless otherwise specified otherwise. Final backfill underlying pavement and backfill under dirt and gravel roads and within the limits of restrained joint pipe shall be compacted to a minimum 95 percent of the maximum dry density, or 98% if adjacent or under a structure, unless specified otherwise.

H. Concrete or bituminous asphalt removed during construction shall not be placed in backfill.

I. The surface of filled areas shall be graded to smooth true lines in conformance with the grades or elevations shown on the Drawings.

3.13 BACKFILL WITHIN GEORGIA DOT RIGHT-OF-WAY

Backfill within the Georgia DOT Rights-of-Way shall meet the requirements stipulated in the "Utility Accommodation Policy and Standards" latest edition as published by the Georgia Department of Transportation.

3.14 FLOWABLE FILL

A. Where flowable fill is utilized, excavate the trench to provide a minimum of 6-inches clearance on either side of the pipe barrel. Lay the pipe to line and grade on solid concrete blocks or bricks. In lieu of bedding, haunching and initial backfill, place flowable fill to the full width and depth of the trench.

B. Flowable fill shall be protected from freezing for a period of 36 hours after placement. Minimum temperature of flowable fill at point of delivery shall be 50 degrees F.

3.15 COMPACTED GRANULAR MATERIAL

Where compacted granular material is required as initial and final backfill material, it shall be placed after bedding and haunching material specified elsewhere has been placed. Compacted granular material shall be compacted to a minimum 95 percent of the maximum dry density.

3.16 RESTORING TRENCH SURFACE

A. Where the trench occurs adjacent to paved streets, in shoulders, sidewalks, or in cross-country areas, thoroughly consolidate the backfill and maintain the surface as the work progresses. If settlement takes place, immediately deposit additional fill to restore the level of the ground.

B. Within roadways and under concrete slabs, curbs, and footings of structures, the top 8-inch layer of trench backfill shall consist of compacted granular material. Backfill, compaction and restoration shall be in strict accordance with all state and local highway/roadway requirements and standards.

C. The surface of any driveway, sidewalk, or any other area which is disturbed by the trench excavation and which is not a part of the paved road shall be restored to a condition at least equal to that existing before work began.

3.17 SETTLEMENT

A. The top surfaces of trenches and other excavation shall be continuously maintained throughout the prosecution of the Work. If settlement takes place, immediately deposit additional fill to restore the level of the ground.

B. The Contractor shall be responsible for all settlement of backfill, fills, and embankments which may occur within one year after final acceptance of the Work by the City.

+ + + END OF SECTION 02225 + + +

SECTION 02231
TREE PROTECTION AND TRIMMING

PART 1 - GENERAL

1.01 SCOPE

A. This section includes the protection and trimming of trees that interfere with, or are affected by, execution of the Work, whether temporary or new construction.

B. Related Work specified elsewhere:

1. Section 02201A - Site Preparation
2. Section 02315A - Excavation and Backfill for Structures
3. Section 02920 - Site Restoration

1.02 SUBMITTALS

Submittals shall be made in accordance with the requirements of 01300 Submittals. In addition, the following specific information shall be provided:

1. Product Data: For each type of product indicated.
2. Qualification Data: For firms and persons specified in the "Quality Control" Article to demonstrate their capabilities and experience. The Contractor shall include lists of completed projects with project names and addresses, names and addresses of engineers and owners, and other information specified.
3. Certification: From a qualified forester that trees indicated to remain have been protected during construction according to recognized standards and that the trees were promptly and properly treated and repaired when damaged.
4. Maintenance Recommendations: From a certified arborist for care and protection of trees affected by construction during and after completing the Work.

1.03 QUALITY CONTROL

A. Reference Standards: The Contractor shall comply with the applicable provisions and recommendations of the latest editions of the following standards, except as otherwise shown on the Plans or specified in these Specifications.

1. Hortus Third, 1976.
2. Standardized Plant Names (American Joint Committee on Horticulture Nomenclature).
3. National Arborist Association "Pruning Standards for Shade Trees", latest revision.
4. ANSI A 300 – Trees, Shrubs, and Other Woody Plant Maintenance – Standard Practices.

5. ASTM D 448 – Standard Classification for Sizes of Aggregate for Road and Bridge Construction.
6. ASTM D 5268 – Standard Specification for Topsoil Used for Landscaping Purposes.

B. Forester Qualifications: A forester licensed in the State of Georgia.

C. Tree Pruning Standards: The Contractor shall comply with the requirements of ANSI A300 unless more stringent requirements are indicated.

D. Pre-installation Conference: The Contractor shall conduct a pre-installation conference at the site of the Work.

Before starting tree protection and trimming, the Contractor shall meet with representatives of authorities having jurisdiction, including the City, the City's Authorized Representative, consultants, and other concerned entities. The Contractor shall review tree protection and trimming procedures and responsibilities. The Contactor shall notify participants at least three (3) working days before convening the conference. The Contractor shall record discussions and agreements and furnish a copy to each participant.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Drainage Fill: Selected crushed stone, or crushed or uncrushed gravel, washed, ASTM D448, Size 24, with ninety (90) to one hundred (100) percent passing a two and one half (2½) inch sieve and not more than ten (10) percent passing a three quarter (¾) inch sieve.

B. Topsoil: Fertile, friable, surface soil, containing natural loam and complying with the requirements of ASTM D5268. The Contractor shall provide topsoil that is free of stones larger than one (1) inch in any dimension and free of other extraneous or toxic matter harmful to plant growth. The Contractor shall obtain topsoil only from well-drained sites where soil occurs in depth of four (4) inches or more; the Contractor shall not obtain topsoil from bogs or marshes.

C. Filter Fabric: Manufacturer's standard, non-woven, pervious, geotextile fabric of polypropylene, nylon, or polyester fibers.

D. Webbed Fabric Fence (temporary fencing): Orange polyethylene webbed fabric, forty six (46) inches high supported by six (6) feet steel channel posts, five (5) feet o.c. The Contractor shall set posts two (2) feet below grade.

PART 3 - EXECUTION

IDENTIFICATION

Prior to any construction, the Contractor shall flag all trees on the site of the Work scheduled to be protected. All flagging shall be approved by the City's Authorized Representative prior to start-up of the Work and construction activities. The City's Authorized Representative shall be notified immediately of any conflicts with proposed Work, structures, or utilities.

3.02 PREPARATION

A. Temporary Fencing: The Contractor shall install temporary fencing as indicated on the Plans or outside the drip line of trees to protect remaining vegetation from construction damage.

B. The Contractor shall protect tree root systems from damage due to noxious materials caused by runoff or spillage while mixing, placing, or storing construction materials. The Contractor shall protect root systems from flooding, eroding, or excessive wetting caused by dewatering operations.

C. The Contractor shall not store construction materials, debris, or excavated material within the drip line of remaining trees. The Contractor shall not permit vehicles or foot traffic within the drip line. The Contractor shall prevent soil compaction over root systems.

D. The Contractor shall not allow fires under or adjacent to remaining trees or other plants.

3.03 EXCAVATION

A. The Contractor shall install shoring or other protective support systems to minimize sloping or benching of excavations that could endanger trees.

B. The Contractor shall not excavate within drip line of trees, unless otherwise indicated.

C. Where excavation for new construction is required within drip line of trees, the Contractor shall hand clear and excavate to minimize damage to root systems. The Contractor shall use narrow-tine spading forks and comb soil to expose roots.

1. The Contractor shall relocate roots in backfill areas where possible. If encountering large, main lateral roots, the Contractor shall expose roots beyond excavation limits as required to bend and relocate them without breaking. If encountered immediately adjacent to the location of new construction and relocation is not practical, the Contractor shall cut roots approximately three (3) inches back from new construction.

2. The Contractor shall not allow exposed roots to dry out before placing permanent backfill. The Contractor shall provide temporary earth cover or pack with peat moss and wrap with burlap. The Contactor shall water and maintain earth in a moist condition. The Contractor shall temporarily support and protect roots from damage until they are permanently relocated and covered with soil.

D. Where utility trenches are required within drip line of trees, the Contractor shall tunnel under or around roots by drilling, auger boring, pipe jacking, or digging by hand.

Root Pruning: The Contractor shall not cut main lateral roots or taproots. The Contractor shall cut only smaller roots that interfere with installation of utilities. The Contractor shall cut roots with sharp pruning instruments. The Contractor shall not break or chop roots.

3.04 REGRADING

A. Grade Lowering: Where new finish grade is indicated below existing grade around trees, the Contractor shall slope grade away from trees as recommended by the forester, unless otherwise directed by the City's Authorized Representative.

Root Pruning: The Contractor shall prune tree roots exposed during grade lowering. The Contractor shall not cut main lateral roots or taproots. The Contractor shall cut only smaller roots. The Contractor shall cut roots with sharp pruning instruments. The Contractor shall not break or chop roots.

B. Minor Fill: Where existing grade is six (6) inches or less below elevation of finish grade, the Contractor shall fill with topsoil. The Contractor shall place topsoil in a single un-compacted layer and hand grade to required finish elevations.

C. Moderate Fill: Where existing grade is more than six (6) inches, but less than twelve (12) inches below elevation of finish grade, the Contractor shall place drainage fill, filter fabric, and topsoil on existing grade as follows:

1. Carefully place drainage fill against tree trunk approximately two (2) inches above elevation of finish grade and extend not less than eighteen (18) inches from the tree trunk on all sides. For balance of area within drip line perimeter, the Contractor shall place drainage fill up to six (6) inches below elevation of grade.
2. The Contractor shall place filter fabric with edges overlapping six (6) inches minimum.
3. The Contractor shall place fill layer of topsoil to finish grade. The Contractor shall not compact drainage fill or topsoil. The Contractor shall hand grade to required finish elevations.

3.05 TREE PRUNING

A. The Contractor shall prune remaining trees affected by temporary and new construction.

B. The Contractor shall prune remaining trees to compensate for root loss caused by damaging or cutting root system. The Contractor shall provide subsequent maintenance during Contract period as recommended by the forester.

C. Pruning Standards: The Contractor shall prune trees according to the most current revision of ANSI A300 following the following types of pruning:

1. Crown cleaning.
2. Crown thinning.
3. Crown raising.
4. Crown reduction.
5. Vista pruning.
6. Crown restoration.

D. The Contractor shall cut branches with sharp pruning instruments. The Contractor shall not break or chop branches.

E. The Contractor shall chip branches removed from trees. The Contractor shall spread chips where indicated or as directed by the City's Authorized Representative.

3.06 TREE REPAIR AND REPLACEMENT

A. The Contractor shall promptly repair trees damaged by construction operations within twenty-four (24) hours. The Contractor shall treat damaged trunks, limbs, and roots according to written instructions of the certified arborist.

B. The Contractor shall remove and replace dead and damaged trees that the certified arborist determines to be incapable of restoring to a normal growth pattern.

C. The Contractor shall aerate surface soil compacted during construction ten (10) feet beyond drip line and no closer than thirty six (36) inches to tree trunk. The Contractor shall drill two (2) inch diameter holes a minimum of twelve (12) inches deep at twenty four (24) inches o.c. The Contractor shall backfill holes with an equal mix of augered soil and sand.

3.07 DISPOSAL OF WASTE MATERIALS

A. Burning at the site of the Work is not permitted.

B. Disposal: The Contractor shall remove excess excavated material, displaced trees, and excess chips from the site and dispose of at an approved location.

3.08 MAINTENANCE

All protected trees that have been root pruned shall be watered deeply twice a week during periods of hot, dry weather.

3.09 REPLACEMENT

The Contractor shall be responsible for replacement of any protected trees that are damaged or destroyed during the construction period. Replacement shall be in equal caliper inches (D.B.H.) to those trees damaged or destroyed and shall be in like species unless otherwise determined by the City's Authorized Representative.

3.10 ADJUSTING AND CLEANING

At the end of the construction period, the Contractor shall remove all protection fencing, trash, and debris within the protection area and finish grade and cover in accordance with the requirements of these Specifications.

+ + + END OF SECTION 02231 + + +

SECTION 02290
DEWATERING

PART 1 - GENERAL

1.1 DESCRIPTION

A. Requirements for providing all labor, supervision, materials, tools, and to perform all operations necessary for the dewatering of the excavation in support of the excavation required to properly construct the underground pump station, as specified herein.

B. Reference Sections

1. Section 02010 – Geotechnical Data
2. Section 02200 – Earthwork
3. Section 02295 – Excavation Support

1.2 SUMMARY

A. Section includes construction dewatering.

B. Related Requirements:

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference

1. Verify availability of Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
2. Review condition of site to be dewatered including coordination with temporary erosion-control measures and temporary controls and protections.
3. Review geotechnical report.
4. Review proposed site clearing and excavations.
5. Review existing utilities and subsurface conditions.
6. Review observation and monitoring of dewatering system.

1.4 ACTION SUBMITTALS

A. Shop Drawings: For dewatering system, prepared by or under the supervision of a qualified professional engineer.

1. Include plans, elevations, sections, and details.

2. Show arrangement, locations, and details of wells and well points; locations of risers, headers, filters, pumps, power units, and discharge lines; and means of discharge, control of sediment, and disposal of water.
3. Include layouts of piezometers and flow-measuring devices for monitoring performance of dewatering system.
4. Include written plan for dewatering operations including sequence of well and well-point placement coordinated with excavation shoring and bracings and control procedures to be adopted if dewatering problems arise.

B. Qualification Data
1. Installer Qualifications: An experienced installer that has specialized in dewatering work.

1.5 FIELD CONDITIONS

A. Project-Site Information: A geotechnical report has been prepared for this Project and is available for information only. The opinions expressed in this report are those of a geotechnical engineer and represent interpretations of subsoil conditions, tests, and results of analyses conducted by a geotechnical engineer. Owner is not responsible for interpretations or conclusions drawn from this data.

1. Make additional test borings and conduct other exploratory operations necessary for dewatering according to the performance requirements.
2. The geotechnical report is referenced elsewhere in Project Manual.

B. Survey Work: Engage a qualified land surveyor or professional engineer to survey adjacent existing buildings, structures, and site improvements; establish exact elevations at fixed points to act as benchmarks. Clearly identify benchmarks and record existing elevations.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Dewatering Performance: Design, furnish, install, test, operate, monitor, and maintain dewatering system of sufficient scope, size, and capacity to control hydrostatic pressures and to lower, control, remove, and dispose of ground water and permit excavation and construction to proceed on dry, stable subgrades.

1. Design dewatering system, including comprehensive engineering analysis by a qualified professional engineer.
2. Continuously monitor and maintain dewatering operations to ensure erosion control, stability of excavations and constructed slopes, prevention of flooding in excavation, and prevention of damage to subgrades and permanent structures.

3. Prevent surface water from entering excavations by grading, dikes, or other means.
4. Accomplish dewatering without damaging existing buildings, structures, and site improvements adjacent to excavation.
5. Remove dewatering system when no longer required for construction.

B. Regulatory Requirements: Comply with governing EPA notification regulations before beginning dewatering. Comply with water- and debris-disposal regulations of authorities having jurisdiction.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by dewatering operations.

1. Prevent surface water and subsurface or ground water from entering excavations, from ponding on prepared subgrades, and from flooding site or surrounding area.
2. Protect subgrades and foundation soils from softening and damage by rain or water accumulation.

B. Install dewatering system to ensure minimum interference with roads, streets, walks, and other adjacent occupied and used facilities.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.

C. Provide temporary grading to facilitate dewatering and control of surface water.

D. Protect and maintain temporary erosion and sedimentation controls, during dewatering operations.

3.2 INSTALLATION

A. Install dewatering system utilizing wells, well points, or similar methods complete with pump equipment, standby power and pumps, filter material gradation, valves, appurtenances, water disposal, and surface-water controls.

1. Space well points or wells at intervals required to provide sufficient dewatering.
2. Use filters or other means to prevent pumping of fine sands or silts from the subsurface.

B. Place dewatering system into operation to lower water to specified levels before excavating below ground-water level.

C. Provide sumps, sedimentation tanks, and other flow-control devices as required by authorities having jurisdiction.

D. Provide standby equipment on-site, installed and available for immediate operation, to maintain dewatering on continuous basis if any part of system becomes inadequate or fails.

3.3 OPERATION

A. Operate system continuously until drains, sewers, and structures have been constructed and fill materials have been placed or until dewatering is no longer required.

B. Operate system to lower and control ground water to permit excavation, construction of structures, and placement of fill materials on dry subgrades. Drain water-bearing strata above and below bottom of foundations, drains, sewers, and other excavations.

1. Do not permit open-sump pumping that leads to loss of fines, soil piping, subgrade softening, and slope instability.
2. Reduce hydrostatic head in water-bearing strata below subgrade elevations of foundations, drains, sewers, and other excavations.
3. Maintain piezometric water level a minimum of 60 inches below bottom of excavation.

C. Dispose of water removed by dewatering in a manner that avoids endangering public health, property, and portions of work under construction or completed. Dispose of water and sediment in a manner that avoids inconvenience to others.

D. Remove dewatering system from Project site on completion of dewatering. Plug or fill well holes with sand or cut off and cap wells a minimum of 36 inches below overlying construction.

3.4 FIELD QUALITY CONTROL

A. Observation Wells: Provide observation wells or piezometers, take measurements, and maintain at least the minimum number indicated; additional observation wells may be required by authorities having jurisdiction.

1. Observe and record daily elevation of ground water and piezometric water levels in observation wells.
2. Repair or replace, within 24 hours, observation wells that become inactive, damaged, or destroyed. In areas where observation wells are not functioning properly, suspend construction activities until reliable observations can be made.

Add or remove water from observation-well risers to demonstrate that observation wells are functioning properly.

3. Fill observation wells, remove piezometers, and fill holes when dewatering is completed.

B. Survey-Work Benchmarks: Resurvey benchmarks monthly during dewatering and maintain an accurate log of surveyed elevations for comparison with original elevations. Promptly notify Architect if changes in elevations occur or if cracks, sags, or other damage is evident in adjacent construction.

C. Provide continual observation to ensure that subsurface soils are not being removed by the dewatering operation.

D. Prepare reports of observations.

3.5 PROTECTION

A. Protect and maintain dewatering system during dewatering operations.

B. Promptly repair damages to adjacent facilities caused by dewatering.

END OF SECTION

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SECTION 02295
EXCAVATION SUPPORT

PART 1 - GENERAL

1.1 DESCRIPTION

A. Requirements for providing all labor, supervision, materials, tools, and to perform all operations necessary for to install a temporary earth support system for the construction of the underground pump station, as specified herein.

B. Reference Sections

1. Section 02010 – Geotechnical Data
2. Section 02200 – Earthwork
3. Section 02290 - Dewatering

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference:

1. Review geotechnical report.
2. Review existing utilities and subsurface conditions.
3. Review coordination for interruption, shutoff, capping, and continuation of utility services.
4. Review proposed excavations.
5. Review proposed equipment.
6. Review monitoring of excavation support and protection system.
7. Review coordination with waterproofing.
8. Review abandonment or removal of excavation support and protection system.

1.3 SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, performance properties, and dimensions of individual components and profiles, and calculations for excavation support and protection system.

B. Shop Drawings: For excavation support and protection system, prepared by or under the supervision of a qualified professional engineer.

1. Include plans, elevations, sections, and details.

2. Show arrangement, locations, and details of soldier piles, piling, lagging, tiebacks, bracing, and other components of excavation support and protection system according to engineering design.
3. Indicate type and location of waterproofing.
4. Include a written plan for excavation support and protection, including sequence of construction of support and protection coordinated with progress of excavation.

C. Delegated-Design Submittal: For excavation support and protection systems, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

D. Qualification Data: For the following:

1. Land surveyor.
2. Professional Engineer: Experience with providing delegated-design engineering services of the type indicated, including documentation that engineer is licensed in the State of Georgia in which Project is located.

E. Contractor Calculations: For excavation support and protection system. Include analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

F. Existing Conditions: Using photographs and video recordings, show existing conditions of adjacent construction and site improvements that might be misconstrued as damage caused by inadequate performance of excavation support and protection systems. Submit before Work begins.

1.4 CLOSEOUT SUBMITTALS

A. Record Drawings: Identify locations and depths of capped utilities, abandoned-in-place support and protection systems, and other subsurface structural, electrical, or mechanical conditions.

1.5 FIELD CONDITIONS

A. Interruption of Existing Utilities: Do not interrupt any utility-serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility according to requirements indicated:

1. Notify City of Atlanta no fewer than thirty (30) days in advance of proposed interruption of utility.
2. Do not proceed with interruption of utility without City of Atlanta written permission.

B. Survey Work: Engage a qualified land surveyor or professional engineer to survey adjacent existing buildings, structures, and site improvements; establish exact elevations at fixed points to act as benchmarks. Clearly identify benchmarks, and record existing elevations.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer to design excavation support and protection systems to resist all lateral loading and surcharge, including but not limited to, retained soil, groundwater pressure, adjacent building loads, adjacent traffic loads, construction traffic loads, material stockpile loads, and seismic loads, based on the following:

1. Compliance with OSHA Standards and interpretations, 29 CFR 1926, Subpart P.
2. Compliance with Georgia State Building Code.
3. Compliance with requirements of authorities having jurisdiction.
4. Compliance with utility company requirements.
5. Compliance with railroad requirements.

2.2 MATERIALS

A. Provide materials that are either new or in serviceable condition.

1. Structural Steel: ASTM A36/A36M, ASTM A690/A690M, or ASTM A992/A992M.
2. Steel Sheet Piling: ASTM A328/A328M, ASTM A572/A572M, or ASTM A690/A690M; with continuous interlocks.
3. Wood Lagging: Lumber, mixed hardwood, nominal rough thickness of size and strength required for application.
4. Cast-in-Place Concrete: ACI 301, of compressive strength required for application.
5. Reinforcing Bars: ASTM A615/A615M, Grade 60 , deformed.
6. Tiebacks: Steel bars, ASTM A722/A722M.
7. Tiebacks: Steel strand, ASTM A416/A416M.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards that could develop during excavation support and protection system operations.

1. Shore, support, and protect utilities encountered.

3.2 INSTALLATION - GENERAL

A. Locate excavation support and protection systems clear of permanent construction, so that construction and finishing of other work is not impeded.

B. Install excavation support and protection systems to ensure minimum interference with roads, streets, walks, and other adjacent occupied and used facilities.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
2. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.

C. Install excavation support and protection systems without damaging existing buildings, structures, and site improvements adjacent to excavation.

3.3 SOLDIER PILES AND LAGGING

A. Install steel soldier piles before starting excavation.

1. Extend soldier piles below excavation grade level to depths adequate to prevent lateral movement.
2. Space soldier piles at regular intervals not to exceed allowable flexural strength of wood lagging.
3. Accurately align exposed faces of flanges to vary not more than 2 inches from a horizontal line and not more than 1:120 out of vertical alignment.

B. Install wood lagging within flanges of soldier piles as excavation proceeds.

1. Trim excavation as required to install lagging.
2. Fill voids behind lagging with soil, and compact.

C. Install wales horizontally at locations indicated on Drawings and secure to soldier piles.

3.4 SHEET PILING

A. Before starting excavation, install one-piece sheet piling lengths and tightly interlock vertical edges to form a continuous barrier.

B. Accurately place the piling using templates and guide frames unless otherwise recommended in writing by the sheet piling manufacturer.

1. Limit vertical offset of adjacent sheet piling to 60 inches.
2. Accurately align exposed faces of sheet piling to vary not more than 2 inches from a horizontal line and not more than 1:120 out of vertical alignment.

C. Cut tops of sheet piling to uniform elevation at five feet below top of excavation.

3.5 TIEBACKS

A. Drill, install, grout, and tension tiebacks.

B. Test load-carrying capacity of each tieback, and replace and retest deficient tiebacks.

1. Have test loading observed by a qualified professional engineer responsible for design of excavation support and protection system.

C. Maintain tiebacks in place until permanent construction is able to withstand lateral earth and hydrostatic pressures.

3.6 BRACING

A. Locate bracing to clear columns, floor framing construction, and other permanent work. If necessary to move brace, install new bracing before removing original brace.

1. Do not place bracing where it will be cast into or included in permanent concrete work unless otherwise approved by Architect.
2. Install internal bracing if required to prevent spreading or distortion of braced frames.
3. Maintain bracing until structural elements are supported by other bracing or until permanent construction is able to withstand lateral earth and hydrostatic pressures.

3.7 MAINTENANCE

A. Monitor and maintain excavation support and protection system.

B. Prevent surface water from entering excavations by grading, dikes, or other means.

C. Continuously monitor vibrations, settlements, and movements to ensure stability of excavations and constructed slopes and to ensure that damage to permanent structures is prevented.

3.8 FIELD QUALITY CONTROL

A. Survey-Work Benchmarks: Resurvey benchmarks weekly during installation of excavation support and protection systems, excavation progress, and for as long as excavation remains open.

1. Maintain an accurate log of surveyed elevations and positions for comparison with original elevations and positions.
2. Promptly notify Architect if changes in elevations or positions occur or if cracks, sags, or other damage is evident in adjacent construction.

B. Promptly correct detected bulges, breakage, or other evidence of movement to ensure that excavation support and protection system remains stable.

C. Promptly repair damages to adjacent facilities caused by installation or faulty performance of excavation support and protection systems.

3.9 REMOVAL AND REPAIRS

A. Remove excavation support and protection systems when construction has progressed sufficiently to support excavation and earth and hydrostatic pressures.

1. Remove in stages to avoid disturbing underlying soils and rock or damaging structures, pavements, facilities, and utilities.
2. Remove excavation support and protection systems to a minimum depth of five feet below overlying construction, and abandon remainder.
3. Fill voids immediately with approved backfill compacted to density specified in Section 02200 - Earthwork
4. Repair or replace, as approved by Architect, adjacent work damaged or displaced by removing excavation support and protection systems.

B. Leave excavation support and protection systems permanently in place.

END OF SECTION

SECTION 02410
UTILITY LINE REMOVAL

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes

Paragraph	Title
1.2	Submittals
3.1	Pipe Removal/Abandonment
3.2	Valve Abandonment
3.3	Manhole Removal/Abandonment

B. Scope

1. The work under this section includes furnishing all labor, materials, and equipment to remove and/or abandon existing utility lines, including water mains, force mains, gravity sewers, etc., as required for the installation of the proposed facilities.

1.2 SUBMITTALS

A. Provide submittals in accordance with the requirements of Submittal Requirements Section.

B. Action Submittals/Informational Submittals

1. Details of all caps or plugs to be installed on abandoned piping to remain in the ground.
2. Details for restraining all existing pipelines to remain in services where a portion of the main has been removed or modified.
3. Location of disposal site for all materials removed with documentation from site owner stating acceptance of each type of material to be disposed of.
4. Photographs or videotape, sufficiently detailed, of existing conditions of project site that might be misconstrued as damage, caused by debris, or construction material removal.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1 PIPE REMOVAL/ABANDONMENT

A. Remove any existing utility pipeline that is to be abandoned that interferes with the installation of the proposed pipelines. Obtain approval from the utility Owner prior to removing any portion of existing pipelines.

B. Isolate the portion of the pipeline to be removed using existing isolation valves. Transfer any service connections on the pipeline to be removed to the new pipeline or an existing pipeline which will remain in service prior to isolation of the pipeline.

C. Suitably cap or plug the ends of piping to remain in the ground to prevent water or soil from entering the pipe.

D. Properly restrain with thrust blocking any existing pipelines that have a portion of pipe removed and are to remain in service to prevent movement of the remaining pipe.

E. Follow all applicable codes and regulations for removal of hazardous materials, such as asbestos cement pipe, and dispose of in a legal and proper manner.

F. Load, haul away, and dispose of in a satisfactory location any debris, trash, structures, piping, etc. removed from the worksite.

3.2 VALVE ABANDONMENT

Fully close buried valves that are to be abandoned. Remove the valve box and fill the hole with suitable compacted material. If the valve is within a paved location, cap the hole with matching materials (asphalt, concrete, etc.). If the valve is at the end of a pipeline that is to remain in service, plug and restrain the valve to prevent leaks.

3.3 MANHOLE REMOVAL/ABANDONEMENT

A. Remove any existing manhole that is to be abandoned that interferes with the installation of the proposed work. Obtain approval from the utility Owner prior to removing any manholes.

B. Where manholes are to be removed, excavate the manhole; remove the manhole and connecting piping, as required, and backfill the void with approved material. If the manhole is located within a road, parking area, driveway or other maintained area, compact the backfill to 95% standard proctor. If the manhole is located in an unmaintained area, compact the backfill to 80% standard proctor and slightly mounded to allow for settlement.

C. Where manholes are to be abandoned in place, grout seal the ends of all pipes entering the manhole, fracture the invert of the manhole to allow for drainage, cut the top of the manhole off to a minimum of three (3) feet below finished grade, fill

the manhole with #57 stone, and bury with suitable fill material. If the manhole is located within a road, parking area, driveway or other maintained area, compact the backfill to 95% standard proctor. If the manhole is located in an unmaintained area, compact the backfill to 80% standard proctor and slightly mounded to allow for settlement.

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SECTION 02490
TREES, SHRUBS, PERENNIALS AND GROUND COVER GENERAL

PART 1- GENERAL

1.01 DESCRIPTION OF WORK

The work covered under this section applies to furnishing all equipment, materials, and labor necessary for soil preparation; planting of trees, shrubs, herbaceous perennials, ground cover, bare root plants, procurement and proper installation of live stakes, dormant woody cuttings, as applicable; protection, maintenance, guarantee, and replacement of plants; and all related items as shown on the drawings and specified herein.

Related Work Specified Elsewhere:

Section 02922 Amended Soil and Mulch

It is not contemplated that planting shall occur where the depth of soil over underground construction or obstructions is insufficient to accommodate the roots or where impervious soil will require drainage. Where such conditions are encountered in excavation of planting areas, other locations for underground construction or for the planting may be designated by the Owner or Owner's Representative.

1. Removal of underground obstructions, relocation of underground construction and provision of drainage for planting areas shall be done only as directed by the Owner or Owner's Representative.
2. If changes in the location of the work or if removal of obstructions involve additional work, the Contractor shall proceed in accordance with the Contract Modifications Procedures Specification 01260.

All planting shall be performed by personnel with experience with these planting procedures and under the supervision of a qualified planting foreman capable of executing the requirements of this specification.

The Contractor shall take all necessary precautions to avoid damage to existing sidewalks, fencing, paving, curbs, lighting, and other site improvements and Contractor shall replace any existing site improvements damaged by his operations at his own expense to match the pre-damaged condition and to a manner acceptable to the Owner or Owner's Representative.

1.02 QUALITY ASSURANCE

Size, quality, root ball preparation, and grading standards shall conform to the American Association of Nurserymen, Inc., as published in the "American Standard for Nursery Stock," ANSI Z60.1, latest approved revision.

Plant names indicated comply with "Standardized Plant Names" as adopted by the latest edition of the American Joint Committee of Horticultural Nomenclature. Names of varieties not listed conform generally with names accepted by the nursery trade. Provide stock true to botanical name and legibly tagged.

The Contractor shall be responsible for all certificates of inspection of plant materials that may be required by federal, state, or other authorities to accompany shipments of plants. All plants must be inspected and approved by the Owner or Owner's Representative before they are planted. Inspection and approval of plants upon delivery shall be for quality, size, and variety only and shall not in any way impair the right of rejection for failure to meet other requirements during progress of the work.

Fertilizer shall conform to the local, state, and federal laws applicable to its manufacture and labeling.

1.03 PLANT GUARANTEE AND REPLACEMENT

Guarantee:

1. Plants shall be alive, healthy, and vigorous at the end of the guarantee period.
2. The guarantee period all plant material other than trees planted as 'recompense' shall be for a period of one year after installation and Owner final acceptance of the plants. Guarantee period for ' recompense trees' shall be for a period of two years after installation and Owner final acceptance of the plants.
3. Damage to plant material resulting from disease, drought, insect infestation, improper maintenance, winter burn, except breakage resulting from freezing rains or winds of 60 mph and greater, shall be the liability of the Landscape Contractor
4. Contractor is required to control weeds and invasive species that threaten the survival of all installed plantings.

Replacement:

5. Live stake, bare rooted and containerized plants and shrubs shall have a one year warranty after completion and acceptance of each contract item as listed in bid package. Replacement plants shall then have an additional 60 day warranty.
6. Recompense trees shall have a two year warranty after completion and acceptance of each contract item as listed in bid package. Recompense trees will be

inspected after one year. Replacement trees will have an additional one year warranty. Any replacement recompense trees requiring replacement after 2 years will have an additional 60 warranty.

PART 2 PRODUCTS

2.01 PLANTS

The names of plants required under this contract conform to those given in "Standardized Plant Names," latest edition, prepared by American Joint Committee on Horticultural Nomenclature. Each plant shall be tagged or labeled at the source with full botanical name on a waterproof tag.

Plant specimens shall conform to those indicated on the Drawings and two specimens of each plant shall be furnished for approval unless otherwise noted on the plant list.

Plants shall be nursery grown locally, unless otherwise noted, and have a habit of growth that is normal for the species. They shall be sound, healthy, vigorous, and free from insect pests, plant diseases, and injuries. All plants shall equal or exceed the measurements specified in the Plant List, which are minimum acceptable sizes. They shall be measured before pruning with branches in normal position. No pruning shall be done until the plants have been inspected by the Owner or Owner's Representative and in no case shall the plants supplied under this contract be pruned back to such an extent that they no longer meet specifications. All trees and shrubs shall have been transplanted or root pruned at least once in the 3 years previous to contract date. Root bound container plants will not be accepted.

Substitutions of genus, species, or variety will be permitted only upon submission of proof, in writing, that the specified plant or its alternative is not obtainable in the continental United States. Written authorization for substitution must be obtained from the Owner or Owner's Representative.

Bare root plants and plants used for branch layering or live stakes may be field collected in a legal manner.

All balled and burlaped trees shall be dug with firm, natural balls of earth of sufficient diameter and depth to encompass the fibrous and feeding root system necessary for full recovery of the plant. Balls shall be firmly wrapped with burlap or similar material and bound with twine, cord or wire mesh. Where necessary to prevent breaking or cracking of the ball during the process of planting, the ball may be secured to a platform.

Container grown plants shall be healthy, vigorous, well-rooted, and shall have become established in the container in which they are delivered. These plants shall have been in the established container long enough for the fibrous roots to have developed so that the root mass will retain its shape and hold together when removed

from the container. No plants shall be loose in the container and shall not be pot bound. sufficiently rigid to firmly hold the soil protecting the root during transporting, handling, and planting.

2.02 MISCELLANEOUS MATERIALS

Water shall be free from ingredients harmful to plant life. Hose and other watering equipment required for the work shall be furnished by the Contractor.

Mulch shall be shredded hardwood mulch as defined in Section 02922 or tightly baled pine straw which is clean, fresh, dark reddish-brown, and free of branches, cones, foreign matter, insects and disease.

Fertilizer shall be as recommended by soil analysis and as specified within Section 3.3 G and 3.5A, within these specifications.

Stakes for securing container or balled and burlapped trees in the ground shall be a minimum of 24-inches in length, 2-inches x 2-inches wooden stakes. Wooden stakes shall be rot resistant wood, e.g., redwood, oak, western cedar, or pressure treated southern pine.

PART 3 EXECUTION

3.01 SOIL PREPARATION

Prior to planting, soil samples shall be taken within each planting zone (minimum of one per 5,000 square ft.) and include a composite sample of each zone with a minimum of four subsamples per instructions from the UGA Extension Service and be analyzed for the appropriate parameters by the UGA Extension Service or State approved soil analytical laboratory. All soil sample results shall be submitted to the Owner for their records. The Contractor shall add the appropriate amount of the deficient elements to the soil prior to planting.

3.02 TIME OF PLANTING

When other sections of the work have progressed sufficiently to commence the work of planting, and the Owner or Owner's Representative have accepted the preceding work, planting operations shall be conducted immediately under favorable weather conditions. These seasons shall be as follows:

1. Permanent Seed
   a. Permanent seed shall be planted between March 1and June 1, or September 1 and October 31, depending on the type of grasses.
   b. Follow recommendations of seed supplier.

2. Shrubs and Trees (container plantings)
   Planting shall occur between November and March, preferably after the first frost

3. Shrubs and Trees (bare root plantings)
   Planting shall occur between November and March, preferably after the first frost

4. Other Ground Cover
   Planting shall occur between November and March

5. At the option and on the full responsibility of the Contractor, planting operations may be conducted under unseasonable conditions without additional compensation.

3.03 PRODUCT HANDLING AND STORAGE

Balled and burlapped plants shall be dug and prepared for shipment in a manner that will not damage roots or branches. The balls or roots of plants not planted immediately on delivery shall be covered with moist soil or mulch, or other protection from drying winds and sun. All plants shall be watered as necessary, until planted. Balled plants shall not be lifted by the trunk of the plant.

3.04 PLANTING OF, TREES, SHRUBS, PERENNIALS, BARE ROOTS, AND GROUND COVER

Except as otherwise specified, the Contractor's work shall conform to accepted horticultural practices as used in the trade.

Live stakes, trees, shrubs, balled and burlapped, containerized plants and seed mixtures shall be planted during the their individual dormant seasons, as directed in the planting schedule, or as advised by a commercial plant supplier. Trees, shrubs, balled and burlapped, containerized plants shall be installed per the recommendations shown on the individual labels and as directed in the planting schedule, or as advised by a commercial plant supplier.

The Owner or Owner's Representative shall verify the staked location of all trees, shrubs, bare root plants and branch layer plants prior to installation with labeled stakes to be furnished for this purpose by the Contractor.

Planting pits shall be dug and soil for planting readied before plants are delivered. Pits shall be at least twice the diameter of the root ball or container. Contractor shall get approval of the planting pit locations from the Owner or Owner's Representative prior to plant installation.

Set plant material in the planting pit to proper grade and alignment. If fabric is used in container plants, remove first before setting in pit. Set plants upright, plum, and no

lower than the finished grade or 2-3 inches above finished grade. Add excavated pit material to fill approximately half of the pit. Fill rest of pit soil and bring to finished grade. Lightly compact fill around root ball and be sure to fill all voids. No filling will be permitted around trunks or stems.

All plants shall be set on prepared soil to such depth that the finished grade level at the plant after settlement will be the same as that at which the plant has grown. They shall be planted upright and plumb. Platforms, wire and burlap for top and sides of the ball as shown on the Details shall be removed. If synthetic fabric is used instead of burlap, all fabric should be removed prior to planting. All broken, frayed , or circling roots shall be cut off cleanly. Soil shall be placed and compacted carefully to avoid injury to roots and to fill voids. When the hole is nearly filled, add water as necessary and allow it to soak away. Fill the hole to finish grade. After the ground settles additional soil shall be filled to the level of the finished grade.

Live stakes shall be installed using a dead blow (shot or sand filled) hammer or rubber mallet to tamp the stakes into the ground, only when the soil is too hard or rocky to allow direct driving of stakes. Stakes should be embedded at least 2/3 of their length.

All trees, shrubs, perennials, ground cover, bare root plants, and branch layer plants shall be installed per the Drawings and Details.

Excess excavated soil from planting operations shall be removed from the site and properly disposed of by the Contractor.

All containerized plants shall be fertilized per soil test recommendations within 2 days of installation. Balled and burlapped trees and shrubs shall not be fertilized for the first year after planting.

If applicable, staking shall be accomplished as shown on Drawings and done only as recommended by Owner or Owner's Representative. Supports shall be removed immediately after the guarantee period..

Unless shown otherwise on the Drawings, all plants shall be mulched with a 3-inch minimum layer of mulch within 2 days of planting. This mulch shall entirely cover the area of the planting pit, bed, or saucer around each plant.

Owner or Owner's Representative shall review and approve method of planting for branch layering and bare planting prior to Contractor beginning installation of these items.

Contractor shall furnish sequencing report to Owner or Owner's Representative for review and approval showing branch layering installation sequencing, including but

not limited to, method of creating branch material, soaking timeframe and location, and handling of material prior to being planted.

3.05 PRUNING AND REPAIR

Upon completion of the work under the contract, all new trees and shrubs shall have been pruned and any injuries repaired. The amount of pruning shall be limited to the minimum necessary to remove dead or injured twigs and branches and to compensate for the loss of roots as a result of transplanting operations. Pruning shall be done in such a manner as not to change the natural habit or shape of the plant. All cuts shall be made flush, leaving no stubs. On all bruises or scars on the bark and cuts over ¾-inch in diameter, the injured cambium shall be traced back to living tissue and removed; wounds shall be smoothed and shaped so as not to retain water.

3.06 INSPECTION FOR ACCEPTANCE

Upon completion of all planting and after written notification, inspection of the landscape work to determine partial completion of the contract work, exclusive of maintenance and replacement of plants, will be made by the Owner or Owner's Representative. Inspection of the work will be made again by the Owner or Owner's Representative at the end of the guarantee period.

3.07 MAINTENANCE

Maintenance shall begin immediately after each plant is planted and shall continue until final acceptance is established by the Owner or Owner's Representative. Planting shall be protected and maintained as necessary by watering, fertilizing, and replanting as necessary throughout the guarantee period.

+ + + END OF SECTION 02490 + + +

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SECTION 02531
MECHANICALLY STABILIZED EARTH (MSE) RETAINING WALL

PART 1 GENERAL

1.01 SCOPE

This work shall consist of designing a mechanically stabilized earth (MSE) retaining wall system in accordance with these specifications and in close conformance with the lines, grades, design and dimensions shown on the plans or established by the Engineer. The MSE wall consists of a non-structural cast in place concrete leveling pad, precast concrete facing panels, solid reinforcement elements mechanically connected to each facing panel, reinforced cast-in-place and precast concrete coping, and impervious membrane with perforated pipe, as detailed on the plans.

A. The MSE walls include the requirement to design the rows of reinforcement located above the impervious membrane for a 125-year design life, as described in this specification.

B. The proposed MSE walls shall be constructed after completion of the footings and columns for all abutments.

C. The following proprietary MSE wall systems are approved for this project.

1. Retained Earth ™ formerly licensed by L.B. Foster Company
   1372 Old Bridge Road, Suite 101 Woodbridge, VA 22192
   (703) 499-9818

1.02 SUBMITTALS

A. Requirements for Supplier Prepared Design and Plans. The Contractor shall submit plans and calculations for the MSE wall system selected, for approval in accordance with the design criteria in this specification and the requirements listed below.

B. The plans and calculations shall be prepared and signed by a Georgia Licensed Professional Engineer and shall be submitted a minimum of 45 days prior to beginning any wall related construction.

C. The MSE wall design calculations shall include a complete and thorough set of calculations. A detailed explanation of any symbols and computer programs used in the design shall be provided. The design calculations shall be provided for external stability (sliding, overturning, and maximum bearing pressure) of the final wall configuration, and internal stability within each layer of reinforcement (tensile stress,

pullout resistance and tensile stress at the connection with the facing) for both seismic and non–seismic loading. The design calculations for internal and external stability.

D. Plan and elevations sheets shall be provided and shall contain the following information:

1. An elevation view of the wall which shall indicate the elevation at the top of the wall at all horizontal and vertical break points and at least every 20 m (50 feet) along the wall, elevations at the top of leveling pads, the designation as to the type of panel, the length, size and number of soil reinforcing strips, mats or mesh and the location of the original and final ground line.
2. A plan view of the wall which shall indicate the offset from the construction centerline to the face of the wall at all changes in horizontal alignment, the limit of the soil reinforcing strips, mats or mesh and the centerline of any drainage structure or drainage pipe which is behind or passes under or through the wall.
3. Any general notes required for design and construction of the wall.
4. All horizontal and vertical curve data affecting wall construction.
5. A summary listing of quantities provided on the elevation sheet of each wall for all items including subsidiary items.
6. Cross section showing limits of construction and the limits and extent of the reinforced soil volume.
7. All details for foundations and leveling pads, including the maximum calculated bearing pressures.
8. All details for the facing panels and all reinforcing steel in the panels and the location of soil reinforcing strip attachment devices embedded in the panel.
9. All reinforcing bar bending details.
10. All details for construction of the wall around bearing piles, drainage facilities, utilities for other items located with the MSE wall.
11. All details for connections to traffic barriers, coping, parapets, attached lighting and other structures.

E. Design Criteria. The MSE wall design shall meet all applicable requirements from the 2002 AASHTO Standard Specifications for Highway Bridges, Division 1, Section 5 – Retaining Walls for both seismic and non-seismic loading conditions. Design criteria shall include the following:

1. The design shall be based on a traffic surcharge of 12 kpa (250 pounds per square foot).
2. All seismic design calculations shall be based on a design acceleration coefficient of 0.17g.
3. The reinforced soil shall assume a soil friction angle of 34 degrees and a soil unit weight of 18.9 kilonewtons per cubic meter (120 pounds per cubic foot). The retained soil shall assume a soil friction angle of 30 degrees and a soil unit weight of 18.9 kilonewtons per cubic meter (120 pounds per cubic foot).

4. The design life of the MSE structure based on corrosion shall be for 125 years for all reinforcement located above the impervious membrane, and 100 years for all reinforcement located below the impervious membrane.
5. The reinforcement shall be designed so that it does not conflict with the concrete columns and metal pipe sleeve that support the proposed stub abutments. The MSE reinforcement shall be offset a minimum of 3 inches from the pipe sleeve.
6. The ultimate bearing capacity of the MSE foundation material for the walls shall be assumed as 720 kPa (7.5 tons per square foot). A safety factor of 2.5 shall be used to calculate the allowable bearing capacity for non-seismic loading and a safety factor of 1.88 shall be used for seismic loading.
7. The sliding resistance of the MSE wall shall be based on a coefficient of sliding equal to 0.58 between the MSE wall and the underlying materials.
8. Loads that are required for the design of the MSE walls are summarized as an attachment to this specification.

PART 2 MATERIALS

The Contractor shall make all arrangements to purchase the materials covered by this section of the specifications, including concrete facing panels, reinforcing mesh, grid or strips, attachment devices, fasteners, joint materials, impervious membrane, perforated pipe, geotextile and all necessary incidentals from the approved wall system supplier. The Contractor shall furnish the Engineer a Certificate of Compliance, certifying that the applicable materials comply with this the specifications. Materials not conforming to this section of the specifications shall not be used without the written consent of the Engineer.

2.01. CONCRETE FACING PANELS.

A. Precast concrete facing panels shall have a minimum thickness of 140 mm (5 ½ inches) and a minimum concrete cover on reinforcing steel of 38 mm (1-1/2) inches). Cement shall be Type II and shall conform to the requirements of AASHTO M 85. Concrete shall have a minimum compressive strength of 35 MPa (5000 psi) at 28 days and meet all other requirements of Concrete Class A as specified in Section 520. A corrosion inhibitor (calcium nitrate) admixture shall be used at a rate of 4 gallons per cubic yard and shall conform to DCI or DCI-S by W.R. Grace or approved equal. Lifting devices shall be set in place to the dimensions and tolerances shown on the approved shop drawings prior to casting.

1. Testing and inspection. Acceptability of the panels shall be determined on the basis of compressive strength tests and visual inspection. The Contractor shall furnish facilities and perform all necessary sampling and testing in an expeditious and satisfactory manner.
2. Casting. The concrete in each panel shall be placed without interruption and shall be consolidated by the use of an approved vibrator, supplemented by such hand tamping as may be necessary to force the concrete into the corners of the forms and to prevent the formation of stone pockets or cleavage planes. Clear form oil or release agent shall be used on the forms prior to each casting operation.

3. Curing. The panels shall be cured as specified in Section 520.3.10. Any production lot which does not conform to the strength requirements shall be rejected.
4. Removal of Forms. The forms shall remain in place until they can be removed without damage to the panel.
5. Concrete Finish. The front face of the panels shall have a form liner finish as indicated on the plans. The rear face of the panels shall have an unformed finish and shall be free of open pockets of aggregate and surface distortions in excess of 6 mm (1/4 inch).
6. Tolerances. All panels shall be manufactured within the following tolerances with respect to the dimensions shown on the approved shop drawings.
7. Attachment Device Locations and Alignment. Lateral position of reinforcing strip attachment devices shall be within 25 mm (one inch). Embedment measured from the back face of the panel shall be within +6 mm, -12 mm (+ ¼ inch, -1/2 inch). Bearing surfaces of multiple attachment points for a single soil reinforcing element shall align with 1.5 mm (1/16 inch).
8. Panel Dimensions. All panel dimensions shall be within 6 mm (1/4 inch). All hardware embedded in the panel with the exception of attachment devices shall be with 6 mm (1/4 inch).
9. Panel Squareness. Squareness, as determined by the difference between the two diagonals, shall not exceed 12 mm (1/2 inch).
10. Panel Surface Finish. Surface defects on smooth-formed surfaces, measured on a length of 1.5 m (5 feet) shall not exceed 6 mm (1/4 inch). Surface defects on textured-finished surfaces, measured on a length of 1.5 m (5 feet) shall not exceed 8 mm (5/16 inch).

B. Compressive Strength. Acceptance of the panels, with respect to compressive strength, shall be determined on the basis of production lots. A production lot is defined as a group of panels that shall be represented by a single set of compressive strength samples and shall consist of not more than 20 panels or a single day's production, whichever is less.

1. During the production of the panels, the manufacturer shall randomly sample the concrete in accordance with AASHTO T 141. A single set of compressive strength samples, consisting of a minimum of four cylinders, shall be made for every production lot.
2. For every compressive strength sample, a minimum of two cylinders shall be cured in the same manner as the panels and tested at several days or less. The average compressive strength of these cylinders, when tested in accordance with AASHTO T 22, will determine the initial strength of the concrete. In addition, a minimum of two cylinders shall be cured in accordance with AASHTO T 23 and tested at 28 days. The average compressive strength of these cylinders, when tested in accordance with AASHTO T 22 will determine the compressive strength of the production lot.
3. If the initial strength test result indicates a compressive strength greater than or equal to the required 28-day strength, then this test result will be utilized as the

compressive strength test results for that production lot, and the requirement for testing at 28 days will be waived for that particular production lot.

4. Acceptance of a production lot will be made if the compressive strength test result is greater than or equal to the required 28-day strength. If the compressive strength test results is less than the required 28-day strength, the acceptance of the production lot will be based on its meeting the following acceptance criteria in its entirety:
5. Ninety percent of the compressive strength test results for the overall production shall exceed 1.0375 times the required 28-day strength.
6. The average of any six consecutive compressive strength test results, including the one in question, shall exceed 1.0625 times the required 28-day strength.
7. No individual compressive strength test result shall fall below 0.9 times the required 28-day strength.
8. In the event that a production lot fails to meet the specified compressive strength requirements, the production lot shall be rejected. Such rejection shall prevail unless the Contractor, at no cost to the Department, obtains and submits evidence of a type acceptable to the Engineer that the strength and quality of the concrete placed in the panels within a production lot is acceptable. If such evidence consists of tests made on cores taken from the panels with the production lot, the cores shall be obtained and tested in accordance with AASHTO T 24.

C. Rejection. Panels shall be subject to rejection because of failure to meet any of the requirements specified above. In addition, any or all of the following defects may be sufficient cause for rejection:

1. Defects that indicate imperfect molding.
2. Defects indicating honeycombed or open-texture concrete.
3. Defects in the physical characteristics of the concrete, such as broken or chipped concrete.

The Engineer shall determine whether spalled, honeycombed, chipped or otherwise defective concrete shall be repaired or be cause for rejection. Repair of concrete, if allowed, shall be done in a manner satisfactory to the Engineer. Repair to concrete surfaces which will be exposed to view after completion of construction must be approved by the Engineer.

B. Marking. The date of manufacture, the production lot number, and the piece-mark shall be clearly scribed on the rear face of each panel.

C. Handling, Storage and Shipping. All panels shall be handled, stored and shipped in such a manner as to eliminate the danger of chipping, cracks, fractures and excessive bending stresses. Panels shall be stored and shipped in stacks, front face down. Firm blocking, of sufficient thickness to prevent the attachment devices from contacting the panel above, shall be located immediately adjacent to the attachment devices. Lifting inserts shall be installed on the top edge of the panels to permit lifting at the

project site. Reinforcement connection inserts (tie strips or loop inserts) shall not be used for lifting or handling the panel.

2.02 SOIL REINFORCING AND ATTACHMENT DEVICES

All reinforcing and attachment devices shall be carefully inspected to insure they are true to size and free from defects that may impair their strength and durability.

A. Ribbed Reinforcing Strips. Ribbed reinforcing strips shall be hot rolled from bars to the required shape and dimensions. Their physical and mechanical properties shall conform to AASHTO M 223 (ASTM A 572) grade 450 (65) or equal. Galvanizing shall conform to the requirements of AASHTO M 111 (ASTM A 123). The minimum coating thickness shall be 605 grams per square meter (2 ounces per square foot).

B. Ladder Reinforcing Strips. Ladder reinforcing strips shall be shop fabricated of cold drawn steel wire conforming to the minimum requirements of AASHTO M 32M/M 32 (ASTM A 82) and welded into the finished strip configuration in accordance with AASHTO M 55M/M 55 (ASTM A 185). The longitudinal and transverse wires shall be of the same size. Galvanizing shall be applied after the ladder strips are fabricated and shall conform to the minimum requirements of AASHTO M 111 (ASTM A 123). The minimum coating thickness shall be 605 grams per square meter (2 ounces per square foot).

C. Reinforcing Mesh and Bar Mats. Reinforcing mesh and bar mats shall be shop fabricated of cold drawn steel wire conforming to the minimum requirement of AASHTO M 32M/M 32 (ASTM A 82) and welded into the finished mesh fabric in accordance with AASHTO M 55M/M 55 (ASTM A 185). The longitudinal and transverse wires shall be of the same size. Galvanizing shall b applied after the mesh is fabricated and shall conform to the minimum requirements of AASHTO M 111 (ASTM A 123. The minimum coating thickness shall be 605 grams per square meter (2 ounces per square foot).

D. Tie Strips. Tie strips shall be shop fabricated of hot rolled steel conforming to the minimum requirements of ASTM A 570M, Grade 50 or equivalent. Galvanizing shall conform to the minimum requirements of AASHTO M 111 (ASTM A 123) or AASHTO M 232 (ASTM A 153). The minimum coating thickness shall be 605 grams per square meter (2 ounces per square foot).

E. Wire Tie Strips and Loop Inserts. Wire tie strips and loop inserts shall be shop fabricated of cold drawn steel wire conforming to the minimum requirements of AASHTO M 32M/M 32 (ASTM A 82). Galvanizing shall conform to the minimum requirements of AASHTO M 111 (ASTM A 123). The minimum coating thickness shall be 605 grams per square meter (2 ounces per square foot).

F. Fasteners. Fasteners shall consist of 12 mm (1/2-inch) minimum diameter hexagonal cap screw bolts and nuts conforming to the minimum requirements of AASHTO M 164M/M 164 (ADTM A 325M/A 325) or equivalent. Galvanizing shall conform to the minimum requirements of AASHTO M 232 (ASTM A 153).

G. Connector Bars and Pins. Connector bars and pins shall be fabricated from cold drawn steel wire conforming to the minimum requirements of AASHTO M 32M/M 32 (ASTM A 82) and shall be galvanized in accordance with the requirement of AASHTO M 111 (ASTM A 123). The minimum coating thickness shall be 605 grams per square meter (2 ounces /square foot).

H. Structural Connectors. Structural plate connectors and fasteners used for yokes to connect soil reinforcing to facing panels around column or utility conflicts shall conform to the material requirements of 2.3.4 Tie Strips and 2.3.6 Fasteners, stated above.

2.03 JOINT MATERIALS

Joint materials shall be as specified by the wall supplier and subject to the following requirements:

A. Bearing Pads. Bearing pads shall be preformed rubber pads having a durometer hardness of 80 ± 5.

B. Joint Cover. Horizontal and vertical joints between panels shall be covered by a geotextile. The geotextile may be either a non-woven needle punched polyester geotextile or a hold the geotextile filter fabric material to the rear of the panels prior to backfill placement shall be approved by the wall supplier.

2.04 GRANULAR BACKFILL

Material used for backfill within the MSE Structure shall conform to the following requirements:

1. Gradation. 100 percent of the particles shall pass the 100 mm (4-inch) sieve and not more than 60 percent of the particles shall pass the 0.425 mm (No. 40) sieve.
2. Plasticity Index. The Plasticity Index (P.I.), as determined by AASHTO T 90, shall not exceed 6.
3. Soundness. The material shall be substantially free of shale or other soft, poor durability particles. The material shall have a magnesium sulfate soundness loss of less than 30 percent after four cycles, as determined by AASHTO T 104.
4. Electrochemical Requirements. The backfill material shall conform to the following electrochemical requirements.

Property	Requirement	Test Methods
Resistivity	Minimum 3000 ohm-cm, at 100% saturation	AASHTO T 288-91 ASTM G 57-78
pH	Acceptable Range 5-10	AASHTO T 289-91 ASTM G 51-77
Chlorides*	Maximum 100 ppm	AASHTO T 291-91 ASTM D 512-88
Sulfates*	Maximum 200 ppm	AASHTO T 290-91 ASTM D 516-88

*If the minimum resistivity exceeds 5000 ohm-cm, at 100% saturation, the need for testing of chlorides and sulfates is waived.

The contractor shall furnish to the Engineer a certificate of compliance certifying that the select granular backfill material complies with this section of the specifications. A copy of all test results performed by the Contractor, which are necessary to assure compliance with the specifications, shall also be furnished to the Engineer. Backfill not conforming to this specification shall not be used without the written consent of both the Engineer and the wall supplier.

2.05 CLEAN STONE FOR STRUCTURAL FILL

Material used within the MSE structure for Clean stone for Structural Fill below the stub abutment shall conform to applicable requirements of Section 02200 and to the plasticity, soundness and electrochemical requirement defined above.

2.06 CONCRETE FOR LEVELING PADS

Concrete for cast in place leveling pad shall conform to the requirements of Concrete Class B as specified in Section 03300.

2.07 Non-Woven Geotextile

Geotextile used directly above the impervious membrane shall be a medium strength, non-woven geotextile fabric

At least two weeks prior to installation of the geotextile, the Contractor shall submit a certificate of compliance. Each roll shall be clearly labeled so as to easily identify the product in the field. The label shall include as a minimum, the manufacturer's name, product name and number and the contract item name.

2.08 IMPERVIOUS MEMBRANE

A. The impervious membrane shall be a 0.75 mm (30 mil) PVC sheet, compounded from first quality domestic virgin material of single ply construction, having polyvinyl chloride as its principal polymer. The membrane shall be produced so as to be free of

holes, undispersed raw materials or blisters and shall meet the following physical requirements:

Property	Test Method	Property Requirements
Thickness [mm (mil)]	ASTM D 1593	0.75 (30) ± 5% min.
Specific Gravity	ASTM D 792	1.20 min.
Dimensional Stability (% change)	ASTM D 1204	5 max.
Tensile Strength [kN per m/% (pounds per inch/%	ASTM D 882	400 (2300) nub,
Tear Resistance [N (pounds)]	ASTM D 1004 Die C	35 (8) min
Low Temperature Brittleness [ºC (ºF)]	ASTM D 1790	-30 (-20) min.
Resistance to Soil Burial (% strength retained)	ASTM D 3083	95 min.
Hydrostatic Resistance [kPa (pounds per square inch)]	ASTM D 751 Method A	520 (75) min.

B. At least two weeks prior to installation of the membrane, the Contractor shall submit a certificate of compliance in accord with 106.04. The membrane shall be clearly labeled so as to easily identify the product in the field. The label shall include as a minimum, the manufacturer's name, product name and number and the contract item name.

C. All factory seams and field seams shall have a strength at lest equal to the specified sheet strength. The factory fabricated panels shall be a size that can be easily handled on the job site with conventional construction equipment. The panels should be as large and as square as possible to minimize the amount of field seaming required.

2.09 PERFORATED PIPE

Perforated pipe shall be smooth-wall polyvinyl chloride (PVC) conforming to AASHTO M 278, profile-wall PVC conforming to AASHTO M 304 or corrugated polyethylene drainage tubing conforming to AASHTO M 252, with Class 2 perforations except that the required pipe stiffness shall be a minimum of 400 kPa (60 psi) and length not exceeding 6 m (20 ft).

2.10 WALL COPING

Concrete for cast in place wall coping shall conform to the requirements of Concrete Class A as specified in Section 03300. Concrete for precast wall coping shall conform to Section 03410.

2.11 REINFORCING STEEL

Reinforcing steel shall conform to Section 03200. Reinforcing steel in the wall copings shall be epoxy coated.

PART 3 EXECUTION

3.01 COORDINATION MEETING

A coordination meeting shall be held prior to initiating the MSE wall construction and related work. The purpose of the meeting shall be to review all aspects of the MSE wall construction and to facilitate coordination between all parties involved. The coordination meeting shall not take place until the Contractor has submitted and received approval for the MSE wall design. Individuals attending the meeting shall include the Engineer, the Contractor, the MSE wall Technical Representative, the Bridge Engineer and the soils Engineer from the Materials and Research Bureau and all other personnel deemed appropriate by the previously mentioned personnel. The Bridge Engineer and the Soils Engineer shall be notified at least 7 days in advance of the meeting.

3.02 WALL SUPPLIER'S REPRESENTATIVE

The Contractor shall make the necessary arrangements with the wall supplier to have a technical representative on the project to supervise the initial construction of the wall. The technical representative shall also be required to be on-site at any time during wall construction as requested by the Engineer. When a technical representative has been requested, no wall construction shall be allowed until the technical representative has arrived at the project site.

3.03 FOUNDATION PREPARATION

The foundation for the structure shall be graded level for a width equal to or exceeding the length of the soil reinforcements, or as shown on the plans. Prior to wall construction, the foundation, if not in rock, shall be compacted with approved compaction equipment. Any foundation soils found to be unsuitable shall be removed and replaced as directed by the Engineer. At each panel foundation level, an unreinforced concrete leveling pad shall be provided as shown on the plans. The leveling pad shall have minimum nominal dimensions of 150 mm by 300 mm (6 inches by 12 inches). The leveling pad shall be cast to the design elevations as minus 6 mm (0.02 foot or ¼ inch), from the design elevation. The leveling pad shall be cured in accordance with Section 03300.

3.04 WALL ERECTION

A. Precast concrete facing panels may be placed in the wall when the initial strength of the panels equals or exceeds 85 percent of the 28-day requirement. Panels shall be placed vertically with the aid of a light crane. For erection, panels shall be handled

by means of lifting devices set into the upper edge of the panels. Panels shall be placed in successive horizontal lifts in the sequence shown on the approved shop drawings as backfill placement proceeds. A non- woven geotextile shall be placed along each panel joint as indicated on the approved shop drawings. As backfill material is placed behind the panels, the panels shall be maintained in a vertical position by means of shoulder clamps to adjacent panels and temporary wooden wedges placed in the joint at the junction of the two adjacent panels on the external side of the wall. External bracing is required for the initial lift.

1. The maximum allowable offset in any panel joint shall be 19 mm (3/4 inch). Vertical and horizontal alignment tolerances shall not exceed 19 mm in 3 m (3/4 inch in 10 feet). The overall vertical tolerance of the wall (plumbness from top to bottom) shall not exceed 12 mm per 3 m (1/2 inch per 10 feet) of wall height.

2. Joint materials and bearing pads shall be installed in accordance with the wall supplier's requirements and the details shown on the approved shop plans.

B. Placement of Soil Reinforcing. Prior to placing the first layer of soil reinforcing (strips, mats or mesh), backfill shall be placed and compacted in accordance with Section 02200, Earthwork.

1. Bending of soil reinforcing in the horizontal plane that results in a kink in their alignment shall not be allowed. Gradual bending in the vertical direction that does not kink the reinforcing is allowable.
2. Connection of soil reinforcing to columns or bending of reinforcing around columns shall not be allowed. A minimum 75 mm (3 inch) clearance shall be provided between the reinforcing and adjacent steel pipe sleeve. Cutting of reinforcing longitudinal bars shall not be allowed to avoid conflicts with piles or utility obstructions. A structural connection (yoke) from the wall panel to the reinforcing shall be used whenever it is necessary to avoid cutting or excessive skewing of reinforcing due to pile or utility conflicts.
3. Soil reinforcing shall be placed normal to the face of the wall, unless otherwise shown on the plans or directed by the Engineer. If skewing of the soil reinforcements is required due to obstruction in the reinforced fill, rotatable connections shall be used and the maximum skew angle shall not exceed 15 degrees from the normal position unless specifically addressed in design calculations that justify that the skewed reinforcing is adequate.
4. The reinforcement shall be placed so as to not conflict with the subsequent installation of the proposed driven guardrail system that will be located with the reinforced zone.

3.05 GRANULAR BACKFILL PLACEMENT

The placement of granular backfill shall closely follow erection of each course of panels. Backfill shall be placed in such a manner as to avoid any damage or disturbance to the wall materials or misalignment of the facing panels. Any wall materials which become

damaged or disturbed during backfill placement shall be either removed and replaced at the Contractor's expense or corrected, as directed by the Engineer. Any backfill material placed within the reinforced soil mass which does not meet the requirements of this specification shall be corrected or removed and replaced at the Contractor's expense, as directed by the Engineer.

A. Testing Requirements. The maximum dry density and optimum moisture content shall be determined in accordance with AASHTO T 99, Method C or D (with oversize correction, as outlined in Note 7 of AASHTO T 99).

   The frequency of sampling of select granular backfill material, necessary to assure gradation control throughout construction, shall be as directed by the Engineer. If 30 percent or more of the select granular backfill material is greater than 19 mm (3/4 inch) in size, AASHTO T 99 is not applicable. For such a material, the acceptance criteria for control of compaction shall be either a minimum of 70 percent of the relative density of the material as determined by ASTM D 4253 and D 4254, or a method specification, based on a test compaction section, which defines the type of equipment, lift thickness, number of passes of the specified equipment, and placement moisture content.

B. Density Requirements. Granular backfill shall be compacted to 95 percent of maximum dry density.

C. Compaction within 900 mm (3 feet) of the back face of the panels shall be achieved by at least three passes of a lightweight mechanical tamper, roller or vibratory system. The specified lift thickness shall be adjusted as warranted by the type of compaction equipment actually used, but no soil density tests need be taken within this area. Care shall be exercise in the compaction process to avoid misalignment of the panels or damage to the attachment devices. Heavy compaction equipment shall be used to compact backfill within 9000 mm (3 feet) of the wall face.

D. Lift Thickness and Placement Requirements. The maximum loose lift thickness shall not exceed 300 mm (12 inches), regardless of the vertical spacing between layers of soil reinforcements. The Contractor shall decrease this lift thickness, if necessary, to obtain the specified density. Prior to placement of the soil reinforcements, the backfill elevation, after compaction, shall be 50 mm (2inches) above the attachment device elevation from a point approximately 300 mm (12 inches) behind the back face of the panels to the free end of the soil reinforcements, unless otherwise shown on the plans.

E. At the end of each day's operation, the Contractor shall slope the last lift of backfill away from the wall facing to direct runoff of rainwater away from the wall face. In addition, the Contractor shall not allow surface run off from adjacent areas to enter the wall construction site.

SECTION 02532
CONCRETE CURBS AND GUTTERS

PART 1 GENERAL

1.01 SCOPE

A. Work included in this Section includes furnishing all labor, materials, equipment, tools and incidentals required for construction of concrete curb, gutter and combined curb and gutter at the locations and to the lines, grades, cross sections, form and dimensions as shown on the Drawings.

B. Work under this section shall also include removal and replacement of concrete gutter, combined curb and gutter as required for construction as shown on the Drawings and as directed by the City's Authorized Representative.

1.02 SUBMITTALS

Submittals shall be made in accordance with the requirements of 01300 Submittals.

1.03 PRODUCT HANDLING

A. Protection: Use all means necessary to protect concrete materials before, during and after installation and to protect the installed work and materials of all other trades.

B. Replacement: In the event of damage, immediately make all repairs and replacements necessary to the approval of the City's Authorized Representative at no additional cost to the City.

PART 2 PRODUCTS

2.01 FORMS

A. Forms for curbs and gutters shall be full depth metal or wood of a size to resist movement during concrete placement and to retain horizontal and vertical alignment until removal. Forms shall be free from distortion and defects which will impair the appearance or structural quality of the completed sidewalk or curb and gutter.

B. Provide stakes and bracing as required to hold forms securely in place.

2.02 CONCRETE REINFORCEMENT

A. Concrete reinforcement shall conform to Section 03200, Concrete Reinforcement and Dowelling.

B. Locate, place and support reinforcement as indicated on the Drawings

2.03 CONCRETE AND RELATED MATERIALS

A. Concrete and related materials including, but not necessarily limited to, joint materials, membranes and curing compounds shall conform to Section 03300, Cast-In-Place Concrete.

B. Ready-mix concrete shall be 3,000 psi and conform to the requirements of Section 03300, Cast-In-Place Concrete.

C. Water used in mixing concrete shall be fresh, clean, potable water free from injurious amounts of oil, acid, alkali, vegetable, wastewater and/or organic matter.

D. Admixtures shall meet the following requirements:

1. Except as herein specified, no curative or hardening admixtures shall be used.
2. An air entrainment agent capable of providing 3 to 6 percent air shall be used. Air entraining admixtures which are added to concrete mixtures shall conform to ASTM C260 for Air Entraining Admixtures for Concrete.

E. Sub-base shall be constructed of granular material. Minimum depth of sub-base shall be 3-inches.

F. Joint filler shall be a non-extruding joint material conforming to AASHTO M213 for Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (non-extruding and resilient bituminous types). The filler for each joint shall be furnished in a single piece for the full depth and width required for the joint unless otherwise specified by the City's Authorized Representative.

PART 3 EXECUTION

3.01 EARTHWORK

All earth work shall be performed in accordance with Section 02225, Trench Excavation and Backfill and as specified in this Section.

3.02 SUBGRADE PREPARATION

A. The subgrade shall be formed by excavating to the required depth below the finished surface of the respective types, in accordance with the dimensions and designs indicated on the Drawings or as directed by the City's Authorized Representative, and shall be of such width as to permit the proper installation and bracing of forms. The subgrade shall be compacted by hand tamping and all soft, yielding or unsuitable material shall be removed and backfilled with satisfactory material and again compacted thoroughly to 98% of dry density per ASTM D698 and finished to a

smooth and unyielding surface.

B. The finished grade shall be to the dimensions and design indicated on the Drawings or as directed by the City's Authorized Representative for the bottom of the proposed construction.

C. After the subgrade is compacted and at the proper grade, spread 3 inches or more of sub-base material. Sprinkle with water and compact by rolling or other approved method. The top of the compacted gravel shall be at the proper level to receive the concrete.

D. After the concrete has set sufficiently, the spaces on both sides of the curb, gutter, and combined curb and gutter shall be backfilled and materials compacted.

E. Curbs to be used in the construction of asphalt pavements shall be backfilled prior to placement of base material for asphalt pavement.

3.03 CONCRETE CURB AND GUTTER CONSTRUCTION

A. Construct curb and gutter to lines and grades shown or established by the City's Authorized Representative. Curbs and gutters shall conform to the details shown on the Drawings.

B. Forming:

1. Forms shall show no vertical variation greater than 1/8-inch from design line and grade and no lateral variation greater than 1/8-inch in 10 feet from the vertical face of the form.
2. Forms shall be of the full depth of the structure and be so constructed as to permit the inside forms to be securely fastened to the outside forms.
3. Securely hold forms in place true to the lines and grades indicated on the Drawings.
4. Wood forms may be used on sharp turns and for special sections as approved by the City's Authorized Representative.
5. All mortar and dirt shall be removed from forms and all forms shall be thoroughly oiled or wetted before any concrete is deposited.
6. The supply of forms shall be sufficient to permit their remaining in place at least 12 hours after the concrete has been placed.
7. Thoroughly clean forms and coat with form release agent as required to insure form separation from concrete without damage before placing concrete.

C. Joints:

1. Joints shall be constructed as indicated on the Drawings and as specified herein.
2. Construct joints true to line with their faces perpendicular to the surface of the sidewalk and curb and within ¼-inch of their designated position.

3. Thoroughly spade and compact the concrete at the faces of all joints to fill all voids.
4. Install expansion joint materials at the point of curve at all street returns.
5. Install expansion joint material behind the curb at abutment to sidewalks and adjacent structures.
6. Place contraction joints every 10 feet along the length of the curbs and gutters.
7. Form contraction joints using steel templates or division plates which conform to the cross section of the structure. Leave the templates in place until the concrete has set sufficiently to hold its shape, but remove them while the forms are still in place.
8. Contraction joint templates or plates shall not extend below the top of the steel reinforcement or shall be notched to permit the reinforcement to be continuous through the joint.
9. Contraction joints shall be a minimum of 1-1/2-inches deep.

D. Finishing:

1. Strike off the surface with a template, and finish the surface with a wood float using heavy pressure, after which, contraction joints shall be made and the surface finished with a wood float or steel trowel.
2. Finish the face of the curbs at the top and bottom with an approved finishing tool of the radius indicated on the Drawings.
3. Finish edges with an approved finishing tool having a 1/4-inch radius.
4. Provide a final broom finish by lightly combing with a stiff broom after troweling is complete.
5. The finished surface shall not vary more than 1/8-inch in 10 feet from the established grade.

E. Concrete Curing:

1. After finishing operations have been completed and immediately after the free water has left the surface, the surface of the structure shall be completely coated and sealed with a uniform layer of curing compound specified in Section 03300, Cast-In-Place Concrete.
2. The compound shall be applied in one or two applications as directed by the City's Authorized Representative. When the compound is applied in two (2) increments, the second application shall follow the first application within 30 minutes.
3. The compound shall be applied continuously by means of an automatic self-propelled, pressure sprayer as approved by the City's Authorized Representative at the rate directed by the City's Authorized Representative, but not less than 1 gallon per 200 square feet of surface.
4. The equipment shall provide adequate stirring of the compound during application.
5. Should the method of applying the compound not produce uniform coverage, its use shall be discontinued, and the curing shall be by another method approved by

the City's Authorized Representative.

F. Protection:

1. Provide and use sufficient coverings for the protection of the concrete in case of rain or breakdown of curing equipment.
2. Provide necessary barricades and lights to protect the work and rebuild or repair to the approval of the City's Authorized Representative.
3. All damage caused by people, vehicles, animals, rain, the Contractor's operations shall be repaired by the Contractor at no additional cost to the City.

3.05 REMOVAL AND REPLACEMENT OF CONCRETE CURB AND GUTTER

A. When a section of existing curb and gutter is removed, the existing curb and gutter shall be cut to a neat line, perpendicular to both the centerline and the surface of the existing curb and gutter. Existing concrete shall be cut along the nearest existing construction joints; if such joints do not exist, the cut shall be made at minimum distances shown on the Drawings.

B. Existing concrete curbs and gutters that have been cut and removed for construction purposes shall be replaced with the same width and surface as the portion removed. The new work shall be neatly jointed to the existing concrete so that the surfaces of the new work shall form an even, unbroken plane with the existing surfaces.

C. All work shall conform to the requirements for new curbs and gutters as detailed on the Drawings and as specified in this Section.

3.06 CLEANING

A. All excess or unsuitable material shall be removed from the site as specified in Section 02920, Site Restoration.

B. All surfaces of the Work and adjacent surfaces shall be broom clean. Contractor shall use pressure washing and other means approved by the City's Authorized Representative to remove splashed and spilled concrete from the Work and adjacent surfaces.

C. Disturbed seeded areas shall be reseeded per requirements of Section 02933, Seeding.

+ + + END OF SECTION 02532 + + +

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SECTION 02537
DUCTILE IRON SANITARY SEWER PIPE

PART 1 GENERAL

1.01 SCOPE

The Contractor shall provide all labor, materials, equipment and incidentals required to install and test ductile iron sanitary sewer pipe and fittings as shown on the Drawings or specified herein.

1.02 SUBMITTALS

A. Submittals shall be made in accordance with the requirements of the General Conditions of the Contract Documents. In addition, the following specific information shall be submitted:

1. Proposed methods, equipment, materials, and sequence of operations for sewer construction. The Contractor shall plan operations to minimize disruption of utilities and to occupied facilities on adjacent property.

2. Manufacturers' instructions indicating special procedures required to install products specified.

3. Product manufacturers shall provide the Engineer with written certification that all products furnished comply with all applicable provisions of these Specifications.

B. Submit shop drawings to the Engineer for review showing a complete laying plan of all pipe, including all fittings adapters, valves and specials along with the manufacturer's drawings and specifications indicating complete details of all items. The pipe details shall include stationing, pipe class or design and supporting computations; and laying schedule which specifies pipe class, class coding, pipe stationing for all changes in grade, and transition stations for various pipe classes and limits of each. The above shall be submitted to the Engineer for review before fabrication and shipment of these items.

1.03 QUALITY ASSURANCE

Reference Standards: The Contractor shall comply with the applicable provisions and recommendations of the latest editions of the following standards, except as otherwise shown on the Drawings or specified herein.

1. ANSI/AWWA C104/A21.4 – Cement-Mortar Lining for Ductile-Iron Pipe and Fittings.

2. ANSI /AWWA C110/A21.10 – Ductile-Iron and Gray-Iron Fittings.

3. ANSI /AWWA C111/A21.11 – Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

4. ANSI /AWWA C115/A21.15 - Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges.

5. ANSI /AWWA C150/A21.50 - Thickness Design of Ductile-Iron Pipe.

6. ANSI /AWWA C151/A21.51 – Ductile-Iron Pipe, Centrifugally Cast.

7. ANSI/AWWA C153/A21.53 – Ductile-Iron Compact Fittings for Water Service

8. ANSI/AWWA C600 - Installation of Ductile-Iron Water Mains and Their Appurtenances.

9. ANSI B16.1 - Cast Iron Pipe Flanges and Flanged Fittings.

10. ASTM A746 - Standard Specification for Ductile Iron Gravity Sewer Pipe.

11. ASTM C969 – Standard Practice for Testing Concrete Pipe Sewer Lines by Low-Pressure Air Test Method

12. ASTM D1248 - Polyethylene Plastics Molding and Extrusion Materials.

13. ASTM G62 - Test Methods for Holiday Detection in Pipeline Coatings.

14. SSPC-SP6 - Steel Structures Painting Council, Commercial Blast Cleaning.

1.03TRANSPORTATION AND HANDLING

A. Furnish equipment and facilities for unloading, handling, distributing and storing pipe, fittings, valves and accessories. Make equipment available at all times for use in unloading. Do not drop or dump materials. Any materials dropped or dumped will be subject to rejection without additional justification.

B. Handle pipe, fittings, valves and accessories carefully to prevent shock or damage. Handle pipe by rolling on skids, forklift, or front loader. Do not use material damaged in handling.

C. Lined pipe shall be handled and transported to prevent damage to lining.

1.05 STORAGE AND PROTECTION

A. Store all pipe which cannot be distributed along the route. Make arrangements for the use of suitable storage areas.

B. Stored materials shall be kept safe from damage. The interior of all pipes, fittings and other appurtenances shall be kept free from dirt or foreign matter at all times.

C. Pipe shall be stored per the manufacturer's recommendations.

D. Store joint gaskets in a cool location, out of direct sunlight. Gaskets shall not come in contact with petroleum products. Gaskets shall be used on a first-in, first-out basis.

1.06 ACCEPTANCE

Acceptance will be on the basis of the Engineer's inspection and the manufacturer's written certification that the pipe was manufactured and tested in accordance with the applicable standards.

PART 2 PRODUCTS

2.01 DUCTILE IRON PIPE

A. Ductile iron pipe shall be manufactured in accordance with ANSI/AWWA C151/A21.51. All pipe, except specials, shall be furnished in nominal lengths of 18 to 20 feet. Sizes will be as shown on the Drawings. All pipe shall have a minimum pressure rating, as indicated in the following table, and corresponding minimum wall thickness, unless otherwise specified or shown on the Drawings. Pipe wall thickness shall also be determined based upon depth of cover, as shown on the Drawings, and anticipated live load, assuming a minimum H20 live load.

Pipe Sizes (inches)	Pressure Class (psi)
4 - 12	350
14 - 20	250
24	200
30 - 64	150

B. Fittings and Accessories:

1. Fittings shall be ductile iron and shall conform to AWWA C110/ANSI A21.10 or AWWA C153/ANSI A21.53, with a minimum rated working pressure of 250 psi.

2. Flanged elbow fittings shall be ANSI pattern using short radius elbows, except where noted differently on the Drawings. Special fittings, ductile iron wall pipes and sleeves shall conform to the dimensions and details as shown on the Drawings.

C. Joints:

1. General:

   a. Joints for ductile iron pipe and fittings shall be mechanical joints, flanged or push-on joint.

   b. Unless otherwise shown on the Drawings, or directed by the Engineer, all buried ductile iron pipe shall be joined using push-on type joints.

   c. Gaskets shall be made of material that will not be damaged by the fluid being transported or by the environment in which the pipe is installed.

   d. Provide the necessary bolts for connections. All bolts and nuts shall be threaded in accordance with ANSI B1.1, Coarse Thread Series, Class 2A external and 2B internal fit.

2. Push on Joints:

   a. Push-on joints and gaskets shall conform to ANSI/AWWA C111/A21.11.

   b. Details of joint design shall be in accordance with the manufacturer's standard practice such as ACIPCO "Fastite", McWane (CLOW) "Bell-Tite" or U.S. Pipe "Tyton".

3. Flanged Joints:

   a. Flanged joints and gaskets shall conform to ANSI/AWWA C115/A21.15.

   b. Nuts and bolts for flanged connections shall be square or hex carbon steel bolts conforming to ASME B18.2.1 Nuts shall conform to ASME B18.2.2.

4. Mechanical Joints:

   a. Joints shall conform to ANSI/AWWA C111/ A21.11.

   b. Tee head bolts and nuts shall be of high strength low-alloy steel in accordance with ASTM A242 to the dimensions shown in ANSI/ AWWA C111/ A21.11.

   c. Gaskets shall be in accordance with ANSIAWWA C111/ A21.11 and shall be constructed of plain rubber.

   d. Mechanical joint glands shall be ductile iron.

D. Polyethylene Encasement:

1. Ductile pipe and fittings shall be encased in polyethylene where shown on the Drawings or specified.
2. Polyethylene encasement shall be as specified in Section 02616.

E. Wall Pipes

1. Where piping passes through concrete structures, furnish and install wall pipes or other provisions as specifically shown on the Drawings. Wall sleeves shall be accurately located and securely fastened into position before concrete is poured.

2. Wall pipes shall be either statically cast iron with integral waterstop collar or centrifugally cast ductile iron with a continuously welded waterstop collar. The waterstop collar shall be capable of withstanding a thrust force caused by a 250 psi dead end load from either direction on that size pipe.

3. Wall pipes shall be furnished uncoated on the outside and cement lined on the inside.

4. Wall pipes shall be cast and/or fabricated and lined in one manufacturer's facilities and delivered to the job site ready for use.

2.02 LINING

A. All ductile iron pipe and fittings shall have a double thickness cement mortar lining conforming to the requirements of ANSI/ AWWA C104/A21.4. Alternate linings shall be a 40 mils thick lining of ceramic epoxy or 40 mils thick lining of polyurethane.

B. Cement Lining (Standard)

1. Interior surfaces of all ductile iron pipe and fittings shall be cleaned and lined with a double cement mortar lining applied in conformity with ANSI/AWWA C104/A21.4. If lining is damaged or found faulty upon delivery, the damaged pipe sections shall be repaired or removed from the site as directed by the Engineer.

2. Lining thickness: The minimum (single) lining thickness shall be as shown in the following table. Lining shall be square and uniform with regard the longitudinal axis of the pipe.

Pipe Diameter (Inches)	Minimum Lining Thickness (Inches)
3 - 12	1/8
14 - 24	3/32
30 - 64	1/8

C. Ceramic Epoxy Lining (Additive Alternate)

1. Where shown on Drawings or where specified, pipe and fittings shall be lined with ceramic epoxy.

2. Ceramic epoxy lining shall cover all exposed surfaces of pipe and fittings subject to contact with sewer liquid or gas. The lining of the pipe barrel shall extend from spigot end through the socket to the edge of the gasket sealing area or recess for pipe using push-on gaskets, and to the edge of the gasket seat for mechanical joints. The lining shall also cover the exterior of the spigot end from the end of the pipe to beyond the gasket sealing area. The lining in fittings shall cover the interior surfaces including the socket areas as defined above. All linings shall be hermetically sealed at the ends.

3. Lining Material: The lining material shall be Protecto 401 Ceramic Epoxy, an amine cured novalac epoxy containing at least 20 percent by volume of ceramic quartz pigment. The material shall meet the following minimum requirements:

   a. A permeability rating of 0.00 when tested according to Method A of ASTM E-96, Procedure A with a test duration of 30 days.

   b. The following test shall be run on coupons from factory lined ductile iron pipe:

      i. ASTM B117 Salt Spray (scribed panel) – Results to equal 0.0 undercutting after two years.
      ii. ASTM G95 Cathodic Disbondment 1.5 volts @ 77° F. Results to equal no more than 0.5 mm undercutting after 30 days.
      iii. Immersion Testing rated using ASTM D714.

         a) 20% Sulfuric Acid – No effect after two years.
         b) 140° F 25% Sodium Hydroxide – No effect after two years.
         c) 160° F Distilled Water – No effect after two years.
         d) 120° F Tap Water (scribed panel) – 0.0 undercutting after two years with no effect.

   c. An abrasion resistance of no more than 3 mils loss after one million cycles using European Standard EN 598: 1994 Section 7.8 Abrasion Resistance.

4. Surface Preparation: Surface preparation shall consist of the ductile iron surface to a near-gray blast finish. This degree of cleanliness is comparable to a SSPC-SP10 for steel with the exception that ductile iron attains a gray color when blast cleaned. The blast cleaning operation shall remove 95% of all surface contaminants, including tightly adhered annealing scale. The anchor tooth pattern, resulting from the blasting operation, shall have a minimum height of 3.0 mils.

5. Applicators: The lining shall be applied using a centrifugal lance applicator by applicators certified by the lining manufacturer. The workers shall be experienced and competent in the surface preparation, application and inspection of the lining to be applied.

6. Lining: After the surface preparation and within 8 hours of surface preparation, the interior of the pipe shall receive 40 mils nominal dry film thickness of Protecto 401. Minimum thickness shall be 30 mils. No lining shall take place when the substrate or ambient temperature is below 40 degrees Fahrenheit. The surface shall be dry and dust free. If flange pipe or fittings are lined, the lining shall not be used on the face of the flange.

7. Bell Sockets and Spigot Ends: The gasket area and spigot end up to 6 inches back from the end of the spigot end shall be coated with 6 mils nominal, 10 mils maximum, using Protecto joint compound. The joint compound shall be applied by brush to ensure coverage. Care should be taken that the joint compound is smooth without excess buildup in the gasket seat or on the spigot ends. Coating of the gasket seat and spigot ends shall be performed after the application of the lining.

8. Number of Coats: The number of coats of lining material applied shall be as recommended by the lining manufacturer. However, in no case shall this material be applied above the dry thickness per coat recommended by the lining manufacturer in printed literature. The maximum or minimum time between coats shall be that time recommended by the lining material manufacturer. To prevent delamination between coats, no material shall be used for lining which is not indefinitely recoatable with itself without roughening of the surface.

9. Touch-Up and Repair: Protecto Joint Compound shall be used for touch-up or repair in accordance with manufacturer's recommendations.

10. Lining Holiday Test: At the manufacturer's facility, the lining shall be tested over 100% of the pipe barrel surface with a high-voltage spark tester as recommended by ASTM Designation G-62 Method B. If holidays are found in the lining by the above test at the manufacturing plant, the holiday shall be repaired per the lining manufacturer's recommendation. The holiday detector shall be a commercially available detector available from holiday detection equipment manufacturers such as Spy, Tinker and Rasor, and Zorelco.

11. All pipe linings shall be checked for thickness using a magnetic film thickness gauge. Thickness testing shall be performed in accordance with SSPC-PA-2.

12. Each pipe joint and fitting shall be marked with the date of application of the lining system and with the numerical sequence of application of that date.

13. Certification: The pipe or fitting manufacturer shall supply a certificate attesting to the fact that the applicator met the requirements of this Specification, and that the material used was as specified.

14. Handling: Protecto 401 lined pipe and fittings shall be handled only from the outside of the pipe and fittings. No forks, chains, straps, hooks, etc., shall be placed inside the pipe and fittings for lifting, positioning or laying.

D. Polyurethane Lining (Additive Alternate)

1. Lining Materials:

a. The lining material shall consist of a polyisolcyanate resin and a polyol resin which are mixed in 1:1 ratio at the time of application. It shall be an ASTM D16 Type V system.

b. The lining materials to be used on the internal of the pipe and fittings for use with municipal wastewater shall meet all of the performance requirements as follows:

Test	Requirement
Tensile Adhesion (ASTM D4541)	>2000 psi (13.8 Mpa)
Cathodic Disbondment (ASTM G-8) 28 day/20C)	<10 mm radius
Flexibility (ASTM D522) 18 mils Over 1-in mandrill	>180 degrees
Hardness (ASTM D2240)	Shore D 75±10
Impact Resistance ASTM (D2794) (5/8-inch ball)	60 in. lbs
Abrasion Resistance (ASTM D4060) CS17, 1kg wheel	<100 mg loss per 1000 rev.
Permeability (ASTM E96)	<0.008 Perms
QUV Weathering (ASTM G53) 12 months	no cracking or checking
Salt Spray (ASTM B117) 1000 hours	no significant undercutting
Chemical Resistance (ASTM D543) 10% H_2SO_4, 10% HCL, 30% NaOH, deionized water	<5 percent weight change after 90 day immersion

c. The lining materials shall have a documented history of successful application and performance in wastewater piping that is greater than five (5) years.

2. Applicator: The Applicator shall be approved by the lining manufacturer for the application of the specific lining being applied. The Applicator shall have

personnel that have been trained by the lining manufacturer within the past 12 months of starting the project. At least one of these trained personnel shall be onsite at all times during the lining application.

3. Surface Preparation: All surfaces to be lined shall be cleaned to a minimum near-white metal finish (SSPC-SP 10, SA2.5) with an angular profile of at least 2.5 mils. All surfaces to be lined shall be completely free of moisture, dust, grease, or any other deleterious substances, at the time the lining is applied. All blasted surfaces shall be lined within 8 hours of blasting. Any blasted surface that is not coated during that time period shall be re-blasted. If the surface suffers from flash rusting or any other contamination before coating, it must be decontaminated and re-blasted. The cleaned interior surfaces of pipe and fittings shall be inspected for adequate surface preparation.

4. Application:

    a. In order to avoid moisture contamination of the steel, the temperature of the substrate surface must at least 5 degrees Fahrenheit above the dew point temperature after blasting and before the application of the lining material. High humidity may cause surface condensation in the form of dew or frost which will affect bonding of the lining. Therefore, the Applicator shall exercise caution if relative humidity exceeds 85 percent. Heating of pipe surfaces may be required to meet the requirements of the above dew point temperature restriction. However, oxidation due to overheating of the pipe and fittings shall not be acceptable. In such case, the pipe shall be cooled to ambient temperatures and recleaned. The lining shall be applied to the steel between -40 degrees Fahrenheit and 140 degrees Fahrenheit. At temperatures below freezing the Applicator shall exercise caution that no frost forms on the substrate. The lining thickness shall be 40 mils nominal measured according to SSPC-PA2 Specification.

    b. When gaskets or mechanical couplings are used to connect the pipe sections together, the pipe is be lined to its end with no cutback. Care is to be taken so that the applied lining thickness is within the tolerance allowed by the pipe or coupling manufacturer. The lining may be applied as thinly as 10 mils (250 microns) on the external of the spigot and/or the internal of the bell provided that area is tested to be holiday free. Touch-up and repair shall be in accordance with the manufacturer's recommendations.

5. Inspection and Certification: Holiday inspection shall be conducted using a 2000 volt spark test according to NACE RP-0188. Each holiday found shall be marked and repaired prior to shipment as per the lining manufacturer's recommendation. The pipe or fitting manufacturer shall certify that the applicator met the requirements of this specification, and that the materials used conform to the composition and requirements of this specification.

2.03 COATING

All ductile iron pipe and fittings shall have a standard bituminous outer coating.

PART 3 EXECUTIONS

3.01 LAYING AND JOINTING PIPE AND ACCESSORIES

A. Lay all pipe and fittings to accurately conform to the lines and grades shown on the Drawings.

B. Pipe Installation

1. Proper equipment, tools and facilities shall be provided for the safe performance of the Work. All pipe, fittings and valves shall be lowered carefully into the trench by means of slings, ropes or other suitable tools or equipment in such a manner as to prevent damage to sewer materials and protective coatings and linings. Under no circumstances shall sewer materials be dropped or dumped into the trench.

2. All pipe, fittings, and other appurtenances shall be examined carefully for damage and other defects immediately before installation. Defective materials shall be marked and held for inspection by the Engineer, who may prescribe corrective repairs or reject the materials.

3. All lumps, blisters and excess coating shall be removed from the socket and plain ends of each pipe, and the outside of the plain end and the inside of the bell shall be wiped clean and dry and free from dirt, sand, grit or any foreign materials before the pipe is laid. No pipe which contains dirt shall be laid.

4. Foreign material shall be prevented from entering the pipe while it is being placed in the trench. No debris, tools, clothing or other materials shall be placed in the pipe at any time.

5. As each length of pipe is placed in the trench, the joint shall be assembled and the pipe brought to correct line and grade. The pipe shall be secured in place with approved backfill material.

6. Lay pipe with the bells up grade.

7. Applying pressure to the top of the pipe, such as with a backhoe bucket, to lower the pipe to the proper elevation or grade shall not be permitted.

C. Excavate, lay the pipe, and backfill as closely together as possible. Do not leave unjointed pipe in the trench overnight. Backfill and compact the trench as soon as possible after laying and jointing is completed. Cover the exposed end of the installed pipe each day at the close of work and at all other times when work is not in progress. If necessary to

backfill over the end of an uncompleted pipe or accessory, close the end with a suitable plug.

D. Joint Assembly

1. Push-on joints shall be assembled in accordance with the manufacturer's recommendations.

2. The Contractor shall internally inspect each pipe joint to insure proper joint assembly after the pipe has been brought to final alignment.

E. Cutting Pipe

1. Cut the pipe per the manufacturer's written recommendations.

2. Remove all burrs and smooth the end before jointing.

3. The Contractor shall cut the pipe and bevel the end, as necessary, to provide the correct length of pipe necessary for installing the fittings, accessories and closure pieces in the correct location. Only push-on and mechanical joint pipe shall be cut.

F. Pipe Coupling Installation

1. Pipe couplings shall be installed where shown on the Drawings. Couplings shall be installed as specified in Section 15095, Pipe Couplings and in strict conformance with the manufacturer's instructions.

2. Pipe ends shall be cleaned, brushed or filed to produce a mating surface that is free of dirt, rust, chuck marks, mill scores, dents, burrs or other foreign substances that would impede proper gasket seating.

3. A lubricant recommended by the coupling manufacturer shall be used in seating all gaskets.

G. Wyes and tees shall be installed as shown on the Drawings at locations to be indicated by the Engineer in the field.

H. Chimneys will be required at locations as shown on the Profiles and as determined in the field by the Engineer. The chimneys shall be constructed of ductile iron pipe and fittings and shall be encased in 4-inches (minimum) of crushed stone as shown on the Detail Drawings.

I. If wye branches, tees and risers are covered before the Engineer has made location measurements, they shall be uncovered at the Contractor's expense.

J. Manhole drops where indicated on the Drawings shall be constructed of ductile iron pipe and fittings as detailed on the Drawings and encased in concrete as specified in Section 03300.

K. Stubs for future pipe connections shall be installed in outlets as shown on the Drawings or where directed by the Engineer. Stubs shall be ductile iron pipe with a plug.

3.02 CLEANING

At the completion of pipe installation, the Contractor shall clean all pipe by flushing with water or other means to remove all dirt, stone wood or other materials which may have entered the pipe during construction.

3.03 TESTING

A. After pipe installation, backfilling and cleaning, the Contractor shall test all sewer pipe and joints by low pressure air testing. Pipe and joints failing the tests are subject to rejection, repair, or replacement at the Contractor's expense.

B. Additional testing and inspection required for acceptability of installed sanitary sewers is specified in Section 02650, Testing for Acceptance of Sanitary and Storm Sewers.

3.03 CLEANUP

After completing each section of the sewer line, the Contractor shall remove all debris and construction materials and equipment from the site of the Work, grade and smooth over the surface on both sides of the line and leave the entire construction area in a clean and neat condition. The Contractor shall restore the site of the Work to its original or better condition.

+ + + END OF SECTION 02537 + + +

SECTION 02641
PRECAST CONCRETE MANHOLES

PART 1 GENERAL

1.01 SCOPE

A. The Contractor shall provide all labor, materials, equipment and incidentals required to furnish and install precast concrete manholes complete as shown on the Drawings or specified herein.

B. This section also includes pipe connections at manholes, manhole testing, backfill, cleanup and all other incidentals necessary to complete the Work specified under this Section.

1.02 SUBMITTALS

Submittals shall be made in accordance with the requirements of the General Conditions of the Contract Documents. In addition, the following specific information shall be provided:

1. Shop drawings of manhole sections and base units and construction details, including reinforcement, jointing methods, and materials.

2. Summary of criteria used in the manhole design including, as a minimum, material properties, loadings, load combinations, and dimensions assumed.

3. Materials to be used in fabricating drop connections.

4. Materials to be used for pipe connections at manhole walls.

5. Materials to be used for stubs and stub plugs, if required.

6. Materials and procedures for corrosion resistant liner and coatings, if required.

7. Plugs to be used for vacuum testing.

8. Manufacturer’s data for pre-mix (bag) concrete, if used for channel inverts and benches.

9. Description of the proposed method of concrete curing.

1.03 QUALITY ASSURANCE

A. Reference Standards: The Contractor shall comply with the applicable provisions and recommendations of the latest editions of the following standards, except as otherwise shown on the Drawings or specified herein.

1. ASTM C270 - Standard Specification for Mortar for Unit Masonry

2. ASTM C443 - Standard Specification for Joints for Circular Concrete Sewer and Culvert Pipe using Rubber Gaskets

3. ASTM C478 - Standard Specification for Precast Reinforced Concrete Manhole Sections

4. ASTM C923 - Standard Specification for Resilient Connectors between Reinforced Concrete Manhole Structures and Pipes

5. ASTM C1107 - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (non-shrink)

6. ASTM C1244 – Standard Test Method for Concrete Sewer Manholes by the Negative Air Pressure (Vacuum) Test Prior to Backfill

B. Prior to delivery, all basic materials specified in this section shall be tested and inspected by an approved independent testing laboratory or, if approved by the Engineer, certified copies of test reports prepared by the manufacturer's testing laboratory will be acceptable. All materials which fail to conform to these Specifications shall be rejected.

C. After delivery to the site of the Work, any materials which have been damaged in transit or are otherwise unsuitable for use in the Work shall be rejected and removed from the site of the Work.

D. The precast concrete producer shall demonstrate adherence to the standards set forth in the National Precast Concrete Association Quality Control Manual. Precast concrete producer shall meet requirements written below.

1. The precast concrete producer shall have been in the business of producing precast concrete products similar to those specified for a minimum of 5 years. The precast concrete producer shall maintain a permanent quality control department or retain an independent testing agency on a continuing basis. The agency shall issue a report, certified by a licensed engineer, detailing the ability of the precast concrete producer to produce quality products consistent with industry standards.

2. The precast concrete producer shall show that the following tests are performed in accordance with the ASTM standards indicated below. Tests shall be performed for each 150 cu. yd. of concrete placed, but not less frequently than once per week.

   a. Slump: C143
   b. Compressive Strength: C31, C192 and C39
   c. Air Content (when air-entrained concrete is being used): C231 or C173
   d. Unit Weight: C138

3. The precast concrete producer shall provide documentation demonstrating compliance with this subparagraph.

4. The plant shall notify the Engineer when the pre-cast products are being produced for the project. The City may place an inspector in the plant when the products covered by this specification are being manufactured.

1.04 DESIGN CRITERIA

Manholes shall be constructed of specified materials to the sizes, shapes, and dimensions as shown on the Drawings or as otherwise directed by the Engineer.

1. The height or depth of the manhole will vary with the locations, but shall be such that the top of the manhole frame will be at the finished grade of the pavement or higher than the ground surface as shown on the Drawings.

2. The invert will be at the indicated elevation.

PART 2 PRODUCTS

2.01 PRECAST CONCRETE MANHOLES

A. Precast concrete manholes shall consist of precast reinforced concrete sections, a conical or flat slab top section, and a base section conforming with the typical manhole details as shown on the Drawings.

B. Precast manhole section shall be manufactured, tested and marked in accordance with the latest provisions of ASTM C478.

C. The minimum compressive strength of the concrete for all sections shall be 4,000 psi.

D. The maximum allowable absorption of the concrete shall not exceed 8 percent of the dry weight.

E. The circumferential reinforcement in the riser sections, conical top sections and

base wall sections shall consists of one (1) line of steel and shall be not less than required by ASTM C478.

F. The ends of each reinforced concrete manhole riser section and the bottom of the manhole top section shall be so formed that when the manhole risers and the top are assembled, they will make a continuous and uniform manhole.

G. Precast manhole section joints shall be offset tongue and groove type, supplied with Tylox Super Seal pre-lubricated gasket as manufactured by Hamilton Kent, RPS lubricated gasket as manufactured by Press-Seal Gasket Corporation or Conseal CS-202 butyl rubber sealant as manufactured by Concrete Sealants, Inc.

H. Each section of the precast manhole shall have not more than two (2) slots for the purpose of handling and laying. These slots shall be tapered and shall be plugged with rubber stoppers or mortar after installation.

I. The interior and exterior surfaces of the manhole shall have a smooth hard finish, and shall be free from cracks, chips, and spalls.

J. All components of a manhole for a particular location shall be clearly marked in order that the manhole may be correctly assembled to suit construction conditions existing at that particular location.

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K. The following sulfide resistant options shall be incorporated in the concrete mix design. (Specifier to select sulfide resistant option as necessary.)

1. Sulfide Resistant Additive

a. Where specified, a sulfide resistant additive shall be added to the concrete mix. The sulfite resistant additive shall permeate the concrete during the mixing phase and molecularly bond to the cement particles to become an integral component of the hardened concrete product and create an environment incompatible to thiobacillus bacteria growth and to inhibit microbial induced corrosion by preventing the thiobacillus bacteria from interacting with hydrogen sulfide gas and producing sulfuric acid.

b. When the additive is used, it shall be introduced into the concrete mix at the pipe manufacturing facility, with one gallon of the additive replacing one gallon of water in each cubic yard of concrete produced.

c. The Contractor shall include provisions in his Quality Control Plan to coordinate with the pipe manufacturer to verify that the additive is placed in the concrete mix in the proper amount on a uniform and consistent basis for all reinforced concrete sanitary sewer pipe produced for this Project requiring the additive.

d. When the additive is used, the pipe manufacturer shall be required to provide special markings on each pipe section designating it a "special design for the City of Atlanta, containing Sulfide Resistant Additive". The manufacturer may also use a dye in the concrete mix to give the finished pipe section a unique color.

e. The sulfide resistant additive shall be Con^{MIC}Shield®, supplied by Vermillion and Associates, Chattanooga, Tennessee, or approved equal.

2. Sulfide Resistant Limestone Aggregate

a. When used, the limestone aggregate shall permeate the concrete during the mixing phase and molecularly bond to the concrete particles to become an integrand component of the hardened concrete product and create an environment incompatible to thiobacillus bacteria growth and to inhibit microbial induced corrosion by preventing the thiobacillus bacteria interacting with the hydrogen sulfide gas and producing sulfuric acid.

b. All precast concrete manholes shall be made with concrete with a minimum compressive strength per ASTM C478 and the absorption shall not exceed nine (9) percent. All cement and aggregate shall conform to the requirements of ASTM C478. Coarse aggregate shall be well graded limestone of a size that provides a homogenous concrete mixture, considering the pipe wall thickness. Fine aggregate shall consist of graded limestone sand, limestone screenings or natural sand that provides a homogenous concrete mixture, considering the pipe wall thickness.

c. The minimum alkalinity of the hardened concrete, as determined by ASTM C497, shall not be less than 50% expressed as calcium carbonate (CaCO3). Cement for pipe shall be Type I, Type II or Type I/II portland cement.

d. All admixtures shall be approved by the Engineer prior to use. Prior to manufacturing any pipe, the manufacturer shall submit the proposed concrete design mix with the estimated finished concrete alkalinity to the Engineer for approval. The requirements of this article shall apply to all reinforced concrete pipe manufactured under the requirements of ASTM C478.

3. Sulfide Resistant Coatings

a. When used, all sulfide resistant coatings shall provide an impenetrable bond to the hardened surface of the concrete pipe. The coating shall prevent the bacillus bacteria from interacting with hydrogen sulfide gas and producing sulfuric acid on the surface of the concrete wall of the pipe.

b. When a coating is used, it shall be applied at the concrete manufacturing facility, tested and inspected in accordance with the coating manufacturer's specifications. Specifications shall be submitted to the Engineer prior to use.

c. The sulfide resistant coating shall be a polyurea elastomer coating or approved equal.

4. Sulfide Resistant Liners

a. When used, all sulfide resistant liners shall be concrete poured against the lining and vibrated and compacted in a manner to protect the lining and to produce a dense homogenous concrete, securely anchoring the lining locking extensions into the concrete in accordance with the liner manufacturer's specifications and create an environment incompatible to thiobacillus growth, to inhibit microbial induced corrosion by preventing the thiobacillus bacteria from interacting with hydrogen sulfide gas and producing sulfuric acid.

b. When a liner is used, it shall be installed at the concrete manufacturing facility, inspected and tested in accordance with the lining manufacturer's specifications. Liner joints shall be field welded in accordance with the liner manufacturer's recommendations.

c. The sulfide resistant liner shall be Agru America HDPE Sure Grip Liner, GSE StudLiner, Ameron T-Lock Liner or approved equal.

2.02 MANHOLE FRAMES, COVERS AND STEPS

Manhole frames and covers and steps are specified in Section 05500, Miscellaneous Metal.

2.03 SPECIALTY ITEMS

A. One piece manholes shall be manufactured in accordance with the requirements of ASTM C478 and as shown on the Drawings. They shall be cast utilizing 4000 psi concrete containing type II cement. They shall be manufactured with a minimum eight (8) inches thick base with dowel steel reinforcement and waterstop. They shall be used only in situations which will not accommodate a twenty-four (24) inch base section and twenty-four (24) inch conical section.

B. Manhole tees shall be manufactured in accordance with the requirements of ASTM C478 and as shown on the Drawings. They shall be cast utilizing 4000 psi concrete.

C. Saddle manholes shall be manufactured in accordance with the requirements of ASTM C478 and as shown on the Drawings. Saddles shall be cast utilizing 4000 psi concrete.

2.04 BRICK

A. Bricks used to adjust manhole frame to grade shall conform to the requirements of ASTM C32, Grade MS. Bricks shall also conform to the following requirements, unless otherwise approved by the Engineer.

B. All brick shall be new and whole, of uniform standard size, and straight and parallel edges and square corners. Bricks shall be of compact textures, burned hard entirely through, free from injurious cracks and flaws, and shall have a clear ring when struck together. No soft or salmon brick shall be used in any part of the Work. Brick shall be culled after delivery, if required, and no culls shall be used except at such places, to such extent, and under such conditions as may be approved by the Engineer.

2.05 MORTAR

A. Mortar shall be made of one part portland cement and two parts clean sand. Cement shall be type 1 and shall conform to ASTM C150. Sand shall meet requirements of ASTM C144.

B. Mortar shall be prepared only in the quantities needed for immediate use. Mortar which has been mixed for more than thirty (30) minutes or which has set or has been retempered shall not be used in the Work.

2.06 GRADE ADJUSTMENT RINGS

A. Grade adjustment rings shall be used to adjust manhole frame to grade and shall be precast reinforced concrete conforming to ASTM C478. Rings shall be free of cracks, voids and other defects.

B. Adjustment rings shall be tested to assure compliance with impact and loading requirements in accordance with AASHTO's Standard Specifications.

2.07 BITUMINOUS WATERPROOFING (Additive Alternate)

A. H. B. Tnemecol 46-465 by Tnemec Company

B. Amercoat 78 Hb by American International

C. Bitumastic Super Service Black by Carboline

D. Or approved equal.

PART 3 EXECUTION

3.01 GENERAL

A. All activities shall be performed in accordance with the manufacturer's recommendations and regulations established by OSHA. Attention shall be drawn to those safety requirements involving working with scaffolding and entering confined spaces.

B. The Contractor shall verify that lines and grades are as shown on the Drawings.

3.02 INSTALLATION OF PRECAST CONCRETE MANHOLES

A. All precast concrete manhole base sections and drop manhole bases shall be set on a foundation of #57 compacted stone aggregate, twelve (12) inches minimum thickness, and covering the entire bottom of the excavation for the manhole.

B. Base sections shall be precast with the vertical walls of sufficient height to allow entry of the required pipes as shown on the Drawings. Manhole inverts shall be constructed of 3000 psi concrete and shall have the same cross-section as the invert of the sewers which they connect. The manhole invert shall be carefully formed to the required size and grade by gradual and even changes in sections. Changes in direction of flow through the sewer shall be made to a true curve with as large a radius as the size of the manhole will permit.

C. After the base section has been set, and inverts formed, the precast manhole sections shall be placed thereon, care being exercised to form the incoming and outgoing sewer pipes into the wall of the manhole at the required elevations.

D. Where the difference in the invert elevation of two (2) or more sewers, eighteen (18) inches in diameter or smaller, intersecting in one (1) manhole is two (2) feet or more, a drop manhole shall be constructed in the manner shown on the Drawings. Drop manholes shall be similar in construction to the standard manhole, except that a drop connection of a pipe and fittings of the proper size and material shall be constructed outside the manhole and encased in 1500 psi (minimum) concrete as shown on the Drawings.

E. The top elevation of manhole frames shall be adjusted to grade unless shown otherwise on the Drawings. A maximum adjustment of twelve (12) inches will be allowed using brick and mortar or grade adjustment rings. Adjustments greater than twelve (12) inches must be made by changing precast riser sections. Brick used will be in accordance with the requirements of this section.

F. The cast iron frame for the manhole cover shall be set at the required elevation and properly anchored to the riser section. Where manholes are constructed in paved areas, the top surface of the frame and cover shall be tilted to conform to the exact slope, crown and grade of the existing adjacent pavement.

G. Shallow manholes shall be constructed to the sizes, shapes, and dimensions as shown on the Drawings, and at the locations shown on the Drawings. Shallow manholes shall be constructed of precast concrete sections as shown on the Drawings and as directed by the Engineer.

3.03 PIPE CONNECTIONS AT MANHOLES

A. Openings in manhole walls for incoming and outgoing sewers shall be precast or cored and after pipe installation sealed with an approved non-shrink grout. In addition to the non-shrink grout, the opening shall be additionally sealed as follows:

1. A rubber boot connector shall be utilized as an additional method of sealing the space between the manhole wall and the pipe. Rubber boot connectors shall be required for all pipes forty-two (42) inches in diameter and smaller. The rubber boot connector shall be Kor-N-Seal as manufactured by Trelleborg Pipe Seals or approved equal as manufactured by Press-Seal Gasket Corporation or Hamilton Kent.

2. Connector shall conform to the requirements of ASTM C923 and shall be made from ethylene propylene diene monomer (EPDM) rubber.

3. All stainless steel elements of the rubber boot connector shall be totally non-magnetic series 304 stainless, excluding the worm screw for tightening the steel band around the pipe which shall be series 305 Stainless. The worm screw for tightening the steel band shall be torqued by a break-away torque wrench. The rubber boot connector shall seal the manhole wall opening by activating the expanding mechanism in strict accordance with the recommendation of the connector manufacturer. The connector shall be of a size specifically designed for the pipe material and size being utilized on the Project.

4. Openings for pipes larger than forty-two (42) inches in diameter shall be sealed by pouring a concrete collar around the pipe.

B. Both methods of sealing manhole openings shall be as shown on the Drawings.

3.04 WATERPROOFING (Additive Alternate)

A. Apply two heavy coats of bitumastic waterproofing material to exterior surfaces of sanitary sewer manholes or structures by brush or spray in accordance with the manufacturer's instructions.

3.05 MANHOLES OVER EXISTING SEWERS

A. Construction of manholes over existing sewers is specified in section 02607, Manholes, Junction Structures, Catch Basins and Inlets.

3.06 MANHOLE TESTING

A. All manholes shall be tested by the Contractor using the vacuum test method, following the manufacturer's recommendations.

B. Testing:

1. Manholes shall be tested for watertightness in accordance with ASTM C1244. Prior to testing manholes for watertightness, all lift holes shall be plugged with a non-shrink grout, all joints between precast sections shall be properly sealed and all pipe openings shall be temporarily plugged and properly braced.

2. Vacuum testing equipment shall be equal to that as manufactured by P.A. Glazier, Inc. or approved equal.

3. All repairs shall be made in accordance with the requirements of ASTM C478.

C. The City reserves the right to have third party consultants perform construction materials testing and assessments on any new manhole.

D. Additional testing and inspection required for the acceptability of installed of sanitary and storm sewers is specified in Section 02650, Testing for Acceptance of Sanitary and Storm Sewers.

3.06 BACKFILL

A. The Contractor shall place and compact backfill materials, in the area of excavation surrounding manholes in accordance with the requirements of Section 02225, Trench Excavation and Backfill.

3.07 CLEANUP

A. After the manhole installation work has been completed and all testing accepted by the Engineer, the Contractor shall cleanup the area. All excess material and debris not incorporated into the permanent installation shall be disposed of by the Contractor. Disturbed grassed areas shall be seeded or sodded. Site restoration shall be performed in accordance with the requirements of Section 02920, Site Restoration.

+ + + END OF SECTION 02641 + + +

SECTION 02645
FIRE HYDRANTS

PART 1 GENERAL

1.01 SCOPE

A. The Contractor shall furnish all labor, materials and equipment to install and test fire hydrants as specified herein and as shown on the Drawings.

B. Fire hydrants shall be Mueller Super Centurion 250 A-423, modified to meet the City of Atlanta standard requirements as specified in this section. In order to insure compatibility with the City's existing inventory of hydrants and spare parts and standardized maintenance procedures, no other hydrants shall be acceptable. Existing hydrants shall be salvaged for spare parts to repair existing hydrants, which do not need to be replaced.

1.02 SUBMITTALS

Submittals shall be made in accordance with the requirements of 01300 Submittals. In addition the following specific information shall be provided:

1. Shop Drawings and Product Data
2. Certificate of compliance with the requirements of ANSI/AWWA C502.
3. Records of standard tests.

1.03 QUALITY CONTROL

A. Reference Standards: The Contractor shall comply with the applicable provisions and recommendations of the latest editions of the following standards, unless indicated otherwise on the Drawings or specified herein.

1. ANSI B18-2.1 - Standard specification for Square and Hex Bolt Screws, including Askew Head Bolts, Hex Cap Screws and Lag Screws
2. ANSI/AWWA C110/A21.10 - Ductile Iron and Gray Iron Fittings
3. ANSI/AWWA C111/A21.11 - Rubber Gaskets Joints for Ductile Iron Pressure Pipe and Fittings.
4. ANSI/AWWA C151/A21.51 - Ductile Iron Pipe, Centrifugally Cast
5. ANSI/AWWA C502 - Dry Barrel Fire Hydrants.
6. ANSI/AWWA C550 – Protective Epoxy Interior Coatings for Valves and Hydrants
7. ANSI/AWWA C600 - Installation of Ductile Iron Water Mains and Their Appurtenances.
8. AWWA M17 - Installation, Field Testing and Maintenance of Fire Hydrants.

B. Testing and Inspection: The Contractor shall perform all tests and inspections required by this specification unless otherwise stated. The Contractor may use the manufacturer's facility or any independent laboratory acceptable to the Owner. The Owner reserves the right to perform any of the test and inspection requirements where such tests and inspections are needed to further determine compliance with this specification.

C. Samples, visual tests and inspections may be required by the Owner. These shall be performed and witnessed in the presence of the City's Authorized Representative at no extra cost. Failure to comply with this provision may cause rejection of the hydrants.

PART 2 PRODUCTS

2.01 FIRE HYDRANTS

A. Fire hydrant shall be three way, post type, dry top traffic design model with compression main valve opening against and closing in the direction of normal water flow. Hydrant shall be designed for 250 psi working pressure.

B. Fire hydrants shall conform to the requirements of ANSI/AWWA C502.

C. Manufacture:

1. Hydrant shall have the name of the manufacturer, the year of manufacture, operating pressure and valve size in legible raised letters cast on the barrel. Hydrant shall also have the letters "AWB" cast on the barrel for identification purposes.
2. Dry Top Bonnet:
   a. Bonnet shall be constructed with a moist proof lubrication chamber which encloses the operating threads and which provides automatic lubrication of the threads and bearing surfaces each time the hydrant is operated.
   b. Bonnet assembly shall be comprised of a top O-ring serving as a dirt and moisture barrier and a lower O-ring which will serve as a pressure seal. The O-ring packing shall be included in an oil filled reservoir so that all operating parts are enclosed in a sealed oil bath.
   c. O-rings shall be Buna N in accordance with ASTM D2000.
   d. An oil filler plug shall be provided in the bonnet to permit checking of the oil level and adding oil when required.
3. Operating Nut:
   a. Operating nut shall be ASTM B584 bronze, 7/8 - 1 inch tapered square nut with tamper-proof device.
   b. The tamper proof device shall be a ductile iron combination hold-down nut and operating nut shield to eliminate operation of hydrant with wrenches other than a special socket-type wrench. Arrow shall be cast on the periphery of the bonnet indicating direction of the operation for opening the hydrant.

4. Nozzles:
    a. Fire hydrant shall have two (2) 2-1/2 inch hose connections, 120 degrees apart and one (1) 4-1/2 inch pumper connection, with National Standard threads. Nozzles to be made of bronze and have interlocking lugs to prevent blowout.
    b. Nozzle caps nuts shall have the same cross section as the operating nut on the bonnet. Nozzle caps shall be secured to the fire hydrant with non-kinking type steel chain with chain loop on cap ends to permit free turning of caps.
    c. Outlet Nozzle Threads shall conform to the National Fire Protection Association (NFPA) for National Standard Fire Hose Coupling Screw Threads.
5. Main Valve:
    a. The internal main valve diameter shall be a minimum of 5 1/4- inches.
    b. The valve shall be designed to open against pressure and close with pressure.
    c. Valve shall be made of synthetic rubber and formed to fit the valve seat accurately.
    d. The valve shall be reversible.
6. Main Valve Seat:
    a. The main valve seat shall be ASTM B584 bronze and its assembly into the hydrant shall involve bronze to bronze thread engagement.
    b. Two (2) O-ring seals shall be provided as a positive pressure seal between the bronze seat ring and the shoe.
    c. Valve assembly pressure seals shall be obtained without the employment of torque or torque compressed gaskets.
    d. The hydrant shall be designed to allow the removal of all operating parts through the hydrant barrel by means of a single disassembly wrench without excavating.
7. Traffic Design:
    a. Hydrant barrel section shall be connected at the ground line in a manner that will prevent damage to the lower part of the hydrant when struck by a vehicle.
    b. Main valve rod section shall be connected at the ground line by a frangible coupling.
    c. The barrel and ground line safety construction shall be such that the hydrant nozzles can be rotated to any desired position without disassembling or removing the top operating components and top section of the hydrant barrel.
8. Drain:
    a. The drain mechanism shall be designed to operate with the operation of the main valve and shall allow a momentary flushing of the drain ports.
    b. A minimum of two (2) internal positive opening drain valves and two (2) external bronze lined drain ports shall be required in the main valve assembly to drain the hydrant barrel.
    c. The drain valve facings shall be made of either rubber or polyethylene

material and retained in position with stainless steel screws.

9. Shoe:
   a. Shoe shall be ductile iron, ASTM A536, grade 65-45-12. Interior of shoe shall be epoxy coated in accordance with ANSI/AWWA C550.
   b. Main valve travel stop shall be an integral part of the shoe permitting full opening of the hydrant and positive stop without over travel of the stem.
10. Barrel Extension Sections: Barrel extension sections shall be available in six (6) inch increments complete with rod, extension, coupling and necessary flanges gaskets and bolts so that extending the hydrant can be accomplished without excavating.
11. Nuts and Bolts: Nuts and bolts shall be corrosion resistant. Bolt material shall develop the physical strength requirements of ASTM A307 and may have either regular or square heads with dimensions conforming to ANSI B18.2.1 Nuts, bolts and studs shall be cadmium-plated (ASTM A165, grade NS) or zinc-coated (ASTM A153 or ASTM B633), or rust-proofed by a process acceptable to the City's Authorized Representative.
12. O-Rings: O-rings shall be rubber and conform to the requirements of ASTM 2000.
13. Markings: Bury mark of fire hydrant shall be cast on the barrel of the hydrant. The bury mark shall provide not less than 18-inches of clearance from the centerline of the lowest nozzle to the ground.
14. Direction of Opening: Hydrant shall be designed to open "right" or clockwise.
15. Joint Assemblies: Complete joint assemblies consisting of glands, gaskets, bolts and nuts shall be furnished.
16. Coating and Painting:
    a. All iron parts of the hydrant, inside and outside, shall be cleaned and all surfaces shall be coated with a two part epoxy. Epoxy shall be Amercoat 370.
    b. The outside of the hydrant above ground level shall be cleaned and thereafter shop painted with two (2) coats of Sherwin Williams Quick Dry Alkyd Enamel, Mueller paint code RP. Color shall be aluminum.
17. Lubrication: All bronze, threaded contact moving parts shall, during shop assembly, be lubricated and protected by a coating of rustproof compound to prevent damage in shipment and storage.

PART 3 EXECUTION

3.01 INSPECTION

Prior to installation, inspect all hydrants for direction of opening, nozzle threading, operating nut and cap nut dimensions, tightness of pressure containing bolting, cleanliness of inlet elbow, handling damage and cracks. Defective hydrants shall be corrected or held for inspection by the City's Authorized Representative.

3.02 HYDRANT INSTALLATION

A. Hydrants shall be placed at the locations indicated on the Drawings. The Contractor shall install proper "bury" hydrants or shall use, at no cost to the City, proper length extensions to ensure that each fire hydrant is installed in accordance with the manufacturer's recommendation and the requirements of these Specifications.

B. Hydrants shall stand plumb with pumper nozzle facing the roadway.

C. Hydrants shall be set to the finished grade with the centerline of the lowest nozzle 18-inches above finished grade.

D. When placed behind curb, the hydrant barrel shall be set such that the distance from the face of the curb to the edge of the hydrant shall be 21-inches. Where no curb exists, the hydrant shall be set as directed by the City's Authorized Representative.

E. Fire Hydrants may be installed at designated locations in lieu of air relief valves as authorized by the City's Authorized Representative.

3.03 CONNECTION TO WATER MAIN

A. Fire hydrant shall be connected to the water main with a ductile iron branch connection. Gate valves shall be used on fire hydrant branches as shown on the Drawings.

B. The connection of the hydrant to the water main shall be through a ductile iron hydrant tee or a welded outlet for main lines. Tapping sleeves shall not be allowed.

C. Hydrants shall be attached to the water main by the following method:

1. For water mains 20 inches and smaller, the isolation valve shall be attached to the water main by connecting the valve to the hydrant tee.
2. For water mains 24 inches and larger, the isolation valve shall be attached to the water main by providing an anchor coupling between the valve and welded outlet or hydrant tee.
3. The isolation valve shall be attached to the hydrant by providing an anchor coupling between the valve and hydrant, if the hydrant and valve are less than two feet apart. Otherwise, provide mechanical joint ductile iron pipe with retainer glands on the hydrant and valve.

D. Pipe connecting the fire hydrant to the water main shall be 6-inch diameter class 350 ductile iron pipe meeting the requirements of Section 02665, Water Mains and Accessories. Anchor coupling shall be as specified in Section 02665.

E. Anchoring and Bracing: The shoe of each fire hydrant and the hydrant tee shall be braced against unexcavated earth at the ends of the trench with poured concrete thrust blocks as shown on the Drawings and detail W-34.

F. Drainage: No. 57 stone shall be placed around the shoe of the fire hydrant for a minimum distance of 18-inches below the drain ports, 6-inches above the drain ports, 15-inches laterally on each side of the shoe and 24-inches from the back of the shoe towards the main.

G. Provide resistance to avoid transmitting shock moment to the lower barrel and inlet connection by pouring a concrete collar 6-inches thick with a diameter of 24 inches at the ground line around the hydrant barrel.

3.04 FIELD PAINTING

A. After hydrant is installed and approved by the City's Authorized Representative, the Contractor shall touch up all exposed hydrant surfaces as directed by the City's Authorized Representative. Touch up paint shall be as specified in paragraph. 2.01 C 16 of this Section.

B. The bonnet of each hydrant shall be painted in one of the following colors to indicate the diameter of the water main that the hydrant is connected to:

Water Main Diameter (inches)	Hydrant Bonnet Color
6 - 8	Silver
10 - 12	Yellow
16 and larger	Green

C. Hydrants that are connected to non-potable water mains (i.e. raw water mains) shall be painted violet (light purple).

D. Private hydrants shall be painted red.

3.05 TESTING

All fire hydrants shall be tested in strict accordance with the requirements of ANSI/AWWA C502, with no additional cost to the City. A certificate of compliance will be furnished to the City's Authorized Representative.

3.06 REMOVAL AND SALVAGE OF EXISTING HYDRANTS

A. Remove all existing hydrants shown on the Drawings to be removed. Hydrants shall be removed as follows:

1. Disconnect hydrant from barrel section.
2. Saw cut or remove barrel section to a minimum of 12-inches below finished

grade.

3. Remove hydrant valve cover and concrete pad, valve box and extension stem. Insure that valve is closed. Valve shall remain in place.
4. Deliver removed hydrant, valve cover, valve box and extension stem to the City's storage yard as directed by the City's Authorized Representative.

B. Backfill excavations and compact as specified in Section 02225 and restore area as required and as directed by the City's Authorized Representative.

+ + + END OF SECTION 02645 + + +

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SECTION 02647
MANHOLES FRAME AND COVER AND VALVE COVER ADJUSTMENT

PART 1 GENERAL

1.01 SCOPE

The Contractor shall provide all labor, materials, equipment and incidentals required to adjust existing manhole frames and covers and valve covers to finished grade as specified herein.

1.02 SUBMITTALS

Submittals shall be made in accordance with the requirements of 01300 Submittals. In addition, the following specific information shall be provided:

1. Manufacturer's data for pre-mix (bag) concrete
2. Description of the proposed method of concrete curing.

1.03 QUALITY CONTROL

Reference Standards: The Contractor shall comply with the applicable provisions and recommendations of the latest editions of the following standards, except as otherwise shown on the Drawings or specified herein.

1. ASTM C270 - Standard Specification for Mortar for Unit Masonry
2. ASTM C443 - Standard Specification for Joints for Circular Concrete Sewer and Culvert Pipe using Rubber Gaskets
3. ASTM C478 - Standard Specification for Precast Reinforced Concrete Manhole Sections
4. ASTM C1107 - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (non-shrink)

1.04 DESIGN CRITERIA

A. The elevation of manhole frame and covers and valve covers will vary with each location. The Contractor shall adjust the top of the manhole frame and cover and valve cover to the finished grade of the pavement or existing ground or higher than the ground surface as directed by the City's Authorized Representative.

B. For Georgia Department of Transportation (GDOT) milling and resurfacing projects, refer to GDOT Utilities Accommodation Manual (UAM) Chapter 5.4 for recommendations on lowering and raising manholes and other utilities in order to adjust them to the new grades.

PART 2 PRODUCTS

2.01 MANHOLE FRAMES AND COVERS AND VALVE COVERS

Refer to the City Standard Details in the Appendix.

2.02 BRICK

A. Bricks used to adjust manhole frames to grade shall conform to the requirements of ASTM C32, Grade MS. Bricks shall also conform to the following requirements, unless otherwise approved by the City's Authorized Representative.

B. All brick shall be new and whole, of uniform standard size, and straight and parallel edges and square corners. Bricks shall be of compact textures, burned hard entirely through, free from injurious cracks and flaws, and shall have a clear ring when struck together. No soft or salmon brick shall be used in any part of the Work. Brick shall be culled after delivery, if required, and no culls shall be used except at such places, to such extent, and under such conditions as may be approved by the City's Authorized Representative.

2.03 MORTAR

A. Mortar used to adjust manhole frames to grade shall be made of one part portland cement and two parts clean sand. Cement shall be type 1 and shall conform to ASTM C150. Sand shall meet requirements of ASTM C144.

B. Mortar shall be prepared only in the quantities needed for immediate use. Mortar which has been mixed for more than thirty (30) minutes or which has set or has been retempered shall not be used in the Work.

2.04 GRADE ADJUSTMENT RINGS

A. Grade adjustment rings shall be used to adjust manhole frames to grade and shall be precast reinforced concrete conforming to ASTM C478. Rings shall be free of cracks, voids and other defects.

B. Adjustment rings shall be tested to assure compliance with impact and loading requirements in accordance with AASHTO's Standard Specifications.

2.05 PRECAST CONCRETE MANHOLE TOP SECTIONS

A. Precast concrete manhole top sections shall conform to the typical manhole details as shown on the Drawings.

B. Precast manhole section shall be manufactured, tested and marked in accordance with the latest provisions of ASTM C478.

C. The minimum compressive strength of the concrete for all sections shall be 4,000 psi.

D. The maximum allowable absorption of the concrete shall not exceed 8 percent of the dry weight.

E. The circumferential reinforcement in the conical top section shall consists of one (1) line of steel and shall be not less than required by ASTM C478.

F. Precast manhole section joints shall be offset tongue and groove type, supplied with Tylox Super Seal pre-lubricated gasket as manufactured by Hamilton Kent, RPS lubricated gasket as manufactured by Press-Seal Gasket Corporation or Conseal CS-202 butyl rubber sealant as manufactured by Concrete Sealants, Inc.

G. Each section of the precast manhole shall have not more than two (2) slots for the purpose of handling and laying. These slots shall be tapered and shall be plugged with rubber stoppers or mortar after installation.

H. The interior and exterior surfaces of the manhole section shall have a smooth hard finish, and shall be free from cracks, chips, and spalls.

PART 3 EXECUTION

3.01 GENERAL

All activities shall be performed in accordance with the manufacturer's recommendations and regulations established by OSHA. Attention shall be drawn to those safety requirements involving working with scaffolding and entering confined spaces.

3.02 ADJUSTMENT OF MANHOLE FRAMES AND COVERS

A. The top elevation of manhole frames shall be adjusted to grade unless shown otherwise on the Drawings. A maximum adjustment of twelve (12) inches will be allowed using brick and mortar or grade adjustment rings. Brick used will be in accordance with the requirements of this section.

B. The cast iron frame for the manhole cover shall be set at the required elevation and properly anchored to the riser section. Where manholes are constructed in paved areas, the top surface of the frame and cover shall be tilted to conform to the exact slope, crown and grade of the existing adjacent pavement.

3.03 ADJUSTMENT OF VALVE COVERS

Valve covers shall be adjusted to grade as directed by the City's Authorized Representative. All components required to adjust the valve box and cover to the required grade will be furnished by the City.

3.04 BACKFILL

The Contractor shall place and compact backfill materials, in the area of excavation surrounding manholes and valve covers in accordance with the requirements of Section 02225, Trench Excavation and Backfill.

3.05 CONCRETE PAD AND PRE-CAST RINGS

After the manhole covers and valve covers have been adjusted to final grade, cast-in–place or precast concrete pads or rings shall be installed around the valve covers as shown on the Standard Details and as directed by the City's Authorized Representative.

3.06 CLEANUP

After the manhole frame and cover and valve cover adjustment work has been completed, the Contractor shall cleanup the area. All excess material and debris not incorporated into the permanent installation shall be disposed of by the Contractor. Site restoration shall be performed in accordance with the requirements of Section 02700, Removing and Replacing Pavement and Section 02920, Site Restoration.

+ + + END OF SECTION 02647 + + +

SECTION 02650
TESTING FOR ACCEPTANCE OF SANITARY AND STORM SEWERS

PART 1 GENERAL

1.01 SCOPE

A. This section includes sanitary and storm sewer inspection and testing methods; joint testing procedures; manhole testing methods; allowable testing limits for sanitary sewers; and any other incidental or appurtenant operations which may be necessary to properly complete the Work.

B. The Contractor shall provide all labor, materials, and equipment required for all sanitary and storm sewers testing and related operations necessary or convenient for completing the Work as shown on the Drawings or specified herein.

1.02 SUBMITTALS

A. Submittals shall be made in accordance with the requirements of the General Conditions of the Contract Documents.

1.03 QUALITY ASSURANCE

A. Reference Standards: The Contractor shall comply with the applicable provisions and recommendations of the latest editions of the following standards, except as otherwise shown on the Drawings or specified in these Specifications.

1. ASTM C828 – Test Method for Low-pressure Air Test of Vitrified Clay Pipe Lines

2. ASTM C969 – Standard Practice for Infiltration and Exfiltration Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines

3. ASTM C1103 - Standard Practice For Joint Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines

4. ASTM C1244 – Standard Test Method for Concrete Sewer Manholes by the Negative Air Pressure (Vacuum) Test Prior to Backfill

5. ASTM F1417 – Standard Practice for Installation Acceptance of Plastic non-pressure Sewer Lines Using Low Pressure Air

1.04 ACCEPTANCE TESTS

A. Upon completion of all or a part of a sanitary sewer installation, the Contractor shall test and/or inspect the sewer for acceptability. The method(s) of testing and/or inspection shall be as specified in the individual Specifications sections. Testing and inspection shall

be performed in accordance with the requirements of this Section.

B. One or more of the following tests and/or inspections may be required:

1. Infiltration of Water

2. Exfiltration of Water

3. Exfiltration of Air under Pressure

4. Smoke Testing

5. Joint Testing

6. Direct Visual Inspection

7. Deflection Testing

8. Dye Testing

9. Closed Circuit Television Inspection (CCTV).

C. The specified testing method shall be completed by the Contractor when directed by the Engineer. The Contractor shall notify the Engineer 48 hours in advance prior to the Contractor performing any testing.

D. Prior to any testing, all lines shall be cleaned of debris and flushed clean. Debris shall be caught and removed from the line and shall not be flushed into existing live sanitary sewers.

1.05 TEST SECTIONS

A. Unless otherwise specified or directed by the Engineer, each section of sanitary sewer between manholes shall be tested by the air testing method.

B. The Contractor may at his option divide the installed sewer into subsections of more convenient length for testing. If the section or subsection tested does not pass the tests, it shall be repaired and the test repeated until a satisfactory test is obtained.

C. The Engineer may allow alternate testing methods at his discretion or require additional testing methods if, in his opinion, they are warranted.

PART 2 PRODUCTS

(NOT USED)

PART 3 EXECUTION

3.01 SANITARY AND STORM SEWER INSPECTION AND TESTING METHODS

A. All Testing Methods: All wyes, tees, and stubs shall be plugged with flexible jointed caps, or acceptable alternate, and securely fastened to withstand the internal test pressure. Plugs or caps shall be readily removable.

B. The Contractor shall clean and test lines before requesting final acceptance. Where any obstruction is met, the Contractor shall clean the sewers by means of rods, swabs, or other instruments. When requested by the Engineer, the Contractor shall flush out lines and manholes before final inspection.

C. Pipe lines shall be straight and show a uniform grade between manholes, except for curves specifically shown on the Drawings. The Contractor shall correct any discrepancies discovered during inspection at no cost to the City.

D. Watertightness

1. All sewers constructed shall be tested for watertightness. Infiltration and exfiltration tests shall be performed on all new sewers constructed as specified in this section, except for those new sewers constructed which have active services tied into them as the pipe is being installed. In such cases the watertightness of the sewers less than or equal to thirty-six (36) inches in diameter shall be based on a visual inspection, and for sewers forty-two (42) inches in diameter and larger based on the individual joint test as specified in this section.

2. All visible leaks, regardless of the amount of leakage, shall be repaired at the Contractor's expense.

E. Infiltration Tests

1. The Contractor shall install weirs in manholes selected by the Engineer to determine the leakage of ground water into the sewer. The Contractor shall install weirs for a minimum of four hours before measuring flow. If leakage in any section of the sewer line exceeds one hundred (100) gallons per inch of diameter per day per mile, the Contractor shall locate and repair leaks. Repair methods shall be approved by the Engineer. After repairs are completed, the Contractor shall re-test for leakage.

2. Infiltration testing shall be performed before sanitary sewer lateral connections or reconnections are made.

3. The Contractor shall furnish, install and remove the weirs, plugs, and bulkheads required to perform the leakage tests.

4. Weirs shall be V-notch type equal to Pollard.

F. Exfiltration Tests

1. Low-Pressure Air Test:

a. Prior to air testing, the section of sewer between manholes shall be thoroughly cleaned and wetted. Immediately after cleaning or while the pipe is water soaked, the sewer shall be tested with low-pressure air. At the Contractor's option, sewers may be tested in lengths between manholes or in short sections using inflatable balls pulled through the line from manhole to manhole.

b. Air shall be slowly supplied to the plugged sewer section until the internal air pressure reaches approximately four (4) psi. After this pressure is reached and the pressure allowed to stabilize (approximately two (2) to five (5) minutes), the pressure shall be reduced to three and one-half (3.5) psi before starting the test.

c. Record the drop in pressure for the test period. If the pressure drop is equal to or less than one (1) psi during the test time, then the line will pass the test. If the pressure drops more than one (1) psi during the test time, the line will fail the test and the Contractor shall locate the failure, make necessary repairs, and retest the line.

d. The minimum test time for various pipe sizes and types is as follows:

Nominal Pipe Size(Inches)	Time (Min/100 feet)	
	VCP, RCP	DIP, PVC
6	0.7	5.7
8	1.2	7.6
10	1.5	9.4
12	1.8	11.3
15	2.1	14.2
18	2.4	17.0
21	3.0	19.8
24	3.6	22.8
30	4.8	35.4
36	6.0	51.2
42	7.3	69.5

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e. Required test equipment, including inflatable balls, braces, air hose, air source, time meter, rotameter as applicable, cut-off valves, pressure reducing valve, 0-15 psi pressure gauge, 0-5 psi pressure gauge with gradations in 0.1 psi and accuracy of ± two (2) percent shall be provided by the Contractor. Testing equipment shall be equal to Cherne Air-Loc Testing Systems.

f. The Contractor shall keep records of all tests made. Copies of records shall be given to the Engineer. Records shall show date, line number and stations, operator, and such other pertinent information as required by the Engineer.

g. The Contractor shall take safety precautions in the performance of the air testing. Plugs shall be properly secured and care be exercised in their removal. Every precaution shall be taken to avoid the possibility of over-pressurizing the sewer line.

2. Individual Joint Test: Pipe joints for sewers thirty (30) inches in diameter and larger shall be air tested individually. The joint tester assembly shall be placed over the joint and the joint area pressurized to four (4) psi. The pressure shall not drop more than two (2) psi in ten (10) seconds. The joint tester assembly shall be equal to Cherne Industries, Inc.

G. Smoke Testing

1. Smoke testing may be used only to locate leaks and in no case shall be considered conclusive or a substitute for air tests, infiltration tests, or exfiltration tests. In all cases a smoke test shall be accompanied by an air test, infiltration test or exfiltration test. The Engineer may order a smoke test if another leakage test fails and the source of the leak cannot be determined by other means. Smoke testing shall only be performed where ground water is low. Smoke shall be blown into a sealed section of sewer under pressure and the Contractor and Engineer shall observe for any smoke appearing on top of the ground indicating the presence of leaks.

2. The Engineer may require that the Contractor excavate the sewer to determine the source of any smoke appearing during the smoke test. All leaks or breaks discovered by the smoke tests shall be repaired and/or corrected by the Contractor at his own expense in a manner acceptable to the Engineer. Equipment and supplies required for smoke tests shall be furnished by the Contractor.

3. The Contractor may perform smoke tests at any time during construction at his option; however, any such tests shall not supplant the final test of the completed work.

H. Deflection Test

1. The Contractor shall test all PVC gravity sewers for excessive deflection by passing a mandrel through the pipe. Deflection of the pipe shall not exceed five (5) percent.

2. The mandrel size shall be based upon the maximum possible inside diameter for the type of pipe being tested, taking into account the allowable manufacturing tolerances of the pipe. The mandrel shall be configured as shown on the Drawings and shall have an odd number of legs, or vanes, with a quantity equal to or greater than nine (9). The legs of the mandrel shall be permanently attached to the mandrel. A mandrel with variable sizes shall not be allowed. The mandrel shall be constructed of steel, aluminum, or other material approved by the Engineer, and shall have sufficient rigidity so the legs of the mandrel will not deform when pulled through the pipe. The Contractor shall provide a proving ring for each size mandrel, with a tolerance of no more than 0.02-inch clearance, and the mandrel dimensions shall be checked by the Engineer, using this proving ring, before use by the Contractor.

3. The Contractor shall excavate and properly install any section of pipe not passing this test and re-test until results are satisfactory.

4. This test shall be performed twice:

    a. Once within the first thirty (30) days of installation, and
    b. Once during final inspection, but no sooner than thirty (30) days after pavement backfill is done, at the completion of this Contract.

I. Dye Testing

1. Dye testing shall be used only to confirm service connection or disconnection and in no case shall be considered conclusive or a substitute for air tests, infiltration tests or exfiltration tests. Dye testing shall only be performed where ground water is low. Dye shall be introduced into the service lateral and the Contractor and Engineer shall observe for any dye appearing on sanitary or storm sewers. Equipment and supplies required for dye tests shall be furnished by the Contractor.

2. The Contractor may conduct dye tests at any time during construction at his option; however, any such tests shall not supplant the final test of the completed work.

J. Closed Circuit Television Inspection

1. The Engineer shall require that the interior of all new gravity sewers be subjected to a televised inspection. Such internal inspection shall be conducted and documented in accordance with the requirements of Section 02655, Sanitary Sewer System Cleaning and Television Inspection.

2. Prior to Final Acceptance the City shall be provided with one copy of the TV inspection report and CD-ROMs showing the entire length of the gravity sewer tested. The report shall contain the condition of pipe, type of pipe, depth, location of services, length, type of joints, roundness and distance between manholes. Any pipe found to be cracked, leaking, misaligned, bellied, or otherwise defective shall be removed and replaced by the Contractor.

3.02 JOINT TESTING PROCEDURES

A. Joint Testing Procedures: Each sanitary sewer joint shall be individually air tested using a packer or other approved testing device at a test pressure of four (4) psi plus one-half (1/2) psi per vertical foot of depth up to a maximum of ten (10) psi. The packer or testing device shall be positioned within the sanitary sewer so as to straddle the joint to be tested. The ends of the packer or testing device shall be expanded to isolate the pipe joint from the remainder of the sewer and create a void space between the packer or testing device and the pipe joint. The sealing elements shall be inflated with air in accordance with the test equipment manufacturer's instructions. Air shall then be introduced into the void space until the required test pressure is recorded on the void pressure meter. If the required test pressure cannot be developed, the joint will fail the test. After the void pressure is observed to be equal to or greater than the required test pressure, the air flow shall be stopped. If the pressure holds or drops less than two (2) psi in fifteen (15) seconds, the joint is acceptable.

1. All test monitoring shall be above ground and in a location to allow for simultaneous and continuous observation by the Engineer. The void pressure data shall be transmitted electronically from the void to the monitoring equipment.

2. Prior to starting the sanitary sewer joint testing, a two (2) part control test shall be performed as follows:

    a. A demonstration test shall be performed in a test cylinder constructed in such a manner that a minimum of three (3) known leak sizes (0.062, 0.094, 0.125 inch diameter) can be simulated. During the demonstration test, the Contractor shall use a test cylinder gauge to measure void pressure. The Contractor shall also install the void pressure monitoring equipment in the same manner as will be done to measure the void pressure at a sanitary sewer joint. The Contractor shall then apply pressure to the void space. During the demonstration test, the void pressure reading on the test cylinder gauge shall be the same as that observed on the void pressure monitoring equipment at all times during the test. If the pressure reading on the test cylinder gauge is not the same as the pressure reading observed on the void pressure monitoring equipment at all times, the Contractor shall repair or otherwise modify the packer or testing device and perform the test until the results are satisfactory to the Engineer. The demonstration test may be required, by the Engineer, at any other time during the joint testing work.
    b. Upon entering each manhole to manhole section with the test equipment, but prior to the commencement of joint testing, the packer or testing device shall be positioned on a section of sound sanitary sewer between pipe joints. The Contractor shall then perform the test at the required pressure. If the test indicates that the sanitary sewer will not meet the joint test requirements, the Contractor shall inform the Engineer who will have the discretion of modifying

the joint test requirements.

3. During the sanitary sewer joint testing work, the Contractor shall keep the following records:

    a. Manhole to manhole section tested.
    b. Test pressure used.
    c. Location (footage) of each joint tested.
    d. Test results for each joint tested.

B. Lamping Procedures: Lamping will be performed on all sewer pipelines by the Engineer.

3.03 MANHOLE TESTING

A. All new manholes, rehabilitated manholes, manhole inserts and replacement manholes shall be tested by the Contractor using the vacuum test method, following the manufacturer's recommendations. Vacuum testing of manholes and structures shall be performed after curing of linings and installation of inserts. Any leakage in the manhole or structure, before, during, or after the test shall be repaired at no cost to the City..

B. Prior to testing manholes for watertightness, all lift holes shall be plugged with a non-shrink grout, all joints between precast sections shall be properly sealed and all pipe openings shall be temporarily plugged and braced.

C. Vacuum Tests:

1. The manhole, after preparation as noted above, shall be vacuum tested. All testing shall be performed in accordance with the requirements of ASTM C1244. A vacuum shall be drawn and the vacuum drop over a specified time period shall be used to determine the acceptability of the manhole.

2. The test head shall be placed at the inside of the top of the manhole in accordance with the manufacturer’s instructions. A vacuum of ten (10) inches of mercury [five (5) psi] shall be drawn on the manhole, the valve on the vacuum line of the test head closed and the vacuum pump shut off. The time shall be measured for the vacuum to drop from ten (10) inches of mercury [five (5) psi] to nine (9) inches of mercury [four and one-half (4.5) psi]. The manhole shall pass the vacuum test if the time for the vacuum reading to drop from 10-inches of mercury to 9-inches of mercury meets or exceeds the values indicated in the table below.

MINIMUM TEST TIMES FOR VARIOUS MANHOLE DIAMETERS				
	Manhole Diameter (Inches)			
]	48	60	66	72
Depth (Feet)	Time (Seconds)			
8	20	28	29	33
10	25	33	36	41
12	30	39	43	49
14	35	48	51	57
16	40	52	58	67
18	45	59	65	73
20	50	65	72	81
22	55	72	79	89
24	59	78	87	97
26	64	85	94	105
28	69	91	101	113
30	74	96	108	121

D. For manholes less than 8-feet in depth, the minimum value listed shall be used.

E. If the manhole fails the initial test, necessary repairs shall be made with non-shrink grout. Retesting shall proceed until a satisfactory test is obtained.

F. Vacuum testing equipment shall be equal to that as manufactured by P.A. Glazier, Inc.

G. The City reserves the right to have third party consultants perform construction materials testing and assessments to any new manhole.

3.04 ALLOWABLE TESTING LIMITS FOR SANITARY SEWERS

A. No infiltration and exfiltration of ground water or other leakage into or out of the sewer shall be allowed during the twenty-four (24) hour test period.

B. Any visible or audible leaks into the sewer shall be repaired or corrected as directed by the Engineer.

+ + + END OF SECTION 02650 + + +

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SECTION 02665
WATER MAINS AND ACCESSORIES

PART I GENERAL

1.01 SCOPE

A. Furnish all labor, materials, equipment and incidentals required for the complete installation of water mains and accessories as shown on the Drawings and as specified herein. The Work of this Section also includes, but is not limited to, hydraulic testing and disinfection of the completed water mains after installation.

B. This Section includes ductile iron pipe and fittings ranging in size from 3-inches in diameter through 64-inches in diameter.

C. Supply all products and perform all work in accordance with applicable American Society for Testing and Material (ASTM), American Water Works Association (AWWA), American National Standards Institute (ANSI), or other recognized standards. Latest revisions of all standards are applicable.

D. Galvanized pipe and fittings shall not be used as any part of the Water Transmission and Distribution System, nor shall it be used to join any appurtenances to the System.

1.02 SUBMITTALS

A. Submittals shall be made in accordance with the requirements of 01300 Submittals. In addition, the following specific information shall be provided:

1. Product data and engineering data, including shop drawings.
2. Evidence that manufacturers have consistently produced products of satisfactory quality and performance for a period of at least two (2) years.
3. Written certification that all products furnished comply with all applicable requirements of these specifications.

B. For pipe 24-inches in diameter or greater, submit shop drawings to the City's Authorized Representative for review showing a complete laying plan of all pipe, including all fittings, adapters, valves and specials along with the manufacturer's drawings and specifications indicating complete details of all items. The pipe details shall include stationing, pipe class or design and supporting computations; and laying schedule which specifies pipe class, class coding, pipe stationing for all changes in grade or horizontal alignment, transition stations for various pipe classes and the limits of each reach of restrained joint pipe. The above shall be submitted to

the City's Authorized Representative for review before fabrication and shipment of these items.

1.03 QUALITY CONTROL

Reference Standards: The design, manufacturing and assembly of elements of the products herein specified shall comply with the applicable provisions and recommendations of the latest editions of the following standards, except as otherwise shown on the Drawings or otherwise specified.

1. ANSI/AWWA C104/A21.4 - Cement-Mortar Lining for Ductile-Iron Pipe and Fittings
2. ANSI/AWWA C110/A21.10 - Ductile-Iron and Gray-Iron Fittings
3. ANSI/AWWA C111/A21.11 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
4. ANSI/AWWA C115/A21.15 – Flanged Ductile-Iron Pipe with Ductile- Iron or Gray-Iron Threaded Flanges
5. ANSI/AWWA C150/A21.50 - Thickness Design of Ductile-Iron Pipe
6. ANSI/AWWA C151/A21.51 - Ductile-Iron Pipe, Centrifugally Cast
7. ANSI/AWWA C153/A21.53 – Ductile-Iron Compact Fittings for Water Service
8. ANSI/AWWA C600 - Installation of Ductile-Iron Water Mains and Their Appurtenances
9. ANSI /AWS D11.2 – Guide for Welding Iron Castings
10. AWWA C651 – Disinfecting Water Mains

1.04 TRANSPORTATION AND HANDLING

A. Furnish equipment and facilities for unloading, handling, distributing and storing pipe, fittings and accessories. Make equipment available at all times for use in unloading. Do not drop or dump materials. Any materials dropped or dumped will be subject to rejection without additional justification. Pipe handled on skids shall not be rolled or skidded against the pipe on the ground.

B. Handle pipe, fittings, and accessories carefully to prevent shock or damage. Handle pipe by rolling on skids, forklift, or front end loader. Do not use material damaged in handling. Slings, hooks or pipe tongs shall be padded and used in such a manner as to prevent damage to the exterior coatings and internal lining of the pipe.

C. Pipe opening shall be tarped during trucking to prevent truck fumes from getting inside pipe in delivery.

1.05 STORAGE AND PROTECTION

A. Store all pipes which cannot be distributed along the route in a secure location.

B. Stored materials shall be kept safe from damage. The interior of all pipes, fittings and other appurtenances shall be kept free from dirt or foreign matter at all times.

C. Pipe shall not be stacked higher than the limits recommended by the manufacturer. The bottom tier shall be kept off the ground on timbers, rails or concrete. Pipe in tiers shall be alternated: bell, plain end; bell, plain end. At least two rows of timbers shall be placed between tiers and chocks, affixed to each other in order to prevent movement. The timbers shall be large enough to prevent contact between the pipes in adjacent tiers.

D. Stored mechanical and push-on joint gaskets and lubricant shall be placed in a cool location out of direct sunlight. Gaskets shall not come in contact with petroleum products. Gaskets shall be used on a first-in, first-out basis.

E. Mechanical joint bolts shall be handled and stored in such a manner that will ensure proper use with respect to types and sizes.

1.06 WATER MAIN LOCATION

A. The minimum depth of cover over the pipe shall be four (4) feet and the maximum cover shall be five (5) feet measured for subgrade. Any deviations must be approved by the City's Authorized Representative.

B. The installation of the water main parallel to another utility in the same vertical plane is not permitted, i.e., "stacking of utilities" is not permitted.

PART 2 PRODUCTS

2.01 DUCTILE IRON PIPE

A. Ductile iron pipe shall be manufactured in accordance with AWWA C151/ ANSI A21.51. All Ductile Iron Pipe shall be manufactured in the United States of America. All pipes, except specials, shall be furnished in nominal lengths of 18 to 20 feet. Sizes will be as shown on the Drawings. All pipe shall have a minimum pressure rating as indicated in the following table and corresponding minimum wall thickness, unless otherwise specified or shown on the Drawings:

Pipe Sizes (inches)	Pressure Class (psi)
3 – 12	350
14 – 18	350
20	300

Pipe Sizes (inches)	Pressure Class (psi)
24	250
30 – 64	200

B. Flanged pipe minimum wall thickness shall be equal to Special Class 53 (Pressure Class 350 for 60 and 64-inch sizes). Flanges shall be furnished by the pipe manufacturer.

C. Fittings shall be ductile iron and shall conform to AWWA C110/ ANSI A21.10 or AWWA C153/ ANSI A21.53 with a minimum rated working pressure of 250 psi.

D. Joints:

1. Unless shown or specified otherwise, joints shall be push-on or restrained joint type for pipe and standard mechanical, push-on or restrained joints for fittings. Push-on and mechanical joints shall conform to AWWA C111/ ANSI A21.11.
2. The only acceptable restrained joint systems are identified in the table below. No field welding of restrained joint pipe will be allowed.

Acceptable Restrained Joints				
Pipe Dia. (inches)	**ACIPCO**	**U.S. Pipe**	**McWane**	**Generic***
3 – 12	Fast-Grip Flex Ring Fastite	Field Lok TR Flex	Push-On Restrained Joint Type A	MJ with Retainer Gland
16 – 24	Fast-Grip Flex Ring Lok-Ring	Field Lok TR Flex	Push-On Restrained Joint Type A	MJ with Retainer Gland
30 – 36	Flex Ring Lok-Ring	TR Flex	Push-On Restrained Joint Type B	MJ with Retainer Gland
42 – 48	Flex-Ring Lok-Ring	HP-Lok	N/A	MJ with Retainer Gland
54 – 64	Lok-Ring	HP-Lok	N/A	N/A

* Fittings and valves only, and only where specifically allowed.

3. Restrained joint pipe (RJ) on supports shall have bolted joints and shall be specifically designed for clear spans of at least 36 feet.
4. Flanged joints shall meet the requirements of AWWA C115/ ANSI A21.15 and ANSI B16.1, Class 125.

E. Gaskets: Gaskets for the various types of joints shall be as follows:

1. Gaskets for mechanical joints shall be made of vulcanized styrene butadiene (SBR) as specified in ANSI/AWWA C111/A21.11 unless specified otherwise. Reclaimed or natural rubber shall not be used. Gaskets shall be free from porous areas, foreign material and other defects that make them unfit for the use intended.
2. Gaskets for flanged joints shall be made of synthetic rubber, ring type or full face type and shall be 1/8-inch thick. Gaskets shall conform to the dimensions specified in ANSI/AWWA C111/A21.11.
3. Gaskets for push-on and restrained joints shall be in accordance with the pipe manufacturer's design dimensions and tolerances. Gaskets shall be made of vulcanized styrene butadiene (SBR) as specified in AWWA C111/ ANSI A21.11 unless specified otherwise. Where restraining gaskets are utilized, the gasket shall be ACIPCO Amarillo/yellow "Fast-Grip" or equal. If a pigmented gasket is not used, the manufacturers restrained joint shall be provided.

F. Bolts and Nuts

1. Provide the necessary bolts for connections. All bolts and nuts shall be threaded in accordance with ANSI B1.1, Coarse Thread Series, Class 2A external and 2B internal fit.
2. Bolts and nuts for mechanical joints shall be tee head bolts and nuts of high-strength low-alloy steel having minimum yield strength of 45,000 psi. Dimensions of bolts and nuts shall be in accordance with the dimensions shown in AWWA C111/ ANSI A21.11.
3. Flanged joints shall be bolted with through stud or tap bolts of required size as directed. Bolt length and diameter shall conform to ANSI/AWWA C115 for Class 125 flanges shown in ANSI/ASME B16.1.
4. Bolts for exposed service shall be zinc plated, cold pressed, steel machine bolts conforming to ASTM A307, Grade B. Nuts for exposed service shall be zinc plated, heavy hex conforming to ASTM A563. Zinc plating shall conform to ASTM B633, Type II.
5. Bolts for submerged service shall be stainless steel machine bolts conforming to ASTM A193, Grade B8. Nuts shall be heavy hex, stainless steel conforming to ASTM A194, Grade 8.

G. Mechanical joint glands shall be ductile iron.

H. Welded Outlets: Welded outlets may be provided in lieu of tees or saddles on mains with a diameter greater than or equal to 24-inches. The pipe joint on the outlet pipe shall meet the joint requirements specified above. The minimum pipe wall thickness of the parent pipe and the outlet pipe shall be Special Thickness Class 53 (Pressure Class 350 for 60 and 64-inch sizes). The welded outlet shall be rated for 250 psi working pressure. Welded outlets shall be designed with a minimum safety factor of 2.0 based on proof-of-design hydrostatic test results of at least 500 psi. The welded outlet shall be fabricated by the manufacturer of the parent pipe. The maximum outlet diameters shall not exceed those listed in the table below:

Parent Pipe Diameter, Inches	**Maximum Outlet Diameter, Inches**
24	16
30	20
36	24
42	30
48	30
54	30
60	30
64	30

I. Thrust collars shall be welded-on ductile iron body type designed to withstand thrust due to 250 psi internal pressure on a dead end from either direction on that pipe size. The thrust collars shall be continuously welded to the pipe by the pipe manufacturer.

J. Solid sleeves shall be used to connect plain end ductile iron pipe. Solid sleeves shall meet the requirements of AWWA C110/ ANSI A21.10 for long pattern and have a minimum pressure rating of 250 psi. Solid sleeves shall have mechanical or restrained joints as specified in this section or as shown on the Drawings. Solid sleeves shall be used only in locations shown on the Drawings or at the discretion of the City or City Representative.

K. Pipe stubs for all structure connections shall not exceed 2-feet in length. Caps shall be furnished where required.

L. Cement Lining:

1. Interior surfaces of all ductile iron pipe and fittings shall be cleaned and lined with a cement mortar lining applied in conformity with ANSI/AWWA C104/A21.4. If lining is damaged or found faulty upon delivery, the damaged pipe sections shall be repaired or removed from the site as directed by the City's Authorized Representative.
2. The minimum lining thickness shall be as shown in the following table. Lining shall be square and uniform with regard to the longitudinal axis of the pipe.

Pipe Diameter (Inches)	Minimum Lining Thickness (Inches)
3 – 12	1/8
14 – 24	3/32
30 – 64	1/8

M. Pipe Coating: Ductile iron pipe shall be coated with a layer of Zinc to a mass of 200 g/m2. The Zinc spray shall be factory applied prior to the black asphaltic coating. The coating system shall conform to ISO 81791. Fittings shall be ductile iron and have a coating consisting of Tnemec Series 94H20 Hydro-Zinc Primer and Tnemec Series 22 Epoxoline Finish Coat Polyamine Epoxy. Both primer and finish coat shall be ANSI/NSF Std. 61 Certified. The coating system as applied shall have a zinc level of at least 200 g/m2. All fittings shall have a cement-mortar lining with an asphaltic seal coat and an asphaltic coating on the exterior. Unless otherwise specified, pipe and fittings shall be coated with a 1 mil asphaltic coating as specified in AWWA C151/ ANSI A21.51.

N. Pipe Insulation: Where a water main is exposed to the elements because the pipe is above ground, the City's Authorized Representative shall determine whether the pipe is to be insulated or not. Where insulation is to be furnished and installed it shall conform to the following:

1. Insulating material shall be 3-inch thick polyurethane pipe covering formed to fit the pipe diameter.
2. Outer covering shall be 0.016-inch thick aluminum chiller jacket with moisture shield and secured with stainless steel wire or stainless steel straps.

O. Acceptance will be on the basis of the City Authorized Representative's inspection and the manufacturer's written certification that the pipe was manufactured and tested in accordance with the applicable standards.

2.02 PIPING APPURTENANCES

A. Mechanical Joint Restraint:

1. Design:
   a. Restraint devices for pipe sizes 4 inches through 48 inches in diameter shall consist of multiple gripping wedges incorporated into a follower gland meeting the applicable requirements of ANSI/AWWA C110/A21.10.
   b. Restraint devices shall have a working pressure rating of 350 psi for 4-inch through16-inch diameter pipe and 250 psi for 18-inch through 48- inch diameter pipe. Ratings shall be for water pressure and shall include a minimum safety factor of 2 to 1 for all pipe diameters.

2. Material:
   a. Gland body, wedges, and wedge actuating components shall be cast from grade 65-45-12 ductile iron material in accordance with ASTM A536.
   b. Ductile iron gripping wedges shall be contoured to fit on the pipe and shall be heat treated within a range of 370 to 470 BHN.
   c. Dimensions of the glands shall be such that they can be used with the standard mechanical joint bell and tee head bolts conforming to the requirements of ANSI/AWWA C111/A21.11 and ANSI/AWWA C 153/A21.53, latest editions.
3. Approvals:
   a. Restraint devices shall be listed by Underwriters Laboratories (3-inch through 24-inch size) and approved by Factory Mutual (3-inch through 12-inch size).
   b. Mechanical joint restraint shall be Megalug Series 1100 as manufactured by EBAA Iron Inc., Uni-Flange Series 1400, as manufactured by Ford Meter Box Company or approved equal.

B. Hydrant Connections:

1. Pipe: Pipe shall have mechanical joints ends.
2. Hydrant Tees: Hydrant tees shall conform to ANSI/AWWA C110/A21.10 or ANSI/AWWA C153/A21.53. Tapping saddles shall not be allowed.
3. Anchor Couplings:
   a. Anchor couplings for hydrant installation shall be class 350 ductile iron pipe meeting the requirements of AWWA C151/ANSI A21.51, Class 53 and shall have an anchoring feature at both ends so that when used with mechanical joint split glands a restrained joint is provided.
   b. Anchor couplings shall be cement lined in accordance with ANSI/AWWA C104/ A21.4 and shall have a bituminous coating in accordance with ANSI/AWWA C151/A21.51.
   c. Anchor couplings shall be equal to swivel anchor pipe and couplings as manufactured by Fab Pipe, Inc., Tyler Utilities Division of Union Foundry Company or approved equal.
4. Hydrant Connector Pipe:
   a. Hydrant connector pipe shall not be used unless specifically directed by the City's Authorized Representative.
   b. Hydrant connector pipe shall be class 350 ductile iron meeting the requirements of AWWA C153/ANSI A21.53 and shall be offset design so

that the hydrant can be adjusted to ensure placement at the proper grade. Connector pipe shall have an anchoring feature at both ends so that when used with mechanical joint split glands a restrained joint is provided.

c. Hydrant connector pipe shall be cement lined in accordance with AWWA C104/ANSI A21.4 and have a tar-coated outside.

d. Hydrant connector pipe shall be equal to the Gradelok as manufactured by Assured Flow Sales, Inc., Sarasota, Florida.

C. Tapping Saddles: Tapping saddles are not allowed.

PART 3 EXECUTION

3.01 LAYING AND JOINTING PIPE AND ACCESSORIES

A. Lay all pipe and fittings to accurately conform to the lines and grades as shown on the Drawings or as established by the City's Authorized Representative.

B. Pipe Installation:

1. Proper equipment, tools and facilities shall be provided for the safe performance of the Work. All pipe, fittings, valves and hydrants shall be lowered carefully into the trench by means of slings, ropes or other suitable tools or equipment in such a manner as to prevent damage to water main materials and protective coatings and linings. Under no circumstances shall water main materials be dropped or dumped into the trench.
2. All pipe, fittings, valves, and other appurtenances shall be examined carefully for damage and other defects immediately before installation. Defective materials shall be marked and held for inspection by the City or City Representative, who may prescribe corrective repairs or reject the materials.
3. All lumps, blisters and excess coating shall be removed from the socket and plain ends of each pipe, and the outside of the plain end and the inside of the bell shall be wiped clean and dry and free from dirt, sand, grit or any foreign materials before the pipe is laid. No pipe containing dirt shall be laid.
4. Foreign material shall be prevented from entering the pipe while it is being placed in the trench. No debris, tools, clothing or other materials shall be placed in the pipe at any time.
5. As each length of pipe is placed in the trench, the joint shall be assembled and the pipe brought to correct line and grade. The pipe shall be secured in place with approved backfill material.
6. It is not mandatory to lay pipe with the bells facing the direction in which work is progressing.
7. Applying pressure to the top of the pipe, such as with a backhoe bucket, to lower the pipe to the proper elevation or grade, shall not be permitted.

C. Alignment and Gradient:

1. Lay pipe straight in alignment and gradient or follow true curves as nearly as practicable. Do not deflect any joint more than the maximum deflection recommended by the manufacturer.
2. Maintain a transit, level and accessories at the work site to lay out angles and ensure that deflection allowances are not exceeded.

D. Expediting of Work: Excavate, lay the pipe, and backfill as closely together as possible. Do not leave un-jointed pipe in the trench overnight. Backfill and compact the trench as soon as possible after laying and jointing is completed. Cover the exposed end of the installed pipe each day at the close of work and at all other times when work is not in progress. If necessary to backfill over the end of an uncompleted pipe or accessory, close the end with a suitable plug, either push-on, mechanical joint, restrained joint or as approved by the City's Authorized Representative.

E. Joint Assembly:

1. Push-on, mechanical, flange and restrained type joints shall be assembled in accordance with the manufacturer's recommendations.
2. Each joint shall be inspected by the Contractor to ensure that it has been "homed" 100 percent.
3. The Contractor shall internally inspect each pipe joint to insure proper assembly for pipe 24-inches in diameter and larger after the pipe has been brought to final alignment.

F. Cutting Pipe: The Contractor shall cut the pipe and bevel the end, as necessary, to provide the correct length of pipe necessary for installing the fittings, valves, accessories and closure pieces in the correct location. Only push-on or mechanical joint pipe shall be cut. Cement lining shall be undamaged.

3.02 CONNECTIONS TO WATER MAINS

A. Make connections to existing pipe lines with tapping sleeves and valves, unless specifically shown otherwise on the Drawings.

B. Location: Before laying pipe, locate the points of connection to existing water mains and uncover as necessary for the City's Authorized Representative to confirm the nature of the connection to be made.

C. Interruption of Services: Make connections to existing water mains only when system operations permit and only when notices are issued to the customer. The Contractor will operate existing valves only with the specific authorization and direct supervision of the Owner.

D. Tapping Sleeves:

1. Holes in the new pipe shall be machine cut, either in the field or at the factory. No torch cutting of holes shall be permitted.
2. Prior to attaching sleeve, the pipe shall be thoroughly cleaned utilizing a brush and rag as required.
3. Before performing field machine cut, the watertightness of the sleeve assembly shall be pressure tested. The interior of the assembly shall be filled with water. An air compressor shall be attached, which will induce a test pressure as specified in this Section. No leakage shall be permitted for a period of five minutes.
4. After attaching the sleeve to an existing main, but prior to making the tap, the interior of the assembly shall be disinfected. All surfaces to be exposed to potable water shall be swabbed or sprayed with a one percent sodium hypochlorite solution.

E. Connections using Solid Sleeves: Where connections are shown on the Drawings using solid sleeves, the Contractor shall furnish materials and labor necessary to make the connection to the pipe line including cutting, excavation and backfill.

F. Connections Using Couplings: Where connections are shown on the Drawings using couplings, the Contractor shall furnish materials and labor necessary to make the connection to the existing pipe line, including all necessary cutting, excavation and backfill.

3.03 THRUST RESTRAINT

A. Provide restraint at all points where hydraulic thrust may develop.

B. Retainer Glands: Provide retainer glands where shown on the Drawings. Retainer glands shall be installed in accordance with the manufacturer's recommendations, particularly, the required torque of the set screws. The Contractor shall furnish a torque wrench to verify the torque on all set screws which do not have inherent torque indicators.

C. Harnessing:

1. Provide harness rods only where specifically shown on the Drawings or directed by the City’s Authorized Representative.
2. Harness rods shall be manufactured in accordance with ASTM A36 and shall have an allowable tensile stress of no less than 22,000 psi. Harness rods shall be hot dip galvanized or field coated with bitumastic before backfilling.
3. Where possible, harness rods shall be installed through the mechanical joint bolt holes. Where it is not possible, provide 90 degree bend eye bolts.
4. Eye bolts shall be of the same diameter as specified in ANSI/AWWA C111/A21.11 for that pipe size. The eye shall be welded closed. Where eye

bolts are used in conjunction with harness rods, an appropriate size washer shall be utilized with a nut on each end of the harness rod. Eye bolts shall be of the same material and coating as the harness rods.

D. Thrust Collars: Collars shall be constructed as shown on the Drawings.

E. Concrete Blocking

1. Provide concrete blocking for all bends, tees, valves, and other points where thrust may develop, except where other exclusive means of thrust restraint are specifically shown on the Drawings.
2. Concrete shall be as specified in Section 03301, Concrete and Reinforcing Steel.
3. Form and pour concrete blocking at fittings as shown on the Drawings and as directed by the City's Authorized Representative. Pour blocking against undisturbed earth. Increase dimensions when required by over excavation.

3.04 INSPECTION AND TESTING

A. All sections of the water main shall be hydrostatically pressure tested in accordance with AWWA C600 and these Specifications. A section of main will be considered ready for testing after completion of all thrust restraint and backfilling.

B. Water used for flushing and testing mains and other construction purposes will be made available to the Contractor as specified in Section 01040.

C. Each segment of water main between main valves shall be tested individually.

D. Test Preparation:

1. For water mains less than 24-inches in diameter, flush sections thoroughly at flow velocities, greater than 2.5 feet per second, adequate to remove debris from pipe and valve seats. For water mains 24-inches in diameter and larger, the main shall be carefully swept clean, and mopped if directed by the City's Authorized Representative. Partially open valves to allow the water to flush the valve seat.
2. Partially operate valves and hydrants to clean out seats.
3. Provide temporary blocking, bulkheads, flanges and plugs as necessary, to assure all new pipes, valves and appurtenances will be pressure tested.
4. Before applying test pressure, air shall be completely expelled from the pipeline and all appurtenances. Insert corporation stops at high points to expel air as main is filled with water as necessary to supplement automatic air valves. Corporation stops shall be constructed with a meter box as shown on the Drawings.
5. Fill pipeline slowly with water. Provide a suitable pump with an accurate

water meter to pump the line to the specified pressure.

6. The differential pressure across a valve or hydrant shall equal the maximum possible, but not exceed the rated working pressure. Where necessary, provide temporary backpressure to meet the differential pressure restrictions.
7. Valves shall not be operated in either the opening or closing direction at differential pressures above the rated pressure.

E. Test Pressure: Test the pipeline for whichever is the greater of either a minimum of 150 psi or 1.5 times the working pressure (measured at the lowest point for at least two hours). Maintain the test pressure within 5 psi of the specified test pressure for the test duration. Should the pressure drop more than 5 psi at any time during the test period, the pressure shall be restored to the specified test pressure. Provide an accurate pressure gauge with graduation not greater than 5 psi. Testing shall be observed and verified by the City's Authorized Representative.

F. Testing Allowance:

1. Testing allowance shall be defined as the sum of the maximum quantity of makeup water that must be added into the pipeline undergoing hydrostatic pressure testing, or any valved section, in order to maintain pressure within 5 psi of the specified test pressure for the test duration plus water required to return line to test pressure at the end of the test. Leakage shall be the total cumulative amount measured on a water meter.
2. The City assumes no responsibility for leakage occurring through existing valves.

G. Test Results: No installed pipe shall be accepted if the quantity of makeup water exceeds the limits determined by the following formula:

$$L = \frac{SD\,(P)^{1/2}}{148{,}000}$$

Where: L = allowable leakage, in gallons per hour
S = length of pipe tested, in feet
D = nominal diameter of the pipe, in inches
P = average test pressure during the hydrostatic test, in pounds per square inch (gauge)

As determined under Section 5 of ANSI/AWWA C600.

H. If the water main section being tested contains lengths of various pipe diameters, the allowable leakage shall be the sum of the computed leakage for each diameter. The leakage test shall be repeated until the test section is accepted. All visible leaks shall be repaired regardless of leakage test results.

I. After a pipeline section has been accepted, relieve test pressure. Record type, size and location of all outlets on record drawings.

J. At the conclusion of the work, the Contractor shall thoroughly clean all new pipelines by flushing with water or other means to remove all dirt, stone, pieces of wood, or other material which may have entered the pipeline during the construction period.

K. The Contractor shall be responsible for legal disposal of all water used for flushing and testing.

L. The Contractor shall completely remove structures where indicated on the Drawings.

M. The Contractor shall be responsible for coordinating with the City's Authorized Representative for all matters related to disinfection and bacteria testing. Disinfection and chlorination shall be performed by the Contractor and coordinated with Freddie Williams of the City of Atlanta (404-436-8949) or other designated City Authorized Representative. Bacteria lab testing shall be performed by the City of Atlanta.

3.05 ABANDONING EXISTING WATER MAINS AND VALVES

A. Abandon in place all existing water main segments and valves indicated on the Drawings to be abandoned or killed. Abandon existing water mains and valves after the new water main has been placed in service and all water main services have been transferred over to the new main.

B. The Contractor shall be responsible for uncovering and verifying the size and material of the existing main to be abandoned and cut and plugged.

C. Abandoned water mains 12" and larger shall be filled with flowable fill or grout. The Contractor shall provide pumping quantities for each run of fill.

D. The Contractor shall abandon existing structures as shown on the Drawings. The Contractor shall remove the existing manhole frames and covers and deliver them to the Owner's pipe yard. The existing structures shall be demolished to a minimum depth of 3-feet below existing or finished grade, whichever is lower.

E. Cutting and Plugging Main: Disconnect existing main by sawing or cutting and removing a segment of existing pipe where cutting and capping or plugging is shown on the Drawings or as directed by the City's Authorized Representative.

1. Provide a watertight pipe cap or plug and a concrete deadman for restraint to seal off existing mains indicated to remain in service.
2. Seal ends of mains to be abandoned with a pipe cap, plug or masonry plug.

F. Valves: Pavement shall be saw cut and removed from around valve box. The direction of the pavement cuts shall be parallel and perpendicular to the direction of the traffic. Size of saw cut shall be 18-inches x 18-inches (maximum).

1. Remove all valve covers, valve boxes and extension stems from valves on mains to be abandoned/killed. Valves shall remain in place with concrete encasement over the operating nut. Deliver all valve covers, valve boxes and extension stems to the Owner's storage yard.
2. Backfill excavations with suitable material and compact to a minimum or 95% compaction with 98% compaction required under structures and roadways. Install 6-inch graded aggregate base and repave area as required and as directed by the City's Authorized Representative.

+ + + END OF SECTION 02665 + + +

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SECTION 02675
DISINFECTION OF WATER MAINS

PART 1 GENERAL

1.01 SCOPE

The work covered by this Section includes furnishing all labor, equipment, materials, chemicals and incidentals required to disinfect all water mains installed under this contract in accordance with the procedures specified herein and as directed by the City's Authorized Representative.

1.02 SUBMITTALS

Submittals shall be made in accordance with the requirements of 01300 Submittals. In addition, the following specific information shall be provided:

1. Disinfection shall be performed by an owner-approved specialty contractor. Before disinfection is performed, the Contractor shall submit a written pipeline disinfection procedure for approval before being permitted to proceed with the disinfection. The plan shall cover the method and procedure proposed, necessary coordination, qualification of personnel performing the disinfection work, sequence of operations, the limits of the pipelines to be cleaned and disinfected, the positions of all valves, location of temporary bulkheads, materials and quantities of each to be used, equipment to be used, manner of filling and flushing the pipelines, chlorine injection points, sample points, bacteriological testing location and schedule, potable water source, method of metering the water if required, neutralization and disposal of wasted water, and all other methods and procedures to be followed in performing the cleaning and disinfection work. The plan shall also include the steps to be taken for the neutralization of the chlorinated water.
2. In addition, for mains 24-inches in diameter and larger, the Contractor shall submit the resume of a Disinfection Supervisor. The Disinfection Supervisor shall have demonstrated prior disinfection experience with at least 10 miles of 24-inch diameter or greater water transmission mains in the state of Georgia. Approval of the Disinfection Supervisor shall also include a 1 hour interview with the DWM.

1.03 QUALITY CONTROL

A. Reference Standards: Procedures for disinfecting water mains unless otherwise modified herein shall conform to the requirements of AWWA Standard C651, Disinfecting Water Mains.

B. Contractor shall notify federal, state, and local regulatory agencies to determine if any special procedures or permits are required for disposal of neutralized or diluted

chlorinated water from the final flushing of pipelines and to identify acceptable locations for disposal of the flushing water. All requirements and costs associated with notification and obtaining any discharge permits shall be the responsibility of the Contractor.

PART 2 PRODUCTS

DISINFECTION AGENT

The disinfection agent shall be free chlorine or chlorine compound.

PART 3 EXECUTION

3.01 DISINFECTION OF PIPELINE

A. After successfully pressure testing each pipeline section, disinfect in accordance with AWWA C651 for the continuous-feed method and these Specifications.

B. Chlorination:

1. Contractor shall meet the disinfection requirements of the current version of the Georgia Environmental Protection Division, Drinking Water Permitting & Engineering Program, Minimum Standards for Public Water Systems, or the requirements below, whichever are more stringent.
2. Contractor shall apply chlorine solution to achieve a concentration of at least 25 milligrams per liter free chlorine in new line. During disinfection, all valves and hydrants shall be operated to ensure that all appurtenances are disinfected. Retain chlorinated water for 24 hours. Water shall be supplied from a temporary source protected by appropriate backflow prevention devices. Backflow preventer must be approved by the DWM prior to connection. Chlorine shall be injected no more than 10 feet from the beginning of the new main.
3. Chlorine concentration shall be recorded at every outlet along the main at the beginning and end of the 24 hour period.
4. After 24 hours, all samples of water shall contain at least 10 milligrams per liter free chlorine. Re-chlorinate if required results are not obtained on all samples.
5. Final pipeline disinfection shall occur at the end of the construction period immediately prior to putting the main in service.
6. Main disinfection shall be performed and evaluated in sequential and contiguous pipe sections between in-line valves.

C. Disposal of Chlorinated Water: Reduce chlorine residual of disinfected water to less than 1 milligram per liter if discharged directly to Waters of the State or to less than 2 milligrams per liter if discharged onto ground prior to disposal. Treat water with sulfur dioxide or other reducing chemicals to neutralize the chlorine residual. Flush all lines until residual is equal to existing system. Disposal of water shall be in accordance with AWWA C651, Section 4. Contractor shall be responsible for any

state or local permits required for the disposal of flushing water.

D. Bacteriological Testing: After final flushing and before the water main is placed in service, the DWM shall collect samples from the main and deliver them to the DWM's designated laboratory for bacteriological testing. One set of samples shall be collected from every 1,200 feet of water main, plus one set from each end of main. Testing shall be performed by the DWM's water laboratory. If test results are not satisfactory, the Contractor shall re-chlorinate the mains until required results are obtained.

+ + + END OF SECTION 02675 + + +

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SECTION 02690
PIPE COUPLINGS

PART 1 GENERAL

1.01 SCOPE

A. The Contractor shall furnish labor, materials, equipment and incidentals required to install and test mechanical couplings, complete in place as shown on the Drawings and as specified herein.

B. Restrained pipe couplings shall be installed together and provide for a leak proof seal at the joint.

C. Sleeve type couplings shall be installed to join sections of buried pipe together where restraint is not required.

1.02 SUBMITTALS

A. Complete shop drawings and product data for the couplings shall be submitted in accordance with the requirements of 01300 Submittals.

B. In addition, the Contractor shall submit the following:

1. Certified dimensional drawings of all couplings.
2. Design calculations of each critical section of the coupling thickness, all sufficient to ascertain conformance of the coupling with these Specifications.
3. Material list and schedules which include and describe all materials to be utilized.

C. The Contractor shall furnish a certified affidavit of compliance for all couplings furnished under this Section, as specified and applicable in ANSI/AWWA C210, C213, and C219, respectively, and the following supplemental requirements:

1. Physical and chemical properties of all steel.
2. Hydrostatic test reports.

1.03 QUALITY CONTROL

Reference Standards: The Contractor shall comply with the applicable provisions and recommendations of the latest editions of the following standards, except as otherwise shown on the Drawings or specified herein.

1. ANSI/ASTM E165 – Standard Practice for Liquid Penetrate Inspection for General Industry
2. ANSI/AWS D1.1 - Structural Welding Code – Steel

3. ANSI/AWWA C200 - Steel Water Pipe 6 Inches and Larger
4. ANSI/AWWA C210 - Liquid Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines
5. ANSI/AWWA C213 - Fusion-Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines
6. ANSI/AWWA C219 - Bolted, Sleeve-Type Couplings for Plain-End Pipe
7. ANSI/AWWA C227 – Bolted Split Sleeve Restrained and Non Restrained Couplings for Plain-End Pipe
8. ANSI C2000 - Classification System for Rubber Products in Automotive Applications
9. AWWA M11 - Steel Water Pipe – A Guide for Design and Installation

1.04 VERIFICATION

A. Inspection: All couplings shall be subject to inspection at the place of manufacture in accordance with the provisions of ANSI/AWWA C210, C213, and C219, respectively, as supplemented by the requirements herein. The Contractor shall notify the City's Authorized Representative in writing of the manufacturing starting date not less than 3 calendar days prior to the start of manufacture.

B. During the manufacture of the couplings, the City's Authorized Representative shall be given access to all areas where manufacturing is in process and shall be permitted to make all inspections necessary to confirm compliance with these Specifications.

C. Testing Requirements: One coupling of each diameter and pressure class shall be shop tested and certified to pressure of 500 psi.

PART 2 PRODUCTS

2.01 COUPLING SYSTEM DESIGN AND COMPONENT UNIT RESPONSIBILITY

A. Gaskets, bolts, nuts, glands, end rings and hardware for pipe couplings of all types shall be furnished by the pipe coupling manufacturer. Gaskets shall be designed for the coupling and appropriately sized to provide a watertight seal at the design pressure and temperature.
B. Gaskets, bolts, nuts, glands, end rings and hardware shall be shipped with the pipe coupling.

2.02 RESTRAINED COUPLINGS

A. General: Coupling shall be a bolted, split-sleeve type and consist of four basic components: one or two piece housing, gasket assembly, bolts and nuts and restraint rings.

B. Coupling Design:

1. Couplings shall be designed to perform under the most critical combination of internal pressure and external loads as determined by the design procedures per AWWA M11 and the requirements of these specifications.
2. Coupling Thickness for Internal Pressure: For resistance to internal pressure, the thickness of the steel coupling shall be as determined by the following formula:

$$t = \frac{P_w D_y}{2F_s}$$

Where: t = Steel coupling thickness, in.
P_w = Design working pressure, psi
D_y = Pipe outside diameter, in.
F_s = 50% of specified minimum yield point of the steel, psi

3. Couplings shall be designed for a working pressure of 250 psi.

C. Coupling Housing:

1. Material: Coupling shall be manufactured from ASTM A36 carbon steel.
2. Description: The coupling shall be of the split-sleeve type with a double arch cross section which closes around pipe ends with steel restraint rings affixed for pipe end restraint requirements.
3. As the coupling closes, it shall confine an elastomeric gasket beneath the arches of the sleeve to create a radial seal. The axial seal shall be effected at the sealing plates as the bolts pull the coupling snug around the pipe. The coupling shall permit angular pipe deflection.

D. Gaskets:

1. Material: Elastomers shall have properties as designated by ASTM C2000.
2. Description: The sealing members shall be comprised of two O-Ring gaskets and an elastomer-sealing pad bonded to the sealing plate. Internal pressure shall not be required to affect the seal.
3. Service: Gasket supplied shall be Isoprene or EPDM conforming to ASTM D2000 for water service within the temperature range of -20 to 180 degrees Fahrenheit.

E. Bolts, Studs and Nuts

1. Material: Carbon steel bolts shall conform to ASTM A325 with a minimum tensile strength equal to 105,000 psi. Carbon steel studs shall conform to ASTM A193 Grade B7 with a minimum tensile strength of 125,000 psi. Carbon steel nuts shall conform to ASTM A194 Grade 2H.
2. Installation: The coupling shall be assembled with bolts or studs at the closure plates and tightened to assure snug coupling contact with the pipe. Contractor

shall follow the manufacturer's written instructions regarding installation and tightening of bolts or studs.

F. Restraint Rings:

1. Material: Restraint rings shall be furnished with the couplings. Carbon steel restraint rings shall conform to ASTM A108 grade 1018.
2. Application: Coupling shall provide a fully restrained pipe joint and shall be Type FxF as manufactured by Depend-O-Lok. One restraint ring welded to each of the pipe ends shall fit inside the coupling shoulders and prevent the pipe ends from pulling out of the coupling. The Contractor shall follow the manufacturer's recommendation for the size and amount of welding required to attach the restraint rings.

G. Epoxy Coating: Fusion Bonded Epoxy Coatings: A fusion bonded epoxy coating shall be applied to the inside and outside of the coupling in conformance with ANSI/AWWA C213.

H. Insulation Sleeve: If required due to the material of the pipe to be joined, insulating sleeves shall be supplied to provide for electrical isolation between the two pipe ends. One sleeve shall be provided for each pipe end. The sleeve width shall be equal to ½ the coupling body width plus 1 inch. Thickness shall be $\frac{1}{8}$-inch. Each sleeve shall have a lip that extends down between the pipe ends that is $\frac{3}{8}$-inch thick by ¾ -inch deep, fully bonded to the sleeve. The insulating sleeve material shall be an EPDM elastomer suitable for potable water services.

I. Restrained couplings shall be Depend-O-Lok as manufactured by Victaulic Inc. or an approved equal.

2.03 SLEEVE TYPE COUPLINGS

A. Pipe coupling shall be a gasketed sleeve-type design and shall consist of a steel middle ring, two steel followers and two rubber compounded wedge section gaskets and track head bolts to compress the gaskets.

B. The middle ring and followers of the coupling shall be true circular sections free of irregularities, flat spots or surface defects. They shall be formed with the follower ring section of such design as to provide containment of the gasket.
C. Coupling shall be provided with gaskets of a composition suitable for exposure to the liquid within the pipe.

D. A fusion bonded epoxy coating shall be applied to the inside and outside of the coupling in conformance with ANSI/AWWA C213. Coating shall also be NSF-61 approved.

E. The coupling shall be provided with high strength low alloy steel bolts and hexagonal semi-finished nuts.

F. Coupling shall have a minimum working pressure rating of 250 psi.

G. Sleeve type couplings shall be Dresser Style 38, Smith Blair Style 411 or approved equal.

PART 3 EXECUTION

3.01 INSTALLATION OF RESTRAINED COUPLINGS

A. The Contractor shall inspect each coupling to insure that there are no damaged portions of the coupling. Particular attention should be paid to the sealing pad/sealing plate area.

B. Before installation of the couplings, each coupling shall be thoroughly cleaned of any foreign substance, which may have collected thereon and shall be kept clean at all times thereafter.

C. In no case shall the deflection in the joint between pipe ends exceed the maximum deflection recommended by the manufacturer. No joint shall be misfit any amount that will be detrimental to the strength and water tightness of this finished joint. The couplings shall be assembled and installed in conformity with the recommendations and instructions of the manufacturer.

D. Wrenches used shall be of a type and size recommended by the manufacturer. Bolts (or studs) shall be tightened so as to secure uniform gasket compression between the coupling and the body of the pipe with all bolts (or studs) tightened approximately the same amount. Final tightening shall be by hand (no air impact wrenches) and shall be complete when the coupling is in uniform contact around the circumference of the pipe.

3.02 INSTALLATION OF SLEEVE TYPE COUPLINGS

A. Sleeve type couplings shall not be installed in sections of restrained pipelines.

B. Sleeve type couplings shall be installed in non-restrained sections of pipelines. Sleeves shall only be installed in locations as directed by the City's Authorized Representative.

C. Prior to the installation of sleeve type couplings, the pipe ends shall be cleaned. A follower and gasket shall be slipped over each pipe and the middle ring shall be placed on the already laid pipe end until it is centered over the joint. The other pipe end shall be inserted into the middle ring and brought into proper position in relation to the pipe already laid. The gaskets and followers shall then be placed evenly and

firmly into the middle ring flares. After the bolts have been inserted and all nuts have been made finger tight, diametrically opposite nuts shall be progressively and uniformly tightened all around the joint by use of a torque wrench of the appropriate size and torque for the bolts.

3.03 TESTING

Pressure test the pipeline in accordance with Sections 02665, Water Mains and Accessories. There shall be no visible leakage allowed at any pipe joints that utilize couplings. Any visible leaks at coupled pipe joints shall be repaired to the satisfaction of the City's Authorized Representative.

3.04 CLEANING

Prior to acceptance of the work of this Section, thoroughly clean all installed materials, equipment and related areas.

+ + + END OF SECTION 02690 + + +

SECTION 02691
VALVES AND APPURTENANCES

PART 1 GENERAL

1.01 SCOPE

A. The Contractor shall furnish all labor, materials, equipment and incidentals required and install complete and ready for operation all valves and appurtenances as shown on the Drawings and as specified herein.

B. Items included under this Section are:

1. Gate Valves
2. Butterfly Valves
3. Insert Valves
4. Valve Boxes
5. Tapping Sleeves and Gate Valves
6. Meter Box Sampling Station
7. Flange Insulating Gasket Kits
8. Electronic Locating and Marking Systems

1.02 SUBMITTALS

Submittals shall be in compliance with the requirements of 01300 Submittals. In addition, the following specific information shall be provided:

1. Complete shop drawings of all valves and appurtenances

1. Manufacturer's certificate certifying that the products meet or exceed the specified requirements

1.03 QUALITY CONTROL

Reference Standards: The design, manufacturing and assembly of elements of the products herein specified shall comply with the applicable provisions and recommendations of the latest editions of the following standards, except as otherwise shown on the Drawings or otherwise specified.

2. ANSI/AWWA C504 – Rubber-Seated Butterfly Valves

2. ANSI/AWWA C509 – Resilient-Seated Gate Valves for Water Supply Service

3. ANSI/AWWA C515 – Reduced-Wall, Resilient-Seated Gate Valves for Water Supply Service.

4. ANSI/AWWA C550 – Protective Epoxy Interior Coatings for Valves and Hydrants.

5. ANSI/AWWA C600 - Installation of Ductile-Iron Water Mains and Their Appurtenances.

6. ANSI/NSF Standard 61 – Drinking Water System Components – Health Effects

1.04 DESCRIPTION OF SYSTEMS

All of the equipment and materials specified herein are intended to be standard for use in controlling the flow of water.

1.05 TOOLS

Special tools, if required for normal operation and maintenance shall be supplied with the equipment.

PART 2 PRODUCTS

2.01 MATERIALS AND EQUIPMENT

A. All valves and appurtenances shall be of the size shown on the Drawings and all equipment of the same type shall be from one manufacturer.

B. All valves and appurtenances shall have the name of the maker and the working pressure for which they are designed cast in raised letters upon some appropriate part of the body.

2.02 GATE VALVES (GV)

A. 20-Inches in Diameter and Smaller:

1. Gate valves shall be resilient seated type conforming to the requirements of

AWWA C509 or AWWA C515.

2. Valves shall have a minimum working pressure of 250 psi.

3. Valve manufacturer shall submit an affidavit to the City or City's Representative indicating valve compliance with all applicable AWWA standards.

4. Valves less than 4-inches in diameter shall have threaded ends. Larger valves shall be mechanical joint unless shown otherwise on the Drawings.

5. Valve shall be non-rising stem type with a 2-inch square operating nut and shall open right (clockwise).

6. All internal and external ferrous surfaces shall be coated with epoxy to a minimum thickness of 4 mils. The epoxy shall conform to ANSI/AWWA C550 and shall be applied electrostatically prior to assembly. Epoxy shall be NSF61 approved.

7. Valve shall have a ductile iron body, bonnet and stuffing box. All joints between valve parts, such as body and bonnet, bonnet and bonnet cover, shall be supplied with o-ring seals.

8. Valve wedges shall be symmetrical, made of ductile iron and totally encapsulated in rubber. Rubber shall be permanently bonded to the wedge per ASTM D429.

9. Valves shall be manufactured by American Flow Control, Mueller, or M & H Valve.

B. 24-Inches in Diameter and Larger:

1. Gate valves shall be resilient seated type conforming to the requirements of AWWA C509 or AWWA C515.

2. Valves shall have a minimum working pressure of 250 psi.

3. Valve manufacturer shall submit an affidavit to the City or City's Representative indicating valve compliance with all applicable AWWA standards.

4. Valves shall be designed for horizontal installation with tracks and rollers, bypass valves, and bevel gear type operator.

5. Valve ends shall be mechanical joint type except where restrained joint ends are shown. Flanged joints shall meet the requirements of ANSI B16.1, Class 125.

6. Valve shall be non-rising stem type with a 2-inch square operating nut and shall open right (clockwise).

7. All internal and external ferrous surfaces shall be coated with epoxy to a minimum thickness of 4 mils. The epoxy shall conform to ANSI/AWWA C550 and shall be applied electrostatically prior to assembly. Epoxy shall be NSF61 approved.

8. Valve shall have a ductile iron body, bonnet and stuffing box. All joints between valve parts, such as body and bonnet, bonnet and bonnet cover, shall be supplied with o-ring seals.

9. Valve wedge shall be symmetrical, made of ductile iron and totally encapsulated in rubber. Rubber shall be permanently bonded to the wedge per ASTM D429.

10. Valves shall be non-rising stem type with a 2-inch square operating nut and shall open right (clockwise).

11. Valves shall be manufactured by American Flow Control, Mueller, or M & H Valve.

2.03 BUTTERFLY VALVES (BV)

A. Class 150 Valves:

1. Class 150 butterfly valves shall be short body design and shall be designed, manufactured and tested in accordance with the requirements of ANSI/AWWA C504 for Class 150B butterfly valves.

2. Valve bodies shall be ductile iron conforming to ASTM A536, Grade 65-45-12 or ASTM A126, Grade B cast iron. Shafts shall be ASTM A276, Type 304 stainless steel, machined and polished. Valve discs shall be ductile iron, ASTM A536, Grade 65-45-12 or ASTM A126, Grade B cast iron.

3. The valve shall have a resilient seat.

B. Class 250 Valves:

1. Class 250 butterfly valves shall be short body design and shall be designed, manufactured, and tested in accordance with the requirements of ANSI/AWWA C504 for class 250B butterfly valves.

2. Valve bodies shall be ductile iron conforming to ASTM A536, Grade 65-45-12 or ASTM A126, Grade B cast iron. Shafts and shaft hardware shall be ASTM A564, Type 630 stainless steel, machined and polished. Valve discs shall be ductile iron, ASTM A536, Grade 65-45-12.

3. The valve shall have a resilient seat.

4. ANSI/AWWA C504 Section 5.1 testing requirements for class 250 valves shall be modified as follows:

   a. The leakage test shall be performed at a pressure of 250 psi.

   b. The hydrostatic test shall be performed at a pressure of 500 psi.

   c. Proof of design tests shall be performed and certification of such proof of design test shall be provided to the City or City's Representative.

C. 24-inch and larger valves shall have a resilient seat that is located either on the valve disc or in the valve body. The valve seat shall be fully field adjustable and field replaceable.

D. Valves shall be installed with the valve shafts horizontal. Valves and actuators shall have seals on all shafts and gaskets on valve actuator covers to prevent the entry of water. Actuator mounting brackets shall be totally enclosed and shall have gasket seals.

E. Actuators

1. Valves shall be equipped with traveling nut, self-locking type actuators designed, manufactured and tested in accordance with ANSI/AWWA C504. Actuators shall be capable of holding the valve disc in any position between full open and full closed without any movement or fluttering of the disc.

2. Actuators shall be furnished with fully adjustable mechanical stop-limiting devices to prevent over travel of the valve disc in the open and closed positions. Actuators that utilize the sides of the actuator housing to limit disc travel are unacceptable.

3. Valve actuators shall be capable of withstanding a minimum of 450 foot pounds of input torque in either the open or closed position without damage.

F. The valve actuator shall be factory mounted on the valve by the valve manufacturer and shipped to the project site as a complete operating unit. Valve shall be designed to open right (clockwise).

G. Valve ends shall be mechanical joint type, except where flanged or restrained joint ends are shown on the Drawings. Flange joints shall meet the requirements of ANSI B16.1, Class 125.

H. Butterfly valves shall be manufactured by Mueller, Pratt, M&H, Val-Matic, Rodney Hunt, or DeZurik.

2.04 BYPASS VALVES AND PIPING

Where shown on the Drawings, valves 24-inches in diameter and larger shall be installed

with bypass piping and valve as specified in the following table:

Valve Diameter (Inches)	Bypass Valve and Pipe Diameter (Inches)
24	4
30	4
36	6
42	6
48	8
54	8
60	10

2.05 INSERT VALVES (IV)

A. Insert valves shall be a resilient seat wedge gate valve. Valve design shall allow the valve to be installed in an existing pressurized pipeline.

B. The valve shall have a ductile iron body, bonnet and wedge suitable for a design working pressure of 250 psi. Valve shall meet the requirements of ANSI/AWWA C515. Ductile iron shall meet the requirements of ASTM A536, Grade 65-45-12.

C. Valves 12-inches and smaller shall be capable of working on cast iron or ductile iron, class A, B, C and D pipe diameters without changing either top or bottom portion of the split valve assembly.

D. Resilient Wedge Gate Assembly

1. The construction of the resilient wedge shall comply with ANSI/AWWA C509.

2. The ductile iron wedge shall be fully encapsulated with EPDM rubber by a high pressure and high temperature compression or injection mold process. There shall be no exposed trim.

3. The resilient wedge shall seat on the valve body and not on the pipe to obtain the maximum seating and flow control results. The resilient wedge shall be totally independent of the carrier pipe. The resilient wedge shall not come into contact with the carrier pipe or depend on the carrier pipe to create a seal.

4. Pressure equalization on the downstream or upstream side of the closed wedge shall not be necessary to open the valve.

5. The wedge shall be symmetrical and seal equally well with flow in both directions.

6. The resilient wedge shall ride inside the body channels to maintain wedge alignment throughout its travel to achieve maximum fluid control regardless of high or low flow pressure or velocity. The resilient wedge shall have more support than the operating stem as the resilient wedge enters and exits the water way.

7. Valve shall have an oversized and unobstructed flow way.

E. Fusion Bonded Epoxy

1. The insert valve shall be fully epoxy coated on the interior and exterior. The fusion bonded coating shall be applied prior to assembly so that all bolt holes and body-to-bonnet flange surfaces are fully epoxy coated.

2. Valve shall be coated with a minimum of 8 mils epoxy in compliance with ANSI/AWWA C550 and certified to ANSI/NSF 61.

F. Gaskets and Triple O-ring Seals

1. The insert valve shall have triple o-ring stem seals. Two o-rings shall be located above and one o-ring located below the thrust collar.

2. The lower two o-rings shall provide a permanently sealed lubrication chamber. The upper o-ring shall insure that sand, dirt or grit cannot enter the valve to cause damage to the lower o-rings.

3. Side flange seals shall be of the o-ring type of either round, oval or rectangular cross-sectional shape.

G. Valve Stem and Thrust Washers

1. The gate valve stem and wedge nut shall be copper alloy in accordance with Section 4.4.5.1 of ANSI/AWWA C515

2. The stem shall have an integral thrust collar in accordance with Section 4.4.5.3 of ANSI/AWWA C515. Two piece stem collars are not acceptable. The wedge nut shall be independent of the wedge and shall be held in place on three sides by the wedge to prevent possible misalignment.

3. Two thrust washers shall be used One shall be located above the stem thrust collar and the other below the stem collar.

4. The stem shall be non-rising type with AWWA standard turns.

5. Valve operating nut shall be 2-inches square in accordance with ASTM A126, Class B. Valve shall open right (clockwise)

H. Hardware: Hardware materials shall develop the physical strength characteristics of ASTM A307 with dimensions conforming to ANSI B18.2.1

I. Split Restraint Devices: Split restraint devices shall be as specified in Section 02665.

J. The stuffing box, operating stem and resilient wedge (complete bonnet and moving parts) shall be removable and replaceable under pressure.

2.06 VALVE BOXES (VB) AND EXTENSION STEMS

A. All buried valves shall be equipped with valve boxes and lids unless access to the valve operator is provided by a manhole or vault.

B. Valve boxes shall be gray cast iron two-piece screw type with drop lids. Valve boxes shall be adjustable a minimum of 6-inches up or down from the nominal required cover over the pipe. Valve boxes shall have a five and one quarter (5-1/4) inch inside diameter. Valve boxes shall be of sufficient length that the bottom flange of the lower belled portion of the box is below the valve operating nut. Cast iron risers shall be provided as necessary. Valve boxes shall be model 8550 as manufactured by East Jordan Iron Works or equal.

C. Valve box lids shall be gray cast iron and shall have "WATER" cast into the top of the lid in ¾-inch (minimum) raised letters. Valve box lids shall weigh a minimum of 13 pounds. Valve box lids shall be model 6800 as manufactured by East Jordan Iron Works or equal.

D. Valve boxes, risers and lids shall be coated with black asphalt.

E. All valves shall be furnished with extension stems if operating nut is greater than four feet deep, to bring the operating nut to within 24-inches of the top of the valve box. Connection to the valve shall be with a wrench nut coupling and a set screw to secure the coupling to the valve's operating nut. The coupling and square wrench nut shall be welded to the extension stem. Extension stems shall be stainless steel and shall be furnished by the valve manufacturer. Extension stems shall be sized by the valve manufacturer to withstand the maximum valve operator output.

F. Where pavement exists, the box shall be adjusted to finished grade. When valves are located out of pavement, the box shall be adjusted to finished grade. A concrete pad shall be poured around the box as detailed on the Drawings.

G. Stem guides shall be fully adjustable stem guides with bronze bushings, and shall be furnished by the valve manufacturer. Stem guides shall be installed as shown on the Drawings and shall conform to the extension guide spacing requirements as specified in AWWA/ANSI C501.

2.07 WRENCHES

Four tee handled wrenches of suitable length shall be furnished to operate all valves.

2.08 VALVE MARKERS (VM)

For installed valves, the Contractor shall furnish and install a concrete valve marker as detailed on the Drawings when directed by the City or City's Representative, except on hydrant isolation valves. Valve markers shall be stamped "WATER".

2.09 TAPPING SLEEVES AND GATE VALVES (TS&V)

A. Tapping sleeves for mains 12-inches in diameter and smaller shall be ductile iron of the split-sleeve, mechanical joint type. Tapping sleeves shall be equal to Mueller H-615.

B. Tapping sleeves for mains larger than 12-inches shall be of all stainless steel construction.

C. The Contractor shall be responsible for determining the outside diameter of the pipe to be connected to prior to ordering the sleeve. The tapping sleeve shall be rated for 250 psi. working pressure

D. Valves shall be gate valves as specified in Paragraph 2.02 of this Section, with a flanged connection to the tapping sleeve and a mechanical joint connection to the branch pipe. The tapping sleeve shall be supplied by the valve manufacturer.

2.10 METER BOX SAMPLING STATION

A. Sampling station shall be meter box, retrofit style. Inlet and outlet connections shall be standard ¾-inch meter threads. The station shall consist of a standard meter resetter with the inlet leading up through the water system's residential meter, through a check valve and then out an outlet.

B. The sampling station shall consist of a ½-inch lockable shut off valve leading to a valve riser and a 3/8-inch male quick disconnect valve. The valve and riser shall be positioned directly in line with the meter setter to avoid turning of the entire sampling station when pushing the sampling rod down on the valve.

C. Sampling station parts shall be brass.

D. Sampling station shall be furnished with a plastic PVC push on cap to protect the quick disconnect valve when not in use. The cap shall be sealed watertight with an o-ring below the quick disconnect valve.

E. A portable sampling rod shall also be provided with each sampling station. The sampling rod shall be furnished with a female inlet which shall couple to the male quick coupling, and a quarter turn valve. The rod shall be brass and shall have two outlets, one for flushing and the other for sampling.

F. The meter box sampling station and portable sampling rod shall be equal to Kupferle Foundry Company, Model 94WM

2.11 FLANGE INSULATION GASKET KITS

A. Flange insulating gasket kits shall be installed as required to isolate dissimilar metals when connecting to pipelines of different metal composition.

B. Flange kits shall consist of insulation gaskets, insulating sleeves and washers, nuts and bolts.

2.12 ELECTRONIC LOCATING AND MARKING SYSTEMS

A. The Contractor shall furnish and install an electronic locating and marking system for all buried water main piping. System shall consist of electronic markers buried above the water main and stand-alone locators.

B. The marker shall contain an antenna or three orthogonal tuned circuits. Electronic ball markers shall be made of high strength 4 1/2-inch (maximum) diameter plastic. Electronic ball markers shall be 3M EMS model 1403-XR as manufactured by 3M, Omni Markers as manufactured by Tempo or approved equal.

C. Full range markers shall be equal to EMS model 1252 as manufactured by 3M or approved equal.

D. The Contractor shall also furnish two (2) 3M Dynatel locators. Locators shall be 3M model 2250M-ID/UU3W-RT or approved equal.

PART 3 EXECUTION

3.01 INSTALLATION

A. All valves and appurtenances shall be installed in the locations shown, true to alignment and rigidly supported. Any damage to the above items shall be repaired to the satisfaction of the City or City's Representative before they are installed.

B. Buried flanged or mechanical joints shall be made with cadmium plated bolts.

C. Prior to installation, valves shall be inspected for direction of opening clockwise, number of turns to open, freedom of operation, tightness of pressure containing bolting and test plugs, cleanliness of valve ports and especially seating surfaces, handling damage and cracks. Defective valves shall be corrected or held for inspection by the City or City's Representative. Valves shall be closed before being installed.

3.02 LAYING AND JOINTING VALVES AND APPURTENANCES

A. Valves, fittings, plugs, and caps shall be set and joined to the pipe in accordance with the manufacturer's recommendations for cleaning, laying and joining pipe. Twelve (12) inch and larger valves shall be provided with special support, such as crushed stone, concrete pads or a tamped trench bottom so that the pipe will not be required to support the weight of the valve.

B. In no case shall valves be used to bring misaligned pipe into alignment during installation. Pipe shall be supported in such a manner as to prevent stress on the valve.

C. A valve box shall be provided on each buried valve. The valve box shall be set over the center of the valve operating nut and plumbed. The box shall not transmit shock or stress to the valve. The bottom portion of the lower belled portion of the box shall be placed below the valve operating nut. The flange shall be set on brick, so arranged that the weight of the valve box and superimposed loads will bear on the base and not on the valve or pipe. The valve box cover shall be flush with the surrounding surface or such other level as directed by the City or City's Representative.

D. Underground valves shall be installed in vaults where indicated on the Drawings. The vault shall be precast or cast-in-place concrete as indicated on the Drawings. The valve box shall not transmit shock or stress to the valve and shall be as detailed on the Drawings. The valve vault cover shall be flush with the surface of the finished area or such other level as directed by the City or City's Representative.

E. Settlement Joints: The first joint on all pipe connected to and outside of a valve vault shall be designed to allow differential settlement. The following joints will be allowed for settlement:

1. Steel Pipe shall use a bolted, sleeve style coupling with joint harness as specified in AWWA M11.

2. Ductile iron pipe shall use standard gasketed joints if unrestrained, or mechanically restrained gasketed joints if required by thrust restraint design.

F. Pipe within 20 feet of each side of a direct-buried butterfly valve shall be protected from vertical deflection to protect proper function of butterfly valve. Vertical deflection of pipe shall be limited to butterfly valve manufacturer recommendation.

3.03 PRESSURE RELIEF VALVES

Pressure Relief Valves shall be installed in locations as directed by the City or City's Representative and as shown on the Drawings. Pressure Relief Valves shall not be connected to any sewer, submerged in any stream or creek, or be installed in any manner that will permit back siphonage into the water distribution system.

3.04 ELECTRONIC LOCATING AND MARKING SYSTEM

A. The Contractor shall install a ball marker at each bend, tee, valve and 500 feet of pipe length installed.

B. Ball markers shall be installed at a maximum depth of 5 feet.

C. Ball markers shall be secured to the pipe with cable ties as shown on the Drawings and shall be installed in accordance with the manufacturer's instructions.

D. Full range markers shall be installed on bends, tees, valves and pipe with 5-feet of cover or greater.

3.05 TESTING

After installation, all valves and appurtenances shall be tested at least 1 hour at 250 psi, unless a different test pressure is specified. If any joint proves to be defective, it shall be repaired to the satisfaction of the City or City's Representative.

+ + + END OF SECTION 15100 + + +

SECTION 02900
TREES, PLANTS AND GROUND COVERS

PART 1 GENERAL

1.01 SCOPE

A. The Contractor shall furnish and plant trees, plants and ground covers as shown on the Drawings and as specified herein.

B. Under this section, the Contractor shall also replace trees, plants and ground covers damaged by his operations. Existing trees, plants and ground covers damaged by the Contractor's operations shall be replaced as directed by the City or City's Representative, to the satisfaction of the City or City's Representative and at no additional cost to the Owner.

C. Work under this Section shall include, but not be limited to:

1. Soil preparation.
2. Planting mixes.
3. Mulch and planting accessories.
4. Furnishing and installing trees, plants and ground covers.
5. Existing tree care.
6. Filling around trees to remain.
7. Maintenance.

1.02 SUBMITTALS

Submittals shall be made in accordance with the requirements of 01300 Submittals. In addition, the following specific information shall be provided:

1. Mulch samples.
2. Planting accessories samples.
3. Certification for topsoil source and pH value; peat moss and plant fertilizer.
4. Material test reports.

5. Upon plant material acceptance, submit written instructions recommending procedures for maintenance of plant materials.

1.03 QUALITY CONTROL

A. Comply with requirements of Section 02000, Site Work

B. Plant names shall comply with "Standardized Plant Names" as adopted by the latest edition of the American Joint Committee of Horticultural Nomenclature. Names of varieties shall conform generally with names accepted by the nursery trade. Provide stock true to botanical name and legibly tagged.

C. Comply with sizing and grading standards of the latest edition of "American Standard for Nursery Stock". A plant shall be dimensioned as it stands in its natural position.

D. All plants shall be nursery grown under climatic conditions similar to those in the locality of the project for a minimum of 2 years.

E. Stock furnished shall be at least the minimum size as stock to be replaced. Larger stock is acceptable, at no additional cost, and providing that the larger plants will not be cut back to the existing plant size.

F. Provide "specimen" plants with height, shape and character of growth. Tag specimen trees or shrubs at the source of supply. The City or City's Representative will inspect specimen selections at the source of supply for suitability and adaptability to selected location. When specimen plants cannot be purchased locally, provide sufficient photographs of the proposed specimen plants for approval.

G. Plants may be inspected and approved at the place of growth, for compliance with specification requirements for quality, size, and variety. Such approval shall not impair the right of inspection and rejection upon delivery at the site or during the progress of the work.

H. Contractor shall provide and pay for material testing. Testing agency shall be acceptable to the City or City's Representative. Provide the following data:

1. Test representative material samples proposed for use.

2. Topsoil:

   a. pH factor.
   b. Mechanical analysis.
   c. Percentage of organic content.
   d. Recommendations on type and quantity of additives required to establish satisfactory pH factor and supply of nutrients to bring nutrients to satisfactory level for planting.

3. Peat Moss:

a. Loss of weight by ignition.
b. Moisture absorption capacity.

1.04 DELIVERY, STORAGE AND HANDLING

A. Deliver fertilizer materials in original, unopened, and undamaged containers showing weight, analysis, and name of manufacturer. Store materials in a manner to prevent wetting and deterioration.

B. Take all precautions customary in good trade practice in preparing plants for moving. Workmanship that fails to meet the highest standards will be rejected. Spray deciduous plants in foliage with an approved "Anti-Desiccant" immediately after digging to prevent dehydration. Dig, pack, transport, and handle plants with care to ensure protection against injury. Inspection certificates required by law shall accompany each shipment invoice or order to stock and on arrival, the certificate shall be submitted to the City or City's Representative.

C. Protect all plants from drying out. If plants cannot be planted immediately upon delivery, properly protect them with soil, wet peat moss, or in a manner acceptable to the City or City's Representative. Water heeled-in plantings daily. No plant shall be bound with rope or wire in a manner that could damage or break the branches.

D. Cover plants transported on open vehicles with a protective covering to prevent wind burn.

E. Provide dry, loose topsoil for planting bed mixes. Frozen or muddy topsoil is not acceptable.

1.05 PROJECT CONDITIONS

A. Notify City or City's Representative at least 7 working days prior to installation of plant material.

B. Protect existing utilities, paving, and other facilities from damage caused by landscaping operations.

C. Locate and protect existing irrigation system(s) during planting operations. Repair irrigation system components, damaged during planting operations, at Contractor's expense.

1.06 WARRANTY

A. Warrant plant material to remain alive and be in healthy condition for a period of 1

year after planting and acceptance. Inspection of plants will be made by the City or City's Representative at completion of planting.

B. Replace, in accordance with these specifications, all plants that are dead or, as determined by the City or City's Representative, are in an unhealthy or unsightly condition, and have lost their natural shape due to dead branches, or other causes due to the Contractor's negligence. The cost of such replacement is at Contractor's expense. Warrant all replacement plants for 1 year after installation.

C. Warranty shall not include damage or loss of trees, plants, or ground covers caused by fires, floods, freezing rains, lightning storms, or winds over 75 miles per hour, winter kill caused by extreme cold and severe winter conditions not typical of planting area; acts of vandalism or negligence on the part of the Owner.

D. Remove and immediately replace all plants, as determined by the City or City's Representative to be unsatisfactory during the initial planting installation.

PART 2 PRODUCTS

2.01 MATERIALS

A. Plants: Provide plants typical of their species or variety; with normal, densely-developed branches and vigorous, fibrous root systems. Provide only sound, healthy, vigorous plants free from defects, disfiguring knots, sunscald injuries, frost cracks, abrasions of the bark, plant diseases, insect eggs, borers, and all forms of infestation. All plants shall have a fully developed form without voids and open spaces. Plants held in storage will be rejected if they show signs of growth during storage.

1. Dig balled and burlapped plants with firm, natural balls of earth of sufficient diameter and depth to encompass the fibrous and feeding root system necessary for full recovery of the plant. Provide ball sizes complying with the latest edition of the "American Standard for Nursery Stock". Cracked or mushroomed balls are not acceptable.

2. Container-grown stock: Grown in a container for sufficient length of time for the root system to have developed to hold its soil together, firm and whole.

    a. No plants shall be loose in the container.
    b. Container stock shall not be pot bound.

3. Provide new tree species to match existing tree species. New species shall be provided with a single main trunk. Trees that have the main trunk forming a "Y" shape are not acceptable.

4. Plants planted in rows shall be matched in form.

5. Plants larger than those existing may be used when acceptable to the City or City's Representative. If the use of larger plants is acceptable, increase the spread of roots or root ball in proportion to the size of the plant.

6. No pruning wounds shall be present with a diameter of more than 1-inch and such wounds must show vigorous bark on all edges.

7. Shrubs and small plants shall meet the requirements for spread as follows:

    a. The measurements for height shall be taken from the ground level to the height of the top of the plant and not the longest branch.
    b. Single stemmed or thin plants will not be accepted.
    c. Side branches shall be generous, well-twigged, and the plant as a whole well-bushed to the ground.
    d. Plants shall be in a moist, vigorous condition, free from dead wood, bruises or other root or branch injuries.

2.02 ACCESSORIES

A. Topsoil for Planting Beds and Tree Pits: Fertile, friable, natural topsoil of loamy character, without admixture of subsoil material, obtained from a well-drained arable site, reasonably free from clay, lumps, coarse sands, stones, plants, roots, sticks, and other foreign materials, with acidity range of between pH 6.0 and 6.8.

1. Topsoil that has been stripped and stockpiled on site shall be the topsoil to be utilized on this project. Provide additional topsoil if necessary.

2. Provide topsoil free of substances harmful to the plants which will be grown in the soil. Provide 12-inches of topsoil in all plant beds and tree pits.

3. Planting mixture shall be composed of four (4) parts topsoil, two (2) parts peat moss, one (1) part sand and one (1) part well rotted manure, mixed together thoroughly, and worked into existing soil.

B. Peat Moss: Brown to black in color, weed and seed free granulated raw peat or baled peat, containing not more than 9% mineral on a dry basis. Provide ASTM D2607 sphagnum peat moss with a pH below 6.0 for ericaceous plants.

C. Fertilizer:

1. Plant Fertilizer Type "A": Commercial type approved by the City or City's Representative, containing 5% nitrogen, 10% phosphoric acid, and 5% potash by weight, 1/4 of nitrogen in the form of nitrates, 1/4 in form of ammonia salt and 1/2 in form of organic nitrogen.

2. Plant Fertilizer Type "B": Approved acid-base fertilizer.

D. Anti-Desiccant: Protective film emulsion providing a protective film over plant surfaces; permeable to permit transpiration. Mixed and applied in accordance with manufacturer's instructions.

E. Premium grade shredded pine bark ¾-inch to 1-1/2-inch diameter. Furnish in 3 cubic feet bags or bulk.

F. Water: Free of substances harmful to plant growth. Hoses or other methods of transportation shall be furnished by the Contractor.

G. Stakes for Staking: Hardwood, 2-inch x 2-inch x 8-feet long.

H. Stakes for Guying: Hardwood, 2-inch x 2-inch x 36-inches long.

I. Guying/Staking/Wire: No. 10 or 12, gage galvanized wire.

1. For large trees (4-inch caliper and greater) use turnbuckles and heavier gage wire as indicated below

   a. Stakes for Staking: Hardwood, 4-inches x 4-inches x 8-feet long.
   b. Guying/Staking/Wire: No. 6 or 8 gage galvanized wire.

2. Turnbuckles: Galvanized steel of size and gage required to provide tensile strength equal to that of the wire. Turnbuckle openings shall be at least 3-inches.

J. Staking and Guying Hose: Two ply, reinforced garden hose not less than ½-inch inside diameter.

K. Tree Wrap: Standard waterproofed tree wrapping paper, 2-1/2-inches wide, made of 2 layers of crepe kraft paper weighing not less than 30 lbs. per ream, cemented together with asphalt. Tree wrap shall be removed at 12 months after installation of plant material.

L. Twine: Two-ply jute material.

M. Soil Separator: Rot resistant polypropylene filter fabric, water permeable, and unaffected by freezing and thawing.

N. Drainage Tile: ASTM F405 corrugated polyethylene drainage tubing, perforated.

O. Drainage Fill: AASHTO M43 #6 (3/8-inch to ¾-inch) clean uniformly graded stone or gravel.

PART 3 EXECUTION

3.01 INSPECTION

Examine proposed planting areas and conditions of installation. Do not start planting work until unsatisfactory conditions are corrected.

3.02 CARE OF TREES TO REMAIN

A. Minor fills of 6-inches or less: Fill with topsoil; hand grade to required finish grade elevation.

B. Moderate fills of 12-inches or less: Place layer of ¾-inch to 1-1/2-inch stone or gravel on grade. Provide aggregate depth 1/2 of fill height, minimum of 3-inches. Cover drainage fill with polypropylene filter fabric or 1" thickness straw choke. Fill remaining depth with loose topsoil; hand grade to required finish grade elevations.

C. Deep fills over 12-inches: Place layer of ¾-inch to 1-1/2-inch stone or gravel on grade. Extend drainage fill to within 2-inch of required finish grade. Cover drainage fill with polypropylene filter fabric or 1-inch thickness straw choke. Fill remaining depth with loose topsoil; hand grade to required finish grade elevation. Provide tile drainage system and vents as indicated.

D. Deep fills over 18-inches: Place 4-inch depth of 1-inch to 2-inches stone or gravel fill on grade, extending three (3) feet beyond the outer branch drip line around tree branch perimeter. Cover drainage fill with polypropylene filter fabric or 1-inch thickness straw choke. Place 1-inch to 2-inches stone or gravel fill around tree trunk, extending to within 2-inches of required finish grade elevation. Fill remaining depth with loose topsoil; hand grade to required finish grade elevation. Do not place earth fill in contact with tree trunk, maintain 18-inches diameter of drainage fill exposed at finish grade.

3.03 PREPARATION

A. Time of Planting:

1. Evergreen Material: Plant evergreen materials between September 1 and November 1 or in spring before new growth begins. If project requirements require planting at other times, plants shall be sprayed with anti-desiccant prior to planting operations.

2. Deciduous Material: Plant deciduous materials in a dormant condition. If deciduous trees are planted in-leaf, they shall be sprayed with an anti-desiccant prior to planting operation.

3. Planting times other than those indicated shall be acceptable to the City or City's Representative.

B. Planting shall be performed only by experienced workmen familiar with planting procedures under the supervision of a qualified supervisor.

C. Locate plants as indicated or as approved in the field after staking by the Contractor. If obstructions are encountered that are not shown on the drawings, do not proceed with planting operations until alternate plant locations have been selected.

D. Excavate circular plant pits with vertical sides, except for plants specifically indicated to be planted in beds. Provide shrub pits at least 12-inches greater than the diameter of the root system and 24-inches greater for trees. Depth of pit shall accommodate the root system. Provide undisturbed tamped down topsoil to hold root ball at nursery grade as shown on the drawings. Remove excavated materials from the site.

E. Provide pre-mixed planting mixture for use around the balls and roots of the plants consisting of planting topsoil and 1/2 lb. plant fertilizer Type "A" for each cu. yd. of mixture.

F. Provide pre-mixed ground cover bed planting mixture consisting of 3 parts planting topsoil to 1 part peat moss and 1/2 lb. plant fertilizer Type "A" per cu. yd. Provide beds a minimum of 12-inches deep. If slopes are greater than 4 to 1 increase depth to 18-inches.

G. Provide pre-mixed planting mixture for use around the balls and roots of ericaceous plants consisting of 2 part planting topsoil to 1 part sphagnum peat moss and 1/2 lb. plant fertilizer Type "B" per cu. yd. of mixture.

3.04 INSTALLATION

A. Set plant material in the planting pit to proper grade and alignment. Set plants upright, plumb, and faced to give the best appearance or relationship to each other or adjacent structure. Set plant material 2-inches to 3-inches above the finish grade. No filling will be permitted around trunks or stems. Backfill the pit with planting mixture. Do not use frozen or muddy mixtures for backfilling. Form a ring of soil around the edge of each planting pit to retain water.

B. After balled and burlapped plants are set, muddle planting soil mixture around bases of balls and fill all voids. Remove all burlap, ropes, and wires from the tops of balls of trees and remove entirely from all other plant material.

C. Space ground cover plants in accordance with indicated dimensions. Adjust spacing as necessary to evenly fill planting bed with indicated quantity of plants. Plant to

within 12-inches of the trunks of trees and shrubs within planting bed and to within 6-inches of edge of bed.

D. Drain tile: The Contractor shall provide drainage tiles if he encounters standing water in planting pits or conditions warrant. Install drainage tile with perforations down and closed joints, firmly bedded in minimum 4-inch layer of granular fill material. Provide full bearing for each pipe section. Provide continuous slope in the direction of flow.

1. Provide collars and couplings for all in-line joints and elbows for all corners and changes in direction.

2. Provide unperforated run out pipe. Extend drainage tile to out fall indicated and make connection.

3. Obtain required inspections and perform testing before backfilling. Remove obstructions, replace damaged components, and retest system as required. Provide a satisfactory free flowing drainage tile system.

4. Place drainage fill over drain piping after satisfactory testing and acceptance. Compact drainage fill layers not exceeding 6" in loose depth. Exercise care to avoid damage or displacement of installed piping.

    a. Completely cover drain lines to width of at least 6-inches each side of pipe and above top of pipe to within 18-inches of finish grade.
    b. Provide soil separator over drainage fill prior to topsoil fill. Overlap a minimum of 6-inches.

5. Install topsoil fill over compacted drainage fill. Compact topsoil fill in layers not exceeding 6-inches in loose depth. Extend topsoil fill to indicated finish or existing grade elevations.

E. Mulching:

1. Mulch tree and shrub planting pits and shrub beds with required mulching material 3-inches deep immediately after planting. Thoroughly water mulched areas. After watering, rake mulch to provide a uniform finished surface.

2. Mulch ground cover beds with mulch 2-inches deep immediately after planting.

F. Wrapping, Guying and Staking:

1. Inspect trees for injury to trunks, evidence of insect infestation, and improper pruning before wrapping.

2. Wrap trunks of all trees spirally from bottom to top with specified tree wrap and secure in place.

    a. Overlap 1/2 the width of the tree wrap strip and cover the trunk from the ground to the height of the second branch.

    b. Secure tree wrap in place with twine wound spirally downward in opposite direction, tied around the tree in at least 3 places in addition to the top and bottom. Wrapping and twine to be removed 12 months after installation of plant material.

3. Staking/Guying:

    a. Stake/guy all trees immediately after lawn seeding or sodding operations and prior to acceptance. When high winds or other conditions which may affect tree survival or appearance occur, the City or City's Representative may require immediate staking/guying.
    b. Stake deciduous trees under 3-inches in caliper. Stake evergreen trees under 8-feet tall.
    c. Guy deciduous trees over 3-inches in caliper. Guy evergreen trees over 8-feet tall.

4. All work shall be acceptable to the City or City's Representative.

G. Pruning:

1. Prune branches of deciduous stock, after planting, to balance the loss of roots and preserve the natural character appropriate to the particular plant requirements. In general, remove 1/4 to 1/3 of the leaf bearing buds, proportion shall in all cases be acceptable to the City or City's Representative. Remove or cut back broken, damaged, and unsymmetrical growth of new wood.

2. Multiple leader plants: Preserve the leader which will best promote the symmetry of the plant. Cut branches flush with the trunk or main branch, at a point beyond a lateral shoot or bud at a distance of not less than 1/2 the diameter of the supporting branch. Make cut on an angle.

3. Prune evergreens only to remove broken or damaged branches.

H. Care of Existing Trees:

1. Selectively prune existing trees in designated areas, under City or City's Representative's direction. Remove sucker shoots, dead, rubbing, and damaged branching.

2. Fertilize designated existing trees with 2 to 3 lbs. of Type "A" plant fertilizer

per inch of trunk diameter, for trees less than 6-inches in diameter and 3 to 5 lbs. for trees greater than 6-inches in diameter.

a. Fertilize in early spring before growth begins or in late October.
b. Fertilize at 2-feet to 3-feet on center in a triangular pattern to a depth of 18-inches within the dripline.
c. Injection or drilling fertilization methods, when used, shall be acceptable subject to City or City's Representative's approval.

3. Water existing trees every 2 weeks until acceptance. Water thoroughly with a fine mist sprinkler head soaker hose or hose at a low flow rate over the entire drip line area as required to allow water to penetrate to a depth of 12-inches to 18-inches.

I. Tree Relocation:

1. Transplant trees designated for relocation to locations shown on the drawings. Prune, dig, ball and burlap, move and plant in accordance with specified tree planting requirements.

3.05 MAINTENANCE

A. Maintain plantings until completion and acceptance of the entire project.

B. Maintenance shall include pruning, cultivating, weeding, watering, and application of appropriate insecticides and fungicides necessary to maintain plants free of insects and disease.

1. Re-set settled plants to proper grade and position. Restore planting saucer and adjacent material and remove dead material.

2. Tighten and repair guy wires and stakes as required.

3. Remove tree wrapping and twine 12 months after installation of plant material.

4. Correct defective work as soon as possible after deficiencies become apparent and weather and season permit.

5. Water trees, plants, and ground cover beds within the first 24 hours of initial planting, and not less than twice per week until final acceptance.

3.06 ACCEPTANCE

A. Inspection to determine acceptance of planted areas will be made by the City or City's Representative, upon Contractor's request. Provide notification at least 10 working days before requested inspection date. Planted areas will be accepted

provided all requirements, including maintenance, have been complied with and plant materials are alive and in a healthy, vigorous condition.

B. Upon acceptance, the Owner will assume plant maintenance.

3.07 CLEANING

Perform cleaning during installation of the work and upon completion of the work. Remove from site all excess materials, soils, debris, and equipment. Repair damage resulting from planting operations.

+ + + END OF SECTION 02900 + + +

SECTION 02920
SITE RESTORATION

PART 1 GENERAL

1.01 SCOPE

A. The Contractor shall provide all, labor, materials, equipment and incidentals required for all site restoration and related operations necessary shown on the Drawings or specified in these Specifications.

B. This section includes disposition of materials and structures encountered in the Work, all cleanups and any other similar, incidental, or appurtenant operations which may be necessary to properly complete the Work.

1.02 SUBMITTALS

Submittals shall be made in accordance with the requirements of 01300 Submittals. In addition, the following specific information shall be provided:

1. The Contractor shall submit certificates of inspection as required by government authorities. The Contractor shall submit other data substantiating that materials comply with specified requirements.
2. The Contractor shall submit instructions recommending procedures to be established by the City for maintenance of site restoration work for one (1) full year.

1.03 QUALITY CONTROL

A. The Contractor shall ship site restoration materials with certificates of inspection required by authorities having jurisdiction. The Contractor shall comply with regulations applicable to site restoration materials.

B. If specified site restoration materials are not obtainable, the Contractor shall submit proof of non-availability to the City's Authorized Representative together with proposal for use of equivalent material.

1.04 SAFETY REQUIREMENTS

A. Hazards Control:

1. The Contractor shall store volatile wastes in covered metal containers, and remove from the site of the Work daily.
2. The Contractor shall prevent accumulation of wastes that create hazardous

conditions.

3. The Contractor shall provide adequate ventilation during use of volatile or noxious substances.

B. The Contractor shall conduct cleaning and disposal operations in compliance with local ordinances and environmental laws and regulations.

1. The Contractor shall not burn or bury rubbish and waste materials on the site of the Work.
2. The Contractor shall not dispose of volatile wastes such as mineral spirits, oil, or fuel in open drainage ditches or storm or sanitary drains.

1.05 DELIVERY

The Contractor shall deliver packaged materials in containers showing weight, analysis, and name of manufacturer. The Contractor shall protect materials from deterioration during delivery and while stored at the site of the Work.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 DISPOSITION OF MATERIALS AND STRUCTURES ENCOUNTERED IN THE WORK

A. Existing materials or structures that may be encountered (within the lines, grades, or trenching sections established for completion of the Work), if unsuitable or unacceptable to the City's Authorized Representative for use in the Work, and for which the disposition is not otherwise specified, shall either be disposed of by the Contractor or shall remain the property of the City as further provided in this section.

B. At the option of the City, any existing materials or structures of "value" encountered in the Work shall remain the property of the City. The term "value" shall be defined by the City.

C. Any existing materials or structures encountered in the Work, and determined not to be of "value" by the City, shall be legally disposed of by the Contractor.

3.02 JOB CONDITIONS

A. The Contractor shall determine the locations of underground utilities and perform Work in a manner which will avoid possible damage. The Contractor shall hand excavate, as required. The Contractor shall maintain grade stakes set by others until removal is mutually agreed upon by parties concerned.

B. All bare earth areas within the limit of work shall be grassed, mulched, or covered

with other plant material.

C. On a continuous basis, the Contractor shall maintain the site of the Work free from accumulations of waste, debris, and rubbish caused by his operations.

D. At completion of the Work, the Contractor shall remove waste materials, rubbish, tools, equipment, machinery, and surplus materials, and clean all sight-exposed surfaces. The Contractor shall leave the site of the Work clean and ready for occupancy or use.

E. The Contractor shall proceed with the complete site restoration work as rapidly as portions of the site of the Work become available, working within seasonal limitations for each kind of site restoration work required. The Contractor will not be allowed to postpone cleanup and seeding or sodding until the end of the Work.

F. When conditions detrimental to plant growth are encountered, such as rubble fill, adverse drainage conditions, or obstructions, the Contractor shall notify the City's Authorized Representative before planting.

G. The Contractor shall install materials during normal planting seasons for each type of site restoration work.

H. The Contractor may, at his option, employ additional measures (other than those specified) to prevent loss of, or damage to the Work resulting from the effects of wind and/or water. No additional compensation will be made for the employment of such additional measures.

3.03 CLEANUP

A. During site restoration work, the Contractor shall keep pavements clean and the site of the Work in an orderly condition.

B. The Contractor shall protect site restoration work and materials from damage due to site restoration operations, operations by other contractors, and trades and trespassers. The Contractor shall maintain protection during installation and maintenance periods. The Contractor shall treat, repair, or replace damaged site restoration work as directed by the City's Authorized Representative.

C. Immediately upon completion of any section of the Work and before payment therefore has been made, the Contractor shall remove from the site of the Work all construction equipment, temporary structures, and debris, and shall restore the site of the Work to a condition equal to or better than that which existed prior to construction. Waste materials shall be disposed of at locations satisfactory to the City or affected regulatory agencies.

D. The Contractor shall not remove barricades and warning and direction signs until

directed by the City's Authorized Representative.

E. After completion of all Work required by the Contract and before final payment has been made, the Contractor shall make a final cleanup of each separate part of the Work; shall restore all surfaces to a neat and orderly condition; and shall remove all construction equipment, tools, and supplies.

3.04 INSPECTION AND ACCEPTANCE

A. When site restoration work is completed, including maintenance, the City's Authorized Representative will, upon request, make an inspection to determine acceptability.

B. Where inspected by the City's Authorized Representative site restoration work does not comply with the requirements, the Contractor shall replace rejected work and continue specified maintenance until re-inspected by the City's Authorized Representative and found to be acceptable. The Contractor shall remove rejected plants and materials promptly and replace at his expense.

+ + + END OF SECTION 02920 + + +

SECTION 05120
STRUCTURAL STEEL

PART 1 GENERAL

1.01 SECTION INCLUDES

Requirements for providing all labor, supervision, materials, tools, equipment and facilities to perform all operations necessary for structural steel as shown and required by Contract Drawings and as specified herein.

1.02 QUALITY CONTROL

A. Reference Standards: The Contractor shall comply with the applicable provisions and recommendations of the latest editions of the following standards, except as otherwise shown on the Drawings or specified herein.

1. ASTM A36 – Standard Specification for Carbon Structural Steel
2. ASTM A48 – Standard Specification for Grey Iron Castings
3. ASTM A53 – Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated, Welded and Seamless
4. ASTM A123 – Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
5. ASTM A153 – Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
6. ASTM A167 – Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet and Strip
7. ASTM A276 – Standard Specification for Stainless Steel Bars and Shapes
8. ASTM A307 – Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength
9. ASTM B241 – Standard Specification for Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube
10. AWS Specifications for Arc Welding

B. Fabricator Qualifications: Engage a firm experienced in fabricating structural steel similar to that indicated for this Contract and with a record of successful in-service performance, as well as sufficient production capacity to fabricate structural steel without delaying the work. Submit such qualifications to the Construction Manager for review.

1. Fabricator shall be currently certified under the AISC Quality Certification Program for Structural Steel Fabricators and shall be designated an AISC Certified Fabricator, Category-Complex Buildings.

C. Professional Engineer Qualifications: A Professional Engineer licensed in the State of Georgia and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for projects with structural steel framing that are similar to that indicated for this Contract in material,

design, and extent.

D. Give advance notice to the Construction Manager before the start of structural steel fabrication at the mill or assembly at the shop. No material shall be rolled or work done before the Construction Manager has been notified.

E. Shop Welding: Comply with applicable provisions of AWS D1.1 and D1.5.

1. Present evidence that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone re-certification.

1.03 SUBMITTALS

A. Product data for each type of product specified.

B. Shop Drawings detailing fabrication of structural steel components.

1. Include details of cuts, connections, splices, camber, holes and other pertinent data. Submit calculations for the design of connection not shown on Contract Drawings.

2. Indicate shop welds by standard AWS symbols and show size, length, and type of each weld.

3. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify high-strength bolted slip-critical, direct-tension or bearing type connections.

C. Shop Drawings and calculations detailing the installation procedure including any specialized erection equipment.

D. Shop Drawings and calculations shall be signed and sealed by a Professional Engineer licensed in the State of New York who is responsible for their preparation.

E. Qualification data for firms and persons specified herein to demonstrate capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

F. Procedure for bolt installation

1.04 DELIVERABLES

A. Mill test reports signed by manufacturers certifying that structural steel products comply with specified ASTM requirements including chemical and physical properties

B. Certificate of Conformance signed by manufacturer certifying compliance with the applicable standards for the following products:

1. Bolts, nuts and washers, including mechanical properties and chemical analysis

2. Direct-tension indicators

3. Shear stud connectors

C. Welding inspection and test reports for production shop welding.

D. Inspection and test reports on the installation and testing of all high strength bolted connections.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver structural steel to the Work Site in such quantities and at such times to ensure continuity of installation.

B. Store materials to permit easy access for inspection and identification. Keep steel members off the ground by using pallets, platforms, or other supports. Protect steel members and packaged materials from erosion and deterioration. Cover and protect steel from snow, rain and ground splatter.

1. Store fasteners in a protected place. Clean and re-lubricate bolts and nuts that become dry or rusty before use.

C. Do not store materials on the structure in a manner that might cause distortion or damage to members or supporting structures. Repair or replace damaged materials or structures.

D. Use nylon slings or padded cables for handling galvanized material. Do not drop or drag galvanized material.

PART 2 PRODUCTS

2.01 GENERAL

A. Structural Steel Shapes, Plates and Bars

1. Carbon and High-Strength Low-Alloy Steel: ASTM A709, Grade 50

2. Members designated as “Fracture Critical Members” (FCM’s) shall conform to AREMA Eng Man regarding Fracture Critical Members for Zone 2, “Fracture Control Plan”.

3. High-Strength, Low-Alloy Columbium-Vanadium Steel: ASTM A572, Grade 50 where specifically required on the Contract Documents.

4. Fracture Critical Members included in ASTM A6 Groups 4 and 5 or plates exceeding 1-1/2-inches in thickness shall be subject to the requirements of AREMA Eng Man Chapter 15.

5. Threaded steel bar shall be ASTM A722.

B. Cold-Formed Structural Steel Tubing: ASTM A500, Grade B

C. Steel Pipe: ASTM A501

1. Finish: Black, except where indicated to be galvanized

D. Shear Connectors: ASTM A108, Grade 1015 through 1020, headed-stud type, cold-finished carbon steel, AWS D1.1 or D1.5, Type B, as applicable.

E. Anchor Bolts: ASTM A449

F. High-Strength Bolts shall conform to either A325 or ASTM A490, Type 1, as indicated on the Contract Drawings. Hex nuts shall conform to ASTM A563 Grade "DH" or better. Flat circular washers and square or rectangular beveled washers shall conform to ASTM F436. Where necessary, washer may be clipped on one side to a point not closer than 7/8 of a bolt diameter from the center of the washer. Unless otherwise specified herein, bolts shall be full-body bolts conforming to the dimensions for heavy hexagon structural bolts specified in ASME B18.2.1 with heavy hex nuts specified in ASME B18.2.2.

G. Direct-Tension Indicators: ASTM F959, Type 490, uncoated

H. Welding Electrodes: E70xx electrodes shall be used for all welds in accordance with AWS D1.1 or D1.5 requirements, as applicable.

I. Steel Shear Studs: Steel shear studs shall be solid flux filled, cold-finished carbon steel, conforming to ASTM A108.Anchor rods shall conform to ASTM F1554.

J. Zinc Coating: ASTM B695, Class 50 for threaded products.

K. Structural steel for temporary works (to be removed before completion of this contract) shall conform to ASTM A36 or ASTM A709, Grades 36, 50, or 50W.

2.02 GROUT

A. Non-Shrink Grout: Pre-mixed, non-metallic, non-corrosive, non-staining grout containing selected silica sands, Portland cement, shrinkage-compensating agents, plasticizing and water-reducing agents, complying with ASTM C1107, of consistency suitable for application and a 30-minute working time.

2.03 GALVANIZING

A. Hot-Dip Galvanized Finish: Refer to Section 05080.

PART 3 EXECUTION

3.01 FABRICATION

A. Fabricate and assemble structural steel in the shop to greatest extent possible.

Fabricate structural steel in accordance with AISC and AREMA Eng Man, as applicable, referenced in this Section and as indicated on the Shop Drawings.

1. Camber structural steel members where indicated.

2. Identify high-strength structural steel according to ASTM A6 and maintain markings until steel has been erected.

3. Mark and match-mark materials for field assembly.

4. Complete structural steel assemblies, including welding of units, before starting shop-priming operations.

5. Comply with fabrication tolerance limits of AISC and AREMA Eng Man, as applicable.

6. Finished members shall be true to line and free from twist, bends, and open joints.

B. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors in accordance with AWS D1.1, D1.5.

C. Holes: Provide holes required for securing other work to structural steel framing and for passage of other work through steel framing members, as shown on Shop Drawings.

1. Cut, drill, or punch holes perpendicular to metal surfaces. Do not flame-cut holes or enlarge holes by burning. Drill holes in bearing plates.

2. Weld threaded nuts to framing and other specialty items as indicated to receive other work.

D. All rolled material before being worked in any way shall be straight. If straightening or flattening is necessary, it shall be done by methods that shall not damage the materials. After punching and before assembling, the material shall again be straightened. Sharp kinks and bends may be cause for rejection.

E. Stiffeners and Web Plates

1. Stiffeners carrying stress shall be faced on the ends where the load is applied and brought to a true contact bearing with the flange; the other ends of the stiffeners shall be sheared square and brought to a tight fit with the flange. All other stiffeners shall be sheared square and brought to a tight fit with the flange to provide full bearing. Web splice plates and fillers under stiffeners shall be cut to fit within 1/8-inch of the flange on each end.

2. Stiffeners and splice plates shall not be crimped. Use filler plates as required. When bolts carrying computed stress pass through fillers, the fillers shall be extended and adequately bolted to distribute the stress uniformly.

F. Planing Sheared Edges: Sheared edges of material more than 5/8-inch in thickness and carrying calculated stress shall be planed to a depth of 3/16-inch. Coping shall be avoided where possible and where coping is necessary, the cut shall be filleted.

G. Bearing and Abutting Surfaces Planed: All abutting surfaces shall be accurately milled or faced to insure even bearing, unless otherwise indicated on the Contract Drawings.

H. Sole plates of plate girders shall have full contact with the girder flange. Sole plates shall be milled or press straightened.

3.02 SHOP WELDED CONNECTIONS

A. Welding: Welding will not be permitted for members or connections subjected to impact or fatigue loading unless otherwise indicated on the Contract Drawings. Shop welding of new structural steel parts is allowed. Perform field welding as shown specifically on Contract Drawings. Detail all structural welds on the Shop Drawings.

B. Perform all welding in accordance with AREMA standards for elevated, subway, and below ground structures, and in accordance with the AISC Specifications for Buildings. Use electric arc welding with a metallic electrode. Welder qualifications, welding procedures, methods, and inspection of welds shall be in accordance with AWS D1.1.

C. All welded joint procedures shall be pre-qualified as defined in AWS D1.1, Section 5, and thereby exempt from test or qualification.

D. In the absence of pre-qualified welding procedure, conduct tests as specified by AWS D1.1 to qualify the procedures.

E. For welding FCM's conform to AWS D1.5, Section 12, "Fracture Control Plan" and AREMA.

F. Assemble and weld built-up sections by methods that will maintain true alignment of axes without warp.

3.04 SHOP PRIMING

B. Shop prime steel surfaces except the following:

1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2-inches.

2. Surfaces to be high-strength bolted with slip-critical connections

3. Galvanized surfaces

4. Surfaces to receive sprayed-on fireproofing, except that surfaces exposed to weather (ignoring fireproofing) shall be shop primed.

C. Surface Preparation: Clean surfaces to be painted. Remove loose rust, loose-mill scale, and spatter, slag, or flux deposits. Prepare surfaces in accordance with SSPC SP-3.

D. Priming: Immediately after surface preparation, apply primer according to manufacturer's instructions and at rate recommended by SSPC to provide a dry film thickness of not less than 1.5-mils. Use priming methods that result in full coverage of joints, corners, edges and exposed surfaces.

1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

2. Apply two coats of shop paint to inaccessible surfaces after assembly or erection. Change color of second coat to distinguish it from first.

E. Primers

1. All non-galvanized steel shall be primed.

2. Fabricator's standard lead- and chromate-free, non-asphaltic, rust-inhibiting primer complying with SSPC PS Guide 7.00. Primer shall be compatible with sprayed fire-resistive coating to be applied in the field as specified in Sections 07810 and 07811.

F. Painting: See Section 09900.

3.05 SOURCE QUALITY CONTROL

B. Engage an independent testing and inspecting agency to perform shop inspections and tests and to prepare test reports.

1. Testing agency will conduct and interpret tests and state in each report whether test specimens comply with or deviate from requirements.

C. Correct deficiencies in, or remove and replace, structural steel that inspections and test reports indicate do not comply with specified requirements.

D. Shop-bolted connections shall be tested and inspected according to AREMA Eng Man and RCSC standards, as applicable.

E. All shop-welded connections shall be 100-percent visually inspected. In addition to visual inspection, shop-welded connections will be inspected and tested according to AWS D1.1 and D1.5.

1. The full penetration welds between the bottom flange and web of all plate girders shall be 100-percent tested by radiographic (X-ray) methods in accordance with ASTM E94.

2. All groove welds carrying live load stress in flanges of flexural members and in tension members shall be inspected by radiographic, ultrasonic or other non-destructive testing methods.

3. All shop welds not listed herein above shall be tested in accordance with the frequency stated in AWS D1.5, Section 6.7.1.2 using the methods described therein. A minimum of 10-percent of all shop welds shall be tested using either ASTM E709 or ASTM E164 at the option of the testing agency.

F. In addition to visual inspection, shop-welded shear connectors shall be inspected and tested in accordance with AWS D1.1 or D1.5, as applicable, for stud welding and as follows:

1. Bend tests shall be performed when visual inspections reveal either less than a continuous 360-degree flash or welding repairs to any shear connector.

2. Tests shall be conducted on additional shear connectors when weld fracture occurs on shear connectors already tested, according to requirements of AWS D1.1 or D1.5, as applicable.

3.06 ERECTION

B. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place, unless otherwise indicated.

C. Before erection proceeds, verify elevations of concrete and masonry bearing surfaces and locations of anchorages for compliance with requirements.

D. Set structural steel in locations and to elevations indicated and according to AREMA Eng Man and AISC specifications, as applicable.

E. Base and Bearing Plates: Clean concrete and masonry bearing surfaces of bond-reducing materials and roughen surfaces prior to setting base and bearing plates. Clean bottom surface of base and bearing plates.

1. Set base and bearing plates for structural members on wedges, shims, or setting nuts, as required.

2. Tighten anchor bolts after supported members have been positioned and plumbed. Do not remove wedges or shims.

3. Pack grout solidly between bearing surfaces and plates so no voids remain. Finish exposed surfaces, protect installed materials, and allow to cure.

a. Comply with manufacturer's instructions for pre-packaged grout materials.

F. Maintain erection tolerances of structural steel within AREMA Eng Man and AISC 303, as applicable.

G. Align and adjust various members forming part of complete frame or structure

before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.

1. Level and plumb individual members of structure.

H. Splice members only where indicated on Shop Drawings.

I. Do not enlarge unfair holes in members by burning or by using drift pins. Ream holes that must be enlarged to admit bolts.

3.07 BOLTED CONNECTIONS

A. Install and tighten high-strength bolts according to RCSC standards.

3.08 FIELD QUALITY CONTROL

A. Engage an independent testing and inspecting agency to perform field inspections and tests and to prepare test reports.

1. Testing agency will conduct and interpret tests and state in each report whether tested work complies with or deviates from requirements.

2. All reports shall be delivered to the Construction Manager for review.

B. Correct deficiencies in, or remove and replace, structural steel that inspections and test reports indicate do not comply with specified requirements.

C. Additional testing shall be performed to determine compliance of corrected work with specified requirements.

D. Field-bolted connections shall be tested and inspected according to AISC/RCSC standards.

3.09 CLEANING

A. Touchup Painting: Clean and touchup bolted connections, and abraded areas of shop paint on structural steel in accordance with SSPC SP-3 prior to re-applying the specified primers.

B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and apply galvanizing repair paint according to ASTM A780.

3.10 SEQUENCING

A. Supply anchorage items to be embedded in, or attached to, other construction without delaying the work. Provide setting diagrams, templates, instructions and directions, as required, for installation.

3.11 FIELD PAINTING

A. Exposed surfaces of structural steel shall receive intumescent fireproofing coating with a 2-hour rating. Refer to Section 07810.

END OF SECTION

SECTION 05500
MISCELLANEOUS METAL

PART 1 GENERAL

1.01 SCOPE

The Contractor shall furnish all labor, materials, equipment and incidentals required and install all miscellaneous metals as shown on the Drawings and specified herein. The miscellaneous metal items include, but are not limited to, the following:

1. Aluminum framing and platforms
2. Anchors or anchor bolts except those specified to be furnished with equipment.
3. Ladders and removable steps
4. Grating
4. Manhole frames and covers
5. Grates and frames
6. Manhole steps
7. Miscellaneous steel items

1.02 SUBMITTALS

Submittals shall be made in accordance with the requirements of 01300 Submittals. In addition, the following specific information shall be submitted:

A. Manufacturer's data on all materials listed in Part 2 of this Section.

B. Detail drawings showing sizes of members, method of assembly, anchorage, and connection other members shall be submitted to the City's Authorized Representative for review before fabrication.

C. Shop Drawings: Shop drawings for the fabrication and erection of all assemblies of miscellaneous metal work, which are not completely shown by manufacturer's data sheets.

D. Engineering Data:

1. Submit engineering data drawings for performance based items specified herein. Contractor is responsible for the structural design and supports for these items and shall show all components of the proposed system on these drawings.
2. These drawings must show all load conditions and design calculations relative to connections, fastening devices and anchorage, as well as size and gauge of members. Calculations and drawings must be prepared, signed, and sealed by a Professional Structural Engineer licensed in the State of Georgia.

E. Welding shall be indicated on shop drawings using AWS symbols and showing length, size, and spacing (if not continuous). Auxiliary views shall be shown to clarify all welding.

1.03 QUALITY CONTROL

A. Reference Standards: The Contractor shall comply with the applicable provisions and recommendations of the latest editions of the following standards, except as otherwise shown on the Drawings or specified herein.

1. ASTM A36 – Standard Specification for Carbon Structural Steel
2. ASTM A48 – Standard Specification for Grey Iron Castings
3. ASTM A53 – Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated, Welded and Seamless
4. ASTM A123 – Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
5. ASTM A153 – Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
6. ASTM A167 – Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet and Strip
7. ASTM A276 – Standard Specification for Stainless Steel Bars and Shapes
8. ASTM A307 – Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength
9. ASTM B241 – Standard Specification for Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube
10. AWS Specifications for Arc Welding
11. Aluminum Design Manual 2010

B. Professional Engineer Qualifications: A Professional Engineer licensed in the State of Georgia and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for projects with structural framing that are similar to that indicated for this Contract in material, design, and extent.

1.04 COORDINATION

A. The work of this Section shall be completely coordinated with the work of other Sections.

B. Verify at the site both the dimensions and work of other trades adjoining items of work in this Section before fabrication and installation of items herein specified.

C. Furnish to the pertinent trades all items included under this Section that are to be built

into the work of other Sections.

1.05 FIELD MEASUREMENTS

Field measurements shall be taken at the site to verify or supplement indicated dimensions and to insure proper fitting of all items.

1.06 PRODUCT HANDLING

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

B. Delivery and storage: Deliver materials to the jobsite, and store in a safe dry place with all labels intact and legible at the time of installation.

C. Replacement: In the event of damage, immediately make all repairs and replacements necessary to the approval of the City's Authorized Representative and at no additional cost to the Owner.

1.06 WARRANTY

Provide a warranty against defective equipment and workmanship in accordance with the requirements of the Warranty Specification 01650.

PART 2 PRODUCTS

2.01 STEEL ITEMS

A. Miscellaneous steel shall be fabricated and installed in accordance with the Drawings and shall include: beams, angles, support brackets, splice plates, anchor bolts (except for equipment furnished in other Divisions of the specifications), lintels and any other miscellaneous steel called for on the Drawings and not otherwise specified.

B. Material shall be as noted on the Drawings.

1. Carbon and High-Strength Low-Alloy Steel: ASTM A709, Grade 50
2. Steel Plates, Shapes and Bars: ASTM A36.
3. Steel bearing, cross bar or grating frame: ASTM A36.
4. Filler Bar, Hot rolled carbon steel or strip: ASTM A1011.
5. Cross Rod, carbon steel wire rods: ASTM A510 except that permissible tolerance on diameter of coarse round wire shall be P/M 0.005-inch.
6. Carbon and High-Strength Low-Alloy Steel: ASTM A709, Grade 50
7. Steel Plates, Shapes and Bars: ASTM A36.

8. Steel bearing, cross bar or grating frame: ASTM A36.
9. Filler Bar, Hot rolled carbon steel or strip: ASTM A1011.
10. Cross Rod, carbon steel wire rods: ASTM A510 except that permissible tolerance on diameter of coarse round wire shall be P/M 0.005-inch.
11. Steel Pipe: ASTM A53, type and grade as selected by fabricator and as required for design loading; black finish unless galvanizing is indicated; standard weight (Schedule 40), unless otherwise indicated.
12. Gray Iron Castings: ASTM A48, Class 30, unless another class is indicated or required by structural loads.
13. Malleable Iron Castings: ASTM A47, grade as selected by fabricator.

C. For fabrication of miscellaneous metal work, which will be exposed to view, use only materials which are smooth and free of surface blemishes including pitting, seam marks, roller marks, rolled trade names and roughness

D. Shop Paint: Shop prime all non-galvanized miscellaneous metal items using Ameron Prep 88 Primer, or approved equal.

E. Shop Paint: Shop prime all non-galvanized miscellaneous metal items using Ameron Prep 88 Primer, or approved equal

F. Bituminous Paint: Cold applied asphalt emulsion complying with ASTM D1187.

G. Galvanize Repair Coating: For touching up galvanized surfaces after erection, provide Z.R.C. Cold Galvanizing Compound made by Z.R.C. Chemical Products Company, or approved equal.

H. Grout: Non-shrink, non-metallic grout conforming to the requirements of Section 03600.

2.02 ANCHORS, BOLTS AND FASTENING DEVICES

A. Anchors, bolts and fastening devices shall be furnished as necessary for installation of the work of this Section.

B. The bolts used to attach the various members to the anchors shall be the sizes shown or required. Aluminum and stainless steel shall be attached to concrete by means of stainless steel machine bolts and iron or steel shall be attached with steel machine bolts unless otherwise specifically noted.

C. For structural purposes, unless otherwise noted, expansion bolts shall be Wej-it "Ankr-Tite", Phillips Drill Co. "Wedge Anchors", or HILTI-HIT(C-100). When length of bolt is not called for on the Drawings, the length of bolt provided shall be sufficient to place the wedge portion of the bolt a minimum of 1-inch behind the reinforcing steel within the concrete.

D. Brackets, Flanges and Anchors: Cast or formed metal of the same type material and finish as supported rails, unless otherwise indicated.

E. Materials
   1. Concrete Inserts: Threaded or wedge type; galvanized ferrous castings, either malleable iron, ASTM A47, or cast steel, ASTM A27. Provide bolts, washers and shims as required, hot-dip galvanized, ASTM A153.
   2. Zinc-coated fasteners for exterior use or where built into exterior walls. Select fasteners for the type, grade and class required.
   3. Bolts and Nuts: Regular hexagon head type, ASTM A307, Grade A.
   4. Anchor Bolts: ASTM F1554, Grade 36.
   5. Lag Bolts: ASME B18.2.1.
   6. Machine Screws: ASME B18.6.3.
   7. Plain Washers: Round, carbon steel, ASME B18.22.1.
   8. Masonry Anchorage Devices: Expansion shields, FS A-A-1922.
   9. Lock Washers: Helical spring type carbon steel, ASME B18.21.1.

2.02 ALUMINUM ITEMS

A. Miscellaneous aluminum shapes and plates shall be fabricated as shown. Furnish all miscellaneous aluminum shown but not otherwise detailed. Structural shapes and extruded items shall conform to the detail dimensions on the Drawings within the tolerances published by the Aluminum Association.

   a. Aluminum for structural and rolled shapes shall be Aluminum Association alloy 6061-T6.
   b. Aluminum for extruded shapes shall be Aluminum Association alloy 6063-T6.
   c. Aluminum for pipe shall be Aluminum Association alloy 6063-T6.
   d. Aluminum for castings shall be Aluminum Association Alloy F-514, or approved equal.
   e. Anchor bolts and connection bolts for aluminum shall be stainless steel.

B. Aluminum in direct contact with dissimilar metals, concrete, or masonry shall be coated with a heavy-bodied bituminous paint or covered with non-absorptive coated with insulating tape or gasket.

C. Grating shall be aluminum as indicated in the drawing. Main bars shall be of the thickness and of the depth indicated in the drawings. Submit manufacturers load tables for grating selected for Engineer's approval.

D. Welding electrode for aluminum shall be ER4043 filler metal and shall conform to AWS D1.2.

2.03 STAINLESS STEEL

A. Stainless Steel. Unless otherwise designated or approved, use stainless steel alloy types as follows which conform to ASTM A167 and ASTM A276.

1. Stainless steel plates and bars shall be Type 316 or Type 317 unless otherwise noted.
2. Stainless steel anchor bolts shall be Type 316.
3. Stainless steel bolts, nuts and washers shall be Type 316.

2.04 GALVANIZING

A. All ferrous metals indicated on the Contract Drawings or in the Specifications to be galvanized, shall be cleaned and then hot-dipped galvanized after fabrication.

B. Cleaning: Thoroughly clean metal surfaces of all mill scale, rust, dirt, grease, oil, moisture and other contaminants prior to galvanizing.

C. Application: Hot-dip galvanizing shall be applied in accordance with ASTM A123, A153, and A924, as applicable. Minimum weight of galvanized coating shall be 2-ounces per square foot of surface.

D. Fabricate joints that will be exposed to the deluge system in a manner to exclude water or provide weep holes where water may accumulate.

E. All galvanized materials must be inspected for compliance with these specifications and marked with a stamp indicating the name of the galvanizer, the weight of the coating, and the appropriate ASTM number.

F. To minimize surface imperfection (e.g., flux inclusions), material to be galvanized shall be dipped into a solution of zinc ammonium chloride (pre-flux) immediately prior to galvanizing. The type of galvanizing process utilizing a flux blanket overlaying the molten zinc will not be permitted.

G. After galvanizing all materials not exposed to view must be chromated by dipping material in a 0.2 percent chromic acid solution.

H. Galvanized surfaces, where exposed to view, must have a smooth, level surface finish. Replace pieces that are not smooth and level surface finish.

I. Galvanized surfaces that are to be painted, shall be cleaned, prepared for painting, shop primed and shop painted.

2.05 MISCELLANEOUS ITEMS

A. Manhole Steps:

1. Manhole steps shall be made of a steel rod encapsulated in copolymer polypropylene and shall be model PS-1 PF as manufactured by M. A. Industries, Inc. or approved equal.

2. Manhole steps shall be installed at intervals as shown on the Drawings. Steps shall be as shown on the Drawings and shall have rod and pull ratings meeting OSHA standards.

B. Ladders:

1. Ladders shall be high strength 6061-T6 aluminum alloy and shall be fabricated to the required height as shown on the Drawings. Rung diameter shall be 1-inch minimum with 12-inches spacing between rungs and 18-inches between ladder rails. Ladder rungs shall have slip resistant surface. Ladders shall have a minimum of 3 pairs of brackets for wall attachment.
2. Ladders shall meet the requirements of OSHA and ANSI standards.
3. Ladders shall be furnished with safety posts to allow for a hand-hold when entering or exiting vaults and other structures.
   a. Safety posts shall be 48-inches long when fully extended. The safety post shall have a telescoping tubular section that locks automatically when fully extended and a release lever to allow it to be returned to its lowered position.
   b. Safety post shall be manufactured of high strength square tubing.
   c. All hardware for mounting safety post to ladder shall be type 316 stainless steel and shall be furnished by the post manufacturer.
   d. Ladder safety post shall be preassembled by the manufacturer and shall be LadderUP Safety Post Model LU-4 as manufactured by the Bilco Company or approved equal.

C. Grating:

Gratings shall be constructed to conform to the following:

1. Exterior Platform grating shall support a live load of 100 psf.
2. Aluminum gratings complying with NAAMM MBG 531. Bars to have heavy duty serrated wearing surface.
3. Welded bar grating fabricated by press welding cross bars into rectangular bearing bars thus permanently locking the bars in place. Sizes and configuration as indicated on Contract Drawings.
4. All openings 2-inches or greater in diameter shall be banded with a bar of the same depth and thickness as the main bearing bars of the grating, or furnished with continuous cross bridges. Each cut bar shall be welded to the band if banding is utilized. The ends of all grating sections shall be likewise banded.
5. Clamps and bolts used for attaching grating to support members shall be stainless steel. All grating shall be clamped unless noted otherwise. Clamps shall be as recommended by the grating manufacturer.

D. Guardrail

1. Fabricate aluminum pipe and tube railings as shown, of sizes and thickness

indicated, but not less than required for design loading. Typical pipe railing shall be 1-1/2-inch nominal diameter, Schedule 80, unless otherwise indicated.

2. Interconnect railing members by butt-welding or welding with internal connectors.

a. At tee and cross intersections provide coped joints.

b. Form bends by use of prefabricated elbow fittings and radius bends or by bending pipe, at fabricator's option.

3. Form curves to produce uniform curvature; maintain cross-section of pipe throughout entire bend without deforming pipe. Close ends of pipe with 3/16-inch thick plate or by use of fabricated fittings.

4. Provide fittings and anchors for joining and anchoring railings. Furnish inserts and other concealed devices for connecting railings to concrete or wall construction indicated.

5. Guardrails and connection shall be designed to resist a linear force of 50-pounds per foot and a concentrated force of 200 pounds in accordance with Section 4.5.1, ASCE 7 applied to the top of the railing. Intermediate and bottom rails shall be designed for a concentrated load of 50 pounds.

E. Manhole Frames and Covers

1. Castings for manhole frames and covers and grates and frames shall conform to ASTM A48 for Class 30 gray iron castings. Castings shall be made accurately to the dimensions as shown on the Drawings. Castings for manhole frames and covers and frames and grates shall be fully interchangeable, sound, smooth, clean, and free from blisters or other defects. Defective castings which have been plugged or otherwise treated shall not be used. Castings shall be thoroughly cleaned and painted or coated with bituminous paint. Each casting shall have its actual weight in pounds stenciled or painted on it in white paint.
2. Manhole frames and covers and grates and frames shall be fitted before leaving the foundry.
3. Manhole frames and covers shall be as shown on the Drawings, and shall be as manufactured by East Jordan Iron Works, Neenah Foundry, or approved equal.
4. Manhole covers on sanitary sewer systems shall be solid type unless indicated otherwise on the Drawings.
5. Manhole covers on storm drainage systems shall be vented, unless indicated otherwise on the Drawings.
6. Watertight manhole frames and covers, where indicated on the Drawings, shall be bolt down type and shall be equipped with four 5/8-inch stainless steel bolts and o-ring gasket.
7. Manhole covers installed on air release and vacuum valve vaults shall be vented as specified in Section 15151 (Facility).
8. Grates and Frames: Grates and frames shall be as shown on the Drawings and shall be as manufactured by East Jordan Iron Works, Neenah Foundry or approved equal.

F. Open Grating Stairs

1. General: Construct open grating stairs to conform to sizes and arrangements shown; join pieces together by welding unless otherwise indicated. Provide complete stair assemblies including metal framing, railings, balusters, struts, clips, brackets, bearing plates and other components necessary for the support of stairs and as required to anchor and contain the stairs on the supporting structure.
2. Stair Framing: Fabricate stringers of aluminum channels, or plates, or a combination thereof, as shown. Provide closures for exposed ends of stringers. Bolt or weld hangers to strings and newels and framing members to strings and headers; fabricate and joins to that bolts, if used, do not appear on finish surfaces.
3. Metal open grating risers, treads and platforms: Shape treads and platforms to conform to configuration shown. Provide thicknesses of structural members indicated but not less than that required to support total design loading.
4. Design stair system to support design live load of 100 lbs./ft^2 or a concentrated load of 300 pounds at a location to cause greatest stress, whichever is greater. Design anchors, connections, support brackets and all other interfaces with the supporting structure.
5. Stair tread grating shall be fabricated from heavy duty serrated welded bar grating in sizes and configuration indicated on drawings supported by angles and channel members, or bolted and/or welded to structural stringers. Gratings shall be aluminum welded rectangular design with 1-1/2" x 3/16" bearing bars 1 3/16" on center and 1/4" cross bars at 4 inches on center. Provide standard cast nosing and kick plate for all stair tread grating.
6. Finish: manufacturer's standard mill finish.
7. Stair Railings and Handrails: Comply with applicable requirements specified for pipe railings and handrails, and as follows;
    a. Railings may be bent at corners, rail returns, and wall returns, instead of using prefabricated fittings.
    b. Connect railing posts to stair framing by direct welding, unless otherwise indicated.
    c. At stairway and landings provide pipe railings on all sides.

PART 3 EXECUTION

3.01 FABRICATION

A. All miscellaneous metal work shall be formed true to detail, with clean, straight, sharply defined profiles and smooth surfaces of uniform color and texture and free from defects

impairing strength or durability.

B. Connections and accessories shall be of sufficient strength to safely withstand stresses and strains to which they will be subjected. Steel accessories and connections to steel or cast iron shall be steel, unless otherwise specified. Threaded connections shall be made so that the threads are concealed by fitting.

C. Welded joints shall be rigid and continuously welded or spot welded as specified or shown. The face of welds shall be dressed flush and smooth. Exposed joints shall be close fitting and jointed where least conspicuous.

D. Welding of parts shall be in accordance with the Standard Code for Arc and Gas Welding in Building Construction of the AWS and shall only be done where shown, specified, or permitted by the City's Authorized Representative. All welding shall be done only by welders certified as to their ability to perform welding in accordance with the requirements of the AWS Code. Component parts of built-up members to be welded shall be adequately supported and clamped or held by other adequate means to hold the parts in proper relation for welding.

E. Welding of aluminum work shall be on the unexposed side as much as possible to prevent pitting or discoloration.

F. Welding of aluminum work shall be on the unexposed side as much as possible to prevent pitting or discoloration.

G. All aluminum finish exposed surfaces, except as specified below, shall have manufacturers' standard mill finish. Aluminum handrails shall be given an anodic oxide treatment in accordance with the Aluminum Association Specification AA C22 A41. A coating of methacrylate lacquer shall be applied to all aluminum before shipment from the factory

H. All aluminum finish exposed surfaces, except as specified below, shall have manufacturer's standard mill finish. A coating of methacrylate lacquer shall be applied to all aluminum before shipment from the factory.

I. Castings shall be thoroughly cleaned and will be subjected to a hammer inspection in the field by the City's Authorized Representative. All finished surfaces shown on the Drawings and/or specified shall be machined to a true plane surface and shall be true and seat at all points without rocking. Allowances shall be made in the patterns so that the thickness specified or shown shall not be reduced in obtaining finished surface. Castings will not be acceptable if the actual weight is less than 95 percent of the theoretical weight computed from the dimensions shown. The Contractor shall provide facilities for weighing castings in the presence of the City's Authorized Representative showing true weights certified by the supplier.

J. All steel finish work shall be thoroughly cleaned, by effective means, of all loose mill

scale, rust, and foreign matter before shipment and shall be given one shop coat of primer compatible with finish coats specified in Painting Section after fabrication but before shipping. Paint shall be applied to dry surfaces and shall be thoroughly and evenly spread and well worked into joints and other open spaces, Abrasions in the field shall be touched up with primer immediately after erection.

K. Galvanizing, where required, shall be the hot-dip zinc process after fabrication. Following all manufacturing operations, all items to be galvanized shall be thoroughly cleaned, pickled, fluxed, and completely immersed in a bath of molten zinc. The resulting coating shall be adherent and shall be the normal coating to be obtained by immersing the items in a bath of molten zinc and allowing them to remain in the batch until their temperature becomes the same as the bath. Coating shall be not less than 2 oz. per sq. ft. of surface. The galvanized coating shall be chromate treated.

3.02 INSTALLATION

A. Install all items furnished except items to be imbedded in concrete which shall be installed under Division 3. Items to be attached to concrete or masonry after such work is completed shall be installed in accordance with the details shown and in accordance with manufacturer's instructions and approved shop drawings. All dimensions shall be verified at the site before fabrication is started.

B. All steel surfaces to come in contact with exposed concrete or masonry shall receive a protective coating of an approved heavy bitumastic troweling mastic applied in accordance with the manufacturer's instructions prior to installation.

C. Where aluminum contacts a dissimilar metal, apply a heavy brush coat of zinc-chromate primer followed by two coats of aluminum metal and masonry paint to dissimilar metal.

D. Where aluminum contacts concrete, apply a heavy coat of approved alkali resistant paint to the concrete.

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SECTION 07141
COLD FLUID-APPLIED WATERPROOFING

PART 1 - GENERAL

1.1 DESCRIPTION

A. Requirements for providing all labor, supervision, materials, tools, and to install a permanent waterproofing system for the underground pump station structure, as specified herein.

1.2 SUMMARY

A. Section Includes:

1. Polyurethane waterproofing.

B. Related Requirements:

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference

1. Review waterproofing requirements including, but not limited to, the following:

a. Surface preparation specified in other Sections.
b. Minimum curing period.
c. Forecasted weather conditions.
d. Special details and sheet flashings.
e. Repairs.
f. Field quality control.

1.4 SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, and tested physical and performance properties of waterproofing.
2. Include manufacturer's written instructions for evaluating, preparing, and treating substrate.

B. Sustainable Design Submittals:

1. Product Certificates: For regional materials, indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include distance to Project and cost for each regional material.

C. Shop Drawings:

1. Show locations and extent of waterproofing.
2. Include details for substrate joints and cracks, sheet flashings, penetrations, inside and outside corners, tie-ins with adjoining waterproofing, and other termination conditions.
3. Include setting drawings showing layout, sizes, sections, profiles, and joint details of pedestal-supported concrete pavers.

D. Samples: For each exposed product and for each color and texture specified, including the following products:

1. Flashing sheet, 8 by 8 inches.
2. Membrane-reinforcing fabric, 8 by 8 inches .
3. Drainage panel, 4 by 4 inches.
4. Plaza-deck paver, 4 by 4 inches square in each color and texture required.
5. Paver pedestal assembly.

E. Qualification Data: For Installer.

F. Field quality-control reports.

G. Sample Warranties: For special warranties.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by waterproofing manufacturer.

B. Mockups: Build mockups to verify selections made under Sample submittals and to set quality standards for installation.

1. Build mockup for each typical waterproofing installation including accessories to demonstrate surface preparation, crack and joint treatments, inside and outside corner treatments, and protection.

a. Size: 100 sq. ft.

2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 FIELD CONDITIONS

A. Environmental Limitations: Apply waterproofing within the range of ambient and substrate temperatures recommended in writing by waterproofing manufacturer.

1. Do not apply waterproofing to a damp or wet substrate, when relative humidity exceeds 85 percent, or when temperatures are less than 5 deg F above dew point.
2. Do not apply waterproofing in snow, rain, fog or mist, or when such weather conditions are imminent during application and curing period.

B. Maintain adequate ventilation during application and curing of waterproofing materials.

1.7 WARRANTY

A. Manufacturer's Special Warranty: Manufacturer agrees to repair or replace waterproofing that fails in materials or workmanship within specified warranty period.

1. Warranty Period: ten (10) years from date of Substantial Completion.

B. Installer's Special Warranty: Specified form, signed by Installer, covering Work of this Section, for warranty period of two (2) years.

1. Warranty includes removing and reinstalling protection board, drainage panels, insulation, pedestals, and pavers on plaza decks.

PART 2 - PRODUCTS

2.1 SINGLE-COMPONENT POLYURETHANE WATERPROOFING

A. Single-Component, Reinforced, Modified Polyurethane Waterproofing: ASTM C836.

2.2 AUXILIARY MATERIALS

A. General: Provide auxiliary materials recommended in writing by waterproofing manufacturer for intended use and compatible with one another and with waterproofing.

1. Furnish liquid-type auxiliary materials that comply with VOC limits of authorities having jurisdiction.

B. Primer: Manufacturer's standard primer, sealer, or surface conditioner; factory-formulated.

C. Sheet Flashing: 50-mil-minimum, nonstaining, uncured sheet neoprene.

1. Adhesive: Manufacturer's recommended contact adhesive.

D. Membrane-Reinforcing Fabric: Manufacturer's recommended fiberglass mesh or polyester fabric, manufacturer's standard weight.

E. Joint Reinforcing Strip: Manufacturer's recommended fiberglass mesh or polyester fabric.

F. Joint Sealant: Multicomponent polyurethane sealant, compatible with waterproofing; ASTM C920, Type M, Class 25 or greater; Grade NS for sloping and vertical applications and Grade P for deck applications; Use NT exposure; and as recommended by manufacturer for substrate and joint conditions.

1. Backer Rod: Closed-cell polyethylene foam.

2.3 PROTECTION COURSE

A. Protection Course: ASTM D6506, semirigid sheets of fiberglass- or mineral-reinforced-asphaltic core, pressure laminated between two asphalt-saturated fibrous liners and as follows:
1. Thickness: 1/4 inch, nominal.
2. Adhesive: Rubber-based solvent type recommended in writing by waterproofing manufacturer.

2.4 MOLDED-SHEET DRAINAGE PANELS

A. Nonwoven-Geotextile-Faced, Molded-Sheet Drainage Panel with Polymeric Film: Composite subsurface drainage panel consisting of a studded, nonbiodegradable, molded-plastic-sheet drainage core; with a nonwoven, needle-punched geotextile facing with an apparent opening size not exceeding No. 70 sieve laminated to one side of the core and a polymeric film bonded to the other side; and with a vertical flow rate through the core of 9 to 21 gpm per ft.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.

1. Verify that concrete has cured and aged for minimum time period recommended in writing by waterproofing manufacturer.
2. Verify that substrate is visibly dry and within the moisture limits recommended in writing by manufacturer. Test for capillary moisture by plastic sheet method according to ASTM D4263.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean, prepare, and treat substrates according to manufacturer's written instructions. Provide clean, dust-free, and dry substrates for waterproofing application.

B. Mask off adjoining surfaces not receiving waterproofing to prevent spillage and overspray affecting other construction.

C. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, acid residues, and other penetrating contaminants or film-forming coatings from concrete.

D. Remove fins, ridges, and other projections, and fill honeycomb, aggregate pockets, holes, and other voids.

3.3 PREPARATION AT TERMINATIONS, PENETRATIONS, AND CORNERS

A. Prepare surfaces at terminations and penetrations through waterproofing and at expansion joints, drains, sleeves, and corners according to waterproofing manufacturer's written instructions and to recommendations in ASTM C898 and ASTM C1471.

B. Apply waterproofing in two separate applications, and embed a joint reinforcing strip in the first preparation coat when recommended by waterproofing manufacturer.

3.4 JOINT AND CRACK TREATMENT

A. Prepare, treat, rout, and fill joints and cracks in substrate according to waterproofing manufacturer's written instructions and to recommendations in ASTM C898 and ASTM C1471. Before coating surfaces, remove dust and dirt from joints and cracks according to ASTM D4258.

1. Comply with ASTM C1193 for joint-sealant installation.
2. Apply bond breaker on sealant surface, beneath preparation strip.
3. Prime substrate along each side of joint and apply a single thickness of preparation strip at least 6 inches wide along each side of joint. Apply waterproofing in two separate applications and embed a joint reinforcing strip in the first preparation coat.

B. Install sheet flashing and bond to deck and wall substrates where required according to waterproofing manufacturer's written instructions.

1. Extend sheet flashings for 4 inches onto perpendicular surfaces and items penetrating substrate.

3.5 WATERPROOFING APPLICATION

A. Apply waterproofing according to manufacturer's written instructions and to recommendations in ASTM C898 and ASTM C1471.

B. Start installing waterproofing in presence of manufacturer's technical representative.

C. Apply primer over prepared substrate unless otherwise instructed in writing by waterproofing manufacturer.

D. Unreinforced Waterproofing Applications: Mix materials and apply waterproofing by spray, roller, notched squeegee, trowel, or other application method suitable to slope of substrate.

1. Apply one or more coats of waterproofing to obtain a seamless membrane free of entrapped gases and pinholes, with a dry film thickness of 120 mils.
2. Apply waterproofing to prepared wall terminations and vertical surfaces.
3. Verify manufacturer's recommended wet film thickness of waterproofing every 100 sq. ft.

E. Reinforced Waterproofing Applications: Mix materials and apply waterproofing by roller, notched squeegee, trowel, or other suitable application method.

1. Apply first coat of waterproofing, embed membrane-reinforcing fabric, and apply second coat of waterproofing to completely saturate reinforcing fabric and to obtain a seamless reinforced membrane free of entrapped gases and pinholes, with an average dry film total thickness of 120 mils.
2. Apply reinforced waterproofing to prepared wall terminations and vertical surfaces.
3. Verify manufacturer's recommended wet film thickness of waterproofing every 100 sq. ft.

F. Cure waterproofing, taking care to prevent contamination and damage during application and curing.

G. Install protection course with butted joints over waterproofing before starting subsequent construction operations.

1. For horizontal applications, install protection course loose laid over fully cured membrane.
2. For vertical applications, set protection course in nominally cured membrane, which will act as an adhesive. If membrane cures before application of protection course, use adhesive.
3. Molded-sheet drainage panels may be used in place of a separate protection course for vertical applications when approved in writing by waterproofing manufacturer.

H. Blind Side Membrane to Sub Slab Waterproofing:
    1. Apply membrane on the prepared soil retention system so it extends just below the bottom of the planned mud slab.
    2. After the mud slab has been poured, install a minimum 3/4" fillet of liquid membrane at the intersection of the mud slab and blind side membrane.
    3. Install Waterproofing System on the mud slab and extend the waterproofing membrane at least 6" onto the blind side membrane.
    4. Apply liquid membrane at the termination of the waterproofing membrane and the blind side membrane and over any side laps within 6" of the corner.

3.6 MOLDED-SHEET DRAINAGE PANEL INSTALLATION

A. Place and secure molded-sheet drainage panels, with geotextile facing away from wall or deck substrate, according to manufacturer's written instructions. Use adhesive or another method that does not penetrate waterproofing. Lap edges and ends of geotextile to maintain continuity. Protect installed molded-sheet drainage panels during subsequent construction.

    1. For vertical applications, install thermal insulation before installing drainage panels.

3.7 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections:

    1. Testing agency shall verify thickness of waterproofing during application for each 600 sq. ft. of installed waterproofing or part thereof.
    2. Flood Testing: Flood test each deck area for leaks, according to procedures in ASTM D5957, after completing waterproofing but before placing overlaying construction. Install temporary containment assemblies, plug or dam drains, and flood with potable water.

        a. Flood to an average depth of 2-1/2 inches with a minimum depth of 1 inch and a maximum depth of 4 inches. Maintain 2 inches of clearance from top of sheet flashings.
        b. Flood each area for 24 hours.
        c. Testing agency shall observe flood testing and examine underside of decks and terminations for evidence of leaks during flood testing.
        d. After flood testing, repair leaks, repeat flood tests, and make further repairs until waterproofing installation is watertight.

B. Manufacturer's Field Service: Engage a site representative qualified by waterproofing membrane manufacturer to inspect substrate conditions, surface preparation, membrane application, flashings, protection, and drainage components and to furnish daily reports to Architect.

C. Waterproofing will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.8 PROTECTION

A. Do not permit foot or vehicular traffic on unprotected membrane.

B. Protect waterproofing from damage and wear during remainder of construction period.

C. Correct deficiencies in or remove waterproofing that does not comply with requirements; repair substrates, reapply waterproofing, and repair sheet flashings.

END OF SECTION

SECTION 08305
ACCESS HATCHES

PART 1 GENERAL

1.01 SCOPE

The Contractor shall furnish all labor, materials, equipment and incidentals required and install all flood resistant access hatches as shown on the Drawings and specified herein.

1.02 SUBMITTALS

Submittals shall be made in accordance with the requirements of 01300 Submittals. In addition, the following specific information shall be submitted:

1. Manufacturer's data on all materials listed in Part 2 of this Section.
2. Detail drawings showing sizes of members, method of assembly, anchorage, and connection to other members shall be submitted to the City or City's Representative for review before fabrication.
3. Structural calculations for hatches designed to support AASHTO H-20 wheel loading. Calculations shall be signed and sealed by a registered professional engineer.

1.03 QUALITY CONTROL

Reference Standards: The Contractor shall comply with the applicable provisions and recommendations of the latest editions of the following standards, except as otherwise shown on the Drawings or specified herein.

1. ASTM A36 – Standard Specification for Carbon Structural Steel
2. ASTM A48 – Standard Specification for Grey Iron Castings
3. ASTM A53 – Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated, Welded and Seamless
4. ASTM A123 – Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
5. ASTM A153 – Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
6. ASTM A167 – Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet and Strip
7. ASTM A276 – Standard Specification for Stainless Steel Bars and Shapes
8. ASTM A307 – Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength
9. AWS Specifications for Arc Welding

1.04 COORDINATION

A. The work of this Section shall be completely coordinated with the work of other Sections.

B. Verify at the site both the dimensions and work of other trades adjoining items of work in this Section before fabrication and installation of items herein specified.

C. Furnish to the pertinent trades all items included under this Section that are to be built into the work of other Sections.

1.05 FIELD MEASUREMENTS

Field measurements shall be taken at the site to verify or supplement indicated dimensions and to insure proper fitting of all items.

1.06 PRODUCT HANDLING

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

B. Delivery and storage: Deliver materials to the jobsite, and store in a safe dry place with all labels intact and legible at the time of installation.

C. Replacement: In the event of damage, immediately make all repairs and replacements necessary to the approval of the City or City's Representative and at no additional cost to the Owner.

1.06 WARRANTY

Provide a warranty against defective equipment and workmanship in accordance with the requirements of the Warranty Specification 01650.

PART 2 PRODUCTS

A. Access Hatches

1. General:
   a. Install Type I access hatches over spaces subject to vehicular traffic (i.e., streets and/or paved areas). Type I access hatches shall be designed to withstand AASHTO H-20 wheel loading.
   b. Install Type II access hatches over spaces intended to be dry such as pipe and valve vaults. Type II hatches shall be designed to support a live load of 300 psf.
   c. Install Type III access hatches over spaces intended to be wet such as wet

wells, liquid holding tanks, etc. Type III hatches shall be designed to support a live load of 150 psf.

2. Access hatches shall be single cover construction in size(s) as shown on the Drawings. Covers shall be aluminum ¼-inch diamond pattern plate. Channel frame shall be ¼-inch aluminum with full anchor flange around the perimeter.
3. Covers shall be reinforced to withstand a 10-foot head of water pressure acting on the topside without leaking during temporary flooding condition.
4. Covers shall be equipped with heavy forged brass hinges with stainless steel pins and shall pivot so cover does not protrude into the channel frame. Hinges shall be through bolted to the cover with tamper proof stainless steel lock bolts and shall be through bolted to the frame with stainless steel bolts and lock nuts.
5. Covers shall be equipped with compression springs enclosed in telescopic tubes. Upper tube shall be the outer tube to prevent accumulation of moisture, grit and debris inside the tube assembly. Lower tube shall interlock with a flanged support shoe fastened to a formed ¼-inch gusset support plate.
5. Covers shall be fitted with the required number and size of compression spring operators to afford ease of operation through the entire arc of opening and to act as a check in retarding downward motion when being closed. Covers shall be equipped with a hold-open arm which automatically locks the cover in the open position. A conveniently located handle shall release the covers for closing.
6. A stainless-steel snap lock with a fixed turn handle shall be mounted on the underside of the cover. A removable exterior latch shall be provided and the latch release shall be protected by a flush gasketed removable screw plug. Covers shall have a lift handle that is designed to be flush with the walking surface when not in use.
7. A 1-1/2-inch drain coupling shall be welded under the channel frame.
8. All hardware shall be 316 stainless steel.
9. Factory finish shall be mill finish aluminum with bituminous coating applied to the exterior of the frame.
10. Access hatches shall be equal to Type J or Type JD as manufactured by the Bilco Company.
11. Access hatches installed on air release and vacuum valve vaults shall be vented as specified in Section 15151.
12. Safety Guards - Hatches shall be provided with removable safety posts and chains along open sides of hatch. Provide cast-in concrete sockets for easy installation and removal of safety posts.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install all items furnished except items to be imbedded in concrete which shall be installed under Division 3. Items to be attached to concrete or masonry after such work is completed shall be installed in accordance with the details shown and in accordance with manufacturer's instructions and approved shop drawings. All

dimensions shall be verified at the site before fabrication is started.

B. Where aluminum contacts a dissimilar metal, apply a heavy brush coat of zinc-chromate primer followed by two coats of aluminum metal and masonry paint to dissimilar metal.

C. Where aluminum contacts concrete, apply a heavy coat of approved alkali resistant paint to the concrete.

+ + + END OF SECTION 08305 + + +

SECTION 11000
EQUIPMENT – GENERAL REQUIREMENTS

PART 1 GENERAL

1.01 GENERAL

A. The work of this Section covers the general clauses and requirements common to all process and mechanical equipment included in Division 11, inclusive, for the supply and installation of all process equipment and other works as specified herein and/or indicated on the Contract Drawings.

B. Provide all labour and materials, obtain all necessary permits and pay all fees as may be required.

C. Comply with all laws, ordinances, rules, regulations, codes, and order of all authorities having jurisdiction relating to this work.

D. All the equipment shall be UL listed and conform to the AIS requirement of the Consolidated Appropriations Act of 2014.

1.02 RELATED WORK

A. Concrete: Division 3

B. Metals: Division 5

C. Finishes: Division 9

D. Process Equipment: Division 11

E. Mechanical: Division 15

F. Electrical: Division 16

G. Controls: Division 17

1.03 COORDINATION

A. Fully coordinate the work of all related Specification Sections. Use equipment specifications together with all site work, concrete, building, electrical and control Specifications as necessary to produce a fully coordinated product meeting all necessary specifications.

1.04 SHOP DRAWINGS

A. Refer to Section 01300 for the general requirements for shop drawings.

B. In addition to the requirements of Section 01300-Submittals, submit the following specific information with shop drawings for each item of equipment specified in Division 11.

C. Assembly drawings showing details of connections and terminations of equipment for connection by others.

D. List of materials of construction, detailing the component parts and reference specifications (ASTM, ANSI, CSA, etc.).

E. Motor operating data, including motor and insulation ratings, start-up and operating current ratings, operating voltage and amperage tolerances, and description of construction, complete with illustrative drawings.

F. Gearbox and drive data, including AGMA/ABFMA ratings for components, materials of construction, tolerances, and description of construction.

G. Control schematics, text, and wiring diagrams as required to describe control operations.

H. Required ancillary services including, but not limited to electrical, non-potable water and drains.

I. Installation instructions indicating assembly and mounting requirements, alignment and assembly tolerances, and point of connection for ancillary services.

J. Start-up instructions including lubricant requirements, electrical requirements, etc.

K. Details of coating systems to be applied.

L. Details of insulation provided to prevent galvanic corrosion between mating surfaces constructed of dissimilar metals.

M. A copy of the Contract Document mechanical layout drawings, control diagrams, and process and instrumentation diagrams, with addenda updates, that apply to the equipment marked to indicate special changes necessary for the supplied equipment. If no changes are required, mark the drawing(s) “no changes required”.

N. A copy of the related specification section with addenda updates, and all referenced sections with addenda updates, with each paragraph check-marked to show specification compliance or marked to show deviations.

1.05 SHIPMENT, PROTECTION AND STORAGE

A. Provide all necessary equipment, materials and labour to off-load equipment at the Site. The methods employed for off- loading and handling must be to the satisfaction of the Consultant.

B. Prior to installation, protect all equipment stored on or off site against corrosion. Provide blanks, plugs, packing grease, special covering, moisture absorbing material, and/or other appurtenances necessary to preclude moisture from equipment interior spaces. Take special care with electrical and control panels.

C. During storage, turn shafts as required, run as necessary, and/or undertake all other special maintenance activities required to ensure that rotating equipment bearings are not subjected to excess wear.

D. Before taking delivery of equipment, examine the equipment for any damage. Rectify damage to the equipment to the satisfaction of the Consultant or remove damaged material from the Site.

E. If not required for immediate use, adequately store and protect all equipment against weather damage and theft. Store mechanical and electrical equipment as recommended by the manufacturer and to the satisfaction of the Consultant.

1.06 TEMPORARY USAGE

A. Temporary usage by the Owner of any process device, apparatus, machinery, or equipment prior to final inspections is not to be construed as acceptance.

1.07 STANDARDS

A. The materials and workmanship employed in the manufacture of all equipment shall conform to the applicable standards established by the ASTM, AWWA, ANSI, CEC, COSB and AIS requirement of the Consolidated Appropriations Act of 2014. American Standards shall take precedence over other Standards in the case of duplication or conflicting requirements.

B. All electrical motors and equipment shall be built to Cable Engineers Association (ICEA) and National Electrical Code (NEC), or NFPA 70 Standards with USA threads and bearings throughout and all motorized and electrical equipment shall be ASTM approved or supplied in accordance with the rules and regulations of the local inspection authority and subject to its approval.

1.08 UNIT RESPONSIBILITY

A. Where specified in the Contract Documents, unit responsibility requires that the specified equipment or package, complete with all accessories and appurtenances, be the end product of the Contractor from a single manufacturer, as specified.

B. Unless otherwise indicated in the Contract Documents, the Contractor shall obtain each unit from the responsible manufacturer of the system. The manufacturer shall furnish all components and accessories of the packaged units to enhance compatibility and ease of operation and maintenance. The Contractor is responsible to the City for providing the systems as specified herein.

1.09 FACTORY TESTING

A. Where witnessed factory testing is specified, 10 working days' notice of the date when equipment will be ready for testing. Confirmation of the test date and time is to be provided 3 working days in advance of the tests. Equipment is not to be delivered to the Site until factory testing has been satisfactorily completed.

B. When certified factory testing of the equipment or any component is specified, provide the Consultant with 2 copies of required certified test reports showing that the equipment complies with the Specification, before the equipment is delivered to the Site. Additional copies are required for the Maintenance Data Manuals.

1.10 SLEEVES

A. Install pipe sleeves at points where pipes pass through masonry, concrete or fire rated assemblies and as indicated on the Contract Drawings.

B. Use ductile-iron pipe or approved equal for all sleeves.

C. Sleeves shall have puddle flange when they are installed in foundation walls and/or floor slabs on grade.

D. Provide a maximum ¼" (6 mm) clearance all around between sleeve and non-insulated pipe or between sleeve and insulation.

E. Terminate sleeves flush with the surface of the concrete and masonry walls and concrete floors on grade and 1" (25 mm) above all other floors unless otherwise requested.

F. Fill voids around pipe as follows:

G. Caulk between the sleeve and pipe in foundations walls and below grade with waterproof, fire retardant non-hardening mastic or approved equal.

H. Where sleeves pass through walls or floors provide space for fire proofing. Where pipes/ducts pass through fire rated walls, floors and partitions, maintain fire rated integrity.

I. Ensure no contact between copper piping and ferrous sleeve.

J. As detailed on the Contract Drawings.

1.11 ESCUTCHEONS

A. Install escutcheons on pipes passing through walls, partitions, floors and ceilings.

B. Use chrome, plated brass or stainless steel 2-piece type escutcheons mechanically secured to the adjacent surface.

C. Outside diameter of escutcheons shall cover the opening of the sleeve.

D. The inside diameter of the escutcheon shall fit around the finished pipe.

1.12 SPARE PARTS

A. Furnish all spare parts as specified.

1.13 TAGGING INSTRUCTIONS

A. For equipment to be replaced, existing equipment tags are to be removed, protected and reused with existing equipment.

B. Tag loose items associated with a particular unit with the equipment number. Make tagging materials of aluminum or stainless steel (no plastic) and securely attach to each item.

1.14 AS-BUILT INFORMATION

A. Submit as-built information as per Division 1 – General Requirements.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Equipment lists included in the specifications may be in two parts:

.1 The "Design Standard" equipment item.

.2 "Acceptable Products" if specific items of equipment are specified or "Acceptable Manufacturers" if the equipment of a specific vendor is specified.

B. The design has been based on the Design Standard. Quality of workmanship, dimensions, operating protocol, basic materials, and ancillary services has been defined on this basis and incorporated in the design.

C. Listed Design Standard:

.1 Where Acceptable Products or Acceptable Manufacturers have been listed after a Design Standard, these products or ranges of products have been recognized by the Engineer as being capable of meeting the basic functional requirements of the equipment, but may not be the same as the Design Standard in detail.

.2 Provide all ancillary services, material upgrades, etc. as necessary to satisfy the quality requirements defined by the Design Standard.

.3 Make all minor changes in arrangement, piping and/or electrical connections, etc. as necessary to suit the requirements of the Acceptable Products or Acceptable Manufacturers.

D. No Listed Design Standards:

.1 Where Acceptable Products or Acceptable Manufacturers have been listed, but no Design Standard is listed, these products or ranges of products have been recognized by the Engineer as being capable of meeting the basic functional requirements of the equipment.

.2 Provide all ancillary services and minor modifications to arrangement, piping and/or electrical connections, etc. as necessary to suit the functional requirements of the equipment.

E. No additional payment will be made for revisions or alterations made to accommodate the equipment supplied.

2.02 FLANGES AND PIPE THREADS

A. Provide flanges on cast iron equipment and appurtenances that conform in dimension and drilling to ANSI B16.1, Class 125 and flanges on steel equipment and appurtenances that conform in dimension and drilling to ANSI B16.5, Class 150 unless otherwise specified.

B. Provide pipe threads that conform in dimension and limits of size to ANSI B1.1, coarse threaded series, Class 2 fit.

C. Unless otherwise specified, provide flange assembly bolts that are heavy pattern, hexagonal head, carbon steel machine bolts with heavy pattern, hot pressed, hexagonal nuts conforming to ANSI B18.2.1 and B18.2.2. Provide threads that conform to Unified Screw Threads, Standard Coarse Thread Series, Class 2A and 2B, ANSI B1.1. Where indicated, provide grade 316 stainless steel bolts of same specifications.

2.03 SMALL PIPING

A. Provide all small connecting pipework, fittings and valves whether shown on the Contract Drawings or not. Perform all such Work strictly in accordance with the instructions of the manufacturer whose equipment is being installed or connected, or with the requirements of the Contract Documents as they apply.

2.04 BEARINGS

A. Unless otherwise specified, provide oil or grease lubricated, ball or roller type equipment bearings, designed to withstand the stresses of the service specified. Rate each bearing in accordance with ABFMA Methods of Evaluating Load Ratings of Ball and Roller Bearings.

B. Provide equipment bearings that have a minimum B-10 rating life of 100,000 hours, as determined using the maximum equipment operating speed, unless otherwise specified.

C. Fit grease lubricated bearings, except those provided factory-sealed and lubricated, with easily accessible grease supply, flush, drain, and relief fittings. Use extension tubes where necessary. Provide standard hydraulic alemite type grease supply fittings.

D. Ensure that all grease fittings on the project are the same size, North American standard and compatible with Owner's standards.

E. Extend grease fittings to an accessible location.

F. Equip oil lubricated bearings with either a pressure lubricating system, or a separate oil reservoir type system. Provide each oil lubrication system to be of sufficient size to absorb the head energy generated in the bearing under a maximum ambient temperature of 104°F (40°C).

G. For pressure lubricating systems or oil reservoirs, provide a filler pipe and an external level indicator gauge. Provide a cap, complete with retention chain, for the oil inlet.

2.05 CRITICAL SPEED

A. For rotating equipment, ensure that operating speed is no more than 80 percent of the first critical speed unless otherwise specified.

2.06 V-BELT ASSEMBLIES

A. Select belt for not less than 150 percent of rated driver power. Where two sheave sizes are specified, ensure belt sizing is appropriate for both sets.

B. For explosion-proof equipment, use anti-static type belts.

C. Statically balance sheaves and bushings. Where sheaves and bushings are to operate at peripheral speeds greater than 5410 fpm (1650 m/min.), dynamically balance the assembly.

D. Separately mount sheaves on their bushings by means of three pull-up grub or cap tightening devices. Key seat bushings to the drive shaft.

2.07 COUPLINGS

A. For equipment with drives over 0.5 hp (0.375 kW) and less than 161 hp (120 kW), and where the driver is directly connected to the driven unit, provide a flexible coupling. Couplings shall accommodate angular misalignment, parallel misalignment, and end float and shall cushion shock loads and dampen torsional vibrations.

B. The flexible member of flexible couplings shall consist of a tire, with synthetic tension members bonded together in rubber. Attach the flexible member to flanges by means of clamping rings and cap screws, and attach the flanges to the stub shaft by means of taperlock bushings. Provide the equivalent of a shrunk-on fit. There will be no metal-to-metal contact.

C. For larger couplings, provide continuous sleeve flexible gear type, forged steel couplings.

D. Size each coupling as recommended by the coupling manufacturer for the specific application, considering applied power, speed of rotation, type of service, and other pertinent details.

2.08 GUARDS

A. On moving parts, provide sheet steel guards in accordance with workplace safety regulations. Fabricate of galvanized 14-gauge steel.

B. Paint guards after fabrication to the same standard as the attached equipment.

C. Guards shall be removable to facilitate maintenance of moving parts.

D. Make provision for extension of lubrication fittings through the guards.

2.09 GAUGE TAPS AND TEST PLUGS

A. Provide gauge taps on the suction and discharge side of pumps, blowers, and compressors.

B. Install gauges at each location indicated.

C. Tap and install plugs at locations indicated in the drawings and as required to practically complete testing of piping and equipment.

2.10 CONCRETE PADS

A. Coordinate location of concrete pads for equipment.

B. Ensure that, unless otherwise shown, concrete pads are a minimum of 6" (150 mm) above finished floor elevation and extend a minimum of 4" (100 mm) outside of the equipment base.

C. Ensure that pads drain way from base.

D. Ensure that conduit, drains, piping, etc. required for the equipment, rise through the pad.

2.11 EQUIPMENT BASES

A. Refer to Drawings and Manufacturer's shop drawings.

B. Structural Steel Bases

.1 Make bases of structural steel shapes with thickened steel pads for dowelling.

.2 Fabricate bases in a rectangular pattern. “T” and “L” patterns may be used where required to accommodate the equipment drive and accessories.

.3 Make perimeter members of structural beams with a minimum depth equal to 0.10 of the longest dimension of the base. Beam depth need not exceed 350 mm provided that the deflection and misalignment is kept within the manufacturer’s recommendations.

.4 Provide grout holes where vibration isolation is not specified.

C. Cast Iron Bases

.1 Terminate fasteners requiring connection to the base by nuts welded to the bottom of the base and plugged with cork, plastic plugs or grease, or acorn nuts.

2.12 MACHINERY BASES

A. Provide concrete bases to all machinery including pumps and floor mounted electrical panels. Bases to be as shown on the Drawings.

B. The final shape and dimensions of these bases and platforms, where not already finalized, will be determined by the Engineer after receipt of the equipment suppliers’ drawings. Sizes shown on the Drawings have been taken from preliminary details only. In general, the concrete bases are to be a minimum 2” (50 mm) longer than the supplied equipment base in each direction.

C. Concrete and grout for bases – as shown on the Drawings.

D. Unless otherwise instructed by the equipment supplier or shown on the Drawings, set equipment operating stands, etc. on 1” (25 mm) of cement grout, chamfered at the edges.

2.13 EQUIPMENT BASE TEMPLATES

A. For rotating equipment where shown in the drawings, or specifically called for in the specifications for that equipment, provide an equipment base template for location of equipment anchor bolts to be embedded in concrete.

B. Manufacture the equipment base template of structural steel with stops or holes placed for the anchor bolts.

C. Provide access holes for the placement of grout or concrete, as applicable.

2.14 EQUIPMENT INSTALLATION

A. Provide nameplate for all equipment in accordance with Section 15075.

B. Provide nameplates for all electrical and control panels supplied with equipment, in accordance with Section 15075 and Division 16 requirements.

2.15 GAUGE TAPS AND TEST PLUGS

A. Refer to Division 13 for general requirements.

B. Provide gauge taps on the suction and discharge side of pumps, blowers, and compressors. Taps shall be of threaded type and be furnished with nut operated plugs if not used for gauges.

C. Install gauges at each location indicated.

D. Tap and install plugs at locations indicated in the drawings and as required to practically complete testing of piping and equipment.

2.16 ANCHOR BOLTS

A. For all permanently or intermittently submerged services and for all exterior mounting locations, provide stainless steel anchor bolts conforming to ASTM A320.

B. For rotating equipment over 47 hp (35 kW), provide anchor bolts with sleeves and washers to permit adjustment during installation of the equipment.

C. Do not use drilled expansion or adhesive anchors for anchor bolts unless submitted and reviewed by the Consultant.

D. Design anchor bolts for lateral forces for both pullout and shear in accordance with the requirements of Division 5.

2.17 JACKING SCREWS

A. On all base mounted rotating equipment larger than 10 hp (7.5 kW), provide jacking screws for the driver and the driven end to facilitate alignment.

B. Provide jacking screws consisting of a ½" (12 mm) nut welded to the frame of the equipment with the hole in a horizontal plane.

C. Provide a ½" (12 mm) bolt that fits through the nut and extends to the mounting feet.

D. Two jacking screws are required at each end of the equipment, one parallel to the axis of the equipment and one perpendicular.

2.18 CAUTION SIGNS

A. For all rotating equipment drives provide caution signs.

B. For caution signs, use vinyl stick-on type decals placed onto clean, smooth surface of equipment to be posted.

C. Where insufficient space exists, use decal applied to galvanized mild steel, fibreglass, or plastic sheet fastened to equipment.

D. Provide signs that read "CAUTION - AUTOMATIC EQUIPMENT MAY START AT ANY TIME".

E. Letters to be 1” (25 mm) in height, red, on a yellow background.

F. Provide mounting posts and hardware and mount close to guarded moving parts.

2.19 ELECTRICAL MOTORS

A. Provide electrical actuators as specified in Division 11 and Division 16:

B. All motors under this contract shall be explosion proof and spark resistant construction rated for Class I Zone/Div. 1 Group D electrical classification and be UL and NEC approved.

2.20 ELECTRICAL, CONTROL AND INSTRUMENTATION

A. All instrumentation, control and electrical devices to be UL approved and to bear the approvals sticker.

B. All instrumentation, control and electrical devices to be in accordance with Division 16.

2.21 CONTROL DEVICES

A. For electrical control devices including switches, relays, and contacts, use heavy-duty industrial quality devices in accordance with Divisions 16 and 17.

B. Contacts which provide alarm, malfunction or control to external systems to be rated 10 amps continuous at 120 volts AC, except that pressure switches and temperature switches to be rated 5 amps continuous at 120 volts AC.

2.22 DISCONNECT

A. In accordance with Division 16.

2.23 CABLE

A. In accordance with Division 16.

2.24 CONDUIT

A. In accordance with Division 16.

PART 3 EXECUTION

3.01 DELIVERY, RECEIVING AND STORAGE EQUIPMENT

A. Arrange for delivery of all items of equipment to the Site of the work as required to meet the schedule.

B. Arrange for delivery of all anchor bolts, templates, embedded metals, and other materials required during the concreting placement and assembly of equipment.

C. Receive equipment at the Site, unload and examine it upon arrival for damage or defects and be responsible for its safekeeping, storage and installation. Immediately notify the Consultant and the supplier of any damages or defects in the equipment delivered.

D. Special measures shall be taken to ensure that electrical motors do not suffer from moisture, dust, dirt or mechanical damage if stored or installed and inactive.

E. Equipment storage, safekeeping and relocation of equipment from one area of the Site to another, for whatever reason, shall be the sole responsibility of the Contractor from the time of initial off-loading at the Site until the date of completion and acceptance by the Owner.

F. Installation of Equipment

.1 Furnish any appurtenant fittings and materials, not herein or elsewhere specifically mentioned or included, but necessary for the installation and operation of the equipment without additional payment.

.2 Provide all materials, labour and equipment to install complete and in full operation all the equipment specified herein.

.3 Install the equipment in strict accordance with the manufacturer's instructions and to the satisfaction of the Consultant.

.4 Install all instruments with an in-line isolating valve and a tee and valve on their sample line to allow easy isolation from the process for maintenance and to allow air or moisture removal.

.5 Be fully acquainted with all Work involved in the complete installation of all equipment. Misunderstandings in regard to the nature or amount of Work to be done will not constitute grounds for extra payment.

.6 Ensure that no unnecessary strain is introduced into equipment due to connections with piping or other appurtenances.

3.02 INSTALLATION

A. Install equipment in accordance with the relevant Sections of the Contract Documents, common millwright practices and the manufacturer's instructions (be responsible for obtaining such instructions and provide proof to the Contract Administrator).

B. Employ competent personnel familiar with the equipment to be installed. Install all process equipment under the supervision of certified millwright(s). Provide proof of certification.

C. Be responsible for coordinating all civil, mechanical, and electrical requirements with and between all trades and/or disciplines.

D. Install anchor bolts, frames and other items cast into concrete Work in accordance with the equipment Supplier's reviewed Shop Drawings, prior to the installation of the equipment.

E. Provide appurtenances, fittings, connecting piping, framing, accessories, anchor bolts, concrete and grout not herein or elsewhere specifically mentioned or included, but which is necessary for the installation, operation and testing of the equipment, without additional payment.

F. Supply and install all electrical power, control wiring and any other electrical requirements for all interconnection of package units where shown on the Contract Drawings. The City will not be responsible for the lack of coordination between the Contractor and his Suppliers or the Contractor and the Pre-purchased Equipment Vendors.

G. Erect equipment on foundations complete with suitably sized anchor bolts and take special care to ensure true alignment of all parts, especially pumps and electrical drives. Have qualified millwrights align the units after their sole plates have been shimmed at the anchor bolts. Recheck alignment after securing equipment to its foundation before grouting sole plates in place. Submit an alignment report for pumps, blowers, sludge collectors, clarifiers and fans.

H. Erect equipment level and plumb. The use of "pipe springing" and Dutchmen to correct misalignment and misfitting is not acceptable. In general, install equipment directly on machined bases without shims; provide at least 0.06” (1.5 mm) of brass shim stock under all driver mounting feet.

I. Install, calibrate and test equipment in accordance with the manufacturer's written instructions and, when specified in the Contract Documents, under the supervision of competent experts provided by the equipment manufacturer.

J. Provide all materials necessary to install equipment. Install piping and miscellaneous items supplied as part of the equipment including lubrication piping, pressure gauge tubing, thermocouple sensors and wiring, bubbler tubing, orifice meter tubing, pneumatic valve operator tubing, flexible tubing, for pressure switches, and grouting of base plates.

K. Manufacturer's instructions are the minimum standard for the installation.

3.03 TIME OF COMPLETION

A. Delay in delivery of equipment or installation materials does not relieve the Contractor of the responsibility to complete the Contract within the agreed date for contract completion.

3.04 CO-ORDINATION

A. Coordinate with all the Suppliers and Subcontractors installing equipment specified in other Divisions of the Contract Documents.

3.05 MANUFACTURERS SERVICES AND CERTIFICATION OF INSTALLATION

A. Provide for all necessary services and expenses of trained personnel representing the manufacturers of various pieces of specified equipment, to ensure correctness of installation and include any start-up costs required by suppliers necessary to ensure satisfactory installation, testing and commissioning of the equipment.

B. Provide all materials, labour and equipment necessary to make any adjustments to the installation as required by the manufacturer or the Consultant until the equipment is fully tested and commissioned.

C. On completion of the installation and testing, obtain from the suppliers or the manufacturers concerned, certification that the equipment is installed correctly, is in full operational condition, and is operating in accordance with its design rating. Submit the original certificate to the Consultant and all copies necessary to comply with other submitted requirements. Certificates are to include a statement to the effect that any adjoining pipe is properly and

independently supported and does not cause undue stress that would be detrimental to the equipment performance.

D. Co-ordinate the work of all equipment suppliers, fully commission all equipment and provide representatives from various manufacturers during plant testing and commissioning as required by the Consultant.

3.06 ACQUAINTANCE WITH WORK

A. The Contractor shall be fully acquainted with all work involved in the complete installation of all equipment. At no time shall the Contractor make any claim that any misunderstanding existed in regard to the nature or amount of work to be done in relation to the installation, testing and commissioning of all specified equipment.

B. The Contractor shall obtain all necessary details from Equipment suppliers including dimensions and other information pertinent to the Work of this Contract.

3.07 MATERIAL AND WORKMANSHIP

A. Material and equipment is to conform to the latest edition of applicable standards in force at the time of tendering. In the case of any conflict between the Specifications with any standards, the more stringent of the two applies.

B. Provide materials and equipment in conformance with the following:

.1 First class in every respect.

.2 Constructed and finished in a workmanlike manner.

.3 Fully suitable for the service intended.

.4 Selected and fabricated to best engineering practice.

C. Furnish safety devices, including shear pins, flexible coupling guards, beltguards and other pertinent items with the equipment.

D. Design machinery such that working parts are readily accessible for inspection and repair, and each part is suitable for the service required.

E. Carefully pack and crate equipment for shipment. Protect polished and machined metal surfaces from corrosion and damage during shipment. Specially pack electrical equipment to prevent damage by moisture. Cover equipment having exposed bearings and glands to exclude foreign matter.

F. Design equipment to have adequate strength, power and capacity for both continuous and intermittent service and have motors and other parts capable

of starting and operating under any conditions or loading likely to occur under normal plant operating conditions.

G. Design the general mechanical and electrical equipment and particularly gearings, contacts and other wearing parts to satisfy the need for long periods of operation without frequent maintenance or attention.

H. Provide adequate and, as far as practicable, authentic means of lubrication for working parts. Arrange lubrication grease nipples, grease boxes and other lubrication devices so that they are readily accessible for routine greasing.

I. Indicate on the Shop Drawings submitted, the type of lubricants to be used (readily available in USA). Use grease nipples of a consistent type (Alemite button head type or equivalent).

J. Make lubrication points readily accessible using grease nipples and Type 316 stainless steel tubing extensions where required. Secure the nipples and tubing to the equipment at appropriate locations.

K. Design equipment installed outdoors for service under climatic conditions typical for the area. Give particular attention to winter operating conditions.

3.08 SPECIAL TOOLS AND ACCESSORIES

A. Furnish a set of any special tools, wrenches and accessories required for removing worn parts, for carrying out maintenance and for making adjustments. Special tools are those tools which, because of their limited use or purpose-made design, are not normally readily available, but which are necessary for maintaining the equipment.

3.09 TEMPORARY SUPPORTS

A. Provide all necessary temporary supports and bracing to prevent the overloading of all floors and walls, while equipment is being installed. Ascertain the weights of all pieces of equipment from the manufacturer, and move equipment into position in a manner and at a time approved by the Consultant.

B. Provide eye bolts or hooks for the safe handling of the equipment during installation. Eye bolts are to be left in place.

3.10 LUBRICATION, GREASE, OIL AND FUEL

A. Perform and complete initial lubrication of equipment in accordance with the manufacturer's instructions and be responsible for obtaining same. In addition, fill grease, oil and fuel tanks, as required for the initial operation of the equipment.

B. Until plant staff take over the Works, perform all necessary periodic maintenance (lubrication, greasing etc.) as required. Maintain a log of such events for each piece equipment, valves etc. Turn the log over to plant staff when they take over the work.

3.11 ANCHOR BOLTS

A. Unless otherwise specified, supply all stainless-steel anchor bolts, such anchor bolts being of a diameter and size as recommended by the manufacturers of the equipment and machinery being installed. Generally, use expansive type anchorages in setting small equipment. Set large pumps by means of bolts with sleeves cast into the concrete to a minimum depth of 6" (150 mm). Elsewhere, cast in place anchor bolts may be used subject to the approval of the Consultant; these must be properly positioned by means of substantial templates.

3.12 PUMP AND MACHINERY BASES

A. Provide concrete bases for all equipment, including pumps, and mixers. Final setting of pump and machinery bases shall be on cement grout placed on concrete bases, or as otherwise recommended by the equipment supplier. Grouting shall be in accordance with Section 03300 – Cast-in-Place Concrete. Provide anchor bolts for all bases. Finish vertical sides of pump bases and bases to match the adjacent floor.

B. The final shape and dimensions of bases and anchor bolt locations for the bases, where not already finalized, will be determined by the Consultant after receipt of the equipment manufacturer's detail drawings. In general, the concrete bases are to be a minimum of 2" (50 mm) larger than the supplied equipment base in each direction.

C. Reinforced concrete bases shall be firmly fixed to the parent concrete slab by adequate dowels as shown on the Contract Drawings or as recommended by the equipment supplier and approved by the Consultant.

3.13 PUMPS AND MOTORS

A. Supply directly connected pumps and motors with flexible shaft couplings.

B. Pumps and motors supplied complete with steel or cast-iron bases.

C. Provide, where necessary, pipe and/or funnel drains to drain bearings, seals and pump and motor bases.

D. Strictly align shafts of pumps and motors and have the shaft connection and alignment approved by the Supplier.

E. Check and charge pumps, seals, the seal water systems, bearings, etc., before testing and start-up of any pumps. Ensure that Supplier's lubricants, especially at pump seals, remain intact during storage, installation, testing and start up as recommended and re-charge as necessary.

F. Charge all pumps and piping with clean water prior to testing.

G. Provide purpose-made temporary cone or flat type basket strainers with maximum 3 mm openings for pump tests. Strainers to be suitably pressure rated and have flared ends for installation between a pair of flanges. After testing remove from the system and properly reconnect piping etc.

3.14 PAINTING

A. After equipment has been installed, remove grease, oil and other deleterious matter from surfaces of equipment.

B. Touch up shop prime coat to render surfaces suitable to receive finish coats.

3.15 EQUIPMENT CABINET BASES

A. Install all floor-mounted cabinets on concrete bases whether shown on the Contract Drawings or not. Concrete shall be as specified in Section 03300 – Cast-in-Place Concrete.

B. Anchor bases as recommended by the manufacturer or as specified elsewhere in these Specifications.

C. Final shape and dimensions shall be determined by the Consultant after receipt of the equipment manufacturer’s detail drawings.

3.16 FIELD WELDING AND FABRICATION

A. Ascertain details of field welding and fabrication to be carried out for the erection and installation of the various items of equipment.

B. Fabricate the equipment in accordance with AWS Standard, Steel Structures for buildings and the manufacturer’s instructions.

C. Have the welding shielded, conforming to AWS Standard, General Specifications.

3.17 EQUIPMENT GUARDS

A. Provide removable protective guards for all open rotating equipment including pulleys, belts, drives, shafts and couplings, etc.

B. Ascertain the extent of the work for the installation and/or the supply etc., of equipment guards by direct contact with the equipment suppliers.

3.18 PROTECTION OF EQUIPMENT

A. After the equipment has been installed and prior to final acceptance, protect the equipment from damage. Ensure that protection measures are to the satisfaction of the manufacturer and the Consultant.

3.19 ALIGNMENT

A. All rotating equipment is to be set and aligned in accordance with the more stringent requirements of either the equipment manufacturer's instructions or the following:

.1 Level base, use machinists level on all machined surfaces.

.2 Base is to be true and leveled.

.3 Alignment of shafts, soft foot or motor and couplings shall be performed by reverse dial, rim to rim and face to face. Soft foot will be rim-to-rim vertical and horizontal mode.

.1 Soft foot of motor shall be checked to be within a tolerance of 0.040 mm.

.2 Shaft to be aligned within a tolerance of ± 0.001" (±0.025 mm) to 0.003" (0.070 mm).

.3 Piping strains to pump shall be within a tolerance of ± 0.001" (±0.025 mm) to 0.003" (0.070 mm).

.4 Provide the Consultant with an alignment report.

3.20 VIBRATION MONITORING

A. Without exception, all rotating equipment shall be checked and tested for vibration.

.1 The vibration level is to be within the specified limit as per the manufacturer's recommendations. (Generally, the peak vibration velocity shall not exceed 1 mm/sec measured in the filter-in mode). Measurement shall be carried out with a Real-Time analyzer, Nicolet 100A. Provide a hard copy Vibration Signature Spectrum showing vibration velocities over a frequency range of 0 to 2000 Hz, measured in a filter-in mode.

.2 Provide the Consultant with the original Vibration Monitoring reports and all copies necessary for the Maintenance Data.

3.21 FIELD INSPECTION

A. After equipment has been installed, notify the equipment Supplier to provide factory trained service representatives to inspect the installation of their equipment and to be present at start-up.

B. In addition to supervision and inspection, make provision for the Supplier to physically set up and align, if necessary, the equipment before or during the initial operation period so that the equipment performs its intended function normally with the most efficiency during normal operating conditions.

C. Prior to plant start-up, inspect all equipment for proper alignment, quiet operation, proper connection, and satisfactory performance, and test in the presence of the Contract Administrator.

D. Test to include checks for excessive vibration, correct operation of control systems and equipment, motor power input, acceptable normal running noise, speed and direction of rotation.

E. Test to demonstrate that the equipment and Work is not defective electrically, mechanically, or otherwise and is in a safe and satisfactory operating condition.

3.22 TESTING AND COMMISSIONING

A. Unless otherwise specified, provide commissioning and start-up in accordance with the requirements of all related Specification Sections. The factory trained supervisor(s) must have a minimum of two (2) year-experience with the firm.

B. Unless otherwise specified, furnish a certificate of final inspection and approvals from the electrical inspection authority to the Consultant. Manufacturer shall issue final

C. Issue manufacturer's certificate (electronic and hard copies) stating that the equipment is installed as per the manufacturer's instructions, operate satisfactory and is ready to function as designed.

3.23 TRAINING

Unless otherwise specified, provide Training in accordance with Division 1 – Training.

+ + + END OF SECTION 11000 + + +

SECTION 11020
VIBRATION AND CRITICAL SPEED LIMITATIONS

PART 1 GENERAL

1.01 INTENT

A. This Section specifies vibration and critical speed limitations for rotating mechanical equipment.

B. Field test and take vibration measurements when specified.

C. Balance all electrical motors and rotating mechanical equipment.

D. Refer to Section 11000 and Division 1.

1.02 SUBMITTALS

A. In addition to the requirements of Section 11000, provide the following in one complete submittal and in accordance with Section 01300:

1. Manufacturer's certified data showing location of critical speeds in relation to operating speeds.

2. Manufacturer's certification of inspection of positive displacement machine as specified in this Section.

3. Field measurement report, digital. Indicate the procedures applied, equipment used and results obtained.

1.03 VIBRATION LIMITATIONS

A. General:

1. Vibration frequencies span the range from 5 to 5000 Hz.

2. Where specified, obtain measurements while the installed equipment is operating within the specified speed range.

B. Centrifugal:

1. Unless otherwise specified, centrifugal machines with sleeve bearing shafts are not to exhibit unfiltered RMS readings for vibration displacement in excess of the following:

Shaft speed range, r/min	Displacement, peak to peak, inch (μm)
Up to 900	0.0034 (87.5)
901 - 1800	0.003 (75.0)
1801 - 3000	0.0025 (62.5)
3001 - 4500	0.0016 (40.0)
Above 4500	0.002 (50.0)

2. Take displacement measurements radially and axially on the shaft at two points at each bearing; except for well pumps, measure at top of motor; measure at points 90° apart.

3. Unless otherwise specified, centrifugal machines with antifriction bearing shafts are not to exhibit unfiltered RMS readings for vibration velocity in excess of 0.0012”/s (30.0 μm/s) or 0.0026”/s (65.0 μm) displacement peak to peak, whichever is lower.

4. Take velocity measurements on one point of each bearing housing.

C. Positive Displacement:

1. Unless otherwise specified, positive displacement machines of the rotary, reciprocating and controlled volume types to operate without any lateral or torsional vibration characteristics that may accelerate wear of the equipment.

2. Provide Manufacturer's certification that the Manufacturer has inspected the machine under operating conditions and found it to comply with the requirements of this Section.

3. The equipment is not to exceed 0.0028” (70 μm) displacement, peak to peak.

1.04 CRITICAL SPEED REQUIREMENTS

A. Unless otherwise specified, rotating mechanical equipment not to exhibit critical speeds within the specified range of operating speeds.

B. Critical speeds for equipment with rigid rotor systems to be at least 20 percent greater than maximum operating speed.

C. Critical speeds for equipment with flexible shaft rotor systems to be at least 15 percent below minimum operating speed and/or 20 percent above maximum operating speed.

PART 2 PRODUCTS

A. Not used.

PART 3 EXECUTION

A. All measurements to be witnessed by the Engineer.

B. Field Vibration Reduction Measures:

1. Where vibration tests show sound levels in excess of the allowable limits, undertake field vibration reduction measures.

A. Repeat vibration level tests after field vibration reduction measures are implemented to show compliance. Consult the equipment supplier for vibration abatement measures to be implemented in the field.

+ + + END OF SECTION 11020 + + +

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SECTION 11440
SUBMERSIBLE PUMPING EQUIPMENT

PART 1 GENERAL

1.01 INTENT OF SECTION

A. This section specifies the design, shop drawing submission, fabrication, supply, shipping, unloading, storage, installation, testing, commissioning and certification of submersible, wet well pumps specifically designed for use in pumping wastewater.

B. Provide all labour, safety procedures, materials, equipment and accessories not only herein or elsewhere specifically mentioned or included, but necessary for the supply, installation, testing, and commissioning of the equipment.

C. Equipment included in this Section:

.1 Two (2), vertical, constant speed, submersible, centrifugal pumps complete with electrical motors, discharge elbows, lifting guides, guide brackets, lifting chains and hoists, control panel and all specified appurtenances. The pumps are designed to provide for the Dry Weather Flow (DWF) condition.

.2 Three (3), vertical, constant speed, submersibles centrifugal pumps complete with electrical motors, lifting chains and hoists, control panel and all specified appurtenances. The pumps are designed to provide for the Wet Weather Flow (WWF) condition.

D. All electrical equipment shall be designed for a Class 1, Division 1, Group D electrical classification and be Code approved.

E. Conform to the General Requirements of Division 1 and Section 11000, unless otherwise specified.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. General Requirements: Division 1.

B. Concrete: Division 3.

C. Metal: Division 5.

D. Painting and Protective-Coatings: Section 09900.

E. General Equipment Requirements: Section 11000.

F. Mechanical: Division 15.

G. Electrical: Division 16.

H. Controls: Division 17.

1.03 REFERENCES

A. ASTM American Society for Testing and Materials

B. ANSI American National Standards Institute

C. AWWA, American Water Works Association

D. ASTM A48, Grey Iron Castings.

E. ASTM A108, Steel Bars, Carbon Cold-Finishes, Standard Quality.

F. ASTM A276, Stainless Steel and Heat Resisting Steel Bars and Shapes.

G. ASTM A532, Abrasion Resistant Cast Iron.

H. SSPMA, Sump and Sewage Pump Manufacturers Association.

I. UL, Underwriters Laboratories Inc.

J. NEMA, National Electrical Manufacturers Association

K. ICEA, Cable Engineers Association

L. NEC, National Electrical Code

M. IEEE, Institute of Electrical and Electronic Engineers, Standard 112

N. NFPA 70.

O. Hydraulic Institute Standards, Standards of the Hydraulic Institute, 14th Edition.

1.04 EQUIPMENT LIST:

Item Tag No.	Equipment Name	Location.
P-01	DWF Pump	Wet Well
P-02	DWF Pump	Wet Well
P-03	WWF Pump	Wet Well
P-04	WWF Pump	Wet Well
P-05	WWF Pump	Wet Well

1.05 SUBMITTALS

A. Submit copies of following shop drawings:

1. General layout of each pump unit completes with motor showing anchor bolt locations, casing position, direction of rotation and electric motor terminal box location.

2. Cross-sectional details of each pump and pump seal with complete cross-referenced materials list.

3. Discharge and steel guide rails complete with anchor bolt details.

4. Certified, characteristic curves including head, capacity, efficiency, and power expressed in kilowatts. Curves must include standard curves for pumping raw sewage.

5. Details of impeller – size, pump rpm, material specification.

6. Dimensioned drawings of motors and drives and details including full output power in hp /kilowatts, rpm and slip.

7. Lubrication requirements.

8. Details of storage and offloading requirements.

B. Shop drawing shall be processed in accordance with Sections 01300 and 11000.

C. Submit certified, non-witnessed, shop test results for all pumps.

D. Provide equipment sized for spaces allocated on the Contract Drawings. Differently sized equipment is subject to approval by the Engineer.

E. Provide installation manuals prior to shipping the equipment. No payment will be made for equipment delivered before installation manuals or storage and offloading requirements.

F. Bind installation, operation and maintenance manuals and certified performance pump curves corrected to actual running rpm in field in indexed manual for equipment.

G. Submit operation and maintenance manuals before requesting initial start-up. Refer to Division 1.

H. Do not construe the Engineer's failure to note errors, omissions or interference modifications during review of shop drawings as approval of such errors, omissions or modifications.

1.06 SPARE PARTS LIST

A. Provide list of recommended spare parts with submission of shop drawings of equipment.

1.07 QUALITY ASSURANCE

A. The following Specifications do not purport to cover all details entering into design of pumping units required, but rather to call attention to certain special features.

B. Workmanship for materials and methods of construction shall conform to best practice and highest standard of industry.

1.08 CERTIFICATES

A. Shop Finishing: Certify that shop finished metal components received protective coating system.

B. Machine Finishing: Certify that machine finishes specified have been provided. Provide hard copies of certification.

PART 2 PRODUCTS

2.01 SUBMERSIBLE RAW SEWAGE PUMPS

A. DWF Pump Design Requirements:

.1 Quantity: 2 pumps (one lead and one lag unit).

.2 Fluid: Raw Sewage (up to 1.5% solid content).

.3 Design Capacity: 350 gpm (one pump operation).

.4 Total Head: 39.5 ft (one pump operation).

.5 Minimum Motor Size: 11 hp (output), 3/60/460 VAC, inverter duty rated in accordance with per NEMA Standard MG-1 Part 31.

.6 Maximum Speed: 1800 rpm.

.7 Discharge Elbow Connection Dia.: 4” (100 mm).

.8 Total Flow and Head for two (2) pumps in parallel Operation: 612 gmp at 41.9 Ft TDH.

B. WWF Pump Design Requirements:

.1 Quantity: 3 pumps (one lead, one lag and one standby unit)

.2 Fluid: Raw Sewage (up to 1.5% solid content)

.3 Design Capacity: 2770 gpm (one pump operation).

.4 Total Head: 41.2 ft (one pump operation).

.5 Minimum Motor Size: 60 hp (output), 3/60/460 VAC, inverter duty rated in accordance with per NEMA Standard MG-1 Part 31.

.6 Maximum Speed: 1800 rpm

.7 Discharge Elbow Connection Dia.: 8” (200 mm)

.8 Total Flow and Head for two (2) pumps in parallel Operation: 4860 gmp at 48 Ft TDH.

C. Total head in the above tabulation includes velocity head but is exclusive of the pump inlet and discharge column head losses.

D. Supply the submersible pumps under this specification suitable for continuous operation.

2.02 PUMP DESIGN CONFIGURATION

A. The pump(s) shall be automatically and firmly connected to the discharge connection, guided by no less than two guide bars extending from the top of the station to the discharge connection. There shall be no need for personnel to enter the wet-well.

B. Sealing of the pumping unit to the discharge connection shall be accomplished by a machined metal to metal watertight contact. Sealing of the discharge interface with a diaphragm, O-ring or profile gasket will not be acceptable. No portion of the pump shall bear directly on the sump floor.

C. Each pump shall be fitted with a Flygt Pump Lift (Grip-Eye) system or approved equal. The entire system shall be made of 316 stainless steel, including 1/4"ø AISI 316 Stainless Steel guide rope.

2.03 MATERIALS OF CONSTRUCTION

Component	Material
Casing, discharge, oil chamber, seal plate, volute, and bottom plate	Close grained cast iron (ASTM A48, Class 35B)
Elbow	Close grained cast iron (ASTM A48, Class 35B)
Bracket	Close grained cast iron (ASTM A48, Class 35B)
O-rings	Nitrile rubber (Buna-N)
Lifting chain	Stainless steel, type 304
Guide rails and accessories	Stainless steel, type 304
Access cover and frame (where applicable)	Stainless Steel Type 304
Impeller	Close grained cast iron or high chromium white cast iron with 0.2 to 3 percent nickel content (ASTM A48, Class 35B), hard iron
Pump & Motor Shaft	Stainless steel, type 304 or 420
Motor Housing	Close grained cast iron (ASTM A48, Class 35B)
Body and cover	Carbon Steel
All External Hardware	AISI 316 Stainless Steel

2.04 PUMP CONSTRUCTION

A. General

1. Major new components of pumps shall be of grey cast iron, ASTM A-48, Class 35B, with smooth surfaces devoid of blowholes or other irregularities. All exposed nuts or bolts shall be of AISI type 316 stainless steel. All metal surfaces coming into contact with the pumpage, other than stainless steel or brass, shall be protected by a factory applied spray coating of acrylic dispersion zinc phosphate primer with a polyester resin paint finish on the exterior of the pump.

2. Sealing design shall incorporate metal-to-metal contact between machined surfaces.

3. Critical mating surfaces where watertight sealing is required shall be machined and fitted with nitrile or Viton rubber O-rings. Fittings shall be the result of controlled compression of rubber O-rings in two planes and O-ring contact of four sides without the requirement of a specific torque limit. Rectangular cross-sectioned gaskets requiring specific torque limits to achieve compression shall not be considered as adequate or equal. No secondary sealing compounds, elliptical O-rings, grease or other devices shall be used.

2.05 MOTOR

A. General

1. The pump motor shall be induction type with a squirrel cage rotor, shell type design, housed in an air filled, watertight chamber. NEMA B design, fully enclosed premium efficiency submersible IP68 protecting rating. The stator windings and leads shall be insulated with moisture resistant Class H insulation rated for 356^{o}F (180^{o}C). The stator shall be dipped and baked three times in Class H varnish (winding fill factor of at least 95%) and shall be heat-shrink fitted into the stator housing. The use of bolts, pins, or other fastening devices requiring penetration of the stator housing is not acceptable. The motor shall be designed for continuous duty handling pumped media and capable of a minimum of 15 starts per hour. The rotor bars and short circuit rings shall be made of cast aluminium.

2. Thermal switches set to open at 260^{o}F (125^{o}C) shall be embedded in the stator lead coils to monitor the temperature of each phase winding. The motors shall be equipped with a moisture sensor relay and moisture detection probe in seal sensing chamber. These thermal switches and moisture sensor relays shall be used in conjunction with and supplemental to external motor overload protection and shall be

connected to the control panel. Sensing chamber filling medium shall be filled with environmentally safe, non-toxic oil.

3. The junction chamber containing the terminal board shall be hermetically sealed from the motor by an elastomer threaded compression type binding posts permanently affixed to a terminal board. Wire nuts or crimping type connection devices are not acceptable.

4. The combined service factor (combined effect of voltage, frequency and specific gravity) shall be a minimum of 1.15. The motor shall have a voltage tolerance of plus or minus 10%. The motor shall be designed for continuous operation handling pumped media of up to 40°C (104°F) ambient and with a temperature rise not to exceed 80°C (176°F). A performance chart shall be provided upon request showing curves for torque, current, power factor, input/output kW and efficiency. This chart shall also include data on starting and no-load characteristics.

5. The power cable shall be sized according to the NEC and ICEA standards and shall be of sufficient length to reach the junction box without the need of any splices. The outer jacket of the cable shall be oil resistant chloroprene rubber. The motor and cable shall be capable of continuous submergence under wastewater without loss of watertight integrity to a depth of 66 ft (20 meters).

6. The motor horsepower shall be adequate so that the pump is non-overloading throughout the entire pump performance curve from shut-off through run-out.

7. The pump motor shall be capable of no less than 30 evenly spaced starts per hour.

8. Motor leak detection/over temperature control relay if required to maintain pump warranty

9. The motor and pump shall be designed and assembled by the same manufacturer.

10. Environmentally safe, non-toxic, oil-filled motor.

2.06 COOLING SYSTEM

A. Each unit shall be provided with an adequately designed cooling system. The water jacket shall encircle the stator housing; thus, providing heat dissipation for the motor regardless of the type of installation. Impeller back vanes shall provide the necessary circulation of the cooling liquid through the water jacket. The cooling media channels and ports shall be non-clogging by virtue of their dimensions. Provisions for external cooling and seal flushing shall also be provided. The cooling system shall provide for continuous pump operation in temperature of up to 40 degrees C (104 degrees F). Restrictions below this temperature are not acceptable.

2.07 CABLE ENTRY SEALS

A. Provide a heavy-duty flexible, water-resistant, continuous non-wicking submersible power cable complete with control conductors (if required), sealed at the motor bell and of sufficient length to connect to a junction box.

B. The cable entry seal design shall preclude specific torque requirements to insure a watertight and submersible seal. The cable entry shall consist of a single cylindrical elastomer grommet, flanked by washers, all having a close tolerance fit against the cable outside diameter and the entry inside diameter and compressed by the body containing a strain relief function, separate from the function of sealing the cable. The assembly shall provide ease of chaining the cable when necessary using the same entry seal. The cable entry junction chamber and motor shall be separated by a terminal board of non-hydroscopic material, which shall isolate the stator housing from foreign material gaining access through the pump top. Epoxies, silicones, or other secondary sealing systems shall not be considered acceptable.

C. Cable entry casting to be cast iron to ASTM A-48, Class 35B.

D. Control cables shall be included in power cable.

E. All cable and wiring must meet the requirements of the CEC and the details of Division 16.

2.08 IMPELLER

A. The impeller shall be of ASTM A-532 (Alloy III A) 25% chrome cast iron, premium efficiency, dynamically balanced, semi-open, multi-vane, backswept, screw-shaped, non-clog design c/w guide pin. The impeller vanes shall be mechanically self-cleaned automatically upon each rotation as they pass across a relief groove(s) located in the pump housing (or in an insert ring in the pump housing) and shall keep the vane clear of debris, maintaining an unobstructed pumping. The screw-shaped leading edges of the gray iron impeller shall be hardened to Rc 45 and shall be capable of handling solids, fibrous materials, heavy sludge and other matter normally found in wastewater. The screw shape of the impeller inlet shall provide an inducing effect for the handling of up to 5% sludge and rag-laden wastewater. The impeller to volute clearance shall be readily adjustable by the means of a single trim screw. The impellers shall be locked to the shaft, held by an impeller bolt and shall be coated with alkyd resin primer.

B. Passing through sphere shall be at least 80 mm diameter.

2.09 WEARING RING

A. Install a wearing ring designed for abrasion resistance at the inlet of each submersible pump to provide protection against impeller wearing.

2.10 PUMP SHAFT

A. Pump and motor shaft shall be the same unit. The pump shaft is an extension of the motor shaft. Couplings shall not be acceptable. The shaft shall be of a deflection-proof type, made of 420 or 304 stainless steel (to ASTM A479 S43100-T) and shall be completely isolated from the pumped liquid.

2.11 MECHANICAL SEALS

A. Each pump shall be provided with a tandem mechanical shaft seal system consisting of two totally independent seal assemblies. Seal shall be made of silicon carbide on silicon carbide.

B. The seals shall operate in a lubricant reservoir that hydrodynamically lubricates the lapped seal faces at a constant rate.

C. The lower, primary seal unit, located between the pumped liquid and the lubricant chamber, shall contain one stationary and one positively driven rotating tungsten-carbide ring.

D. The upper, secondary seal unit, located between the lubricant chamber and the motor housing, shall contain one stationary tungsten-carbide seal ring and one positively driven rotating tungsten-carbide seal ring.

E. Each seal interface shall be held in contact by its own spring system. The seals shall require neither maintenance nor adjustment nor depend on direction of rotation for sealing. The position of both mechanical seals shall depend on the shaft. Mounting of the lower mechanical seal on the impeller hub will not be acceptable. For special applications, other seal face materials shall be available.

F. The following seal types shall not be considered acceptable nor equal to the dual independent seal specified: shaft seals without positively driven rotating members, or conventional double mechanical seals containing either a common single or double spring acting between the upper and lower seal faces. No system requiring a pressure differential to offset pressure and to effect sealing shall be used.

G. Each pump shall be provided with a lubricant chamber for the shaft sealing system. The lubricant chamber shall be designed to prevent overfilling and to provide lubricant expansion capacity. The drain and inspection plug, with positive anti-leak seal shall be easily accessible from the outside. The seal system shall not rely upon the pumped media for lubrication. The motor shall be able to operate dry without damage while pumping under load.

H. Seal lubricant shall be non-toxic and FDA approved for potable water applications.

2.12 SPIN-OUT

A. In order to reduce wear of the lubricant chamber, open surfaces of the seal, seal surfaces, and increase reliability of the seal itself, the lubricant chamber shall incorporate a specially designed seal chamber. The seal chamber houses the outer seal and consists of a spiral track in the wall of the seal chamber. This spiral track catches particles and transports them out towards the impeller, into the main rotational flow, where they are discharged back into the pump medium.

2.13 VOLUTE / SUCTION COVER

A. The pump volute shall be a single piece gray cast iron, ASTM A-48, Class 35B, non-concentric design with smooth passages of sufficient size to pass any solids that may enter the impeller. Minimum inlet and discharge size shall be as specified.

B. The volute shall have a replaceable suction cover insert ring in which are cast spiral-shaped, sharp-edged groove(s). The spiral groove(s) shall provide trash release pathways and sharp edge(s) across which each impeller vane leading edge shall cross during rotation so to remain unobstructed. The insert ring shall be cast of ASTM A-532 (Alloy III A) 25% chrome cast iron and provide effective sealing between the multi-vane semi-open impeller and the volute housing.

2.14 PROTECTION

A. Purpose: for Pump Monitoring and Status System

B. Quantity (5) monitoring and status system units one per each pump, that records the pump motor temperature and leakage data shall be provided, including five (5) Mini-CAS II units for the DWF and WWF pumps. The system shall include a base module and an operator's panel enclosed in the same stainless steel NEMA 4X enclosure with a viewing window on the operator's panel door as the PSM controllers. An input 20 Amp circuit breaker shall also be included within the same enclosure. The system shall have the capability of communicating with the facility's monitoring status control panel.

C. All stators shall incorporate three (3) thermal switches, connected in series, to provide overtemperature protection of the motor winding. Should high temperature occur, the thermal switches shall open, stop the motor and activate an alarm. At 125°C (260°F) the thermal switches shall open, stop the motor and activate an alarm.

D. The stator shall also include three (3) PT-100 type temperature probes to monitor the stator temperature.

E. Furnish and install two (2) leakage sensors per pump, which shall detect water intrusion into the stator chamber and junction/oil chamber. A Float Leakage Sensor (FLS) shall be used to detect the presence of water in either the stator chamber or junction/oil chamber. When activated, the FLS shall stop the motor and activate an alarm. Use of voltage sensitive solid-state sensors will not be allowed. Use of voltage sensitive solid-state sensors and trip temperature above 125°c (260°f) shall not be allowed.

F. The three thermal switches and two FLS switches shall all be connected to a MiniCAS II Monitoring and Status unit.

G. Power: 110-120VAC (to be coordinated with the control panel supplier).

H. The MiniCAS II units shall be designed to be mounted in the control panel.

I. Remote indication of pump unit statuses shall be possible with connection to customer PLC or via LAN.

J. Manufacturers:

1. Flygt – MiniCAS II Monitoring System.

2. Or approved equivalent.

2.15 BEARINGS

A. The pump shaft shall rotate on two bearings. Motor bearings shall be permanently grease lubricated. The upper bearing shall be a single roller bearing. The lower bearing shall be a two-row angular contact bearing to compensate for axial thrust and radial forces. Single row, or sleeve lower bearings are not acceptable.

2.16 PAINT STANDARD

A. The exterior of the pump, including all metal surfaces coming into contact with the pumpage shall be protected by a factory-applied spray coating of acrylic dispersion zinc phosphate primer and finished with polyester, epoxidized resin paint (minimum of 4.7 mil DFT). Prior to the final paint finish being applied, the pump components shall be primed and washed. The components shall then be assembled and washed a second time before the final topcoat is applied.

2.17 ACCESSORIES

A. The vertical, wet pit submersible wastewater pumps shall have the following accessories per each pump:

1. Discharge elbow: manufacturer’s standard flanged automatic discharge elbow connection complete with support, guide bar seats and mounting hardware.

2. Two of 4”x8” (100x150mm) and three of 8”x14” (200x350 mm) eccentric type, stainless steel flanged increasers to connect to the pump discharge elbows and discharge riser pipes.

3. Sets of 2” (50 mm) and 3” (75 mm) DIA stainless steel slide rails (two slide rails per each pump), base mount with pump bracket and top rail bracket. Provide two (2) 304 stainless steel evenly-spaced interim guide rail supports for each pump guide rail. The number of required guide rails per pump shall be confirmed with the pump supplier.

4. Two (2) hoist hooks c/w latches and hoist lifting chains for a depth of 40 ft (12 m) wet well (confirm the exact length at the site before the supply); guide ropes, grip-eyes, chain slings connected to pump hook. All metals shall be made of AISI 316 stainless steel.

5. Cable holder, heavy duty, made of AISI 316 stainless steel.

6. Power cable/ control cable per pump (confirm the cable required length at the site before supply; coordinate with the control panel installation location).

7. Float switches and hydrostatic pressure transmitters – refer to Division 17.

8. All 316 Stainless steel hardware and anchor bolts.

2.18 CONTROL PANELS:

A. The pump monitoring and status monitoring system shall include a base microprocessor-based control module(s) and an operator’s panels. The panels shall have a minimum of two controllers or two control modes; a primary controller (hydrostatic pressure transmitters) and a back-up control system (float switches) to ensure operation in the event of hardware failure, which can be used for primary and or secondary control.

B. The control panel shall be provided with a two-position selector switch, which shall allow the operator to select the primary or backup controller. If the selected controller fails, the pump control shall switch to the back- up controller automatically.

C. Each controller shall have two probes for level control. Each controller shall have its own dedicated level probe such that each controller can function in complete isolation from the other. While the primary controller is active the backup controller or level probes are constantly monitored for readiness.

D. In the event the backup controller is not available; an alarm shall be generated indicating Back-up control is unavailable so maintenance crew can be dispatched.

E. All programming/configuration devices, display units, and field control wiring terminals shall be accessible on the front of the control module. Exposure to control circuit boards or electrical power devices during routine adjustments is prohibited.

F. For each pump provide a Flygt Xylem/Multitrode – Multismart Pump Station Manager and RTU.

G. Control panels shall be supplied by the pump manufacturer and installed under Divisions 16 and 17. Includes:

1. Vandal proof, lockable, double door, duplex and triplex pump control panels on legs located outside, made of stainless steel; NEMA 4X; heat and seal complete with inner door; padlock Hasp, industrial grade LED lights; 120V strip heaters, thermostats and circulation fans. The power compartment of the panels shall be separated from the control section of the panels.

2. Non-fusible main disconnect, coordinated magnetic motor starters with adjustable overload protection for each pump with circuit breakers, control transformer with primary fuses and control fuses; pump alternators.

3. Hand-Off-Auto (H-O-A) operation switches with led pilot light indicators for RUN and OVERLOAD conditions; Acknowledge, Start, Stop, Test and Reset push buttons, P-01-Auto-P-02 lead pump selector circuit and P-03-Auto-P-04– P-05 lead pump selector circuit; alarm globe/beacon c/w metal guard, door switch, receptacle, laptop folding shelf.

.1 4. Each local pump control panel shall have the following:

Lights: Pump Ready-White; Pump Off-Green; Pump Running-

.2 Red; Overload Tripped–Red; Temperature and Leakage

.3 Alarms (2)– Amber; High-level - Red.

.4 Push-buttons: Start, Stop, Overload Reset.

Switches: Hand-Off-Auto.

ETM Screen.

5. Provide the terminal blocks and ground lugs, as required. Provide “Run”, “General Fault”, selector switch “Auto” mode and “Run Command” remote control and alarm interface, unauthorized access (from the door switch), and one (1) spare dry contact Form C relay for each pump to connect pumps to control panel for monitoring and control.

6. Space for 2000 VA UPS and two (2) UPS.

7. Engraved Labels: as required.

8. Panel shall be supplied as a complete package with the pumps.

9. Install panels outdoors on concrete foundation or metal platform (refer to the drawings).

H. Control of Pump Operation:

1. Refer to Division 17 and Process Control Narrative for details on the pumping station operation modes and sequences.

2. Signals (wiring) from level transmitters shall be run to the pump control panels.

3. Controls shall be supplied and installed under Division 13.

2.19 ACCEPTABLE SUPPLIER:

A. The design has been prepared based on the Flygt pumps.

B. Dry weather condition: Flygt, Model FP-3127.850 HT 3~489 and Wet weather condition: Flygt, Model FP 3202.390 MT 3~641.

C. Other suppliers are acceptable if they meet the specification and wet well requirements. Any additional design, materials, equipment and installation cost associated with Alternative Pumping Equipment shall be borne by the supplier and contractor. Contractor will also be charged for additional Engineer's time based on a 'Time and Material' basis.

PART 3 EXECUTION

3.01 EQUIPMENT INSTALLATION

A. The equipment specified herein shall be located as shown and installed in conformance with the Manufacturer's written instruction.

B. Install pumps and valves into the chambers and pit as shown in drawings.

C. Connect all pipes, joints, electrical equipment, wiring with accordance to the drawings and specifications.

D. Paint newly installed equipment, pipes (if not S.S.) as per Division 9.

E. Certify proper installation and operation of all components in accordance with Section 11000 and Division 1.

3.02 FIELD SERVICE

A. In accordance with Division 1.

B. The equipment manufacturer will provide the services of a certified factory-trained representative to inspect and verify the installation of the equipment, make any necessary adjustments and initiate start-up.

C. The manufacturer's field representative must prepare field reports and submit digital copy of the report to Engineer.

D. The equipment Manufacturer will provide the services of a certified factory-trained representative to instruct Owner's personnel in the proper maintenance of the equipment.

3.03 FUNCTIONAL TESTING

A. Functional Test: Prior to pump start-up, all equipment shall be inspected for proper alignment, quiet operation, proper connection, and satisfactory performance and tested in the presence of the Engineer and Manufacturer’s representative.

B. After completion of installation, demonstrate functional operation of systems, including sequence of operation to approval of Engineer.

C. Test in presence of Engineer and equipment supplier representative.

D. Provide all labour and ancillary equipment necessary to fulfill tests.

E. Test to demonstrate that:

1. Pumps, valves and equipment are to run free from heating, leakage, vibration, and noise.

2. Pumps can be removed from wet well, hauled away for maintenance, and re-installed.

F. Water for testing shall be supplied by the Contractor. Quantity shall be equal to the wet well volume.

G. Provide all labour and ancillary equipment necessary to fulfill tests.

3.04 FIELD TESTS

A. All field tests and associated expenses shall be borne by the Contractor.

B. First testing will be conducted with water supplied by the Contractor.

C. Second test will be conducted with waste water after commissioning. Coordinate with General Contractor.

D. Refer to Division 1 for details of testing.

3.05 COMMISSIONING

A. Commission equipment in accordance with Division 1.

B. Provide the services of a factory-trained and certified technician to calibrate and confirm the correct installation, operation and written certification of the equipment. Modify the installation as per his recommendations (if any).

C. Certify commissioning in accordance with Division 1 and Section 11000.

3.06 MANUFACTURER'S REPRESENTATIVE SUPPORT

A. Provide a qualified equipment service representative to perform the service herein specified.

B. Supervise the handling and installation of units by others.

C. Prior to commencement of commissioning review mechanical, electrical and structural works to ensure that the equipment is correctly installed, supported, connected and wired. Immediately advise the Owner, in writing, of any deficiencies or deviations from the installation instructions, during the installation of the unit.

D. Inspect, operate, test and adjust the equipment.

E. The inspection is to include, but is not limited to, the following points as applicable.

1. Soundness (without cracked or otherwise damage parts).

2. Completeness on all details as specified.

3. Correctness of setting, alignment and relative arrangement of various parts.

4. Adequacy and correctness of packing, sealing and lubricants.

F. Commission the equipment and instruct the Owner's operating personnel in all aspects of equipment, maintenance and troubleshooting.

G. Make any necessary changes and adjustments to the equipment.

H. After successful commissioning of the equipment submit a complete signed report on the results of the inspection, operations, adjustments and tests. The report shall be in digital format.

I. Include in the report detailed descriptions of the points inspected, tests and adjustments made, quantitative results and suggestions for precautions to be

taken to ensure proper maintenance. Include certification that equipment conforms to the requirements of the specifications and is ready for permanent operation. Hand over to the Owner all adjustments, settings and test sheets.

J. Manufacturer's representative for the pumps shall be present at the jobsite for installation assistance, inspection and certification of the installation, equipment testing, startup assistance and training of the Owner's personnel, for the period of (applies to each pump):

1. Minimum of 4 days – installation, assistance & certification.

2. Minimum of 16 hours – testing.

3. Minimum of 8 hours – training (training to include in-class and field components; provide the training plan including Power Point presentation for review and approval).

4. Freestanding bridge crane training – 8 hours*.

K. Minimum number of trips six (6).

L. * Note, that during the freestanding bridge crane training session, the Contractor, together with the bridge crane and pumping equipment suppliers, shall demonstrate the operation of the bridge crane, including each pump removal from the wet well and loading the pump on a maintenance truck and the reverse operation, i.e. back from the truck to the wet well. The pump supplier shall be part of this demonstration. Price the event in your bid.

M. Refer to Division 1 for the certification forms and procedures.

+ + + END OF SECTION 11440 + + +

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SECTION 11440A
SUBMERSIBLE PUMPS CONTROL SYSTEM AND INSTRUMENTATION

PART 1 GENERAL

1.01 THE REQUIREMENT

A. The Pump Supplier shall provide all components and required and/or specified ancillary services in connection with a fully operational Pump Control System as specified in this Section. The System includes all materials, labor, tools, fees, charges and documentation required to furnish, install, test and place in operation a complete and operable Pump Control System as shown and/or specified. The system shall include all measuring elements, signal converters, transmitters, local control panels, digital hardware and software, operator workstations, remote telemetry units, signal and data transmission systems, interconnecting wiring and such accessories as shown, specified, and/or required to provide the functions indicated.

B. All submittals, services, training, and testing associated with controls and devices provided under this section that are required under Division 17 shall be provided by the pump supplier for the Pump Control System and shall meet the requirements of the Division 17 specifications. All components, control panels, and panel hardware and software of the Pump Control System shall meet the requirements of the Division 17 specifications. The Pump Supplier shall have overall responsibility for all equipment (including field instrumentation and control system hardware and software) provided under this Division for the Pump Control System while retaining the option of obtaining the services of an instrumentation and control system subcontractor for portions of the work. Any instrumentation and control system subcontractor providing services for this project under this Section shall meet the requirements of Section 17000.

C. A MultiSmart pump controller Xylem Flygt Multismart Pump Station Manager 3MP RTU Pump Station Manager 3MP RTUshall be provided by the pump supplier which shall be configured for pump station control as specified in this Section. Controller shall provide out-of-the-box configuration of typical pump station control using selectable parameters as well as the programmability to develop control logic required to meet the requirements specified in this Section. Controller I/O shall be expandable for the number of I/O shown on the drawings and listed in Section 17920 I/O List plus 20 percent for future use. The controller shall include a user interface for operation and configuration. Pump controller and user interface shall meet the requirements of Section 17121 and 17125, respectively.

D. Provide Owner with two (2) disk copies of the unlocked source code for the final as-built controller program along with the printed copies of the program required for inclusion in the O&M Manual. Provide the Owner one copy of the pump controller loading software.

E. Pump controller inputs and outputs are listed in the Input/Output Schedule attached to this Section. The controller shall also provide I/O for equipment provided by others as shown

on the Drawings and listed in the Input/Output Schedule. This information, together with the functional control descriptions, process and instrumentation diagrams, and electrical control schematics, describes the real-time monitoring and control functions to be performed. In addition, the system shall provide various man/machine interface and data reporting functions as specified in the software sections of this Specification.

F. Final acceptance of the Pump Control System will be determined complete by the Engineer and shall be based upon the following:

1. Receipt of acceptable startup completion and availability reports and other documentation as required by the Contract Documents.

2. Completion of the Availability Demonstration

3. Completion of all specified control system training requirements

4. Completion of all punch-list items that are significant in the opinion of the Engineer.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 11440 – Submersible Pumping Equipment

B. Section 17000 – Control and Information System Scope and General Requirements

C. Section 17030 – Control and Information System Submittals

D. Section 17040 – Control and Information System Training Requirements

E. Section 17050 – Tools, Supplies and Spare Parts

F. Section 17060 – Signal Coordination Requirements

G. Section 17070 – Control and Information System Testing

H. Section 17071 – Factory Acceptance Test

I. Section 17072 – Field Testing

J. Section 17073 – Final Acceptance Test

K. Section 17080 – Quality Assurance

L. Section 17100 – Control and Information System Hardware

M. Section 17121 – Programmable Pump Controllers

N. Section 17125 – Operator Interface Units

O. Section 17180 – Process Control System Networks

P. Section 17190 – Uninterruptible Power Systems

Q. Section 17500 – Enclosures, General

R. Section 17510 – Cabinets and Panels

S. Section 17520 – Field Panels

T. Section 17550 – Panel Instruments and Accessories

U. Section 17650 – Surge Protection Devices

V. Section 17600 – Unpowered Instruments, General

W. Section 17670 – Level Switches

X. Section 17700 – Powered Instruments, General'

Y. Section 17749 – Submersible Level (Pressure) Sensors

Z. Section 16620 – Packaged Engine Generator Systems

1.03 PROCESS OVERVIEW

A. Woodward Way Pump Station 1 is designed to manage its wet well level under both dry weather and wet weather conditions.

B. Two small submersible chopper pumps (DWP) shall operate in a Lead-Lag configuration during dry weather, low flow conditions. The Lead large pump shall act as the Standby Pump for dry weather operations.

C. During wet weather, high-flow conditions, three large submersible chopper pumps (WWP) shall also operate in addition to the small pumps in a Lead-Lag-Standby configuration.

D. A pump controller shall provide local manual control of the pumps, automatic control of the pumps based on level, a local human-machine Interface (HMI), and remote telemetry communication with the City of Atlanta SCADA network through a cellular modem furnished by others.

E. Under normal conditions, the pump station shall be automatically controlled by logic in the pump controller based on wet well level as measured by a submersible level transmitter.

F. In the event of failure of the pump controller or the submersible level transmitter, backup level control of the pumps shall be accomplished with relay logic in the Pump Station

Control Panel using discrete inputs from float level switches in the wet well. This relay logic backup control shall be accomplished in complete isolation from the pump controller.

G. There are separate force mains for the small dry weather pumps and the large wet weather pumps. Discharge flows through the two force mains shall be measured individually.

H. Two motor-operated valves allow the contents of the wet well to be recirculated during low wet well level conditions to prevent sedimentation at the bottom of the wet well. The pump controller shall provide control logic for the recirculation events which may be regularly scheduled, initiated manually, or not permitted to occur.

PART 2 PRODUCTS

2.01 CONTROL EQUIPMENT

A. Two small submersible chopper pumps (P-01, P-02) are provided under this Section for dry weather operation. The OIT touchscreen and selector switches provide local manual control of the pumps. Automatic level control is provided through relay (float switches) or pump controller logic (submersible level transmitter). Remote manual control of the pumps shall be provided through telemetry. Pumps are equipped with vendor-provided high temperature and moisture protection.

B. Three large submersible chopper pumps (P-03, P-04, P-05) are provided under this Section for wet weather operation. The OIT touchscreen and selector switches provide local manual control of the pumps. Automatic level control shall be provided through relay (float switches) or pump controller logic (submersible level transmitter. Remote manual control of the pumps shall be provided through telemetry. Pumps shall be equipped with vendor-provided high temperature and moisture protection.

C. Two motor-operated valves, V-08 on the small pump discharge header, Sanitary Force Main 1, and V-09 on the recirculation line, are provided under Division 15. These valves can be positioned locally through controls on the actuator or remotely through the pump controller. Positioning these valves allows the contents of the wet well either to be pumped to discharge or to be recirculated to prevent sedimentation in the wet well. During low wet well level conditions, recirculation can be performed either manually or automatically on a timed basis when the Lead dry weather pump is called to run.

D. A dead-front, lockable, 316 SST, NEMA 4X control panel with sunshade, maximum size XXXX, shall contain all electrical and control panel components required and shall be provided under this Section. Operator controls mounted on the inner swingout panel shall include:

1. Operator interface terminal (OIT)

2. Controller/Auto/Backup Mode selector switch for pump station

3. Reset Controls pushbutton

4. Pump Hand/Off/Remote selector switch for each pump

5. Pump Run and Fault indicators for each pump

6. Small Pump Lead Select 1/2/Alternate

7. Large Pump Lead Select 3/4/5/Alternate

8. Non-resettable Runtime meters for each pump

E. Electrical requirements for the control panel shall include:

1. The control panel shall have a single point of connection to 480 VAC, 3-phase power and shall be furnished with a main circuit breaker. The main circuit breaker shall be interlocked with the panel door mechanism to prevent opening of the panel door when the panel is energized. Additional circuit breakers shall be provided in the circuits of the system major pieces of equipment. The panels shall include all necessary circuit breakers and protective devices including surge suppressors. The panel main breaker shall be sized to supply all equipment and devices associated with the system as specified herein and indicated on the drawings. Step-down transformers shall be provided for all associated 120 VAC or 24 VAC circuits.

2. Panel shall contain all motor controls (circuit breakers, motor starters, etc.) for equipment associated with the pumping system.

3. Panel shall include a single fused or circuit breaker type NEMA 4X lockable disconnect switch operable from outside the control panel.

4. Panel shall have a Short Circuit rating of 42kA RMS Symmetrical.

5. Panel shall be UL508 labeled.

6. Panel shall contain a motor circuit protector and reversing magnetic starter for each pump.

7. Panel shall contain a control power transformer with primary fuses.

8. Panel shall have a surge protection device (SPD) connected to the load side of the main circuit breaker. SPD shall have a surge current rating of 100kA per mode for each phase and shall meet UL1449.

9. Panel shall have surge protection on all analog signals and all copper data signal wiring entering or leaving the panel.

F. A pump controller in the pump control panel at the pump station shall be provided under this Section to provide local manual control of the pumps, automatic control of the pumps based on level, and remote telemetry communication with the City of Atlanta SCADA network through a cellular modem furnished by others.

G. An operator interface terminal (OIT) on the swingout panel of the pump control panel shall be provided under this section. Operator interface (handswitches, indicators, alarms) shall be provided on the OIT screen as shown on the Drawings and as described in this Section at minimum.

H. A submersible level transmitter (LE/LT-110) located in the pump wet well shall be provided under this Section for level control of the pumps.

I. Float switches located in the pump wet well (LS-115 A-G) shall be provided under this Section for backup level control of the pumps in the event of submersible level transmitter or pump controller failure. Provide intrinsic safety barriers in the pump control panel for the signals from the float switches.

J. Magnetic flowmeters on Sanitary Force Mains 1 and 2 (FE/FIT-131, 132) shall be provided under Section 17 to measure pump station discharge.

K. A sump pump in the Valve Vault Dry Well sump with vendor control panel shall be provided under Division 11. The sump pump control panel shall provide inputs as shown on the Drawings and as listed in the I/O list for local and remote indication and alarms.

L. A combustible gas detection system shall be provided under Division 17 to monitor combustible gas levels in the pump station wet well. The combustible gas detection control panel shall provide inputs as shown on the Drawings and as listed in the I/O list for local and remote alarms.

M. A generator shall be provided under Division 16 to provide emergency power for the pump station. The generator shall provide inputs as shown on the Drawings and as listed in the I/O list for local and remote indication and alarms. Coordinate communication protocol and register locations with the generator supplier.

N. A UPS in the pump control panel shall be provided under this Section to provide emergency backup power for the pump controls. The UPS controls shall provide inputs as shown on the Drawings and as listed in the I/O list for local and remote indication and alarms.

O. A cellular modem, SIM card, and any required antennas shall be furnished by the Owner for communications between the pump controller and the City of Atlanta SCADA system. The modem shall be located in a future telemetry panel at the pump station which shall be provided under Division 17. The Owner shall provide configuration of the modem and modifications to the City's SCADA system.

P. Coordinate IP addresses with the Owner.

Q. Provide complete register mapping to the Owner.

PART 3 EXECUTION

3.01 PUMP CONTROL OPERATIONS FOR AUTOMATIC LEVEL CONTROL (ANALOG)

A. The Hand-Off-Remote (H/O/R) selector switches on the pump control panel shall determine whether the pumps shall be manually run, run by control logic in the pump control panel, or prohibited from running. When a pump Hand-Off-Remote (H/O/R) selector switch is in the Hand position, the pump shall run continuously. When the H/O/R selector switch is in the Off position, the pump shall not run under any condition. When the H/O/R selector switch is in the Remote position, the pump shall be controlled by the pump controller or by the relay control logic as determined by the Controller/Auto/Backup selector switch on the pump control panel.

B. The Controller/Auto/Backup selector switch on the pump control panel shall determine whether the pump station (all five pumps and the two valves) shall be controlled by either the pump controller or the level-based relay control logic. When the Controller/Auto/Backup selector switch is in the Controller position, pumps and valves shall be operated either manually or automatically through the pump controller. When the Controller/Auto/Backup selector switch is in the Auto position, pumps and valves shall be controlled by the pump controller unless the pump controller or the analog level transmitter fails (loss of signal, signal out of range, analog level input disagrees with level float switch input). Upon failure of either the controller or the level transmitter, the controller shall provide a discrete signal to the level-based relay control logic to transfer pump station control (see description below) to relay control. Any pumps currently running shall remain running if called to do so by the relay control logic. Pump station control from the pump controller shall be disabled. The pumps shall continue to operate under relay control logic control until the pump controller operation and analog level signal are operational and control is manually switched back to the analog control mode by the operator with the Reset Controls pushbutton at the pump control panel. When the Controller/Auto/Backup selector switch is in the Backup position, pumps shall be controlled by level-based relay control logic (see description below) and valves shall be positioned for pump station discharge (see valve control description below).

C. When the Hand/Off/Remote (H/O/R) selector on the pump control panel is in the Remote position, the Hand/Off/Auto (H/O/A) selector on the OIT display shall determine control of the pump. When the OIT H/O/A switch is in the Hand position, the pump shall run continuously. When the OIT H/O/A switch is in the Off position, the pump shall not run under any condition. When the OIT H/O/A switch is in the Auto position, the pump shall be controlled automatically based on level through pump controller logic or level-based relay control logic (see descriptions below). Pump Controller outputs to the pump starters to call the pumps to run shall be momentary discrete outputs.

D. In either the Hand or the Auto mode, all pumps running shall be stopped at the All Pumps Off level setpoint (see chart below).

E. In the Auto mode, a maximum of four pumps will be permitted to run at the same time.

F. Automatic pump control (analog)

1. In the Auto mode, the two small pumps (P-01 and P-02) will operate in a Lead-Lag-Standby configuration based on level in the wet well. The operator will select Pump 1 or Pump 2 as the Lead pump with the handswitch on the pump control panel or select the Lead pump to automatically alternate between Pump 1 and Pump 2 each time the Lead pump shuts down. The current Lead large pump (Pump P-03, P-04, or P-05) shall act as the Standby small pump in the event a small pump is called to run and is not available.

2. In the Auto mode, the three large pumps (P-03, P-04, P-05) will operate in a Lead-Lag-Standby configuration based on level in the wet well. The operator will select the Lead Large Pump from Pumps 3, 4 or 5 with the handswitch on the pump control panel or select the Lead pump to automatically alternate between Pumps 3, 4 and 5 each time the Lead pump shuts down. When a Lead pump has been selected, the next pump in the sequence becomes the Lag large pump. If the Lead large pump has been called to run as the Standby small pump, the Lag large pump shall become the Lead large pump and the Standby large pump shall become the Lag large pump.

3. Pumps that are not in Auto or are failed shall not be considered for Auto control. If a pump fails to start when called to run or fails during operation, the next pump in the sequence shall immediately be started.

4. In the Auto mode, the small and large pumps shall be controlled according to wet well levels as shown below. Setpoint levels shall be operator adjustable.

Analog Setpoint Level	**Action**
El. 776.5 feet	Overflow Invert Elevation High High Level Alarm Calculate Overflow Amount
El. 762.9 feet	Inlet Sewer Invert Elevation (no action)
El. 762.5 feet, increasing	High Level Alarm

El. 761.4 feet, increasing	Start Lag Large Pump
El. 758.1 feet, decreasing	Stop Lag Large Pump
El. 758.2 feet, increasing	Start Lead Large Pump
El. 754.9 feet, decreasing	Stop Lead Large Pump
El. 754.9 feet, increasing	Start Lag Small Pump
El. 753.9 feet, decreasing	Stop Lag Small Pump
El. 753.9 feet, increasing	Start Lead Small Pump
El. 752.9 feet, decreasing	Stop Lead Small Pump
El. 752.0 feet, decreasing	All Pumps Off, Low Low Level Alarm
El. 750.6 feet	Wet well floor elevation (no action)

5. In the Auto mode, if the small pumps have been selected to automatically alternate and the Lead small pump has been running continuously for 24 hours, the Lag small pump shall become the new Lead small pump. If the former Lead small pump has been running alone (wet well level below the Start Lag Small Pump setpoint), the new Lead small pump shall start and the former Lead small pump shall stop. If both the Lead and Lag small pumps are currently running, the former Lead pump shall stop the next time the wet well level drops below the Stop Lag Small Pump setpoint while the new Lead pump shall continue running.

3.02 ANALOG LEVEL MEASUREMENT

A. Under normal conditions, wet well level control shall be based on the analog input from the submersible level transmitter.

B. The analog wet well level signal shall be displayed on the pump controller OIT and used for pump control logic as described in this Section.

C. High Wetwell Level, Low Wetwell Level, and Wetwell Overflow alarms shall be displayed on the pump controller OIT.

D. The pump controller shall at all times monitor both the analog level input from the submersible level transmitter and the discrete level inputs from the float switches to compare levels transmitted by each to verify that the submersible transmitter is operating properly. If the analog level signal fails or goes out of range (below 4 mA or above 20

mA), or if the compared analog and discrete level signals are not within close agreement, the condition shall be alarmed at the pump controller OIT.

3.03 FLOW MEASUREMENT

A. The small pumps discharge to Sanitary Forcemain 1 (dry weather flows). Dry weather flows are measured by magmeter FE/FIT-131 which provides an analog input to the pump controller. The dry weather flow is indicated on the pump controller OIT. Daily, weekly and monthly dry weather flows are totalized and indicated on the pump controller OIT.

B. The large pumps discharge to Sanitary Forcemain 2 (wet weather flows). Wet weather flows are measured by magmeter FE/FIT-132 which provides an analog input to the pump controller. The wet weather flow is indicated on the pump controller OIT. Daily, weekly and monthly wet weather flows are totalized and indicated on the pump controller OIT.

3.04 MOTOR-OPERATED VALVE CONTROL

A. Two motor-operated valves allow the contents of the wet well to be recirculated during low wet well level conditions to prevent sedimentation at the bottom of the wet well.

B. Local/Remote handswitches on the valve actuators shall determine whether operation of the valve will be controlled by Open/Close operators on the actuator when the handswitch is in the Local position or by outputs from the pump control panel when the handswitch is in the Remote position.

C. Hand/Auto handswitches on the pump controller OIT display shall determine whether operation of the valve will be controlled by Open/Close operators on the OIT display when the handswitch is in the Hand position or by outputs from the pump control panel when the handswitch is in the Auto position.

D. A Recirculation Manual/Auto handswitch on the pump controller OIT display shall determine whether a Recirculation Event occurs automatically based on time or manually as initiated by the operator. An Initiate Recirculation operator on the pump controller OIT display shall initiate one Recirculation Event sequence.

E. Valve V-08, located on Forcemain 1, shall be in the Open position during pump discharge operations. Valve V-08 shall be in the Closed position during a Recirculation Event.

F. Valve V-06, located on the small pump recirculation line, shall be in the Closed position during pump discharge operations. Valve V-06 shall be in the Open position during a Recirculation Event.

G. Either Valve V-08 or Valve V-06 must be open for the small pumps to operate. If both valves are detected to be in the closed position when a small pump is called to run, the pump shall not be permitted to run and the condition shall be alarmed at the pump controller OIT. The level in the wetwell shall be permitted to rise to the Lead Large Pump Run level, at which point the Lead Large Pump shall pump down the wetwell level.

H. Provide an alarm on the pump controller OIT display if a valve has been placed in the Local mode at the valve actuator and remains in the Local mode for an operator-adjustable length of time, originally set at 30 minutes.

I. Wetwell Recirculation:

1. Contents of the wet well shall be periodically recirculated to prevent sedimentation. A Recirculation Event consists of closing motorized valve V-08 on the Sanitary Forcemain 1 discharge, opening motorized valve V-09 on the recirculation line, and operating one of the small pumps for an adjustable length of time.

2. A recirculation event may be manually initiated at the pump controller OIT display or performed automatically through logic in the pump controller. Automatic recirculation may be scheduled every 1-7 days for a predetermined length of time (0-15 minutes) upon the first Lead small pump automatic start of the scheduled day. A manually initiated semi-automatic recirculation event will begin the next time level in the wet well rises to the Lead Small Pump Start setpoint level. Both V-08 and V-09 and the Lead small pump must be in the Auto mode for an automatic recirculation event to begin. If an automatic recirculation event cannot be initiated because valves and/or pumps are failed or not in the Auto mode, a Recirculation Event Fail to Start alarm shall be displayed at the pump controller OIT. Automatic recirculation frequency and recirculation time period length shall be adjustable through the pump controller logic.

3. When a recirculation event is manually initiated or scheduled to begin, Valve V-08 on the discharge line shall close and Valve V-09 on the recirculation line shall open. If either valve is not verified to be in the proper recirculation position after an adjustable length of time, initially set at 30 seconds, the recirculation event shall be aborted and the condition shall be alarmed at the pump controller OIT display. When the valves are in the proper recirculation position, the Lead Small Pump shall be called to run when level in the wet well rises to the Lead Small Pump Start setpoint level. The Lead Small Pump shall run for the duration of the scheduled recirculation. At the end of the recirculation event, Valve V-08 on the discharge line shall open. When V-08 is verified open, Valve V-09 on the recirculation line shall close. The Lead Small Pump shall continue to run as determined by pump controller automatic pump control logic. If the valves do not return to the proper pump out position, the condition shall be alarmed at the pump controller OIT display and the small pumps shall not be permitted to run. The

level in the wetwell shall be permitted to rise to the Lead Large Pump Run level, at which point the Lead Large Pump shall pump down the wetwell level.

4. If level in the wet well continues to rise during the recirculation event to the Start Lag Small Pump setpoint level, V-08 on the discharge line shall open. When V-08 is verified open, Valve V-09 on the recirculation line shall close. The recirculation event shall be terminated and the Lead and Lag small pumps shall run as determined by automatic pump control logic. A Recirculation Event Terminated alarm shall be displayed at the pump controller OIT.

3.05 PUMP CONTROL OPERATIONS FOR BACKUP LEVEL CONTROL (DISCRETE)

A. The Hand-Off-Remote (H/O/R) selector switches on the pump control panel shall determine whether the pumps shall be manually run, run by control logic in the pump control panel, or prohibited from running. When a pump Hand-Off-Remote (H/O/R) selector switch is in the Hand position, the pump shall run continuously. When the H/O/R selector switch is in the Off position, the pump shall not run under any condition. When the H/O/R selector switch is in the Remote position, the pump shall be controlled by the pump controller or by the relay control logic as determined by the Controller/Auto/Backup selector switch on the pump control panel.

B. The Controller/Auto/Backup selector switch on the pump control panel shall determine whether the pump station (all five pumps and the two valves) shall be controlled by either the pump controller or the level-based relay control logic. When the Controller/Auto/Backup selector switch is in the Controller position, pumps and valves shall be operated either manually or automatically through the pump controller. When the Controller/Auto/Backup selector switch is in the Auto position, pumps and valves shall be controlled by the pump controller unless the pump controller or the analog level transmitter fails (loss of signal, signal out of range, analog level input disagrees with level float switch input). Upon failure of either the controller or the level transmitter, the controller shall provide a discrete signal to the level-based relay control logic to transfer pump station control (see description below) to relay control. Any pumps currently running shall remain running if called to do so by the relay control logic. Pump station control from the pump controller shall be disabled. The pumps shall continue to operate under relay control logic control until the pump controller operation and analog level signal are operational and control is manually switched back to the analog control mode by the operator with the Reset Controls pushbutton at the pump control panel. When the Controller/Auto/Backup selector switch is in the Backup position, pumps shall be controlled by level-based relay control logic and valves shall be positioned for pump station discharge (see valve control description).

C. When the Hand/Off/Remote (H/O/R) selector on the pump control panel is in the Remote position, the Hand/Off/Auto (H/O/A) selector on the OIT display determines control of the pump. When the OIT H/O/A switch is in the Hand position, the pump shall run

continuously. When the OIT H/O/A switch is in the Off position, the pump shall not run under any condition. When the OIT H/O/A switch is in the Auto position, the pump shall be controlled automatically based on level through pump controller logic or level-based relay control logic (see descriptions below). Pump Controller outputs to the pump starters to call the pumps to run shall be momentary discrete outputs.

D. In either the Hand or the Auto mode, all pumps running shall be stopped at the All Pumps Off level setpoint (see chart below).

E. In the Auto mode, a maximum of four pumps will be permitted to run at the same time.

F. Automatic pump control (discrete):

1. In the Backup Control mode, control by the pump controller shall be disabled and operator interface with the pumps shall be limited to the Hand/Off/Remote and Lead Select handswitches and Run and Fault indicators on the pump control panel. All pumps selected at the pump control panel to be in the Remote mode shall operate in the Auto mode as described herein. Pumps shall be called to run and stop based on discrete inputs from float level switches located in the wetwell. The relay logic shall provide outputs to open Discharge Valve V-08 if it is closed and to close Recirculation Valve V-06 if it is open.

2. The two small pumps (P-01 and P-02) shall operate in a Lead-Lag-Standby configuration based on level in the wet well. The operator shall select Pump 1 or Pump 2 as the Lead pump with the handswitch on the pump control panel or select the Lead pump to automatically alternate between Pump 1 and Pump 2 each time the Lead pump shuts down. The current Lead large pump (Pump P-03, P-04, or P-05) shall act as the Standby small pump in the event a small pump is called to run and is not available.

3. The three large pumps (P-03, P-04, P-05) shall operate in a Lead-Lag-Standby configuration based on level in the wet well. The operator shall select the Lead Large Pump from Pumps 3, 4 or 5 with the handswitch on the pump control panel or select the Lead pump to automatically alternate between Pumps 3, 4 and 5 each time the Lead pump shuts down. When a Lead pump has been selected, the next pump in the sequence becomes the Lag large pump. If the Lead large pump has been called to run as the Standby small pump, the Lag large pump shall become the Lead large pump and the Standby large pump shall become the Lag large pump.

4. If a pump fails to start when called to run or fails during operation, the next pump in the sequence shall immediately be started.

5. The small and large pumps shall be controlled according to wet well levels as shown below. Installed setpoint levels shall be manually adjustable in the field.

Float Switch	Action
Float 7	Overflow Invert Elevation High High Level Alarm Calculate Overflow Amount
	Inlet Sewer Invert Elevation (no action)
Float 6	Start Lag Large Pump High Level Alarm
Float 5	Stop Lag Large Pump
Float 5	Start Lead Large Pump
Float 4	Stop Lead Large Pump
Float 4	Start Lag Small Pump
Float 3	Stop Lag Small Pump
Float 3	Start Lead Small Pump
Float 2	Stop Lead Small Pump
Float 1	All Pumps Off, Low Low Level Alarm
	Wet well floor elevation (no action)

3.06 JAMMED PUMP CONTROLS

A. The pump controller shall monitor the input from the current transmitter for each pump. On detection of a Pump Jammed (High Current) condition in either the Hand or Auto mode, the pump controller shall automatically stop the pump and jog it in the Reverse direction to attempt to clear the obstruction. The length of time that the pump shall run in reverse shall be determined at startup. When the pump has run in Reverse for the required length of time, the pump controller shall stop the pump and restart it in the Forward direction. If the jam (High Current alarm) is cleared, the pump shall resume normal operation. If the jam (High Current condition) still exists, the pump controller shall perform up to two additional reversing cycles (three cycles total maximum) before stopping the pump and generating a Fault alarm if the High Current alarm is still active. If called by level control logic, the next pump in the sequence shall be called to run as replacement.

3.07 WETWELL OVERFLOW CALCULATIONS

A. Parameters:

1. X = Elevation (in feet) of the top of the overflow box, determined by the submersible level transmitter. This parameter shall be set at startup by filling the wetwell with clean water to the top of the overflow box. Supervisory access shall be required to change this parameter.
2. Y = Water surface elevation (in feet) as measured by the submersible level transmitter. This parameter shall be continuously measured during pump station operations.
3. C = Weir coefficient = 3.3. Supervisory access shall be required to change this parameter.
4. L = Length of weir = 5.33 feet. This parameter shall be verified from the installed weir box during startup. Supervisory access shall be required to change this parameter.
5. H = Depth of water over weir (Y – X)
6. Q = Estimated flow (gal/min) = $C * L * H^{(3/2)} * (448.6 \text{ gal/min}/1 \text{ ft}^3/\text{sec})$
7. Interval Duration = Time interval over which to perform the calculation. Initial value shall be 1 minute. Supervisory access shall be required to change this parameter.
8. Event = Sequential number of events in which a spill has occurred. Event 1 is the first spill recorded, Event 2 is the second spill recorded, etc.

B. Procedure:

1. When Y is greater than or equal to X, assign a new event and begin calculating overflow

2. When Y drops below X, end event

3. Calculate overflow Q across each interval.

4. Total spill volume for event = Interval * (Q1 + Q2 + Q3 . . .)

3.08 VALVE CHAMBER SUMP

A. The dry well sump pump with vendor-furnished control panel and level switch operates automatically upon detection of liquid in the dry well sump.

B. The sump pump control panel shall provide outputs to the pump controller for Sump Pump Run and Sump Pump Fault. Pump Run and Fault conditions shall be displayed at the pump controller OIT.

3.09 COMBUSTIBLE GAS MONITORING

A. The level of combustible gas in the pump station wetwell shall be monitored and displayed locally at combustible gas sensor panel and the pump controller OIT.

B. A High Combustible Gas Level condition shall be alarmed locally at the combustible gas sensor panel and the pump controller OIT.

3.10 GENERATOR

A. The generator operates automatically on loss of utility power to provide backup power for the pumps.

B. The generator will provide the following inputs to the pump controller for indication and alarm at the pump controller OIT:

1. Normal power
2. Generator power
3. Generator Fault
4. Low Fuel

C. The pump controller shall generate an alarm if the generator has been run longer than a length of time determined by the generator manufacturer that will alert the operator prior to the generation of a Low Fuel Alarm.

D. The pump controller shall receive Remote Start and Remote Stop inputs from the City of Atlanta SCADA System to exercise the generator.

+++ END OF SECTION 11440A +++

SECTION 11440 INPUT/OUTPUT LIST

SORTED BY NODE AND I/O TYPE

I/O Tag	Service Description	Function	PLC	I/O Type	P&ID	Comments
YA-300A	UPS	Fault	Pump Station Control Panel	DI	I-003	
YN-300B	UPS	Low Battery	Pump Station Control Panel	DI	I-003	
YN-300	UPS	On UPS Power	Pump Station Control Panel	DI	I-003	
LI-110	Wetwell	Level	Pump Station Controller	AI	I-003	
FI-131	Dry Weather	Flow	Pump Station Controller	AI	I-003	

I/O Tag	Service Description	Function	PLC	I/O Type	P&ID	Comments
FI-132	Wet Weather	Flow	Pump Station Controller	AI	I-003	
AI-210	Wetwell Combustible Gas	% LEL	Pump Station Controller	AI	I-003	
YA-220A	Generator	Fault	Pump Station Controller	DDI	I-003	
YA-220B	Generator	Low Fuel	Pump Station Controller	DDI	I-003	
YN-220B	Generator	Generator Power	Pump Station Controller	DDI	I-003	
YN-220A	Generator	Normal Power	Pump Station Controller	DDI	I-003	
HS-220A	Generator	Remote Start	Pump Station Controller	DDO	I-003	

I/O Tag	Service Description	Function	PLC	I/O Type	P&ID	Comments
HS-220B	Generator	Remote Stop	Pump Station Controller	DDO	I-003	
IA-101	Pump 1	Fault Alarm	Pump Station Controller	DI	I-003	
II-101	Pump 1	Current Fault	Pump Station Controller	DI	I-003	
MAH-101	Pump 1	Moisture Alarm	Pump Station Controller	DI	I-003	
TAH-101	Pump 1	High Temp Shutdown	Pump Station Controller	DI	I-003	
YA-101	Pump 1	Fault	Pump Station Controller	DI	I-003	
YN-101	Pump 1	Run Status	Pump Station Controller	DI	I-003	

I/O Tag	Service Description	Function	PLC	I/O Type	P&ID	Comments
LAH-115	Wetwell	High Level	Pump Station Controller	DI	I-003	
LI-115B	Wetwell	Level 2	Pump Station Controller	DI	I-003	
LI-115C	Wetwell	Level 3	Pump Station Controller	DI	I-003	
LI-115D	Wetwell	Level 4	Pump Station Controller	DI	I-003	
LI-115E	Wetwell	Level 5	Pump Station Controller	DI	I-003	
LI-115F	Wetwell	Level 6	Pump Station Controller	DI	I-003	
LI-115A	Wetwell	Low Level	Pump Station Controller	DI	I-003	

I/O Tag	Service Description	Function	PLC	I/O Type	P&ID	Comments
LAH-116	Drywell	High Level	Pump Station Controller	DI	I-003	
YN-121	Recirculation Valve	In Remote	Pump Station Controller	DI	I-003	
ZNC-121	Recirculation Valve	Closed Status	Pump Station Controller	DI	I-003	
ZNO-121	Recirculation Valve	Open Status	Pump Station Controller	DI	I-003	
YN-122	Dry Weather Discharge Shutoff Valve	In Remote	Pump Station Controller	DI	I-003	
ZNC-122	Dry Weather Discharge Shutoff Valve	Closed	Pump Station Controller	DI	I-003	
ZNO-122	Dry Weather Discharge Shutoff Valve	Open	Pump Station Controller	DI	I-003	

I/O Tag	Service Description	Function	PLC	I/O Type	P&ID	Comments
YA-140	Sump Pump	Fault	Pump Station Controller	DI	I-003	
YN-140	Sump Pump	Run	Pump Station Controller	DI	I-003	
TAH-190	Control Panel	High Temperature	Pump Station Controller	DI	I-003	
ZNO-190	Control Panel	Intrusion Alarm	Pump Station Controller	DI	I-003	
YA-210	Wetwell Combustible Gas	Gas Detector Fail	Pump Station Controller	DI	I-003	
HS-101D	Pump 1	Jog Reverse	Pump Station Controller	DO	I-003	
HS-101A	Pump 1	Start/Stop	Pump Station Controller	DO	I-003	

I/O Tag	Service Description	Function	PLC	I/O Type	P&ID	Comments
HSC-121	Recirculation Valve	Close Command	Pump Station Controller	DO	I-003	
HSO-121	Recirculation Valve	Open Command	Pump Station Controller	DO	I-003	
HSC-122	Dry Weather Discharge Shutoff Valve	Close	Pump Station Controller	DO	I-003	
HSO-122	Dry Weather Discharge Shutoff Valve	Open Status	Pump Station Controller	DO	I-003	

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PUMP SUPPLIER INSTRUMENT LIST

Level Switches (Suspended Float Type) - 17670

Tag	Service Description	Range/Setpoint	Size	P&ID	Comment
LS-115A	Wetwell Level Float Switch	-	-	I-003	Class 1, Division 1 Service; Provide 80 feet cable minimum
LS-115B	Wetwell Level Float Switch	-	-	I-003	Class 1, Division 1 Service; Provide 80 feet cable minimum
LS-115C	Wetwell Level Float Switch	-	-	I-003	Class 1, Division 1 Service; Provide 80 feet cable minimum
LS-115E	Wetwell Level Float Switch	-	-	I-003	Class 1, Division 1 Service; Provide 80 feet cable minimum
LS-115F	Wetwell Level Float Switch	-	-	I-003	Class 1, Division 1 Service; Provide 80 feet cable minimum
LS-115D	Wetwell Level Float Switch	-	-	I-003	Class 1, Division 1 Service; Provide 80 feet cable minimum
LS-115G	Wetwell Level Float Switch	-	-	I-003	Class 1, Division 1 Service; Provide 80 feet cable minimum

Submersible Level (Pressure) Systems - 17749

Tag	Service Description	Range/Setpoint	Size	P&ID	Comment
LE-110	Wetwell Hydrostatic Level Sensor	-	-	I-003	Class 1, Division 1 Service; Provide 80 feet cable minimum

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1.1 INSTRUMENTATION AND CONTROLS:

.1 GENERAL

.a The Pump Supplier shall provide all components and required and/or specified ancillary services in connection with a fully operational Pump Control System as specified in this Section. The System includes all materials, labor, tools, fees, charges and documentation required to furnish, install, test and place in operation a complete and operable Pump Control System as shown and/or specified. The system shall include all measuring elements, signal converters, transmitters, local control panels, digital hardware and software, operator workstations, remote telemetry units, signal and data transmission systems, interconnecting wiring and such accessories as shown, specified, and/or required to provide the functions indicated.

.b All submittals, services, training, and testing required under Division 17 shall be provided by the pump supplier for the Pump Control System and shall meet the requirements of the Division 17 specifications. All components, control panels, and panel hardware and software of the Pump Control System shall meet the requirements of the Division 17 specifications. The Pump Supplier shall have overall responsibility for all equipment (including field instrumentation and control system hardware and software) offered under this Division for the Pump Control System while retaining the option of obtaining the services of an instrumentation and control system subcontractor for portions of the work. Any instrumentation and control system subcontractor providing services for this project under this Section shall meet the requirements of Section 17000.

.c Pump controller inputs and outputs are listed in the Input/Output Schedule attached to this Section. The controller shall also provide I/O for equipment provided by others as shown on the Drawings and listed in the Input/Output Schedule. This information, together with the functional control descriptions, process and instrumentation diagrams, and electrical control schematics, describes the real-time monitoring and control functions to be performed. In addition, the system shall provide various man/machine interface and data reporting functions as specified in the software sections of this Specification.

.d Final acceptance of the Pump Control System will determined complete by the Engineer and shall be based upon the following:

1) Receipt of acceptable startup completion and availability reports and other documentation as required by the Contract Documents.

2) Completion of the Availability Demonstration

3) Completion of all specified control system training requirements

4) Completion of all punch-list items that are significant in the opinion of the Engineer.

.2 PROCESS OVERVIEW

.a Woodward Way Pump Station 1 is designed to manage its wet well level under both dry weather and wet weather conditions.

.b Two small submersible chopper pumps (DWP) shall operate in a Lead-Lag configuration during dry weather, low flow conditions. The Lead large pump shall act as the Standby Pump for dry weather operations.

.c During wet weather, high-flow conditions, three large submersible chopper pumps (WWP) shall also operate in addition to the small pumps in a Lead-Lag-Standby configuration.

.d A pump controller shall provide local manual control of the pumps, automatic control of the pumps based on level, a local human-machine Interface (HMI), and remote telemetry communication with the City of Atlanta SCADA network through a cellular modem furnished by others.

.e Under normal conditions, the pump station shall be automatically controlled by logic in the pump controller based on wet well level as measured by a submersible level transmitter.

.f In the event of failure of the pump controller or the submersible level transmitter, backup level control of the pumps shall be accomplished with relay logic in the Pump Station Control Panel using discrete inputs from float level switches in the wet well. This relay logic backup control shall be accomplished in complete isolation from the pump controller.

.g There are separate force mains for the small dry weather pumps and the large wet weather pumps. Discharge flows through the two force mains shall be measured individually.

.h Two motor-operated valves allow the contents of the wet well to be recirculated during low wet well level conditions to prevent sedimentation at the bottom of the wet well. The pump controller shall provide control logic for the recirculation events which may be regularly scheduled, initiated manually, or not permitted to occur.

.3 CONTROL EQUIPMENT

.a Two small submersible chopper pumps (P-01, P-02) are provided under Division 11 for dry weather operation. The OIT touchscreen and selector switches provide local manual control of the pumps. Automatic level

control is provided through relay (float switches) or pump controller logic (submersible level transmitter). Remote manual control of the pumps shall be provided through telemetry. Pumps are equipped with vendor-provided high temperature and moisture protection.

.b Three large submersible chopper pumps (P-03, P-04, P-05) are provided under Division 11 for wet weather operation. The OIT touchscreen and selector switches provide local manual control of the pumps. Automatic level control shall be provided through relay (float switches) or pump controller logic (submersible level transmitter. Remote manual control of the pumps shall be provided through telemetry. Pumps shall be equipped with vendor-provided high temperature and moisture protection.

.c Two motor-operated valves, V-08 on the small pump discharge header, Sanitary Force Main 1, and V-09 on the recirculation line, are provided under Division 15. These valves can be positioned locally through controls on the actuator or remotely through the pump controller. Positioning these valves allows the contents of the wet well either to be pumped to discharge or to be recirculated to prevent sedimentation in the wet well. During low wet well level conditions, recirculation can be performed either manually or automatically on a timed basis when the Lead dry weather pump is called to run.

.d A dead-front, lockable, 316 SST, NEMA 4X control panel with sunshade, maximum size XXXX, which will contain all electrical and control panel components required shall be provided under this Section. Operator controls mounted on the inner swingout panel shall include:

1) Operator interface terminal (OIT)

2) Controller/Auto/Backup Mode selector switch for pump station

3) Reset Controls pushbutton

4) Pump Hand/Off/Remote selector switch for each pump

5) Pump Run and Fault indicators for each pump

6) Small Pump Lead Select 1/2/Alternate

7) Large Pump Lead Select 3/4/5/Alternate

8) Non-resettable Runtime meters for each pump

.e Electrical requirements for the control panel shall include:

1) The control panel shall have a single point of connection to 480 VAC, 3-phase power and shall be furnished with a main circuit breaker. The main circuit breaker shall be interlocked with the panel door mechanism to prevent opening of the panel door when the panel is energized. Additional circuit breakers shall be provided in the circuits of the system major pieces of equipment. The panels shall include all necessary circuit breakers and protective devices including surge suppressors. The panel main breaker shall be sized to supply all equipment and devices associated with the system as specified herein and indicated on the drawings. Step-down transformers shall be provided for all associated 120 VAC or 24 VAC circuits.

2) Panel shall contain all motor controls (circuit breakers, motor starters, etc.) for equipment associated with the pumping system.

3) Panel shall include a single fused or circuit breaker type NEMA 4X lockable disconnect switch operable from outside the control panel.

4) Panel shall have a Short Circuit rating of 42kA RMS Symmetrical.

5) Panel shall be UL508 labeled.

6) Panel shall contain a motor circuit protector and reversing magnetic starter for each pump.

7) Panel shall contain a control power transformer with primary fuses.

8) Panel shall have a surge protection device (SPD) connected to the load side of the main circuit breaker. SPD shall have a surge current rating of 100kA per mode for each phase and shall meet UL1449.

.f A pump controller in the pump control panel at the pump station shall be provided under this Section to provide local manual control of the pumps, automatic control of the pumps based on level, and remote telemetry communication with the City of Atlanta SCADA network through a cellular modem furnished by others.

.g An operator interface terminal (OIT) on the swingout panel of the pump control panel shall be provided under this section. Operator interface (handswitches, indicators, alarms) shall be provided on the OIT screen as shown on the Drawings and as described in this Section at minimum.

.h A submersible level transmitter (LE/LT-110) located in the pump wet well shall be provided under this Section for level control of the pumps.

.i Float switches located in the pump wet well (LS-115 A-G) shall be provided under this Section for backup level control of the pumps in the event of submersible level transmitter or pump controller failure.

.j Magnetic flowmeters on Sanitary Force Mains 1 and 2 (FE/FIT-131, 132) shall be provided under Section 17 to measure pump station discharge.

.k A sump pump in the Valve Vault Dry Well sump with vendor control panel shall be provided under Division 11. The sump pump control panel shall provide inputs as shown on the Drawings and as listed in the I/O list for local and remote indication and alarms.

.l A combustible gas detection system shall be provided under Division 17 to monitor combustible gas levels in the pump station wet well. The combustible gas detection control panel shall provide inputs as shown on the Drawings and as listed in the I/O list for local and remote alarms.

.m A generator shall be provided under Division 16 to provide emergency power for the pump station. The generator shall provide inputs as shown on the Drawings and as listed in the I/O list for local and remote indication and alarms.

.n A UPS in the pump control panel shall be provided under this Section to provide emergency backup power for the pump controls. The UPS controls shall provide inputs as shown on the Drawings and as listed in the I/O list for local and remote indication and alarms.

.o A cellular modem, SIM card, and any required antennas shall be provided by the Owner for communications between the pump controller and the City of Atlanta SCADA system. The modem shall be located in a future telemetry panel at the pump station which shall be provided by others. The Owner shall provide configuration of the modem and modifications to the City's SCADA system.

.4 PUMP CONTROL OPERATIONS FOR AUTOMATIC LEVEL CONTROL (ANALOG)

.a The Hand-Off-Remote (H/O/R) selector switches on the pump control panel determines whether the pumps shall be manually run, run by control logic in the pump control panel, or prohibited from running. When a pump Hand-Off-Remote (H/O/R) selector switch is in the Hand position, the pump shall run continuously. When the H/O/R selector switch is in the Off position, the pump shall not run under any condition. When the H/O/R selector switch is in the Remote position, the pump shall be controlled by the pump controller or by the relay control logic as determined by the Controller/Auto/Backup selector switch on the pump control panel.

.b The Controller/Auto/Backup selector switch on the pump control panel determines whether the pump station (all five pumps and the two valves) shall be controlled by either the pump controller or the level-based relay control logic. When the Controller/Auto/Backup selector switch is in the Controller position, pumps and valves shall be operated either manually or automatically through the pump controller. When the Controller/Auto/Backup selector switch is in the Auto position, pumps and valves shall be controlled by the pump controller unless the pump controller or the analog level transmitter fails (loss of signal, signal out of range, analog level input disagrees with level float switch input). Upon failure of either the controller or the level transmitter, the controller shall provide a discrete signal to the level-based relay control logic to transfer pump station control (see description below) to relay control. Any pumps currently running shall remain running if called to do so by the relay control logic. Pump station control from the pump controller shall be disabled. The pumps shall continue to operate under relay control logic control until the pump controller operation and analog level signal are operational and control is manually switched back to the analog control mode by the operator with the Reset Controls pushbutton at the pump control panel. When the Controller/Auto/Backup selector switch is in the Backup position, pumps shall be controlled by level-based relay control logic (see description below) and valves shall be positioned for pump station discharge (see valve control description below).

.c When the Hand/Off/Remote (H/O/R) selector on the pump control panel is in the Remote position, the Hand/Off/Auto (H/O/A) selector on the OIT display determines control of the pump. When the OIT H/O/A switch is in the Hand position, the pump shall run continuously. When the OIT H/O/A switch is in the Off position, the pump shall not run under any condition. When the OIT H/O/A switch is in the Auto position, the pump shall be controlled automatically based on level through pump controller logic or level-based relay control logic (see descriptions below). Pump Controller outputs to the pump starters to call the pumps to run shall be momentary discrete outputs.

.d In either the Hand or the Auto mode, all pumps running shall be stopped at the All Pumps Off level setpoint (see chart below).

.e In the Auto mode, a maximum of four pumps will be permitted to run at the same time.

.f Automatic pump control (analog)

1) In the Auto mode, the two small pumps (P-01 and P-02) will operate in a Lead-Lag-Standby configuration based on level in the wet well. The operator will select Pump 1 or Pump 2 as the Lead pump with the handswitch on the pump control panel or select the Lead pump to automatically alternate between Pump

1 and Pump 2 each time the Lead pump shuts down. The current Lead large pump (Pump P-03, P-04, or P-05) shall act as the Standby small pump in the event a small pump is called to run and is not available.

2) In the Auto mode, the three large pumps (P-03, P-04, P-05) will operate in a Lead-Lag-Standby configuration based on level in the wet well. The operator will select the Lead Large Pump from Pumps 3, 4 or 5 with the handswitch on the pump control panel or select the Lead pump to automatically alternate between Pumps 3, 4 and 5 each time the Lead pump shuts down. When a Lead pump has been selected, the next pump in the sequence becomes the Lag large pump. If the Lead large pump has been called to run as the Standby small pump, the Lag large pump shall become the Lead large pump and the Standby large pump shall become the Lag large pump.

3) Pumps that are not in Auto or are failed shall not be considered for Auto control. If a pump fails to start when called to run or fails during operation, the next pump in the sequence shall immediately be started.

4) In the Auto mode, the small and large pumps shall be controlled according to wet well levels as shown below. Setpoint levels shall be operator adjustable.

Analog Setpoint Level	**Action**
El. 776.5 feet	Overflow Invert Elevation High High Level Alarm Calculate Overflow Amount
El. 762.9 feet	Inlet Sewer Invert Elevation (no action)
El. 762.5 feet, increasing	High Level Alarm
El. 761.4 feet, increasing	Start Lag Large Pump
El. 758.1 feet, decreasing	Stop Lag Large Pump
El. 758.2 feet, increasing	Start Lead Large Pump
El. 754.9 feet, decreasing	Stop Lead Large Pump
El. 754.9 feet, increasing	Start Lag Small Pump
El. 753.9 feet, decreasing	Stop Lag Small Pump
El. 753.9 feet, increasing	Start Lead Small Pump

El. 752.9 feet, decreasing	Stop Lead Small Pump
El. 752.0 feet, decreasing	All Pumps Off, Low Low Level Alarm
El. 750.6 feet	Wet well floor elevation (no action)

5) In the Auto mode, if the small pumps have been selected to automatically alternate and the Lead small pump has been running continuously for 24 hours, the Lag small pump shall become the new Lead small pump. If the former Lead small pump has been running alone (wet well level below the Start Lag Small Pump setpoint), the new Lead small pump shall start and the former Lead small pump shall stop. If both the Lead and Lag small pumps are currently running, the former Lead pump shall stop the next time the wet well level drops below the Stop Lag Small Pump setpoint while the new Lead pump shall continue running.

.5 ANALOG LEVEL MEASUREMENT

.a Under normal conditions, wet well level control is based on the analog input from the submersible level transmitter.

.b The analog wet well level signal shall be displayed on the pump controller OIT and used for pump control logic as described in this Section.

.c High Wetwell Level, Low Wetwell Level, and Wetwell Overflow alarms shall be displayed on the pump controller OIT.

.d The pump controller shall at all times monitor both the analog level input from the submersible level transmitter and the discrete level inputs from the float switches to compare levels transmitted by each to verify that the submersible transmitter is operating properly. If the analog level signal fails or goes out of range (below 4 mA or above 20 mA), or if the compared analog and discrete level signals are not within close agreement, the condition shall be alarmed at the pump controller OIT.

.6 FLOW MEASUREMENT

.a The small pumps discharge to Sanitary Forcemain 1 (dry weather flows). Dry weather flows are measured by magmeter FE/FIT-131 which provides an analog input to the pump controller. The dry weather flow is indicated on the pump

controller OIT. Daily, weekly and monthly dry weather flows are totalized and indicated on the pump controller OIT.

.b The large pumps discharge to Sanitary Forcemain 2 (wet weather flows). Wet weather flows are measured by magmeter FE/FIT-132 which provides an analog input to the pump controller. The wet weather flow is indicated on the pump controller OIT. Daily, weekly and monthly wet weather flows are totalized and indicated on the pump controller OIT.

.7 MOTOR-OPERATED VALVE CONTROL

.a Two motor-operated valves allow the contents of the wet well to be recirculated during low wet well level conditions to prevent sedimentation at the bottom of the wet well.

.b Local/Remote handswitches on the valve actuators determine whether operation of the valve will be controlled by Open/Close operators on the actuator when the handswitch is in the Local position or by outputs from the pump control panel when the handswitch is in the Remote position.

.c Hand/Auto handswitches on the pump controller OIT display determine whether operation of the valve will be controlled by Open/Close operators on the OIT display when the handswitch is in the Hand position or by outputs from the pump control panel when the handswitch is in the Auto position.

.d A Recirculation Manual/Auto handswitch on the pump controller OIT display determines whether a Recirculation Event occurs automatically based on time or manually as initiated by the operator. An Initiate Recirculation operator on the pump controller OIT display shall initiate one Recirculation Event sequence.

.e Valve V-08, located on Forcemain 1, shall be in the Open position during pump discharge operations. Valve V-08 shall be in the Closed position during a Recirculation Event.

.f Valve V-06, located on the small pump recirculation line, shall be in the Closed position during pump discharge operations. Valve V-06 shall be in the Open position during a Recirculation Event.

.g Either Valve V-08 or Valve V-06 must be open for the small pumps to operate. If both valves are detected to be in the closed position when a small pump is called to run, the pump shall not be permitted to run and the condition shall be alarmed at the pump controller OIT.

.h Wetwell Recirculation:

1) Contents of the wet well shall be periodically recirculated to prevent sedimentation. A Recirculation Event consists of closing motorized valve V-08 on the Sanitary Forcemain 1 discharge, opening motorized valve V-09 on the recirculation line, and operating one of the small pumps for an adjustable length of time.

2) A recirculation event may be manually initiated at the pump controller OIT display or performed automatically through logic in the pump controller. Automatic recirculation may be scheduled every 1-7 days for a predetermined length of time (0-15 minutes) upon the first Lead small pump automatic start of the scheduled day. A manually initiated semi-automatic recirculation event will begin the next time level in the wet well rises to the Lead Small Pump Start setpoint level. Both V-08 and V-09 and the Lead small pump must be in the Auto mode for an automatic recirculation event to begin. If an automatic recirculation event cannot be initiated because valves and/or pumps are failed or not in the Auto mode, a Recirculation Event Fail to Start alarm shall be displayed at the pump controller OIT. Automatic recirculation frequency and recirculation time period length shall be adjustable through the pump controller logic.

3) When a recirculation event is manually initiated or scheduled to begin, Valve V-08 on the discharge line shall close and Valve V-09 on the recirculation line shall open. The Lead Small Pump shall be called to run when level in the wet well rises to the Lead Small Pump Start setpoint level. The Lead Small Pump shall run for the duration of the scheduled recirculation. At the end of the recirculation event, Valve V-08 on the discharge line shall open. When V-08 is verified open, Valve V-09 on the recirculation line shall close. The Lead Small Pump shall continue to run as determined by pump controller automatic pump control logic.

4) If level in the wet well continues to rise during the recirculation event to the Start Lag Small Pump setpoint level, V-08 on the discharge line shall open. When V-08 is verified open, Valve V-09 on the recirculation line shall close. The recirculation event shall be terminated and the Lead and Lag small pumps shall run as determined by automatic pump control logic. A Recirculation Event Terminated alarm shall be displayed at the pump controller OIT.

.8 PUMP CONTROL OPERATIONS FOR BACKUP LEVEL CONTROL (DISCRETE)

.a The Hand-Off-Remote (H/O/R) selector switches on the pump control panel determines whether the pumps shall be manually run, run by control logic in the pump control panel, or prohibited from running. When a pump Hand-Off-Remote (H/O/R) selector switch is in the Hand position, the pump shall run continuously. When the H/O/R selector switch is in the Off position, the pump shall not run under

any condition. When the H/O/R selector switch is in the Remote position, the pump shall be controlled by the pump controller or by the relay control logic as determined by the Controller/Auto/Backup selector switch on the pump control panel.

.b The Controller/Auto/Backup selector switch on the pump control panel determines whether the pump station (all five pumps and the two valves) shall be controlled by either the pump controller or the level-based relay control logic. When the Controller/Auto/Backup selector switch is in the Controller position, pumps and valves shall be operated either manually or automatically through the pump controller. When the Controller/Auto/Backup selector switch is in the Auto position, pumps and valves shall be controlled by the pump controller unless the pump controller or the analog level transmitter fails (loss of signal, signal out of range, analog level input disagrees with level float switch input). Upon failure of either the controller or the level transmitter, the controller shall provide a discrete signal to the level-based relay control logic to transfer pump station control (see description below) to relay control. Any pumps currently running shall remain running if called to do so by the relay control logic. Pump station control from the pump controller shall be disabled. The pumps shall continue to operate under relay control logic control until the pump controller operation and analog level signal are operational and control is manually switched back to the analog control mode by the operator with the Reset Controls pushbutton at the pump control panel. When the Controller/Auto/Backup selector switch is in the Backup position, pumps shall be controlled by level-based relay control logic and valves shall be positioned for pump station discharge (see valve control description).

.c When the Hand/Off/Remote (H/O/R) selector on the pump control panel is in the Remote position, the Hand/Off/Auto (H/O/A) selector on the OIT display determines control of the pump. When the OIT H/O/A switch is in the Hand position, the pump shall run continuously. When the OIT H/O/A switch is in the Off position, the pump shall not run under any condition. When the OIT H/O/A switch is in the Auto position, the pump shall be controlled automatically based on level through pump controller logic or level-based relay control logic (see descriptions below). Pump Controller outputs to the pump starters to call the pumps to run shall be momentary discrete outputs.

.d In either the Hand or the Auto mode, all pumps running shall be stopped at the All Pumps Off level setpoint (see chart below).

.e In the Auto mode, a maximum of four pumps will be permitted to run at the same time.

.f Automatic pump control (discrete):

1) In the Backup Control mode, control by the pump controller shall be disabled and operator interface with the pumps shall be limited to the Hand/Off/Remote and Lead Select handswitches and Run and Fault indicators on the pump control panel. All pumps selected at the pump control panel to be in the Remote mode shall operate in the Auto mode as described herein. Pumps shall be called to run and stop based on discrete inputs from float level switches located in the wetwell. The relay logic shall provide outputs to open Discharge Valve V-08 if it is closed and to close Recirculation Valve V-06 if it is open.

2) The two small pumps (P-01 and P-02) will operate in a Lead-Lag-Standby configuration based on level in the wet well. The operator will select Pump 1 or Pump 2 as the Lead pump with the handswitch on the pump control panel or select the Lead pump to automatically alternate between Pump 1 and Pump 2 each time the Lead pump shuts down. The current Lead large pump (Pump P-03, P-04, or P-05) shall act as the Standby small pump in the event a small pump is called to run and is not available.

3) The three large pumps (P-03, P-04, P-05) will operate in a Lead-Lag-Standby configuration based on level in the wet well. The operator will select the Lead Large Pump from Pumps 3, 4 or 5 with the handswitch on the pump control panel or select the Lead pump to automatically alternate between Pumps 3, 4 and 5 each time the Lead pump shuts down. When a Lead pump has been selected, the next pump in the sequence becomes the Lag large pump. If the Lead large pump has been called to run as the Standby small pump, the Lag large pump shall become the Lead large pump and the Standby large pump shall become the Lag large pump.

4) If a pump fails to start when called to run or fails during operation, the next pump in the sequence shall immediately be started.

5) The small and large pumps shall be controlled according to wet well levels as shown below. Installed setpoint levels shall be manually adjustable in the field.

Float Switch	**Action**
Float 7	Overflow Invert Elevation High High Level Alarm Calculate Overflow Amount
	Inlet Sewer Invert Elevation (no action)
Float 6	Start Lag Large Pump

	High Level Alarm
Float 5	Stop Lag Large Pump
Float 5	Start Lead Large Pump
Float 4	Stop Lead Large Pump
Float 4	Start Lag Small Pump
Float 3	Stop Lag Small Pump
Float 3	Start Lead Small Pump
Float 2	Stop Lead Small Pump
Float 1	All Pumps Off, Low Low Level Alarm
	Wet well floor elevation (no action)

.9 JAMMED PUMP CONTROLS

.a The pump controller shall monitor the input from the current transmitter for each pump. On detection of a Pump Jammed (High Current) condition in either the Hand or Auto mode, the pump controller shall automatically stop the pump and jog it in the Reverse direction to attempt to clear the obstruction. The length of time that the pump shall run in reverse shall be determined at startup. When the pump has run in Reverse for the required length of time, the pump controller shall stop the pump and restart it in the Forward direction. If the jam (High Current alarm) is cleared, the pump shall resume normal operation. If the jam (High Current condition) still exists, the pump controller shall perform up to two additional reversing cycles (three cycles total maximum) before stopping the pump and generating a Fault alarm if the High Current alarm is still active. If called by level control logic, the next pump in the sequence shall be called to run as replacement.

.10 WETWELL OVERFLOW CALCULATIONS

.a Parameters:

- X = Elevation (in feet) of the top of the overflow box, determined by the submersible level transmitter. This parameter shall be set at startup by filling the

wetwell with clean water to the top of the overflow box. Supervisory access shall be required to change this parameter.

- Y = Water surface elevation (in feet) as measured by the submersible level transmitter. This parameter shall be continuously measured during pump station operations.
- C = Weir coefficient = 3.3. Supervisory access shall be required to change this parameter.
- L = Length of weir = 5.33 feet. This parameter shall be verified from the installed weir box during startup. Supervisory access shall be required to change this parameter.
- H = Depth of water over weir (Y – X)
- Q = Estimated flow (gal/min) = C * L * $H^{(3/2)}$ * (448.6 gal/min/1 ft^3/sec)
- Interval Duration = Time interval over which to perform the calculation. Initial value shall be 1 minute. Supervisory access shall be required to change this parameter.
- Event = Sequential number of events in which a spill has occurred. Event 1 is the first spill recorded, Event 2 is the second spill recorded, etc.

.b Procedure:

1) When Y is greater than or equal to X, assign a new event and begin calculating overflow

2) When Y drops below X, end event

3) Calculate overflow Q across each interval.

4) Total spill volume for event = Interval * (Q1 + Q2 + Q3 . . .)

.11 VALVE CHAMBER SUMP

.a The dry well sump pump with vendor-provided control panel and level switch operates automatically upon detection of liquid in the dry well sump.

.b The sump pump control panel shall provide outputs to the pump controller for Sump Pump Run and Sump Pump Fault. Pump Run and Fault conditions shall be displayed at the pump controller OIT.

.12 COMBUSTIBLE GAS MONITORING

.a The level of combustible gas in the pump station wetwell shall be monitored and displayed locally at combustible gas sensor panel and the pump controller OIT.

.b A High Combustible Gas Level condition shall be alarmed locally at the combustible gas sensor panel and the pump controller OIT.

.13 GENERATOR

.a The generator operates automatically on loss of utility power to provide backup power for the pumps.

.b The generator will provide the following inputs to the pump controller for indication and alarm at the pump controller OIT:

1) Normal power
2) Generator power
3) Generator Fault
4) Low Fuel

.c The pump controller shall generate an alarm if the generator has been run longer than a length of time determined by the generator manufacturer that will alert the operator prior to the generation of a Low Fuel Alarm.

.d The pump controller shall receive Remote Start and Remote Stop inputs from the City of Atlanta SCADA System to exercise the generator.

SECTION 13034

SECURITY WALL

1.01 DESCRIPTION

A. This Section specifies the design, manufacture, delivery and erection of an eighteen-foot (18') high security wall system including foundations, retaining wall, panels, steel support posts, sliding gate, and all accessories complete in place in the location as shown on the Drawings. The work includes furnishing all materials, labor and equipment, providing all other incidental items of work as specified herein, and/or as otherwise directed by the Engineer. The work shall also include, removing the existing stockade fence, excavation for test pits to locate existing utilities, and geotechnical explorations as needed to determine site soil characteristics for foundation design.

1.02 RELATED WORK

A. Other specifications sections which directly relate to the work of this section include, but are not limited to, the following:

1. Section 02010 – Geotechnical Data
2. Section 02100 - Site Preparation
3. Section 02200 - Earthwork
4. Section 03100 - Concrete Formwork
5. Section 03200 - Concrete Reinforcement
6. Section 03300 - Cast-In-Place Concrete
7. Section 05120 – Structural Steel
8. Section 05500 - Miscellaneous Metal

1.03 SUBMITTALS

A. Design computations and drawings:

1. Submit a copy of design computations and drawings for the security wall system including, but not limited to panels, posts, foundations and any connections, for review and approval prior to beginning construction. The design computations and drawings shall be signed, sealed and detailed by a Professional Engineer licensed to practice Engineering in the State of Georgia. Foundation design to include stability analysis of foundation for security wall and section of retaining wall attached to the security wall.

   a. The design computations shall include all test reports and certifications as specified.

   b. The design drawings shall include all details, dimensions, quantities and cross-sections necessary to construct the wall and foundations, and shall include the following:

      1) A plan view of the wall showing all locations of turning points and beginning and end of wall stations.

a) The plan view shall also show all above ground and underground utilities within 10 feet of the wall location.
b) Underground utility locations shall be based on test pits (see Sections 02200 and 02650).
c) Where existing utilities are to be relocated, the plan view shall also show the new location of the utility.
d) The plan view shall show the location of the boundary of flagged wetlands, as indicated on the Drawings.
e) The plan view shall show the location of each foundation, including offsets to utilities or structures within 5 feet of the centerline of wall.
f) The plan view shall show the Authority's right-of-way line and indicate Authority property and private property.

2) An elevation view of the wall including the elevation at the top of the wall at all horizontal and vertical break points and at least every 50 feet along the face of the wall. All steps in the top and bottom of the wall, the designation as to the type of panel, the distance along the face of the wall to where changes in the, exposure condition, design wall height, and wind pressure occur, and an indication of the original and final ground lines.

3) Cross sections at each change in elevation, showing the elevation relationship between ground conditions and proposed grades. Cross sections shall also show all utilities adjacent to the wall, including underground pipes, overhead wires, and poles.

4) General notes pertaining to design criteria and wall construction.

5) A summary of quantities for each wall.

6) Clearly indicated details for construction of walls around sliding access gate and drainage facilities.

7) Details of the architectural treatment, including color, on both sides of the security wall.

8) The shop drawings shall include all details, dimensions, quantities and cross-sections necessary to construct the security wall and foundations (drilled shafts with cap beam and retaining wall), including a schedule which shall include stations, offsets, top and bottom of shaft elevations, vertical and spiral reinforcement diameter and length, and all other relevant information.

c. Submit the following independent testing laboratory reports with the design computations, and certifying that the security wall panels to be supplied will meet the requirements stated herein.

1) Salt Scaling Resistance: Testing for resistance to deicing chemicals shall be performed in accordance with modified ASTM Standard C 672 "Standard Test Method for Scaling Resistance of Concrete Surfaces Exposed to Deicing Chemicals". After 50 cycles of freezing and thawing in a minimum 3% solution of sodium

chloride, the sound absorptive concrete shall not exhibit excessive deterioration in the form of cracks, spalls, aggregate disintegration or other objectionable features.

2) Resistance to rapid Freezing and Thawing: The panel material shall not exhibit significant deterioration when subjected to 300 cycles of freezing and thawing under ASTM Standard C 666 procedure A "Rapid Freezing and Thawing .in Water".

3) Resistance to Vermin Damage: Sound absorptive materials shall be resistant to damage caused by insects.

4) Flame Spread and Smoke Density Developed: The sound absorptive material shall exhibit a Flame Spread Index of 10 or less and a Smoke Density Developed Value of 10 or less, when tested in accordance with ASTM E84 for flame spread and smoke density developed.

5) Weatherometer tests, Minimum 2400 hours ASTM G26 to be submitted on coated samples

B. Sliding Gate

1. Manufacturer's product data.
2. Detailed shop drawings of the sliding gate layout, including installation details of the gates, fabric, hardware and accessories.
3. PVC Coated Fencing: manufacturer's color chart of available colors and physical sample of the selected color.

1.04 QUALITY CONTROL

A. The manufacturer must have a minimum of 5 years proven experience in the manufacturing of similar panels.

B. The visual appearance of the security wall panels in terms of color, pattern and texture, shall be uniform when viewed at a distance 50 feet from the face of the wall. Any visual blemishes shall be repaired and touched-up per Manufacturer's specifications.

C. Sliding Gate: Chain Link Fence Manufacturers Institute (CLFMI): CLFMI Publication, "Standards for Chain Link Fence Installation"

1.05 SITE CONDITIONS

A. Environmental Controls:

1. Prior to the start of construction, install erosion and sedimentation control devices as specified in Section 02100.

B. Work Zone:

1. Prior to the start of wall construction, remove existing fence and create work zone to construct new security wall.

C. Safety:

1. Refer applicable sections of Division 1 for site safety requirements.

D. For limitations on operation, public convenience and safety, hours of operation, and other site constraints, refer to the Supplementary Conditions and the applicable sections of Division 1.

E. Existing Utilities

1. The Contractor shall notify "Dig Safe" prior to the start of construction to determine the exact location of existing utilities. Prior to the design of the layout of wall foundations, take test pits to verify locations of underground utilities.

3. The layout of wall foundations shall avoid conflicts with existing utilities.

4. Overhead wires and utility poles are located near the alignment of the security wall. Unless otherwise indicated on the Drawings, these lines shall remain in place. Protect utilities prior to the construction of the proposed wall. Care shall be taken so as not to damage these utilities.

F. Site Restoration

1. Seeding and Sodding - Upon completion, the Contractor shall restore the surfaces of all work areas to the satisfaction of the Engineer. Restoration shall include the obliteration of wheel tracks and ruts, and where necessary, shall also include the disposal of excess excavated material, regrading and loaming and seeding, as shown on the Contract plans and/or as directed by the Engineer.

PART 2 - PRODUCTS

2.01 GENERAL

A. The Security wall shall consist of decorative panels placed between steel posts spaced a maximum of 8 feet on center, supported by drilled shaft foundations with cap beams.

B. The residential side (outside) shall have a molded high relief ashlar stone finish, minimum relief of 1", with a smooth projecting coping cast integral with the top panel of the wall. The pump station side (interior side) shall have a pressed-in line finish with minimum relief of 1/2".

C. The security wall components shall be supplied by one of the following manufacturer's or Engineer approved Substitute.

1.

2.

3.

E. The security wall system and its components shall conform to and be in accordance with all Federal, State and Local standards, and specifications governing the design, structural integrity, manufacturing, materials and installation of the security wall system.

2.02 DESIGN CRITERIA

A. The structural and foundation (drilled shafts) design of the security wall system shall be in accordance with the AASHTO Guide Specifications for Structural Design of Sound Barriers, 1989, including 2002 Interim, and the Georgia State Building Code.

B. All material shall have a minimum maintenance free life span of 20 years.

C. Unless otherwise shown on the plans or approved by the Engineer, the Contractor shall design the top of the security wall to be horizontal. The bottom of the security wall shall be raised a minimum 6 inches above finished grade. Changes in elevation shall be accomplished by stepping panels at post locations. Steps shall not exceed 2 feet in height, unless specifically noted.

D. The security wall shall be designed to withstand wind pressure, as applied perpendicular to the security, in each direction. Design wind pressure shall be the greater of 21 pounds per square foot (PSF), or as specified in AASHTO Guide Specifications for Structural Design of Sound Barriers.

E. The maximum allowable panel deflection shall be no more than the panel length divided by 180 (L/180) when subjected to the design wind load. Panels shall be tested for bending strength. The test shall apply lateral loads to the panel simulating uniform wind pressure. A lateral load test report shall be submitted to the Engineer to confirm compliance.

F. The Contractor shall carry out site investigations to determine soil parameters, water tables, location of underground services and above grade obstructions. The Manufacturer shall use these parameters to determine the depths, sizes and locations of foundations.

G. The maximum allowable post deflection shall be no more than the length above grade divided by 180 (L/180).

H. The wall shall be designed for the hydraulic effects of a flood at El. 789.10.

I. The retaining wall shall be designed for an HS20 axel load or 250 psf surcharge load.

J. The Contractor shall perform and submit a stability analysis of the security wall foundation including the section of security wall and retaining wall attached.

2.03 MATERIALS

A. All concrete work shall be in accordance with Standard Specifications Sections 03100, 03200, 03300, 03310, 03350 and 03400. Concrete compressive strength at 28 days shall be not less than 5,000 psi.

B. Panels to be heavy duty vinyl with simulated stone facing.

C. Posts

1. Posts, base plates and other steel members shall conform to the requirements of ASTM A36, Structural Steel, and shall be galvanized, after fabrication, in accordance with the requirements of ASTM A 123, Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products and the following. Posts and base plates shall be factory coated with an epoxy coating after fabrication. Exposed surfaces of anchor bolts and nuts shall be painted in the field after installation with an epoxy paint. Damaged coating shall be repaired in the field.

2. The galvanizing bath shall contain 0.05% to 0.09% nickel (by weight).

3. Galvanized members requiring shop assembly shall be welded prior to galvanizing.

4. Steel anchor bolts shall meet the requirements of ASTM A307, and shall be galvanized in accordance with ASTM A 153. Steel nuts and washers shall meet the requirements of ASTM A 325, and galvanized in accordance with ASTM A 153.

5. Steel posts shall be designed for the maximum spacing of 8 feet on center, and designed for the required wall height of 18 feet. Post design details shall be noted on the shop drawing submittal.

6. The posts shall be attached to the cap beam by means of a base plate and anchor bolt assembly. The supplier of the wall shall design the connection to the foundation.

2.03 SLIDING GATE

A. Sliding Gates: Gates shall be sliding type, furnished complete with all hardware and accessories as required for a complete installation. Fencing shall include fabric, covering, framework, concrete footings, gates, hardware and all appurtenances and accessories required for a complete installation.

1. Height of sliding gate shall be 12 feet.
2. Gate Frames: Gate frames shall be fabricated from zinc-coated steel pipe members to match zinc-coated fencing having a minimum outside dimension of 1.90-inches and weighing not less than 2.72 pounds per linear foot.
3. Fabrication: Conform to the applicable requirements of ASTM F900, Federal Specification RR-F-191/2C and the following:
   a. Assemble gates by welding or with fittings and rivets for rigid connections. Install fabric with stretcher bars at vertical edges and wire ties at top and

bottom edges. Attach stretcher bars to gate frames at not more than 15-inches on center. Attach hardware with rivets or by other means that will provide security against removal or breakage.

b. Provide additional horizontal and vertical members to ensure proper gate operation and for attachment of fabric, hardware and accessories.

c. Provide diagonal cross bracing consisting of minimum ½-inch diameter adjustable length truss rods on gates where necessary to provide frame rigidly without sag or twist.

4. PVC Coated Steel Fence Fabric
   a. Fabric shall be 9-gauge wire, woven to 2-inch squares.
   b. Fabric shall be PVC coated in accordance with ASTM F 668.
   c. Color shall be selected by the Owner from manufacturer's standard colors as specified in ASTM F934.
5. Gate Hardware:
   a. Sliding Gates: Provide manufacturer's standard rubber tired rollers and roller track for floor supported sliding gates. Include intermediate rollers or casters where required to prevent gate sag or deflection. Provide locking device and padlock eyes as part of latch for locking gate with a padlock,

PART 3 - EXECUTION

3.01 SITE PREPARATION

A. Site preparation is specified in Section 02100.

B. The Contractor shall clear, grub, and trim vegetation along the alignment of the security wall. Refer to Section 02100. Do not remove vegetation beyond the limits of work as indicated on the Drawings.

C. Prior to the start of construction, install erosion and sedimentation controls as specified in Section 02100.

3.02 EARTHWORK AND FOUNDATIONS

A. General:

1. Earthwork shall be performed in accordance with Section 02200.

B. Test Pits:

1. Prior to the layout and design of the security wall, take test pits to locate existing underground utilities that cross the alignment of the wall or are within 10 feet of the wall alignment.

C. Foundations:

1. The depth, type and size of foundations shall be clearly indicated on the shop drawings, and shall be designed with reference to the soil strength and site conditions for the project by a Registered Professional Engineer in the State of Georgia.

2. Drilled shaft excavation shall consist of the removal and disposal of all materials, including rock, encountered in forming the drilled shaft to the dimensions shown on the shop drawings or as directed by the Engineer. The Contractor shall provide the necessary equipment and special tools and shall use the necessary procedures to accomplish the excavation in an acceptable fashion. Should liners be required for augured holes, concrete shall be poured into the liner and the liner withdrawn as pouring of the concrete progresses.

3. The drilled hole shall be reasonably true and plumb to the stated diameter and depth. Precautions shall be taken in the operational procedures to protect the hole from collapse. Should rock or other obstructions be encountered in making the hole, this material shall be removed and any space outside the designed pier diameter shall be replaced with concrete.

4. The concrete in foundations shall be cured for a minimum period of five (5) days before work which places stress on the posts may be carried out. The tops of all cap beams are to be leveled shaped to allow shedding of water.

5. Where grade changes require bottom of the wall to be stepped the top of footing shall be constructed as shown on the Drawings and as per Manufacturer's specifications.

D. Protection of Existing Structures:

1. The Contractor shall take all reasonable precautions to prevent damage to existing structures and utilities. Preventive measures shall include, but are not limited to, selecting construction methods and procedures that will prevent caving of the shaft excavation, and monitoring and controlling the vibrations from construction activities such as the driving of casing or drilling of the shaft.

E. <u>Excavation and Drilling Equipment:</u>

1. Excavation and drilling equipment shall have adequate capacity including power, torque and down thrust to excavate a hole of the specified diameter and to a depth beyond the depth shown on the plans. The equipment shall be of adequate design to perform the work as indicated by the plans and as described herein. When the material encountered cannot be drilled using conventional earth augers or drill buckets the Contractor shall provide drilling equipment including but not limited to rock core barrels, rock tools, air tools and other equipment necessary to complete the shaft excavation to the required depth. Blasting will not be permitted unless specifically approved in writing by the Engineer.

2. Excavated materials which are removed from shaft excavations shall be disposed of by the Contractor in accordance with the applicable specifications for disposal of excavated materials.

3. The excavated shaft shall be cleaned so that a minimum of 50 percent of the base will have less than - inch of sediment and at no place on the base more than 1-1/2 inches of sediment.

Shaft cleanliness will be determined by the Engineer. In addition, for dry excavation the maximum depth of water shall not exceed 3 inches prior to concrete placement. For greater depth of water, a tremie placement shall be made- The use of casing shall be considered, particularly for excavation below the water table.

4. The Contractor shall provide equipment for checking the dimensions and alignment of each shaft excavation. The dimensions and alignment shall be determined by the Contractor under the direction of the Engineer. Final shaft depth shall be measured, after final cleaning, with a suitable weighted tape or other approved method.

5. The bottom of the drilled shaft may be adjusted during construction if the Engineer determines that the foundation material encountered during excavation is unsuitable or differs from that anticipated in the design of the drilled shaft.

6. All depths and diameters of drilled shafts will be as designed by the manufacturer, and as per the approved shop drawings.

3.03 INSTALLATION

A. General:

1. Security walls shall be installed and aligned in accordance with the fabrication drawings submitted by the Contractor and approved by the Engineer.

2. Field measurements shall be taken at all locations as required to ascertain dimensions that are pertinent to the installation of the security wall. Ill-fitting connections and details shall be cause for rejection and replacement or correction shall be made at the sole expense of the Contractor.

B. Post and Panel Installation:

1. Posts shall be installed plumb to within 1/2" of vertical for every 18' of height and to within 1/2" of the station and offset as specified on the shop drawings.

2. Panels shall be handled and installed with care to prevent damage to the surfaces. Damaged areas of the panels shall be repaired at the Contractor's expense in accordance with the manufacturer's recommendations and as approved by the Engineer.

3. The panels shall be delivered to the project site in full truckload quantities. They may be off-loaded from the flatbed truck individually or by forklift with a solid steel plate spanning between the forks, providing uniform, fully distributed bearing against the underside of the panels.

4. Panels shall be lifted into place with the use of the embedded lifting inserts. Tag lines shall be attached to the spreader cables to control swinging of the panel while suspended and to facilitate alignment of the panel for lowering into the posts. Panels shall be lowered into position between the post flanges. The bottom panel shall be placed directly upon the concrete cap and checked for level. If shimming is required, precast concrete blocks or a

grout base may be used. It is recommended that all bottom panels be installed for the full length of the wall prior to placing middle or top panels. After bottom panels are in place, finish grading can be accomplished with heavy equipment by reaching over the in-place panels. Problems associated with lack of access to the backside of the wall or limited right-of-way can be thereby avoided.

5. Provide all accessories, materials, and methods which are not specified herein, but which are essential for installation or construction of the panels commensurate with the best standard practice of the industry, subject to the approval of the Engineer, without additional compensation.

7. After erection is complete and before Final Acceptance of the Project, clean the security wall to remove dirt or stains.

C. Sliding Gate

1. Gate frames shall be welded or with fittings and rivets and shall be coated after assembly. The PVC coated fabric shall be rigidly attached to the frames. Frames shall be suitably braced and trussed.
2. Gate assemblies shall be provided with a combination spring latch and plunger rod of approved design for padlocking.
3. Furnish gates with galvanized steel stop/hold open device with catch or plunger rod of standard manufacture and approved design.

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SECTION 14600
FREESTANDING BRIDGE CRANE

PART 1 GENERAL

1.01 DESCRIPTION

A. The Work under this Section consists of the supply, installation, commissioning, performance testing after the installation and certification of a fully automated, custom-designed and -made, outdoor located Freestanding Bridge Crane (Crane).

B. This Section covers the work for the design, shop drawing submission, manufacturing, supply, shipping, unloading, site storage, installation, performance testing, training, commissioning of the specified equipment.

A. All the equipment shall be UL listed and conform to the AIS requirement of the Consolidated Appropriations Act of 2014.

1.02 RELATED SECTIONS

A. Freestanding Bridge Crane supply shall be coordinated with the works and equipment listed in the below sections:

1. Section 03300– Cast -in-Place Concrete

2. Section 11440 - Submersible Pumping Equipment.

3. Section 15100 - Valves & Actuators.

1.03 REFERENCES

A. All referenced standards shall be of the latest edition.

B. The following is a list of standards which will be referenced in this section:

1. American National Standards Institute (ANSI): ANSI B30.11 – Monorails and Under-Hung Cranes C.

2. American Institute of Steel Construction (AISC) - Manual of Steel Construction, Part 5, Specification for Structural Joints Using ASTM A325 or ASTM A490 Bolts.

3. AREMA Eng Man - Manual for Railway Engineering

4. ANSI B30.11 - Monorails and Underhung Cranes.

5. ASTM A36 - Carbon Structural Steel.

6. ASTM A325 - Structural Bolts, Steel, Heat Treated, 120/150 ksi Minimum Tensile Strength.

7. ASTM A490 - Structural Bolts, Alloy Steel, Heat Treated, 150 ksi Minimum Tensile Strength.

8. American Society for Testing and Materials (ASTM) B221 - Aluminum-Alloy Extruded Bar, Rod, Wire, Shape, and Tube.

9. American Welding Society (AWS) D1.1 - Structural Welding Code.

10. Occupational Safety and Health Administration (OSHA) - Specification 1910.179 - Overhead and Gantry Cranes.

11. CMAA Specifications 70 and 74: Traveling Bridge Cranes

12. MMA Specification MH27.2: Enclosed Track Under-Hung Cranes and Monorail Systems L.

13. American Recovery and Reinvestment Act (ARRA): Buy American Clause of May 2009

14. American Welding Society (AWS): Certified Shop I. Occupational Safety and Health Administration (OSHA) – Specification 1910.179: Overhead and Gantry Cranes

15. Workstation Bridge Cranes: AISC Steel Construction Manual, OSHA 1910.179, ANSI B30.11, AWS D1.1/D1.6, and MMA MH27.2.

16. Buy American Clause of the American Recovery and Reinvestment Act (ARRA) of May 2009.

1.04 DESCRIPTION OF WORK

A. Standard Equipment Specifications:

1. Length: Runway length is determined by length of a specific area requiring coverage.

2. Width: Bridge span is the length of a bridge between the center of two runways. Bridge length is the overall length.

3. Capacity: The maximum weight of the application should not exceed design weight. Bridge dead weight adds to the load the operator is moving.

4. Height: Height is measured from the floor to the trolley clevis from which the hoist is suspended.

5. Construction: Fabricated using ASTM A36 steel sections with finished ends and surfaces.

B. Work includes, but is not limited to the following:

1. Design and fabrication of a custom-made fully automated Freestanding Work Station Bridge Crane consisting of freestanding support structure, two runways, bridge moving perpendicular to runways and equipped with enclosed track, end trucks, hoist trolley, festooning conductor systems, bumpers, and other accessories.

2. Supply, delivery to the site, unloading, storage, supervision of installation and commissioning.

3. Instruction of facility staff in operating and maintenance procedures for the crane.

4. Supply of auxiliary equipment and services.

5. Supply and installation of field wiring and all the electrical and control components of the crane equipment. System shall be complete with pre-wired control panel.

6. Coordination of the crane design and operation with the process equipment specified in Division 11 and Division 15 and the Owner's maintenance truck dimension (the truck dimensions shall be confirmed with the Owner before the crane fabrication).

C. Retain the service of the Authorities Having Jurisdiction to certify installed and commissioned systems. Provide 3 hard copies of the certificates. All associated expense shall be borne by Contractor.

D. Provide instructions for any equipment maintenance required during storage.

E. During commissioning, make all changes and adjustments to the equipment. Supply all materials, equipment, labour and supervision required for such work. This work is to be done at the Supplier's expense.

1.05 PERFORMANCE REQUIREMENTS

A. Coverage: Crane shall provide coverage of rectangular area of the size indicated on drawings and consist of:

1. Support structure requiring only primary structural support without longitudinal or lateral bracing. The supports to be anchored to the concrete slab.

2. Two rigid, parallel runways; cranes with more than two runways or with articulating runways are not acceptable.

3. Rigid, single or double girder bridge moving perpendicular to runways or monorail.

B. Modular, Pre-engineered Design: Crane system shall be capable of expansion, disassembly, relocation, and the addition of multiple mixed capacity bridges.

C. Productivity Ratio: Crane shall be designed to manually move load with maximum force of 1/100 load weight if electrical components are disabled.

D. Deflection Guidelines: Workstation Bridge Crane shall be designed with maximum deflection of 1/450.

E. Crane Operating Temperature: +5 to +200 degrees F (-15 to 93 C).

F. Structural Design: The crane's structural design is based on live load capacity plus ~~15 percent for~~ hoist and trolley weights and additional 25 percent for impact.

G. Crane shall be designed to withstand:

1. Crane and hoist dead loads;

2. Live load capacity equal to net rated hook load;

3. Inertia forces from crane and load movement;

4. Outdoor condition of the site (humidity, corrosive environment, rain and snow events, wind, dust, sun light and UV irradiation, etc.).

1.06 EQUIPMENT LIST

Equipment Name	Location	Capacity, Ton.	Operators	Quantity	Equipment Tag No.
Free Standing Overhead Bridge Crane	Outdoor, on PS roof slab	1	Automated	1	**CRN01**

1.07 SUBMITTALS

A. Submit shop drawings and data for O&M Manuals in accordance with Division 1 and this section.

B. In shop drawings provide additional following information in one complete submittal:

1. Manufacturer's data, including equipment weight and applied forces to foundation.

2. General arrangement of the crane systems.

3. Make, model and weight of each equipment assembly.

4. Shop drawings showing Crane and rail beam, including catalog information, descriptive literature, materials of construction, all components of the crane structure, including columns, bridge, hoist trolley, hoist, operator, control system, control panels, festoon cable systems for power and pendant pushbutton station; portable, wireless, 2-position enabling device; electrical and control diagrams, as well as rail beam, rail beam connections, hangers, motors, electrical materials and equipment, electrical ratings and all other pertinent data and information, details, etc.

5. Structural design calculations, presented in the Imperial Units, for crane system including the trussed steel runways, truss hangers, truss bridge, support columns, cantilevers, trolley, rail beam, rail beam stops, rail beam connections, hangers and calculations of deflection, reactions on building structure, etc. The submitted calculations to be sealed and signed by a Professional Engineer licensed in the State of Georgia (USA).

6. Indicate requirements (size, material of construction, finishing, etc.) and installation procedure for the crane anchor bolts. If the anchor bolts are not the crane manufacturer supply scope, then the anchor bolts shall be supplied and installed by Contractor as per the crane manufacturer’s recommendations.

7. Submit installation manuals and testing procedures before shipping equipment.

8. Shipment and storage instructions.

C. Suggested spare parts list 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.

D. Submit certified test results of load tests for hoists.

1.08 QUALITY ASSURANCE

A. Cranes shall be designed, fabricated, and installed in accordance with ANSI B30.11, MH27.2, OSHA 1910.179, and IBC. Manufacturer shall assure the

safety and quality of all systems when installed and maintained according to their Installation and Maintenance Manual.

B. Workstation Bridge Cranes are designed to withstand the worst seismic condition in the U.S. or as defined by the IBC.

C. Freestanding Work Station Bridge Crane to be manufactured by crane manufacturer which is accepted by Engineer and capable of supplying specified type of crane meeting design and performance criteria.

D. Installation of crane shall be by Manufacturer or forces licensed and approved by Manufacturer.

E. Manufacturer's Qualifications: A company with more than 25 years of experience successfully designing and manufacturing cranes and material handling solutions for numerous industries.

F. Installer Qualifications: Company experienced in assembly and installation of freestanding bridge cranes with 5 years successful experience and acceptable to crane manufacturer.

1. Perform welding by certified operators in accordance with AWS D14.1.

2. Bolted connections shall be in accordance with torque tightening procedures specified in AISC Manual, Part 5.

3. Clearly label crane with rated load capacity. Place label at height and location easily read from floor level and loading position.

4. Perform OSHA Load Test Certification.

1.09 WARRANTY

A. Manufacturer's Warranty: Included on manufacturer's standard form and outlines the manufacturer's agreement to repair or replace assemblies and components that fail in materials and/or execution within warranty period from date of substantial completion.

B. Warranty covers ten (10) years or 20 thousand (20,000) hours for manual push-pull workstation bridge crane products to cover defects in materials and execution.

C. Warranty covers two (2) years or four thousand (4,000) hours for motorized tractor products.

1.10 CERTIFICATION

A. Submit certifications for standard railway fittings as outlined in AREMA Manual and for base plates, grout, and aggregate materials used in crane track support in accordance with requirements specified herein.

1.11 DELIVERY, STORAGE, AND HANDLING

A. Deliver assembled items, and other materials to the job site in an undamaged condition. Handle and store materials to protect against damage before and after delivery.

B. Project Conditions

1. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results.

2. Do not install products under environmental conditions outside manufacturer's absolute limits.

C. Delivery, Storage, and Handling

1. Store products in manufacturer's packaging until ready for installation.

2. Store and dispose of solvent-based materials in accordance with requirements of local authorities.

PART 2 PRODUCTS

2.01 DESIGN REQUIREMENT

A.	Crane Capacity	1 Ton
B.	Operation Spans	Refer to Drawings
C.	Crane Type	Free Standing Work Station Bridge Crane
D.	Cantilevers	Refer to drawings
E.	Hoist Type	Motorized
F.	Lifting Height	36.5 feet in Wet Well and refer to Drawings to confirm the distance hook at the highest point. Note 1: Crane shall lift up pumps from wet well and load them on a truck (all located outdoors).

G.	Hoisting Speed	40 ft/min (12 m/min)
H.	Trolley Type	Overrunning, motorized
I.	Trolley Speed	60 ft/min, motorized
J.	Bridge Speed	60 ft/min, motorized
K.	Hoist Limit Switches	Upper and Lower and Overload limit
L.	Chain Guide	Include
M.	Trolley & Bridge Conductors	Festooned Flat Cables
N.	Brake on all Motions	Include
O.	Safety Disconnect on Bridge	Include
P.	Mainline Contactor (Start-Stop)	Include
Q.	Runway Conductors	Refer to Drawings to size
R.	Runway Rail	#40 to ASCE c/w weld on clips
S.	Dimensions of Crane	As per Drawings

T. Cranes will be installed outdoor, on a concrete roof slab of new Sewage Pumping Station, as shown on the drawings.

U. Crane environment is of a corrosive nature.

V. All hoist, hoist trolley and bridge will be controlled from sliding pendant push button station running in a box track within the full area of the hook operation zone of the crane bridge allowing the operator independent movement from the trolley.

W. It is not intended that this specification describe in complete detail the various parts of the equipment. Supply equipment, which will meet in all respects the requirements regarding to tests, performance, durability and successful operation

X. All materials and workmanship shall conform to the following requirements:

1. Construction: Fabricated from ASTM A36 steel sections with finished ends and surfaces.

2. All materials shall be in accordance with the latest standards of the ASTM or other recognized bodies. In the matter case, information

shall be supplied to show the standards to be at least equal to the relevant ASTM Standards.

3. All materials shall be new. The materials and workmanship throughout shall be of the highest quality that may be considered usual and suitable for such type of machinery and equipment.

4. Copies of material test certificates shall be available and supplied by the Company when requested by the Consultant. For standard stocked components a certificate of compliance will be accepted. Tests shall be in accordance with the latest standards of the ASTM.

Y. The following information shall be shown on, or supplied with, the shop drawings:

1. Type of weld – using AWS symbols,

2. Weld procedure employed.

3. NDE procedure applied.

2.02 BRIDGE CRANE STRUCTURE DESIGN CRITERIA

A. Free Standing Bridge Crane shall be of work station type bridge crane with free standing support structure, two runways, bridge moving perpendicular to runways, and equipped with enclosed track, end trucks, hoist trolley, festooning system (clamps, trolleys, etc.), bumpers, and other accessories.

B. Construction: Bridge Crane shall be fabricated from ASTM A36 steel sections with finished ends and surfaces.

C. Support Structure: Support crane runways with frames consisting of two columns and horizontal header.

1. Columns: Square tubes with full bottom base plate (weld on angles not permitted) and top header plate.

2. Header: Fabricated from singlewide flange beam. Includes clamp plates, minimum grade 5 bolts, lock washers, and hex nuts for attaching header to column.

3. Hanger Assemblies: Includes each support frame with pair of hanger assemblies that provide a rigid connection for suspending runways. Assembly to consist of clamp angles, clamp plates, minimum grade 5 bolts, lock washers, and hex nuts. Use of threaded rods in flush hanger assemblies not permitted.

D. Runways: Vertical truss fabricated from square steel tubes and enclosed steel track.

1. Track: Enclosed, cold formed, steel box track that serves as bottom cord of runway and permits end trucks and festoon carriers to ride on lower inside flanges. Fabricate lower running flanges with flat surface for higher durability and wheel contact. Sloped flanges not permitted.

2. Splice Joint: Includes truss splice plates, channel-shaped track splice joints, bolts, lock washers, and nuts for joining runway sections. Splice joints must be located within four feet of a support point.

3. Runway Cantilevers: Custom-made cantilever shall be provided; its length shall be as indicated on drawings.

4. Festoon stack section: Includes enclosed track extension to allow for stacking festoon carriers at end of runway. To be located on the opposite end from the loading/unloading area.

E. Bridge, Enclosed: Cold formed steel box track that permits hoist trolley, hoist and festoon conductor carriers to ride along track's lower inside flanges. Fabricate lower running flanges with flat surfaces. Sloped flanges not permitted.

1. Bridge: Single girder, Vierendeel truss fabricated from rectangular steel tubes and enclosed steel box track; truss to be designed for required capacity.

2. Track serves as bottom cord of bridge and permits hoist trolley and festoon carriers to ride on lower inside flanges.

F. End Trucks: Rigid frame end truck designed to ride inside enclosed runway track and connect to and suspend bridge.

1. Construction: Stamped steel fabrication with both vertical and horizontal wheels to prevent binding in runway.

2. Wheels: Steel, removable, self-centering wheels with sealed lifetime lubricated bearings. Vertical wheels shall be flat to match track profile. Non-removable wheels are not acceptable.

3. Drop Lugs: Included on both sides of truck to limit truck drop in the event of wheel or axle failure.

4. Connection to the Bridge: Includes a sliding or flexible connection between bridge and end truck. Rigid connections or articulating connections with threaded hardware are not acceptable.

G. Hoist Trolley: Rigid-body trolley designed to ride inside enclose track of bridge and to carry hoist and load. Articulating trolleys are not acceptable.

1. Construction: Two-piece stamped steel body with two wheels on each side and tapered clevis positioning hoist hook at center of trolley so load weight is evenly distributed to trolley wheels. Includes removable clevis pin. Trolleys with non-removable clevis pins are not acceptable. Holes provided in body for mechanical connections.

2. Wheels: Steel, removable, self-centering wheels with sealed lifetime lubricated bearings. Vertical wheels shall be flat to match track profile. Non-removable wheels are not acceptable.

3. Drop Lugs: Included on both sides of trolley to limit trolley in the event of wheel, axle, or load bar failure.

4. Designed for hook attachment of hoist.

H. End Stops: Molded composite, resilient bumper installed in runway and bridge tracks to prevent end trucks, hoist trolley, and festoon carriers from rolling out of track. Bolt stops without energy absorbing bumper are not acceptable.

I. Tractor Drives: Motorized bridge and hoist trolley. 460 volts, three phases, 60 hertz, electric operation. Speeds from 34 F.P.M. to 75 F.P.M.

J. Festoon Assemblies

1. Includes length of cable to supply lifting device. Supply shall be festooned along boom.

2. Festoon Trolleys: Four wheeled trolleys with pivoting saddle and applicable attachment to support service run on boom and allowing festooning as hoist trolley travels. Festoon gliders are not acceptable.

3. Festoon Clamp: Steel clamp assembly attached to track to prevent festoon trolleys and gliders from exiting track.

2.03 BRIDGE CRANE SYSTEM COMPONENTS

A. End Stop Bumper for Enclosed Track System:

1. End stops are equipped with resilient rubber bumpers to increase impact resistance and are through bolted to the enclosed track.

2. Standard on all enclosed track bridge crane systems.

B. Cable Trolley for Enclosed Track System:

1. Utilized for conveying the power supply flat cable.

2. Four wheels insure easy movement.

C. Festoon Section for Enclosed Track System

1. Furnished for end of one runway to allow stack-up of cable trolleys.

2. Through-bolted to runway track profile. Festoon trolleys pass under through-bolt into festoon section.

D. End Truck for Enclosed Track System (End trucks provide smooth running connection between enclosed track workstation bridge crane and runway track.)

1. Standard wheels are large diameter steel, equipped with anti-friction ball bearings.

2. Placement of horizontal steel guide rollers on either end of the truck guards against "crabbing" of workstation bridge crane.

3. Zinc chromate plated finish.

E. Hoist Trolley for Enclosed Track System

1. Fabricated from precision cut steel plate.

2. Equipped with large diameter steel wheels with anti-friction ball.

3. Zinc chromate plated finish.

F. Cable Clamps for Enclosed Track System

1. Fitted at one end of runway and bridge to hold cable.

2. Flat cable 4 wire #14 A.W.G.

G. Hanger Assembly for Enclosed Track System

1. Freestanding Workstation Bridge Crane to be provided with flush type hanger assemblies, which allow for adjustment in both lateral and longitudinal directions.

2. Hangers are of appropriate size and numbers.

H. Flat Cable Festooning Systems (four wires #14 A.W.G.) for Enclosed Track

1. Supplied with bridge crane systems.

2. Festoon loops are 18 inches for bridges and 36 inches for runways.

I. Track Splice Assemblies for Enclosed Track System

1. Slide over track profile to insure proper alignment.

2. Trussed track splice assembly bolts through top chord to prevent joints from separating.

J. Universal Bumper for Enclosed Track System

1. Frictionally clamped to track opening to buffer between multiple bridges.

2. Do not use as end stop.

K. Enclosed Track for Runway and Bridge Beams

1. Trussed tracks.

2.04 SHOP FINISHING

A. All finishes shall be rated for outdoor installation and be rain, frost, dust and UV-resistant. Provide confirmation with shop drawings.

B. Standard Paint Colors:

1. All runways and structural supports are painted with Grey enamel.

2. All bridges painted Yellow.

C. Surface Preparation and Painting Procedures:

1. Meets the standards of the Society for Protective Coatings (SSPC) for all product surface preparation.

2. Deburr and descale using power tools equipped with sanding discs and wire wheels prior to painting.

3. Components to be washed with high-pressure/ high temperature biodegradable degreaser solution.

4. All components to be coated with quick drying, semi-gloss enamel, applied to a minimum dry-film thickness of two to three mils.

5. A finishing coat to be applied with a hot, airless, electrostatic spray paint system.

6. Painted components to be cured at air temperature.

D. Provide signs showing rated capacity in Pounds and Tons visibly and permanently displayed.

2.05 ACCEPTABLE MANUFACTURER OF BRIDGE CRANE SYSTEM

A. Spanco Inc.,

B. Gorbel Inc.,

C. L.K. Goodwin Co., Inc.,

D. Approved equivalent.

2.06 ELECTRIC CHAIN HOIST

A. Hoists to meet the requirements of ANSI B30.16 “Overhead Hoists (UNDEHUNG)” and of H4 Service classification as defined in ANSI/ASME HST-1 M ‘’Performance Standard for Electric Chain Hoists’.

B. The entire assembly shall be designed for continuous outdoor application.

C. Single speed motorized hoist and motorized trolley.

D. FRAME - shall be of lightweight aluminum or steel and precision machined for accurate gear and bearing alignment.

E. BEARINGS - shall be high quality anti-friction type of either needle or ball design throughout the hoist.

F. BRAKES - Hoist shall have an AC electrical motor brake spring set electrically released. Brake shall have the capability of holding rated load.

G. OVERLOAD DEVICE - shall be provided to prevent lifting excessive overloads. This load limiting (clutch) device shall be preset at factory to disengage the hoist motor from the gearing in event of excessive overload condition.

H. MOTORS - shall be designed specifically for hoist service with permanently lubricated ball bearings, rated for the service required. The motor enclosure is to be designed for the outdoor application. Motor is to have automatic reset temperature actuated switch (TAS) in motor windings to provide motor running overheat protection.

I. GEARING - shall be a combination of helical and spur, precision cut and heat treated to ensure quiet, efficient operation. Gears shall be totally enclosed and run in a bath of oil to provide maximum lubrication and avoid environmental contamination.

J. LOAD CHAIN - Link load chain shall be accurately formed closely calibrated pocket wheel chain of high strength zinc plated heat-treated alloy steel, case

hardened for long wear heavy duty service. Grade 1000 load chain with ultimate strength of not less than 5 times the rated capacity. Provide a chain canvas container. Chain to NACM, ASME and OSHA requirements.

K. Load bearing parts made of hardened material

L. LIMIT SWITCHES - Automatic upper and lower limit switches that will prevent raising or lowering the load beyond a pre-set upper or lower limit will be furnished.

M. SUSPENSION - shall be of high strength forged steel and be capable of full 360-degree rotation. Each hook shall have spring loaded hook latches to prevent accidental slippage from mounting. Suspension shall also have a lug to receive a motor driven trolley.

N. LOAD HOOKS - shall be of zinc plated high strength forged carbon steel construction and be capable of full 360-degree rotation, designed to open gradually and not fracture under excessive load. Load hook shall have bearing supported rotation. Each hook shall have spring loaded hook latches to prevent accidental slippage from lift points.

O. CONTROLS - shall be a centralized electrical system, easily accessible in one compartment. Control circuit voltage to the pushbutton station shall not exceed 120 volts.

P. PUSHBUTTON STATION - shall be of molded contour grip type and supported from hoist by strain relief cable to avoid damage from pull on control wires. Pushbutton station shall accommodate all motions. The enclosure is to be NEMA 4X watertight. Note, the hoist pushbutton station shall also include the controls for the crane bridge and trolley travelling.

Q. TROLLEY - motor driven trolleys shall have heavy section rolled steel side frames. The wheels shall be steel with contour treads and shall operate on either flat or tapered beam flanges. Motor driven trolley shall have squirrel cage, totally enclosed right angle gear motor. Trolley wheel gears and pinions shall have machine cut gear teeth. Spacer washers shall be provided for trolley adjustment to various beam sizes. Motorized trolley shall have a pull-rotor brakes, with prevention load free fall due to motor circuit failure. Provide bumpers on the ends of trolleys. Provide safety lugs on trolley. Trolley shall be compatible with the runways of the Freestanding Bridge Crane.

R. Acceptable Manufacturers:

1. Harrington
2. Budgit
3. Kito

4. P&H Engineered Hoist

5. Demag

2.07 ELECTRICAL AND CONTROL REQUIREMENTS

A. POWER: 460 volt three-phase. Wiring per NEC/CMAA for the outdoor use.

B. All electrical motor, panels, wiring and electrical components of the freestanding bridge crane system shall be designed for the outdoor application at the site. Outdoor condition of the site includes humidity, corrosive environment, rain and snow events, wind, dust, sun light, UV irradiation, etc.

C. Electrical rating shall be min. NEMA 4.

D. Supply and install all panels. Coordinate the panel connection with the power supply and controls at site.

E. Main power disconnect shall be installed at the pump service platform. Refer to electrical drawings.

F. Bridge crane shall be furnished with a portable, wireless, 2-position enabling device. The enabling device shall be separate from the bridge crane controller and shall be designed in accordance with ergonomic principles. When the pushbutton on the enabling device is depressed, bridge crane operation shall be enabled. When the pushbutton on the enabling device is released, bridge crane operation shall be disabled.

PART 3 EXECUTION

3.01 GENERAL

A. Comply with the requirements for installation, testing, start-up and commissioning in accordance with Division 1.

B. Install equipment and appurtenances in accordance with manufacturer's instructions, recommendations, and as shown on the drawings.

C. Coordinate with various sub-trades, suppliers and manufacturers to ensure complete installation of all equipment.

D. No claims for extra work will be entertained for lack of coordination and conflicts between various items of equipment not installed properly.

E. Certify proper installation and operation of all components. A written installation certification (3 copies) shall be provided.

F. Loading, unloading, installation & adjustment shall be carried out by General Contractor.

G. The crane supplier shall provide support as specified herein and as needed.

3.02 PREPARATION

A. DO NOT start installation until support structures are properly prepared.

B. INVENTORY:

1. Check materials to ensure all parts are present.

2. Anchor bolts for support columns are not included. Four, 13/16-inch diameter holes are provided for anchor bolts.

3. Sway bracing is recommended.

C. Motorized tractor drives and hoist:

1. Check electrical supply, conduit, wiring, disconnect switch, and other electrical components.

D. FOUNDATION

1. Check concrete footings, slabs, or other foundations to ensure sufficient system support.

2. Ensure accurate anchor bolt patterns are provided for foundation design.

3.03 INSTALLATION

A. Units and accessories should be installed in accordance with manufacturer's written instructions and approved shop drawings. The below installation list is of a general nature and provided for reference.

B. Do not modify crane components without manufacturer's approval.

C. Clearances for moving crane components:

1. Minimum vertical clearance: Three inches (76 mm) from any overhead obstruction.

2. Minimum horizontal clearances: Two inches (51 mm) from any lateral obstruction.

3. Prior to applying proper torque to the bolts, ensure runways are:

.1 Level to within plus or minus 1/8 inch in 20 feet (3 mm in 6.1 m).

.2 Parallel with opposite runway to within plus or minus 1/8 inch in 20 feet (3 mm in 6.1 m).

D. Column and Header Installation

1. Arrange installation area, position columns, and verify orientation. Bolt columns to floor and attach header beam to columns with 5/8-inch fasteners. Torque fasteners at 108 foot-pounds.

2. Follow the same procedure for subsequent sets of columns and headers.

E. Runway Installation

1. Raise runway track into position and clamp it to header beams with 5/8-inch fasteners. Torque fasteners at 108 foot-pounds.

2. Do not cantilever ends of runway tracks more than 18 inches beyond support centers.

3. Center of runway is located approximately 14 inches from inside edge of support column.

4. OSHA regulations require a minimum clearance of two inches from end of bridge track to face of support columns or other obstructions.

F. Splice Installation

1. For systems with more than one section of runway track, additional section is installed in the same manner, with the addition of splice joint assembly.

2. The track splice joint is made using a sleeve with eight setscrews threaded into top and sides. Slide sleeve over end of first runway track, and butt second runway track against first. Center sleeve over joint. Tighten all top setscrews and side setscrews for correct track alignment. Do not over tighten screws.

3. Trussed runway splice joints include two splice plates and four 1/2-inch bolts with nuts. Install splice plates to connect ends of truss top tubes with four through bolts. Torque through bolts to 50 foot-pounds.

4. Trussed Runway: Splice joints should be within 48 inches of support hanger.

G. Bridge End Truck Installation

1. Insert bridge track into end truck sleeves. Locate center of end trucks approximately 12 inches from ends of bridge. One end truck is secured to bridge track with setscrews and one end truck is allowed to slide freely on bridge track.

2. Install bridge crane by inserting end trucks of runway tracks at one end of runway. Adjust and tighten bridge end truck setscrews to provide a minimum clearance of two inches between ends of bridge and support columns.

H. Runway End Stop Installation

1. Secure end stop assemblies, end stop bolts, and lock nuts at both ends of runway tracks, except for end of festoon storage area, where applicable.

I. Festoon Track Extension Installation

1. Place festoon track extension on end of runway as close as possible to power junction box. Align festoon track extension prior to tightening bolts. Adjust bolts on side of festoon track extension to ensure alignment of bottom flanges of track. Clamp festoon track extension firmly into a straight level position prior to tightening top of extension.

Check to ensure all surfaces of track ends and festoon track extension are in contact.

2. Tighten top bolts to required torque.

3. Install bolt in top or through side of festoon track extension. Place lock nut on through bolt and tighten. Do not place end stop or end stop bumper at this location. Using end stop supplied with system, install in end of festoon track extension.

4. All end stop bolts must have rubber bumper to ensure festoon trolleys remain in track.

5. Ensure all end stop warning labels are in place.

6. Install festoon end clamp to secure festoon cable at end of festoon track extension.

7. Ensure trolleys slide across runway and festoon track extension joint smoothly.

8. Ensure all trolleys stack properly in festoon track extension area, clear through bolts, and contact end stop.

J. Runway Festoon Installation

1. Install festoon trolleys into storage area of runway track if system includes festooning.

2. Secure end-stop bolts and rubber bumpers. Locate and secure festoon end clamps. Install festoon cable on festoon trolleys at equal spacing, approximately six feet, seven inches apart for 36-inch loops. Note: Festooning can be located on the end of runway that is off the equipment loading area.

K. Hoist Trolley and Bridge Festoon Installation

1. Install hoist trolley and festoon trolleys on bridge track. Secure end stop bolts and rubber bumpers. Install festoon cable on festoon trolleys at equal spacing, approximately three feet four inches for 18-inch loops. Festoon storage area is within bridge length.

2. Once installation is complete, bridge and runways should be leveled. Check tightness for all bolts and nuts.

L. Hoist Installation

1. Attach hoist to hoist-trolley. Use washers on hoist mounting pin to center hoist inside hoist trolley. Reinstall washers on outside of hoist trolley (both sides) before installing or reinstalling cotter pins to secure hoist-mounting pin. Replace cotter pin(s) if worn or broken. Bend cotter pin around mounting pin.

2. Do not operate hoist or crane if cotter pins are not in place and properly bent over on both sides of hoist trolley. Check regularly that cotter pins are in place and securing hoist on hoist trolley.

M. Electrical Items

1. Install electrical components, motors, wiring and control panels.

2. Power all electrical components.

3.04 FIELD QUALITY CONTROL

A. General

1. Perform field quality control testing as recommended by manufacturer.

B. Inspection

1. Verify all bolts are tight and lock washers fully compressed.

C. Field Test

1. Ensure crane operates properly (movement is smooth and consistent).

2. Verify motorized operation and controls function properly.

3. Make adjustments as needed, and correct inadequacies.

D. Acceptance Test

1. After the enclosed track crane system has been installed, OSHA requires an acceptance test before operating and also after any modifications. An authorized dealer or installer should perform acceptance tests.

E. Maintenance

1. A system inspection should be performed 30 days after installation. All nuts, bolts, and screws should be checked for tightness. All end stops, cotter pins, and hoist trolleys should be checked for abnormal wear or breakage. Check track splices for alignment, and verify that end trucks and festoon trolleys travel smoothly through joints. Check

that festoon cables and/ or hoses are securely clamped to festoon trolleys and end clamps.

2. A complete inspection of all fasteners and connections should be performed annually or every two thousand (2,000) hours. This requirement shall be part of the Contractor's base scope within the warranty period.

3. Operators should visually inspect the system before each use to note any unusual or abnormal system operations.

F. Clean Surfaces

1. Touch up scratches and blemishes with matching paint from manufacturer.

2. Keep surfaces clean and clear of build-up and residue.

G. Protect Crane

1. Protect installed products until completion of project.

2. Touch up, repair, or replace damaged products before substantial completion.

3.05 OPERATION AND TESTING

A. After completion of installation, provide testing to demonstrate compliance with operating requirements as specified in related Sections of Division 1 and this section.

B. Prior to plant start-up, inspect all equipment for proper alignment, quiet operation, proper connection, and satisfactory performance and tested in the presence of the Engineer

C. Test to include checks for excessive vibration, correct operation of control systems and equipment, motor power input, acceptable normal running noise, speed and direction of rotation.

D. Test to demonstrate that the equipment and work is not defective electrically, mechanically, or otherwise and is safe and satisfactory.

E. Provide all required metering devices and gauges necessary to demonstrate equipment performance. Provide temporary installation of these devices as required.

F. Operation and testing to be carried out by the Supplier following installation.

G. Running Test. After erection has been completed, and before being placed into service, the crane machinery shall be operated by power and tests carried out to prove the following:

1. All clearance and alignments are in order; gearing is sufficiently quiet and lubrication is adequate.

2. Operation of each controller switch, contactor relay and other control devices are satisfactory; all limit switches operate correctly under the most unfavorable conditions.

3. All circuits and interlocks and sequence of operation are correct.

4. All protective devices operate satisfactorily.

H. Load Test: The crane shall have each motion tested with the hook carrying (loads to be provided by the Crane Supplier)

1. 25% overload: during this test the specified speeds need to be attained but the crane shall show itself capable of dealing with the overload without difficulty.

2. Rated load: during these tests the specified speeds are to be attained, provided that the current supply to the crane is correctly maintained. Contractor shall provide calibrated instruments to demonstrate the adherence to the design requirements.

I. Brake Test: all brakes shall be tested under full load conditions, from maximum speed to rest, three times in quick succession without overheating.

J. Record, summarize and certify all testing procedures and provide report with appropriate certification.

3.06 COMMISSIONING

A. Commission in accordance with Section 01810 Commissioning.

B. In addition to Section 01810, provide the services of a factory-trained and certified technician for two (2) days to calibrate and confirm the correct installation, operation and written certification of the equipment. Modify the installation as per his recommendations (if any).

C. Certify commissioning in accordance with Division 1 and Section 11000.

3.07 TRAINING

A. Allows one (1), 8-hour session for each system. The schedule shall be discussed with and approved by the Owner. The sessions shall be completed prior to commissioning.

3.08 DEMONSTRATION

A. During the training session, the Contractor together with the bridge crane and pumping equipment suppliers shall demonstrate the operation of the bridge crane, including the pumps removal from the wet well and putting the pump on a maintenance truck and the reverse operation, i.e. back from the truck to the wet well.

B. The pump supplier representative shall be part of this demonstration. Coordinate the event with all suppliers.

3.09 MANUFACTURERS SERVICES

A. Manufacturer's representative for the equipment specified shall be present at the jobsite for installation assistance, inspection and certification of the installation, equipment testing, startup assistance and training of the owner's personnel, for the period of:

1. 4 days - installation assistance
2. 1 day – testing& certification
3. 1 day – training

B. Minimum number of trips 4.

+ + + END OF SECTION 14600 + + +

SECTION 15010
BASIC MECHANICAL REQUIREMENTS

PART 1 GENERAL

1.01 SUMMARY

A. Comply with Division 1 – General Requirements. These general instructions are intended to supplement and not replace the requirements of the Division 1–General Requirements.

B. The requirements of this section apply to Division 15 – Mechanical.

C. The specification is divided into divisions of work and a division may consist of the work of more than one subcontractor. The responsibility as to which subcontractor provides labor, materials, equipment and services required to complete the work rests solely with the Contractor.

D. Section Includes

1. Basic requirements for the supply, installation and testing of mechanical equipment and piping systems in Division 15 including ductwork and breeching and is supplemented by other specific details shown or specified in the respective system Sections.

1.02 REFERENCES

A. Work in this Division includes:

1. Process piping
2. Miscellaneous Piping
3. Valves and Actuators
4. Hydrostatic and Pressure Testing
5. Plumbing Specialties and Accessories

1.03 SCOPE

A. Provide all labor, materials, equipment and services to complete the work specified and shown on the drawings.

B. The work specified herein includes fire protection and control system, plumbing, building drainage, piping and ventilating systems in buildings.

C. Provide all accessories and appurtenances as required to ensure complete and operational systems.

D. The plans and specifications and any addenda are intended to set the acceptable minimum and shall not be construed to relieve this Contractor of the responsibility of:

1. Installing complete and trouble-free systems.

2. Good workmanship acceptable for approval by the Owner and its designated operators for the completed system.

1.04 CODES, REGULATORY ACT STANDARDS

A. The work shall conform strictly with all rules, regulations, by-laws and the requirements and interpretations of all authorities having jurisdiction.

B. Do not reduce the standard established in the Contract Drawings and specifications. Drawings, standards and specifications with most stringent requirements shall apply for all aspects of this project.

C. Upon the request of the Consultant, the Contractor's suppliers are required to provide proof of compliance with all applicable codes and standards. If requested, provide standard section and conformance clause.

D. Conform to the following codes, regulations and standards including the latest revisions issued up to date of tender submission.

1. Occupational Safety and Health Administration (OSHA) Laws and Regulations

2. The latest application regulation of the Georgia Construction Codes which shall include but not be limited to:

.1 International Building Code

.2 International Fire Code

.3 International Plumbing Code

.4 International Mechanical Code

.5 International Electrical Code

3. ASPE Data Book

4. ASHRAE Guide and Data Books

5. SMACNA “HVAC Duct Construction Standards – Metal and Flexible” “Thermoset FRP Duct Construction Manual”

E. All other codes, standards, regulations referred to in the above documents, adopted by the authorities having jurisdiction and/or applicable to the work of this Division as shown on the Contract Documents.

1.05 SYSTEM DESCRIPTION

A. Supply the equipment complete in all respects including all other accessories and auxiliaries necessary to provide for a satisfactory installation.

B. All external piping and electrical connections to this equipment, and all concreting and foundation bases (excluding grouting and shimming) will be done under the respective sections for such work.

C. Check dimensions associated with existing structures, equipment and piping in the field before the Work commences.

1.06 MAINTENANCE DATA

A. Refer to Section 01780 – Finalization of Project.

B. Operation data to include:

1. Control schematics for each system and its components including environmental controls.

2. Description of each system and its controls.

3. Description of operation of each system at various loads together with reset schedules and seasonal variances.

4. Operation instruction for each system and each component.

5. Description and sequence of actions to be taken in event of equipment malfunction and/or failure.

6. Valves schedule and flow diagram.

7. Color coding chart.

C. Maintenance data shall include:

1. Servicing, maintenance, operation and trouble-shooting instructions for each item of equipment.

2. Recommended spare parts list, including supplier name, address, telephone and contact name.

3. Data to include schedules of tasks, frequency, tools and materials required and task time.

D. Performance data to include:

1. Equipment manufacturer's performance data sheets with point of operation as left after commissioning is complete.

2. Equipment performance verification test results.

3. Special performance data as specified elsewhere.

4. Testing, adjusting and balancing reports.

E. Additional data:

1. Prepare and insert into operation and maintenance manual when need for same becomes apparent during demonstrations and instructions specified above.

1.07 SHOP DRAWINGS AND PRODUCT DATA

A. Submit shop drawings and product data in accordance with Section 01300 – Submittals.

B. Shop Drawings shall include:

1. Piping systems require plans and sectional views, or single line dimensioned isometrics, identifying movements due to thermal expansion and contraction. Locations of the expansion pieces, guides, and anchors, sway braces shall be identified. The resultant movements due to these thermal expansions and contractions shall be shown on shop drawings.

2. Provide details of expansion pieces including list of materials.

3. Valve schedule and identification list.

4. Sectional details of drains, traps, valves and valve operators including list of materials and current ANSI pressure-temperature ratings for valve bodies, seats and stem seals.

5. Provide general layout of equipment including anchor bolt locations, direction of rotation for rotating equipment and electric motor terminal box location.

6. Cross-sectional details of equipment with complete materials test.

C. Shop drawings and product data shall show:

1. Equipment and material

2. Operating voltage and rating

3. Dimensions

4. Blade, linkage and damper motor arrangements

5. Performance curves

6. Mounting arrangements

7. Operating and maintenance clearances, e.g., access door swing spaces

D. Provide fabrication and installation details including anchorage, accessories and finishes.

E. Provide shop drawings for the following (as applicable):

1. Fans

2. Heating Equipment

3. Automatic Dampers and Actuators

4. Louvers

5. Specialty Ductwork (FRP Ductwork)

6. Silencers

7. Duct Accessories, bird and insect screens

8. Grilles, Registers and/or Diffusers

9. Fire Stopping Material with UL Listed Installation Details

10. Control Devices

11. Duct and piping insulation

12. Plumbing fixtures and trims

13. Plumbing specialties and accessories

14. Water heater

15. Piping, valves and accessories

16. Thermal insulation

F. Shop drawings and product data shall be accompanied by:

1. Detailed drawings of bases, supports, and anchor bolts.

2. Acoustical sound power data, where applicable.

3. Points of operation on performance curves.

4. Manufacturer to certify as to current model production.

5. Certification of compliance to applicable codes.

6. Electrical schematics and wiring diagrams for all equipment.

G. Test Reports and Certificates

1. Manufacturer's representative signed report.

2. Field test reports for piping systems.

3. Installation, Operation and Maintenance Manuals

4. Manual shall include installation, operation and maintenance instructions for equipment, valves and appurtenances.

5. Refer to Division 1 individual equipment specification in Division 11, regarding requirements for submission of working drawings, equipment manuals, etc.

H. Submittals to Owner's Consultant shall be for compliance purposes only.

I. Do NOT order equipment until shop drawings have been reviewed by the Consulting Consultant.

1.08 DRAWINGS

A. The drawings show approximate location of equipment in diagrammatic form. Obtain any information involving accurate dimensioning in relation to structure, fixture locations, etc. on the site.

B. Equipment dimensioning to be obtained from reviewed shop drawings.

C. Make, without additional charge to the Owner, any necessary change to ductwork to accommodate structural conditions and headroom. Obtain the Consultant's approval prior to making any changes required due to conflict of trades.

1.09 AS-BUILT DRAWINGS

A. Refer to Section 01780 - Closeout Submittals.

B. Site records:

1. The Consultant shall provide the Contractor with one set of reproducible, mechanical, electrical and instrumentation and structural drawings at the commencement of site construction activities. Provide sets of white prints, as required, for each phase of the work. Mark thereon all changes as work progresses and as changes occur including Change Orders.

2. On a weekly basis, transfer information to reproducibles, revising reproducibles to show all work as actually installed.

3. Use different color waterproof ink for each service.

4. Drawings shall show all inverts and sizes of all pipes, buried pipes and ductwork, and exact routing of the pipes and ductwork.

5. Make available for reference purposes and inspection at all times.

C. As-built drawings:

1. Prior to start of Testing, Adjusting and Balancing (TAB), finalize production of as-built drawings.

2. Identify each drawing in lower right-hand corner in letters at least ½ in high as follows: - "AS BUILT DRAWINGS: THIS DRAWING HAS BEEN REVISED TO SHOW MECHANICAL SYSTEMS AS INSTALLED" (Signature of Contractor) (date).

3. Submit to the Owner's Consultant for compliance purposes and make corrections as directed.

4. TAB to be performed using as-built drawings.

5. Submit completed reproducible as-built drawings with Operating and Maintenance Manuals.

D. Include copies of as-built drawings in the final TAB report.

1.10 PERMITS, FEES AND INSPECTIONS

A. Execute all work in accordance with all applicable rules, by-laws and regulations. Give all necessary notices, obtain all necessary permits, pay all required fees and furnish any certificates necessary as evidence that the work conforms with the rules and regulations of all authorities having jurisdiction.

B. Carry out all changes and alterations required by an authorized inspector of any authority having jurisdiction. Advise the Owner's Consultant of any such changes.

C. Pay for all fees related to permits, variance applications, commissioning and inspections.

1.11 MATERIALS HANDLING AND STORAGE

A. Provide all necessary equipment materials and labor to off-load equipment at the Site and provide for any additional transportation necessary for storage or installation on Site. The methods employed for off-loading and handling must be to the satisfaction of the equipment supplier and the Contract Administrator.

B. Before taking delivery examine the equipment for any damage. Rectify any damage to the equipment. Ensure that the equipment supplier first approves any repairs required, such that guarantees are not invalidated.

C. If not required for immediate use, adequately store and protect all equipment against weather, damage and theft. Take particular care with corrodible electrical equipment. Store mechanical equipment in an area heated to a minimum of 50°F (10°C). If extended storage time is required, perform periodic maintenance in accordance with the manufacturers' instructions.

D. Immediately upon delivery or unpacking, turn over all spare parts, in working condition, to the authority having jurisdiction.

1.12 RELATION TO OTHER TRADES

A. Co-ordinate works with all other Trades involved in the execution of the Works. Arrange work so as not to interfere with or delay other sub-trades.

B. Related work as specified elsewhere is as follows:

1. Concrete: Division 3.

2. Process Equipment: Division 11.

1.13 GUARANTEES

A. Provide warranty and guarantees in accordance with the Section 5 – General Conditions Item 7.15 and Section 5A- Specific Conditions of Contract Item 27.

B. Guarantee against failure due to faulty design, workmanship, materials, or failure to achieve specified operating conditions, or other conditions implied from data provided by the Contract Administrator, or noted during the review of Shop Drawings.

1.14 INSTALLATION AND COMMISSIONING

A. Comply with Section 01810 – Equipment Testing and Facility Commissioning

B. When the Contractor has completed his installation work and before any equipment is operated, the Contractor is to instruct the equipment or material Vendor to commission the equipment.

C. Provide the services of a skilled representative at the site to carry out the following work:

1. Check the installation as to its workmanship and completeness.

2. Check the equipment operation.

3. Perform running tests under load conditions to check power draw and ensure units operate smoothly and without excessive vibration.

4. Instruct the plant personnel in the routine operation, preventive maintenance and breakdown repair of the equipment. Refer to Section 01830 – Training for details.

5. Issue manufacturer's certificate (electronic and hard copies) stating that the equipment is installed as per the manufacturer's instructions, operate satisfactory and is ready to function as designed.

1.15 ACQUAINTANCE WITH WORK

A. Be fully acquainted with all work involved in the complete installation of all equipment. At no time make any claim that any misunderstanding existed in regard to the nature or amount of work to be done.

B. Obtain from Equipment Vendors' the details, dimensions and other information pertinent to the work of this Contract.

1.16 MATERIAL AND WORKMANSHIP

A. Material and equipment to conform to the latest edition of applicable standards in force at the time of tendering. In the case of conflict of these specifications with any standards, the more stringent of the two applies.

B. Provide Materials and Equipment:

1. First class in every respect. All materials shall be new and not refurbished.

2. Constructed and finished in a workmanlike manner.

3. Suitable for the service intended.

4. Selected and fabricated to best Consulting practice.

C. Furnish safety devices including shear pins, flexible coupling guards, belt guards and other pertinent items with the equipment.

D. Carefully pack and crate equipment for shipment. Protect polished and machined metal surfaces from corrosion and damage during shipment. Specially pack electrical equipment to prevent damage by moisture. Cover equipment having exposed bearings and glands to exclude foreign matter.

1.17 QUALITY ASSURANCE

A. Testing

1. Comply with Section 01810 – Equipment Testing and Facility Commissioning

2. Insulate and/or conceal work only after testing is satisfactorily completed.

3. Conduct all tests in the presence of the Contract Administrator.

4. Bear all costs of testing including retesting and making good.

5. Maintain test pressures for at least 4 hours unless otherwise specified.

6. Piping to be tested to 150psi (1035 kPa) water pressure. Process air piping to be tested to 125psi (860 kPa) air pressures. Leakage from pipes will be zero. No loss of pressure will be accepted.

7. If leaks are detected in the pipe or any of the appurtenances connected thereto, make any necessary repairs and retest.

8. Test equipment as specified in the relevant sections and as a minimum, demonstrate that each piece of equipment operates as specified.

9. Prior to tests, isolate all equipment or other parts, which are not designed to withstand test pressures.

B. Standards

1. ANSI/ASME Boiler and Pressure Vessel Code, Section VIII, Division 1

2. ANSI/ASME B16.25 – Buttwelding Ends

3. ANSI/ASME B31.1 – 2018 Power Piping

4. ANSI/ASME B31.3 – 2016 Process Piping

5. ANSI/ASME B31.9 – 2017 Building Services Piping

6. ANSI Z49.1 – 2012 Safety in Welding, Cutting, and Allied Processes

7. ANSI/AWS B1.10 Guide for the Nondestructive Examination of Welds

8. ANSI/AWS B2.1-1/8 Standard Welding Procedure Specifications

9. ANSI/AWS D1.6/D1.6M:2017 Structural Welding Code -Stainless Steel

10. ANSI/AWS D10.18 Pipe Welding (Stainless Steel)

11. ANSI/AWS B2.1/B2.1M:2014-AMD1 Specification for Welding Procedure and Performance Qualification

12. ISO 14732:2013 Welding personnel — Qualification testing of welding operators and weld setters for mechanized and automatic welding of metallic materials

13. ANSI/AWS B5.1:2013-AMD1 Specification for The Qualification of Welding Inspectors

C. Welding Procedure for Stainless Steel

1. Weld using AWS/ASME qualified welders.

2. Conform to ANSI B31.1 and Section VIII, Division 1 of ASME Boiler and Pressure Vessel Code.

3. Submit Welding Procedure Specifications.

4. Include in welding procedures the following:

.1 Materials free of grease, oils and other contaminants prior to welding.

.2 Technique that minimizes heat input to parent metal.

.3 Welds free of grain boundary carbide precipitation.

.4 Stainless steel tools, grinding wheels and brushes.

.5 X-ray where specified in respective system Section.

5. Following removal of weld spatter and slag, finish grind stainless steel surfaces and passivate with Ferroclene 510 supplied by Surbond Lubricants Ltd.

6. When X-raying is specified, submit X-ray results.

7. Repair welds which do not meet the following acceptance criteria:

.1 Cracks - not permitted.

.2 Incomplete penetration and lack of fusion: Depth - not greater than 30mil (0.8mm) length - not more than 1.5 in (38mm) in 6 in (150mm) of weld length.

.3 Reinforcement - maximum 0.125 in (3.2mm).

.4 Undercut - maximum 30mil (0.8mm) deep.

8. Follow special procedures in classified areas as directed by Section 01100 – Special Project Procedures.

D. Certificates

1. Shop Finished Metal

.1 Certify that the shop finished metal components received the specified protective coating system.

1.18 TAGGING INSTRUCTIONS

A. For equipment to be replaced, existing equipment tags are to be removed, protected and reused with new equipment or replaced. If an equipment tag is missing, damaged or does not meet current City of Atlanta tagging standards,

a new tag is to be supplied by the Contractor in accordance with the Equipment Tagging Specification found in Division 13 of the Contract Documents.

PART 2 PRODUCTS

2.01 STANDARDS OF MATERIALS

A. Materials and equipment are specifically described and named in this Specification in order to establish a standard of material and workmanship.

B. Materials required for performance of work shall be new and the best of their respective kinds and of uniform pattern throughout work.

C. Equipment items shall be standard products of approved manufacture. Identical units of equipment shall be of same manufacture. Any unit of equipment, specified herein, shall be in accordance with latest issue of applicable Standards or Authorities when such are either mentioned herein, or have jurisdiction over such materials or items of equipment.

D. Materials shall bear approval labels as required by Code and/or Inspection Authorities.

E. Install materials in strict accordance with manufacturer's recommendations.

F. Include items of material and equipment not specifically noted on drawings or mentioned in Specifications but which are necessary to make a complete and operating installation.

G. Confirm capacity or ratings of equipment being provided, when based on ratings of equipment being provided under other trade Sections, before such items are purchased.

H. Remove materials, condemned as not approved for use, from job site and deliver and install suitable approved materials in their place.

2.02 EQUIPMENT

A. Use only new and best quality materials and equipment. Install and rig all equipment in workmanlike manner.

B. Deliver equipment to site painted with one heavy coat of rust resisting primer or prefinished with standard factory applied baked enamel finish unless otherwise specified. See equipment specifications and schedules for specific coatings.

2.03 MATERIALS

A. All materials, fixtures, fittings, appliances and apparatus supplied and installed by the Contractor shall be new, of recognized manufacture, and the best of their kind suited to the application, and free from all defects.

B. Include in the work all jointing, couplings, fittings, gaskets, insulation, wrapping, flanges, bolts and nuts, wall pieces, blocking, all pipe supports (including steel pipe racks), and all other material necessary to properly install the pipe. Include all other items necessary for the proper functioning of the equipment or reasonably inferable from the Drawings, whether indicated on the Drawings or specified herein, or not.

2.04 BASES, SUPPORTS

A. If not indicated otherwise and is not part of the equipment supply package, the Contractor shall supply and install all iron and steel structures as may be required for the installation of equipment supplied by the Contractor, including any curbs, forms and flashing required for equipment and work located on and/or passing through the finished roof.

B. Concrete and masonry work and lintels, related to mechanical work will be done by General Trade. Mechanical contractor shall coordinate with General contractor for location and size.

2.05 PIPE SUPPORTS

A. Saddle Supports - Grinnell Fig. 264 and 259 (stainless steel) adjustable pipe saddles.

B. Concrete Supports - reinforced as detailed on the Drawings.

C. Pipe Hangers – Anvil Fig.181, Grinnell Fig. 260 adjustable wrought clevis for horizontal pipe and Fig. 100, 103, 261 riser clamps for vertical pipe. Where pipe is insulated, use Anvil Fig. 160 to 166A, 167, 168 (for copper), Grinnell Fig. 167 or equal.

D. Angle Brackets - Grinnell Fig. 199 (No. 1-5), Anvil Fig 194 – all stainless steel.

E. Galvanize all metal supports and pipe hangers to ASTM A153 requirements.

F. Provide 1/8 in (3mm) thick rubber between pipes and supports. Strap pipe to concrete and saddle supports.

G. All of the above and any others as detailed on the Drawings.

2.06 ELECTRICAL

A. Unless otherwise noted, all starters, all power and line voltage (over 24 V) control wiring shall be done under Division 16; however, it is the responsibility of the Prime Contractor to confirm work covered by each subtrade.

B. All motors required for equipment supplied by this division shall be supplied and installed by this Contractor except as noted above.

C. Supply a list of all motors with electrical characteristics to the Electrical Contractor.

2.07 ELECTRIC MOTORS AND AUXILIARY EQUIPMENT

A. Provide electrical motors as specified in Division 11 and Division 16.

B. Fully coordinate all work to complete all mechanical and electrical work associated with electric motors and equipment.

C. Refer to electrical specifications for starters, disconnect switches, etc., and electrical wiring to complete the power supply system to each motor or piece of equipment, unless specifically noted otherwise.

D. For availability of electrical services, refer to electrical specifications.

2.08 MECHANICAL COUPLINGS

A. Refer to Section 15200 – Process Piping.

2.09 CHAIN OPERATORS FOR VALVES

A. Refer to Section 15100 – Valves.

2.10 FLUSHING CONNECTIONS

A. If not specified otherwise, provide flushing connections, as detailed, with Crane Fig. No. 428 gate valves, equipped with brass hose thread nipples having 1.5 in (38mm) straight iron pipe thread, at intervals of approximately 100ft (30m) on process sump discharge, sludge and other piping of ductile iron.

2.11 DIELECTRIC UNIONS

A. Provide a screwed nipple, an iron body bronze-mounted Crane Fig. No. 464 1/2 or Fig. No. 465 1/2, gate valve and a dielectric union ahead of copper lines which branch off steel, stainless steel or cast-iron headers.

B. For cast iron soil pipe in drainage systems, brass couplings may be used to connect copper lines in lieu of dielectric unions and no gate valve is required.

2.12 NUTS AND BOLTS FOR PIPING

A. Use American National Standard hexagonal nuts and bolts for bolted connections. Project bolt ends beyond the nut faces at least 1/8 in (3mm) but not more than 1 bolt diameter.

B. Provide new stock stainless steel ASTM A193 Grade B8A machine bolts with hexagonal heads and ASTM A194 Grade 8A hexagon with scale free shiny stainless-steel finish on stainless steel flanges. Provide stainless steel washers under bolts and nuts. Note: bolts, nuts, washer and lock washers are also referred as “hardware” in this contract documents.

C. Provide separate anchor bolt templates for each piece of equipment mounted on concrete.

2.13 FLANGES

A. For equipment, valves, and devices with integrally cast flanges, provide flanges to the dimensions and drilling of ANSI B16.1 or ANSI B16.5 with bolt-holes straddling the vertical centreline.

B. For fabricated equipment and vessels, provide forged flanges of the same material as the equipment or vessel. Stainless steel lap-joint flanges with carbon steel backing rings are not acceptable. Neither lap-joint nor Van Stone flanges are acceptable on gas systems. Orient flanges with bolt-holes straddling the vertical centreline.

C. Finish flanges in accordance with MSS standard of practice SP-6.

D. Refer to the detailed equipment and piping Specifications for working pressures and class.

2.14 VALVE EXTENSION STEM AND GUIDES

A. Where indicated, provide extension stems with the following features:

1. Naval bronze or hardened Type 410 stainless steel.

2. Cast iron stem guides with bronze bushings and stainless-steel bolts, nuts, and washers to support extension stems.

3. 2 in (50mm) square operating nuts in floor boxes equipped with threaded bronze covers having slotted, flush heads.

4. A 36 in (914mm) long steel valve key for each valve.

2.15 FINISHES

A. Refer to Section 09900 – Painting.

B. Shop prime all ductile iron, cast iron and steel piping and fittings with one 2 mil (0.05mm) thick coat of Glidden G-G 5205 Universal Primer or approved equal.

C. Shop prime all pipe to be insulated with one 2 mil (0.05mm) thick coat of Glidden G-G 5205 Universal Primer.

D. Field painting over bituminous type or temporary black lacquer type coatings will not be allowed. Pipe must be sandblasted accordingly to SSPC-SP-6 and primed.

E. Finish piping and mechanical equipment to the following quality:

1. Welds free of slag, ground and buffed.

2. Surfaces of castings ground smooth.

3. Corners and edges on sheet metal work rounded.

4. Stainless steel pipe free of steel wire rope marks.

5. Materials, piping and equipment free of dents.

6. Machined surfaces finished to specified tolerances.

2.16 BELT DRIVES, SHEAVES, AND GUARDS

A. If specified, provide belt driven equipment with V-belt drive, designed for at least 130% of motor nameplate power rating and in accordance with manufacturer's recommendations for type of service intended, ensuring belt drives are at least 95 percent efficient. Provide matched sets of belts for multiple belt assemblies. Select belts to suit starting torque of driver. Use single belt drives only for motors 2hp (1.5kW) and smaller. Provide one set of spare belts throughout for all equipment. All sets to matched type as above. Provide a complete list of belts and sizes etc. in the spare parts list.

B. Provide motor sheaves for one and two belt drives of variable pitch type, with key adjustments. Supply two sets of fixed drive sheaves for drives with three or more belts. Install first set of fixed motor sheaves to obtain the originally specified rpm. After initial test and preliminary adjustment, install the second set of fixed sheaves if necessary, to provide design flow quantities as established on site. Obtain correct total air flow for fans through speed changes and not by throttling.

C. Provide belt driven equipment with perforated guards with frame. Frame and guard to be 316 stainless steel or epoxy coated aluminum but must be rigid. Securely fasten to equipment. Provide guards to enclose drives and pulleys with access panel or opening opposite motor and drive shafts, easily removable for servicing and insertion of tachometer.

D. Provide 18-gauge sheet metal guards typical to above for couplings of direct driven equipment which have projecting parts.

PART 3 EXECUTION

3.01 EXAMINATION OF SITE

A. Visit and examine the site. No allowance will be made for any expense incurred due to failure to make this examination.

3.02 COORDINATION

A. Coordinate the work of all trades installing equipment and services which may affect work and arrange equipment in proper relation with equipment installed under all Divisions of the specifications.

B. Should the Contractor fail to correspond with requests or misdirect other trades, such corrections and/or additional work as directed by the Owner's Consultant, shall be at this Contractor's expense.

C. Furnish items to be built-in, in time, with pertinent information, commensurate with the progress of the work.

D. Coordinate provision of curbing and flashing for pipes, vents, ducts, etc., passing through roof and walls. Make provision for expansion and contraction and provide counter flashing.

E. Coordinate concrete work for support of piping not laid on solid stable ground. Provide concrete bed, solid concrete block or concrete piers to satisfaction of local inspectors.

3.03 EXISTING SERVICES AND EQUIPMENT

A. The Contractor shall be responsible for making all necessary connections to existing systems as indicated on the drawings. Coordinate with existing services regarding location and elevation, confirming locations prior to any excavating.

3.04 DELIVERY, STORAGE, AND HANDLING OF EQUIPMENT, VALVES, ETC.

A. Provide suitable skids boxes or other framework to adequately protect equipment, valves, etc., during shipping and unloading.

B. Arrange for delivery to Site of equipment, valves, etc., provided that construction of structures has advanced so far as to adequately protect units from weather and construction dust and debris. If units are delivered to Site prior to structure being suitably enclosed, provide weather tight heated storage enclosure at no additional cost to the Owner. Improperly stored equipment, valves, etc., will be cause for rejection.

C. Provide equipment, valves, etc., and labor for unloading, moving and placing units into final position.

D. Store motors shipped in a protected and heated area free from dust, moisture and other conditions that could damage motors.

3.05 INSTALLATION OF EQUIPMENT

A. Coordinate exact location and placements of all equipment and items with subtrades. Interference drawings are the responsibility of the Contractor.

B. Coordinate opening locations and sizing with structural drawings. Where different or additional sizes or locations are required, prepare drawings for submission to the Consultant indicating all wall, floor and roof penetrations for ducts and piping with dimensions.

C. Install, calibrate and test equipment in accordance with manufacturer's written instructions and when specified, under supervision of competent experts provided by the equipment manufacturer. Provide calibration and test reports.

D. Erect mechanical equipment on foundations complete with suitably sized anchor bolts and take special care to ensure true alignment of parts, especially pumps and electrical drives. Align the units after their sole plates have been shimmed at the anchor bolts. Recheck alignment after securing equipment to its foundation before grouting sole plates in place.

E. Recheck alignment of equipment handling hot fluids, during initial operation.

F. Erect equipment level and plumb. The use of "pipe springing" and "Dutchmen" to correct misalignment and misfitting is not allowed. In general, install mechanical equipment directly on machined bases without shims; provide at least 60 mils (1.5mm) of brass shim stock under driver mounting feet.

G. Provide all materials necessary to install equipment. Install piping and miscellaneous items supplied as part of the equipment including lubrication piping, pressure gauge tubing, thermocouple sensors and wiring, bubbler tubing, orifice meter tubing, pneumatic valve operator tubing and flexible tubing for pressure switches.

H. Minimum standard of installation shall be in accordance with the manufacturer's instructions.

3.06 PIPE SUPPORTS

A. Support piping in accordance with MSS SP-69, after careful alignment and before tightly securing joints.

B. Take special care not to move pipe after tightening joints.

C. Place pipe supports where required to provide for true horizontal level or a uniform slope in the pipe without sagging as indicated.

D. Location of sway braces, vibration dampeners, flexible connectors and restraints to control piping movement due to vibration are indicated on the Drawings. These locations are specific to the piping design layout shown. For any deviation from the piping design layout shown, provide additional braces, restraints and flexible connectors to control movements of piping due to vibration.

E. Provide hangers, supports, anchors, guides, vibration dampeners, flexible connectors, restraints and sway braces that will cope with the loads, moments and stresses developed in the piping system and prevent these loads and moments from being transferred to the equipment to which the piping is connected.

F. Install two hangers at each horizontal joint in mechanical joint cast iron soil pipe.

G. Install sufficient hangers and supports to provide an adequate safety factor as outlined in the ANSI B31.1, Chapter II Design, Part 5: Expansion, Flexibility and Supporting.

H. Install spring hangers where shown or needed to eliminate the concentration of loads on individual hangers or equipment due to expansion and contraction.

I. Provide two wall-mounted riser clamps at each vertical joint in mechanical joint cast iron soil pipe.

J. Provide additional hangers and supports at concentrated loads such as valves, flanges and specialties and at changes in direction.

K. Do not exceed the maximum horizontal pipe hanger spacings on straight runs having no valves or fittings

L. Do not exceed the maximum horizontal pipe hanger and support spacings, on straight runs having no valves or fittings listed in the following references:

1. Steel: Table 121.1.4, ANSI B31.1.

2. Stainless Steel: ANSI B31.3.

3. Ductile cast iron copper, cast iron soil pipe, CPVC, PVC, FRP, and ABS: Table 3, MSS SP-69.

3.07 JOINTS

A. Apply Teflon tape to male threads at screwed joints on systems which operate at less than 70°F (21°C). Use Masters Metallic on gas piping and where the service temperature is greater than 70°F (21°C).

B. Apply Denso paste to bolt threads at expansion pieces, flanged, victaulic and mechanical joints. For buried piping apply paste to the fasteners.

3.08 VENT AND RELIEF PIPES

A. Where vent and relief pipes are indicated, route to outside the building preferably through the roof and discharge vertically upwards. Where vent and relief piping pass through roofs and walls provide cover flashing on same with counter flashing provided under Division 7 and caulk between pipes and sleeves in accordance with good practice.

B. Design, provide and install vent and relief pipes in accordance with ANSI B31.1, .2, .3.

3.09 VALVE POSITION INDICATION

A. Install valve and damper operators whether manual, pneumatic or electric, to clearly indicate whether the valve or damper is open, closed or partially open from a point no less than 10ft (3m) away and visible from a position compatible with normal plant operation.

3.10 ORIENTATION OF VALVE OPERATORS

A. Orient valves and valve operators to satisfy the following:

1. Ease of operation.

2. Limit interference with structures and with any other equipment or piping.

3. Show valve position indicator from operating position.

4. Allowance for maintenance and disassembly.

5. Re-orient valves as required to satisfy the above conditions or any other interference condition that may exist.

3.11 FIELD TESTS FOR PIPING SYSTEMS

A. Provide necessary equipment and perform work required to field test piping systems, including remedial and re-testing work.

B. Clean piping systems by flushing with water or blowing with air with valves wide open prior to testing and before installing any primary element instrumentation on the piping systems.

C. Provide temporary supports if necessary to support the weight of test liquid for piping designed for vapour or gas.

D. Provide temporary restraints or isolate expansion joints which cannot sustain the reactions due to test pressure.

E. Isolate from the piping, equipment that is not to be subjected to the test pressure.

F. Piping must pass field tests in presence of the Commissioner.

G. No leakage will be allowed.

H. Hydrostatically test piping using clean water at ambient temperature except where there is risk of damage due to freezing. Another fluid may be used if it is safe for workmen and compatible with the piping.

I. Apply the hydrostatic test pressure for four (4) hours.

J. If leaks are found, repair and retest until no leakage is found.

K. Drain piping and blow dry following successful completion of testing.

L. Do not install insulation until field testing on that piping system is completed.

M. Prepare a report for each test. Include in the report the following:

1. Location or section of piping.

2. Time and duration of test.

3. Test pressure at start and completion.

4. Ambient and water temperatures.

3.12 FIELD TESTS FOR VALVES

A. Hydrostatically test randomly selected valves as directed, to demonstrate drip-tight shut-off where valves are so specified.

B. Test valves with rated pressure [first on one side] for 10 minutes, [then on the other if specified as bi-directional], without any pressure decrease on the pressurized side of the valves. Contractor shall provide all equipment and labor to satisfy the Consultant of the field pressure test.

C. Proceed with this test in a manner that will demonstrate that the valves are not leaking. Submit test procedure details prior to the test.

3.13 CUTTING AND PATCHING

A. The Contractor shall confer with the Architectural and Structural Drawings and provide all cutting and patching as required in a manner approved by the Consultant.

B. The Contractor shall liaise and coordinate with other subcontractors before walls or floors are built.

C. The location of holes, recesses and chases, as well as any sleeves and inserts required for passage of system components through vertical and horizontal surfaces to the building. All entry and exit of pipes into and out of buildings shall be sealed by use of link-seal approved by the Consultant and acceptable to the Owner.

D. If such provisions are not made, all remedial work shall be at the Contractor's expense and in a manner approved by the Consultant at no extra cost to the Contract.

E. Supply labor, materials, tools and equipment to complete work of cutting and patching. Include cutting and patching of all mechanical openings regardless of size; and responsibility for damages caused to building components during the performance of mechanical cutting and patching work. Cutting and

patching of any building component shall be performed by tradesman skilled in the particular work involved (i.e., masons, drywallers etc.).

F. Cut, patch and make good so as to leave work in a finished condition. Fill any holes left in floors and walls.

G. Cutting of any building structural element must have the Consultant's approval.

3.14 PROTECTION

A. Protect all buildings and structures from damage during mechanical installation.

B. Protect finished and unfinished mechanical work from damage. Maintain services and equipment dry and clean.

C. Protect equipment and systems openings from dirt, dust, and other foreign materials with materials appropriate to the system and approved by the appropriate equipment manufacturer.

D. Cover all openings in equipment and material. Cover temporary openings in ducts and pipes with polyethylene sheets securely tied in place or plastic pipe covers, until final connection is made, or service is permanently closed up. Cups, rags, and similar makeshift coverings are not permitted.

3.15 CLEANING

A. Interior and exterior of all systems shall be clean upon project completion to the satisfaction of the Consultant. Where systems are not clean to the satisfaction of the Consultant, this Contractor shall cover all costs to meet the Consultant's requirements.

3.16 HOISTING AND SCAFFOLDING

A. Perform all unloading, hoisting and warehousing for all mechanical equipment and materials and assume responsibility for damage caused to the property of the Owner in the performance of the work.

B. Ensure that all equipment can be hoisted and set into the specified location. Include for the cost of dismantling and reassembling of equipment where required. Reassembly shall be to the equipment manufacturer's written approval.

3.17 PAINTING

A. Deliver equipment to site painted with one heavy coat of rust resisting primer or prefinished with standard factory applied baked enamel finish unless

otherwise specified. All final painting inside and outside building is by Section 09900 – Painting.

B. Touch up any damage to prime coat. Provide coating to match original where applicable. Protect equipment and prefinished panels throughout construction period.

C. Restore to new condition, finishes that have been damaged too extensively to be merely primed and touched up.

D. Paint all new bolts and nuts with PVC paint after their installation.

E. Paint new services as specifically indicated in Division 15 Sections.

3.18 SPECIAL TOOLS

A. Provide one set of any special tools required to service equipment as recommended by manufacturers and in accordance with Section 01780 - Closeout Submittals.

3.19 TRIAL USAGE

A. The Owner has the privilege of the trial usage of mechanical system or parts thereof for the purposed of testing and learning the operational procedures.

B. Carry out the operations only with the express knowledge and under supervision of the Sub-Contractor who shall not waive any responsibility because of trial usage.

C. Trial usage shall not be construed as acceptance by the Owner.

3.20 START-UP AND TESTING

A. Fully coordinate all start-up and testing activities and ensure they are performed by manufacturer's representatives and/or qualified technicians.

B. Submit a copy of the manufacturer' start-up and testing reports and certification to the Consultant within one week. Systems shall not be approved for use until all start-up and testing is complete and the reports have been reviewed and accepted by the Consultant. Manufacturer's certificate shall state that the equipment is is installed as per the manufacturer's instructions, operate satisfactory and is ready to function as designed.

3.21 BALANCING AND COMMISSIONING

A. Refer to Section 15500 – Balancing (if applicable) and Section 01810 – Testing and Commissioning.

B. Balancing and commissioning of mechanical systems shall be performed by a Balancing and Commissioning Company independent of the Mechanical Contractor.

C. Fully coordinate all balancing and commissioning activities and ensure that the Consultant and the Owner representatives are notified in advance as required. Obtain written approval of balancing and commissioning activities and times from the Consultant.

D. The Mechanical Contractor shall cooperate with the independent company(ies) and perform the functions described below with respect to the balancing and commissioning of the systems.

E. Consult with the Independent Balancing and Commissioning Company confirming the locations of all volume dampers prior to the installation of ductwork, the locations of ductwork air volume measuring ports, and the locations of balancing valves and measuring stations, etc.

F. Provide the assistance of a qualified mechanic to assist and make all necessary adjustments as directed by the independent company and replace system components (i.e., filters) to achieve the specified system conditions for balancing.

G. Change motor sheave, fan sheave and belts for the necessary systems as directed by the independent company to achieve final balance.

H. Assist the authorities in all required tests with respect to operation of the systems.

3.22 DEMONSTRATION AND TRAINING

A. Provide and pay for services of fully experienced and competent Consultant or Technician to instruct personnel designated by the Owner in proper operation and maintenance of equipment installed under this Division including controls and their functions.

B. In addition, provide specialized instructions by respective manufacturers as may be required to fully illustrating any particular system or component.

C. Instruct personnel designated by the Owner to ensure full comprehension of the mechanical systems up to one full working day per session. Arrange and conduct two, one day sessions or four half day sessions as requested by the Owner. Owner shall finalize instruction times.

D. Arrange with Owner most suitable time for instruction and keep records of dates and durations of each instruction period together with name(s) of

person(s) to whom instructions were given. Forward one signed copy of records to the Consultant prior to the release of holdback.

A. Refer to Division 1 for Demonstration and Training.

+ + + END OF SECTION 15010 + + +

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SECTION 15050
EQUIPMENT – GENERAL REQUIREMENTS

PART 1 GENERAL

1.01 DESCRIPTION

A. This section specifies requirements, products, characteristics, and methods and executions that are common to one or more sections, and it is intended as a supplement to each section and is to be read in conjunction with the drawings.

B. The drawings indicate the general location and route to be followed by the piping and ductwork. Where details are not shown on the drawings or only shown diagrammatically, the equipment shall be installed in such a way as to conserve headroom and interfere as little as possible with the free use of space through which they pass.

C. Related Work Specified in other sections:

1. Excavation and backfill of mechanical work in Division 2.

2. Flashing for mechanical work penetrating the roof in Division 7.

3. Motors, starters, and accessories, unless otherwise specified in Division 16

4. Electrical power wiring connections to power and control panels supplied with equipment or part of the mechanical work, Division 16

1.02 GENERAL

A. Supply the equipment complete in all respects including all other accessories and auxiliaries necessary to provide for a satisfactory installation.

B. Where equipment is supplied with larger or smaller power requirements than that shown, coordinate with the electrical requirements (Division 16) to ensure compatibility with electrical and control components so that a complete working system is in place without extra cost to the Owner.

C. The exact location and routing of mechanical and electrical services are to be properly planned, coordinated and established with all affected trades prior to installation such that the services will clear each other as well as any obstruction. Generally, give the right of way to piping requiring uniform pitch and locate and arrange other services to suit.

D. Check dimensions associated with existing structures, equipment and piping in the field before fabrication and installation are started.

E. All shutoff valves, balancing devices, air vents, and similar products, must be located for easy access for servicing. Products, which do not meet this location requirement, are to be relocated at no cost.

F. All mechanical piping system work including equipment, must comply in all respects with ASME Standard B31.3 - 2016 Process Piping.

G. All Codes and Standards referred to in the specifications are the latest edition at the time of tendering. All electrical items associated with mechanical equipment are to be certified and/or approved per standards noted under Division 16.

1.03 APPURTENANCES AND ACCESSORIES

A. Provide all jointing, couplings, fittings, gaskets, insulation, wrapping, flanges, bolts and nuts, wall pieces, blocking, all pipe supports (including steel pipe racks), and all other necessary materials. Include all couplings, gaskets and bolts and nuts for valves, meters, and connections to equipment, whether indicated on the drawings or specified herein, or not.

1.04 MATERIALS HANDLING AND STORAGE

A. Provide all necessary equipment materials and labour to off-load equipment at the site and provide for any additional transportation necessary for storage or installation on site. The methods employed for off-loading and handling must be to the satisfaction of the equipment supplier and Engineer.

B. Before taking delivery examine the equipment for any damage. Rectify damage to equipment. Ensure that the equipment supplier first approves any repairs such that guarantees are not invalidated.

C. If not required for immediate use, adequately store and protect all equipment against weather, damage and theft. Take particular care with corrodible and electrical equipment. Store mechanical equipment in an area heated to a minimum of 50 deg F (10 degrees C). If extended storage time is required, perform periodic maintenance in accordance with manufacturers' instructions.

D. Immediately upon delivery or unpacking, turn over all spare parts, in working condition, to the Owner or Owner's agent for safe storage.

1.05 ANCHOR BOLTS

A. Provide anchor bolts of 316L stainless steel for non-submerged and submerged services.

1.06 EXPEDITING DELIVERY

A. Take full responsibility for expediting the delivery, installing and putting all equipment into specified working operation.

B. Develop a construction schedule based on the information available from the Equipment Suppliers' at the time of tendering.

C. Failure or delay in delivery of equipment does not relieve the Contractor of his responsibility to complete the Contract in the time stated in the Form of Tender.

1.07 ACQUAINTANCE WITH WORK

A. Be fully acquainted with all work involved in the complete installation of all equipment. At no time make any claim that any misunderstanding existed in regard to the nature or amount of work to be done.

B. Obtain from Equipment Suppliers the details, dimensions and other information pertinent to the work of this Contract.

1.08 MATERIAL AND WORKMANSHIP

A. Material and equipment to conform to the latest edition of applicable standards in force at the time of tendering. In the case of conflict of these specifications with any standards, the more stringent of the two applies.

B. Provide materials and equipment:

1. First class in every respect

2. Constructed and finished in a workmanlike manner

3. Suitable for the service intended

4. Selected and fabricated to best engineering practice

C. Furnish safety devices including shear pins, flexible coupling guards, belt guards and other pertinent items with the equipment.

D. Design machinery such that working parts are readily accessible for inspection and repair, and each part is suitable for the service required.

E. Carefully pack and crate equipment for shipment. Protect polished and machined metal surfaces from corrosion and damage during shipment. Specially pack electrical equipment to prevent damage by moisture. Cover equipment having exposed bearings and glands to exclude foreign matter.

F. Design equipment to have adequate strength, power and capacity for both continuous and intermittent service. Motors and other parts to be capable of starting and operating under any conditions of loading likely to occur under normal plant operating conditions.

G. Design the general mechanical and electrical equipment and particularly bearings, contacts and other wearing parts to satisfy the need for long periods of operation without frequent maintenance or attention.

H. Provide adequate and, as far as practicable, automatic means of lubrication for working parts. Arrange lubrication grease nipples, grease boxes and other lubrication devices so that they are readily accessible for greasing.

I. Indicate on the working drawings submitted, the type of lubricants to be used (readily available in Canada). Use grease nipples of a consistent type, Alemite button head type or equivalent.

J. Make lubrication points readily accessible using grease nipples and Type 316 stainless steel or copper tubing extensions where required. Secure the nipples and tubing to the equipment at appropriate locations.

K. Design equipment installed outdoors for service under climatic conditions typical for the area. Give particular attention to winter operating conditions.

PART 2 PRODUCTS

2.01 PRESSURE GAUGES AND THERMOMETERS

A. Pressure Gauges:

1. Furnish miscellaneous pressure gauges where shown and where required. Provide gauges having a black phenol case with a dial diameter of not less than 4.5 in (114 mm), and having an indicating range equal to twice the working pressure. Provide a gauge with accuracy within 1% of span. Furnish with shut-off cocks for gauge isolation. Acceptable manufacturer, “Ashcroft”, Fig. 1279, or equivalent from Wika, Trerice, Ametek U.S. Gauge.

2. Provide and install diaphragm seals complete with flushing connections. For sewage applications, provide Ashcroft 101ES or 102ES, 316SS diaphragms or approved equal. For chemical applications provide PVC (top and bottom) diaphragms. Filling Fluid: Glycerin.

B. Thermometers:

1. Thermometers are to be 5.0 in (125mm) diameter round, adjustable angel bimetal dial type. Accurate to within 1% of full scale and complete with a hermetically sealed stainless-steel case with stainless steel ring, dampened bimetal coil, calibration adjustment screw, white aluminium dual scale dial with black marking and a range that the working temperature of the system is the approximate mid-point of the scale, 0.5 in (12mm) NPT connection with 0.25 in (6.4mm) diameter stainless steel stem and suitable thermowell. Approved manufacturer: Ashcroft Series EL; Weiss Instruments or approved equal.

2.02 WATERPROOFING AND SEAL MATERIALS

A. Modular, mechanical seal assemblies consisting of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe and the pipe sleeve or wall opening, assembled with stainless steel bolts and pressure plates and designed so that when the bolts are tightened the links expand to seal the opening watertight, the seal assemblies are to be selected to suit the pipe size and the sleeve size or wall opening size.

B. Acceptable manufactures: Thunderline Corp “Link Seal” model S; Metraflex “MetraSeal Type ES.

2.03 PIPE ESCUTCHEON PLATES

A. One-piece chrome plated brass or stainless-steel plates with screws, each sized to cover the pipe sleeve or wall or slab opening and to fit tightly around the pipe or insulation.

2.04 PIPE, FITTINGS & VALVES

A. All piping materials, fittings and standard valves to be in accordance with the line code sheets accompanying this section.

2.05 UNIONS, FLANGES AND DIELECTRIC COUPLINGS

A. Provide unions or flanges at connections to equipment requiring servicing or replacing, installed to permit equipment servicing or removal without disturbing piping.

B. Use only cadmium plated machine bolts and nuts for all new or relocated flanged connections and PVC paint after installation.

C. For copper pipes use wrought copper unions with soldered joints up to and including 2 in (50mm). Use brass ground joints for 2.5 in (65mm) and 3.0 in

(80mm) pipe. Use 150 psi (1050 kPa) cast brass flanges for pipes (3/8 in) 10 mm and larger.

D. Install approved dielectric coupling insulation at transition between materials such as copper, brass, bronze, high alloy castings or stainless steel and low alloy ferrous materials such as black iron, steel galvanized iron, or cast iron. Install dielectric insulators so that they are not shorted out by accidental contacts to process equipment, building steel, instrumentation tubing or electric neutrals. Provide dielectric unions constructed of materials that are compatible galvanically with the systems to which they are connected, i.e., a dielectric union for installation between copper and iron shall be constructed with a body of iron and a tailpiece of copper or brass.

E. For insulating flanged connections use flange insulation kit designed for use in standard flanges with standard blots. Align flanges so that sleeves can be inserted easily by hand. Avoid nut over-tightening, a torque wrench is recommended. After assembly, each bolt should withstand a 500 V megger insulation test between each bolt and each flange.

F. For threaded joints use insulated union with a steel body and a brass tailpiece.

G. Use similar types of dielectric insulation to electrically isolate piping systems that are cathodically protected.

2.06 DRAIN AND AIR VENT VALVES

A. Locate drain valves at all low points and section isolating valves.

B. Drain valves to be minimum 3/4 in (20 mm) size unless otherwise specified: straight pattern bronze with hose end male thread and complete with cap, chain and vacuum breaker.

C. Provide air vent valves at high points together with means for “blowing out” lines piped to floor drain.

2.07 PIPING HANGERS AND SUPPORTS

A. Pipe hangers and supports material, including accessories, are to be unless otherwise specified, in accordance with the MSS standard practice manual. Hangers and supports for insulated piping are to be sized to fit around the insulation and covering. Hangers to be zinc plated unless otherwise noted.

B. Horizontal pipe support from horizontal surfaces:

1. Adjustable steel clevis hanger Myatt Fig 122, 124, 125, Taylor 22/22Z or 24/24Z

2. Adjustable swivel ring band type hanger Myatt Fig 41, Taylor Fig 41

3. Adjustable roller hanger Myatt Fig 258, 261 & 262, Taylor Fig 93, 95 and 95S

4. Trapeze hangers Myatt Fig 172, 173, 174, Taylor Fig 170

C. Horizontal pipe support from vertical surfaces:

1. Steel offset pipe clamp Myatt Fig 321, Taylor Fig87

2. Heavy duty steel pipe bracket Myatt Fig 322, Taylor 802

3. Single steel pipe hook Myatt Fig 156 or approved equal

D. Vertical riser through floors

1. Copper tubing riser clamp Myatt Fig 151CT, Taylor Fig 85

2. Heavy duty steel riser clamp Myatt Fig 182, 183, 190, 191, Taylor Fig 82H

E. Vertical pipe on vertical surfaces

1. Steel offset pipe clamp Myatt Fig 170, Taylor Fig 87

2. Heavy duty steel pipe bracket or soil pipe bracket Myatt Fig 161, 162, Taylor Fig 161, 162

F. Special hanger and supports

1. Vibration isolation support: black steel riser clamps as specified above, complete with vibration isolation pads between the clamp and the floor. Vibro-Acoustic type NSN or approved equal.

2. Piping on roof: insulated aluminium support risers with diameter height, mounting methods and flashing to suit the application, channel type aluminium cross members and galvanized steel pipe hangers and or supports conforming to MSS SP-48 complete with al required accessories. Lexcor “Flash-Tite” or approved equal.

2.08 VIBRATION ISOLATION

A. Elastomeric Pads, Type EP

1. Neoprene waffle or ribbed, 1/2 in (12mm) minimum thickness, 50 durometers, maximum loading 50 psi (350 kPa).

2. Rubber waffle or ribbed, 1/2 in (12 mm) minimum thickness, 30 durometer natural rubber, maximum loading 60 psi (415 kPa).

3. Neoprene-steel-neoprene, 1/2 in (12 mm) minimum thick neoprene bonded to 1/4 in (6 mm) steel plate, 50 durometer neoprene, waffle or ribbed, holes sleeved with isolation washers.

4. Rubber-steel-rubber, 1/2 in (12 mm) thick rubber bonded to 1/4 in (6 mm) steel plate, 30 durometer natural rubber, waffle or ribbed, holes sleeved with isolation washers.

B. Spring Hangers, Type SH

1. Color coded springs, rust resistant, painted, box type hangers. Swivel arrangement to permit hanger box or rod to move through a 20* arc without metal-to-metal contact, stable spring, elastomeric element.

2. Performance: to be determined by equipment supplier.

3. Acceptable products: Korfund, Masdom VM, Vibron, Vibro-Acoustic.

4. Acoustic Barriers for Anchors and Guides:

.1 Acoustic barriers: between pipe and support, consisting of 1.0 in (25 mm) minimum thick heavy-duty duck and neoprene isolation material.

.2 Acceptable products: Masdom VM, Vibron, Vibro-Acoustics.

C. Horizontal Thrust Restraint:

1. Spring and elastomeric element housed in box frame, assembly complete with rods and angle brackets for equipment and ductwork attachment, provision for adjustment to limit maximum start and stop movement to 3/8 in (9 mm).

2. Restraints arranged symmetrically on either side of unit and attached at centerline of thrust.

3. Acceptable products: Korfund, Masdom, VM, Vibron, Vibro-Acoustic.

2.09 DRIVES, GUARDS AND LUBRICATION ACCESSORIES

A. Sheaves

1. Select variable and adjustable pitch sheaves unless otherwise specified.

2. Provide motor driven equipment using 2 or more belts with fixed sheaves.

3. Fit reinforced belts in sheave matched to drive. Multiple belts on unit to be matched set.

4. Use cast iron or steel sheaves secured to shafts with removable keys.

5. Standard adjustable pitch drive sheaves having + 10% range to be used on motors from 1/3 hp (0.25 kW) to 10 hp (7.5 kW). Use mid-position of range for specified RPM.

6. For drives larger than 10 hp (7.5 kW), sheaves to be split tapered bushing and keyway having a fixed pitch, unless specifically required for item concerned. Provide sheave of correct size for balancing.

B. Drive Rating

1. Minimum drive rating to be 1.5 times nameplate rating of motor. Keep overhung loads within manufacturer’s design requirements on prime mover shafts.

C. Adjustment

1. Motor slide rail adjustment plates to allow for centerline adjustment.

D. Guards

1. Provide guards for exposed drives.

2. For drive guards for the existing high lift pumps refer to Section 15076 - Pump Guards.

3. Unless specified, guards for drives (except for the existing high lift pumps) to have:

   .1 Expanded metal screen welded to 1 in (25 mm) steel angle frame.

   .2 18 Ga. galvanized sheet metal tops and bottoms.

   .3 Removable sides for servicing.

   .4 1 ½ in (40 mm) diameter holes on both shaft centers for insertion of a tachometer.

4. Secure guards to driven machine, foundations or floors with heavy angle supports and anchor bolts.

5. Do not short circuit vibration isolators.

6. Provide means to permit lubrication, use of speed counters, or other maintenance and testing operations, with the guard in place.

7. Install belt guards to permit movement of motors for adjusting belt tension.

8. For flexible couplings, provide removable "U" shaped guards fabricated from 12 Ga. galvanized steel frame with 18 Ga. expanded mesh face.

9. Provide protective screen on both inlet and outlet of exposed fan blades. Screen to be fabricated from 3/4 in (20 mm) mesh minimum galvanized expanded metal such that the net free area of openings is not less than 80% of the original opening.

10. Provide oil gauges, grease cups, oil cups or grease gun fittings at all points requiring lubrication. Extend all fittings as required to be fully accessible without requiring any disassembly or removal of guards.

PART 3 EXECUTION

3.01 STANDARDS

A. Do work in accordance with, but not limited to, the following codes and standards deemed to be part of this specification.

1. International Building Code
2. International Fire Code
3. International Plumbing Code
4. International Mechanical Code
5. International Electrical Code
6. The American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE)
7. The American National Standards Institute (ANSI)
8. The American Society for Testing and Materials (ASTM)
9. Sheet Metal and Air Conditioning Contractor's National Association (SMACNA)
10. Georgia Department of Natural Resources
11. Air-Conditioning and Refrigeration Institute (ARI)
12. National Fire Protection Association (NFPA)
13. American Water Works Association (AWWA)
14. Air Movement and Control Association (AMCA)

3.02 EXAMINATION

A. Examine areas where work is to be performed for:

1. Anything that affects execution and quality of work.
2. Piping clearances.

3.03 PIPING INSTALLATION

A. General

1. Conform to requirements of ANSI/ASME B31 code for pressure piping.

2. Install straight, parallel to building lines and close to walls and ceilings, with specified pitch. Use standard fittings for direction changes.

3. Install groups of piping parallel to each other, spaced to permit application of insulation, identification, and service access, on trapeze hangers.

4. Install eccentric reducers in horizontal piping to permit drainage and eliminate air pockets.

5. Where pipe sizes differ from connection sizes of equipment, install reducing fittings close to equipment. Reducing bushings are not permitted.

6. Install flanged or welded nozzles, branch connections, welding outlets, adapters and taps, true and faced at right angles to the axis of the pipe. Do not extend connection inside of pipe.

7. Make pipe ends round and true, suitable for weld connection.

8. Prepare pipe ends in accordance with ANSI/ASME B16.25 for butt welding.

9. Copper pipe and tubing to be free from surface damage. Replace damaged pipe or tubing.

10. Ream ends of pipe and tubes before being made up.

11. Lay copper tubing so that it is not in contact with dissimilar metal and will not be kinked or collapsed.

12. Use non-corrosive lubricant or Teflon tape applied to male thread only.

13. Groove pipe ends, cut square, seating surface clean and free from indent and score marks.

14. Install dielectric fittings wherever piping of dissimilar metals are joined.

15. Install flanges or unions to permit removal of equipment without disturbing piping systems, as required by piping standard.

16. Clean ends of pipes or tubing and recesses of fittings to be brazed or soldered. Assemble joints without binding.

17. Support piping during construction to prevent abnormal stresses on the pipe works.

18. Install pipe supports and hangers as required.

19. For submerged piping, all supports and hangers, etc. to be Type 316 stainless steel.

20. Provide a minimum of two pipe diameters of straight pipe length between PVC fittings.

B. Flanges Bolting to Valves

1. Do not weld adjacent flanges on butterfly valves when the valve is in place.

2. Remove valve prior to welding.

3. Clean gasket surfaces, flange faces and butt welding connections.

4. Protect connecting surfaces.

C. Bolted Connections

1. Clean pipe ends and gaskets.

2. Lubricate gaskets with soapy water and bolts with thread lubricant.

3. Tighten bolts progressively by crossover method and not in rotation around the joint.

4. Tighten bolts to the torque recommended by the manufacturer.

5. Use properly sized wrenches for bolt tightening to prevent rounding of nut and bolt heads.

3.04 INSTALLATION

A. Storage of Valves

1. Store valves in cool and clean location, away from moving vehicles or other objects.

2. Prevent dirt and debris entering the valve internals.

3. Protect the valve seats against painting.

4. Store valves with their hand-wheels, operator shafts and operators in an upright position.

B. Handling Valves

1. Do not place chains, cables and ropes through valve ports or make attachment to operators or hand-wheels.

2. Use sling either around valve body or with bolts or rods through the flange holes.

C. Installation of Valves

1. Installation of valves to be by competent personnel and in strict accordance with manufacturer's instructions.

2. Inspect and remove all foreign debris or objects that may prevent closing of valves prior to the installation of any valves.

3.05 INSTALLATION OF PIPE HANGERS AND SUPPORTS

A. Provide all required pipe hangers and supports. Provide any additional structural steel channels, angles, inserts, beams clamps, and similar accessories required for hanging or supporting pipe. Unless otherwise shown or specified hang or support from the structure only.

B. For insulated pipe, size the hanger support to suit the insulated pipe install the hanger or support on the outside of the insulation and covering

C. Underground piping:

1. Support underground pipe on a well-tamped bed of dry natural undisturbed earth free from rocks or protrusions of any kind, or on compacted material as specified.

2. Support underground service piping penetrating building exterior walls or foundations to prevent pipe damage if minor building settlement occurs.

3. Ensure that all bedding and support for underground pipes are flat and true and that allowances are made for pipe hubs, couplings, or other protrusions so that no voids are left between the pipes and the bedding.

D. Horizontal above ground piping

1. Cast iron pipe, hangers and supports at every joint with max 8 ft (2.4m) spacing.

2. Copper and steel pipe, hangers and supports in accordance to the following schedule;

Pipe Diameter in (mm)	Max. Spacing – steel Ft (m)	Max Spacing – copper ft (m)
Up to 1 ¼ (32)	7 (2.1)	6 (1.8)
1 ½ (40)	9 (2.7)	8 (2.4)
2 (50)	10 (3.0)	9 (2.7)
2 ½ (65)	12 (3.6)	10 (3.0)
3 (75)	12 (3.6)	10 (3.0)
3 ½ (90)	13 (3.9)	12 (3.6)
4 (100)	14 (4.2)	12 (3.6)
5 (125)	16 (4.8)	
8 (200)	18 (5.4)	
10 (250)	20 (6.0)	
12 (300)	22 (6.7)	

3. For flexible grooved joint steel piping, provide not less than one hanger or support between joints.

4. In a change of direction, provide hanger or support not more than 12 in (300mm) from the elbow, and where pipes drop from tee branches, support the tees in both directions not more than 2 in (50mm) on each side of the tee.

5. Provide roller hangers or supports for all piping 6 in (150mm) diameter and larger and conveying a material 167°F (75°C) or greater to facilitate pipe movement due to expansion and contraction, and at each hanger or support tack weld a steel protection saddle to the pipe to protect the piping insulation.

E. Vertical piping

1. Unless otherwise shown or specified, support vertical piping by means of supports specified in this section, spaced in accordance with the following:

.1 Support pipes at maximum 10ft (3m) intervals or at every floor

.2 Section of pipe less than 10ft (3m), support at least once

.3 For vertical cast iron end pipe (mechanical joint type), secure the riser or pipe clamp around the pipe under a flange integral with the pipe for vertical support purposes, or provide a length of hub and spigot pipe to facilitate proper support.

.4 For vibration isolated piping risers, provide rubber-steel-rubber vibration pads under riser clamps between the riser clamps and the floor.

3.06 PROTECTION OF OPENINGS

A. Protect equipment and system openings from dirt, dust and other foreign materials.

B. Thoroughly clean piping, ducts and equipment of dirt, cuttings, and other foreign substances prior to being put into operation.

3.07 V-BELT DRIVES

A. Tension all belt drives to manufacturer's recommendations before start-up and after first 100 hours of operation, using calibrated belt tensioning gauge.

3.08 EQUIPMENT PIPE CONNECTIONS

A. Where equipment connections are a different size from the piping serving it, all associated isolating valves and fittings to be the larger pipe size unless

specifically indicated otherwise on the drawings. This rule to also apply in the case of control valves.

3.09 EQUIPMENT LUBRICATION

A. All equipment placed in operation prior to the completion of the contract to be maintained and adequately lubricated in accordance with the manufacturer's instructions.

B. All equipment to be lubricated in accordance with the manufacturer's instructions prior to acceptance of any system.

C. Oil level gauges, grease cups and grease fittings for all machinery bearings, etc., to be provided as recommended by the manufacturer. Locate oil level gauges for easy viewing.

D. All bearings to be flushed out and refilled with new change of oil prior to final acceptance.

E. Protect bearings and shafts during installation. Grease shafts and sheaves to prevent corrosion.

3.10 SLEEVES

A. Provide individual metal sleeves for all pipes, tubes or ducts penetrating all walls and floor slabs. Grout tightly in place for full depth of wall or slab.

B. Standard sleeves to be standard weight galvanized steel or epoxy coated steel pipe.

C. Use cast iron or steel pipe sleeve with annular fin continuously welded at midpoint:

1. Through foundation walls.

2. Where sleeve extends above finished floor.

D. Sizes

1. Refer to mechanical drawings for details.

2. Provide 1/4 in (6 mm) minimum clearance all around, between sleeves and pipe or between sleeve and insulation.

E. Terminate sleeves flush with vertical surfaces of concrete and masonry and 4 in (100 mm) above floors.

F. For pipes passing through roofs, use cast iron sleeves with caulking recess and flashing clamp device. Anchor sleeves in roof construction; caulk between sleeve recess and pipe; fasten roof flashing to clamp device; make water-tight, durable joint.

G. Voids Around Pipes

1. Caulk between sleeve and pipe in foundation walls and below grade floors with oakum and PC-4 caulking compound between sleeve and pipe.

2. Where sleeves pass through walls or floors, caulk space between sleeve and insulation or between sleeve and pipe with dry oakum. Seal space at each end of sleeve with waterproof, fire retardant, non-hardening mastic.

3. Ensure no contact between copper tube or pipe and ferrous sleeve.

4. Coat exposed exterior surfaces of ferrous sleeves with heavy application of zinc rich paint.

H. Where pipes and ducts pass through walls and floors having a fire separation rating, pack the space with approved caulking material and seal in accordance with CGSB 19-GP-9.

3.11 ESCUTCHEONS AND PLATES

A. Install on pipes passing through finished walls, floors and ceilings.

B. Use chrome or nickel-plated brass, solid type with set screws for ceiling or wall mount.

C. Inside diameter to fit around finished pipe. Outside diameter to cover opening or sleeve.

D. Where sleeve extends above finished floor, escutcheons or plates to clear sleeve extension.

E. Secure to pipe or finished surface but not to insulation.

3.12 VIBRATION ISOLATION

A. Installation

1. Install vibration isolation equipment in accordance with manufacturer’s instructions and adjust mounting to level equipment.

2. Unless specified with the unit, vibration isolation shall be provided by the mechanical contractor in accordance with the following schedule:

Equipment	Isolation Type	Deflection in (mm)	Min. No. of Isolators	Base Type in (mm)
Air Handling Units	EP	2 (50)	8	4 (100) concrete
Heating Pumps	EP	¼ (6)	1	---
Boilers	EP	--	4	4 (100) concrete
Unit Heaters, Fan Coil Units	SH	1 (25)	4	Suspended
In-Line Fans	SH	2 (50)	4	---

3. Ensure piping, ducting and electrical connections to isolated equipment do not reduce system flexibility and that piping and ducting passage through walls and floors do not transmit vibrations.

4. Unless indicated otherwise, support piping connected to isolated equipment with spring mounts or spring hangers with 1 in (25mm) minimum static deflection as follows:

   .1 Up to 4 in (100 mm) size: first 3 points of support; 6 in (150 mm) to 8 in (200 mm) size: first 4 points of support; 10 in (250 mm) size and larger: first 6 points of support.

   .2 First point of support to have static deflection of twice deflection of isolated equipment, but not more than 2 in (50 mm).

5. Where isolation is bolted to the floor avoid short circuiting of sound pads by using vibration isolation washers.

6. Block and shim level all bases so that ductwork and piping connections can be made to a rigid system at the operating level before isolator adjustment is made. Ensure that there is no physical contact between isolated equipment and building structure.

3.13 CUTTING AND PATCHING

A. Minimize cutting and patching required. Set sleeves and mark openings in concrete forms and masonry structure prior to the placement of concrete or masonry.

+ + + END OF SECTION 15050 + + +

SECTION 15065
HYDROSTATIC AND PRESSURE TESTING

PART 1 GENERAL

1.01 SCOPE

A. Hydrostatic and pressure test piping where required.

1.02 RELATED WORK IN OTHER SECTIONS

.A The following related sections are included for reference only. It is the Contractor's responsibility to coordinate and include all works described, shown, and referenced in the contract documents.

.1 15010 – Mechanical General Requirements.

.2 15200 – Process Pipes.

1.03 GENERAL

.A Test all wastewater and water retaining or carrying pipes for leakage.

.B All testing to be as specified herein or as directed by the Engineer. Provide written notice of date when tests will be made at least 48 hours in advance of test. Perform all testing in the presence of the Engineer.

.C Furnish suitable temporary service connections, testing plugs or caps, pressure pumps, pipe connections, gauges, thrust supports, and all other required equipment and labor without additional compensation necessary for filling the pipeline or structure, expelling air, pumping to the required test pressure, and dewatering the line or structure.

.D Test other components as specified elsewhere in these specifications.

.E Conduct other tests as required by regulatory authorities.

PART 2 PRODUCTS

2.01 MATERIALS

.A Water used for the hydrostatic and pressure testing will be supplied by the Contractor.

PART 3 EXECUTION

3.01 CLEANING

.A Prior to hydrostatic or pressure testing, thoroughly clean all structures, pipework and conduits and remove all dirt and loose material.

3.02 TESTING

.A All new and existing process piping shall be pressure tested to 150% of the working pressure unless noted otherwise or required by applicable Code, whatever is greater.

.B The testing procedure shall be approved prior to commencement of the work and all leaks shall be repaired to the satisfaction of the Engineer.

3.03 LEAKAGE TEST

.A Conduct a leakage test on the pipelines to the pressures indicated in piping schedule and duration of a minimum of two (2) hours without a pressure drop.

.B The allowable amount of leakage during the test to be zero.

3.04 FLUSHING

.A Clean the installed piping systems of dirt and other foreign materials. Flush the pipe at water velocities of 3 ft/s (1.0 m/s) or as high a velocity as can be obtained from the available water sources. Discharge flushing water to sanitary sewer, watercourses or ditches that have sufficient capacity to carry the flow. Obtain approval prior to flushing water offsite.

3.05 BUILDING SERVICES SYSTEMS TESTING

.A Test all equipment and materials where required by specification or authority having jurisdiction. Obtain certificates of approval, acceptance, and compliance with rules and regulations of authorities having jurisdiction.

.B Carry out hydrostatic and pressure testing for a period of eight (8) hours unless otherwise stated and maintain pressure with no appreciable pressure drop. Where leakage occurs, make repairs and retest the entire system. Conduct all testing prior to covering pipe in any way.

.C Hydrostatically test all drainage systems for a period of two (2) hours or as required by local authority. No leakage will be allowed.

.D After the work is completed, the Contractor shall adjust and put all parts of the system into proper working order.

3.06 INSTRUMENTATION PROTECTION

.A Remove or isolate all instruments that have a maximum range of less than the hydrostatic or pneumatic test pressure noted above during the pressure test. On successful completion of the system test, lower the pressure and re-pressurize if required to a pressure within the range of the instruments, and then retest the isolated or removed instruments in accordance with other sections of these specifications.

3.07 SAFETY RELIEF VALVES

.A Supply all safety relief valves for water services with test gags for hydrostatic testing purposes. Upon completion of the hydrostatic testing, remove the test gags and re-pressurize the system to the relieving pressure of the relief valves to ensure that the valves are relieving at their set point.

3.08 DEFECTS AND REPAIRS

.A Make good defects disclosed in the work and retest or replace the work without additional cost to the Region. Make repairs to piping systems with new material. No caulking of screwed joints, cracks or holes will be accepted. Where it becomes necessary to replace pieces of pipe, such replacements to be the same lengths as the defective pieces.

.B Repeat tests after any work have been replaced if, in the judgment of the Engineer, it is necessary.

.C Conduct all pressure testing in the presence of the Engineer.

3.09 CLEAN-UP

.A The Contractor shall remove all his materials and equipment and clean-up all the work areas continuously as he progresses with the work.

.B At the completion of the work, the Contractor shall, at his own expense, remove and dispose of all rubbish and remove all equipment, surplus materials, plants and construction building, and shall leave the site absolutely clean and in good order and condition, all to the satisfaction of the Engineer.

3.10 SAFETY REQUIREMENTS

A. The Contractor shall comply with all pertinent safety requirements of the Occupational Safety and Health Administration (OSHA) Laws and Regulations, and any appropriate association or associations for accident prevention having to do with the kind of work being carried on.

+ + + END OF SECTION 15065 + + +

SECTION 15075
EQUIPMENT, PIPING AND VALVE IDENTIFICATION

PART 1 GENERAL

1.01 DESCRIPTION

A. This section specifies the work of mechanical identification, including, but not limited to process, mechanical, electrical and instrumentation equipment and piping/valve systems.

1.02 RELATED SECTIONS

A. Motors, starters, and accessories, unless otherwise specified in Division 16.

B. Division 11 – Process equipment.

C. Section 09900 - Painting.

D. Section 15100 - Valves

E. Section 15200 - Process Piping

F. Section 15430 - Plumbing Specialties and Accessories

1.03 REFERENCES

A. Occupational Safety and Health Administration (OSHA).

B. ANSI/ASME A13.1 - Scheme for the Identification of Piping Systems

1.04 GENERAL

A. Supply the equipment complete in all respects in accordance with Codes, ANSI and the Occupational Safety and Health Administration (OSHA).

B. All piping shall be labelled to conform to the Occupational Safety and Health Administration (OSHA) policy.

C. Provide piping system identification of contents and direction of flow at valves and fittings, where a pipe passes through a wall or floor, and where circumstances may make such contents and directions of flow doubtful.

1.05 SHOP DRAWINGS

A. Refer to Division 1, regarding requirements for submission of shop drawings, equipment manuals, etc.

B. Submit lists of all items to be identified, and for each type of identification required for approval, sufficiently ahead of when identification is required, obtain lists from names, Tag numbers, etc. that may be included in the Contract.

C. Submit samples of each label, tag, marker and fastening devices to the Engineer for review.

D. Do not order labels until shop drawings have been approved.

PART 2 PRODUCTS

2.01 EQUIPMENT IDENTIFICATION

A. Identification nameplates listing equipment names and numbers of the laminated Lamacoid type, black background with white custom engraved lettering, beveled edges, counter-sunk screws holes.

B. Nameplate size for most equipment shall be 1/2 in (12mm) larger than lettering on all four edges, not less than 2 in (50mm) high and not less than 4 in(100mm) wide.

C. Provide all equipment in this Contract with an identification label and tag number including but not limited to the following (as applicable):

1. Pumps
2. Valves and Pipes
3. Blowers and fans
4. All chemical equipment
5. Safety equipment

D. For pumps, include:

1. Type
2. Model Number
3. Serial Number
4. Rated Capacity
5. Rated Dynamic Head
6. Number of Stages (Vertical Turbine Pump)

7. Impeller Diameter
8. Speed
9. Diameter of Suction / Discharge
10. Efficiency
11. Weight
12. Year of Manufacture
13. Other information required to uniquely identify the equipment

E. For drive units:

1. Size
2. Type
3. Serial Number
4. Electrical Requirements
5. Current Draw
6. Frame Number
7. Rated Temperature Rise
8. Continuous Service Factor
9. Bearing Details
10. Weight
11. Year of Manufacture

F. For submersible pumps and equipment, duplicate nameplates shall be provided for installation both on submerged and non-submerged portions.

G. Supply and install Hazard Communication Standard (HCS) / Globally Harmonized System of Classification and Labeling of Chemicals (GHS) hazard symbols on all equipment as required by Occupational Safety and Health Administration (OSHA).

2.02 EXISTING IDENTIFICATION SYSTEMS

A. Apply existing identification system to new work.

B. When existing identification system does not cover for new work; use identification system specified in this section.

C. Before starting work, obtain written approval of identification system from Engineer.

2.03 PIPING IDENTIFICATION LABELS

A. Identification labels listing pipe/duct contents/duties and flow direction arrows custom pre-printed on pre-curved PVC wrap around type label carriers to suit varying piping sizes. Labels designed to suit indoor and outdoor use, rated for -40°F (-40°C) to 180°F (82°C) temperature range with built in ultraviolet inhibitors.

B. Hazard Communication Standard (HCS) / Globally Harmonized System of Classification and Labeling of Chemicals (GHS) symbols are required with each label on all hazardous lines.

C. Adhesive tapes directly on the piping are not acceptable.

D. Painted piping system:

1. Labels shall be 2 mil vinyl/polyester of sufficient lengths to wrap completely around the pipe with a minimum of 1/3 in (8mm) overlap for piping 1 3/4 in (45mm) diameter or less.

2. Labels shall be 10 mil vinyl/polyester of sufficient lengths to wrap completely around the pipe with a minimum of 1 in (25mm) overlap for piping over 1 3/4 in (45mm) diameter.

3. PVC to be 25/50 fire rated.

E. Traced lines: Identify piping which is electrically traced and insulated with "ELECTRICALLY TRACED" lettering at all standard identification locations.

F. Pipe to be labeled with flow direction and identification label every 10 ft (3m) or as instructed by Engineer.

G. Use color code as per ANSI/ASME A13.1 Standard. Where not covered by the Standard, submit legend and background colors to Engineer for review.

2.04 VALVE AND GATE IDENTIFICATION

A. Identification tags or nameplates listing the valve or gate alpha-numerical symbols of non-ferrous metal of punched non-ferrous metal type or the laminated Lamacoid type, black background with white custom engraved lettering beveled edges, one 1/4 in (6mm) diameter fastening hole.

B. Tag/nameplate size for non-ferrous metal type shall be a minimum of 2 in (50mm) diameter. For laminated Lamacoid type, not less than 2 in (50mm) wide and 3/4 in (20mm) high.

C. Fasten tags with approved heavy gauge, non-ferrous metal chain or ring or S hock to suit valve details.

D. The identification label shall include:

1. Type of valve or gate
2. Size
3. Service of Fluid
4. Function
5. Normal Position (Open or Close, Modulating)

2.05 VALVES CONTROLLERS

A. Brass tags with 1/2 in (12mm) stamped identification data filled with black paint.

B. Include flow diagrams for each system, of approved size, showing charts and schedules with identification of each tagged item, valve type, service, function, normal position, location of tagged item.

2.06 DEVICE AND EQUIPMENT TAGGING

A. Colours: Black letters, white background (except where required otherwise by applicable codes).

B. Construction:

1. 1/10 in (3mm) thick laminated plastic, matte finish, with square corners, letters accurately aligned and machine engraved into core.

2. Sizes:

.1 Nominal 3/4 in (20mm) x 4 in (100mm) backing with 1/3 in (8mm) high letters.

.2 Use maximum of 25 letters/numbers per line.

3. All valves and instruments will be labeled with corresponding tag numbers (as shown on the mechanical Drawings).

2.07 DUCT IDENTIFICATION

A. Custom made Mylar stencils to accurately describe the duct service, ("AHU-0001 SUPPLY"), complete with a directional arrow and colored inks with ink pads and rollers applicators, ink colors are to contrast with the lettering background.

2.08 LABLE LETTER SIZE

A. Pipe label lettering to be block capitals in sizes as indicated in table.

Character Item	Character Height	Symbol Line Width	Character Line Width
Equipment	2in (50mm)	2/3 in (16mm)	1/3 in (8mm)
Pipes 3 in (75mm) Diameter and Larger	1 1/2 in (40mm)	1/2 in (12mm)	1 1/2 in (40mm)
Pipes smaller than 3 in (75mm)	1 in (25mm)	1/3 in (8mm)	1/6 in (4mm)
Ducts	2 1/2 in (65mm)	3/4 in (20mm)	3/8 in (10 mm)
Valve, Instrument and Analyzer Tags	1 1/2 in (40mm)	1/2 in (12mm)	1/4 in (6mm)

2.09 CONTROLS COMPONENTS IDENTIFICATION

A. Identify all systems, equipment, components, controls, sensors with system nameplates specified in this section.

B. Inscription to include function and (where appropriate) fail-safe position.

2.10 SPECIAL SIGNS

A. Before fabrication submit the list of ALL signs to Engineer for review and approval.

1. Process Piping combined with the flow direction arrow: Qty.: every 25 ft (8m); before and after each pipe turn.

2. Provide identification tags on

.1 All pumps, flow meters, valves and valve positioners, pipes (services), equipment lifting equipment, power equipment, hatches, etc.

.2 On MCC and PLC cabinets: upgraded and new equipment identification TAGs the MCC and PLC serves.

3. Note: The Owner’s Tag Number shall be confirmed before fabrication and supply.

2.11 ARROWS

A. Arrows:

1. Outside diameter of pipe (incl. insulation) 3 in (75mm) and greater: 6 in (150mm) long by 2 in (50mm) high.

2. Outside diameter of pipe (incl. insulation) less than 3 in (75mm): 4 in (100mm) long by 2 in (50mm) high.

3. Use double headed arrows where flow is reversible.

B. On ductwork use 2 in (50mm) high stenciled flow arrows as requested by Engineer. Stencil over final finish only.

2.12 HAZARD SYMBOLS

A. Supply and install Hazard Communication Standard (HCS) / Globally Harmonized System of Classification and Labeling of Chemicals (GHS) hazard symbols on all tankage, piping and equipment.

2.13 LANGUAGE

A. Identification to be in English.

PART 3 EXECUTION

3.01 TIMING

A. Provide identification only after all painting has been completed.

3.02 FINISHES

A. Finish all necessary field primed and finish paint coatings, ensure proper time for drying, of all equipment, piping, valves, fittings, and ductwork. Colors of equipment, piping etc. see Section 09900.

B. All colors for piping and pipe labels shall meet ANSI/ASME A13.1.

3.03 INSTALLATION

A. Perform work in accordance with ANSI/ASME A13.1 except as otherwise specified.

B. Provide UL registration plates as required by respective agency.

3.04 APPLICATION OF PIPE AND DUCT LABELS

A. Apply identification labels and directional arrow as per Code and as minimum at or near:

1. Both sides of valves.

2. All branch fittings and elbows.

3. Both sides where pipes and ducts pass through walls, floors and ceilings.

4. Straight runs at maximum distance of 20ft (6m) interval and at least once in each room.

5. Where circumstances make contents or direction of flow doubtful.

B. Clean sufficient area of equipment, tanks, pipes, pipe jackets and ducts and apply labels as recommended by label manufacturer.

C. Apply labels in positions that allow them to be easily read normal operating positions

D. All labels shall be installed in a workmanlike manner.

3.05 CONCEALED PIPING AND DUCTWORK

A. Identify concealed piping and ductwork as indicated in the following:

1. At point where pipes or ducts enter and leave rooms, shafts, pipe chases, furred spaces and similar areas.

2. At maximum 20ft (6m) interval on piping and ductwork above suspended accessible ceilings and at least once in each room.

3. At each access door location.

4. At each piece of connected equipment, automatic valve, etc.

3.06 VALVE TAGGING AND CHART

A. Tag valves and prepare a valve tag chart in accordance with the following:

1. Attach a valve tag to each new valve, except for valves located immediately at the equipment they control.

2. Prepare a typed or computer printed valve tag chart to list all tagged valves, with, for each valve, the tag number, location, valve size, piping service and valve attitude (normally open or normally closed).

3. If an existing valve tag chart is available at the site, valve tag numbering is to be an extension of existing numbering and the new valve tag chart is to incorporate the existing chart.

4. Frame and glaze one copy of the chart and affix same to a wall where later directed at the site.

5. Include a copy of the valve tag chart in each copy of the operating and maintenance instructions.

+ + + END OF SECTION 15075 + + +

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SECTION 15100
VALVES AND ACTUATORS

PART 1 GENERAL

1.01 DESCRIPTION

.A This Section specifies the design, shop drawing submission, fabrication, supply, delivery, unloading, safe storage, installation, testing, start-up, training and commissioning of process valves and actuators.

.B All equipment shall be UL listed and conform to AIS requirement of the Consolidated Appropriations Act of 2014.

.C Modify certain existing equipment and pipe fittings as hereinafter specified.

.D In general, include all manual and powered operators, floor stands, wrenches, chains, extension stems, stem guides, operating nuts, floor boxes, valve boxes, wall thimbles and auxiliaries in the work.

.E Unless otherwise specified, furnish valves for Process and Miscellaneous Piping, their respective Sections.

.F Supply all external piping and electrical connections to this equipment and all concreting for foundation bases (excluding grouting and shimming) under the respective Sections for such work.

1.02 REFERENCES

.A AWWA – American Water Works Association (applicable Standards).

.B American National Standards Institute (ANSI):

.1 B16.1 Cast Iron Pipe Flanges and Flanged Fittings.

.2 C111/A21.11, Rubber-Gasket Joints for Ductile Iron Pressure Pipe and Fittings.

.3 ANSI/NSF Standard 61 – Drinking Water System Components – Health Effects

.4 ANSI/AWWA C550 – Protective Epoxy Interior Coatings for Valves and Hydrants.

.5 ANSI/AWWA C512 – Air-Release, Air/Vacuum and Combination Air Valves for Waterworks Service

.C American Society for Testing and Materials (ASTM):

.1 ASTM A126 - Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings, Class B.

.2 A276, Standard Specification for Stainless Steel Bars and Shapes.

.3 A351, Standard Specification for Castings, Austenitic, Austenitic-Ferric (Duplex), for Pressure Containing Parts.

.4 A564, Standard Specification for Hot-Rolled and Cold-Finished Age Hardening Stainless Steel Bars and Shapes.

.5 D429, Test Methods for Rubber Property- Adhesion to Rigid Substrates.

.6 ASTM A240 - Heat Resisting Chromium and Chromium Nickel Stainless Steel Plate, Sheet and Strip for Pressure Vessels

.D ASME B1.20.1-1983(R2001) Pipe Threads, General Purpose (Inch).

.E ASME B16.34-2004 Valves Flanged, Threaded and Welding End.

.F ASTM B62-02 Standard Specification for Composition Bronze or Ounce Metal Castings.

1.03 DEFINITIONS

.A Valve Identification: Valves are identified on the drawings.

1.04 SHOP DRAWINGS AND PRODUCT MAINTENANCE DATA

.A Submit data for all valves, actuators and other accessories specified in this section and shown in the drawings.

.B Shop Drawings: Submit the following information in accordance with Section 01300:

.1 Catalogue cuts and/or shop drawings for each type of valve indicating the valve number, materials of construction, dimensions, head loss characteristics through the valve, operating torque and valve end configuration.

.2 Valve Specification Sheet for all valves and actuators.

.3 Copies of specified certification.

.C Operating and Maintenance data for incorporation in Contractor's Operation and Maintenance manual, as specified in Division 1. Include complete description of operation together with detailed drawings, a complete list of replacement and repair parts, and parts manufacturer's identifying numbers.

.D Affidavits and registration numbers described below in Quality Assurance.

1.05 VALVE SCHEDULE

Valve Tags	Location, Valve Type
V-01 to V-07 (except V-06)	Valve Chamber, Plug Valves, with Manual Operators
V-06 and V-08	Valve Chamber, Plug Valves, with Electrical Actuators
CV-01 to CV-05	Valve Chamber, Check Valves
ARV-01, ARV-02 and ARV-03	Valve Chamber, Sewage Combination Air/ Vacuum Release Valves
No Tag	Valve Chamber, Miscellaneous Isolating Valves (ball and gate types)

PART 2 PRODUCTS

2.01 VALVE REQUIREMENTS

.A General

.1 A Valve to include operator, actuator, handwheel, chain wheel, extension stem, floor stand, worm and gear operator, operating nut, chain, wrench, remote control panel, limit switches and accessories for a complete operation.

.2 Valve to be suitable for intended service. Renewable parts not to be of a lower quality than specified.

.3 Valve to be same size as adjoining pipe.

.4 Valve ends to suit adjacent piping.

.5 Size operator to operate valve for the full range of pressures and velocities.

.6 Valve to open by turning counter clockwise. Provide turn-counts on all valves supplied under this contract. The number shall be embedded on the valve body.

.7 Factory mount operator, actuator, and accessories where applicable.

.8 Valve shall be NSF-372 lead free certified or NSF-61 certified.

.9 Materials:

.1 Water: Brass and bronze valve components and accessories that have surfaces in contact with water to be alloys containing less than 16 percent zinc and 2 percent aluminum.

.2 Approved alloys are of the following ASTM designations:

.3 B61, B62, B98 (Alloy UNS No. C65100, C65500, or C66100), B139 (Alloy UNS No. C51000), B584 (Alloy UNS No. C90300 or C94700), B164, B194, and B127.

.4 Stainless steel Alloy 18-8 may be substituted for bronze.

.B Where there is an applicable recommended standard for the design, construction, and testing of a valve and/or actuator, e.g. AWWA. etc., equipment to be supplied under this section will refer to this standard and the equipment supplied shall comply in all respects. Where specifically requested, provide certificates of compliance with the applicable standards.

.C Where it is not intended to supply equipment or valves to a specific standard, the specification will indicate a reference product.

.D All flanged valves shall have flanges as specified for the line into which they are to be installed. As a minimum standard a Class 125 rating will be required. See this specification and drawings for class ratings required for each valve with respect to the valve location in the pumping station piping system.

.E Supply all valves free of asphalt varnish or other non-potable protective coatings if it is intended for potable water service.

.F Mark valves 4" (100 mm) in diameter and larger with size, pressure rating and manufacturer on a corrosion resistant nameplate mounted on the body.

.G Equip the valve with a disc position indicator and a direction of flow indicator where applicable.

.H Provide stem guides as recommended by the Manufacturer and as follows. Space stem guides such that the slenderness (l/r) ratio does not exceed 150 and at no greater distance than 10 ft (3 meters). They shall be fully adjustable, split design with stainless steel body and bracket with bronze bushings.

.I Epoxy Lining and Coating:

.1 In accordance with AWWA C550 unless otherwise specified.

.2 Either two-part liquid material or heat-activated (fusion) material except only heat-activated material if specified as "fusion" or "fusion bonded" epoxy.

.3 Minimum 0.007" (0.178mm) dry film thickness except where limited by valve operating tolerances.

.J All valves shall have the following embossed in casing:

.1 Manufacturer's badge

.2 Type of casing (material code)

.3 Nominal diameter

.4 Pressure rating

.5 Flange drilling

.6 Year of manufacturing

.K "Hardware" is defined as bolts, nuts, washers, lock-washers, straps, etc. Material of construction will be 316 stainless steel, unless specified otherwise, to ASTM F594, Group 2, Condition CW with galling reducing coating.

.L Gaskets, bolts and nuts for valves are covered under the Piping Section except connection for special valves.

.M All valves shall be designed to allow removal and/or maintenance of the actuator (manual, electrical, pneumatic or hydraulic) without a need to depressurize or draining the media in pipe on either side of the valve.

2.02 VALVE ENDS

.A In pipe runs less than 75 mm diameter (DIA), provide valves with female threaded ends, unless indicated otherwise. Threads to conform to ANSI B1.20.1.

.B Valves in pipe runs equal to or greater than 75 mm diameter to be flanged unless indicated otherwise.

.C For cast iron body valves, drill flanges to Class 125 pattern conforming to ANSI B16.1. For steel body valves, flanges to be Class 150 pattern or Class 300 pattern conforming to ANSI B16.5.

.D Do not use grooved joint valve ends.

.E For gate valves, end flanges shall be integral with the gate valve body and be faced and drilled in accordance with ANSI B16.1, Class 125 flanges.

2.03 VALVE MANUAL OPERATORS

.A Provide valves with manual operators unless specifically indicated otherwise on the process schematic drawings, mechanical drawings or the Instrumentation Specification sheets.

.B Supply valve operators or actuators for all types of valves specified as follows:

.1 Supply removable lever handles (1/4 turn type) or handwheels (as applicable) for valves 4" (100 mm) and smaller. Provide chain levers (1/4 turn type) for valves mounted 68" (1700 mm) above the floor. Should space preclude the use of a chain lever, provide a chain

operated geared handwheel operator. Provide additional round speed knob in handwheel operator for valves 4” (100 mm) DIA and larger.

.2 Provide gear actuated handwheels or chain wheel as applicable for ¼ turn valves 6” (150 mm) and larger DIA. For all manual valves with gearboxes, provide the torque required for shutoff operation and the number of turns required and direction of opening. All this information shall be indicated in the valve/gear body.

.3 The chain operators shall consist of cast iron chain wheels with chain guide and zinc coated chain. Provide means, by split pins or other locking devices, to positively prevent the chains or wheels coming off the shaft.

.4 Provide gear actuated handwheels or chain wheel as applicable for ¼ turn valves of 6” (150 mm) and larger DIA.

.5 Mount all valves, regardless of size, with operators orientated having due regard to the ease of access and operation. Should space preclude the use of a chain lever, provide a chain operated geared hand-wheel operator. Electrical or pneumatic actuators are specified below (where applicable).

.6 For hand wheels, clearly show the direction of opening in raised lettering and symbols.

.7 Size actuator to provide adequate torque. Follow AWWA C-540 in determining the required torque.

.C Ensure that each valve and operator is of suitable construction and rating for the long-term service with the fluid or product being conveyed and at the pressure and operating frequencies required by the relevant service.

.D The allowable pull on a manual operator to open or close the valve shall be #180 N (30 lb force), when one side of the valve is at test pressure and the other side is at atmospheric pressure. Manual operators shall operate in a clockwise motion to close the valve. Where a shaft mounted hand wheel would require greater than this force to operate, provide a gear operator. Note: the maximum of #218 N (49 lb-force) shall be provided.

.E Supply cast iron hand-wheels clearly marked with an arrow indicating direction of opening of a valve and the word "open" cast in relief on the handwheel. Provide hand-wheels 12” (300 mm) for valves 4” to 8” (100,150, and 200 mm) DIA and 18” (450 mm) DIA for larger valves as required to allow for manual operation. In confined areas, furnish smaller hand-wheels with higher ratio gearing of the valve to compensate. Hand-wheels of the valves 3” (75 mm DIA) and smaller shall be as per manufacturer standard.

.F Where applicable, provide disc, plug, ball, etc. position indicator.

.G Where applicable, supply steel pipe Tee wrenches with socket to suit nut dimensions. In cases of valves in tanks requiring extension stems and Tee wrenches, the wrench is to be secured in place.

.H Where shown or called for on the drawings, supply and install housing stem floor stands (pedestals). Floor stands shall be standard pattern, as manufactured by Clow Valve, Model F-5500 or approved equal.

.I Lever operators to conform to the following dimensions:

Nominal Valve Diameter Inch (mm)	Minimum Length of Lever Inch (mm)
¼" (6)	3" (80)
½" (12)	3" (80)
¾" (20)	4" (100)
1.5" (38)	6" (150)
2" (50)	6" (150)
1.5" (65)	6" (150)
3" (75)	7" (175)
4" (100)	9" (225)
6" (150)	10" (250)
8" (200)	12" (300)
10" (250)	18" (450)
12" (300)	18" (450)

.J Quarter turn lever operators to be perpendicular to the pipe run when the valve is closed.

.K Lever operators on ball valves to be two positions.

.L The maximum pull at the end of the lever arm not to exceed 50 lb force (300 N) when one side of the valve is at test pressure and one side is at atmospheric pressure. Where greater than this force would be required to operate the valve with a lever, provide a gear operator.

.M Gear operator to be worm gear type, equipped with a hand wheel and a visual indicator of the valve position. Equip operators with adjustable mechanical stop-limiting devices to prevent over-travel of the disc/ball in the open and closed positions and which are self-locking and designed to hold the valve in any intermediate position between full open and full closed. Gear operators shall be grease lubricated. Where gear operators are intended for direct bury or submergence, seal units with long life lubricant.

.N For manual valves on lines 3” (75 mm) and greater, mounted over 1.7 m above the operating floor, provide chain wheel gear operators. Design the operator so that a force of 25 lb-force (150 N) is sufficient to open the valve when one side of the valve is at test pressure and the other side is at atmospheric pressure. The chain pulley to mesh positively with the chain. Extend the chain from the valve operator to operating height 4’ (1.2 m) above the floor or as directed by the Engineer. The exact dimensions shall be field determined. Provide approved chain hooks where required to prevent chain from hanging within traffic paths.

.O Provide gear actuators with combination of hand-wheel and 50 mm (2 inch) operational nut or chain wheel as applicable for ¼ turn valves of 6” (150 mm) diameter and larger. Totally enclose geared hand-wheel actuators, to be of sealed construction for protection against damage or corrosion.

.P Where applicable, supply steel pipe Tee wrenches with socket to suit nut dimensions. In cases of valves in tanks requiring extension stems and Tee wrenches, the wrench is to be secured in place.

.Q For buried applications provide extension stems, valve boxes, box extensions and Tee wrenches. The stem is to be secured to square nut with a pin.

.R Furnish cast iron valve boxes where indicated. Suppliers: J.B. Clow and Sons, Kennedy Valve Mfg., Co, Charlotte Pipe and Foundry or equal.

.S Floor Boxes to be by J.B. Clow and Sons Model F-2520, Kennedy Valve Mfg., Co, Fig. #122 or approved equivalent.

.T Have valves located below grating and slabs operated by a key. Provide vale extension stems, hub nuts, 2” (50 mm) operating nuts, cast-in-place floor boxes, etc., by valve supplier or approved equal, where required on the Drawings. Provide standard length short operating “T” keys, levers, etc. For plug vales, provide “L’ shape keys 3.3’ (1 m).

.U Acceptable products:

.1 Clow

.2 Dresser

.3 Walworth

2.04 ELECTRIC ACTUATORS

.A General:

.1 Comply with ANSI/AWWA C540-02 “AWWA Standard for Power-Actuating Devices for Valves and Slide Gates”.

.2 Motor stall torque not to exceed torque capacity of valve. Stem protection for rising stem valves.

.3 Integral controls with actuator built-in self-protection features.

.4 When application required or indicated, actuators serving larger valves shall consist of two primary components: a gear operator and electric drive assembly. The two components shall be separable.

.5 All actuators shall be from a single manufacturer.

.B Actuator Operation:

.1 Function to match valve characteristic:

.1 Suitable for full 90-degree rotation of quarter-turn valves.

.2 Suitable for full 360-degree rotation of multi-turn valves (gates).

.2 Size actuators to provide sufficient torque to operate the control valves at differential pressures across the closed valve equivalent to the maximum valve pressure rating specified. Such differential pressure shall be applied in either direction. Size the actuators to adequately operate valves at all intermediate conditions with the maximum flow rate specified.

.3 Manual override hand-wheel with maintained position and pad-lockable hand/auto lever and valve position indicator. Actuators that automatically restore auto operation when hand-wheel is released are not acceptable.

.4 Size motors for one complete "Open-Close-Open" cycle no less than once every 10 minutes for isolation duty and for 1200 starts per hour for modulating duty. Operate from fully closed to fully opened positions or the reverse in approximately 15-30 seconds for valves 12" (300 mm) DIA and smaller, 30-60 seconds for valves 14" to 18" (350 to 450 mm) DIA, and 60-120 seconds for larger than 18" (450 mm) DIA, if not specifically listed.

.5 The combined service factor (combined effect of voltage, frequency) shall be a minimum of 1.15. The motor shall have a voltage tolerance of plus or minus 10%.

.6 Valve and actuator mounting bracket shall withstand the stall torque of actuator with torque and limit switches disconnected.

.C Control and Electrical System

.1 The actuator shall be suitable for operation from 3ph, 460 VAC, 60 Hz source, rated for 60 Hz source, UL certified, intended for indoor service. The actuator enclosures and associated equipment shall be Explosion Proof and rated for the Class 1, Group D, Division 2 Electrical Classification.

.2 The motor shall be equipped with reversing motor starter with built-in internal overload, single phasing and winding thermostat protection.

.3 The control circuitry shall be powered from internal control transformer and shall include integral local Remote-Stop-Local and Open-Stop-Close operator control devices and remote input/output controls for isolation or modulating duty in addition to standard actuator internal control devices. The internal circuitry shall allow travel reversal in any position and valve positioning by using local Open-Stop-Close operator controls.

.4 The valve shall operate in local or remote modes only when HAND/AUTO mechanical lever is in AUTO position. The valve shall not perform any electrical based control when HAND/AUTO mechanical lever is in HAND position. The actuator shall operate through the valve mounted operator control devices in local mode and respond to remote input/output control requests in remote mode.

.5 The isolation duty (open/close) actuator controls shall include 120 VAC / 24 VDC open/close discrete signals. The actuator remote control outputs shall have dry 120 VAC / 24 VDC, 1A contacts and include: two sets of opened, closed status limit switches, REMOTE/AUTO control mode status, actuator "MONITOR" alarm contact indicating loss of power supply phases, control board fault, motor thermostat/overload tripped.

.6 The flow control duty (modulating) actuator controls shall include 4-20 mA position reference current signal. The actuator remote control outputs shall have dry 120 VAC / 24 VDC, 1A contacts and include: opened, closed status limit switches, remote/auto control mode status, actuator "monitor" alarm contact indicating loss of power supply phases, control board fault, motor thermostat/overload tripped. The modulating duty actuator shall also include 4-20 mA valve position feedback signal. The analog 4-20 mA signals shall be isolated type, 0-500Ω min. load.

.7 The valve body shall have dedicated terminal compartment c/w terminal blocks.

.8 Anti-condensation heater of suitable size shall be provided.

.9 All actuators shall be provided with detailed control schematics.

.10 Equipment Supplier:

.1 Rotork, IQ Series

.2 Auma. SA Series

.3 EIM, 2000 Series or

.4 Limitorque.

2.05 AWWA GATE VALVE

.A Supply and install Gate Valves as shown on the Contract Drawings and/or as specified herein. Designation: isolation of ARV.

.1 Gate valves shall be resilient seated, ductile iron construction, rising stem conforming to the latest revision of AWWA C509, UL/FM listed;

.2 Pressure-temperature ratings: 50 mm to 300 mm: 1400 kPa (200 psi) @ 65ºC; 350 mm to 750 mm: 1050 kPa (150 psi) @ 65ºC.

.3 Cast iron to ASTM A 126, Class B or Ductile Iron to ASTM-525 or 536 body and bonnet, FF flanged to ANSI B16.1, Class 150.

.4 Cast iron resilient wedge. The wedge shall be fully encapsulated in the elastomer, including the guides. The brass stem nut must be rigidly enclosed in the wedge to maintain alignment. The wedge elastomer shall be bonded to the wedge.

.5 Stuffng Box Gland has a minimum of three (3) O-rings, which can be replaced under pressure while the gate is in the full open position.

.6 Non-asbestos packing and gasket.

.7 The waterway shall be full size to allow for tapping use; no cavities or depressions are permitted in the seat area.

.8 Valve body and bonnet shall be electrostatically applied fusion bonded epoxy, coated both inside and out by the valve Manufacturer. The coating shall meet the requirements of AWWA C550. Coating to be applied only at the valve Manufacturer's facilities.

.9 Suitable for submerged water service where indicated.

.10 Hand wheel operated or 50 mm square operating nut where noted.

.B Shaft spindle to have “O” rings to resilient materials.

.C Valve operators to be waterproof type suitable for continuous submergence duty.

.D Operators to be greased packed, enclosed gear type. Provide disc position indicator.

.E All fasteners, nuts and bolts shall be 316L stainless steel.

.F Trim material: bronze.

.G If valve operator located more than 5.6’ (1.7m) from finished floor provide chain wheel.

.H Valves to open in a counter clockwise direction. Provide disc position indicator.

.I Plugged body standard taps of ½” (12.7mm) DIA.

.J Acceptable Suppliers:

.1 AVK 65 Series;

.2 Clow, Fig.F6102, full wall ductile iron;

.3 American Flow Control,

.4 Mueller,

.5 M & H Valve Co.

2.06 MISCELLANEOUS BALL VALVES

.A Non-lubricated type, all stainless-steel construction ball valve 2" (50 mm) DIA and smaller.

.B ASTM A276-05 GR 316 or ASTM A351/A351M-05 GR CF8M stainless steel body, end cap and ball.

.C Two-piece type, screwed ends, full bore.

.D All valve stems shall be blow out proof.

.E All balls to be solid. Hollow construction is unacceptable.

.F All valves to be designed to seal bubble tight at the rated and low pressure.

.G Seats are to be TFM 1600 or reinforced PTFE, stem packing - adjustable Teflon.

.H All valves shall be supplied with stainless steel locking levers and locating stops.

.I Pressure rating: 225 psi (1500 kPa).

.J Manufacturers and Products:

.1 Watts S-FBV-1 Series

.2 Neo Valves, Cat. #2500

.3 Flo Tech Triad

.4 Velan.

2.07 RUBBER FLAPPER CHECK VALVES

.A Stop check action on pipes 50 mm diameter and larger.

.B Design valves in accordance with the following:

.1 Swing type, fast-acting, full body flanged type with a full size domed access cover. Non-Slam Closing Action - short 35° stroke.

.2 Designed, manufactured and tested in accordance with AWWA/ANSI C508-01.

.3 Body - ductile iron (ASTM A536 Gr. 65 45 12) or cast iron (ASTM A126 Class B) with removable top maintenance flange c/w gasket.

.4 Reinforced Disc - steel coated hinge pin/disc with single moulded memory return EPDM (ASTM A36/D 2000 BG), hinge portion of disc nylon reinforced and warranted for 25 years, full flow area, low head loss, rated for 66 deg. C and 1035 kPa minimum.

.5 Steel reinforced EPDM flapper (100% encapsulated), raised seating ring, Rubber Lining.

.6 Flapper shall be replaced without removing the valve from the line.

.7 Coating: prime coated interior and exterior, fusion bonded epoxy lined interior and exterior, removable threaded plug at invert.

.8 Ends - ANSI B16.1 Class 125 flanges.

.9 Hydrostatically tested in the factory at two (2) times their rated pressure. Conduct a seat closure test at the valve to demonstrate zero leakage.

.10 Accessories to include: backflow actuator and mechanical indicator c/w a modified robust spring.

.C Acceptable manufacturers:

.1 Val-Matic, "Surgebuster" 7200 Series.

.2 APCO, S-100

.3 Golden Anderson, Series 200

2.08 ECCENTRIC PLUG VALVES

.A Plug valves shall be of the non-lubricated, quarter-turn, eccentric type with flanged ends and hand-wheel operators, in full conformance with the latest revision of the AWWA C517 Standard.

.B Valves through 12” size shall have a minimum 175 PSI and 14” to 24” shall be rated for 150 PSI working pressure. Plug valves shall seat tightly in both directions at rated pressure and be capable of operation after long periods of inactivity.

.C Plug Valves shall be 100% full round ported for reduced pumping costs and improved flow characteristics.

.D The valves shall have the following minimum full open flow coefficients (Cv): 4” DIA-Cv=982; 6” DIA-Cv=1997; 8” DIA Cv=3371; 10” DIA Cv=4870; 12” DIA Cv=7643; 14” DIA Cv=8220; 16” DIA Cv=11300; 18” DIA Cv=12400; 20” DIA Cv=17500; 24” DIA Cv=19500.

.E Flange diameter, thickness, and drilling shall conform to ANSI B16.1 Class 125.

.F Valve shaft seals shall be of the self-adjusting U-cup design for reduced maintenance and replaceable without removing the cover from the valve.

.G Valves shall have bodies and covers of ductile iron per ASTM A536 Grade 65-45-12 ductile iron for superior strength. Valve sizes 6" and larger shall have body seats of 95% welded nickel applied directly to the body and machined to a smooth finish. Sprayed, plated or removable seats are not acceptable. Valves shall have plugs made from ductile iron per ASTM A536 with a vulcanized synthetic rubber seat facing tested per ASTM D429 for all sizes.

.H The valve shall have an ASTM A536 Grade 65-45-12 ductile iron plug with molded and vulcanized Buna-N rubber coating per ASTM D429.

.I The plug shaft shall be fitted with permanently lubricated 316 stainless steel upper and lower shaft bearings, upper and lower thrust bearings and grit excluders to minimize the entry of grit into the bearing area.

.J Shaft packing shall be Buna-N rubber that is adjustable and replaceable without removing the actuator. The packing gland shall be epoxy coated ductile iron with stainless steel gland studs and nuts.

.K Valves shall be provided with stainless steel thrust bearings on the upper and lower plug shaft to eliminate plug-to-body contact and ensure long lasting plug-to-seat alignment. Grit seals shall be provided on the upper and lower bearing journals to minimize the entrance of grit into the shaft seal and bearing areas.

.L Valves shall be coated internally and externally with 6-8 mils NSF approved two-part epoxy paint for corrosion protection. Valve body shall be electrostatically applied fusion bonded epoxy. The coating shall meet the requirements of AWWA C550. Coating to be applied only at the valve Manufacturer's facilities.

.M All valves 4" (100 mm) and larger shall be supplied with a gear actuator and hand-wheel. Manual actuators shall mount on a pre-drilled ISO 5211/MSS SP-101 mounting pad to minimize the need for brackets and adaptors. Provide plug position indicator in the gear body and number of turns to fully close-open.

.N Acceptable Suppliers:

.1 Golden Anderson Industries LLC, Figure 517 "ECO-Centric"

.2 Dezurik; Style PEC

.3 Valmatic

.4 M & H Valve Co.

2.09 SEWAGE COMBINATION AIR / VACUUM RELEASE VALVE

.A Wastewater Combination Air Valves suitable for pressures up to 150 psig (1033 kPa).

.B Wastewater Combination Air Valves shall be automatic float operated valves designed to exhaust large quantities of air during the filling of a piping system and close upon liquid entry. The valve shall open during draining or if a negative pressure occurs. The valve shall also release accumulated air from a piping system while the system is in operation and under pressure. The valve shall perform the functions of both Wastewater Air Release and Wastewater Air/Vacuum Valves and furnished as a single body type as indicated on the plans.

.C Standards, Approvals and Verification:

.D Valves shall be manufactured and tested in accordance with American Water Works Association (AWWA) Standard C512.

.E Manufacturer shall have a quality management system that is certified to ISO 9001 by an accredited, certifying body.

.F Connections: Single body valves sizes 4 in. (100 mm) and smaller shall have full size NPT inlets and outlets equal to the nominal valve size with a 2 in. (50 mm) inlet on 1 in. (25 mm) valves. The body inlet connections shall be hexagonal for a wrench connection. The body shall have 2" NPT cleanout and 1" NPT drain connection on the side of the casting. The valve shall have three additional NPT connections for the addition of backwash accessories.
Air release shall have a 5/16" self- adjusting orifice.

.G Design: The cover shall be bolted to the valve body and sealed with a flat gasket. Resilient seats shall be replaceable and provide drop tight shut off to the full valve pressure rating. Floats shall be unconditionally guaranteed against failure including pressure surges. Mechanical linkage shall provide sufficient mechanical advantage so that the valve will open under full operating pressure. Simple Lever Designs shall consist of a single pivot arm and resilient orifice button. Compound Lever Designs shall consist of two levers and an adjustable threaded resilient orifice button. The valves body shall be threaded with NPT inlets and outlets (hexagonal – for a wrench connection). Three additional NPT connections for the gauges, flushing and draining.

.H Materials: The valve body and cover shall be constructed of ASTM A126 Class B cast iron. The orifice, float, plug, guide shafts, linkage mechanism and bushings shall be constructed of Type 316 stainless steel. Non-metallic guides and bushings are not acceptable. Resilient seats shall be Buna-N. Orifice Button – Viton for simple lever designs, and Buna-N for compound lever designs

.I Coating: Valve interiors and exteriors shall be coated with a fusion bonded epoxy.

.J Accessories:

.1 Backwash accessories shall be furnished and shall consist of an inlet shut-off valve, a blow-off valve, a clean water inlet valve, 5' (1.5m) rubber supply hose, and quick disconnect couplings. Accessory valves shall be

quarter-turn, full ported bronze ball valves. Separately pipe drain and outlet ports of each valve to the wet well.

.2 Isolating gate or ball valve.

.K Manufacturer and Product:

.1 Val-Matic, VM 801 ASV-M.

.2 APCO, 440 SCAV Series.

.3 Cla-Val.

.4 Vent-O-Mat, Series RGX.

2.10 GASKET MATERIAL

.A Refer to Section 15200 - Process Pipes.

PART 3 EXECUTION

3.01 GENERAL

.A Install all valves by competent personnel in strict accordance with the manufacturer's instructions and as described in these specifications.

3.02 PROTECTION OF OPENING DURING SHIPMENT

.A Flange connections must be blanked with bolted wood or metal covers no smaller than the flange outside diameter. Threaded connections shall be fitted with pipe plugs. All exterior-bearing housings shall be enclosed in polyethylene wrapping to positively exclude moisture, dust, or dirt.

3.03 HANDLING OF VALVES

.A Chains, cables and ropes must not be placed through valve ports or attached to operating cylinders or handwheels. Slings must be used either around the valve body or with bolts or rods through the flange bolt holes.

3.04 STORAGE OF VALVES

.A Store valves in a cool location clear of moving vehicles or other objects. Prevent dirt and debris from entering the valve internals. On no account shall the valve seats on butterfly valves be painted. Valves must not be rested on handwheels or operating shafts.

.B Store butterfly valves with valves slightly off the closed position.

.C Cover the valves to shield them from dirt and to avoid exposing the seats to sunlight or mercury arc light.

3.05 PREPARATION

.A The valve and piping arrangement indicated in the drawings is based on typical dimensions for valves of the specified type. Make the necessary modifications in the piping to allow for discrepancies between the valve dimensions shown and those supplied for the work.

.B Prior to the installation of the valves, field measure and check all equipment locations, pipe alignments, and structural installation. Ensure that the valve location and orientation provides suitable access to manual operators and that sufficient space and accessibility is available.

.C Where conflicts are identified, inform the Engineer and initiate the necessary piping modifications at no cost to the City.

3.06 VALVE INSTALLATION

.A Before installing valves, inspect the pipeline to ensure that no foreign debris or objects may work loose and prevent the valve from closing.

.B Install valves in conjunction with the piping described in Sections 15200.

.C In horizontal pipe runs other than in locations where space does not permit, mount all valves with a vertical operating shaft with the actuator at the top. In no case install a valve with the operator shaft pointing down.

.D When joining valves to pipe or fittings, do not over torque bolts to correct for misalignment.

.E Support valves in position using temporary supports until valves are fixed in place.

.F Permanently support valves to prevent transmission of loads to adjacent pipe work and/or equipment.

.G Generally, pipe supports and hangers are not shown unless for indication purposes only.

.H Install gate valves in the closed position.

.I Install valves, which are bubble tight in one direction to seal in a direction opposite to normal flow unless otherwise noted or directed by the Engineer.

.J Unless otherwise specified, install single seated ball valves and knife gate valves with the seat downstream. Install on pump discharge and suction lines with seat adjacent to the pump.

.K Install all valves and actuators in accordance with the manufacturer's recommendations.

.L Temporarily support the equipment as required. All temporary supports shall be rigid and so constructed as not to subject the equipment to any undue stresses or cause any damage.

3.07 COMBINATION AIR / VACUUM RELEASE VALVE

.A Air release and vacuum valves shall be installed in locations as indicated on the Drawings. The locations shown on the Drawings are approximate. The City or City's Representative may adjust the location of the valves to the high point in the area.

.B Valves shall be installed in strict accordance with manufacturer's recommendations.

.C Isolation valves shall be provided below each air valve.

3.08 VALVE IDENTIFICATION

.A Engraved lamacoid nameplates 30 mm by 60 mm with white lettering on a black background shall be supplied and installed for all valves supplied and/or installed. The nameplate must be suitable for mounting on the valve or immediately adjacent to the equipment. The code lettering and number system must be as shown on the drawings and directed by the Contract Administrator.

3.09 SUPERVISION AND START-UP

.A Provide a factory trained supervisor(s), from the supplier, skilled and experienced in the assembly, installation, operation and maintenance of all equipment supplied in this Section. Arrange for the supervisor(s) to check all completed installations and certify in writing to the Contract Administrator their correctness. The supervisor(s) must fully cooperate with the Contract Administrator and the Contractor and must provide such direction and assistance as is required by the Contract Administrator and Contractor in testing and commissioning the equipment.

3.10 TESTING

.A Valves shall be tested after installation initially without and subsequently with the media following charging the piping system. Notify Contract Administrator who may choose to witness the tests.

.B Operate valves and operators under simulated and/or real process conditions to ensure they operate as intended.

.C Pressure test the valves in conjunction with the pipes in which the valves are installed as specified in Divisions 11 and 15.

3.11 COMMISSIONING

.A Attend during commissioning of the process system which includes the equipment specified in this section and to ensure the equipment functions as intended in the process system.

.B Comply with the Division 1 Sections.

3.12 MANUFACTURER'S REPRESENTATIVE SUPPORT

.A Provide a qualified equipment service representative to perform the service herein specified.

.B Supervise the handling and installation of equipment and materials by others.

.C Prior to commencement of commissioning review mechanical, electrical and structural works to ensure that the equipment is correctly installed, supported, connected and wired. Immediately advise the Owner in writing of any deficiencies or deviations from the installation instructions, during the installation of the unit.

.D Inspect, operate, test and adjust the equipment.

.E The inspection is to include, but is not limited to, the following points as applicable.

.1 Soundness (without cracked or otherwise damage parts).

.2 Completeness on all details as specified.

.3 Correctness of setting, alignment and relative arrangement of various parts.

.4 Adequacy and correctness of packing, sealing and lubricants.

.F Commission the equipment and instruct the Owner's operating personnel in all aspects of equipment, maintenance and troubleshooting.

.G Make any necessary changes and adjustments to the equipment.

.H After successful commissioning of the equipment submit, in triplicate, a complete signed report on the results of the inspection, operations, adjustments and tests.

.I Include in the report detailed descriptions of the points inspected, tests and adjustments made, quantitative results and suggestions for precautions to be taken to ensure proper maintenance. Include certification that equipment conforms to the requirements of the specifications and is ready for permanent operation. Hand over to the Owner all adjustments, settings and test sheets.

.J Manufacturer's representative for the valves shall be present at the jobsite for installation assistance, inspection and certification of the installation,

equipment testing, startup assistance and training of the Owner's personnel, for the period of (for each valve type):

.1 Two (2) days - installation assistance and certification.

.2 One (1) day – testing.

.K Training (non-consecutive days) – 2 days according to the Division 1 requirements.

.L Minimum number of trips 2 per each valve type.

A. Refer to Division 1 for the certification forms and procedures.

+ + + END OF SECTION 15100 + + +

SECTION 15200
PROCESS PIPING

PART 1 GENERAL

1.01 INTENT

.A Provide, install and satisfactorily operate all piping systems within the pumping station, as specified herein and as shown on the Drawings.

.B Carry out cutting and patching, drilling and fitting under this Section, as required for these piping systems.

.C The term piping as used herein, includes pipe, fittings, valves, pressure and temperature gauges, cocks, strainers, funnels, supports, insulation, wrapping, and all else necessary to properly complete the work.

.D In general, include all manual operators, floor stands, wrenches, chains, extension stems, stem guides, operating nuts, floor boxes, valve boxes, wall thimbles and auxiliaries.

.E Supply and installation of all supports, hangers, braces, etc., required for the proper installation of piping.

.F Supply of all items and information required by other trades as work progresses.

.G Installation of in-line primary elements and valves supplied under Divisions 15.

.H Supply of all items and information required by other trades as work progresses.

.I Supply and installation of all flushing, drain and vent connections.

1.02 CODES AND STANDARDS

.A Comply with all relevant Codes and Standards.

.B Where provisions of the pertinent codes and standards conflict with these Specifications and Drawings or with each other, comply with the more stringent provision.

.C Standards shall be the latest issues.

1.03 REFERENCE STANDARDS

.A Conform to the following reference standards:

.1 ANSI A13.1, Scheme for the Identification of Piping Systems.

.2 ANSI B16.5, Pipe Flanges and Flanged Fittings.

.3 ANSI B16.9, Factory-Made Wrought Steel Butt Welding Fittings.

.4 ANSI B16.15, Pipe Flanges and Flanged Fittings, Classes 150 and 300.

.5 ANSI B36.10M, Welded and Seamless Wrought Steel Pipe.

.6 ANSI B36.19M, Stainless Steel Pipe.

.7 ASTM A105/A105M, Forgings, Carbon Steel, for Piping Components.

.8 ASTM A135, Electric-Resistance-Welded Steel Pipe.

.9 ASTM A139, Electric-Fusion (ARC)-Welded Steel Pipe (NPS 4 and Over).

.10 ASTM A167, Stainless Steel and Heat-Resisting Chromium-Nickel Steel Plate.

.11 ASTM A181/181M, Forgings, Carbon Steel, for General Purpose Piping.

.12 ASTM A269, Seamless and Welded Austenitic Stainless-Steel Tubing for General Service.

.13 ASTM A312/312M, Seamless and Welded Austenitic Stainless-Steel Pipe.

.14 ASTM A320/320M, Alloy Steel Bolting Materials for Low-Temperature Service.

.15 ASTM A403/A403M, Wrought Austenitic Stainless-Steel Piping Fittings.

.16 ASTM A563, Carbon and Alloy Steel Nuts.

.17 ASTM A774/A774M, As-Welded Wrought Austenitic Stainless-Steel Fittings for General Corrosive Service at Low and Moderate Temperatures.

.18 ASTM A778, Welded, un-annealed Austenitic Stainless-Steel Tubular Products.

.19 AWWA C606, Grooved and Shouldered Joints.

.20 AWWA M11, Steel Pipe - A Guide for Design and Installation.

.21 MSS SP25, Standard Marking System for Valves, Fittings, Flanges and Unions.

.22 MSS SP43, Wrought Stainless Steel Butt Welding Fittings.

1.04 DELIVERY, STORAGE, AND HANDLING

.A Protection:

.1 Use all means necessary to protect pipes and appurtenances before, during, and after installation and to protect the installed work of other trades from the work of this Section.

.B Replacements:

.1 In the event of damage to piping and appurtenances, immediately make all repairs necessary for the approval of the Contract Administrator, at no additional cost to the City.

1.05 SUBMITTALS

.A Submit to the Contract Administrator for review shop drawings showing pipe dimensions, maximum external loadings, pipe class details, elevations, bends, joints, restraining joint details and thrust blocks when required.

.B Start construction of the piping system only when the shop drawings are reviewed. Review of the drawings by the Contract Administrator will in no way relieve the Contractor of the responsibility for errors in the drawings or for deviations from the contract documents.

.C For each piping system submit documentation listing pipe and fittings to be used for each pipe size and category.

.D Radiographic Weld Testing: Submit the name and qualifications of at least two (2) independent firms for the radiographic weld testing to be undertaken by the Contractor. The selected firm will be subject to the review and acceptance of the Engineer.

.E For all pipes submit isometric drawings, to indicate the assembly details, the welds, flanges, valve placement, couplings and expansion joints, anchors, hangers, supports, provisions for thrust restraint, half couplings for drains, sensors and vents, as well as any other pertinent details.

.F For couplings and expansion joints submit manufacturer's catalogue data, shop drawings and assembly drawings confirming general arrangement, dimensions, tolerances, materials of construction, weights and installation details.

.G Welding: Prior to commencing any welding of stainless steel pipe, prepare and submit to the Engineer a written description of welding techniques

including but not limited to materials, methods, and quality control. Identify differences in shop and field techniques. Written procedures will be certified by Authority Having Jurisdiction Standards.

.H Submit weld test results to the Engineer for approvals.

.I Prior to the commencement of welding, submit current and complete documentation of the welder's qualifications prior to the commencement of welding.

.J Submit installation and testing reports in accordance with the Authority Having Jurisdiction Regulation Piping Systems Installation and Test Data Report.

1.06 COORDINATION

.A Process and Utility Piping Identification: Refer to Section 15075 for process piping identification.

.B Pipe Support and Hangers: Refer to this Section, Sections 15010 and 15050 and Drawings.

.C Routing: Coordinate piping installation routes and elevations with installation of structural, mechanical, instrumentation, and electrical work.

.D Review on site conditions prior to submittal of station piping shop drawing, and provide custom fittings as required to meet the intended design.

1.07 QUALITY ASSURANCE

.A Welding Certification

.1 All welders to be certified under the Authority Having Jurisdiction Regulation.

.2 All welders who work on this project must provide the correct documentation.

.B Weld Tests

.1 Provide for one (1) full circumference radiographic inspection for every 20-welded pipe-to-pipe and pipe-to-fitting joints. All sizes and types of pipe welds to be tested at locations identified by the Engineer.

.2 Have radiographic test firm evaluate welds in accordance with ASME B31 and prepare report summarizing results.

.3 Have radiographic weld test report, complete with results, submitted directly to Engineer.

.4 For each defective weld, three additional radiographic inspections at locations identified by the Engineer, will be required plus a radiograph of the repair.

PART 2 PRODUCTS

2.01 GENERAL

.A Comply with the product requirements outlined in the Specification.

.B Select all other materials not specifically described but required for proper completion of the work of this Section, subject to the approval of the Contract Administrator.

2.02 PIPE MATERIALS

.A Supply all pipe materials as shown in the Pipe Schedule in this Section, as described herein, and as shown on the Contract Drawings.

.B Pipe sizes shown are normal sizes in inches (mm), as shown on the Nominal Pipe Nomenclature Chart at the end of the Section. Actual pipe dimensions shall be those commercially available and in accordance with the applicable standards and specifications.

2.03 CEMENT LINED DUCTILE IRON PIPE AND FITTINGS

.A Primary Flange Rating: ANSI Class 150.

.B Design Pressure: 150 psi (1033 kPa).

.C Temperature (Max,): 104ºF (40ºC).

Item	Sizes	General Description
Pipe C110/A21.10	4” (100 mm) and larger	Ductile iron to ANSI /AWWA C151/A21.51 Class 53
Fittings	4” (100 mm) and larger	Cast iron or ductile iron to ANSI/AWWA C110/A21.10
Bolts	All	316 Stainless steel to ASTM A193/A193M Grade B8M, carbide treated and strain hardened to a surface Brinnell of 320 maximum

Item	Sizes	General Description
Nuts	All	316 Stainless steel to ASTM A194/A194M-04a, Grade 8 or 8M, carbide treated to match bolts
Flange Gaskets	3" to 10" (75 to 250 mm)	0.2" (5 mm) THK, red rubber or black neoprene, full face
	12" to 18" (300 to 450 mm)	0.2" (5 mm) THK, red rubber or black neoprene, full face
Joints	All	- Flanged to ANSI/AWWA C110/A21.10 - Grooved (Victaulic) to ANSI/AWWA C110/A21.10

.D Notes:

.1 All joints shall be restrained.

.2 Victaulic Couplings: CSA B242, radius grooved type for rigid joints, Style 31 and 341 as required.

.3 Victaulic Fittings: ANSI B16.1 where applicable, grooved to suit Victaulic Couplings.

.4 Flange Adaptors: Provide all valves connection with Victaulic 741 flange adaptor for valve installation and removal.

.5 Pipe and fittings for exposed installation (indoor or outdoor) shall be factory primed and site painted with two coats of oil-based enamel. Colour to match respective plant's colour codes.

.6 Provide double layer cement mortar lining for Ductile Iron Pipes and Fittings, (for services as indicated in Piping Schedule Table).

.7 Gaskets for sludge heater pipe connections: refer to Gasket Material section.

2.04 STAINLESS STEEL PIPING AND FITTINGS

.A Design Pressure: 150 psi (1033 kPa).

.B Pressure (Max.): 250 psi (1700 kPa).

.C Temperature (Max.): 104ºF (40°C).

Item	Sizes	General Description
Pipe	1" (25 mm) and smaller	Type 316L Stainless steel tubing, ASTM A312/A312M, welded (seam), soft

Item	Sizes	General Description
Fittings	1” (25 mm) and smaller	ASTM A182/A182M, Grade F304, forged, flare-less compression type
Pipe	1” (25 mm) and larger	Austenitic stainless steel to ASTM A312 Grade TP316 Stainless steel, Sch. 10S and 40S, seamless, as per ANSI/ASME B36.19
Fittings	1” (25 mm) and larger	Austenitic stainless steel to ASTM A403, CR316, MSS-SP-43 and ANSI/ASME B16.9, Sch. 10S, butt-weld
Flanges	1” (25 mm) and larger	Class 150 welding neck, flat face, as per ANSI/ASME B16.5, austenitic stainless steel, Sch. 10S, butt-weld
Bolts and nuts	All sizes	316 stainless steel to ANSI B18.2.1
Gaskets	All Sizes	0.2“ (5 mm),Buna-N (full face)

.D Notes:

.1 Provide dielectric unions where different metal connections are applied.

.2 Buried stainless steel piping and fittings shall be coated with Denso LT tape applicable to buried services.

.E Thread Lubricant: Teflon tape.

.F ASTM A-240, Type 316. Design pipe and fittings to suit spans shown on the Drawings and specified herein. Standard mill-finish of exterior surfaces. Protect pipe during storage and construction from surface marring. Refinish damaged areas to satisfaction of the Engineer.

.G Provide stainless steel pipes as follows: Schedule 40S for pipes up to and including 300mm dia. and Schedule 10S for pipes from 350 to 500mm dia. Refer to drawings for pipe diameters. All pipes to be sloped to provide proper drainage.

.H Smooth flow elbows for pipes up to 900 mm Ø.

.I Flanges for all pipe sizes - rolled type Van-Stones/ Lap-Joint or rolled angle, thickness not less than thickness of pipe, with stainless steel backing flanges to ASTM A-240, Class 150 or Class 300. Place true and perpendicular to the axis. Fasten with bolts and nuts. Gaskets – 0.2“ (5 mm) thick red rubber, cloth insert, full faced.

.J Design fittings such as base elbows to support vertical pipe loadings. Design wall flanges where shown on the drawings to support all loads due to weight and dynamic thrust.

.K Provide couplings as shown on the Drawings and at locations where required for equipment or valve easy disassembly. Fit pipe and fittings for couplings with appropriate pipe preparation in relation to manufacturer's recommendations.

.L Brackets and supports – stainless steel – pipe hangers – purpose made SS c/w rubber lines. Provide integral steel pipe supports to process pipe where indicated on drawings or required. Drill support bases for anchors to concrete pads.

.M The use of stainless steel piping is subject to the following:

.1 That all welding be done by certified welders.

.2 That the alignment of welds be true to prevent any bending stresses in the welds from the pipe joining.

.3 That minimum welding work is performed in the field.

.4 That shop drawings for the various pipe work systems are submitted for review.

.5 That each piping system be designed to withstand the Contract working and test pressures.

.6 That all necessary joint shown on the Contract drawings be included or as determined by the Engineer.

.7 That pipe and fittings be provided with a standard mill finish.

2.05 SLAB, FLOOR, WALL, AND ROOF PENETRATIONS AND CLOSURES

.A Piping penetration of slabs, walls, slabs, ceilings, and roofs shall be ductile iron wall pipes or stainless-steel wall pipes with thrust collars and sleeved penetrations unless otherwise noted on the Drawings.

.B Verify size and location of all building and structure penetrations prior to pouring concrete. Co-ordinate with structural trade the installation and size.

.C Ductile Iron Wall Pipes:

.1 Provide ductile iron wall pipes where ductile iron piping passes through concrete walls, ceilings, slabs and roofs that are to be watertight and where shown on the Drawings.

.2 Wall pipes shall be as manufactured by American Cast Iron Pipe Company, CLOW, or approved equal.

.3 Wall pipe shall be of a thickness equal to or greater than the remainder of the piping in the line and shall comply with the requirements for fittings as detailed on the Pipe Data Sheets. Flanges set flash to the face of concrete shall be tapped for stud bolts.

.4 Provide thrust collars for wall pipes. Thrust collars shall be of ductile iron or cast iron and cast integral with the wall pipe wherever possible.

.5 Wall pipes that cannot be cast with integral thrust collars shall be fabricated by welding ductile iron thrust collar continuously around the pipe on both sides of the collar. All welds shall be done in the manufacturer's shop by qualified welders and shall be electric arc welds or ductile iron with NI-55 or FC-55, nickel-iron-carbon weld rod. The thrust collar shall be ductile iron.

.6 Thrust collar shall be rated for the thrust load developed at 250 psi (1,725 kPa) and shall have a minimum safety factor of 2. Submit the pressure rating and safety factor specified.

.7 Coat wall pipes as specified in Section Painting.

.8 Support wall pipes by formwork to prevent contact with reinforcing steel.

.D Pipe Sleeves:

.1 Cast Iron: Cast or fabricate wall pipe equivalent to ductile iron pressure pipe, with plain ends, flanges or grooved ends and integral water-stop, unless otherwise indicated.

.E Core drilled holes drilled with a suitable rotary drill will be considered in lieu of sleeves in existing walls. Permanent sleeves are not required for holes formed by removable PE sleeves.

.F Provide a water stop center flange for all sleeves in exterior or water-bearing wall. Make the annular space between pipes and sleeves in exterior wall watertight.

.G Seal the annular space between the pipes and sleeves in exterior wall by calking with rubber sealant, or be modular annular mechanical sealing unit. The installed closure shall provide electrical isolation of the pipe from the wall sleeve.

.H Wall sleeves shall be coated as specified in Section Painting. When placing non-insulating type wall sleeves in concrete forms, support them by formwork to prevent contact with the reinforcing steel.

2.06 POLYVINYL CHLORIDE (PVC) PROCESS PIPE AND FITTINGS

.A Primary Flange Rating: Class 150.

.B Design Pressure: 50 psi (345 kPa).

.C Temperature (Max.): 104°F (40°C).

.D Corrosion Allowance:

Item	Sizes	General Description
Pipe	8” (200 mm) and smaller	PVC, Type I, Grade I, Sch. 40 and Sch.80, conforming to CSA B137.3. Clear PVC: Cell Classification of 12454 per ASTM D1784 and manufactured as to ASTM D1785.
Fittings	2.5” (65 mm0 and smaller	PVC, Type I, Grade I, Sch. 80, socket type to ASTM D2467.
Flanges	3” to 8” (80 mm to 200 mm)	150 lb., Sch. 80, PVC, socket type, conforming to ANSI B16.1
Bolts	All sizes	Bolts shall be stainless steel to ASTM A193, Grade B8M, carbide treated.
Nuts, Washers	All sizes	Nuts, washers shall be stainless steel to ASTM A194, Grade 8M, carbide treated to match bolts.
Unions	3” (80 mm) and smaller	Sch. 80, PVC, socket type connection.
	3” to 6” (75 mm to 150 mm)	Use flange connection.
Gaskets	3” to 6” (80 mm to 150 mm)	0.13” (3.2 mm) thick, red rubber or black neoprene.

.1 Notes:

.1 The pipe material shall include 1.5% TiO2 for ultraviolet protection.

.2 Reducing bushings shall not be used on sizes 4” (100 mm) and larger. Reducer couplings, concentric or eccentric as indicated, shall be used and manufactured to have at least the same working and burst pressures as the pipe.

.3 Only PVC glue rated for hypochlorite service to be used. Provide confirmation in shop drawings.

.4 All solvent welding joints for pressure pipe system shall be strictly in accordance with Manufacturer's installation instructions using heavy duty gray industrial grade PVC solvent cement #711 and purple primer P#70.

.1 The summary of the procedure is provided below for convenience. Obtain the entire procedure and follow accordingly:

.1 Bevel pipe ends.

.2 Apply primer to female and male end. Re-apply primer to socket, and ensure primer does not dry out on either of the surfaces.

.3 Apply glue to pipe diameter and socket.

.4 Re-apply glue to the pipe.

.5 Join pipe and socket with a quarter twist and hold for 30 seconds.

.5 Teflon tape Mil, spec P –27730A – rated or service compatible. Teflon paste shall be used for threaded joints. No substitute shall be permitted.

.6 Notify Engineer prior to any solvent welding joint work. Engineer, at his discretion, may choose to be present during this work and during the pressure test.

2.07 MISCELLANEOUS PIPING SPECIALTIES

.A Flange adapters:

.1 For stainless steel pipe: Victaulic Style 441, grade CF8M stainless steel conforming to ASTM A-351, A-743 and A-744; Grade E EPDM gaskets.

.2 Groove pipe ends to make the connections rigid:

.1 For connecting steel pipe to flanged valves, fittings and equipment use Victaulic Style 741 and 743 (to ANSI Standard). ANSI Class 150 bolt hole patterns; Grade E EPDM gaskets.

.2 Victaulic Style 341 (to AWWA C606 standard) for connecting ductile iron pipe to flanged valves, fittings and equipment. ANSI Class 150 bolt hole patterns; Grade E EPDM gaskets.

.B All Victaulic type couplings and flanged adapters shall be furnished with 316 stainless steel hardware to ASTM F594, Group 2, Condition CW with galling reducing coating.

.C Link-seal: EPDM rubber elastomer, 316 SST hardware pipe penetration seal, Model "S-316" as supplied by Power Plant or approved equal.

.D Transition couplings for joining metal pipes shall be for carbon steel and DI pipe: Dresser Style 253, Smith - Blair Style 441; stainless steel pipe: Metal Grip or Grip-L by Straub Tadco Inc. (AISI 304 stainless steel casing, bolts, nuts, washers and 316 SST strip inserts; sealing sleeve: EPDM, H-NBR for hot water service). Provide additional thrust ties or other means of restraining the joint as approved by Engineer.

.E Pipe service saddles for metal piping shall be Smith-Blair 372; or equal, and shall be all TIG welded, rated for 1030 kPa internal pressure. Saddles shall have NPT or AWWA threaded female outlet, have all stainless-steel bodies and all components, stainless steel hex nuts with washers, and Buna –N seals.

.F Transition couplings for joining pipes of differing material, having varying OD, shall be Combi-Grip by Straub Tadco Inc. (AISI 304 stainless steel casing, bolts, nuts, washers and 316 SST strip inserts; EPDM gaskets), or approved equal. Provide additional thrust ties or other means of restraining the joint as approved by Engineer. Bolts, nuts and washers shall be 304 SST.

.G Transition couplings for joining plastic pipes shall be Plastic Grip by Straub Tadco Inc. (AISI 304 stainless steel casing, bolts, nuts, washers and 316 SST strip inserts; sealing sleeve: EPDM).

.H Flanged coupling adapters shall be Dresser, Style 127 and 128 for ductile iron and steel piping respectively. Bolts, nuts and washers shall be 304 SST.

.I Bellows type Flexible Couplings shall be elastomer expansion joints as manufactured by Red Value or E.V.R. or Redflex. Pressure rating shall be as required pressure test for adjacent piping system.

.J Thrust restrained joints for pressurized services to be by EBAA Iron Sales Inc. Series 1100HD Harness (restrains push-on-pipe bell) for ductile iron piping and Series 1100HV Harness (restrains push-on-pipe bell) for PVC piping.

2.08 PIPE SUPPORTS

.A Concrete Supports - reinforced as detailed on the Drawings.

.B Saddle Supports - Grinnell Fig. 264, 265 and 259; Anvil Fig. 191 and 264 (both 316 stainless steel) adjustable pipe saddles.

.C Pipe Hangers – Anvil Fig.181, 65, 69, 260, 300, CT-65; Grinnell Fig. 260 adjustable wrought clevis (316 S.S.) for horizontal pipe and Fig. 100, 103, 261, CT-121 and CT-121C riser clamps for vertical pipe. Where pipe is insulated, use Anvil Fig. 160 to 166A, 167, 168; Grinnell Fig. 167 or equal.

.D Angle Brackets - Grinnell Fig. 199 (No. 1-5), Anvil Fig 194, 195, 199 – all 316 stainless-steel.

.E Beam Clamps: Anvil Fig. 92, 93, 94, 292, 292L; Grinnell or approved equivalent.

.F Provide 3 mm (1/8 in.) thick rubber between pipes and supports. Strap SST pipe to concrete and saddle supports.

.G All pipe supports and hardware installed in the wet well and valve chamber shall be made of 316 Grade stainless steel.

.H All of the above and any others as detailed on the Drawings.

2.09 GASKET MATERIALS

.A Material will be suitable for media and thermal conditions of piping system components.

.B ASME B16.21, non-metallic, flat, asbestos-free, 0.2“ (5 mm) maximum thickness unless thickness or specific material is indicated.

.C Full-Face Type E: For flat-face, Class 125, cast-iron and cast-bronze flanges.

.D Full-face Type E, flat-face Class 125, 3.2 mm thick for stainless steel/ stainless steel flange pair.

.E Narrow-face Type: For raised- face, Class 250, cast-iron and steel flanges.

.F Gasket Materials: Ductile Iron - Buna-N; Stainless steel – neoprene. Waste Water – EPDM.

.G Suppliers:

.1 W. L. Gore & Associates, Inc.

.2 Garlock

.3 Durlon 7910

.4 Global Rubber Products Ltd.

2.10 DIELECTRIC UNIONS

.A Provide the following items ahead of copper lines which branch off steel, stainless steel or cast-iron headers:

.1 Screwed Nipple.

.2 Cast iron, bronze-mounted gate valve, Crane Fig. 464 ½ or Fig. 465 ½ or equivalent.

.3 Dielectric Union.

PART 3 EXECUTION

3.01 GENERAL

.A Comply with the special execution requirements outlined in the Specifications.

3.02 EXAMINATION

.A Inspection:

.1 Prior to installation of the work of this Section, carefully inspect the installed work of all other trades and verify that all other work is complete to a point where this installation may properly commence. Field verify dimensions shown on the Drawings.

.B Discrepancies:

.1 In the event of a discrepancy, immediately notify the Contract Administrator.

.2 Do not proceed with fabrication or installation in areas of discrepancies until all such discrepancies have been fully resolved.

3.03 INSTALLATION

.A Install all piping to the dimensions noted on the Drawings, true to line, grade and elevation.

.B Provide constant slope towards pipe discharge on all gravity plumbing lines.

.C All joints shall be well made and free from stress due to misalignment and lack of support, etc.

.D Install pipe supports whether indicated on the Drawings or not, as necessary to adequately support the pipe as shown and/or as detailed hereinafter. Hot dip galvanized the pipe supports after fabrication and use stainless steel or galvanized fasteners, unless specifically noted otherwise elsewhere in these Specifications or on the Drawings. Support all insulated piping directly on the pipe or on supports welded to the pipe and protruding through the insulation.

.E Install piping to provide free movement of the pipe due to thermal expansion/contraction, except at anchoring points.

.F Do not install insulation until all field-testing of the system is completed.

3.04 INSTALLATION OF STAINLESS STEEL PIPE

.A Welding:

.1 Welding of stainless steel shall be carried out as specified under Part 3 – Execution. All pipe and fittings shall be shop assembled and welded in an accredited welding shop by certified welders for specified type of medium. Any required field welds shall be approved by the engineer and only be allowed where pipe assemblies are too large or awkward to install. All welds including fittings and spool piece assemblies shall be fall-penetration-welded butt joints.

.2 For pipe wall thickness up to 4.76 mm (3/16 in.) and the root pass on thicker materials use Inert-Gas Tungsten-Arc (TIG) welding process. Subsequent passes by the Gas-Metal-Arc (MIG) process.

.3 Filler metal shall be as follows:

.1 Where field welding is approved by the Engineer use:

.1 Shielded Metal Arc Welding (SMAW) electrode shall be E308L for type 304L stainless steel pipe and E316L for type 316L stainless steel pipe.

.2 Tungsten Inert Gas (TIG) or Metal Inert Gas (MIG) filler metal shall be bare wire type ER 308L for type 304L stainless steel pipe and ER316L for type 316L stainless steel pipe.

.B Welding Qualifications:

.1 The Contractor shall be qualified for welded fabrication under the Boiler and Pressure Vessels Act and as such shall have:

.1 Engineering and supervisory personnel listed with the Authority Having Jurisdiction as meeting the requirements of the appropriate Clauses of the above Act.

.2 Welding procedures whether deemed pre-qualified or not, accepted by the Authority Having Jurisdiction under the provisions of the appropriate Clauses of the above Act filed with it records.

.3 Tested and qualified welders and welding operators as per the provisions of the above Act.

.C Preparation:

.1 Surfaces and edges to be welded shall be free from tears, cracks and other defects, which may adversely affect the quality and/or strength of the weld. Surfaces to be welded shall also be free from scale, grease, slag or foreign material which may impair weld quality.

.2 Edges prepared by carbon arc gouging shall be ground to sound metal to eliminate carbon pick-up. Cleaning by means of wire brushing shall be done using stainless steel wire brushes, followed by wiping dry with a chloride free cleaner.

.D Welds:

.1 Welds shall comply with the requirements of the PQE welding procedure obtained under the above-mentioned qualifications and shall comply with Sec. IX, Part A, of the ASME Boiler and Pressure Vessel Code.

.2 The work-piece temperature shall be at least 10°C prior to commencing welding and where multi-pass welding is required, the inter-pass temperature shall not exceed 175 deg. C.

.3 Where inert gas shielding is used gas shall be applied on both sides of the weld and application shall continue until the weld has cooled sufficiently to avoid discolouring and oxidation.

.4 Collapsible dams or partitions containing back-up gas may be used where it is not practical to fill large sections with gas.

.5 After welding, all slag and weld splatter shall be completely removed from all welds. Welds which have a reinforcement exceeding 3.0 mm shall be smooth, on both sides as the case may be. Finished welds shall be smooth and free from pinholes, heat tint, undercut and overlap.

.E Pipe Tolerances:

.1 Finished pipe sections shall be truly straight with walls parallel to the axis of the pipe. Any pipe section with a fault in alignment exceeding 3.5 mm for each 3000 mm in length from a line parallel to the axis of the pipe will be rejected.

.2 Special sections of pipe shall not vary from the specified length by more than 3.5 mm.

.F Finish:

.1 The finished pipe sections shall be thoroughly pickled, passivated, scrubbed and washed until all discoloration and iron picked up during manufacture is completely removed. Any field welds shall be treated with pickling paste, scrubbed with stainless steel wire brushes and thoroughly washed. Completed pipelines shall be washed, inside and out to remove dirt picked up during shipping and installation, including the removing of any stains or discoloration made on the pipe during construction.

.G Precautions:

.1 Care shall be exercised during handling and installation of stainless steel pipe to avoid the contact of stainless steel with non-stainless-steel tools, wire ropes, etc., as ferrous metal contamination may leave marks caused by rusting or embedded steel.

3.05 PIPES THROUGH WALL AND FLOOR

.A Conform to the details on the drawings.

.B Unless specified differently, couple piping passing from a rigid structure to trench conditions with a Dresser type coupling within 1.6’ (0.5 m) of the external face of the structure. Locate the next pipe joint a maximum of 5’ (1.5 m) from the first coupling.

.C Provide piping cast into walls that divides liquid containing structures from dry structures or trench conditions from structures with integrally cast or weld flanges in the wall, as water-stops. Have the flange diameter a minimum of 6 in. greater than the outside diameter of the pipe and a minimum of 0.25” (6 mm) thick.

.D Where pipes pass through floors or slabs provide a concrete curb around the pipe.

.E On no account will the cutting of reinforcing steel in a wall or a slab be permitted without the approval of the Engineer. Where it is deemed necessary to cut, bend locally or re-space steel reinforcement to accommodate pipes or other works, the Engineer’s approval must be obtained before such work proceed.

.F Where approval is given by the Engineer for the cutting, local bending or re-spacing of the main reinforcing steel, additional reinforcing will be added as directed by the Engineer.

.G Unless otherwise specified, set pipes through walls, floors and roofs of concrete or similar material in suitable openings for grouting in place under the Concrete

Section. Provide suitable pipe connections on both sides of the opening to permit ready dismantling of the pipelines.

.H For pipes passing through concrete block walls, place a 0.25" (6 mm) thick strip of non-bituminous type joint filler between the pipe and the grout to provide for pipe expansion. Provide joint filler of sponge rubber equal to ASTM D1752, Type 1.

.I For pipes passing through double walls use the same joint filler as specified above. Ensure that the joint sealer and its application conform to Type 'C' joint sealer as specified in the Concrete Accessories Section.

.J Where required for anchoring steel pipe, furnish thrust rings in the number and thickness required to absorb the full thrust imposed by the Field Test Pressure. Provide thrust rings of steel plate not less than 6 mm thick; reference AWWA Report 11 "Steel Water Pipe Manual", page 239.

.K Provide all openings necessary for the installation of the piping. See the Concrete Section for details of the concrete work associated with pipe openings.

3.06 SUPPORTS

.A Carefully align and support all pipe fittings before the joints are securely bolted to prevent excessive stresses in the pipes. Take special care to see that the pipe is not moved thereafter. Unless otherwise shown or specified, provide a distance between supports, for metallic pipe, of not greater than 8' (2.5 m). For steel pipe racks, space as shown on the Drawings and, in any case, not greater than 10' (3m).

.B Install concrete supporting piers for pipes placed near the floor level, and approved thrust anchors at all points of change in pipe direction. Securely support piping by brackets or hangers well fastened to inserts in walls and ceilings. Support vertical pipes by lateral struts secured to adjacent walls.

.C Supply hangers of the clevis type equal to "Anvil" manufacture, and arrange to suit the direction of thermal expansion and contraction. Perforated hangers are not permitted. Furnish brackets of heavy steel construction, equal to "Anvil". Provide special supports as shown. Provide galvanized hanger rods.

.D Supply concrete fasteners for pipe supports equal to HILTI or "Phillips Redhead" cinch anchors and of ample capacity for the loading envisaged.

.E Furnish field welded structural steel pipe racks of the general design shown on the Drawings. Fabricate them of structural steel members having ample size for all conditions of loading.

.F Otherwise, provide supports as follows:

.1 PVC Piping: in accordance with manufacturer's recommendations; 5' (1.5 m) centres maximum and as shown.

.2 Other Piping:

.1 1" (25 mm) diameter and less; 6.5' (2 m) centres maximum.

.2 Greater than 1" (25 mm) diameter; 8' (2.5 m) centres maximum.

3.07 PIPE HANGERS AND SUPPORTS

.A Spacing for metal piping:

.1 Spacing (for hangers) and middle attachment rod diameter as specified in the paragraphs below or as in the table below, whichever is the more stringent.

.1 Plumbing piping: most stringent requirements of the Plumbing Code for the Authority Having Jurisdiction.

.2 Fire protection: to applicable fire code.

.3 Gas piping: up to 0.6" (15 mm) size - every 6' (1.8 m).

.4 Copper piping: up to 0.6" (15 mm) size - every 5' (1.5 m).

.5 Flexible joint roll groove pipe: in accordance with table below, but not less than one hanger at joints.

.6 Within 300 mm of each horizontal elbow.

Pipe Size in/mm	**Rod Diameter, in/mm**	**Maximum Spacing CLDI & Steel, ft./m**	**Maximum Spacing Copper, ft./m**
To 1.25/30	0.4/10	6/1.8	5/1.5
1.5/40	0.4/10	6.6/2.0	6/1.8
2/50	0.4/10	8/2.4	8/2.4
2.5/65	0.4/10	8/2.4	8/2.4
3/75	0.4/10	10/3.0	8/2.4
4/100	0.6/16	10/3.0	8/2.4
6/150	0.9/22	10/3.0	

8/200	0.9/22	12/3.6	
10/250 & larger	0.9/22	13.2/4.0	

.B Spacing of supports for horizontal PVC pipes (up to 95°F/35°C) shall not exceed the following:

Pipe Size, in/mm	Rod Diameter, in/mm	Sch 40/Sch 80 Maximum Spacing, ft/m
0.4/10 mm or under	0.4/10 mm	3.3/1.0 metres
0.6-0.75/15mm to 20 mm	0.4/10 mm	3.3/1.0 metres
1-2/25 mm to 50 mm	0.4/10 mm	3.3/1.0 metres
1-2/25 mm to 50 mm	0.4/10 mm	4/1.2 metres
3/75 mm	0.5/12 mm	4/1.2 metres
4/100 mm	0.6/15 mm	5/1.5 metres
6/150 mm	0.75/20 mm	5/1.5 metres
8/200 mm	0.75/20 mm	6/1.8 metres
12/300 mm or over	0.75/20 mm	6.6/2.0 metres

.A Spacing of vertical clamp supports for vertical PVC pipes shall not exceed 5’ (1.5 metres).

.B Provide pipe supports as indicated on the drawings and/or as specified hereinafter, as required for proper support of piping.

.C Hanger rods may be attached to beam or joist clams, bolted brackets or concrete inserts. Ramsets or similar devices shall not be permitted.

.D Hangers, brackets, etc. shall not be welded to structural steel unless approved by the Engineer.

.E Hangers for pipes of diameter larger than 100 mm shall not be attached to the ceiling sheathing or the roof trusses. Design and provide floor supports for these pipes. Alternatively, provide hangers with spreader beams which can distribute hanger load over the several roof trusses, subject to Engineer’s approval.

3.08 PIPE COATING

.A Shop coat pipe, fittings and related appurtenances, unless otherwise specified. Remove all mill scale, rust and foreign matter prior to coating.

.1 Steel Piping: Primer Exterior Surfaces: Painting in accordance with Section Painting.

.2 Mechanical Groove, Sleeve Couplings, and other Pipe Couplings; same treatment as associated pipes.

.3 Bolts and nuts used underground or submerged couplings; coat with an approved varnish or bitumastic solution after connection.

.B Wrap all fabricated steel piping buried in earth with a petroleum based tape of "Denso" manufacture or coal tar covering of "Tape-coat" manufacture.

.C Touch-up interior and exterior coatings damaged from field welding or other causes to the satisfaction of the Engineer. During extremes of hot or cold weather handle pipe coated with coal tar carefully to prevent coating damage.

3.09 PIPING CONNECTIONS

.A All couplings, tapped saddles, valves, flexible connectors and fittings must be of material similar to that of the piping system, and have pressure and temperature ratings equivalent to the piping system in which they are installed.

3.10 PIPE TOLERANCES

.A Finished pipe sections shall be truly straight with walls parallel to the axis of the pipe. Any pipe section with a fault in alignment exceeding 0.14" (3.5 mm) for each 9.8' (3000 mm) in length from a line parallel to the axis of the pipe will be rejected.

.B Special sections of pipe shall not vary from the specified length by more than 0.14" (3.5 mm).

3.11 PIPES CAST IN CONCRETE

.A Remove coating from cast iron or steel pipe, including sleeves to provide a good bond.

3.12 TESTING AND CLEANING PRIOR TO SETTING

.A Before setting into place and while suspended, inspect the pipe or fittings for defects and ring with a light hammer to detect cracks. Reject any defective, damaged or unsound pipe. Remove all lumps, blisters and excess coating from flanged ends. Ensure pipe is clean and dry and free from oil and grease before setting.

3.13 TESTING

.A All process piping shall be pressure tested to 150% of the working pressure unless noted otherwise.

.B Give 48 hour written notice of date of tests.

.C Insulate and/or conceal work only after testing is satisfactorily completed.

.D Conduct all tests in the presence of the Engineer.

.E Bear all costs of testing including retesting and making good.

.F Maintain test pressures for at least 4 hours unless otherwise specified.

.G Ductile iron and SST piping to be tested to 150 psi (1000 kPa) water pressure. Leakage from pipes will be zero. No loss of pressure will be accepted.

.H If leaks are detected in the pipe or any of the appurtenances connected thereto, make any necessary repairs and retest.

.I Test equipment as specified in the relevant sections and as a minimum, demonstrate that each piece of equipment operates as specified.

.J Prior to tests, isolate all equipment or other parts that are not designed to withstand test pressures.

.K The testing procedure shall be approved prior to commencement of the work and all leaks shall be repaired to the satisfaction of the Contract Administrator.

.L Allowable Leakage:

.1 No leakage is allowed in piping installed under this Division.

.2 If any section discloses leakage under test, the Contractor shall discover the cause, make any changes indicated, and re-inspect/re-test that section at his expense and to the satisfaction of the Contract Administrator.

3.14 FLUSHING

.A Before operating any piping system, thoroughly flush with water to remove any construction debris and dirt from the system. All piping must be cleaned before completion.

.B Flushing operations shall be witnessed by Engineer and the Utility and carried out by specialist contractor.

.C Flush pipes through available outlets with a sufficient flow of water to produce a velocity of 1.5 m/s, within pipe for 10 min., or until foreign materials have been removed and flushed water is clear.

.D Flushing flows shall be as follows:

Pipe Diameter	Flow, gpm (L/s) Minimum
6" (150 mm) and below	600 (38)
8" (200 mm)	1190 (75)
10" (250 mm)	1820 (115)
12" (300 mm)	2380 (150)

.E Provide connections and pumps for flushing as required.

.F Open and close valves, and service connections to ensure thorough flushing.

3.15 SAFETY RELIEF VALVES

.A Supply all safety relief valves for water services with test gauges for hydrostatic testing purposes. Upon completion of the hydrostatic testing, remove the test gauges and re-pressurize the system to the relieving pressure of the relief valves to ensure that the valves are relieving at their set-point.

3.16 CERTIFICATION

.A On completion of installation and testing of all equipment, submit the manufacturer's certification of the correctness of the installation to the Engineer.

3.17 DEFECTS AND REPAIRS

.A Make good defects disclosed in the work and retest or replace the work without additional cost to the Region. Make repairs to piping systems with new material. No caulking of screwed joints, cracks or holes will be accepted. Where it becomes necessary to replace pieces of pipe, such replacements to be the same lengths as the defective pieces.

.B Repeat tests after any work have been replaced if, in the judgment of the Engineer, it is necessary.

.C Conduct all pressure testing in the presence of the Engineer.

3.18 NOMINAL PIPE SIZE NOMENCLATURE CHART

.A Metric Size (mm), Imperial Size (in)

Metric Sizes	Equivalent Imperial	Metric Size	Equivalent Imperial	Metric Size	Equivalent Imperial	Metric Size	Equivalent Imperial
6.4	1/4	50	2	300	12	675	27
10	3/8	65	2-1/2	350	14	750	30
12	1/2	80	3	375	15	825	33
18	5/8	90	3-1/2	400	16	900	36
20	3/4	100	4	450	18	1050	42
25	1	150	6	500	20	1200	48
32	1-1/4	200	8	525	21	1500	60
40	1-1/2	250	10	600	24	1800	72
45	1-3/4						

3.19 PIPING SCHEDULE

.A The table below is a Piping Schedule to be used for piping located in Pumping Station.

Service	Material	Joint Type	Test Pressure	Remarks	Colour Code
Raw Sewage (Valve Chamber), Exposed	CLDI	FLG	150 psi	All elbows - long radius	Light Brown
Raw Sewage (Wet Well), Exposed	SST	FLG, WLD	150 psi	Sch. 40S & 10S, Grade 316; All elbows - long radius	N/A
Drain, Valve Chamber: Sump Pump Access Hatch	 SST PVC	 THRD, WLD SOLV, THRD	 150 psi 50 psi	 Sch. 10S, Grade 316 Sch.40	 N/A N/A
Vent (Wet Well, Valve Chamber)	SST	FLG, WLD	15 psi	Sch. 10S. Grade 316	N/A
Exhaust Vent, Air/Vacuum Relief Valves	SST	THRD, WLD	15 psi	Sch. 10S, Grade 316	N/A

Gauge/Instrument Pipe Stub	SST	THRD, WLD	150 psi	Sch. 10S, Grade 316	N/A

.B Abbreviations used:

.1 B&S - Bell and Spigot

.2 COMP - Compression joint

.3 FLG - Flanged

.4 GC - Grooved Coupling

.5 MJ - Mechanical Joint

.6 H&S - Hub and Spigot

.7 SOLV - Solvent Welded

.8 SOLDR - Soldered

.9 WLD - Welded

.10 TYT - Tyton (Push-On)

.11 THRD - Threaded

.12 FSW - Fusion Socket Welded

.13 CLDI - Cement Lined Ductile Iron

.14 CPVC - Chlorinated Polyvinyl Chloride

.15 CS - Carbon Steel

.16 CU - Copper

.17 DI - Ductile Iron

.18 GALV - Galvanized Steel

.19 PVC - Polyvinyl Chloride

.20 SST - Stainless Steel

.21 HDPE - High Density Poly Ethylene

+ + + END OF SECTION 15200 + + +

SECTION 15430
PLUMBING SPECIALTIES AND ACCESSORIES

PART 1 GENERAL

1.01 SCOPE

.A This section refers to the supply and installation of all plumbing specialties and accessories not specified in other sections.

.B This section specifies the design, shop drawing submission, fabrication, supply, shipping, unloading, storage, installation, testing, commissioning and certification of sump pump specifically designed for use in pumping wastewater.

.C Provide all labour, safety procedures, materials, equipment and accessories not only herein or elsewhere specifically mentioned or included, but necessary for the supply, installation, testing, and commissioning of the equipment.

.D Equipment included in this Section:

.1 One (1) sump pump complete with motor, controls and all associated equipment. All sump pump equipment shall be explosion proof and designed and manufactured for operation in a classified environment (Class 1 Div.1 Group D) as per electrical classification and be rated for such an application by approved testing agency prior to delivery to site.

.E All the equipment shall be UL listed and conform to the AIS requirement of the Consolidated Appropriations Act of 2014.

.F Conform to the General Requirements of Division 1 and Section 11000, unless otherwise specified.

.G Supply, install and satisfactorily operate all miscellaneous systems and miscellaneous equipment as drawn and specified.

1.02 RELATED WORK IN OTHER SECTIONS

.A The following related sections are included for reference only. It is the Contractor's responsibility to coordinate and include all works described, shown, and referenced in the contract documents.

.1 Mechanical General Requirements - Section 15010

.2 Basic Mechanical Materials and Methods - Section 15050

.3 Applicable sections of Division 16.

1.03 REFERENCES

.A American Society for Testing and Materials, ASTM A 167 – Stainless and Heat-Resisting Chromium Nickel Steel Plate Sheet and Strip.

.B ASTM - American Society for Testing and Materials.

.C ANSI - American National Standards Institute.

.D AWWA - American Water Works Association.

.E ASTM A48, Grey Iron Castings.

.F ASTM A108, Steel Bars, Carbon Cold-Finishes, Standard Quality.

.G ASTM A276, Stainless Steel and Heat Resisting Steel Bars and Shapes.

.H ASTM A532, Abrasion Resistant Cast Iron.

.I Hydraulic Institute Standards, Standards of the Hydraulic Institute, 14th Edition

1.04 SUBMITTALS

.A Submit shop drawings for all products specified in this section in accordance to Section 01300 – Submittals.

.B Submit copies of following shop drawings:

.1 General layout of each pump unit completed with motor showing anchor bolt locations, casing position, direction of rotation and electric motor terminal box location.

.2 Footprints and cross-sectional details of each pump and pump seal with complete cross-referenced materials list.

.3 Impeller, size, rotor, stator, solid sphere passing diameter details, motor specification.

.4 Seal lubrication and oil bath arrangements.

.5 Electrical wiring diagram for control and protection equipment.

.6 List of recommended spare parts.

.7 Maintenance procedures and schedules.

.8 Seal water system, including supply and drainage tubing sizes (if applicable).

.9 Certified, characteristic curves including head, capacity, efficiency, and power expressed in kilowatts. Curves must include standard curves for pumping digester sludge.

.10 Dimensioned drawings of motors and drives and details including full output power in kilowatts, rpm and slip.

.11 Details of storage and off-loading requirements.

.12 Do not construe the Engineer's failure to note errors, omissions or interference modifications during review of shop drawings as approval of such errors, omissions or modifications.

.13 Submit certified, non-witnessed, shop test results for all pumps, including hydro, vibration and motor tests.

.14 Provide installation manuals prior to shipping the equipment. No payment will be made for equipment delivered before installation manuals or storage and off-loading requirements.

.15 Bind installation, operation and maintenance manuals and certified performance pump curves corrected to actual running rpm in field in indexed manual for equipment.

.16 Submit operation and maintenance manuals before requesting initial start-up.

.17 Provide equipment sized for spaces allocated on the Contract Drawings. Differently sized equipment is subject to approval by the Engineer.

1.05 MAINTENANCE DATA

.A Provide maintenance data for incorporation into manual as specified under Division 1 Section – Operation and Maintenance Manuals.

1.06 FIXTURES AND TRIM

.A Fixtures to be product of one Manufacturer and of same type in any one washroom or location.

.B Trim to be product of one Manufacturer and of same type in any one washroom or location.

1.07 CERTIFICATES

.A Shop Finishing: Certify that shop finished metal components received protective coating system.

.B Machine Finishing: Certify that machine finishes specified have been provided. Provide hard copies of certification.

1.08 WARRANTY

.A The equipment shall be warranted for a period of twenty-four (24) months from the date of Substantial Performance of the entire project.

1.09 QUALITY ASSURANCE

.A Obtain the services of a qualified balancing organization to perform testing, balancing, and component check at no additional cost to the Owner. The balancing agency shall be independent of the installer.

.B The following Specifications do not purport to cover all details entering into design of pumping units required, but rather to call attention to certain special features.

.C Workmanship for materials and methods of construction shall conform to best practice and highest standard of industry.

.D To insure a consistent high standard of quality, the manufacturer of this pumping equipment shall comply with the requirements of the ISO 9001 Quality System, and such compliance shall be verified by an independent certification agency approved by the International Organization for Standardization. Documentation shall be submitted for approval showing compliance with this requirement, and the equipment will not be released for shipment until approved.

.E Perform checks before testing and balancing.

.F Perform balancing in accordance with AABC 12173.

PART 2 PRODUCTS

2.01 PIPING AND FITTINGS

.A STAINLESS STEEL PIPE

.1 Refer to Sections 15200 – Process Piping.

.2 Joints: Threaded and flanged.

.3 Designation: all sump pump piping to discharge to Wet Well.

2.02 GATE VALVE

.A All valves shall be CSA approved.

.B Up to 65 mm DIA – Rising Stem, screwed Bonnet, Solid Wedge Disc, Back Seat, Full Ports, Integral Bronze Seat.

.C Cold water working pressure of 1035 kPa.

.1 Body, screwed bonnet and disc: All Bronze, B62 alloy to ASTM C83600.

.2 Stem 1/2"–2": Bronze, B505 alloy to ASTM C83600.

.3 Stem 2 1/2"–3": Bronze, B371 alloy to ASTM C69400.

.A Acceptable Manufacturers are:

.1 Crane No.431.

.2 Jenkins 310J.

.3 Kitz or Toyo Red/White.

2.03 BALL VALVE

.1 Application: isolation valve in new drain service as shown in the drawings.

.2 Stainless steel ball valve 50 mm and smaller.

.3 ASTM A276-05 GR 316 or ASTM A351/A351M-05 GR CF8M stainless steel body.

.4 Type 316 stainless steel.

.5 Three-piece type, screwed ends (or compression where applicable).

.6 Rated to 4,100 kPa

.7 All valve stems shall be blow out proof.

.8 All balls to be solid. Hollow construction is unacceptable.

.9 All valves to be designed to seal bubble tight at the rated and low pressure.

.10 Seats are to be RTFE, stem packing – adjustable PTFE.

.11 All valves shall be supplied with stainless steel locking levers and locating stops.

.12 Manufacturers and Products:

.1 Neo Valves Cat #2500,

.2 Watts S-FBV-1 Series,

.3 Bray,

.4 Flo Tech Triad

2.04 BALL CHECK VALVES

.1 Designation: sump pump discharges.

.A Epoxy coated Cast Iron body and cap with corrosion resistant phenolic resin ”Sinking Ball”.

.B Simple two bolt access cover for clean out.

.C Replaceable NITRILE (Buna-N) valve seat.

.D Hardware: 304 S.S.

.E Pressure rating 1000 kPa.

.F Temperature rating 80ºC.

.G Connection: Threaded.

.H Manufacturers and Products:

.1 Flomatic Model 508

.2 ABS

.3 AVK-HDL Model 53/NNI

2.05 EXPLOSION-PROOF SUMP PUMP

.A Service: There shall be one explosion-proof design sump pump assembly (Class 1 Div. 1, Group D hazardous locations) at the SPS site installed in the Valve Chamber.

.B Operating Conditions

.1 Capacity: 16 gpm (1 L/s).

.2 Total Dynamic Head: 20’ (6 m) W.C.

.3 Speed: Max of 1750 rpm.

.4 Operating temperature: Up to 104°F (40°C).

.5 Liquid Specific Gravity: 1.02.

.6 Minimum sphere size: 0.75” (20 mm).

.7 Minimum Motor Size: 0.5 hp, 120VAC/1phase/60 Hz, constant speed, intermittent operation; NEMA B Type.

.8 The pumping equipment shall fit into new sump (refer to drawings).

.9 Protective coating:

.1 Shop prime and finish with manufacturer’s standard coating system to be suitable for wet, corrosive environment.

.2 Adequately grease and/or protect with anti-rust compound prior to shipment.

.C Sump Pump: one (1) automatic, vertical, free-standing, single stage, bottom suction, heavy duty, wet pit, non-clog submersible centrifugal pump with cast-iron support legs for transfer of the process drainage to the wet well. Equipment and installation to include the following:

.1 Supply and installation of one (1) vertical, wet pit, centrifugal sump pump.

.2 Associated supports and accessories, including suction connection base assembly, thermal and leak detection sensors for motor, welded lifting hook.

.D Pump shall be of the centrifugal type with an integrally built in submersible type motor. Discharge shall be 50 mm DIA (2 inch) NPT. Pump shall can pass the full 20 mm (3/4 inch) diameter solids.

.E STATOR winding shall be of the open type with Class B insulation good for 130°C (266°F) maximum operating temperature. Winding housing shall be filled with clean high dielectric oil that lubricates bearings and seals and transfers heat from windings and rotor to outer shell. Air-filled motors which do not have the superior heat dissipating capabilities of oil-filled motors shall not be considered equal. Service Factor to be 1.15.

.F MOTOR shall have two heavy duty ball bearings to support pump shaft and take radial and thrust loads and a sleeve guide bushing directly above the lower seal to take radial load and act as flame path for seal chamber. ball bearings shall be designed for 50,000 hours B-10 life. Stator shall be pressed into motor housing.

.G A HEAT SENSOR thermostat shall be attached to top end of motor winding and shall be connected in series with the magnetic contactor coil in control box to stop motor if motor winding temperature reaches 221°F. Thermostat to reset automatically when motor cools. Two heat sensors shall be used on 3 phase motors.

.H The motor pump shaft shall be of #416 stainless steel threaded to take pump impeller.

.I SEAL: motor shall be protected by two mechanical seals mounted in tandem with a seal chamber between the seals. Seal chamber shall be oil filed to lubricate seal face and to transmit heat from shaft to outer shell. Seal face shall be silicon carbide/carbon lower seal and carbon/ceramic upper seal with Buna-N elastomer and 316 spring and lapped to a flatness of one light band. A double electrode shall be mounted in the seal chamber to detect any water entering the chamber through the lower seal. Water in the chamber shall cause a red light to turn on at the control box. This signal shall not stop motor but shall act as a warning only, indicating service is required.

.J PUMP IMPELLER: the pump impeller shall be of the recessed type to provide an open unobstructed passage through the volute for solids. Impeller shall be of cast iron and shall be threaded onto stainless steel shaft.

.K The PUMP CASE shall be designed for a recessed vortex impeller and have unobstructed pas-sage ways to handle full spherical solids. The pump volute shall be constructed of Class 30 gray cast iron.

.L The MOTOR HOUSING castings shall be high tensile strength Class 30 gray cast iron.

.M CORROSION PROTECTION: All iron castings shall be pretreated with phosphate and chromic rinse and to be painted before machining and all machined surfaces exposed to the sewage water to be repainted with double epoxy finish. All fasteners to be 316 stainless steel.

.N BEARING AND CAP: Upper motor bearing cap shall be a separate casting for easy mounting and replacement.

.O POWER CORD and Control Cord shall be double sealed. the power and control conductor shall be single strand sealed with epoxy potting compound and then clamped in place with rubber seal bushing to seal outer jacket against leakage and to provide for strain pull. Cords shall withstand a pull of 300 pounds to meet U.L. Requirements. Insulation of power and control cords shall be type SOOW. Both control and power cords shall have a

green carrier ground conductor that attaches to motor frame. The cable shall be designed for continued exposure to the pumped fluid. Power cord shall be sized for the rated full load amp loading of the pump in accordance with the National Electric Code. Power cable shall enter into the junction box through a compression type-sealing gland. Each conductor in the cord is individually sealed to eliminate wicking of liquids. The entire junction chamber shall be sealed off from the motor housing by through wall terminals to protect the motor from moisture.

.P Accessories

.1 Threaded pipe adaptor, flexible hose piece, cast iron ball check valve, isolating S.S. ball-type valve.

.2 One integral or a separate float switch and intrinsically safe float module.

.3 Data Plates: All data plates shall be stainless steel suitably attached to the pump and motor. Data plates shall contain the manufacturer's name, pump size and type, serial number, speed, impeller diameter, capacity and head rating, and other pertinent data.

.Q Control Panel:

.1 Supply and install one (1) control panel to be installed outdoor as indicated in the drawings.

.1 Control panel shall be made of NEMA 4X stainless steel enclosure c/w lockable hasp, inner door; lightning arrestor; UL labelled and anticondensation heater.

.2 Control panel shall be furnished with an input power terminal block and float switch terminal block; ground lug; control side fuses; main non-fused disconnect; control On/Off switch; HOA switch; IEC rated motor contactor; 120 Volt control circuit and transformer; pump disconnect and motor overload protection; capacitors and start relay; thermal cut-out circuit; alarm reset; float switch and intrinsically safe float module.

.3 Provide lights, switches and accessories: external high-water alarm light; green pump run light; float status indicator light; seal fail relay w/ indication; overload tripped light; audible high-water alarm horn; alarm test and silence switch.

.4 Provide dry contacts of Form C Relay for connections for: high water alarm; pump Run; seal fail; pump general failure and one spare. Refer to I-Series drawings for details.

.5 Lights, Switches, and Resets shall be mounted through the panel inner door.

.6 Panel power and control schematics (laminated) shall be attached to the inside door.

.2 Engraved Labels as required.

.3 Panel shall be supplied as a complete package with the pump.

.4 60’ of multiconductor power and control cable for pump; confirm the exact length at the site.

.5 All metal parts of the accessories should be made of 316 stainless steel.

.6 All 316-stainless steel hardware and anchor bolts.

.7 All pumps, control panels, float switches, etc. shall have tags reviewed and approved by City.

.8 All electrical components shall meet the Class 1 Group D Div. 1 requirements.

.9 A special data plate shall be attached to the pump frame which shall contain identification of frame and bearing numbers.

.R Pump Manufacturer: Zoeller Pump Co. Model MX282, Myers, Hydromatic,

.S Miscellaneous:

.1 Pump Data Plates: All data plates shall be stainless steel suitably attached to the pump and motor. Data plates shall contain the manufacturer’s name, pump size and type, serial number, speed, impeller diameter, capacity and head rating, and other pertinent data.

.2 A special data plate shall be attached to the pump frame which shall contain identification of frame and bearing numbers.

.3 Hardware: All machine bolts, nuts and cap-screws shall be of the hex head type. Hardware (or parts) requiring special tools or wrenches shall not be used.

.T Spare Parts

.1 Provide the following spare parts:

.1 One (1) flow switch level regulator.

.2 Additional lubricants for all pumps (one can of each).

.3 Tag and store spare parts.

PART 3 EXECUTION

3.01 INSTALLATION

.A Install in accordance with State Plumbing Code except where specified otherwise.

.B Install in accordance with Manufacturer's written instructions and as specified.

.C Install unions in piping system wherever they will expedite removal of equipment and valves.

3.02 PIPING INSTALLATION

.A Make all pipe runs straight, true and parallel, and run at the specified slope to drain.

.B Install piping to clear and/or to provide service for future equipment.

.C Provide flanged joints or unions for ready disconnection of piping at all equipment and apparatus.

.D Unions in copper tubing to be cast bronze solder joint with spherical ground joint and bronze seat.

.E Unions in steel piping 2” (50 mm) size and under to be rated for 150 psi (1 MPa) minimum steam working pressure, malleable iron, screwed, with spherical ground joint and bronze seat.

.F Provide unions in steel piping 64 mm size and over in cast iron gasket type Class 125 flange unions or companion flanges as specified under “Pipe Joints”.

.G No close right and left-hand nipples are to be used. Supply all nipples of suitable length that the correct size of pipe wrench can be used on them when in place.

.H Care must be taken to maintain hot and cold-water pipes at least 150 mm apart.

.I Anchor interior hose valves securely to the walls or columns as shown on the Drawings.

.J Approved di-electric fittings to be installed where ferrous piping and equipment connects to non-ferrous piping and equipment.

3.03 PIPES THROUGH WALLS AND FLOORS

.A Coordinate with General trade and provide openings in walls and floors necessary for the installation of apparatus. Supply and place pipe sleeves for building walls, floors and so forth, as required. Project floor sleeves 75 mm above the floor. Seal the pipe through the sleeve with "Link-Seal". For pipe passing through fire rated walls and floors and not integrally cast into the wall or floor; pack with approved fire containment materials in accordance with UL listing.

.B Where exposed piping penetrates an exposed or finished area, provide chrome plated escutcheon plates.

.C Details for the concrete work associated with pipe openings are described in the Concrete Section.

.D Voids of all pipe wall penetrations shall be filled with unshrinkable fire rated material. Refer to drawings. Confirm the details in the shop drawing submission.

3.04 PIPE SUPPORTS

.A Refer to section 15050 for pipe hanger and spacing requirements and drawings.

.B Securely support piping by galvanized brackets or hangers well fastened to inserts in walls and ceilings. Support vertical pipe by lateral struts secured to adjacent walls.

.C Use hangers of the clevis type "Grinnell" Fig. 260, arranged to suit the direction of thermal expansion and contraction. Perforated hangers are not permitted. Use brackets of heavy welded steel construction, galvanized "Grinnell" Fig. 199. Provide special supports as shown. Use galvanized hanger roads.

.D Where copper tubing is used, isolate hangers from the tubing with lead shield or similar pad. Alternatively, provide copper plated "Grinnell" Fig. CT69 hangers.

.E For submerged piping and wet well piping/ fittings provide 304L stainless steel supports.

.F For concrete fasteners of pipe supports use "Phillips Redhead", of ample capacity for the loading envisaged.

3.05 INSTALLATION OF SUMP PUMP

.A Installation and operation of the sump pump must be performed in accordance with the manufacturer's specifications.

.B Align all pumps, pipes, valves, and fittings.

.C Experience:

.1 The manufacturer/supplier of the pumps shall have several units of similar pump types installed and operating in USA.

.2 Preference will also be given to the supplier who can offer local parts and labor service by factory trained technicians.

3.06 FUNCTIONAL TESTING

.A Functional Test: Prior to pump start-up, all equipment shall be inspected for proper alignment, quiet operation, proper connection, and satisfactory performance and tested in the presence of the Engineer and Manufacturer's representative.

.B Test to include checks for excessive vibration, correct operation of control systems and equipment, motor power input, acceptable normal running noise, speed and direction of rotation.

.C Test to demonstrate that the equipment and work is not defective electrically, mechanically, or otherwise and is safe and satisfactory.

.D The plant operation takes precedence and the pump start-up, testing and commissioning may be scheduled for a later date after the installation certification. The contractor shall submit a 3-week-in advance notice and testing and commissioning plan to the Engineer for review and approval.

.E After completion of installation, demonstrate functional operation of systems, including sequence of operation to approval of Engineer.

.F Test in presence of Engineer and equipment supplier representative.

.G Provide all labour and ancillary equipment necessary to fulfill tests.

.H Test to demonstrate that:

.1 Pumps, valves and equipment are to run free from heating, leakage, vibration, and noise.

.2 Pumps can be removed from sump, hauled away for maintenance, and re-installed.

3.07 FIELD TESTING

.A Refer to Division 1 Section– Equipment Testing and Starting of Systems for details of testing.

.B After completion of installation, provide testing to demonstrate compliance with operating requirements.

.C Test to demonstrate that the equipment and work is not defective electrically, mechanically, or otherwise and is safe and satisfactory.

.D The equipment manufacturer will provide the services of a qualified field representative to inspect and verify the installation of the equipment, make any necessary adjustments and initiate start-up.

3.08 MANUFACTURER'S REPRESENTATIVE SUPPORT

.A Provide a qualified equipment service representative to perform the service herein specified.

.B Supervise the handling and installation of units by others.

.C Prior to commencement of commissioning review mechanical, electrical and structural works to ensure that the equipment is correctly installed, supported, connected and wired. Immediately advise the Owner in writing of any deficiencies or deviations from the installation instructions, during the installation of the unit.

.D Inspect, operate, test and adjust the equipment.

.E The inspection is to include, but is not limited to, the following points as applicable.

.1 Soundness (without cracked or otherwise damage parts).

.2 Completeness on all details as specified.

.3 Correctness of setting, alignment and relative arrangement of various parts.

.4 Adequacy and correctness of packing, sealing and lubricants.

.F Commission the equipment and instruct the Owner's operating personnel in all aspects of equipment, maintenance and troubleshooting.

.G Make any necessary changes and adjustments to the equipment.

.H After successful commissioning of the equipment submit, in triplicate, a complete signed report on the results of the inspection, operations, adjustments and tests.

.I Include in the report detailed descriptions of the points inspected, tests and adjustments made, quantitative results and suggestions for precautions to be taken to ensure proper maintenance. Include certification that equipment conforms to the requirements of the specifications and is ready for permanent operation. Hand over to the Owner all adjustments, settings and test sheets.

.J Manufacturer's representative for the sump pump shall be present at the jobsite for installation assistance, inspection and certification of the installation, equipment testing, startup assistance and training of the Owner's personnel, for the period of (applies to each pump):

.1 One (1) day - installation assistance and certification.

.2 One (1) day – testing.

.K Training (non-consecutive days) – 1 day according Division 1.

.L Minimum number of trips 3.

.M Refer to Division 1 for the certification forms and procedures.

3.09 COMMISSIONING

.A Schedule time for startup and commissioning. Provide instruments, meters, equipment and personnel. Demonstrate unit operation. The system shall be tested in all operational modes. Carry out tests in the presence of Engineer and Owner.

.B After start up, test, adjust and prove operation as indicated, to suit site conditions.

.C Commission equipment in accordance with Division 1 and Section 15010 Mechanical General Requirements.

.D In addition to Division 1 and Section 15010, provide the services of a factory-trained and **certified** technician (1) one day to calibrate and confirm the correct installation, operation and written certification of the equipment. Modify the installation as per his recommendations (if any).

.E Certify commissioning in accordance with Divisions 1 and 15.

3.10 TRAINING

.A Provide minimum (1) one 6-hour instruction lesson about operation, maintenance, and safety procedure of each sump pump assembly. The instruction shall be provided by the supplier's certified personnel before commissioning.

3.11 COMPLETION AND CLEANING

A. When all the work has been finally tested, proven tight and accepted, remove all paper protection from the fixtures, etc. All traps, wastes and supplies shall be free and unobstructed, all plated, polished or painted work and all fixtures shall be bright and clean, and the whole of the work shall be left in perfect operating condition.

+ + + END OF SECTION 15430 + + +

SECTION 16000
BASIC ELECTRICAL REQUIREMENTS

PART 1 GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall furnish all labor, materials, tools, and equipment, and perform all work and services necessary for, or incidental, to the furnishing and installation of all electrical work as shown on the Drawings, and as specified in accordance with the provisions of the Contract Documents and completely coordinate with the work of other trades involved in the general construction. Although such work is not specifically shown or specified, all supplementary or miscellaneous items, appurtenances, and devices incidental to or necessary for a sound, secure, and complete installation shall be furnished and installed as part of this work. The Contractor shall obtain approved Shop Drawings showing wiring diagrams, connection diagrams, roughing-in and hook up details for all equipment and comply therewith. All electrical work shall be complete and left in operating condition in accordance with the intent of the Drawings and the Specifications for the electrical work.

B. Reference Section 17000, Control and Information System Scope and General Requirements for scope of work details as they relate to the Division 17 Subcontractor.

C. The electrical scope of work for this project primarily includes, but is not limited to, the following:

1. Furnish and install new utility power feeder and main service circuit breaker.

2. Furnish and install standby diesel engine-generator and automatic transfer switch.

3. Furnish and install power panelboards, lighting panelboards, dry-type transformers, and other low voltage electrical power distribution equipment.

4. Furnish and install all aboveground raceway systems including conduit, fittings, boxes, supports, and other pertinent components.

5. Furnish and install all underground raceway systems including conduit, fittings, handholes, and other pertinent components.

6. Furnish and install all low voltage wire and cable resulting in a complete and operable electrical system.

7. Other electrical work as specified herein and indicated on the Drawings.

D. All material and equipment must be the product of an established, reputable, and approved manufacturer; must be new and of first class construction; must be designed and guaranteed to perform the service required; and must bear the label of approval of the Underwriters Laboratories, Inc., where such approval is available for the product of the listed manufacturer as approved by the Engineer.

E. When a specified or indicated item has been superseded or is no longer available, the manufacturer's latest equivalent type or model of material or equipment as approved by the Engineer shall be furnished and installed at no additional cost to the Owner.

F. Where the Contractor's selection of equipment of specified manufacturers or additionally approved manufacturers requires changes or additions to the system design, the Contractor shall be responsible in all respects for the modifications to all system designs, subject to approval of the Engineer. The Contractor's bid shall include all costs for all work of the Contract for all trades made necessary by such changes, additions or modifications or resulting from any approved substitution.

G. Furnish and install all stands, racks, brackets, supports, and similar equipment required to properly serve the equipment which is furnished under this Contract, or equipment otherwise specified or indicated on the Drawings.

H. All electrical components and systems, including electrical equipment foundations, shall be designed to resist operational forces as well as lateral sway and axial motion from seismic and thermal forces. Seismic support design shall be in accordance with Section 01900 – Seismic Requirements.

1.02 EQUIPMENT LOCATION

A. The Drawings show the general location of feeders, transformers, outlets, conduits, and circuit arrangements. Because of the small scale of the Drawings, it is not possible to indicate all of the details involved. The Contractor shall carefully investigate the structural and finish conditions affecting all of his work and shall arrange such work accordingly; furnishing such fittings, junction boxes, and accessories as may be required to meet such conditions. The Contractor shall refer to the entire Drawing set to verify openings, special surfaces, and location of other equipment, or other special equipment prior to roughing-in for panels, switches, and other outlets. The Contractor shall verify all equipment dimensions to ensure that proposed equipment will fit properly in spaces indicated.

B. Where outlets are shown near identified equipment furnished by this or other Contractors, it is the intent of the Specifications and Drawings that the outlet be located at the equipment to be served. The Contractor shall coordinate the location of these outlets to be near the final location of the equipment served whether placed correctly or incorrectly on the Drawings.

1.03 LOCAL CONDITIONS

A. The Contractor shall examine the site and become familiar with conditions affecting the work. The Contractor shall investigate, determine, and verify locations of any overhead or buried utilities on or near the site, and shall determine such locations in conjunction with all public and/or private utility companies and with all authorities having jurisdiction. All costs, both temporary and permanent to connect all utilities, shall be included in the Bid. The Contractor shall be responsible for scheduling and coordinating with the local utility for temporary and permanent services.

B. In addition, the Contractor shall relocate all duct banks, lighting fixtures, receptacles, switches, boxes, and other electrical equipment as necessary to facilitate the Work included in this project. Costs for such work shall be included in the Bid.

C. The Contractor is responsible for coordinating all electric utility equipment installations with the serving electric utility. The Contractor shall furnish and install all electric utility equipment required by the electric utility to be installed by the Contractor whether specifically shown on the Drawings or not.

D. The Contractor shall furnish and install the following electrical utility equipment as a minimum:

1. Metering equipment cabinets and/or bases

2. Conduit and wire required from metering cabinet to metering current transformers and potential transformers.

3. Secondary conductors

4. Secondary terminations

E. The electric utility will furnish and install the following equipment:

1. Primary conductors and terminations

F. The Contractor is responsible for ensuring all electric utility equipment and construction installed by the Contractor is furnished and installed in accordance with the electric utility's design specifications and requirements. The Contractor is fully responsible for coordinating his scope of work with the electric utility. Any additional required electric utility construction or equipment not specified herein or shown on the Drawings shall be supplied by the Contractor at no additional cost to the Owner.

G. The contact person at the serving electrical utility is:

Buz Merritt
Georgia Power Company
Chemical and Pipeline Account Manager
(770) 621-2338
DWMerrit@southernco.com

1.04 SUBMITTALS

A. In accordance with the procedures and requirements set forth in the General Conditions, Section 01350, Project Document Tracking and Control System and the requirements of the individual specification sections, the Contractor shall obtain from the equipment manufacturer and submit the following:

1. Shop Drawings

2. Operation and Maintenance Manuals

3. Spare Parts List

4. Proposed Testing Methods and Reports of Certified Shop Tests.

5. Reports of Certified Field Tests.

6. Manufacturer's Representative's Certification.

B. Submittals shall be sufficiently complete in detail to enable the Engineer to determine compliance with Contract requirements.

C. Submittals will be approved only to the extent of the information shown. Approval of an item of equipment shall not be construed to mean approval for components of that item for which the Contractor has provided no information.

D. Some individual Division 16 specification sections may require a Compliance, Deviations, and Exceptions (CD&E) letter to be submitted. If the CD&E letter is required and shop drawings are submitted without the letter, the submittal will be rejected. The letter shall include all comments, deviations and exceptions taken to the Drawings and Specifications by the Contractor AND Equipment Manufacturer/Supplier. This letter shall include a copy of this specification section. In the left margin beside each and every paragraph/item, a letter "C", "D", or "E" shall be typed or written in. The letter "C" shall be for full compliance with the requirement. The letter "D" shall be for a deviation from the requirement. The letter "E" shall be for taking exception to a requirement. Any requirements with the letter "D" or "E" beside them shall be provided with a full typewritten

explanation of the deviation/exception. Handwritten explanation of the deviations/exceptions is not acceptable. The CD&E letter shall also address deviations, and exceptions taken to each Drawing related to this Specification Section.

E. Seismic support design for all nonstructural electrical components (conduit, raceways, freestanding equipment, etc.) shall be in accordance with all applicable federal, state and local building code requirements and Section 01900 – Seismic Requirements.

1.05 APPLICABLE CODES AND REQUIREMENTS

A. Conformance

1. All work, equipment and materials furnished shall conform with the existing rules, requirements and specifications of the following:

   a. Insurance Rating Organization having jurisdiction

   b. The serving electrical utility company

   c. The currently adopted edition of the National Electrical Code (NEC)

   d. The National Electric Manufacturers Association (NEMA)

   e. The Institute of Electrical and Electronic Engineers (IEEE)

   f. The Insulated Cable Engineers Association (ICEA)

   g. The American Society of Testing Materials (ASTM)

   h. The American National Standards Institute (ANSI)

   i. The requirements of the Occupational Safety Hazards Act (OSHA)

   j. The National Electrical Contractors Association (NECA) Standard of Installation

   k. National Fire Protection Association (NFPA)

   l. International Electrical Testing Association (NETA)

   m. Federal Specifications (FS)

   n. Underwriters Laboratory (UL)

   o. All other applicable Federal, State and local laws and/or ordinances.

2. Provide complete electrical Installation in accordance with the National Electrical Code (NFPA 70), Life Safety Code (NFPA 101), and in accordance with applicable local codes. Obtain all necessary permits and have all work inspected bu appropriate authorities.

3. All products shall be designed, manufactured, and tested in accordance with industry standards. All material and equipment bear the inspection labels of Underwriters Laboratories, Inc., if the material and equipment is of the class inspected by said laboratories.

B. Nonconformance

1. Any paragraph of requirements in these Specifications, or Drawings, deviating from the rules, requirements and Specifications of the above organizations shall be invalid and their (the above organizations) requirements shall hold precedent thereto. The Contractor shall be held responsible for adherence to all rules, requirements and specifications as set forth above. Any additional work or material necessary for adherence will not be allowed as an extra, but shall be included in the Bid. Ignorance of any rule, requirement, or Specification shall not be allowed as an excuse for nonconformity. Acceptance by the Engineer does not relieve the Contractor from the expense involved for the correction of any errors which may exist in the drawings submitted or in the satisfactory operation of any equipment.

C. Certification

1. Upon completion of the work, the Contractor shall obtain certificate(s) of inspection and approval from the National Board of Fire Underwriters or similar inspection organization having jurisdiction and shall deliver same to the Engineer and the Owner.

1.06 PERMITS AND INSPECTIONS

A. The Contractor shall reference the General Conditions and Section 01010, Summary of Work.

1.07 TEMPORARY LIGHTING AND POWER

A. The Contractor shall reference the General Conditions and Section 01510, Temporary Facilities.

1.08 TESTS

A. Upon completion of the installation, the Contractor shall perform tests for operation, load (Phase) balance, overloads, and short circuits. Tests shall be made with and to the satisfaction of the Owner and Engineer.

B. The Contractor shall perform all field tests and shall provide all labor, equipment, and incidentals required for testing and shall pay for electric power required for the tests. All defective material and workmanship disclosed shall be corrected by the Contractor at no

cost to the Owner. The Contractor shall show by demonstration in service that all circuits and devices are in good operating condition. Test shall be such that each item of control equipment will function not less than five (5) times.

C. Refer to each individual specification section for detailed test requirements.

D. The Contractor shall complete the installation and field testing of the electrical installation at least two (2) weeks prior to the start-up and testing of all other equipment. During the period between the completion of electrical installation and the start-up and testing of all other equipment, the Contractor shall make all components of the Work available as it is completed for their use in performing Preliminary and Final Field Tests.

E. Before each test commences, the Contractor shall submit a detailed test procedure, and also provide test engineer resume, manpower and scheduling information for the approval by the Engineer. In addition, the Contractor shall furnish detailed test procedures for any of his equipment required as part of the field tests of other systems.

F. After final review and acceptance, turn over to the Engineer all keys for electrical equipment locks.

1.09 INFRARED INSPECTION

A. Just prior to the final acceptance of a piece of equipment, the Contractor shall perform an infrared inspection to locate and correct all heating problems associated with electrical equipment terminations.

B. The infrared inspection shall apply to all new equipment and existing equipment that is in any way modified under this Contract. All heating problems detected with new equipment furnished and installed under the Scope of this Contract shall be corrected by the Contractor. All problems detected with portions of existing equipment modified under this Contract shall also be corrected by the Contractor.

C. Any issues detected with portions of existing equipment that were not modified under this Contract are not the responsibility of the Contractor. Despite the Contractor not being held responsible for these problems, the Contractor shall report them to the Owner and Engineer immediately for resolution.

D. The infrared inspection report shall include both digital and IR pictures positioned side by side. Both the digital and IR pictures shall be clear and high quality. Fuzzy, grainy, or poorly illuminated pictures are not acceptable. The IR picture shall be provided with a temperature scale beside it, and an indication of the hot spot temperature in each picture. Reports shall be furnished in a 3-ring binder, with all pages printed in full color, with equipment assemblies separated by tabs.

1.10 PROTECTIVE DEVICE SETTING AND TESTING

A. The Contractor shall provide the services of a field services organization to adjust, set, calibrate and test all protective devices in the electrical system. The qualifications of the organization and resumes of the technicians as well as all data forms to be used for the field testing shall be submitted.

B. All protective devices in the electrical equipment shall be set, adjusted, calibrated and tested in accordance with the manufacturers' recommendations, the coordination study, and best industry practice.

C. Proper operation of all equipment associated with the device under test and its compartment shall be verified, as well as complete resistance, continuity and polarity tests of power, protective and metering circuits. Any minor adjustments, repairs and/or lubrication necessary to achieve proper operation shall be considered part of this Contract.

D. All solid state trip devices shall be checked and tested for setting and operation using manufacturers recommended test devices and procedures.

E. Circuit breakers and/or contactors associated with the above devices shall be tested for trip and close functions with their protective device.

F. When completed, the Contractor shall provide a comprehensive report for all equipment tested indicating condition, readings, faults and/or deficiencies in same. Inoperative or defective equipment shall be brought immediately to the attention of the Engineer.

G. Prior to placing any equipment in service, correct operation of all protective devices associated with this equipment shall be demonstrated by field testing under simulated load conditions.

1.11 POWER SYSTEM STUDIES

A. General:

1. The Contractor shall provide Power System studies performed by a Professional Engineer registered with the state of Georgia to the firm providing the protective device setting and testing services. The Contractor shall notify the Engineer six (6) weeks in advance of the scheduled date for the protective device setting and testing.

2. The studies shall include all protective devices in the pump station.

B. Data Collection for the Studies:

1. The Contractor shall provide the required data for preparation of the studies.

2. The Contractor shall expedite collection of the data to assure completion of the studies as required for final approval of the distribution equipment shop drawings and/or prior to release of the equipment for manufacture.

C. Protective Device Coordination Study:

1. A protective device coordination study shall be performed to provide the necessary calculations and logic decisions required to select or to check the selection of power fuse ratings, protective relay characteristics and settings, ratios and characteristics of associated current transformers, and low voltage circuit breaker trip characteristics and settings.

2. The coordination study shall include all low voltage classes of equipment from the utility company service protective devices down to and including the main circuit breakers of motor control centers. The phase and ground overcurrent protection shall be included as well as settings of all other adjustable protective devices.

3. The time-current characteristics of the specified protective devices shall be drawn on log-log paper. The plots shall include complete titles, representative one-line diagram and legends, significant motor starting characteristics, complete parameters of transformers, complete operating bands of low voltage circuit breaker trip curves and fuses. The coordination plots shall indicate the types of protective devices selected, proposed relay taps, time dial and instantaneous trip settings, transformer magnetizing inrush and ANSI transformer withstand parameters, cable thermal overcurrent withstand limits and significant symmetrical and asymmetrical fault currents. All restrictions of the National Electrical Code shall be adhered to and proper coordination intervals and separation of characteristic curves shall be maintained. The coordination plots for phase and ground protective devices shall be provided on a system basis. A sufficient number of separate curves shall be used to clearly indicate the coordination achieved.

4. The selection and settings of the protective devices shall be provided separately in a tabulated form listing circuit identification, IEEE device number, current transformer ratios and connections, manufacturer and type, range of adjustment and recommended settings. A tabulation of the recommended power fuse selection shall be provided for the medium voltage fuses where applied in the system. Any discrepancies, problem areas, or inadequacies shall be promptly brought to the attention of the Engineer.

D. Arc Flash Hazard Analysis:

1. An Arc Flash Hazard Analysis shall be performed with the aid of a digital computer program in accordance with IEEE Std. 1584, “IEEE Guide For Performing Arc Flash Hazard Calculations”, NFPA 70E, and OSHA 29-CFR, Part 1910 Subpart S.

2. Arc Flash Warning Labels and Bus Detail Sheets shall be produced for each bus affected by the electrical modifications in this project. Labels shall be printed in color on adhesive backed labels. Labels shall be attached to the doors of the equipment. Each label and detail sheet shall list the following:

   a. Bus name.

   b. System operating voltage.

   c. Date of issue.

   d. Flash hazard protection boundary.

   e. Limited approach boundary.

   f. Restricted boundary.

   g. Prohibited boundary.

   h. Incident energy level.

   i. Required personal protective equipment class.

   In addition, each Bus Detail Sheet shall list the following:

   a. Upstream Protective Devices Names, Type and Settings.

3. Arc Flash Evaluation Summary Sheets shall be produced. Summary sheets shall list the following:

   a. Bus name.

   b. Upstream protective device name, type and settings.

   c. Bus line-to-line voltage.

   d. Bus bolted fault.

   e. Protective device bolted fault current.

   f. Arcing fault current.

   g. Protective device trip / delay time.

   h. Breaker opening time.

   i. Solidly grounded column.

   j. Equipment type.

   k. Gap.

   l. Arc flash boundary.

   m. Working distance.

   n. Incident energy.

o. Required personal protective equipment class.

4. Analyze the short circuit, protective device coordination, and arc flash calculations and highlight any equipment that is determined to be underrated or causes an abnormally high incident energy calculation. Propose approaches to reduce the energy levels. Proposed major corrective modifications will be taken under advisement by the Engineer and the Contractor will be given further instructions.

E. Study Report:

1. The results of the power system studies shall be summarized in a report. The report shall be submitted to the Engineer.

2. The report shall be provided in hard cover 3-ring binders and shall be submitted in accordance with the requirements of Section 01350, Project Document Tracking and Control System.

3. The report shall include the following sections:

a. Description, purpose, basis and scope of the study and a detailed single line diagram with "nodes" cross-referenced to the calculated values tabulated in the study report of that portion of the power system which is included within the scope of the study.

b. Tabulations of circuit breaker, fuse and other protective device ratings versus calculated short circuit duties and commentary regarding same.

c. Protective device time versus current coordination curves, tabulations of relay and circuit breaker trip settings, fuse selection, and commentary regarding same.

d. Fault current calculations including a definition of terms and guide for interpretation of computer printout.

4. Prior to commencing the work, the preparer the studies shall meet with the testing firm that will do the relay field testing and the Owner's representative at the site for a walk through of the facility to ensure that existing conditions are taken into account.

5. The study shall include a detailed explanation of all software programs and procedures used to arrive at the calculated values, settings, and drawings (e.g. single line diagrams) showing fault valves at all busses.

1.12 SCHEDULES AND FACILITY OPERATIONS

A. Since the equipment testing required herein shall require that certain pieces of equipment be taken out of service, all testing procedures and schedules must be submitted to the Engineer for review and approval one (1) month prior to any work beginning. When testing has been scheduled, the Engineer must be notified 48 hours prior to any work to allow time for load switching and/or alternation of equipment. In addition, all testing that requires temporary shutdown of facility equipment must be coordinated with the Owner/Engineer so as not to affect proper facility operations.

B. At the end of the workday, all equipment shall be back in place and ready for immediate use should a facility emergency arise. In addition, should an emergency condition occur during testing, at the request of the Owner, the equipment shall be placed back in service immediately and turned over to Owner personnel.

C. In the event of accidental shutdown of Owner equipment, the Contractor shall notify Owner personnel immediately to allow for an orderly restart of affected equipment.

1.13 MATERIALS HANDLING

A. Materials arriving on the job site shall be stored in such a manner as to keep material free of rust and dirt and so as to keep material properly aligned and true to shape. Rusty, dirty, or misaligned material will be rejected. Electrical conduit shall be stored to provide protection from the weather and accidental damage. Rigid non-metallic conduit shall be stored on even supports and in locations not subject to direct sun rays or excessive heat. Cables shall be sealed, stored, and handled carefully to avoid damage to the outer covering or insulation and damage from moisture and weather. Adequate protection shall be required at all times for electrical equipment and accessories until installed and accepted. Materials damaged during shipment, storage, installation, or testing shall be replaced or repaired in a manner meeting with the approval of the Engineer. If space heaters are provided in a piece of electrical equipment, they shall be temporarily connected to a power source during storage. The Contractor shall store equipment and materials in accordance with Section 01550, Site Access and Storage.

1.14 WARRANTIES

A. Unless otherwise specified in an individual specification section, all equipment and electrical construction materials furnished and installed under Division 16 shall be provided with a warranty in accordance with the requirements of Section 11000, Equipment General Provisions and the General Conditions.

1.15 TRAINING

A. Unless otherwise specified in an individual specification section, all training for equipment furnished and installed under Division 16 shall be provided in accordance with the requirements of Section 11000, Equipment General Provisions.

PART 2 PRODUCTS

2.01 PRODUCT REQUIREMENTS

A. Unless otherwise indicated, the materials to be provided under this Specification shall be the products of manufacturers regularly engaged in the production of all such items and shall be the manufacturer's latest design. The products shall conform to the applicable standards of UL and NEMA, unless specified otherwise. International Electrotechnical Commission (IEC) standards are not recognized. Equipment designed, manufactured, and labeled in compliance with IEC standards is not acceptable.

B. All items of the same type or ratings shall be identical. This shall be further understood to include products with the accessories indicated.

C. All equipment and materials shall be new, unless indicated or specified otherwise.

D. The Contractor shall submit proof if requested by the Engineer that the materials, appliances, equipment, or devices that are provided under this Contract meet the requirements of Underwriters Laboratories, Inc., in regard to fire and casualty hazards. The label of or listing by the Underwriters Laboratories, Inc., will be accepted as conforming to this requirement.

2.02 SUBSTITUTIONS

A. Unless specifically noted otherwise, any reference in the Specifications or on the Drawings to any article, service, product, material, fixture, or item of equipment by name, make, or catalog number shall be interpreted as establishing the type, function, and standard of quality and shall not be construed as limiting competition. The Contractor, in such cases may, at his option use any article, device, product, material, fixture, or item of equipment which in the judgment of the Engineer, expressed in writing, is equal to that specified.

2.03 CONCRETE

A. The Contractor shall furnish all concrete required for the installation of all electrical work, Concrete shall be Class A unless otherwise specified. Concrete and reinforcing steel shall meet the appropriate requirements of Division 3 of the Specifications.

B. The Contractor shall provide concrete equipment pads for all free standing electrical apparatus and equipment located on new or existing floors or slabs. The Contractor shall provide all necessary anchor bolts, channel iron sills, and other materials as required. The exact location and dimensions shall be coordinated for each piece of equipment well in advance of the scheduled placing of these pads. Equipment pads shall be 4 inches high unless otherwise indicated on the Drawings and shall conform to standard detail for

equipment pads shown on the Contract Drawings. Equipment pads shall not have more than 3" excess concrete beyond the edges of the equipment.

C. The Contractor shall provide concrete foundations for all free standing electrical apparatus and equipment located outdoors or where floors or slabs do not exist and/or are not or provided by others under this Contract. The Contractor shall provide all necessary anchor bolts, channel iron sills, and other materials as required. The location and dimensions shall be coordinated for each piece of equipment well in advance of the scheduled placing of the foundations. Equipment foundations shall be constructed as detailed on the Drawings or if not detailed on the Drawings shall be 6 inches thick minimum reinforced with #4 bars at 12-inch centers each way placed mid-depth. Concrete shall extend 6 inches minimum beyond the extreme of the equipment base and be placed on a compacted stone bed (#57 stone or ABC) 6 inches thick minimum.

PART 3 EXECUTION

3.01 CUTTING AND PATCHING

A. Coordination

1. The Work shall be coordinated between all trades to avoid delays and unnecessary cutting, channeling and drilling. Sleeves shall be placed in concrete for passage of conduit wherever possible.

B. Damage

1. The Contractor shall perform all chasing, channeling, drilling and patching necessary to the proper execution of his Contract. Any damage to the building, structure, or any equipment shall be repaired by qualified mechanics of the trades involved at the Contractor's expense. If, in the Engineer's judgment, the repair of damaged equipment would not be satisfactory, then the Contractor shall replace damaged equipment at his own expense.

C. Existing Equipment

1. Provide a suitable cover or plug for openings created in existing equipment as the result of work under this Contract. For example, provide round plugs in equipment enclosures where the removal of a conduit creates a hole and the enclosure. Covers and plugs shall maintain the NEMA rating of the equipment enclosure. Covers and plugs shall be watertight when installed in equipment located outdoors.

3.02 EXCAVATION AND BACKFILLING

A. The Contractor shall perform all excavation and backfill required for the installation of all electrical work. All excavation and backfilling shall be in complete accordance with the applicable requirements of Division 2.

3.03 CORROSION PROTECTION

A. Wherever dissimilar metals, except conduit and conduit fittings, come into contact, the Contractor shall isolate these metals as required with neoprene washers, nine (9) mil polyethylene tape, or gaskets.

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SECTION 16111
CONDUIT

PART 1 GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall furnish and install conduits and conduit fittings to complete the installation of all electrically operated equipment as specified herein, indicated on the Drawings, and as required.

B. Requirements for conduit clamps, support systems, and anchoring are not included in this Section. Reference Section 16190, Supporting Devices, for these requirements.

C. Reference Section 16000, Basic Electrical Requirements.

1.02 CODES AND STANDARDS

A. Conduits and conduit fittings shall be designed, manufactured, and/or listed to the following standards as applicable and shall be UL approved:

1. American National Standards Institute (ANSI)

    a. ANSI B1.20.1 – Pipe Threads, General Purpose

    b. ANSI C80.1 – Electrical Rigid Steel Conduit

    c. ANSI C80.3 – Steel Electrical Metallic Tubing

    d. ANSI C80.5 – Electrical Rigid Aluminum Conduit

    e. ANSI FB 1 – Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable

2. Underwriters Laboratories (UL)

    a. UL 1 – Standard for Flexible Metal Conduit

    b. UL 6 - Electrical Rigid Metal Conduit-Steel

    c. UL 6A – Electrical Rigid Metal Conduit-Aluminum, Red Brass, and Stainless Steel

    d. UL 360 – Standard for Liquid-tight Flexible Metal Conduit

    e. UL 467 – Grounding and Bonding Equipment

f. UL 514B – Conduit, Tubing, and Cable Fittings

g. UL 651 – Standard for Schedule 40 and 80 Conduit and Fittings

h. UL 797 – Electrical Metallic Tubing-Steel

i. UL 1203 - Standard for Explosion-proof and Dust-ignition-proof Electrical Equipment for use in Hazardous (Classified) Locations

j. UL 1479 – Standard for Fire Tests of Penetration Fire Stops

k. UL 1660 – Liquid-tight Flexible Nonmetallic Conduit

3. National Electrical Manufacturer's Association (NEMA)

a. NEMA RN 1 – PVC Externally Coated Galvanized Rigid Steel Conduit

b. NEMA TC-2 – Electrical PVC Conduit

c. NEMA TC-3 – PVC Fittings for Use with Rigid PVC Conduit and Tubing

d. NEMA TC 6 – PVC Plastic Utilities Duct for Underground Installations

4. Federal Specifications (FedSpec)

a. Fed Spec WW-C-581E

b. Fed Spec WW-C-1094A

5. National Fire Protection Association (NFPA)

a. NFPA 70 – National Electrical Code

B. Others

1. ACI-318 – Building Code Requirements for Structural Concrete

1.03 SUBMITTALS

A. In accordance with the procedures and requirements set forth in the General Conditions and Section 01350, Project Document Tracking and Control System, the Contractor shall obtain from the equipment manufacturer and submit the following:

1. Shop Drawings

B. Each submittal shall be identified by the applicable specification section.

1.04 SHOP DRAWINGS

A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.

B. Partial, incomplete, or illegible submittals will be returned to the Contractor without review for resubmittal.

C. Shop drawings shall include but not be limited to:

1. Product data sheets for conduits and fittings.

2. Conduit identification methods and materials.

3. Evidence of training for all personnel that will install PVC coated rigid metal conduit.

1.05 DEFINITIONS

A. Conduits are categorized by the circuit type of the wiring to be installed inside. Conduits are defined as follows:

1. Power Conduits – Conduits that carry AC or DC power wiring from a source to a load. Conduits that carry lighting and receptacle wiring.

2. Control Conduits – Conduits that carry AC or DC discrete control wiring between devices and/or equipment. Conduits that carry fiber optic cables between devices and/or equipment.

3. Instrumentation Conduits – Conduits that carry AC or DC analog signal wiring between devices and/or equipment.

B. Conduit categories are indicated on the Drawings by the leading letter of the conduit tag. Conduit tag leading letters are defined as follows:

1. P – Power Conduit

2. C – Control Conduit

3. I – Instrumentation Conduit

PART 2 PRODUCTS

2.01 GENERAL

A. Conduit and conduit fitting products are specified in the text that follows this article. Reference Part 3 herein for the application, uses and installation requirements of these conduits and conduit fittings.

B. All metallic conduit fittings shall be UL 514B and UL 467 Listed, and constructed in accordance with ANSI FB 1. All metallic conduit fittings for use in Class I Division I hazardous areas shall be UL 1203 Listed. All non-metallic fittings shall be UL 651 Listed and constructed in accordance with NEMA TC-3.

C. Flexible conduit couplings for use in Class I Division I hazardous areas shall have threaded stainless steel end fittings and a flexible braided core. Flexible braid shall be constructed of stainless steel where available in the conduit trade size required for the application. Where stainless steel braid is not available, the braid shall be provided with a PVC coating. No other braid types or materials are acceptable.

D. Where threading is specified herein for conduit fitting connections, the fittings shall be manufactured to accept conduit that is threaded to ANSI B1.20.1 requirements.

E. Conduit expansion fittings for all conduit materials of construction shall be capable of 4 inches of movement along the axis of the conduit for trade sizes 2 inches or less. Expansion fittings shall be capable of 8 inches of movement along the axis of the conduit for trade sizes greater than 2 inches.

F. Conduit deflection fittings for all conduit materials of construction shall be provided with a flexible neoprene outer jacket that permits up to ¾ inch of expansion/contraction along the axis of the conduit as well as up to ¾ inch of parallel misalignment between the conduit axes. Outer jacket shall be secured to the conduit hubs by stainless steel clamps.

G. Conduit seals shall either be Listed and labeled for 40% fill, or conduit reducing fittings and a trade size larger conduit seal shall be provided to achieve 25% or less fill within the seal. Percentage fill calculation shall be based on the conductors to be installed. Conduit seals shall be provided with breathers and/or drains where required by the NEC.

H. Conduit insulating bushings shall be constructed of plastic and shall have internal threading.

I. Additional conduit and conduit fitting requirements are specified in the articles that follow based on the specific conduit material of construction to be used.

J. Manufacturers offering products that comply with these specifications include:

1. Conduit: Allied, Republic, Triangle, Wheatland or equal

2. PVC Coated Conduit: Permacote, Robroy or equal

3. PVC Conduit: Amoco, Carlon, Certainteed or equal

4. Flexible Conduit: Anamet, Columbia, Electrilex or equal

5. Fittings: Appleton, Crouse-Hinds, Thomas & Betts or Equal

2.02 RIGID GALVANIZED STEEL (RGS) CONDUIT AND ASSOCIATED FITTINGS

A. Conduit

1. Conduit shall be hot dip galvanized on the inside and outside, and made of heavy wall high strength ductile steel. Conduit shall be manufactured in accordance with ANSI C80.1, and shall be UL 6 Listed.

2. Conduit shall be provided with factory-cut 3/4 inch per foot tapered threads at each end in accordance with ANSI B1.20.1. Threads shall be cut prior to galvanizing to ensure corrosion protection adequately protects the threads. Conduit shall be provided with a matching coupling on one end and a color-coded thread protector on the other.

B. Conduit Bodies for use with Rigid Galvanized Steel

1. Conduit bodies shall be constructed of an electro-galvanized malleable iron alloy which is coated with an acrylic paint finish. Conduit bodies shall have integral threaded conduit hubs.

2. Conduit bodies for Class I Division I hazardous areas shall be provided with integrally threaded covers constructed of an electro-galvanized malleable iron alloy which is coated with an acrylic paint finish.

3. Conduit bodies for all other areas shall be provided with covers that are affixed in place by stainless steel screws which thread directly into the conduit body. Covers that utilize wedge nuts or any other method of attachment to the conduit body are not acceptable. Covers shall be constructed of an electro-galvanized malleable iron alloy which is coated with an acrylic paint finish. Covers shall be provided with matching gasket.

C. Conduit Couplings, Nipples, and Unions for use with Rigid Galvanized Steel

1. Couplings and nipples shall be threaded and shall be constructed of hot dipped galvanized steel. Split-type couplings that use compression to connect conduits are not acceptable.

2. Unions shall be threaded, rain-tight, and constructed of an electro-galvanized malleable iron alloy which is coated with an acrylic paint finish.

D. Conduit Expansion and Deflection Fittings for use with Rigid Galvanized Steel

1. Conduit expansion fittings and conduit deflection fittings shall be constructed of an electro-galvanized malleable iron alloy which is coated with an acrylic paint finish. Expansion and deflection fittings shall have threaded conduit connections.

2. Expansion fittings shall have an integral bonding jumper and deflection fittings shall have an external bonding jumper.

E. Conduit Seals for use with Rigid Galvanized Steel

1. Conduit seals shall be constructed of an electro-galvanized malleable iron alloy which is coated with an acrylic paint finish. Conduit seals shall have threaded conduit connections.

F. Conduit Termination Fittings for use with Rigid Galvanized Steel

1. Conduit hubs shall be constructed of stainless steel and shall have threaded connections to the conduit and enclosure. Hubs shall have a plastic insulated throat and shall be watertight when assembled to an enclosure.

2. Conduit locknuts shall be constructed of zinc plated steel. Locknuts shall have internal threading. Locknuts with integral gasket or seal are not acceptable. Locknuts shall have integral bonding screw where required for proper bonding.

3. Conduit bonding bushings shall be constructed of zinc plated malleable iron. Bonding bushings shall have a threaded conduit connection. Bonding bushing shall be provided with properly sized set screw for connecting bonding conductor and an integral plastic insulator rated for 150 degrees C located in the throat.

2.03 RIGID NONMETALLIC CONDUIT AND ASSOCIATED FITTINGS

A. Conduit

1. Conduit shall be Schedule 40 or 80 (dependent on application) polyvinyl chloride (PVC) construction, manufactured in accordance with NEMA TC-2, UL 651 Listed, and suitable for conductors with 90 degree C insulation.

2. Use only conduit with a factory formed bell on one end. Conduit that requires the use of couplings for straight runs will not be acceptable.

B. Conduit Bodies for use with Rigid Nonmetallic Conduit

1. Conduit bodies shall be constructed of PVC. Conduit hubs shall be integral to the conduit body and shall be smooth inside to accept a glued conduit connection.

2. Conduit body shall be provided with cover that is affixed in place by stainless steel screws which thread directly into the conduit body. Covers that utilize wedge nuts

or any other method of attachment to the conduit body are not acceptable. Covers shall be provided with matching gasket.

C. Conduit Couplings and Unions for use with Rigid Nonmetallic Conduit

1. Conduit couplings and unions shall be constructed of PVC and shall be smooth inside to accept a glued conduit connection.

D. Conduit Expansion and Deflection Fittings for use with Rigid Nonmetallic Conduit

1. Conduit expansion fittings and conduit deflection fittings shall be constructed of PVC and shall be smooth inside to accept a glued conduit connection.

E. Conduit Termination Fittings for use with Rigid Nonmetallic Conduit

1. Conduit hubs shall be constructed of PVC and shall be smooth inside to accept a glued conduit connection. Hubs shall have external threads and an accompanying PVC locknut, and shall be watertight when assembled to an enclosure.

2. Conduit locknuts shall be constructed of zinc plated steel. Locknuts shall have internal threading. Locknuts constructed of PVC and locknuts with integral gasket or seal are not acceptable.

3. Conduit end bells shall be constructed of PVC and shall be smooth inside to accept a glued conduit connection. End bell shall have a smooth inner surface that curves outward towards the edge of the fitting.

F. Use conduits, couplings, bushings, elbows, nipples, and other fittings meeting the requirements of NEMA TC 2 and TC 3, Federal Specification W-C-1094, UL, NEC, and ASTM specified tests for the intended use. Fittings for PVC conduits shall comply with Standard for PVC Fittings for use with Rigid Conduit and Tubing, NEMA TC 3, and shall be NEMA Type IV.

2.04 PVC COATED RIGID GALVANIZED STEEL CONDUIT AND ASSOCIATED FITTINGS

A. General

1. Where an external coating of polyvinyl chloride (PVC) is specified for conduit and fittings, the coating shall be 40 mil (minimum) thickness. Where an internal coating of urethane is specified for conduit and fittings, the coating shall be 2 mil (minimum) thickness.

2. All conduit fittings shall have a sealing sleeve constructed of PVC which covers all connections to conduit. Sleeves shall be appropriately sized so that no conduit threads will be exposed after assembly.

B. Conduit

1. Conduit shall be hot dip galvanized on the inside and outside, and made of heavy wall high strength ductile steel. Conduit shall be manufactured in accordance with ANSI C80.1, and shall be UL 6 Listed.

2. Conduit shall be provided with factory-cut 3/4 inch per foot tapered threads at each end in accordance with ANSI B1.20.1. Threads shall be cut prior to galvanizing to ensure corrosion protection adequately protects the threads. Conduit shall be provided with a matching coupling on one end and a color-coded thread protector on the other.

3. Conduit shall be coated on the exterior with a PVC jacket and coated on the interior with a layer of urethane. Conduit shall be manufactured in accordance with NEMA RN-1.

C. Conduit Bodies for use with PVC Coated Rigid Galvanized Steel Conduit

1. Conduit bodies shall be constructed of an electro-galvanized malleable iron alloy which is coated on the exterior with a PVC jacket and coated on the interior with a layer of urethane. Conduit bodies shall have integral threaded conduit hubs.

2. Conduit bodies for Class I Division I hazardous areas shall be provided with integrally threaded covers constructed of an electro-galvanized malleable iron alloy which is coated on the exterior with a PVC jacket and coated on the interior with a layer of urethane.

3. Conduit bodies for all other areas shall be constructed of an electro-galvanized malleable iron alloy which is coated on the exterior with a PVC jacket and coated on the interior with a layer of urethane. Covers shall be affixed in place by stainless steel screws which thread directly into the conduit body and have a plastic encapsulated head. Covers that utilize wedge nuts or any other method of attachment to the conduit body are not acceptable. Covers shall be provided with matching gasket.

D. Conduit Couplings, Nipples, and Unions for use with PVC Coated Rigid Galvanized Steel Conduit

1. Couplings and nipples shall be threaded and shall be constructed of hot dipped galvanized steel which is coated on the exterior with a PVC jacket and coated on the interior with a layer of urethane. Split-type couplings that use compression to connect conduits are not acceptable.

2. Unions shall be threaded, rain-tight, and constructed of an electro-galvanized malleable iron alloy which is coated on the exterior with a PVC jacket and coated on the interior with a layer of urethane.

E. Conduit Expansion and Deflection Fittings for use with PVC Coated Rigid Galvanized Steel Conduit

1. Conduit expansion fittings and conduit deflection fittings shall be constructed of an electro-galvanized malleable iron alloy which is coated on the exterior with a PVC jacket and coated on the interior with a layer of urethane. Expansion and deflection fittings shall have threaded conduit connections.

2. Expansion fittings shall have an integral bonding jumper and deflection fittings shall have an external bonding jumper.

F. Conduit Seals for use with PVC Coated Rigid Galvanized Steel Conduit

1. Conduit seals shall be constructed of an electro-galvanized malleable iron alloy which is coated on the exterior with a PVC jacket and coated on the interior with a layer of urethane. Conduit seals shall have threaded conduit connections.

G. Conduit Termination Fittings for Use with PVC Coated Rigid Galvanized Steel Conduit

1. Conduit hubs shall be constructed of an electro-galvanized malleable iron alloy which is coated on the exterior with a PVC jacket and coated on the interior with a layer of urethane. Hubs shall have threaded connections to the conduit and enclosure. Hubs shall have a plastic insulated throat and shall be watertight when assembled to an enclosure.

2. Conduit bonding bushings shall be constructed of zinc plated malleable iron which is coated on the exterior with a PVC jacket and coated on the interior with a layer of urethane. Bonding bushings shall have a threaded conduit connection. Bonding bushing shall be provided with properly sized set screw for connecting bonding conductor and an integral plastic insulator rated for 150 degrees C located in the throat.

2.05 LIQUID TIGHT FLEXIBLE METAL CONDUIT (LFMC) AND ASSOCIATED FITTINGS

A. Conduit

1. Conduit shall be manufactured using a single strip of hot dip galvanized high strength steel alloy, helically formed into a continuously interlocked flexible metal conduit. Trade size 1-1/4 inch and smaller conduits shall be provided with an integrally woven copper bonding strip.

2. Conduit shall be covered with an outside PVC jacket that is UV resistant, moisture-proof, and oil-proof. Conduit shall be UL 360 Listed.

B. Conduit Termination Fittings for use with LFMC

1. Conduit termination fittings shall be constructed of either 304 stainless steel or an electro-galvanized malleable iron alloy which is coated on the exterior with a 40 mil (minimum) PVC jacket and coated on the interior with a 2 mil (minimum) layer of urethane. PVC coated fittings shall have a sealing sleeve constructed of PVC which covers the connection to conduit.

2. Termination fittings shall have a threaded end with matching locknut and sealing ring for termination to equipment, and shall have an integral external bonding lug where required for proper bonding. Termination fittings shall have a plastic insulated throat and shall be watertight when assembled to the conduit and equipment.

2.06 FLEXIBLE METAL CONDUIT (FMC) AND ASSOCIATED FITTINGS

A. Conduit

1. Conduit shall be manufactured using a single strip of hot dip galvanized high strength steel alloy, helically formed into a continuously interlocked flexible metal conduit. Conduit shall be UL 1 Listed.

B. Conduit Termination Fittings for use with FMC

1. Conduit termination fittings shall be constructed of an electro-galvanized malleable iron alloy. Fittings shall have a threaded end with matching locknut for termination to equipment, and a compression-style connection to the associated conduit.

2.07 CONDUIT BENDS

A. Rigid conduit bends, both factory fabricated and field fabricated, shall meet the same requirements listed in the articles above for the respective conduit type and material of construction.

B. Conduit bend radii for standard radius bends shall be no less than as follows:

TRADE SIZE (inches)	3/4	1	1-1/4	1-1/2	2	2-1/2	3	3-1/2	4	5	6
MIN. RADIUS (inches)	4-1/2	5-3/4	7-1/4	8-1/4	9-1/2	10-1/2	13	15	16	24	30

C. Conduit bend radii for long radius bends shall be no less than as follows:

TRADE SIZE (inches)	3/4	1	1-1/4	1-1/2	2	2-1/2	3	3-1/2	4	5	6
MIN. RADIUS (inches)	N/A	12	18	24	30	30	36	36	48	48	60

2.08 MISCELLANEOUS

A. Conduit Periphery Sealing

1. The sealing of the exterior surface of conduits to prevent water and/or air from passing around the conduit periphery from one space to another (where required) shall be through the use of one of the following:

   a. A conduit sleeve and pressure bushing sealing system. Acceptable products are FSK or WSK by OZ-GEDNEY, Link-Seal by Crouse-Hinds, or Engineer approved equal.

   b. A conduit sleeve that is two trade sizes larger than the conduit being sealed, with 2-hour fire rated UL 1479 Listed caulk filling the entire void between the conduit and sleeve. This method is only suitable for penetrations in non-fire rated walls and floors between spaces within buildings. This method shall not be used for the sealing of conduits leaving a building and/or structure.

2. Conduit penetrations through fire-rated walls and floors shall be made with an approved UL 1479 Listed product specifically intended for the trade size of the conduit.

B. Primer and Cement

1. Nonmetallic conduit shall be cleaned with primer and connected to fittings with the manufacturer's recommended cement that is labeled Low VOC.

C. Galvanizing Compounds

1. Galvanizing compounds for field application shall be the cold-applied type, containing no less than 93% pure zinc.

D. Conduit Interior Sealing

1. The sealing of the inside of conduits against water ingress shall be achieved through the use of one of the following:

a. Two-part expanding polyurethane foam sealing compound, dispensed from a single tube which mixes the two parts as it is injected into the conduit. Expanding foam shall be compatible with the conduit material of construction as well as the outer jacket of the cables in the conduit. Acceptable products are Q-Pak 2000 by Chemque, FST by American Polywater Corporation, or Hydra-seal S-60 by Duraline.

b. Inflatable bag that provides seal around cables and around inside diameter of conduit. Provide appropriate quantity of additional fittings for applications with three or more cables in the conduit to be sealed. Acceptable products are Rayflate by Raychem, or Engineer approved equal. This sealing method is only applicable to conduits trade size 2 inch and larger.

c. Neoprene sealing ring provided with the required quantity and diameter of holes to accommodate the cables in each conduit. Sealing ring shall be compressed by two stainless steel pressure plates. Acceptable products are type CSB by OZ-GEDNEY, or Engineer approved equal. This sealing method is only applicable to metallic conduits containing 4 or less cables.

2. The use of aerosol-based expanding foam sealants or any other method of sealing against water ingress not listed above is not acceptable.

E. Provide sealing compound equal to Chico A or Chico B where conduit passes from hazardous or corrosive area in to a nonclasified area.

F. Pull Rope

1. Pull ropes for empty and/or spare conduits shall be woven polyester, 1/2 inch wide, with a minimum tensile strength of 1250 lbs.

2. Pull ropes for the Contractors use in installing conductors shall be the size and strength required for the pull, and shall be made of a non-metallic material.

PART 3 EXECUTION

3.01 GENERAL

A. Minimum trade size for all rigid conduits shall be 3/4 inch in exposed applications and 1 inch in embedded applications. Conduits installed within ductbanks shall be allowed to be increased in size to trade size 2 inch, at the Contractor's option, to accommodate the saddle size of the ductbank spacers. However, no combining of circuits shall be allowed in the larger conduits.

B. Minimum trade size for flexible metal conduits (where specifically allowed herein) shall be 1/2 inch in all applications.

C. Minimum trade size for liquidtight flexible metal conduits (where specifically allowed herein) shall be 3/4 inch in all applications.

D. Conduit routing and/or homeruns within structures is not shown on the Drawings. Conduits shall be installed concealed wherever practical and within the limitations specified herein. All other conduits not capable of being installed concealed shall be installed exposed.

E. Empty and/or spare conduits shall be provided with pull ropes which have no less than 12 inches of slack at each end.

F. Nonmetallic conduits for installations requiring less than a factory length of conduit shall be field cut to the required length. The cut shall be made square, cleaned of debris, and primer shall be applied to ready each joint for fusing. Conduits shall then be fused together with the conduit manufacturer's approved cement compound.

G. Metallic conduits for installations requiring less than a factory length of conduit shall be field cut to the required length. The cut shall be made square, be cleaned of all debris and be de-burred, then threaded. Conduit threading performed in the field shall be ¾ inch per foot tapered threads in accordance with ANSI B1.20.1.

H. Conduits shall be protected from moisture, corrosion, and physical damage during construction. Install dust-tight and water-tight conduit fittings on the ends of all conduits immediately after installation and do not remove until conductors are installed.

I. Conduits shall be installed to provide no less than 12 inches clearance from pipes that have the potential to impart heat upon the conduit. Such pipes include, but are not limited to, hot water pipes, steam pipes, exhaust pipes, and blower air pipes. Clearance shall be maintained whether conduit is installed in parallel or in crossing of pipes.

J. Where non-metallic instrumentation conduits are installed exposed, the following clearances to other conduit types shall be maintained:

    1. Instrumentation conduits installed parallel to conduits with conductors energized at 480V or above shall be 18 inches.

    2. Instrumentation conduits installed parallel to conduits with conductors energized at 240V and below shall be 12 inches.

    3. Instrumentation conduits installed at right angles to conductors energized at 480V and below shall be 6 inches.

    4. Instrumentation conduits installed at right angles to conductors energized at voltages above 480V shall be 12 inches.

K. Where conduit fittings do not include an integral insulated bushing, an insulated bushing shall be installed at all conduit termination points.

L. Conduits which serve multi-section equipment shall be terminated in the section where wiring terminations will be made.

M. Conduits shall not penetrate the floors or walls inside liquid containment areas without specific written authorization from the Engineer.

N. All field fabricated threads for rigid galvanized steel conduit shall be thoroughly coated with two coats of galvanizing compound, allowing at least two minutes to elapse between coats for proper drying.

O. The appropriate specialized tools shall be used for the installation of PVC coated conduit and conduit fittings. No damage to the PVC coating shall occur during installation. Conduit and conduit fittings with damaged PVC coating shall be replaced at the Contractor's cost. The use of PVC coating touch-up compounds is not permitted.

P. Conduits which emerge from within or below concrete encasement shall be PVC coated rigid galvanized steel in accordance with Standard Detail 1611102 where the conduit is not protected by an equipment enclosure that surrounds the conduit on all sides at the point where it emerges from the encasement.

Q. Aluminum conduits shall not be installed in direct contact with concrete surfaces. Where aluminum conduits are routed along concrete surfaces, they shall be installed with one-hole electro-galvanized malleable iron alloy straps with matching clamp-backs to space the conduit ¼ inch away from concrete surface. Where aluminum conduit passes through concrete, CMU or brick walls, the penetration shall be made such that the aluminum conduit does not come in contact with concrete, CMU, brick or mortar.

R. Arrange conduit to maintain headroom and present a neat appearance. Run exposed conduits parallel or perpendicular to building surfaces and adjacent piping. Group conduit in parallel runs where practical and provide rack space for 25 percent additional conduits.

S. Support conduits to prevent distortion of alignment by wire pulling operations. Fasten single conduits with one hole malleable iron straps. For multiple runs use steel channel and clamps. Wire, perforated pipe straps and the like are not acceptable support means.

T. Support conduit at a maximum of 7 feet on center and within 3 feet of each box, cabinet, or fitting. Hang trapeze assemblies with threaded rods not less than 3/8-inch diameter. Remove all temporary supports prior to pulling conductors.

U. The maximum length between pull points is 400 feet. This length shall be reduced by 100 foot for each 90 degree of bend.

V. Avoid moisture traps where possible; where unavoidable, provide junction box with drain fitting at conduit low point.

W. Use suitable conduit caps to protect installed conduit against entrance of dirt and moisture. Install threaded PVC end caps on conduits stubbed up for future use.

X. Unless otherwise specified, conduit entering field equipment enclosures shall enter the bottom or side of the box.

Y. Provide clamp backs for conduits on exterior or damp surfaces to prevent the raceway from bearing directly on the damp surface.

Z. Route conduits in slabs above the bottom reinforcing and below the top reinforcing. Maximum size for conduits in slabs above grade is 1-inch. Route so conduits in slabs above grade do not cross.

AA. PVC conduit bends: Use PVC-coated rigid steel factory elbows.

3.02 CONCEALED AND EMBEDDED CONDUITS

A. Conduits are permitted to be installed concealed and/or embedded with the following requirements:

1. Conduits shall not be installed horizontally when concealed within CMU walls, only vertical installation is acceptable.

2. Conduits installed embedded within concrete floors or walls shall be located so as not to affect the designed structural strength of the floor or wall. Embedded conduits shall be installed in accordance with Standard Detail 0331604 and ACI-318.

3. Where conduit bends emerge from concrete embedment, none of the curved portion of the bend shall be visible. Only the straight portion of the bend shall be visible.

4. Where multiple conduits emerge from concrete embedment or from concealment below a concrete floor, ample clear space shall be provided between conduits to allow for the appropriate and required conduit termination fittings to be installed.

5. Conduits installed embedded within concrete encasement of any kind shall be installed such that conduit couplings for parallel conduits are staggered so that they are not side by side.

B. Conduits are NOT permitted to be installed concealed and/or embedded for the following situations:

1. Conduits shall not be installed embedded within any water-bearing floors or walls. Conduits shall not be installed embedded within any liquid containment area floors or walls.

2. Conduits shall not be installed concealed within CMU walls or gypsum walls that are adjacent to Class I and II hazardous areas (Division 1 and Division 2).

3.03 CONDUIT USES AND APPLICATIONS

A. Rigid Conduit

1. Rigid conduit for non-hazardous areas shall be furnished and installed in the materials of construction as follows:

RIGID CONDUIT FOR NON-HAZARDOUS AREAS		
INSTALLATION AREA DESIGNATION/ SCENARIO	**CONDUIT CATEGORY BY WIRING/CIRCUIT TYPE**	
	Power and Control	**Instrumentation**
Exposed in indoor wet process areas	PVC coated rigid galvanized steel conduit	Same as Power and Control
Exposed in indoor dry process areas	Rigid galvanized steel conduit	Same as Power and Control
Exposed in indoor dry non-process areas	Rigid galvanized steel conduit	Same as Power and Control
Exposed in outdoor areas	PVC coated rigid galvanized steel conduit	Same as Power and Control
Exposed within pre-fabricated electrical equipment center buildings	Electrical Metallic Tubing	Same as Power and Control
Concealed within underground direct-bury or concrete-encased ductbanks	Schedule 40 rigid non-metallic PVC conduit	Rigid galvanized steel conduit
Concealed within non-elevated (i.e. "slab-on-grade" construction) concrete slabs	Schedule 40 rigid non-metallic PVC conduit	Rigid galvanized steel conduit
Concealed within elevated concrete slabs	Rigid galvanized steel conduit	Same as Power and Control
Concealed below concrete slabs (within earth or fill material)	Schedule 40 rigid non-metallic PVC conduit	Rigid galvanized steel conduit
Concealed within concrete walls	Schedule 40 rigid non-metallic PVC conduit	Rigid galvanized steel conduit
Emerging from concealment within or below a concrete floor and transitioning to exposed conduit (Reference Detail 1611102)	PVC coated rigid galvanized steel conduit	Same as Power and Control

2. Rigid conduit for hazardous areas shall be furnished and installed in the materials of construction as follows:

RIGID CONDUIT FOR HAZARDOUS AREAS		
INSTALLATION AREA HAZARD/SCENARIO	**CONDUIT CATEGORY BY WIRING/CIRCUIT TYPE**	
	Power and Control	**Instrumentation**
Exposed in Class I and II areas (Division 1 and Division 2)	PVC coated rigid galvanized steel conduit	Same as Power and Control
Concealed within concrete slabs in Class I and II areas (Division 1 and Division 2)	Rigid galvanized steel conduit	Same as Power and Control
Concealed below concrete slabs (within earth or fill material) in Class I and II areas (Division 1 and Division 2)	Rigid galvanized steel conduit	Same as Power and Control
Concealed within concrete walls in Class I and II areas (Division I and Division II)	Rigid galvanized steel conduit	Same as Power and Control
Concealed below concrete slabs encased in at least two inches of concrete and buried 24 inches below top of slab in Class I Division 1 areas	Schedule 40 rigid non-metallic PVC conduit	Rigid galvanized steel conduit

The tables for the materials of construction for rigid conduits are intended to exhaustively cover all possible scenarios and installation areas under this Contract. However, if a scenario or installation area is found that is not explicitly governed by these tables, it shall be assumed for bid purposes that the conduit material of construction is to be rigid galvanized steel. This discrepancy shall be brought to the attention of the Engineer (in writing) immediately for resolution.

B. Conduit Bends

1. All conduit bends shall be the same material of construction as the rigid conduit listed in the tables above, with the following exceptions:

   a. All 90 degree bends or combinations of adjacent bends that form a 90 degree bend where concealed within concrete or below a concrete slab shall be rigid galvanized steel.

2. Field fabricated bends of metallic conduit shall be made with a bending machine and shall have no kinks. Field fabricated standard radius and long radius bends shall have minimum bending radii in accordance with the associated tables in Part 2 herein.

3. Field bending of non-metallic conduits is not acceptable, factory fabricated bends shall be used.

4. Long radius bends shall be furnished and installed for the following specific applications, all other bends shall be standard radius:

    a. All conduits containing fiber optic cable.

    b. All conduits containing shielded VFD cable.

    c. Where specifically indicated on the Drawings.

C. Flexible Conduit

1. Flexible conduit shall only be installed for the limited applications specified herein. Flexible conduit shall not be installed in any other application without written authorization from the Engineer. Acceptable applications are as follows:

    a. Connections to motors and engine-generator sets (and similar vibrating equipment)

    b. Connections to solenoid valves and limit switches

    c. Connections to lighting transformers

    d. Connections to pre-fabricated equipment skids

    e. Connections to HVAC equipment

    f. Connections to instrument transmitters and elements

    g. Where specifically indicated in the Standard Details

2. Flexible conduit length shall be limited to three (3) feet, maximum. Flexible conduit shall not be installed buried or embedded within any material.

3. Flexible conduit for non-hazardous areas shall be furnished and installed in the materials of construction as follows:

FLEXIBLE CONDUIT FOR NON-HAZARDOUS AREAS		
INSTALLATION AREA DESIGNATION/SCENARIO	**CONDUIT CATEGORY BY WIRING/CIRCUIT TYPE**	
	Power and Control	**Instrumentation**
Exposed in indoor wet process areas	Liquid-tight flexible metal conduit	Same as Power and Control
Exposed in indoor dry process areas	Liquid-tight flexible metal conduit	Same as Power and Control
Exposed in indoor dry non-process areas	Flexible metal conduit	Same as Power and Control
Exposed in outdoor areas	Liquid-tight flexible metal conduit	Same as Power and Control

4. For Class I Division 1 hazardous areas, the NEC does not permit the installation of flexible conduit. In lieu of flexible conduit in these areas, flexible conduit couplings shall be installed as specified in Part 2 herein. Flexible conduit for all other hazardous areas shall be furnished and installed in the materials of construction as follows:

FLEXIBLE CONDUIT FOR HAZARDOUS AREAS		
INSTALLATION AREA HAZARD/SCENARIO	**CONDUIT CATEGORY BY WIRING/CIRCUIT TYPE**	
	Power and Control	**Instrumentation**
Exposed in Class I Division 2 areas	Liquid-tight flexible metal conduit	Same as Power and Control

3.04 CONDUIT FITTING USES AND APPLICATIONS

A. General

1. Conduit fittings shall be furnished and installed in the materials of construction as indicated in Part 2, herein. Conduit fitting materials of construction are dependent on the material of construction used for the associated conduit.

2. Conduit fittings shall be provided in the trade size and configuration required to suit the application.

B. Conduit Bodies

1. Conduit bodies shall be installed where wire pulling points are desired or required, or where changes in conduit direction or breaking around beams is required.

2. Where conduit bodies larger than trade size 2 inches are intended to be used as a pull-through fitting during wire installation, oversized or elongated conduit bodies shall be used. Oversized or elongated conduit bodies shall not be required if the conduit body is intended to be used as a pull-out point during wire installation.

C. Conduit Nipples and Unions

1. Conduits with running threads shall not be used in place of 3-piece couplings (unions) or close nipples. After installation of a conduit fitting of any kind, there shall be no more than ¼ inch of exposed threads visible. Factory fabricated all-thread nipples may be used between adjacent enclosures, however, the same restriction applies regarding the length of exposed threads that are visible.

D. Conduit Expansion and Deflection Fittings

1. Conduit expansion fittings shall be installed where required by the NEC and where indicated on the Drawings. Expansion fittings shall also be installed for exposed straight metallic conduit runs of more than 75 feet, in both indoor and outdoor locations. Expansion fittings for runs of non-metallic conduit shall be installed in accordance with the NEC.

2. Conduit deflection fittings shall be installed where required by the NEC and where conduits are installed (exposed and concealed) across structural expansion joints.

E. Conduit Seals

1. Conduit seals shall be installed for conduits installed within or associated with hazardous areas and other areas as required by the NEC.

F. Conduit Termination Fittings

1. Where conduits terminate at enclosures with a NEMA 4, 4X, or 3R rating and the enclosure does not have integral conduit hubs, an appropriately sized watertight conduit hub shall be installed to maintain the integrity of the enclosure. The use of locknuts with integral gasket in lieu of watertight conduit hubs is not acceptable.

2. Where conduits terminate at enclosures that do not require conduit hubs, a two-locknut system shall be used to secure the conduit to the enclosure. One locknut shall be installed on the outside of the enclosure, and the other inside, drawn tight against the enclosure wall. The locknut on the interior of the enclosure shall be the type with integral bonding lug, or a conduit bonding bushing may be used in place of the locknut.

3. Conduits shall not be installed such that conduit fittings penetrate the top of any enclosure located outdoors, except in cases where specifically required by the serving electric utility. Conduits which serve outdoor equipment or an enclosure from above shall instead be routed into the side of the enclosure at the bottom. The conduit termination fitting shall be provided with a conduit drain to divert moisture from the raceway away from the enclosure.

3.05 MISCELLANEOUS

A. Conduit Periphery Sealing

1. All conduit penetrations through exterior walls shall be sealed around the periphery using the appropriate products specified in Part 2 herein to prevent air and/or water entry into the structure.

2. All conduit penetrations through interior walls and floors shall be sealed through the use of with conduit sleeves and caulk as specified in Part 2 herein. Alternatively, mortar may be used to seal around the conduit periphery.

3. Conduit penetrations through fire-rated walls as floors shall be made with the appropriate fire rated penetration product.

B. Conduit Interior Sealing

1. All conduits (including spares) entering a structure below grade shall be sealed on the interior of the conduit against water ingress. Sealing shall be at an accessible location in the conduit system located within the building structure and shall be via one of the methods specified in Part 2 herein. If conduit sealing cannot be achieved at an accessible location within the building structure, sealing shall be placed in the conduits in the nearest manhole or handhole outside the structure.

3.06 CONDUIT IDENTIFICATION

A. Exposed conduits shall be identified at the source, load, and all intermediate components of the raceway system. Examples of intermediate components include but are not limited to junction boxes, pull boxes, and disconnect switches. Identification shall be by means of an adhesive label with the following requirements:

1. Labels shall consist of an orange background with black text. Text for the label shall be the conduit number as indicated in the conduit and wire schedules.

2. In addition, at the source end of the conduit, a second line of text shall be included to indicate the load equipment name. This second line shall consist of the word "TO:" and the text in the 'TO' column of the conduit and wire schedule (e.g. TO: Raw Sewage Pump No. 1). At the load end of the conduit, a second line of text shall be included to indicate the source equipment name. This second line shall consist of the word "FROM:" and the text in the 'FROM' column of the conduit

and wire schedule (e.g. FROM: PP-1). This requirement applies only to the source and load ends of the conduit, and not anywhere in between.

3. For conduits trade sizes 3/4 inch through 1-1/2 inch, the text shall be a minimum 18 point font. For conduits trade size 2 inch and larger, the text shall be a minimum 24 point font.

4. Label height shall be 3/4 inch minimum, and length shall be as required to fit required text. The label shall be installed such that the text is parallel with the axis of the conduit. The label shall be oriented such that the text can be read without the use of any special tools or removal of equipment.

5. Labels shall be installed after each conduit is installed and, if applicable, after painting. Labels shall be printed in the field via the use of a portable label printing system. Handwritten labels are not acceptable.

6. Labels shall be made of permanent vinyl with adhesive backing. Labels made of any other material are not acceptable.

B. Conduits that are not exposed but installed beneath free standing equipment enclosures shall be identified by means of a plastic tag with the following requirements:

1. The tag shall be made of white Tyvek material, and have an orange label with black text, as described above, adhered to it. Text for the label shall be the conduit number as indicated in the conduit and wire schedules.

2. The tag shall be affixed to the conduit by means of a nylon cable tie. The tag shall be of suitable dimensions to achieve a minimum text size of 18 points.

C. Conduits for lighting and receptacle circuits shall not require identification.

D. Any problems or conflicts with meeting the requirements above shall immediately be brought to the attention of the Engineer for a decision.

3.07 TESTING

A. All tests shall be performed in accordance with the requirements of the General Conditions and Division 1. The following tests are required:

1. All conduit installed below grade or concrete encased shall be tested to ensure continuity and the absence of obstructions by pulling through each conduit a swab followed by a mandrel 85% of the conduit inside diameter. After testing, all conduits shall be capped after installation of a suitable pulling rope.

3.08 TRAINING OF INSTALLATION PERSONNEL

A. All Contractor personnel that install PVC coated RGS conduit shall be trained by the PVC coated RGS conduit manufacturer. Training shall include proper conduit system assembly techniques, use of tools appropriate for coated conduit systems, and field bending/cutting/threading of coated conduit. Training shall have been completed within the past 24 months prior to the Notice to Proceed on this Contract to be considered valid. Contractor personnel not trained within this timeframe shall not be allowed to install coated conduit, or shall be trained/re-trained as required prior to commencement of conduit installation.

+ + + END OF SECTION 16111 + + +

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SECTION 16118
UNDERGROUND ELECTRICAL

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall furnish and install underground duct systems, electric manholes, and electric handholes as specified herein and as indicated on the Drawings. The work shall be complete and shall include excavation, concrete construction, backfilling, and all materials, items, and components required for a complete system.

B. The provisions of this Division are applicable to all underground conduit work. All work shall be coordinated with that of the various utility companies and other Contractors. The Contractor shall adhere to all utility company requirements including the serving electric utility.

C. Reference Section 16000, Basic Electrical Requirements; Section 16111, Conduit; Section 16170, Grounding and Bonding; the applicable sections of Division 2, Sitework; Section 03200, Reinforcing Steel; and 03300, Cast-In-Place Concrete.

1.02 CODES AND STANDARDS

A. Products specified herein shall be designed, manufactured, and/or listed to the following standards as applicable:

1. AASHTO H20

2. ANSI/SCTE 77-2010 – Specification for Underground Enclosure Integrity

1.03 SUBMITTALS

A. In accordance with the procedures and requirements set forth in the General Conditions and Section 01350, Project Document Tracking and Control System, the Contractor shall obtain from the equipment manufacturer and submit Shop Drawings. Each submittal shall be identified by the applicable Specification Section.

1.04 SHOP DRAWINGS

A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.

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B. Partial, incomplete, or illegible submittals will be returned to the Contractor without review for resubmittal.

C. Shop drawings shall include but not be limited to, the following:

1. Product data sheets.

2. Outline and dimensional drawings including detailed sections of the manholes and/or handholes.

3. Materials specifications and structural calculations for the manholes sealed by a Professional Engineer in the State of Georgia.

1.05 IDENTIFICATION

A. Each electric manhole and handhole cover shall be lettered with the word “Electric”, the manhole or handhole identification number (e.g. PHH-1, PMH-2, CMH-2, etc.), manufacturer's name or trademark, and such other information as the manufacturer may consider necessary, or as specified, for complete identification.

PART 2 -- PRODUCTS

2.01 MANUFACTURERS

A. The material covered by this Specification is intended to be standard material of proven performance as manufactured by reputable concerns. Material shall be fabricated, constructed and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as specified herein and indicated on the Drawings.

2.02 DUCT SYSTEM

A. The underground duct system shall be comprised of conduits, conduit bends, and conduit fittings as specified in Section 16111, Conduit. Conduits shall be encased in reinforced concrete envelopes, unless otherwise specified herein or indicated on the Drawings.

B. Base and intermediate conduit spacers shall be furnished to provide a minimum of two-inch (2”) separation between conduits. Conduit spacers shall be provided in the proper size as required for the conduit that they secure. For example, a 4” conduit spacer shall not be used to secure a 2” conduit. Conduit spacers shall be as manufactured by Carlon Electrical Products Company, Aeroquip Corporation, Underground Devices, Incorporated, or equal.

C. Raceways number tags shall be brass with stainless steel attachment wire. Raceway number shall be embossed on to the tag with ¼-inch letters.

2.03 ELECTRIC PRECAST HANDHOLES AND MANHOLES

A. Install handholes and manholes with 28-day, 3,000 psi minimum compressive strength concrete and designed for AASHTO H-20 loading. Minimum dimensions for handholes and manholes are shown on the Drawings. Increase these as required by use of extension sections to accommodate the several raceway entrances at their required elevations.

B. Slope floors toward drain points, leaving no pockets or other nondraining areas. Provide a drainage outlet at the low point of the floor constructed with a heavy, cast iron, slotted or perforated hinged cover, and 4-inch minimum outlet and outlet pipe.

C. Provide raceway entrances on all four sides. For raceways installed under this Contract, knockout panels or precast individual raceway openings may be used. On sides where no raceways are installed under this Contract, provide 12-inch high by 24-inch wide (minimum) knockout panels for future raceway installation.

D. For manholes, utilize heavy-duty type frames and covers made of stainless steel, suitable for H-20 loading, and having machined bearing surfaces. Provide indented type covers, solid top design, with two drop handles each. On the upper side of each cover, cast or burn by welder, in integral letters not less than 2 inches high appropriate titles, ELECTRIC HV (for above 600 volts), ELECTRIC LV (for 600 volts and below), or COMMUNICATION. Field stamp covers with handhole and manhole numbers indicated on the Drawings.

E. For handholes, frames and covers shall conform to ASTM A48-83 and shall be slab type with letters as indicated above.

F. Provide heavy weight non-metallic cable racks with adjustable arms and acceptable insulators for all cables in each handhole and manhole. Set adjustable inserts in the concrete walls for the attachment of racks. Do not use bolts or studs embedded in concrete for attaching racks. Set racks and inserts on not greater than 3-foot centers around the entire inside perimeter of the manhole, arranged so that all spare conduit ends are clear for future cable installation. Provide racks with a sufficient number of arms and insulators to accommodate cables for each conduit entering or leaving the handhole, including spares.

G. Provide pulling irons. Utilize ¾-inch round stock securely fastened to the overall steel reinforcement before concrete is poured.

H. Utilize handhole and manhole hardware of steel, hot-dip galvanized after fabrication.

I. Manufacturers: Brooks Products, Inc.; Penn-Cast Products, Inc.; Concrete Conduit Company; Associated Concrete Products, Inc.; or equal.

PART 3 -- EXECUTION

3.01 GENERAL

A. The underground duct system, manholes, and handholes shall be installed as specified herein, indicated on the Drawings, and in accordance with manufacturers' instructions.

3.02 DUCT SYSTEM

A. All underground conduit shall be encased in concrete and shall be reinforced. Encasement and reinforcement shall be as indicated in the standard details. Concrete shall be furnished and installed in accordance with Section 03300. Reinforcing steel shall be furnished and installed in accordance with Section 03200. Concrete electrical duct banks shall contain red dye; the red dye shall be mixed into the concrete mix before being poured. Each 50 lb. bag of concrete shall include 3 lbs of red oxide Red dye applied to the top of concrete encasement after placement of concrete is not acceptable.

B. Concrete pours shall be complete from handhole to handhole and from manhole to manhole where practicable. Partial pours in general shall not be permitted. Where a complete pour is impractical, written authorization shall be obtained from the Engineer for the partial pour.

C. Conduit ductbank elevations at the manholes and handholes shall be based on minimum ductbank cover as indicated in the standard details, or deeper to avoid conflicts with other obstacles. Where deviation is necessary to clear unforeseen obstacles, the elevations may be changed after authorization by the Engineer.

D. Slope all conduits continuously away from structures and buildings with a minimum slope of 3" per 100' unless otherwise indicated on the Drawings.

E. The minimum clearance from the top of the concrete encasement and finished grade shall be as indicated in the standard details, except where otherwise accepted in writing by the Engineer or shown on the Drawings.

F. Care shall be exercised during excavation for the duct banks to prevent digging too deep. Backfilling of low spots with earth fill will not be permitted unless thoroughly compacted and acceptable to the Engineer.

G. If a specific ductbank arrangement is shown on the Drawings, the conduits in that ductbank shall be arranged as shown. Where no specific ductbank arrangement is shown on the Drawings, the Contractor shall arrange conduits within each ductbank based on field conditions. Spare conduits shown going from ductbanks into buildings or structures shall be stubbed up in the location(s) as indicated on the Drawings.

H. A minimum of one (1) ground rod, furnished in accordance with Section 16170, shall be driven adjacent to each manhole, handhole, or other concrete box. A No. 4/0 AWG bare copper ground cable shall be connected between this rod and the copper ground strap using a silicon bronze connector. Connect all noncurrent-carrying metal parts in the manhole or handhole and any metallic raceway grounding bushings to this ground rod. Provide ground bar as required. All ground rods shall be interconnected by means of the No. 4/0 AWG bare copper ground cable located within each duct bank. The ends of these cables shall also be connected to substation and/or building ground buses where the conduits terminate.

I. Care shall be exercised and temporary plugs shall be installed during installation to prevent the entrance of concrete, mortar, or other foreign matter into the conduit system. Conduit spacers shall be utilized to support conduit during the pouring of concrete to prevent movement and misalignment of the conduits. Conduit spacers shall be installed in accordance with manufacturer's instructions unless otherwise noted. Horizontal spacing of conduit spacers along ductbank shall be as indicated on the Standard Details.

J. Where connections to existing underground conduits are indicated, excavate to the maximum depth necessary. After addressing the existing conductors, cut the conduits and remove loose concrete from the conduits before installing new concrete encased ducts. Provide a reinforced concrete collar, poured monolithically with the new duct line, to take the shear at the joint of the duct lines.

K. Construct concrete-encased conduits connecting to underground structures to have a flared section adjacent to the manhole to provide shear strength. Construct underground structures to provide shear strength. Construct underground structures to provide for keying the concrete encasement of the duct line into the wall of the structure. Use vibrators when this portion of the encasement is poured to ensure a seal between the encasement and the wall of the structure.

L. Six (6) inches above all duct banks, the Contractor shall furnish and install a two (2) inch wide and 4-mil thick red plastic electrical hazard tape. Tapes shall be metallic detectable type and shall have a continuous message in bold black letters, with message similar to: "CAUTION – STOP DIGGING - ELECTRIC LINE BURIED BELOW." Tape shall be Detectable Identoline by Brady, Services and Materials "Buried Underground Tape"; Somerset (Thomas & Betts) "Protect-A-Line";or equal.

   Underground marking tape for directly buried cables and conduits shall be 6-inch-wide metallic lined tape with red polyethylene film on top and clear polyethylene film on the bottom. The message shall be clearly printed with black over red tape and shall read "CAUTION ELECTRIC LINE BURIED BELOW".

M. The Contractor shall perform all earthwork including excavation, backfill, bedding, compaction, shoring and bracing, grading and restoration of surfaces and seeded areas disturbed during the execution of the work.

N. All conduit joints in the duct system shall be staggered such that adjacent conduits do not have joints in the same location. Stagger conduit joints in concrete encasement 6-inches minimum.

3.03 ELECTRIC MANHOLES

A. Install handholes and manholes where shown on the Drawings. Provide excavation, shoring, bracing, backfilling, grading, etc., in accordance with requirements specified in Division 2 of these Contract Documents.

B. Do not install handholes or manholes until final conduit grading, including field changes necessitated by underground interferences, has been determined. Set frames to final grades as required

C. Electric manholes shall be installed to a sufficient depth to accommodate the required grading of ducts as well as maintaining a minimum distance of 14" from the bottom of the lowest duct centerline entrances to finished floor line and/or highest duct centerline entrance to the roof. All manholes shall be built on, or placed over a 6" layer of well-tamped gravel.

D. Duct envelopes and conduit with bell ends shall enter at approximately right angles to the walls, except as may otherwise be shown on the Drawings.

E. All concrete work and fully assembled manholes shall be completely watertight and shall be furnished with sloped floors that pitch towards a drain. The outside surfaces shall be coated with an approved asphaltic waterproofing compound (all sides, bottom, and roof). Precast concrete manholes may be installed; however, all requirements of this section and other divisions of the Specifications and the details shown on the Drawings shall apply.

F. Install pulling eye irons imbedded in walls opposite each duct entrance securely fastened to manhole reinforcing rods. All hardware shall be hot-dipped galvanized steel. Copper bars shall be provided in the walls for grounding. No. 4/0 AWG bare copper cables shall be connected to these bars and all non-current carrying metal parts shall be grounded to these copper bars.

G. All cables shall be well supported on walls by nonmetallic cable racks. The cable racks shall be heavy-duty type for medium and low voltage power cables and light duty type for control, signal, communications and similar small conductors. All racks shall be rigidly attached to the wall and equipped with adjustable rack arms.

3.04 ELECTRIC HANDHOLES

A. Electric handholes shall be installed to a sufficient depth to accommodate the required grading of ducts as well as maintaining a minimum distance of 9" from the bottom of the lowest duct centerline entrances to finished floor line and/or highest duct centerline

entrance to roof. All handholes shall be built on, or placed over a 6" layer of well-tamped gravel.

B. Duct envelopes and conduit with bell ends shall enter at approximately right angles to the walls, except as may otherwise be shown on the Drawings.

C. All fully assembled handholes shall be completely watertight.

D. All individual cables and/or bundles of conductors shall be identified and "dressed" along the wall of the enclosure. Cable racks as specified herein shall be provided if any handhole dimension exceeds 24 inches.

3.05 TESTING

A. All tests shall be performed in accordance with the requirements of the General Conditions and Division 1. The following tests are required:

1. Field tests

a. Field tests for all completed duct systems shall consist of pulling a swab through each conduit followed by a mandrel equal in size to 85% of the conduit inside diameter.

b. After testing, all conduits shall be capped after installation of a suitable pull rope. All field tests shall be witnessed by the Engineer.

+ + + END OF SECTION 16118 + + +

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SECTION 16123
LOW VOLTAGE WIRE AND CABLE

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall furnish, install, connect, test, and place in satisfactory operating condition, all low voltage wire and cable indicated on the Drawings and as specified herein and/or required for proper operation. The work of connecting cables to equipment and devices shall be considered a part of this Section. All appurtenances required for the installation of wire and cable systems shall be furnished and installed by the Contractor.

B. The scope of this Section does not include internal wiring factory installed by electrical equipment manufacturers.

C. Reference Section 16000 – Basic Electrical Requirements and Section 16130 – Boxes.

1.02 CODES AND STANDARDS

A. Low voltage wire, cable, and appurtenances shall be designed, manufactured, and/or listed to the following standards as applicable:

1. Underwriters Laboratories (UL)

    a. UL 13 – Standard for Power-Limited Circuit Cables

    b. UL 44 – Thermoset-Insulated Wires and Cables

    c. UL 83 – Thermoplastic-Insulated Wires and Cables

    d. UL 1277 – Standard for Electrical Power and Control Tray Cables with Optional Optical-Fiber Members

    e. UL 1581 – Reference Standard for Electrical Wires, Cables, and Flexible Cords

    f. UL 1685 – Standard for Vertical-Tray Fire-Propagation and Smoke-Release Test for Electrical and Optical-Fiber Cables

    g. UL 2250 – Standard for Instrumentation Tray Cable

    h. UL 2556 – Wire and Cable Test Methods

2. American Society for Testing and Materials (ASTM)

a. ASTM B3 – Standard Specification for Soft or Annealed Copper Wire

b. ASTM B8 – Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft

c. ASTM B33 – Standard Specification for Tin-Coated Soft or Annealed Copper Wire for Electrical Purposes

d. ASTM D69 – Standard Test Methods for Friction Tapes

e. ASTM D4388 – Standard Specification for Nonmetallic Semi-Conducting and Electrically Insulating Rubber Tapes

3. Insulated Cable Engineers Association (ICEA)

a. ICEA S-58-679 – Standard for Control, Instrumentation and Thermocouple Extension Conductor Identification

b. ICEA T-29-250 – Conducting Vertical Cable Tray Flame Tests with Theoretical Heat Input Rate of 210,000 B.T.U./Hour

4. Institute of Electrical and Electronics Engineers (IEEE)

a. IEEE 1202 – Standard for Flame Testing of Cables

1.03 SUBMITTALS

A. In accordance with the procedures and requirements set forth in the General Conditions and Section 01350, Project Document Tracking and Control System, the Contractor shall obtain from the wire and cable manufacturer and submit the following:

1. Shop Drawings

2. Reports of Field Tests

B. Each submittal shall be identified by the applicable specification section.

1.04 SHOP DRAWINGS

A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed material's compliance with the Contract Documents.

B. Partial, incomplete, or illegible Submittals will be returned to the Contractor without review for resubmittal.

C. Shop drawings shall include but not be limited to:

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1. Product data sheets for wire and cable, terminations, and pulling lubricant.

2. Cable pulling calculations (if required).

3. Wiring identification methods and materials.

D. The shop drawing information shall be complete and organized in such a way that the Engineer can determine if the requirements of these specifications are being met. Copies of technical bulletins, technical data sheets from "soft-cover" catalogs, and similar information which is "highlighted" or somehow identifies the specific equipment items the Contractor intends to provide are acceptable and shall be submitted.

1.05 CABLE PULLING CALCULATIONS

A. Prior to the installation of the wire and cable specified herein, the Contractor shall submit cable pulling calculations for engineer review and approval when all of the following are true:

1. The amount of cable to be installed will be greater than 200 linear feet between pull points.

2. The installation will have one or more bends.

3. The wire and cable is size #1/0 AWG and larger.

B. Cable pulling calculations shall be performed by a currently registered professional engineer in the State of Georgia and shall define pulling tension and sidewall loading (sidewall bearing pressure values).

PART 2 -- PRODUCTS

2.01 MANUFACTURERS

A. The wire and cable to be furnished and installed for this project shall be the product of manufacturers who have been in the business of manufacturing wire and cable for a minimum of ten (10) years. Wire and cable shall be designed, constructed, and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as specified herein and indicated on the Drawings. Only one (1) manufacturer for each wire and cable type shall be permitted.

2.02 POWER AND CONTROL WIRE AND CABLE

A. Power and control wire shall consist of insulated copper conductors with a nylon (or equivalent) outer jacket. Conductor insulation shall be rated 90°C for dry locations, 75°C for wet locations, and 600V. Insulated conductors shall be UL 83 Listed as NEC Type THHN/THWN.

B. Unless specified otherwise herein, conductors shall be stranded copper per ASTM B-8 and B-3, with Class B or C stranding contingent upon the size. Power conductors for lighting and receptacle branch circuits shall be solid copper per ASTM B-3.

C. Power conductor size shall be no smaller than No. 12 AWG and Control conductor size shall be no smaller than No. 14 AWG.

D. Multi-conductor cable assemblies shall include a grounding conductor and an overall PVC jacket. The jacket shall be PVC and resistant to abrasion, sunlight, and flame in accordance with UL 1277. Multi-conductor cable assemblies shall be UL 1277 Listed as NEC Type TC (Power and Control Tray Cable).

E. Power wire and cable shall be as manufactured by the Okonite Company, the Southwire Company, General Cable, Encore Wire, or equal.

2.03 INSTRUMENTATION CABLE

A. For single-analog signal applications, instrumentation cable shall consist of a single, twisted pair or triad of individually insulated and jacketed copper conductors with an overall cable shield and jacket. Conductor insulation shall be rated 90°C in both wet and dry locations, and 600V. The jacket shall be PVC and resistant to abrasion, sunlight, and flame in accordance with UL 1277. Cable shall be UL 1277 Listed as NEC Type TC (Power and Control Tray Cable).

B. For multiple-analog signal applications, instrumentation cable shall consist of multiple, twisted pairs or triads (i.e. groups) of individually insulated and jacketed copper conductors with individual pair/triad shields (i.e. group shields) and an overall cable shield and jacket. Conductor insulation shall be rated 90°C in both wet and dry locations, and 600V. The jacket shall be PVC and resistant to abrasion, sunlight, and flame in accordance with UL 1277. Cable shall be UL 1277 Listed as NEC Type TC (Power and Control Tray Cable).

C. Cable and group shields shall consist of overlapped aluminum/polyester tape/foil providing 100% coverage. Instrumentation cables shall include an overall copper shield drain wire. Cables containing multiple twisted pairs or triads shall also include group shield drain wires.

D. Conductors, including drain wires, shall be tin or alloy coated (if available), soft, annealed copper, stranded per ASTM B-8, with Class B stranding unless otherwise specified.

E. Instrumentation signal conductor size shall be no smaller than No. 16 AWG.

F. Instrumentation cable shall be Okoseal-N Type P-OS (for single pair or triad applications) or Okoseal-N Type SP-OS (for multiple pair or triad applications) as manufactured by the Okonite Company, Belden equivalent, Southwire Company equivalent, or equal.

2.04 CONDUCTOR IDENTIFICATION

A. Conductors shall be identified using a color coding method. Color coding for individual power, control, lighting, and receptacle conductors shall be as follows:

1. 480/277V AC Power

    a. Phase A - BROWN

    b. Phase B - ORANGE

    c. Phase C - YELLOW

    d. Neutral – GREY

2. 120/208V or 120/240V AC Power

    a. Phase A - BLACK

    b. Phase B - RED

    c. Phase C - BLUE

    d. Neutral - WHITE

3. DC Power

    a. Positive Lead - RED

    b. Negative Lead - BLACK

4. DC Control

    a. All wiring - BLUE

5. 120 VAC Control

    a. 120 VAC control wire shall be RED except for a wire entering a motor control center compartment, motor controller, or control panel which is an interlock. This interlock conductor shall be color coded YELLOW. For the purposes of this Section, an interlock is defined as any wiring that brings voltage into the above mentioned equipment from a source outside that equipment.

6. 24 VAC Control

    a. All wiring - ORANGE

7. Equipment Grounding Conductor

a. All wiring - GREEN

B. Individual conductors No. 2 AWG and smaller shall have factory color coded insulation. It is acceptable for individual conductors larger than No.2 AWG to be provided with factory color coded insulation as well, but it is not required. Individual conductors larger than No.2 AWG that are not provided with factory color coded insulation shall be identified by the use of colored tape in accordance with the requirements listed in Part 3 herein. Insulation colors and tape colors shall be in accordance with the color coding requirements listed above.

C. Conductors that are part of multi-conductor cable assemblies shall have black insulation. The conductor number shall be printed on each conductor's insulation in accordance with ICEA S-58-679, Method 4. Each conductor No.2 AWG and smaller within the cable assembly shall also be identified with a heat shrink tag with color coded background. Each conductor larger than No.2 AWG within the cable assembly shall also be identified by the use of colored tape. Heat shrink tags and colored tape shall be in accordance with the requirements listed in Part 3 herein. Tape color and heat shrink tag background color shall be in accordance with the color coding requirements listed above.

2.05 CABLE PULLING LUBRICANTS

A. Cable pulling lubricants shall be non-hardening type and approved for use on the type of cable installed. Lubricant shall be Yellow #77 Plus by Ideal, Cable Gel by Greenlee, Poly-Gel by Gardner Bender, or equal.

PART 3 -- EXECUTION

3.01 WIRE AND CABLE INSTALLATION

A. General

1. Wire and Cable shall be installed as specified herein and indicated on the Drawings. Unless specifically indicated otherwise on the Drawings, wire and cable shall be installed in separate raceways according to wiring type. For example, power wiring shall not be combined with control wiring, and control wiring shall not be combined with instrumentation wiring.

2. Wire shall be furnished and installed as single conductor cables, with limited exceptions. Multi-conductor cable assemblies shall only be installed where indicated on the Drawings, required by the NEC, or after obtaining written permission from the Engineer.

3. Where instrumentation cables are installed in control panels, motor controllers, and other locations, the Contractor shall arrange wiring to provide maximum clearance between these cables and other conductors. Instrumentation cables shall not be installed in same bundle with conductors of other circuits.

4. Instrumentation cable shielding shall be continuous and shall be grounded at one point only.

B. Splices

1. Splices shall not be allowed in power or control wire and cable unless approved in writing by the Engineer. If unique field conditions exist or pulling calculations indicate that splices may be required, the Contractor shall submit a detailed request indicating why splices are required to the Engineer. The Engineer shall be under no obligation to grant such request.

2. Splicing materials shall be barrel type butt splice connectors and heat shrink tubing as manufactured by 3M, Ideal, or equal. The use of screw-on wire connectors (wire nuts) shall only be permitted for lighting and receptacle circuits.

3. No splicing of instrumentation cable is permitted.

C. Wire and Cable Sizes

1. The sizes of wire and cable shall be as indicated on the Drawings, or if not shown, as approved by the Engineer. If required due to field routing, the size of conductors and respective conduit shall be increased so that the voltage drop measured from source to load does not exceed 2-1/2%.

D. Additional Conductor Identification

1. In addition to the color coding identification requirements specified in Part 2 herein, individual conductors shall be provided with heat shrinkable identification tags. Identification tags for individual conductors shall have a white background where the conductor insulation is colored. Identification tags for individual conductors shall have a colored background where the conductor insulation is black. Background color shall match that of the taping provided on the individual black conductors.

2. Multi-conductor cables shall be provided with heat shrinkable identification tags in accordance with Part 2 herein.

3. All wiring shall be identified at each point of termination. This includes but is not limited to identification at the source, load, and in any intermediate junction boxes where a termination is made. The Contractor shall meet with the Owner and Engineer to come to an agreement regarding a wire identification system prior to installation of any wiring. Wire numbers shall not be duplicated.

4. Wire identification shall be by means of a heat shrinkable sleeve with appropriately colored background and black text. Wire sizes #14 AWG through #10 AWG shall have a minimum text size of 7 points. Wire sizes #8 AWG and larger shall have a minimum text size of 10 points. Sleeves shall be of appropriate length to fit the

required text. The use of handwritten text for wire identification shall not be permitted.

5. Sleeves shall be suitable for the size of wire on which they are installed. Sleeves shall not be heat-shrunk onto control cables. Tags shall remain loose on cable to promote easier identification. For all other applications, sleeves shall be tightly affixed to the wire and shall not move. Sleeves shall be heat shrunk onto wiring with a heat gun approved for the application. Sleeves shall not be heated by any means which employs the use of an open flame. The Contractor shall take special care to ensure that the wiring insulation is not damaged during the heating process.

6. Sleeves shall be installed prior to the completion of the wiring terminations and shall be oriented so that they can be easily read.

7. Sleeves shall be polyolefin as manufactured by Brady, Seton, Panduit, or equal.

8. Wire identification in manholes, handholes, pull boxes, and other accessible components in the raceway system where the wiring is continuous (no terminations are made) shall be accomplished by means of a tag installed around the bundled group of individual conductors or around the outer conductor jacket of a multi-conductor cable. Identification shall utilize a FROM-TO system. Each group of conductors shall consist of all of the individual conductors in a single conduit or duct. The tag shall have text that identifies the bundle in accordance with the 'FROM' and 'TO' column for that particular conduit number in the conduit and wire schedule. Minimum text size shall be 10 point. The tag shall be affixed to the wire bundle by the use of nylon wire ties, and shall be made of polyethylene as manufactured by Brady, Seton, Panduit, or equal.

9. Where colored tape is used to identify cables, it shall be wrapped around the cable with a 25% overlap and shall cover at least 2 inches of the cable.

E. Wiring Supplies

1. Rubber insulating tape shall be in accordance with ASTM D4388. Friction tape shall be in accordance with ASTM D69.

F. Training of Cable in Manholes, Handholes, and Vaults

1. The Contractor shall furnish all labor and material required to train cables around cable vaults, manholes, and handholes. Sufficient length of cable shall be provided in each handhole, manhole, and vault so that the cable can be trained and racked in an approved manner. In training or racking, the radius of bend of any cable shall be not less than the manufacturer's recommendation. The training shall be done in such a manner as to minimize chaffing.

2. Instrumentation cable shall be racked and bundled separate from AC wiring to maintain the required separation as follows:

a. 18 inches for 480/277 VAC wiring

b. 12 inches for 208/120 VAC wiring

c. 6 inches for 24 VAC wiring

G. Conductor Terminations

1. Where wires are terminated at equipment which requires lugs, connections shall be made by solderless mechanical lug, crimp type ferrule, or irreversible compression type lugs. Reference individual equipment specification sections as applicable for additional termination requirements.

2. Where enclosure sizes and sizes of terminals at limit switches, solenoid valves, float switches, pressure switches, temperature switches, and other devices make terminations impractical due to the size of the field wiring, the Contractor shall terminate field wiring in an adjacent junction box per the requirements of Section 16130 – Boxes, complete with terminal strips. Contractor shall install the smaller wiring from the device to the junction box in a conduit, using the terminal strip as the means for joining the two different wire sizes. Splicing of wires in lieu of using terminal strips is not acceptable.

3. The cables shall be terminated in accordance with the cable and/or termination product manufacturer's instructions for the particular type of cable.

4. To minimize oxidation and corrosion, wire and cable shall be terminated using an oxide-inhibiting joint compound recommended for "copper-to-copper" connections. The compound shall be Penetrox E as manufactured by Burndy Electrical, or equal.

5. All spare conductors shall be terminated on terminal blocks mounted within equipment or junction boxes. Unless otherwise noted, coiling up of spare conductors within enclosure is not acceptable.

H. Pulling Temperature

1. Cable shall not be installed when the temperature of the jacket is such that damage will occur due to low temperature embrittlement. When cable will be pulled with an ambient temperature of 40°F or less within a three (3) day period prior to pulling, the cable reels shall be stored three (3) days prior to pulling in a protected storage area with an ambient temperature of 55°F or more. Cable pulling shall be completed during the work day for which the cable is removed from the protected storage. Any cable reels with wire remaining on them shall be returned to storage at the completion of the workday.

3.02 FIBER OPTIC CABLE INSTALLATION

A. The Contractor shall install the fiber optic cable furnished by the General Contractor and/or the Instrumentation and Control Subcontractor. The cable shall be installed in its respective raceway system(s) as specified herein, indicated on the Drawings, and in accordance with the cable manufacturer's instructions. Reference Division 17 for additional information regarding the fiber optic cable.

3.03 TESTING

A. All testing shall be performed in accordance with the requirements of the General Conditions and Division 1. The following tests are required:

1. Shop Test

    a. Wires and cables shall be tested in accordance with the applicable ICEA Standards. Wire and cable shall be physically and electrically tested in accordance with the manufacturer’s standards.

2. Field Tests

    a. After installation, all wires and cables shall be tested for continuity. Testing for continuity shall be “test light” or “buzzer” style.

    b. After installation, some wires and cables shall be tested for insulation levels. Insulation resistance between conductors of the same circuit and between conductor and ground shall be tested. Testing for insulation levels shall be as follows:

        i. For #8 AWG and larger 600V wire and cable, apply 1,000 VDC from a Megohmmeter for one (1) minute. Resistance shall be no less than 100 Megohms. Insulation testing is not required for power and control cables smaller than #8 AWG.

        ii. Instrumentation signal cable shall be tested from conductor to conductor, conductor to shield, and conductor to ground using a Simpson No. 260 volt-ohmmeter, or approved equal. The resistance value shall be 200 Megohms or greater.

B. Wires and cables shall be tested after required terminations are made, but before being connected to any equipment.

C. If tests reveal defects or deficiencies, the Contractor shall make the necessary repairs or shall replace the cable as directed by the Engineer, without additional cost to the Owner. All conductors of a multi-phase circuit shall be replaced if one conductor fails the required testing. If part of a multi-set (parallel conductors per phase) circuit fails testing, only the set containing failure shall be replaced.

D. All tests shall be made by and at the expense of the Contractor who shall supply all testing equipment. Test reports shall be submitted to the Engineer.

(EXHIBIT A) TEST DATA - MEGOHMS TEST NO. ____							
Date:			Company:				
Time:			Location:				
Circuit:	Circuit Length:	Aerial:	Duct:	Buried:	No. of Conductors	Size:	AWG MCM Shield:
Insulation Material:			Insulation Thickness:		Voltage Rating:		Age:
Type: _____Pothead _____Terminal					Location: Indoors_____ Outdoors_____		
Number and Type of Joints:							
Recent Operating History:							
Manufacturer:							
State if Potheads or Terminals were grounded during test:							
List associated equipment included in test:							
Miscellaneous Information:							

(EXHIBIT A)
TEST DATA - MEGOHMS
TEST NO. ____

Part Tested:	Test Performed: _____ Hours/Days: _____ After Shutdown: _____
Grounding Time:	Dry Bulb Temperature: _____ Wet Bulb Temperature: _____
Test Voltage:	Equipment Temperature: _____ How Obtained: _____ Relative Humidity: _____ Absolute Humidity: _____ Dew Point: _____

Megohmmeter: Serial Number: _____ Range: _____
Voltage: _____ Calibration Date: _____

Test Connections	To Line To Earth To Ground	To Line To Earth To Ground	To Line To Earth To Ground	Test Connections	To Line To Earth To Ground	To Line To Earth To Ground	To Line To Earth To Ground
1/4 Minute				5 Minutes			
1/2 Minute				6 Minutes			
3/4 Minute				7 Minutes			
1 Minute				8 Minutes			
2 Minutes				9 Minutes			
3 Minutes				10 Minutes			
4 Minutes				10/1 Minute Ratio			

Remarks:

+ + + END OF SECTION 16123 + + +

SECTION 16130
BOXES

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. The scope of work under this Section includes furnishing and installing all pull boxes, junction boxes, and outlet boxes.

B. Requirements for other boxes and enclosures are not included in this Section. Reference each specific Division 16 equipment Section for requirements related to that equipment's respective enclosure.

C. Reference Section 16000, Basic Electrical Requirements, and Section 16111, Conduit.

1.02 CODES AND STANDARDS

A. Boxes shall be designed, manufactured, and/or listed to the following standards as applicable:

1. UL 514A - Metallic Outlet Boxes

2. UL 514C - Standard for Non-metallic Outlet Boxes, Flush Device Boxes, and Covers

3. UL 50 – Enclosures for Electrical Equipment, Non-environmental Considerations

4. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations

5. UL 1203 – Standard for Explosion-proof and Dust-ignition-proof Electrical Equipment for use in Hazardous (Classified) Locations.

6. NEMA 250 – Enclosures for Electrical Equipment

1.03 SUBMITTALS

A. In accordance with the procedures and requirements set forth in the General Conditions and Section 01350, Project Document Tracking and Control System, the Contractor shall obtain from the equipment manufacturer(s) and submit the following:

1. Shop Drawings

B. Each submittal shall be identified by the applicable specification section.

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1.04 SHOP DRAWINGS

A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.

B. Partial, incomplete or illegible Submittals will be returned to the Contractor without review for resubmittal.

C. Shop drawings shall include but not be limited to:

1. Product data sheets for boxes, terminal strips, and all accessories

1.05 OPERATION AND MAINTENANCE MANUALS

A. The Contractor shall submit operation and maintenance manuals in accordance with the procedures and requirements set forth in the General Conditions and Division 1.

B. As-built drawings showing dimensions, internal box layout, terminal strip information, and terminal strip identification information shall be provided for all junction boxes. As-built drawings are not required for pull boxes or outlet boxes.

1.06 IDENTIFICATION

A. Each pull and junction box shall be identified with the box name as indicated on the Contract Drawings (e.g. PPB-1, CJB-1, TJB-P-1) or as directed by the Engineer. A nameplate shall be securely affixed in a conspicuous place on each box. Nameplates shall be as specified in Section 16195, Electrical – Identification.

PART 2 -- PRODUCTS

2.01 MANUFACTURERS

A. The equipment covered by this Specification is intended to be standard equipment of proven performance as manufactured by reputable concerns. Equipment shall be designed, constructed, and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as shown on the Drawings.

2.02 PULL AND JUNCTION BOXES

A. General

1. All pull and junction boxes shall be UL listed and labeled.

2. Pull and junction boxes shall not be provided with eccentric or concentric knockouts.

3. Pull and junction boxes mounted embedded in concrete shall be UL listed for embedment.

4. Where metallic boxes are used they shall be of all welded construction. Tack welded boxes are not acceptable.

B. Pull Boxes

1. All pull boxes shall be provided with a matching gasketed cover. For covers with dimensions of 24 inches by 24 inches or less, the cover shall be held in place by machine screws. Other screw types are not acceptable. For covers with dimensions greater than 24 inches by 24 inches, the cover shall be hinged and held in place by screw-operated clamp mechanisms. Hinge pins shall be removable. Clamp mechanism material of construction shall match that of the associated box.

2. Pull boxes shall not have any wire terminations inside, other than those for grounding/bonding. A ground bar shall be provided with the necessary number of screw type terminals. Twenty (20) percent of the total amount of terminals otherwise required for the pull box (minimum of two) shall be provided as spare terminations. Boxes requiring any other wire terminations shall be furnished and installed in accordance with the requirements for junction boxes herein.

3. Pull boxes shall be 6 inches wide by 6 inches tall by 4 inches deep, minimum. For applications requiring larger boxes, the box shall be sized in accordance with the fill requirements and dimensional requirements of the NEC.

4. Barriers shall be provided in pull boxes to isolate conductors of different voltages, types, and functions. Barrier material of construction shall match that of the box. Isolation shall be provided between the following groups:

a. Power wiring

b. AC control wiring

c. DC control wiring

d. Instrumentation wiring

C. Junction Boxes

1. Junction boxes used for lighting and receptacle circuits only shall be provided with a matching gasketed cover held in place by machine screws. Other screw types are not acceptable.

2. Junction boxes for all uses other than lighting and receptacle circuits shall be provided with a hinged, gasketed cover. Hinge pins shall be removable. Cover

shall be held in place by screw-operated clamp mechanisms. Clamp mechanism material of construction shall match that of the associated box.

3. Barriers shall be provided in junction boxes to isolate conductors and terminal blocks of different voltages, types, and functions. Barrier material of construction shall match that of the box. Isolation shall be provided between the following groups:

   a. Power wiring

   b. AC control wiring

   c. DC control wiring

   d. Instrumentation wiring

4. Junction boxes used for lighting and receptacle circuits only shall be allowed to have screw-on (wire nut) type connectors for wire terminations/junctions.

5. Junction boxes for all uses other than lighting and receptacle circuits shall be provided with terminal strips, consisting the necessary number of screw type terminals. Current carrying parts of the terminal blocks shall be of ample capacity to carry the full load current of the circuits connected, with a 10A minimum capacity. Terminal strips shall be rated for the voltage of the circuits connected. A separate ground bar shall be provided with the necessary number of screw type terminals. Twenty (20) percent of the total amount of terminals otherwise required for the junction box (minimum of two) shall be provided as spare terminations. When barriers are provided within the box, separate terminal strips shall be provided in each barrier area. Terminals shall be lettered and/or numbered to conform to the wiring labeling scheme in place on the project.

6. Junction boxes shall be 6 inches wide by 6 inches tall by 4 inches deep, minimum. For applications requiring larger boxes, the box shall be sized in accordance with the fill requirements and dimensional requirements of the NEC. Terminal blocks (including spare terminals) shall be considered when sizing the junction box.

D. Enclosure Types and Materials

1. In non-hazardous locations, pull and junction boxes shall be furnished with the following enclosure type and material of construction, dependent upon the designation of the area in which they are to be installed. Area designations are indicated on the Drawings.

AREA DESIGNATION	ENCLOSURE TYPE AND MATERIAL
Indoor Wet Process Area	NEMA 4X, Type 304 Stainless Steel
Indoor Dry Process Area	NEMA 12, Painted Steel
Indoor Dry Non-process Area	NEMA 1, Painted Steel
All Outdoor Areas	NEMA 4X, Type 304 Stainless Steel

2. In hazardous locations, pull and junction boxes shall be furnished with the following enclosure type and material of construction, dependent upon the classification of the area in which they are to be installed. Area classifications are indicated on the Drawings.

AREA CLASSIFICATION	ENCLOSURE TYPE AND MATERIAL
Class I, Division 1, Group D	NEMA 7, Die Cast Aluminum
Class I, Division 2, Group D	NEMA 4X, Type 304 Stainless Steel

3. Non-metallic enclosures, NEMA 7 enclosures, and NEMA 9 enclosures shall be provided with threaded integral conduit hubs.

2.03 OUTLET BOXES

A. General

1. Outlet boxes shall be provided with a trim appropriate for the wiring device installed inside. Reference Section 16141, Wiring Devices, for outlet box trim requirements. An appropriate outlet box trim is required to achieve the NEMA rating of the outlet boxes as specified herein.

B. Surface Mount Outlet Boxes

1. Outlet boxes shall be the deep type, no less than 2.5 inches deep.

2. Outlet boxes shall be provided in single or multi-gang configuration as required, sized in accordance with the requirements of the NEC.

3. In non-hazardous locations, outlet boxes shall be furnished with the following enclosure type and material of construction, dependent upon the designation of the area in which they are to be installed. Area designations are indicated on the Drawings.

AREA DESIGNATION	**ENCLOSURE TYPE AND MATERIAL**
Indoor Wet Process Area	NEMA 4X, PVC Coated Steel
Indoor Dry Process Area	NEMA 1, Cast Aluminum
Indoor Dry Non-process Area	NEMA 1, Cast Aluminum
All Outdoor Areas	NEMA 4X, PVC Coated Steel

4. In hazardous locations, outlet boxes shall be furnished with the following enclosure type and material of construction, dependent upon the classification of the area in which they are to be installed. Area classifications are indicated on the Drawings.

AREA CLASSIFICATION	**ENCLOSURE TYPE AND MATERIAL**
Class I, Division 1, Group D	NEMA 7, Die Cast Aluminum
Class I, Division 2, Group D	NEMA 4X, Cast Aluminum

5. Outlet boxes shall be provided with integral threaded conduit hubs mounted external to the box. Boxes with threaded conduit hubs mounted internal to the box or as a part of the box wall are not acceptable.

C. Flush Mount Outlet Boxes

1. Outlet boxes shall be no less than 2-1/8 inches deep, and 4-11/16 inches square. Boxes shall be UL listed and labeled. Pre-punched single diameter conduit knockouts are acceptable, however, concentric and eccentric knockouts are not acceptable.

2. Outlet boxes mounted flush in CMU walls shall be made of galvanized, tack welded steel, and suitable for installation in masonry walls. Sectional type boxes are not acceptable for this application.

3. Outlet boxes mounted flush in gypsum walls shall be made of galvanized pressed steel. Tack welded boxes are not acceptable for this application. Sectional type boxes are not acceptable for this application.

4. Outlet boxes mounted cast into concrete shall be concrete tight, and shall be made of galvanized steel or PVC.

PART 3 -- EXECUTION

3.01 INSTALLATION

A. Pull and Junction Boxes

1. Pull boxes and junction boxes shall be solidly attached to structural members prior to installation of conduit and set true and plumb. Boxes shall not be supported by their associated conduits.

2. Wooden plugs are not permitted for securing boxes to concrete. Appropriately rated anchors specifically suited for use in concrete shall be used.

3. Box penetrations for conduits shall be made with a punch tool, and penetrations shall be of the size required for the conduit entry and/or hub. Oversized penetrations in boxes are not acceptable.

4. Watertight conduit hubs shall be provided for boxes where a NEMA 4X enclosure rating is specified. Reference Section 16111, Conduit, for conduit hub requirements.

5. Pull and junction boxes may be installed flush mounted in gypsum, concrete or CMU walls where appropriate provided that covers are easily removed or opened.

6. Pull and junction boxes shall be provided in the enclosure type and material of construction required for the area in which it is installed. Reference the requirements in Part 2 herein, and the area designations indicated on the Drawings.

B. Outlet Boxes

1. Outlet boxes shall be solidly attached to structural members prior to installation of conduit and set true and plumb. Boxes shall not be supported by their associated conduits.

2. Wooden plugs are not permitted for securing boxes to concrete. Appropriately rated anchors specifically suited for use in concrete shall be used.

3. Flush mounted outlet boxes shall be arranged and located so that tile and grout lines fit closely around the boxes, and so placed that the cover or device plate shall fit flush to the finished wall surface.

4. Outlet boxes shall be flush mounted in finished areas and other areas where practical. Flush mounted outlet boxes shall not be installed in hazardous areas and type 1 or 2 chemical storage/transfer areas.

5. For the below-named items, mounting heights from finished floor, or finished grade to top is applicable, depending on the type of wiring device to be installed in the

outlet box. Mounting heights for outlet boxes shall be as follows, unless otherwise specified herein, indicated on the Drawings, or required by the Americans with Disability Act (ADA):

a. Light switches and wall mounted occupancy sensors, 48 inches

b. Receptacles in indoor dry process/non-process areas, 16 inches

c. Receptacles in indoor wet process areas and all indoor chemical storage/transfer areas, 48 inches

d. Receptacles in outdoor locations, 24 inches

6. Outlet boxes shall be provided in the material of construction required for the area in which it is installed. Reference the requirements in Part 2 herein, and the area designations indicated on the Drawings.

+ + + END OF SECTION 16130 + + +

SECTION 16141
WIRING DEVICES

PART 1 GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall furnish and install all switches, occupancy sensors, and receptacles as shown on the Drawings.

B. All switches and receptacles shall be furnished and installed in outlet boxes. Reference Section 16130, Boxes, for outlet box requirements.

C. Reference Section 16000, Basic Electrical Requirements, and Section 16123, Low Voltage Wire and Cable.

1.02 CODES AND STANDARDS

A. Wiring devices shall be designed, manufactured, and/or listed to the following standards as applicable:

1. UL 20 – General Use Snap Switches

2. UL 498 – Standard for Attachment Plugs and Receptacles

3. UL 943 – Ground Fault Circuit Interrupters

4. UL 1203 – Standard for Explosion-proof and Dust-ignition-proof Electrical Equipment for use in Hazardous (Classified) Locations.

1.03 SUBMITTALS

A. In accordance with the procedures and requirements set forth in the General Conditions and Section 01350, Project Document Tracking and Control System, the Contractor shall obtain from the equipment manufacturer and submit shop drawings. Each submittal shall be identified by the applicable specification section.

1.04 SHOP DRAWINGS

A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.

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B. Partial, incomplete, or illegible submittals will be returned to the Contractor without review for resubmittal.

C. Shop drawings shall include, but not be limited to:

1. Product data sheets.

1.05 SPARE PARTS

A. The Contractor shall furnish 10% (minimum of 1) spare of each receptacle, switch, and plug furnished and installed for this project.

B. Spare parts lists, included with the shop drawing submittal, shall indicate specific sizes, quantities, and part numbers of the items to be furnished. Terms such as "1 lot of packing material" are not acceptable.

C. Parts shall be completely identified with a numerical system to facilitate parts inventory control and stocking. Each part shall be properly identified by a separate number. Those parts which are identical for more than one size shall have the same parts number.

1.06 IDENTIFICATION

A. Each switch and receptacle shall be identified with the equipment item number, manufacturer's name or trademark, and such other information as the manufacturer may consider necessary, or as specified, for complete identification.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. The equipment covered by these Specifications is intended to be standard equipment of proven performance as manufactured by reputable concerns. Equipment shall be designed, constructed and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as shown on the Drawings.

B. The Contractor shall use the products of a single manufacturer for each type of wiring device.

C. The Contractor shall use the products of a single manufacturer for all device plates. Plate variations are allowed for the following devices:

1. Where the selected plate manufacturer does not manufacture a suitable finish plate.

2. For heavy-duty receptacles rated at more than 30A.

3. Where non-standard plates are required, specified, or shown.

D. The Contractor shall furnish and install all wiring devices and device plates.

E. In non-hazardous areas, provide specification grade devices manufactured by Appleton, Crouse-Hinds, Leviton, Hubbell, Pass & Seymour, or Engineer approved equal.

F. In hazardous areas, provide devices manufactured by Appleton, Cooper Crouse-Hinds, Hubbell-Killark, or Engineer approved equal.

2.02 WIRING DEVICES

A. Wall switches for non-hazardous areas shall be rated for the current required to suit the application, but not less than 20A. Double pole, three-way, and four-way switches shall be provided where indicated on the Drawings, and as required. Switches shall be rated for 120-277VAC and shall be UL 20 Listed.

B. Convenience receptacles for non-hazardous areas shall be rated for 20A at 125VACand shall be UL 498 Listed. Receptacles shall be weather resistant where installed in wet or damp locations.

C. Special purpose receptacles (welders, lab equipment, etc.) shall be provided with the proper NEMA configuration and ampacity as indicated on the Drawings. The coordinating plug for each special purpose receptacle shall be provided with the equipment which it is serving.

D. Ground fault circuit interrupter receptacles shall be rated for 20A at 125VACand shall be UL 943 Listed. Receptacles shall be weather resistant where installed in wet or damp locations.

E. Wall switches for hazardous areas shall be the factory sealed type, UL 1203 Listed for use in the hazardous area. Wall switches shall be rated for 120-277VAC, and shall be rated for the current required to suit the application, but not less than 20A

F. Receptacles for hazardous areas shall be rated 20A at 120-240VAC. Receptacles shall be UL 1203 listed for use in the hazardous area, utilizing delayed-action construction.

G. All wiring devices shall be approved for use with stranded conductors, if stranded conductors are to be used with the device. Reference Section 16123, Low Voltage Wire and Cable for conductor requirements

2.03 DEVICE PLATES

A. Device plates for indoor flush-mounted receptacles and switches shall be made of Type 304 stainless steel, not less than 0.032 of an inch thick, with beveled edges and milled on the rear so as to lie flat against the wall. Devices plates shall be provided with a gasket.

B. Device plates for outdoor installations, indoor wet process areas, and chemical storage/transfer areas shall be Appleton Type FSK, Crouse-Hinds #DS185, or equal for wall switches. Device plates for receptacles shall be "in-use" style. "In-use" weatherproof covers shall be rugged, minimum 3 ¼" depth, die-cast aluminum as manufactured by Thomas & Betts "Red Dot," Intermatic International, Inc., or equal.

C. Device plates for indoor dry process and non-process areas with surface mounted boxes shall be Crouse-Hinds DS32, or equal for switches, and Crouse-Hinds DS23 or equal for receptacles.

2.04 PLUGS

A. The Contractor shall furnish suitable plugs with equipment furnished under the respective specification Section. Plugs shall be black rubber or plastic. For waterproof receptacles, the plugs shall be similar in construction to the receptacles and shall be encased in corrosion resistant yellow housing provided with clamping nuts and stuffing gland cable outlets.

2.05 PROCESS INSTRUMENTS

A. The Contractor shall furnish and install a local disconnect switch at each process instrument (e.g., level transmitter, flow transmitter, analytical instrument etc.,) to disconnect the 120VAC power supply to the instrument. The device shall be a NSSC series manual motor starting switch without overload protection as manufactured by Crouse-Hinds, Appleton equivalent, or equal. For hazardous locations, the device shall be UL 1203 Listed.

PART 3 EXECUTION

3.01 INSTALLATION

A. Where more than one (1) switch occurs at one (1) location, gang plates shall be used.

B. All device plates shall be set true and plumb and shall fit tightly against the finished wall surfaces and outlet boxes.

C. Wiring device box (outlet box) mounting heights shall be as specified in Section 16130, Boxes.

D. When indicated height would place any of the equipment at an unsuitable location such as at a molding or break in wall finish, the Contractor shall bring it to the attention of the Engineer for a decision.

E. Receptacles installed in toilet, locker, and bathrooms, and within 6 feet of a sink, shall be of ground fault interrupter type. Ground fault circuit interrupter receptacles shall also be furnished and installed in additional locations where indicated on the Drawings, and as required by the NEC.

All receptacles shall have a self-adhesive label installed on the top at the respective device plate that indicates which panel and which circuit number the receptacle is supplied from. Labels shall have a white background and black lettering in 14 point font.

3.02 CIRCUITING

A. Convenience receptacles shall be grouped on circuits separate from the lighting circuits. A maximum of eight (8) convenience receptacles are permitted per 20A, 120V circuit, unless otherwise indicated on the Drawings.

+++ END OF SECTION 16141 +++

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SECTION 16170
GROUNDING AND BONDING

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall furnish and install grounding systems complete in accordance with the minimum requirements established by Article 250 of the NEC. Article 250 of the NEC shall be considered a minimum requirement for compliance with this Specification.

B. Contract Drawings show only functional features and some of the required external connections. They do not show all components required for a complete installation nor exact dimensions particular to any manufacturer's equipment. Contractor shall supply all parts, devices and equipment necessary to meet the requirements of the Contract Documents and shall make all dimensional adjustments particular to the equipment being furnished. All costs associated with such changes and adjustments shall be considered as being included in the price bid for the work shown and specified.

C. Grounding of all instrumentation and control systems shall be furnished and installed in accordance with the manufacturer/system requirements and IEEE 1100. Conflicts shall be promptly brought to the attention of the Engineer.

D. In addition to the NEC requirements, building structural steel columns shall be permanently and effectively grounded:

E. Reference Section 16000, Basic Electrical Requirements

1.02 CODES AND STANDARDS

A. Equipment and materials covered under this Section shall be designed, manufactured, and/or listed to the following standards as applicable:

1. UL 467 – Grounding and Bonding Equipment

2. IEEE 81 – Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System.

3. IEEE 1100 – Recommended Practice for Power and Grounding Electronic Equipment

1.03 SUBMITTALS

A. In accordance with the procedures and requirements set forth in the General Conditions and Section 01350, Project Document Tracking and Control System, the Contractor shall obtain from the equipment manufacturer and submit the following:

1. Shop Drawings

2. Reports of certified field tests. Submit directly to the Engineer two copies of the test reports certified by the testing technician.

B. Each submittal shall be identified by the applicable specification section.

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1.04 SHOP DRAWINGS

A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.

B. Partial, incomplete, or illegible submittals will be returned to the Contractor without review for resubmittal.

C. Shop drawings shall include but not be limited to:

1. Product data sheets.

2. Drawings and written description of how the Contractor intends to furnish and install the grounding system.

PART 2 -- PRODUCTS

2.01 MANUFACTURERS

A. The equipment covered by these specifications shall be standard equipment of proven performance as manufactured by reputable concerns. Equipment shall be designed, constructed, and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as shown on the Drawings.

2.02 GROUND RODS AND GRID

A. Ground rods shall be rolled to a commercially round shape from a welded copper-clad steel manufactured by the molten-welding process or by the electro-formed process (molecularly bonded). They shall have an ultimate tensile strength of 75,000 pounds per square inch (psi) and an elastic limit of 49,000 psi. The rods shall be not less than 3/4 inch in diameter by 10 feet in length; and the proportion of copper shall be uniform throughout the length of the rod. The copper shall have a minimum wall thickness of 0.010 inch at any point on the rod. Ground rods shall be UL 467 listed. The ground rods shall be manufactured by Erico Products, Blackburn, JosyIn , or equal.

B. Except where specifically indicated otherwise, all exposed non current-carrying metallic parts of electrical equipment, metallic raceway systems, grounding conductors in nonmetallic raceways and neutral conductors of wiring systems shall be grounded.

C. The ground connection shall be made at the main service equipment and shall be extended to the ground grid surrounding the structure. The ground grid shall also be connected to the point of entrance of the metallic water service. Connection to the water pipe shall be made by a suitable ground clamp or lug connection to a plugged tee. If flanged pipes are encountered, connection shall be made with the lug bolted to the street side of the flanged connection.

D. Where ground fault protection is employed, care shall be taken so that the connection of the ground and neutral does not interfere with the correct operation of the ground fault protection system.

2.03 FITTINGS

A. Grounding connections to equipment shall be bolted. Cable end connections shall be made by hydraulic crimp or exothermically welded. Split bolt type connectors are not acceptable. Fittings shall be UL 467 listed.

2.04 BARE GROUND CABLE

A. Bare ground cable shall be soft-drawn, bare copper stranded cable complying with ASTM B8. No. 4/0 AWG minimum size unless otherwise shown or indicated on the Drawings. No. 6 A.W.G., when installed bare, shall be solid

2.05 EQUIPMENT GROUNDING CONDUCTORS

A. An insulated equipment grounding conductor, which shall be separate from the electrical system neutral conductor, shall be furnished and installed for all circuits. Insulation shall be of the same type as the ungrounded conductors in the raceway and shall be green in color. Equipment grounding conductors shall be furnished and installed in all conduits. Use of conduits as the NEC required equipment grounding conductor is not acceptable.

2.06 EQUIPMENT GROUNDS

A. Equipment grounds shall be solid and continuous from a connection at earth to all distribution panelboards. Ground connections at panelboards, outlets, equipment, and apparatus shall be made in an approved and permanent manner.

B. For all control panels, disconnect switches, and other electrical enclosures, equipment grounds and bonding jumpers shall be terminated individually on a ground bar or mechanical lugs. No wire nuts will be permitted.

2.07 EXOTHERMIC WELDS

A. All exothermic welding shall be completed per welding kit manufacturer's instructions. Exothermic welds shall be CadWeld by Erico or ThermoWeld.

PART 3 -- EXECUTION

3.01 INSTALLATION

A. Metal surfaces where grounding connections are to be made shall be clean and dry. Steel surfaces shall be ground or filed to remove all scale, rust, grease, and dirt. Copper and galvanized steel shall be cleaned with emery cloth to remove oxide before making connections.

B. Ground Grid

1. A main ground grid shall be provided for each structure and interconnecting structure grids consisting of driven ground rods as shown on the Drawings. Ground rods shall be driven straight down into the earth, or if objects are encountered, at an angle to avoid the obstruction.

2. The ground rods shall be interconnected by the use of copper cable exothermically welded to the rods. The grounding cables shall be installed after the excavations for the building have been completed and prior to the pouring of concrete for the footings, mats, etc. Copper "pigtails" shall be connected to the ground grid and shall enter the buildings and structure from the outside and shall be connected to steel structures, and equipment as described in this Section and as required to provide a complete grounding system. The copper pigtails shall be exothermically welded to the ground grid, and connected to building reinforcement steel by hydraulic crimp.

3. Grounding conductors shall be continuous between points of connection; splices shall not be permitted.

4. Where conductors are exposed and subject to damage from personnel, traffic, etc., conductors shall be installed in metal raceway. The raceway shall be bonded to the grounding system.

5. Where subsurface conditions do not permit use of driven ground rods to obtain proper ground resistance, rods shall be installed in a trench or plate electrodes shall be provided, as applicable and necessary to obtain proper values of resistance.

6. Buried exothermic welds and ground ring shall not be backfilled until inspected by Engineer.

C. Raceways

1. Conduit which enters equipment such as switchgear, motor control centers, transformers, panelboards, variable frequency drives, instrument and control

panels, and similar equipment shall be bonded to the ground bus or ground lug, where provided, and as otherwise required by the NEC.

A. Items to be grounded shall include, but not necessarily be limited to, the following:

1. Steel building structures and all other above-ground metal structures.

2. Metallic raceways.

3. Electrical equipment enclosures.

4. Electrical system neutrals, only, at the point of supply.

5. Ground buses of switchboards, motor control centers, panelboards, etc.

6. Grounding pole of all receptacles.

7. Lighting fixture housings, outdoor metal light poles, etc.

8. Motors and other electrically operated equipment.

9. Outdoor metal fences.

10. Telephone service equipment (provide grounding leads only).

13. Transformers.

14. Any equipment likely to become energized due to a malfunction

15. Ground grid systems with ground rod and water pipe connections.

3.02 TESTING

A. All tests shall be performed in accordance with the requirements of the General Conditions and Division 1. The following tests are required:

1. Witnessed Shop Tests

   a. None required.

2. Field Tests

   a. Field testing shall be done in accordance with the requirements specified in the General Conditions, Division 1, and NETA Acceptance Testing Specifications, latest edition.

b. Fall of potential tests shall be performed on the ground grid per IEEE81 recommendations by a third party, independent testing firm. A fall of potential plot shall be submitted at the conclusion of testing for Engineer review. Documentation indicating the location of the rod and grounding system as well as the resistance and soil conditions at the time the measurements were made shall be submitted. Testing shall show that the ground grid has 5 ohms resistance or less. Due to soil conditions and/or unforeseen field conditions, ground resistances greater than 5 ohms may be acceptable if specifically approved in writing by the Engineer. Ground resistance measurements shall be made in normally dry weather not less than 48 hours after rainfall and with the ground grid under test isolated from other grounds.

c. Continuity tests for the grounding electrode conductor shall be performed. Test will be accepted when a resistance of less than 1 ohm is shown for this conductor.

d. Test all ground fault circuit interrupter (GFCI) receptacles and circuit breakers for proper connection and operation with methods and instruments prescribed by the manufacturer.

e. Provide copies of reports of all grounding system tests for inclusion in Operation and Maintenance Manuals and for review by the Engineer.

+ + + END OF SECTION 16170 + + +

SECTION 16190
SUPPORTING DEVICES

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall furnish and install structural supports for mounting and installing all conduit, electrical equipment, lighting, alarm systems, instrumentation, and communications equipment furnished under this Contract.

B. Equipment shall be installed strictly in accordance with recommendations of the manufacturer and best practices of the trade resulting in a complete, operable, and safe installation. The Contractor shall obtain written installation manuals from the equipment manufacturer prior to installation.

C. Reference Section 16000, Basic Electrical Requirements.

1.02 CODES AND STANDARDS

A. Equipment and materials covered under this Section shall be designed, manufactured, and/or listed to the following standards as applicable:

1. ASTM A123 – Standard Specification for Zinc (Hot Dip Galvanized) Coatings on Iron and Steel Products.

2. ASTM A153 – Standard Specification for Zinc Coating (Hot Dip) on Iron and Steel Hardware.

3. ASTM A240 – Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.

4. ASTM A276 – Standard Specification for Steel Bars and Shapes

5. ASTM B783 – Standard Specification for Materials for Ferrous Powder Metallurgy Structural Parts

1.03 SUBMITTALS

A. In accordance with the procedures and requirements set forth in the General Conditions and Section 01350, Project Document Tracking and Control System, Submittals, the Contractor shall obtain from the equipment manufacturer and submit the following:

1. Shop drawings

2. Structural support calculations (if required)

B. Each submittal shall be identified by the applicable Specification section.

1.04 SHOP DRAWINGS

A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.

B. Partial, incomplete, or illegible submittals will be returned to the Contractor without review for resubmittal.

C. Shop drawings shall include but not be limited to:

1. Product data sheets.

2. Complete assembly, layout, installation, and foundation drawings with clearly marked dimensions.

PART 2 -- PRODUCTS

2.01 MANUFACTURERS

A. The equipment covered by this Specification is intended to be standard equipment of proven performance as manufactured by reputable concerns. Equipment shall be designed, constructed, and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as shown on the Drawings.

2.02 MATERIALS

A. Support channel shall be 1-5/8” by 1-5/8” minimum, with 12 gage material thickness.

B. Support channel, support channel fittings, and threaded rod shall be furnished with the following material of construction, dependent upon the designation of the area in which they are to be installed. Area designations are indicated on the Drawings.

AREA DESIGNATION	**MATERIAL OF CONSTRUCTION**
Indoor Wet Process Area	Type 304 Stainless Steel
Indoor Dry Process Area	Hot Dipped Galvanized Steel
All Outdoor Areas	Type 304 Stainless Steel
All Hazardous Areas	Type 304 Stainless Steel

C. Fastening hardware (bolts, nuts, washers, and screws) shall be furnished with the following material of construction, dependent upon the designation of the area in which they are to be installed. Area designations are indicated on the Drawings.

AREA DESIGNATION	MATERIAL OF CONSTRUCTION
Indoor Wet Process Area	Type 304 Stainless Steel
Indoor Dry Process Area	Type 304 Stainless Steel
All Outdoor Areas	Type 304 Stainless Steel
All Hazardous Areas	Type 304 Stainless Steel

PART 3 -- EXECUTION

3.01 INSTALLATION

A. Concrete or Masonry Inserts

1. The Contractor shall be responsible for the furnishing and installation of all anchor bolts, masonry inserts, and similar devices required for installation of equipment furnished under this Contract.

2. If a time delay for the arrival of any special inserts or equipment drawings, etc. occurs, the Contractor may, if permitted by the Engineer, make arrangements for providing approved recesses and openings in the concrete or masonry and, upon subsequent installation, the Contractor shall be responsible for filling in such recesses and openings. Any additional costs that may be incurred by this procedure shall be borne by the Contractor.

3. The Contractor shall furnish leveling channels for all switchgear, switchboards, motor control centers, and similar floor mounted equipment. The leveling channels shall be provided for embedment in the equipment housekeeping pads. Coordination of the installation of these channels with the concrete pad is essential and required. Pad height shall be as required to maintain concrete coverage of the reinforcement bars while not causing associated equipment to exceed the maximum mounting height requirements of the NEC.

B. Support Fastening and Locations

1. All equipment fastenings to columns, steel beams, and trusses shall be by beam clamps or welded. No holes shall be drilled in the steel.

2. Unless otherwise indicated on the Drawings or in the Specifications, handrails/guardrails shall not be utilized as supports for electrical equipment, devices, or appurtenances. Handrails/guardrails shall not be cut, drilled, or

otherwise modified in order to accommodate electrical supports without written approval from the Engineer.

3. All holes made in reflected ceilings for support rods, conduits, and other equipment shall be made adjacent to ceiling grid bars where possible, to facilitate removal of ceiling panels.

4. Support channel shall be provided wherever required for the support of starters, switches, panels, and miscellaneous equipment.

5. All equipment, devices, and raceways that are installed on the dry side of a water bearing wall shall not be installed directly onto the wall. Support channel shall be used to allow ventilation air to pass behind the equipment, devices, or raceway.

6. All supports shall be rigidly bolted together and braced to make a substantial supporting framework. Where possible, control equipment shall be grouped together and mounted on a single framework.

7. Aluminum support members shall not be installed in direct contact with concrete. Stainless steel or non-metallic "spacers" shall be used to prevent contact of aluminum with concrete.

8. Actual designs for supporting framework should take the nature of a picture frame of support channels and bracket with a plate for mounting the components. The Contractor is responsible for the design of supporting structure; Contractor shall submit design details to the Engineer for acceptance before proceeding with the fabrication.

9. Wherever dissimilar metals come into contact, the Contractor shall isolate these metals as required with neoprene washers, nine (9) mil polyethylene tape, or gaskets.

10. For all installations where fiberglass supporting materials are required, the Contractor shall submit structural calculations and the details of the proposed system of support. Structural calculations shall be signed and sealed by a registered professional engineer in the state in which the project is located.

11. For the following installations where conduits are provided with a support system suspended from the above or attached to a vertical structure, the Contractor shall submit structural calculations and details of the proposed system of support. Structural calculations shall be signed and sealed by a registered professional engineer in the state in which the project is located.

    a. A quantity of twelve (12) or more conduits trade size 1” and smaller are proposed for a conduit support rack.

b. A quantity of eight (8) or more conduits trade sizes 1 ½" to 2 1/2" are proposed for a conduit support rack.

c. A quantity of four (4) or more conduits trade sizes 3" and larger are proposed for a conduit support rack.

12. Single conduits installed exposed along walls and ceilings shall be secured to the wall or ceiling with a one-hole conduit clamp and clamp-back. Where multiple conduits are installed exposed together, support channel and conduit clamps shall be used.

C. Equipment, boxes, and enclosures which are factory-constructed with integral mounting provisions (such as brackets, mounting feet, bolt holes, etc.) shall be installed/supported utilizing those mounting provisions. Equipment, boxes and enclosures shall not be field modified to enable mounting by any other means. Equipment, boxes, and enclosures that are field-modified by any means which compromises the UL Listing or NEMA rating of the enclosure/assembly shall be removed and replaced by the Contractor at no additional cost to the Owner

+ + + END OF SECTION 16190 + + +

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SECTION 16195
ELECTRICAL - IDENTIFICATION

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. All electrical equipment shall be properly identified in accordance with these Specifications and the Contract Drawings. All switchgear, switchboards, motor control centers, variable frequency drives, lighting and distribution panelboards, combination starters, control panels, pull and junction boxes, enclosures, disconnect switches, control stations, and similar equipment shall be identified in the manner described, or in an equally approved manner.

B. The types of electrical identification specified in this section include, but are not limited to, the following:

1. Operational instructions and warnings.

2. Danger signs.

3. Equipment/system identification signs.

4. Nameplates.

1.02 SIGNS

A. "DANGER-HIGH-VOLTAGE" signs shall be securely mounted on the entry doors of all electrical rooms.

1.03 LETTERING AND GRAPHICS

A. The Contractor shall coordinate names, abbreviations, and other designations used in the electrical identification work with the corresponding designations shown, specified or scheduled. Provide numbers, lettering, and wording as indicated or, if not otherwise indicated, as recommended by manufacturers or as required for proper identification and operation/maintenance of the electrical systems and equipment.

1.04 SUBMITTALS

A. In accordance with the procedures and requirements set forth in the General Conditions and Section 01350, Project Document Tracking and Control System, the Contractor shall obtain from the equipment manufacturer and submit shop drawings. Each submittal shall be identified by the applicable specification section.

1.05 SHOP DRAWINGS

A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.

B. Partial, incomplete, or illegible submittals will be returned to the Contractor without review for resubmittal.

C. Shop drawings shall include but not be limited to:

1. Product data sheets.

PART 2 -- PRODUCTS

2.01 MANUFACTURERS

A. The material covered by these Specifications is intended to be standard material of proven performance as manufactured by reputable concerns. Material shall be fabricated, constructed, and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as specified herein and shown on the Drawings.

2.02 NAMEPLATES

A. Nameplates shall be engraved, high pressure plastic laminate, white with black lettering.

B. Nameplates shall be attached to NEMA 4X enclosures utilizing UL-recognized mounting kits designed to maintain the overall UL Type rating of the enclosure. Mounting kit fasteners shall be stainless steel Type AHK10324X as manufactured by Hoffman, or equal.

2.03 HIGH VOLTAGE SIGNS

A. Standard "DANGER" signs shall be of baked enamel finish on 20 gage steel; of standard red, black and white graphics; 14 inches by 10 inches size except where 10 inches by 7 inches is the largest size which can be applied where needed, and except where a larger size is needed for adequate identification.

2.04 CONDUIT IDENTIFICATION

A. Conduit identification shall be as specified in Section 16111, Conduit.

2.05 WIRE AND CABLE IDENTIFICATION

A. Field installed wire and cable identification shall be as specified in Section 16123, Low Voltage Wire and Cable.

B. A plastic laminate nameplate shall be provided at each panelboard, motor control center, switchgear assembly, and switchboard assembly. This nameplate shall be used to clearly convey the conductor identification means used at that piece of equipment (i.e. Phase A=Brown, Phase B=Orange, C = Yellow).

C. Wiring identification for factory installed wiring in equipment enclosures shall be as specified in the respective section.

2.06 BOX IDENTIFICATION

A. Pull, junction and device box identification shall be as specified in Section 16130 – Boxes.

PART 3 -- EXECUTION

3.01 NAMEPLATES

A. Nameplates shall be attached to the equipment enclosures with (2) two stainless steel sheet metal screws for nameplates up to 2-inches wide. For nameplates over 2-inches wide, four (4) stainless steel sheet metal screws shall be used, one (1) in each corner of the nameplate. The utilization of adhesives is not permitted.

3.02 OPERATIONAL IDENTIFICATION AND WARNINGS

A. Wherever reasonably required to ensure safe and efficient operation and maintenance of the electrical systems and electrically connected mechanical systems and general systems and equipment, including prevention of misuse of electrical facilities by unauthorized personnel, install plastic signs or similar equivalent identification, instruction, or warnings on switches, outlets, and other controls, devices, and covers or electrical enclosures. Where detailed instructions or explanations are needed, provide plasticized tags with clearly written messages adequate for the intended purposes. Signs shall be attached as specified above for nameplates.

3.03 POWER SOURCE IDENTIFICATION

A. After installation of all field equipment (i.e. valves, motors, fans, unit heaters, instruments, etc) install nameplates at each power termination for the field equipment. Nameplate data shall include equipment designation (tag number), power source (MCC number, panelboard, etc), circuit number, conduit number from schedule and voltage/phase.

B. Contractor to coordinate with the Engineer and the Owner regarding exact nameplate placement during construction.

C. Nameplates shall be as specified herein.

+ + + END OF SECTION 16195 + + +

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SECTION 16440
DISCONNECT SWITCHES

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall furnish and install separately mounted, individual disconnect switches as specified herein and indicated on the Drawings.

B. Disconnect switches for process instruments are not included in the scope of this Section and shall be as specified in Section 16141 – Wiring Devices.

1.02 CODES AND STANDARDS

A. Disconnect switches shall be designed, manufactured, and/or listed to the following standards as applicable:

1. UL 98 – Enclosed and Dead-Front Switches

2. UL 1203 – Standard for Explosion-proof and Dust-ignition-proof Electrical Equipment for use in Hazardous (Classified) Locations.

3. NEMA 250 – Enclosures for Electrical Equipment

4. NEMA KS 1 – Heavy Duty Enclosed and Dead-Front Switches

1.03 SUBMITTALS

A. In accordance with the procedures and requirements set forth in the General Conditions and Section 01350, Project Document Tracking and Control System, the Contractor shall obtain from the equipment manufacturer and submit the following:

1. Shop Drawings

2. Spare Parts List

3. Each submittal shall be identified by the applicable specification section.

1.04 SHOP DRAWINGS

A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.

B. Partial, incomplete or illegible submittals will be returned to the Contractor without review for resubmittal. Shop drawings shall include but not be limited to:

1. Product data sheets.

2. Complete layout and installation drawings with clearly marked dimensions for each type/size/rating of disconnect switch.

3. Assembled weight of each unit.

C. The shop drawing information shall be complete and organized in such a way that the Engineer can determine if the requirements of these Specifications are being met. Copies of technical bulletins, technical data sheets from "soft-cover" catalogs, and similar information which is "highlighted" or somehow identifies the specific equipment items that the Contractor intends to provide are acceptable and shall be submitted.

1.05 SPARE PARTS

A. The equipment shall be furnished with all spare parts as recommended by the equipment manufacturer.

B. One (1) complete set of spare fuses for each ampere rating installed shall be furnished and delivered to the Owner at the time of final inspection.

C. Spare parts lists, included with the shop drawing submittal, shall indicate specific sizes, quantities, and part numbers of the items to be furnished. Terms such as "1 lot of packing material" are not acceptable.

D. Parts shall be completely identified with a numerical system to facilitate parts inventory control and stocking. Each part shall be properly identified by a separate number. Those parts which are identical for more than one size, shall have the same parts number.

1.06 IDENTIFICATION

A. Each equipment item shall be identified with a nameplate. The nameplate shall be engraved indicating the circuit number and equipment name with which it is associated. Equipment identification shall be in accordance with Section 16195, Electrical - Identification.

PART 2 -- PRODUCTS

2.01 MANUFACTURERS

A. The equipment covered by this Specification is intended to be standard equipment of proven performance as manufactured by reputable concerns. Equipment shall be designed,

constructed and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as shown on the Drawings.

B. Switches shall be manufactured by the Square D Company, Eaton, or ABB - General Electric.

2.02 DISCONNECT SWITCHES

A. Disconnect switches shall be heavy-duty type and/or as specified in these Specifications. Switches shall be furnished and installed as shown on the Drawings and as required by the NEC. Handles shall be lockable.

B. Disconnect switches for non-hazardous areas shall be UL 98 Listed. Disconnect switches for hazardous areas shall be UL 1203 Listed.

C. Switches shall meet NEMA Standard KS 1 type HD requirements, be, single-throw, be externally operated, and be fused or non-fused as indicated on the Drawings. Switches shall have the number of the poles, voltage, and ampere ratings as shown on the Drawings.

D. In non-hazardous locations, disconnect switches shall be furnished with the following enclosure type and material of construction, dependent upon the designation of the area in which they are to be installed. Area designations are indicated on the Drawings.

AREA DESIGNATION	**ENCLOSURE TYPE AND MATERIAL**
Indoor Wet Process Area	NEMA 4X, Type 304 Stainless Steel
Indoor Dry Process Area	NEMA 12, Painted Steel
All Outdoor Areas	NEMA 4X, Type 304 Stainless Steel

E. In hazardous locations, disconnect switches shall be furnished with the following enclosure type and material of construction, dependent upon the classification of the area in which they are to be installed. Area classifications are indicated on the Drawings.

AREA CLASSIFICATION	**ENCLOSURE TYPE AND MATERIAL**
Class I, Division 1, Group D	NEMA 7, Die Cast Aluminum
Class I, Division 2, Group D	NEMA 7, Die Cast Aluminum

F. Disconnect switches shall be quick-make, quick-break and with an interlocked cover which cannot be opened when switch is in the "ON" position and capable of being locked in the "OPEN" position.

G. A complete set of fuses for all switches shall be furnished and installed as required. Time-current characteristic curves of fuses serving motors or connected in series with

circuit breakers shall be coordinated for proper operation. Fuses shall have voltage rating not less than the circuit voltage.

H. Disconnect switches shall be furnished with a factory installed internal barrier kit that helps prevent accidental contact with live parts and provides "finger-safe" protection when the door of the enclosed switch is open.

I. Disconnect switches shall be furnished with a manufacturer-supplied ground lug kit for termination of equipment grounding conductors. Where a grounded (neutral) conductor is shown on the Drawings in the conduits connected to the disconnect switch, a manufacturer-supplied neutral bar shall be furnished for termination of the grounded conductors. Third party ground lug and neutral lug kits not supplied by the disconnect switch manufacturer are not acceptable.

J. Fused disconnect switches shall be furnished for motor operated valve and gate actuators where shown on the Drawings. The Contractor shall coordinate the supply of these fused switches with the specific requirements of the actuator. Fuses with fast fault clearing times may be required for modulating valve actuators.

K. Disconnect switches for all motors connected to variable frequency drives (VFDs) shall be furnished with a factory installed electrical interlock kit that includes one (1) early-break auxiliary contact rated for 5A (minimum) at 120 VAC to be used to open the control circuit before the main switch blades break.

PART 3 -- EXECUTION

3.01 INSTALLATION

A. All disconnect switches shall be mounted five (5) feet above the floor or finished grade, at the equipment height where appropriate, or where shown otherwise.

B. Disconnect switches shall be provided in the enclosure type and material of construction required for the area in which it is installed. Reference the requirements in Part 2 herein, and the area designations indicated on the Drawings.

3.02 TESTING

A. All tests shall be performed in accordance with the requirements of the General Conditions and Division 1. The following tests are required:

1. Field Tests

a. Field testing shall be done in accordance with the requirements specified in the General Conditions, Division 1, and NETA Acceptance Testing Specifications, latest edition.

+ + + END OF SECTION 16440 + + +

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SECTION 16461
DRY TYPE DISTRIBUTION TRANSFORMERS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall furnish, install, and test transformers for power and lighting distribution systems as specified herein, as indicated on the Drawings, and as required to complete the electrical installations.

B. All equipment specified in this Section shall be furnished by the transformer manufacturer who shall be responsible for the suitability and compatibility of all included equipment.

C. Reference Section 16000, Basic Electrical Requirements.

1.02 CODES AND STANDARDS

A. Transformers shall conform to all applicable Federal, UL, and NEMA standards. Materials and components shall be new and conform to grades, qualities and standards as specified herein and shown on the Drawings.

B. Transformers shall comply with the following standards:

1. UL 1561 – Dry Type General Purpose and Power Transformers

2. U.S. Department of Energy 2016 Efficiency

3. National Electrical Code

4. NEMA ST-20 – Dry Type Transformers for General Applications

5. ANSI C57 – Standard General Requirements for Dry Type Distribution and Power Transformers

1.03 SUBMITTALS

A. In accordance with the procedures and requirements set forth in the General Conditions and Section 01350, Project Document Tracking and Control System, the Contractor shall obtain from the equipment manufacturer and submit the following:

1. Shop Drawings.

2. Operation and Maintenance Manuals.

3. Spare Parts List.

4. Reports of Certified Shop Field Tests.

B. Each submittal shall be identified by the applicable specification section.

1.04 SHOP DRAWINGS

A. Each submittal shall be complete in all respects, incorporating all information and data listed herein, and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.

B. Partial, incomplete, or illegible submittals will be returned to the Contractor without review for resubmittal.

C. Shop drawings shall include but not be limited to:

1. Product data sheets.

2. Drawings showing clearly marked dimensions and weight for each transformer.

3. Sample equipment nameplate diagram.

D. The submittal information shall reflect the specific equipment identification number as indicated on the Drawings (e.g. TX-1).

E. The shop drawing information shall be complete and organized in such a way that the Engineer can determine if the requirements of these Specifications are being met. Copies of technical bulletins, technical data sheets from "soft-cover" catalogs, and similar information which is "highlighted" or somehow identifies the specific equipment items that the Contractor intends to provide are acceptable and shall be submitted.

1.05 OPERATION AND MAINTENANCE MANUALS

A. The Contractor shall submit operation and maintenance manuals in accordance with the procedures and requirements set forth in the General Conditions and Division 1.

1.06 SPARE PARTS

A. All spare parts as recommended by the equipment manufacturer shall be furnished to the Owner by the Contractor.

B. Spare parts lists, included with the Shop Drawing submittal, shall indicate specific sizes, quantities, and part numbers of the items to be furnished. Terms such as "1 lot of packing material" are not acceptable.

C. Parts shall be completely identified with a numerical system to facilitate parts inventory control and stocking. Each part shall be properly identified by a separate number. Those parts which are identical for more than one size, shall have the same parts number.

1.07 IDENTIFICATION

A. Each transformer shall be identified with the equipment item number indicated on the Contract Drawings and the accepted Shop Drawings. A nameplate shall be securely affixed in a conspicuous place on each transformer. Nameplates shall be as specified in Section 16195, Electrical - Identification.

PART 2 -- PRODUCTS

2.01 MANUFACTURERS

A. The equipment covered by this Specification is intended to be standard equipment of proven performance as manufactured by reputable concerns. Equipment shall be designed, constructed and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as shown on the Drawings.

B. Dry type distribution transformers shall be Energy Star compliant and manufactured by the Square D Company, ABB - General Electric, or Eaton, or Siemens Energy and Automation, Inc.

2.02 DRY TYPE TRANSFORMERS

A. Furnish and install single-phase and three-phase general purpose, dry-type transformers, as specified herein and indicated on the Drawings. The transformers shall be 60 Hz, self-cooled, quiet-design insulated of the two winding type.

B. The transformers shall be UL 1561 Listed.

C. The primary windings shall be rated 480 VAC for use on 3-phase systems and connected delta unless indicated otherwise on the Drawings. KVA ratings shall be as shown on the Drawings. Furnish transformers with two 2-1/2% primary taps above, and four 2-1/2% primary taps below rated voltage for transformers 15 KVA and above, and two 2-1/2% primary taps above, and two 2-1/2% primary taps below rated voltage for transformers less than 15 kVA. All taps shall be full capacity rated.

D. The ratings of the secondary windings shall be as indicated on the Drawings.

E. Transformers shall be designed for continuous operation at rated KVA, 24 hours a day, 365 days a year, with normal life expectancy as defined in IEEE 65 and ANSI C57.96. This performance shall be obtainable without exceeding 150 degrees Celsius average temperature rise by resistance or 180 degrees Celsius hot spot temperature rise in a 40 degrees Celsius maximum ambient and 30 degrees Celsius average ambient. The

maximum coil hot spot temperature shall not exceed 220 degrees Celsius. All insulating materials shall be flame retardant and shall not support combustion as defined in ASTM Standard Test Method D 635. All insulating materials shall be in accordance with NEMA ST 20 Standard for a 220 degrees Celsius UL component recognized insulation system.

F. Transformer coils shall be of the continuous wound copper construction and shall be impregnated with non-hygroscopic, thermosetting varnish.

G. All cores are to be constructed of high grade, non-aging, grain-oriented silicon steel with high magnetic permeability and low hysteresis and eddy current loses. Magnetic flux densities are to be kept well below the saturation point. The core laminations shall be tightly clamped and compressed with structural steel angles. The completed core and coil shall then be bolted to the base by means of vibration-absorbing mounts to minimize sound transmission. There shall be no metal-to-metal contact between the core and coil assembly and the enclosure.

H. All transformers shall be equipped with a wiring compartment suitable for conduit entry and large enough to allow convenient wiring. The maximum temperature of the enclosure shall not exceed 90 degrees Celsius. Transformers shall be furnished with lugs of the size and quantity required and suitable for termination of the field wiring.

I. The core of the transformer shall be visibly grounded to the enclosure by means of a flexible grounding conductor sized in accordance with applicable NEMA, IEEE, and ANSI standards.

J. Transformers shall have core and coil assemblies mounted on rubber isolation pads to minimize the sound levels. Transformers shall not exceed the sound levels listed in NEMA ST-20.

K. Transformers shall be furnished with the following enclosure type and material of construction, dependent upon the designation of the area in which they are to be installed. Area designations are indicated on the Drawings.

AREA DESIGNATION	**ENCLOSURE TYPE AND MATERIAL**
Indoor Wet Process Area	NEMA 3R, Painted Steel
Indoor Dry Process Area	NEMA 2, Painted Steel
All Outdoor Areas	NEMA 3R, Painted Steel

L. The enclosure shall be made of heavy gauge steel and shall be degreased, cleaned, primed, and finished with a baked weather-resistant enamel using the manufacturer's standard painting process. Color shall be ANSI 61.

PART 3 -- EXECUTION

3.01 INSTALLATION

A. The transformers shall be furnished and installed as shown on the Drawings and as recommended by the equipment manufacturer.

B. Conduit routed to and from the transformer shall be arranged for easy removal of the transformer access covers.

C. Where transformers 50 kVA and smaller are shown to be wall mounted, a transformer manufacturer supplied wall mounting kit shall be used. The lowest point of the wall mounting bracket shall be no lower than 7'-0" above the finished floor. Field fabricated mounting hardware is not acceptable unless reviewed and approved in writing by the Engineer.

D. Prior to final completion of the work, all metal surfaces of the equipment shall be cleaned thoroughly, and all scratches and abrasions shall be retouched with the same lacquer as used for shop finishing coats.

3.02 TESTING

A. All tests shall be performed in accordance with the requirements of the General Conditions and Division 1. The following tests are required:

1. Certified Shop Tests

    a. The transformers shall be given routine factory tests in accordance with the requirements of the ANSI and NEMA standards. Temperature rises may be certified from basic design.

    b. As a minimum, the following tests shall be made on all transformers:

        i. Ratio tests on the rated voltage connection and on all tap connections.
        ii. Polarity and phase-relation tests on the rated voltage connection.
        iii. Applied potential tests.
        iv. Induced potential tests.
        v. No-load and excitation current at rated voltage on the rated voltage connection.

2. Field Tests

    a. Field testing shall be done in accordance with the requirements specified in the General Conditions, Division 1, and NETA Acceptance Testing Specifications, latest edition.

b. Insulation between windings shall be tested by 1000 VDC Megaohmeter for one (1) minute. Resistance value shall be no less than 100 Megaohms.

+ + + END OF SECTION 16461 + + +

SECTION 16470
PANELBOARDS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall furnish and install panelboards of voltage and current ratings as specified herein and indicated on the Drawings. Panelboards shall be furnished with circuit breaker ratings, number of breakers, number of poles and locations conforming to the panelboard schedules on the Drawings.

B. Reference Section 16000, Basic Electrical Requirements; and Section 16195, Electrical Identification.

1.02 CODES AND STANDARDS

A. Panelboards shall be designed, manufactured, and/or listed to the following standards as applicable:

1. Underwriters Laboratories

   a. UL 50 – Enclosures for Electrical Equipment, Non-environmental Considerations

   b. UL 67 – Standard for Panelboards

   c. UL 489 - Molded Case Circuit Breakers, Molded Case Switches, and Circuit Breaker Enclosures

   d. UL 943 – Ground Fault Circuit Interrupters

   e. UL 1449 – Standard for Surge Protective Devices

2. NEMA PB1 - Panelboards

3. National Electrical Contractors Association (NECA) Standard 407 – Standard for Installing and Maintaining Panelboards

1.03 SUBMITTALS

A. In accordance with the procedures and requirements set forth in the General Conditions and Section 01350, Project Document Tracking and Control System, the Contractor shall obtain from the equipment manufacturer and submit the following:

1. Shop Drawings.

2. Spare Parts List.

3. Operation and Maintenance Manuals.

4. Reports of Field Tests.

B. Each submittal shall be identified by the applicable specification section.

1.04 SHOP DRAWINGS

A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.

B. Partial, incomplete, or illegible submittals will be returned to the Contractor without review for resubmittal.

C. Shop drawings shall include but not be limited to:

1. Product data sheets.

2. Complete assembly, layout, and installation drawings with clearly marked dimensions for each panelboard.

3. Complete panelboard schedules indicating circuit designations as shown on the Drawings for each panelboard.

4. The submittal information shall reflect the specific equipment identification number as indicated on the Drawings (e.g., LP-1, PP-1, etc.).

1.05 OPERATIONS AND MAINTENANCE MANUALS

A. The Contractor shall submit operation and maintenance manuals in accordance with the procedures and requirements set forth in the General Conditions and Division 1. The manuals shall include:

1. Instruction books and/or leaflets.

2. Recommended spare parts list.

3. Final as-built construction drawings included in the shop drawings incorporating all changes made in the manufacturing process and during field installation.

1.06 SPARE PARTS

A. For each panelboard, the Contractor shall furnish to the Owner all spare parts as recommended by the equipment manufacturer. All spaces in the panelboards shall be furnished with a spare breaker as indicated in the panelboard schedules shown on the Drawings.

B. Spare parts lists shall indicate specific sizes, quantities, and part numbers of the items to be furnished. Terms such as "1 lot of packing material" are not acceptable.

C. Parts shall be completely identified with a numerical system to facilitate parts inventory control and stocking. Each part shall be properly identified by a separate number. Those parts which are identical for more than one size shall have the same parts number.

1.07 IDENTIFICATION

A. Each panelboard shall be identified with the identification name/number indicated on the Drawings. A nameplate shall be securely affixed in a conspicuous place on each panelboard. Nameplates shall be as specified in Section 16195, Electrical - Identification.

PART 2 -- PRODUCTS

2.01 MANUFACTURERS

A. The Equipment shall be designed, constructed and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as shown on the Drawings.

2.02 CONDUCTORS (MAIN BUS AND BRANCH CONNECTORS)

A. All main bus shall be copper sized in accordance with UL standards to limit the temperature rise on any current carrying part to a maximum of 50 degrees C above a maximum ambient temperature of 40 degrees C.

2.03 LIGHTING PANELBOARDS

A. General

1. Lighting panelboards shall be dead-front type with automatic trip-free, non-adjustable, thermal-overload, branch circuit breakers. Panelboards shall be of the configuration and rating as specified herein and indicated on the Drawings. Panelboards shall be UL 67 Listed and shall be constructed to NEMA PB1 standards. Panelboards shall be service entrance rated where indicated on the Drawings.

2. Lighting panelboards shall be equipped with a main breaker or main lugs complete with branch circuit breakers, as indicated on the Drawings. The panelboards shall be suitable for flush or surface mounting.

3. Lighting panelboards shall be fully rated and shall have a minimum short circuit rating of 22,000 amperes symmetrical, unless otherwise indicated on the Drawings.

4. Lighting panelboards shall be Eaton Pow-R-Line Series, the Square D Company equivalent, the General Electric Company equivalent, or Siemens Energy and Automation, Inc. equivalent.

B. Enclosures

1. Enclosures shall be UL 50 listed and have a NEMA rating as indicated on the Drawings. An Underwriter's Laboratories, Inc. inspection label shall appear on the interior of the cabinet. Enclosures designated as NEMA 4X shall be constructed of 304 stainless steel. Enclosures with all other NEMA ratings shall be constructed of No. 12 U.S.S. code gauge galvanized steel, painted ANSI #61 light gray. The enclosure shall have wiring gutters on sides and shall be at least 5-3/4 inches deep.

2. The door shall be fastened to the enclosure with concealed hinges and shall be equipped with flush-type catches and locks. The Contractor shall equip cabinet doors exceeding 40 inches in height with vertical bolt three point locking mechanism. All locks shall be keyed alike. The panelboard trim shall have a removable hinge assembly, in addition to the door hinge, that allows work inside the enclosure without the need to remove the trim.

3. The panelboard shall be provided with an information label. The information label shall include the panelboard designation, voltage, phase, wires, and bus rating.

C. Bus Work

1. Main bus bars shall be of ample size so that a current density of not more than 1000 amperes per square inch of cross section will be attained. This current density shall be based on the application of the full load connected to the panel plus approximately 25% of the full load for spare capacity. The main bus shall be full capacity as based on the preceding for the entire length of the panel so as to provide full flexibility of circuit arrangement.

2. Solid neutral bus bars are required and neutral bus ampacity shall be the same as the main bus bars unless otherwise noted. Ratings shall be in accordance with applicable standards.

3. A separate ground bus shall be provided with lugs for termination of equipment grounding conductors.

4. Branch bus work shall be rated to match the maximum branch circuit breaker which may be installed in the standard space.

5. All bus shall be tin plated copper and shall extend the entire useable length of the panelboard, including spaces.

D. Circuit Breakers

1. Circuit breakers shall be bolt-on, molded-case type and UL 489 Listed. All circuit breakers shall have quick-make, quick-break, toggle mechanism for manual as well as automatic operation. Tandem or half-size circuit breakers are not acceptable.

2. Where indicated on the Drawings, or where required by Code, circuit breakers shall be equipped with integrally mounted ground fault interrupters complete with "TEST" push button and shall be of a type which fit standard panelboard spaces for the breaker continuous current rating required. Ground fault circuit interrupter style circuit breakers shall be UL 943 Listed. Circuit breakers used for lighting circuit switching shall be approved for the purpose and shall be marked "SWD". Where required by Article 440 of the NEC, circuit breakers installed for air conditioning units shall be HACR type.

3. Circuit breaker voltage ratings shall meet or exceed the panelboard voltage indicated on the Drawings. Trip elements of circuit breakers shall be 20A unless otherwise indicated on the Drawings. Circuit breakers shall have an interrupting rating at 240 VAC that matches the panelboard short circuit rating.

4. Main circuit breakers shall be individually mounted. Branch mounted circuit breakers are not acceptable unless specifically indicated on the panel schedules. Coordinate top or bottom mounting of main circuit breaker with incoming conduit location.

5. Where indicated on the Drawings, branch circuit breakers shall be provided with a padlockable hasp or handle padlock attachment for padlocking in the off position as required to meet the NEC requirement for disconnecting means and/or OSHA lock-out/tagout standard. Locking hardware shall remain in place even when the padlock is removed. Branch circuit breakers shall be provided with a similar lock-on device where indicated on the Drawings.

E. Directories

1. Approved directories with noncombustible plastic cover, and with typewritten designations of each branch circuit, shall be furnished and installed in each panelboard. The Contractor shall maintain in each panel, during the duration of the Contract, a handwritten directory clearly indicating the circuit breakers in service. This directory shall be updated as work progresses, and final, typewritten directories, as specified above, shall be installed at the end of the project. Designations and circuit locations shall conform to the panelboard schedules on the Drawings, except as otherwise authorized by the Engineer.

2.04 POWER DISTRIBUTION PANELBOARDS

A. General

1. Power distribution panelboards shall be of the configuration and rating as specified herein and as indicated on the Drawings. The panelboards shall be dead-front type with automatic trip-free, non-adjustable, thermal overload branch circuit breakers. Panelboards shall be UL 67 Listed and shall be constructed to NEMA PB1 standards. Panelboards shall be service entrance rated where indicated on the Drawings.

2. Power panelboards shall be equipped with a main breaker or main lugs complete with branch circuit breakers as indicated on the Drawings. The panelboards shall be suitable for flush or surface mounting.

3. Power distribution panelboards shall be fully rated and shall have a minimum short circuit rating of 65,000 amperes symmetrical unless otherwise indicated on the Drawings.

4. Power distribution panelboards shall be Eaton Pow-R-Line Series, the Square D Company equivalent, the General Electric Company equivalent, or Siemens Energy and Automation, Inc. equivalent.

B. Enclosures

1. Enclosures shall be UL 50 listed and have a NEMA rating as indicated on the Drawings. An Underwriter's Laboratories, Inc. inspection label shall appear on the interior of the cabinet. Enclosures designated as NEMA 4X shall be constructed of 304 stainless steel. Enclosures with all other NEMA ratings shall be constructed of No. 12 U.S.S. code gauge galvanized steel, painted ANSI #61 light gray. The enclosure shall have wiring gutters on sides and shall be at least 5-3/4 inches deep.

2. The door shall be fastened to the enclosure with concealed hinges and shall be equipped with flush-type catches and locks. The Contractor shall equip cabinet doors exceeding 40 inches in height with vertical bolt three point locking mechanism. All locks shall be keyed alike. The panelboard trim shall have a removable hinge assembly, in addition to the door hinge, that allows work inside the enclosure without the need to remove the trim.

3. The panelboard shall be provided with an information label. The information label shall include the panelboard designation, voltage, phase, wires, and bus rating.

C. Bus Work

1. Main bus bars shall be of ample size so that a current density of not more than 1,000 amperes per square inch of cross section will be attained. This current density shall be based on the application of the full load connected to the panel plus approximately 25% of the full load for spare capacity. The main bus shall be full capacity as based on the preceding for the entire length of the panel so as to provide full flexibility of circuit arrangement.

2. Solid neutral bus bars, where required, shall be provided. Neutral bus shall have the same ampacity as the main bus, unless otherwise indicated. Ratings shall be in accordance with applicable standards.

3. A separate ground bus shall be provided with lugs for termination of equipment grounding conductors.

4. Branch bus work shall be rated to match the maximum branch circuit breaker which may be installed in the standard space.

5. All bus shall be tin plated copper and shall extend the entire useable length of the panelboard, including spaces. Panelboards Listed and Labeled as a four-wire panel shall not be used in place of a three-wire panel where a neutral conductor does not exist in the supply conductors to that panel.

D. Circuit Breakers

1. Circuit breakers shall be bolt-on, molded-case type and UL 489 Listed. All circuit breakers shall have quick-make, quick-break, toggle mechanism for manual as well as automatic operation.

2. Circuit breakers used for lighting circuit switching shall be approved for the purpose and shall be marked "SWD" where required by Article 440 by the NEC. Circuit breakers installed for air conditioning units shall be HACR type.

3. Circuit breaker voltage rating shall meet or exceed the panelboard voltage indicated on the Drawings. Trip elements of circuit breakers shall be 20A, unless otherwise indicated on the Drawings. Circuit breakers shall have an interrupting rating at 480 VAC that matches the panelboard short circuit rating.

4. Main circuit breakers shall be individually mounted. Branch mounted circuit breakers are not acceptable unless specifically indicated on the panel schedules. Coordinate top or bottom mounting of main circuit breaker with incoming conduit location.

5. Where indicated on the Drawings, branch circuit breakers shall be provided with a padlockable hasp or handle padlock attachment for padlocking in the off position as required to meet the NEC requirement for disconnecting means and/or OSHA lock-out/tagout standard. Locking hardware shall remain in place even when the padlock is removed. Branch circuit breakers shall be provided with a similar lock-on device where indicated on the Drawings.

E. Directories

1. Approved directories with noncombustible plastic cover, and with typewritten designations of each branch circuit, shall be provided in each panel. The Contractor shall maintain in each panel, during the duration of the Contract, a handwritten

directory clearly indicating the circuit breakers in service. This directory shall be updated as work progresses, and final, typewritten directories, as specified above, shall be installed at the end of the project. Designations and circuit locations shall conform to the panelboard schedules on the Drawings, except as otherwise authorized by the Engineer.

2.05 SURGE PROTECTIVE DEVICES

A. The panelboards shall be furnished with integrated Type II surge protective devices (SPD). SPDs shall be provided in the location and quantity as shown on the Drawings. SPD shall be installed within the panelboard enclosure in a location that allows the required quantity and rating of branch circuit breakers to be installed. Reducing the quantity of branch circuit breakers to less than that required by the panel schedules is not acceptable.

B. The SPD shall be rated, designed, tested, listed, and labeled in accordance with UL-1449, latest edition.

C. The SPD shall be factory installed by the panelboard manufacturer using a direct bus connection. There shall be no cable connection between the bus bar and the SPD device.

D. The SPD shall have a fault current rating equal to or greater than that of the fault current rating of the panelboard. The SPD shall employ metal-oxide varistor (MOV) technology. If integral fusing is used, the fuses shall allow the maximum rated surge current to pass without fuse operation.

E. The SPD shall have a maximum continuous operating voltage (MCOV) of at least 115% of the nominal voltage of the panelboard. The Voltage Protection Rating (VPR) of each SPD shall not exceed the following:

SYSTEM VOLTAGE	L-N	L-G	L-L	N-G
208Y/120	700V	700V	1200V	700V
480Y/277	1200V	1200V	1800V	1200V
480 DELTA	N/A	1200V	2000V	N/A
240 DELTA	N/A	1200V	1200V	N/A
120/240	700V	700V	1200V	700V

F. The Nominal Discharge Current (In) of the SPD shall be 20kA. Peak surge current ratings shall not be used as a basis for applying the SPD to the system.

G. The surge current rating for each SPD shall be as indicated on the Drawings. Surge current ratings are indicated in panel schedules. Surge current rating indicated is on a per phase basis.

H. Each SPD system shall provide surge protection in all possible modes. Surge protection shall be as follows:

SYSTEM CONFIGURATION	MODES OF PROTECTION	NUMBER OF MODES
3-Phase Wye	L-N, L-G, N-G	7
3-Phase Delta	L-L, L-G	6
3-Phase Impedance Grounded	L-L, L-G	6
Single-Phase	L-N, L-G, N-G	3

I. The SPD shall be furnished with an audible alarm and silence pushbutton, integral SPD status LEDs (one per phase), and a Form C dry contact for remote indication of alarm. A surge counter shall also be provided.

J. The SPD equipment shall be SPD Series by Eaton, SurgeLogic by the Square D Company, Tranquell by the General Electric Company, Siemens Energy and Automation Inc. equivalent, or equal.

PART 3 -- EXECUTION

3.01 INSTALLATION

A. Panelboards be furnished and installed as shown on the Drawings and as recommended by the equipment manufacturer, and as required by NECA 407.

B. Panelboards shall be set true and plumb in locations as shown on the Drawings. The top of panelboard enclosure shall not exceed six (6) feet above finished floor elevation.

C. Enclosures shall not be fastened to concrete or masonry surfaces with wooden plugs. Appropriate cadmium plated or galvanized steel bolts shall be used with expansion shields or other metallic type concrete insert for mounting on concrete or solid masonry walls. Cadmium plated or galvanized steel toggle bolts shall be used for mounting on concrete block or other hollow masonry walls. Bolt diameter shall be as required considering the size and weight of the completed panelboard and enclosure to provide adequate structural support.

D. The Contractor shall not use factory furnished knockouts with surface mounted back boxes. The Contractor shall punch or drill required openings during installation and shall equip flush mounted back boxes with manufacturer's standard pattern of knockouts.

E. The Contractor shall install cabinets (and other enclosure products) in plumb with the building construction. Flush mounted enclosures shall be installed so that the trim will rest against the surrounding surface material and around the entire perimeter of the enclosure.

F. Bus loads in all panelboards shall be balanced between phases to within a tolerance of one (1) KVA. Convenience receptacles shall be distributed evenly among all phase buses as much as practical.

G. Prior to final completion of the work, all metal surfaces of the equipment shall be cleaned thoroughly, and all scratches and abrasions shall be retouched with the same lacquer as used for shop finishing coats.

3.02 TESTING

A. All tests shall be performed in accordance with the requirements of the General Conditions and Division 1. The following tests are required:

1. Field Tests

a. Prior to termination of any conductors to the circuit breakers , all bus work and circuit breakers shall be tested from phase to phase and phase to ground with a 1000 VDC megaohmeter for 1 minute in accordance with NECA 407. Resistance values shall be recorded and shall not be less than 100 megohms.

b. Prior to terminating any wires to the circuit breakers, the resistance of the connection between the bus work and each circuit breaker shall be tested through the use of a low-resistance ohmmeter. Record the resistance values for each circuit breaker.

+ + + END OF SECTION 16470 + + +

SECTION 16476
ENCLOSED CIRCUIT BREAKERS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall furnish and install enclosed circuit breakers of voltage and current ratings as specified herein and indicated on the Drawings.

B. This specification is intended to apply to circuit breakers separately-mounted from other equipment in an individual enclosure. This Section does not apply to circuit breakers as part of an equipment assembly such as motor control centers, panelboards, switchboards, etc.

C. Reference Section 16000, Basic Electrical Requirements.

1.02 CODES AND STANDARDS

A. Enclosed circuit breakers shall comply with the following codes and standards:

1. UL 489 - Molded Case Circuit Breakers, Molded Case Switches, and Circuit Breaker Enclosures

2. NEMA 250 – Enclosures for Electrical Equipment

3. National Electrical Code

1.03 SUBMITTALS

A. In accordance with the procedures and requirements set forth in the General Conditions and Section 01350, Project Document Tracking and Control System, the Contractor shall obtain from the equipment manufacturer and submit the following:

1. Shop Drawings.

2. Spare Parts List.

3. Operation and Maintenance Manuals.

B. Each submittal shall be identified by the applicable specification section.

1.04 SHOP DRAWINGS

A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.

B. Partial, incomplete, or illegible submittals will be returned to the Contractor without review for resubmittal.

C. Shop drawings shall include but not be limited to:

1. Product data sheets.

2. Complete assembly, layout, and installation drawings with clearly marked dimensions for each enclosed circuit breaker.

1.05 SPARE PARTS

A. For each enclosed circuit breaker, the Contractor shall furnish to the Owner all spare parts as recommended by the equipment manufacturer.

1.06 IDENTIFICATION

A. Each enclosed circuit breaker shall be identified with the identification name and/or number indicated on the Drawings. A nameplate shall be securely affixed in a conspicuous place on the front of each enclosed circuit breaker. Nameplates shall be as specified in Section 16195, Electrical - Identification.

PART 2 -- PRODUCTS

2.01 MANUFACTURERS

A. The Equipment shall be designed, constructed and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as shown on the Drawings.

B. Enclosed circuit breakers shall be manufactured by Eaton, the General Electric Company, the Square D Company, or Siemens Energy and Automation, Inc.

2.02 ENCLOSED CIRCUIT BREAKERS

A. Circuit breakers shall be molded case type with trip and frame ratings as indicated on the Drawings. Provide electronic trip unit where indicated on the Drawings, with adjustable functions as indicated on the Drawings.

B. Circuit breakers shall have an interrupting rating of 65,000 amperes symmetrical at 480 VAC, unless otherwise indicated on the Drawings.

C. Enclosed circuit breakers in non-hazardous locations shall be UL 489 Listed. Circuit breakers in hazardous locations shall be UL 1203 Listed.

D. In non-hazardous locations, enclosed circuit breakers shall be furnished with the following enclosure type and material of construction, dependent upon the designation of the area in which they are to be installed. Area designations are indicated on the Drawings.

AREA DESIGNATION	**ENCLOSURE TYPE AND MATERIAL**
Indoor Wet Process Area	NEMA 4X, Type 304 Stainless Steel
Indoor Dry Process Area	NEMA 12, Painted Steel
All Outdoor Areas	NEMA 3R, Type 304 Stainless Steel

E. In hazardous locations, enclosed circuit breakers shall be furnished with the following enclosure type and material of construction, dependent upon the classification of the area in which they are to be installed. Area classifications are indicated on the Drawings.

AREA CLASSIFICATION	**ENCLOSURE TYPE AND MATERIAL**
Class I, Division 1, Group D	NEMA 7, Die Cast Aluminum
Class I, Division 2, Group D	NEMA 7, Die Cast Aluminum

F. Enclosed circuit breakers shall be quick-make, quick-break and with an interlocked cover which cannot be opened when the breaker is in the “ON” position and capable of being locked in the “OPEN” position.

G. An Underwriter's Laboratories, Inc. inspection label shall appear on the interior of the enclosure.

H. Enclosed circuit breakers shall be suitable for use as service entrance equipment where indicated on the Drawings and so labeled to suit the application.

I. Where indicated on the Drawings, enclosed circuit breakers shall be 100% rated.

PART 3 -- EXECUTION

3.01 INSTALLATION

A. The enclosed circuit breaker shall be furnished and installed as shown on the Drawings and as recommended by the equipment manufacturer.

B. Enclosed circuit breakers shall be set true and plumb in locations as shown on the Drawings. The top of enclosure shall not exceed six (6) feet above finished floor elevation.

C. Enclosed circuit breakers shall be provided in the enclosure type and material of construction required for the area in which it is installed. Reference the requirements in Part 2 herein, and the area designations indicated on the Drawings.

3.02 TESTING

A. All tests shall be performed in accordance with the requirements of the General Conditions and Division 1. The following tests are required:

1. Witnessed Shop Tests

    a. None required

2. Field Tests

    a. Field testing shall be done in accordance with the requirements specified in the General Conditions, Division 1, and NETA Acceptance Testing Specifications, latest edition.

+ + + END OF SECTION 16476 + + +

SECTION 16496
AUTOMATIC TRANSFER SWITCH

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall furnish, install, connect, test and place in satisfactory operation automatic transfer switches as specified herein and indicated in Drawings.

B. All devices and components of the automatic transfer switch shall be NEMA rated. IEC rated devices are unacceptable and shall be cause for rejection of the submittals/equipment.

C. This Section does not stand alone. The automatic transfer switch shall be furnished by the Supplier of the Engine Generator specified in Section 16620.

1.02 TESTING

A. All tests shall be performed in accordance with the requirements of the General Conditions and Division 1. The following tests are required:

1. Witnessed Shop Tests

    a. Shall be made available at manufacturing facilities if requested.

2. Certified Shop Tests and Reports

    a. Automatic transfer switches shall be given routine factory tests. The factory tests shall demonstrate that the completed switches function correctly and that the required timing has been set. Certification of these settings shall be submitted to the Engineer upon request.

    b. Test procedures shall be in accordance with UL-1008. During the 30-cycle withstand tests, there shall be no contact welding or damage.

    c. The three cycle tests shall be performed without the use of current limiting fuses.

    d. Oscillograph traces across the main contacts shall verify that contact separation has not occurred and there is contact continuity across all phases after completion of the test.

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e. When conducting temperature rise tests in accordance with UL-1008, include post-endurance temperature rise tests to verify the ability of the transfer switch to carry full rated current after completing the overload and endurance tests.

f. Manufacturer shall submit test reports upon request.

3. Field Tests

a. Field testing shall be done in accordance with the requirements specified in the General Conditions, Division 1, and Section 16000, Basic Electrical Requirements.

b. Prior to acceptance of the installation, load test the equipment with all available motor load, but do not exceed the generator's or automatic transfer switch's nameplate rating. Correct defects which become evident during this test.

1.03 SUBMITTALS

A. In accordance with the procedures and requirements set forth in the General Conditions and Section 01350, Project Document Tracking and Control System, the Contractor shall obtain from the equipment manufacturer and submit the following:

1. Shop Drawings

2. Operation and Maintenance Manuals

3. Spare Parts Lists

4. Special Tools List

5. Reports of certified shop tests shall be submitted which indicates a closing and withstand ampere rating as required based on short circuit study requirements. Rating shall be symmetrical, 30 cycles at 480 VAC.

6. Guarantee/Warranty Program

B. Each submittal shall be identified by the applicable specification section.

1.04 SHOP DRAWINGS

A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.

B. Partial, incomplete or illegible submittals will be returned to the Contractor for resubmittal without review.

C. Shop drawings for each automatic transfer switch shall include but not be limited to:

1. Product data sheets.

2. Complete assembly, layout, and installation drawings with clearly marked dimensions and conduit entrance locations.

3. Example equipment nameplate data sheet.

4. Complete internal schematic and interconnecting wiring diagrams.

5. Nameplate schedule.

6. Manufacturer's standard installation instructions.

7. Manufacturer's standard warranty.

D. The shop drawing information shall be complete and organized in such a way that the Engineer can determine if the requirements of these specifications are being met. Copies of technical bulletins, technical data sheets from "soft-cover" catalogs, and similar information which is "highlighted" or somehow identifies the specific equipment items the Contractor intends to provide are acceptable and shall be submitted.

E. Prior to completion and final acceptance of the project, the Contractor shall furnish and install "as-built" wiring diagrams for each automatic transfer switch. These final drawings shall be plastic laminated and securely placed inside each transfer switch and included in the O&M manuals.

1.05 OPERATION AND MAINTENANCE MANUALS

A. The Contractor shall submit operation and maintenance manuals in accordance with the procedures and requirements set forth in the General Conditions and Division 1.

1.06 TOOLS, SUPPLIES AND SPARE PARTS

A. The automatic transfer switches shall be furnished with all special tools necessary to disassemble, service, repair and adjust the equipment. All spare parts as recommended by the equipment manufacturer shall be furnished to the Owner by the Contractor.

B. The spare parts shall be packed in containers suitable for long term storage, bearing labels clearly designating the contents and the pieces of equipment for which they are intended.

C. Spare parts shall be delivered at the same time as the equipment to which they pertain. The Contractor shall properly store and safeguard such spare parts until completion of the work, at which time they shall be delivered to the Owner.

D. Spare parts lists, included with the shop drawing submittal, shall indicate specific sizes, quantities, and part numbers of the items to be furnished. Terms such as "1 lot of packing material" are not acceptable.

E. Parts shall be completely identified with a numerical system to facilitate parts inventory control and stocking. Each part shall be properly identified by a separate number. Those parts which are identical for more than one size, shall have the same parts number.

1.07 SERVICES OF MANUFACTURER'S REPRESENTATIVE

A. The Contractor shall provide the services of a qualified manufacturer's technical representative who shall adequately supervise the installation and testing of all equipment furnished under this Contract and instruct the Contractor's personnel and the Owner's operating personnel in its maintenance and operation as outlined elsewhere in Division 1 and Section 11000, Equipment - General Provisions. The services of the manufacturer's representative shall be provided for a period of not less than as follows:

1. One trip of one (1) working day during installation of the equipment for <u>each</u> automatic transfer switch.

2. One trip of one (1) working day after acceptance of the equipment.

3. One trip of one (1) working day during the warranty period.

B. Any additional time required to achieve successful installation and operation shall be at the expense of the Contractor. The manufacturer's representative shall sign in and out at the office of the Engineer's Field Representative on each day he is at the project.

C. The manufacturer shall have an established network of service centers capable of servicing the specified equipment

D. Service center personnel shall be on call 24 hours a day, 365 days a year. Personnel shall be factory-trained and certified in the maintenance and repair of the specified equipment.

E. After-warranty service contracts shall be made available to the Owner by the manufacturer, through the service centers, to provide periodic maintenance and/or repair of the specified equipment.

1.08 IDENTIFICATION

A. Each automatic transfer switch shall be identified with the identification number indicated on the Drawings (e.g. ATS-1, etc.). A nameplate shall be securely affixed in a conspicuous place on each switch. Nameplates shall be as specified in Section 16195, Electrical - Identification.

1.09 TRAINING

A. The Contractor shall provide training for Owner personnel. Training shall be conducted by the manufacturer's factory trained specialists who shall instruct Owner personnel in operation and maintenance of all equipment provided under this Section. Training shall be in accordance with the requirements of Section 11000, Equipment-General Provisions.

B. Provide the services of an experienced, factory trained technician or service engineer of the switch manufacturer at the jobsite for minimum of one (1) days for training of Owner personnel, beginning at a date mutually agreeable to the Contractor and the Owner. The technician shall be on duty at the site for at least 8 hours per day and shall be available 24 hours per day when required to advise concerning special problems with equipment and systems.

1.10 WARRANTY

A. The manufacturer shall warrant each automatic transfer switch for a minimum of five (5) years from date of shipment. In addition, the manufacturer shall repair or replace equipment found faulty under the terms of the warranty. The manufacturer shall submit data outlining the guarantee/warranty program.

PART 2 -- PRODUCTS

2.01 MANUFACTURERS

A. The equipment covered by this Specification is intended to be standard equipment of proven performance as manufactured by reputable concerns. Equipment shall be designed, constructed and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as shown on the Drawings.

B. The equipment described herein, as a minimum, shall meet all of the requirements specified in this Section and shall be a product of a manufacturer who has produced automatic transfer switches for a period of at least five (5) years. The equipment shall be compatible with the loads to be served. Assembly of the switches by a fabricator is not acceptable.

C. The manufacturer of the automatic transfer switch shall verify that the switches are listed by Underwriters Laboratories, Inc., standard UL-1008, with 30-cycle withstand and close-in values as indicated on the Drawings or specified herein.

D. The automatic transfer switches shall be Model RTS-30 as manufactured by Russelectric, Inc., Zenith ZTS equivalent, or ASCO Series equivalent.

2.02 AUTOMATIC TRANSFER SWITCH

A. General

1. Switches shall have ampere ratings and number of poles as indicated on the Drawings and shall be suitable for 480 VAC, three-phase, 60 Hertz operation.

2. For three phase, four-wire systems where a neutral is required, a true four-pole switch shall be supplied with all four electrically and mechanically identical poles mounted on a common shaft. The continuous current rating and the closing and withstand rating of the fourth pole shall be identical to the rating of the main poles.

3. The transfer switch shall be housed in a NEMA 4X (gasketed) enclosure fabricated from 12-gauge steel suitable for floor mounting. The enclosure shall exceed the UL-1008 minimum wire bending space requirements. The enclosure shall be equipped with an internal, welded steel, door-mounted print pocket.

4. The transfer switch shall have both top and bottom mounted cable access.

5. The switch shall be capable of switching all classes of load and rated for continuous duty when installed in a non-ventilated enclosure.

6. The 30-cycle closing and withstand current rating of the switch shall be 42,000 amperes RMS (minimum). This rating shall not be restricted by the use of a specific manufacturer's circuit breaker.

7. This switch shall be complete with all accessories and listed by UL under Standard UL-1008 for use on emergency systems.

8. All bolted bus connections shall have Belleville compression type washers. Switches for four-wire systems shall be furnished with a fully rated solid neutral bus.

9. The switch shall be equipped with 90□C rated copper/aluminum solderless mechanical type lugs of the proper quantity and size to accommodate the termination of field wiring.

10. Switches shall be capable of normal operation during and after seismic loading. Seismic loading shall not cause false operation.

B. Design Requirements

1. The switch shall utilize dual operators. Operators shall provide for an adjustable neutral off position in which the load is disconnected from both sources during transfer from utility to generator and re-transfer back the utility.

2. Switches shall be capable of transferring successfully in either direction with 70 percent of rated voltage applied to the terminals.

3. The time delay between the opening of the closed contacts and the closing of the open contacts shall allow for voltage decay before transfer, allowing the motor and transformer loads to be re-energized after transfer with normal in-rush current. Switches using in-phase monitors are not acceptable.

4. Normal and standby contacts shall be positively interlocked mechanically and electrically to prevent simultaneous closing. Main contacts to be of silver-tungsten alloy, mechanically locked in position in both the normal and standby positions without the use of hooks, latches, or magnets. Provide separate arcing contacts, with magnetic blowouts on each pole. Interlocked molded case circuit breakers switches or contactors are not acceptable.

5. Equip the transfer switch with a permanently attached, safe, manual operator designed to prevent injury to personnel in the event the electrical operator should become energized during manual transfer. The manual operator shall provide the same contact-to-contact transfer speed as the electrical operator to prevent a flashover from slowly switching the main contacts.

C. Sequence of Operation

1. Should the voltage on any phase of the normal source drop below 80 percent or increase to 120 percent, or frequency drops below 90 percent, or increase to 110 percent, or 20 percent voltage differential between phases occur, after a programmable time delay period of 0-9999 seconds factory set at three (3) seconds

to allow for momentary dips, the engine starting contact(s) shall close to start the standby plant or connect the standby source.

2. Transfer to the standby power source shall occur when 90 percent of rated voltage and frequency has been reached by the standby power source.

3. After restoration of normal power on all phases to a preset value of 90 percent to 110 percent of rated voltage, at least 95 percent to 105 percent of rated frequency, and voltage differential is below 20 percent between phases, an adjustable time delay period of 0-9999 seconds factory set at 300 seconds shall delay the transfer to allow stabilization of the normal source. Should the standby source fail during this time delay period, the switch shall automatically retransfer to the normal source.

4. After retransfer to the normal power source, the standby plant shall operate at no load for a programmable period of 0-9999 seconds factory set at 300 seconds. Should the normal power source fail during this time delay period, the transfer switch shall automatically return to the standby source.

D. Controls

1. The transfer switch shall be equipped with a microprocessor-based control system to provide all the operational functions of the automatic transfer switch. The controller shall have two asynchronous serial ports. The controller shall have a real time clock with Nicad battery back-up.

2. The CPU shall be equipped with self diagnostics which perform periodic checks of the memory, I/O, and communication circuits with a watchdog power fail circuit.

3. The controller shall use Modbus RTU Ethernet communication protocol to communicate with the Pump Station Control System. Refer to P&ID Drawings for additional information and requirements.

4. The serial communication port shall allow interface to either the manufacturer's or the Owner's furnished remote supervisory control system.

5. The controller shall have password protection to limit access to authorized personnel.

6. The controller shall include a 20 character LCD display with a keypad, which allows access to the system.

7. The controller shall include three-phase over/under voltage, over/under frequency, phase sequence detection, and phase differential monitoring on both normal and standby sources.

8. The controller shall be capable of storing the following records in memory for access either locally or remotely:

    a. Number of hours the transfer switch is in the standby position (total since record reset).

    b. Number of hours standby power source is available (total since record reset).

    c. Total transfer in either direction (total since record reset).

    d. Date, time, and description of the last four source failures.

    e. Date of the last exercise period.

    f. Date of record reset.

9. Light emitting diodes shall be mounted on the controller to indicate:

    a. Switch is in normal position

    b. Switch is in standby position.

    c. Controller is running.

10. A three-phase digital LCD voltage readout, with 1% accuracy shall display all three separate phase-to-phase voltages simultaneously for both the normal and standby source.

11. A digital LCD frequency readout with 1% accuracy shall display frequency for both the normal and standby source.

12. An LCD readout shall display both normal source and standby source availability.

13. The microprocessor controller shall meet the following requirements:

    - Storage conditions - 25°C to 85°C

    - Operation conditions - 20°C to 70°C ambient

- Humidity 0 to 99% relative humidity, non-condensing
- Capable of withstanding infinite power interruptions
- Surge withstand per ANSI/IEEE C-37.90A-1978

14. All control wiring shall be 18 gauge (minimum), 600 VAC, SIS switchboard type. All control wiring shall be identified at each termination (both ends) using tubular, sleeve-type wire markers.

15. The automatic transfer switch controller shall be a Model RPTCS as manufactured by Russelectric, GE Zenith Controls equivalent, or ASCO equivalent. The controller shall be programmed by the manufacturer's field representative during start-up and testing in conjunction with standby generator.

E. Metering

1. The transfer switch shall provide for metering of phase-to-phase and phase-to-neutral voltage and frequency of both normal and emergency sources as standard. Optional phase and neutral current shall also be provided. The controller shall calculate voltage unbalance, accumulated energy (KWH, KVAH, KVARH), instantaneous real, apparent, and reactive power (KW, KVA, KVAR), and power factor (PF). All measured electrical parameters and calculated values shall be available to the Owner's SCADA system via the controller Modbus RTU communication port.

F. Accessories

1. Programmable three phase sensing of the normal source set to pickup at 90% and dropout at 80% of rated voltage and overvoltage to pickup at 120% and dropout out at 110% of rated voltage. Programmable frequency pickup at 95% and dropout at 90% and over frequency to pickup at 110% and dropout at 105% of rated frequency. Programmable voltage differential between phases, set at 20%, and phase sequence monitoring.

2. Programmable three phase sensing of the standby source set to pickup at 90% and dropout at 80% of rated voltage and overvoltage to pickup at 120% and dropout out at 110% of rated voltage. Programmable frequency pickup at 95% and dropout at 90% and over frequency to pickup at 110% and dropout at 105% of rated frequency. Programmable voltage differential between phases, set at 20%, and phase sequence monitoring.

3. Time delay for override of momentary normal source power outages (delays engine start signal and transfer switch operation). Programmable 0-9999 seconds. Factory set at 3 seconds.

4. Time delay on retransfer to normal, programmable 0-9999 seconds, factory set at 300 seconds, with overrun to provide programmable 0-9999 second time delay, factory set at 300 seconds, unloaded engine operation after retransfer to normal.

5. Time delay on transfer to standby, programmable 0-9999 seconds, factory set at 3 seconds.

6. A maintained type load test switch shall be included to simulate a normal power failure, keypad initiated.

7. A time delay bypass on retransfer to normal shall be included. Keypad initiated.

8. Contact, rated 10 A at 30VDC, to close on failure of normal source to initiate engine starting.

9. A plant exerciser shall be provided with (10) 7 day events, programmable for any day of the week and (24) calendar events, programmable for any month/day, to automatically exercise the standby plant programmable in one minute increments. Also include a control switch for selection of either "no load" (switch will not transfer) or "load" (switch will transfer) during the exercise period. Keypad initiated.

10. Relay contacts which close when normal source fails wired to a terminal strip.

11. Relay contacts which open when normal source fails wired to a terminal strip.

12. Two auxiliary contacts rated 15 A at 120 VAC on main shaft, closed on normal and wired to a terminal strip.

13. Two auxiliary contacts rated 15 A at 120 VAC on main shaft, closed on standby and wired to a terminal strip.

2.03 PAINTING

A. Painting shall conform with the requirements of Section 09900. Finish coat shall be ANSI #61.

B. Prior to final completion of the work, all metal surfaces of the equipment shall be cleaned thoroughly, and all scratches and abrasions shall be retouched with the same coating as used for factory finishing coats.

PART 3 -- EXECUTION

3.01 INSTALLATION

A. Each automatic transfer switch shall be installed as shown on the Drawings and in accordance with the manufacturer's installation instructions.

B. The automatic transfer switch shall be provided with adequate lifting means for installation of wall or floor mounted enclosures.

C. The Contractor shall tighten all assembled bolted connections to the manufacturer's torque recommendations prior to energizing.

D. Install each switch to allow complete door swing required for component removal. This is specifically required where a switch is set next to a wall to the left of the switch enclosure.

+ + + END OF SECTION 16496 + + +

SECTION 16500
LIGHTING

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall furnish and install all lighting fixtures, labor, and material, in accordance with the preceding Specifications, the requirements of this Section, and as shown on the Drawings.

B. Lighting shall be in accordance with the latest requirements of the Illuminating Engineering Society, and all lighting fixtures shall have the Underwriters Laboratories, Inc. label of approval.

C. All wiring shall be placed in conduit and shall comply with the Specifications for conduit, outlet boxes, pull and junction boxes, wires and cables, grounding, and other Sections as set forth in these Specifications and as noted herein.

D. Reference Section 16000, Basic Electrical Requirements, and Section 16170, Grounding and Bonding.

1.02 CODES AND STANDARDS

A. The equipment specified herein shall comply with the following codes and standards, where applicable.

1. Underwriter's Laboratories, Inc. (UL):

    a. UL 924 – Emergency Lighting and Power Equipment

    b. UL 1598 – Luminaires

2. American National Standards Institute (ANSI):

    a. ANSI C62.41 – Guide for Surge Voltages in Low-Voltage AC Power Circuits

3. National Electrical Code (NEC), latest edition.

1.03 SUBMITTALS

A. In accordance with the procedures and requirements set forth in the General Conditions and Section 01350, Project Document Tracking and Control System, the Contractor shall obtain from the equipment manufacturer and submit the following:

1. Shop Drawings

2. Operation and Maintenance Manuals

3. Spare Parts Lists

B. Each submittal shall be identified by the applicable specification section.

1.04 SHOP DRAWINGS

A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.

B. Partial, incomplete or illegible submittals will be returned to the Contractor for resubmittal without review.

C. Shop drawings shall include but not be limited to:

1. Product data sheets.

2. Catalog cuts for each fixture type showing performance and construction details of standard fixtures, and complete working drawings showing all proposed construction details of special or modified standard fixtures.

3. Photometric curves.

4. LED data including efficiency (Efficacy lumens/watt) information.

5. LED Driver information

6. Catalog data including applicable coefficients of utilization tables, isolux chart of illumination on a horizontal plane, beam efficiency, horizontal and vertical beam spread, and beam lumens.

7. Manufacturer’s warranty information

8. Custom wiring diagrams for each individual lighting contactor. Standard wiring diagrams that are not custom created by the manufacturer for the individual lighting

contactors for this project are not acceptable. One wiring diagram which is typical for all lighting contactors is not acceptable. Each wiring diagram shall include wire identification and terminal numbers. Indicate all devices, regardless of their physical location, on the diagrams. Identify on each respective wiring diagram specific equipment names and equipment numbers consistent with those indicated on the Drawings.

9. Pole calculations.

D. Shop drawings shall be submitted to the Engineer for review and acceptance for all fixtures before fixtures and poles are manufactured. Substitutions will be permitted only if acceptable to the Engineer.

E. Manufacturer's catalog number and description in the fixture schedule on the Contract Documents establishes a level of quality, style, finish, etc. The use of a catalog number describing the various types of fixtures shall be used as a guide only, and does not exclude all the required accessories or hardware that may be required for a complete installation.

1.05 OPERATION AND MAINTENANCE MANUALS

A. The Contractor shall submit Operation and Maintenance Manuals in accordance with the procedures and requirements set forth in the General Conditions and Division 1.

1.06 SPARE PARTS

A. All spare parts as recommended by the equipment manufacturer shall be furnished to the Owner by the Contractor. The following minimum spare parts shall be furnished:

1. A minimum of one (1) LED driver for every ten (10) drivers (of the same type) installed.

B. The spare parts shall be packed in containers suitable for long term storage, bearing labels clearly designating the contents and the pieces of equipment for which they are intended.

C. Spare parts shall be delivered at the same time as the equipment to which they pertain. The Contractor shall properly store and safeguard such spare parts until completion of the work, at which time they shall be delivered to the Owner.

D. Spare parts lists, included with the shop drawing submittal, shall indicate specific sizes, quantities, and part numbers of the items to be furnished. Terms such as "1 lot of packing material" are not acceptable.

E. Parts shall be completely identified with a numerical system to facilitate parts inventory control and stocking. Each part shall be properly identified by a separate number. Those parts which are identical for more than one size, shall have the same parts number.

1.07 LIGHTING CONTROLS

A. The lighting systems shall be controlled as specified herein and indicated on the Drawings.

1.08 WARRANTY

A. The manufacturer's warranty shall in no event be for a period of less than five (5) years from date of delivery of fixtures to the project site and shall include repair labor, travel expense necessary for repairs at the jobsite, shipping costs, expendables used during the course of repair, or complete replacement of the failed lighting unit.

B. Warranty for LED fixtures shall be provided for the entire fixture and shall include all parts and accessories. Warranty for non-LED fixtures shall be provided for the entire fixture and shall include all parts and accessories except the replaceable bulb. Submittals received without written warranties as specified shall be rejected in their entirety.

PART 2 -- PRODUCTS

2.01 MANUFACTURERS

A. The equipment covered by this Specification is intended to be standard equipment of proven performance as manufactured by reputable concerns. Equipment shall be designed, constructed, and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as shown on the Drawings.

2.02 FIXTURES

A. Each fixture shall bear the Underwriters Laboratories, Inc. label. All lighting fixtures shall be furnished complete with lamps of the size and type as indicated on the Drawings and all fittings and hardware necessary for a complete installation. Lighting fixtures shall have all parts and fittings necessary to completely and properly install the fixtures.

B. Fixture leads shall be as required by NEC and shall be grounded by the equipment grounding conductor in the conduit.

C. All glassware shall be high quality, homogeneous in texture, uniform in quality, free from defects, of uniform thickness throughout, and properly annealed. Edges shall be well rounded and free from chips or rough edges.

D. Housings shall be finished with a seven-stage phosphate pretreatment and thermal-set, electrostatically applied polyester paint. Color shall be as indicated in the fixture schedule or as selected by the Engineer.

E. Fixtures for use in hazardous locations shall be UL 844 Listed.

F. Fixtures specified to be damp or wet locations rated shall be UL 1598 listed.

G. Fixtures shall be complete with housing, louvers (if required), and accessories of the types and quantities specified herein and indicated on the Drawings.

H. Fixtures shall be as specified in the fixture schedule below.

FIXTURE TYPE	LAMP/ FIXTURE WATTAGE	DESCRIPTION	MFR AND MODEL
LW5	34W (max)	Wall-mounted LED light fixture, 120VAC, color temperature of 4000K, 70 CRI, forward throw distribution, die cast aluminum housing, bronze finish, stainless steel external hardware, 2900 lumen minimum, integral photocell and wet location Listed, 5 year warranty.	LSI Industries Patriot Series, Cooper Lighting XTOR Lumark Crosstour MAXX Series, or GE EWNB Series
LL3	98W (max)	Pole-mounted, 120VAC, LED light fixture, color temperature of 4000K, 20 LEDs, IESNA roadway Type 4 distribution, bronze die cast aluminum housing with side shields, 700mA driver, 6000 lumen minimum, full-cutoff optics, integral photocell, wet location Listed. Provide with house side shield. Square, base mounted, tapered, 12ft. bronze anodized aluminum pole.	AEL Autobahn ATB0 Series, GE Evolve LED EAMT, or Gardco Radiant RL Series.
LL3A	196W (max)	Similar to LL3 except two fixtures per pole mounted at 180-degrees.	AEL Autobahn ATB0 Series, GE Evolve LED EAMT, or Gardco Radiant RL Series.
LL3B	98W (max)	Similar to LL3 except 18ft pole.	AEL Autobahn ATB0 Series, GE Evolve LED EAMT, or Gardco Radiant RL Series.

FIXTURE TYPE	LAMP/ FIXTURE WATTAGE	DESCRIPTION	MFR AND MODEL
LL3C	98W (max)	Similar to LL3 except IESNA roadway Type 2 distribution.	AEL Autobahn ATB0 Series, GE Evolve LED EAMT, or Gardco Radiant RL Series.

2.05 LED DRIVERS

A. Drivers shall have a voltage range of (120-277) +/- 10% at a frequency 60Hz.

B. All drivers shall be designed to a power factor >90% with a total harmonic distortion THD <20% at full load.

C. Case temperature shall be rated for -40°C through +80°C.

D. Drivers shall have overheat protection, self-limited short circuit protection and overload protected.

E. Drivers shall be furnished with a fused primary.

F. Drivers shall have an output current ripple <30%

G. Drivers shall be manufactured by Advance, Universal or equal.

H. Drivers shall be UL Listed for damp location, UL1012, UL935, ROHS.

I. Drivers shall meet FCC 47 Sub Part 15.

J. All drivers shall be provided with ANSI/IEEE C62.41 Category C (10kV/5kA) surge protection.

2.07 LEDs

A. Luminaires provided with LED technology shall utilize high brightness LEDs with a group binning code of P and/or Q.

B. Color Temperature: as specified in fixture schedule.

C. Junction point shall be designed and manufactured to allow adequate heat dissipation.

D. LEDs shall be rated for 50,000 hours of life, minimum (based on IESNA L70).

2.08 POLES

A. Poles shall be designed to withstand calculated wind force based on wind velocity in accordance with the provisions of the Georgia Building Code.

B. Pole mounted fixtures shall be mounted on poles as designated in the fixture schedule or as indicated on the Drawings. Poles shall have adequate handholes and weatherproof receptacles where indicated. All anchor bolts and nuts shall be stainless steel.

PART 3 -- EXECUTION

3.01 INSTALLATION

A. Lighting fixtures shall be located symmetrically with building lines as shown on the Drawings. The Contractor shall furnish and install the lighting fixtures to allow "convenient" access for maintenance such as cleaning, relamping, and other activities. The fixtures shall be installed to be accessed by a 12 ft. (max.) ladder. Where fixtures are shown in locations on the Drawings where maintenance would be difficult, the Contractor shall notify the Engineer for direction.

B. The Contractor shall provide and install all inserts, conduit, structural supports as required, lamps, ballasts, poles, wiring, and any other items required for a complete system. Contractor shall properly adjust and test, to the satisfaction of the Engineer, the entire lighting system. The Contractor shall provide pigtails and flexible conduit connected to an outlet box where necessary or required resulting in a neat and complete installation.

C. The Contractor shall protect all fixtures at all times from damage, dirt, dust, and the like. Before final acceptance, all fixtures and devices shall be cleaned of all dust, dirt or other material, and in operating condition to the satisfaction of the Engineer.

D. Fixtures located on the exterior of the building shall be provided with neoprene gasket and non-ferrous metal screws finished to match the fixtures.

E. The Contractor shall furnish and install all boxes for lighting fixtures such that the box is not the sole support of the fixture. The boxes shall be offset to allow maintenance such that access to wiring within the box can be attained without having to consider supporting (holding) the fixture.

F. All lighting units, when installed, shall be set true and be free of light leaks, warps, dents, and other irregularities. All hangers, cables, supports, channels, and brackets of all kinds for safely erecting this equipment in place, shall be furnished and erected in place by the Contractor.

G. The Contractor shall install fixtures at mounting heights indicated on the Drawings or as instructed by the Engineer. In areas with exposed ducts and/or piping, installation of lighting fixtures shall be adapted to field conditions as determined by the Engineer.

H. The Contractor shall support each fixture securely. The Contractor shall furnish and install all steel members and supports as required to fasten and suspend fixtures from the structure.

I. In all mechanical equipment areas, the Contractor shall install lighting fixtures after all piping and equipment therein has been installed. Exact locations for such fixtures may be determined by the Engineer on the site during the course of the work.

J. Upon completion of work, and after the building area is broom clean, all fixtures shall be made clean and free of dust and all other foreign matter both on visible surfaces, and on surfaces that affect the lighting performance of the fixture including diffusers, lenses, louvers, reflectors, and lamps.

K. All fixtures that require physical adjustment shall be so adjusted in accordance with the directions of the Engineer. The Contractor shall also adjust angular direction of fixtures and/or lamps, as directed.

L. Relamping access of fixtures including LED fixtures shall require no special tools. All optical control surfaces such as lenses and reflectors shall be safely and securely attached to fixtures and shall be easily and quickly removed and replaced for cleaning without the use of special tools. No fixture part that may be removed, for maintenance, shall be held in place by metal tabs that must be bent to remove said part.

M. The Contractor shall furnish and install time switches and photocells as specified herein or indicated on the Drawings. Time switches shall be provided with a manual bypass switch controlling the lights locally and remotely. Time switches shall control contactors, relays, or direct controlling of one, two, or three lighting circuits, as indicated. The Contractor shall furnish and install photocells as specified herein or indicated on the Drawings for automatic "ON/OFF" switching of outdoor lighting.

N. The Contractor shall furnish and install a concrete foundation for the pole mounted fixtures as indicated on the Drawings and as required. This applies to foundations for pole mounted fixtures located in the yard (i.e. site lighting) and foundations that are part of a structure (e.g. pump station). Foundation shall be approved by a professional structural engineer currently registered in the State of Georgia. The wind design shall be in accordance with ASCE 7 and the Georgia Building Code. Pole structure/foundation shall be able to handle fixture/pole weight and withstand wind velocity of up to 110 MPH with a 1.3 gust factor. Provide calculations signed and sealed by a Professional Structural Engineer for review.

O. One (1), ¾" diameter, 10'-0" long ground rod, furnish in accordance with Section 16170, shall be driven adjacent to each pole. The pole, anchor bolts, steel reinforcement bar in the

base, and equipment grounding conductor shall all be bonded to the ground rod as indicated in the standard details.

3.02 TESTING

A. All tests shall be performed in accordance with the requirements of the General Conditions and Division 1. The following tests are required:

1. Certified Shop Tests

    a. The lighting fixtures shall be given routine factory tests in accordance with the requirement of ANSI, NEMA and Underwriters Laboratories standards.

2. Field Tests

    a. Field testing shall be done in accordance with the requirements specified in the General Conditions, Division 1, and NETA Acceptance Testing Specifications, latest edition.

+ + + END OF SECTION 16500 + + +

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SECTION 16620
PACKAGED ENGINE GENERATOR SYSTEMS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall furnish and install a standby power engine generator set complete with base-mounted fuel storage tank, fuel transfer pumps, leak detection systems, piping, exhaust silencer, batteries, charger, enclosure, and devices for automatic and manual control.

B. It is the intent under this Contract to require an installation complete in every detail whether or not indicated on the Drawings or specified. Consequently, the Contractor is responsible for all details, devices, accessories and special construction necessary to properly install, adjust, test, and place in successful and continuous operation the engine-generator set.

C. This Section does not stand alone. Furnish Automatic Transfer Switch in accordance with Section 16496.

D. Use materials which are new, unused, and as specified, or, if not specifically indicated, the best and most suitable of their kinds for the purpose intended, and for the design and expected conditions of service, subject to the approval of the Engineer.

E. Provide workmanship that is first class in every respect. Employ workers thoroughly experienced in such work. A neat and workmanlike appearance in the finished work shall be required.

F. All materials used must bear the inspection labels of the Underwriter's Laboratories, if the material is of a class inspected by the Laboratory.

G. Unless otherwise indicated, the materials to be provided under this Specification shall be the products of manufacturers regularly engaged in the production of all such items and shall be the manufacturer's latest design. The products shall conform to the applicable standards of UL and NEMA, unless specified otherwise. International Electrotechnical Commission (IEC) standards are not recognized. Equipment designed, manufactured, and labeled in compliance with IEC standards is not acceptable.

H. The engine generator sets shall fully comply with all current Environmental Protection Agency (EPA) emission regulations including, but not limited to, the New Source Performance Standards (NSPS) for stationary and non-road generator sets. The engine generator set(s) must meet the EPA new source performance requirements required at the time the engine generator set(s) submittal is approved by the engineer. Engines

manufactured previous to the submittal approval date that do not meet the current regulated emissions levels are not acceptable.

I. Reference Section 16000 - Basic Electrical Requirements, and Section 16496, Automatic Transfer Switch.

1.02 CODES AND STANDARDS

A. The packaged engine-generator system shall comply with the following Codes and Standards as a minimum:

1. NEMA MG1, Motors and Generators.

2. NEMA MG2, Safety Standard for Construction and Guide for Selection, Installation and Use of Motors and Generators.

3. ISO STD 8528, Reciprocating Internal Combustion Engines.

4. ISO STD 3046, Performance Standard for Reciprocating Internal Combustion Engines.

5. NFPA 30, Flammable and Combustible Liquids Code.

6. NFPA 37, Standard for Installation and use of Stationary Combustible Engine and Gas Turbines.

7. NFPA 70, National Electrical Code

8. NFPA 70E, Standard for Electrical Safety in the Workplace

9. NFPA 110, Standard for Emergency and Standby Power Systems.

10. UL 508, Industrial Control Equipment.

11. EGSA, Electrical Generating Systems Association.

12. UL 2200 – Stationary Engine Generator Assemblies

13. ANSI C57, Dry-Type Transformers.

14. UL 142, Steel Aboveground Tanks for Flammable and Combustible Liquids.

15. UL 1236 – Standard for Battery Chargers for Charging Engine Starter Batteries.

1.03 SUBMITTALS

A. In accordance with the procedures and requirements set forth in the General Conditions and Section 01350, Project Document Tracking and Control System, the Contractor shall obtain from the equipment manufacturer and submit the following:

1. Shop Drawings

2. Spare Parts List

3. Reports of Certified Shop and Field Tests

4. Operation and Maintenance Manuals

5. Manufacturer's Field Start-up Report

6. Manufacturer's Representative's Installation Certification

B. Each submittal shall be identified by the applicable specification section.

1.04 SHOP DRAWINGS

A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.

B. Partial, incomplete or illegible submittals will be returned to the Contractor without review for resubmittal.

C. Shop drawings for <u>each engine-generator set</u> shall include but not be limited to:

1. A Compliance, Deviations, and Exceptions (CD&E) letter. If the shop drawings are submitted without this CD&E letter, the submittal will be rejected. The letter shall include all comments, deviations and exceptions taken to the Drawings and Specifications by the Contractor AND Equipment Manufacturer/Supplier. This letter shall include a copy of this specification section. In the left margin beside each and every paragraph/item, a letter "C", "D", or "E" shall be typed or written in. The letter "C" shall be for full compliance with the requirement. The letter "D" shall be for a deviation from the requirement. The letter "E" shall be for taking exception to a requirement. Any requirements with the letter "D" or "E" beside them shall be provided with a full typewritten explanation of the deviation/exception. Handwritten explanation of the deviations/exceptions is not acceptable. The CD&E letter shall also address deviations, and exceptions taken to each Drawing related to this specification section.

2. Manufacturers printed specification sheets showing critical engine and generator set specifications including the following:

   - Dimensions, and weights
   - Guaranteed fuel consumption at 25%, 50%, 75% and 100% of full rated load
   - Engine bhp available
   - Brake Mean Effective Pressure (BMEP)
   - Engine jacket water heat rejection
   - Exhaust flow rate and temperature at 100% of rated load
   - Ventilation and combustion air requirements
   - Exhaust backpressure limitation
   - Liquid refill capacities
   - Voltage regulation characteristics
   - Guaranteed noise levels

3. Alternator technical electrical data, including, but not limited to:

   - Alternator efficiency at 50%, 75%, and 100% load
   - Telephone Interference Factor (TIF)
   - Harmonic waveform distortion
   - Type of winding insulation and generator temperature rise
   - Per unit subtransient impedance X'' and X/R ratios for positive, negative, and zero sequences
   - Transient reactance (Xd')
   - Synchronous reactance (Xd)
   - Sub transient time constant (Td'')
   - Transient time constant (Td)
   - DC time constant (Tdc)
   - Decrement curve

4. Manufacturer's printed warranty statement of the engine and generator set showing single source responsibility by the engine manufacturer.

5. Generator control panel equipment and features. Include a written explanation of the auto start/stop logic and operation.

6. Engine-generator set and accessory product data sheets including, but not limited to, the following:

- Alternator strip heater
- Radiator
- Seismically rated vibration isolators
- Flexible exhaust coupling
- Exhaust silencer
- Batteries
- Battery charger
- Engine manufacturers shutdown contactors
- Jacket coolant heater
- Fuel cooler
- Fuel tank(s) and pump(s)
- Fuel level devices
- Output circuit breaker and trip unit
- Conduit
- Wire and Cable
- Wiring Devices
- Lighting

7. Standard dealer preventative maintenance contract for review and possible adoption under a separate contract. Dealer must have existing contracts and personnel and contractual detailed performance information available.

8. Normal operating ranges for systems temperature, pressure and speed.

9. Manufacturer's part number for the engine and generator operation guide, parts book, service manual, warranty policy, and installation guide.

10. Location of other similar units showing compliance with the experience requirements specified herein.

11. Phone numbers of twenty-four (24) hour products support contacts and locations.

12. Drawing showing right hand, left hand, and top views of proposed assembly; battery rack, isolators, exhaust silencer, conduit stub up locations, and flexible fittings; wiring schematics, interconnection diagrams (point to point), and written description of engine generator controls and alarm circuits.

13. Control panel layout drawings and wiring diagrams.

14. Drawings and specifications for base-mounted fuel storage tank with accessories.

15. EPA Certificate of Conformity for Exhaust Emissions

16. Detailed drawings showing plan, front, and side views as well as appropriate section views of the weatherproof, engine-generator enclosure. Include product data sheets for all appurtenances (e.g. exhaust fan, thermostat, lighting, switches, receptacles, combination power unit, etc.) to be furnished and installed in the enclosure. Drawings shall be of sufficient detail to assure proper installation by the Contractor.

17. Detailed drawings of the portable trailer including product data sheets.

D. The shop drawing information shall be complete and organized in such a way that the Engineer can determine if the requirements of these Specifications are being met. Copies of technical bulletins, technical data sheets from "soft-cover" catalogs, and similar information which is "highlighted" or somehow identifies the specific equipment items the Contractor intends to provide are acceptable and shall be submitted.

1.05 REPORTS OF CERTIFIED SHOP AND FIELD TESTS

A. Submit two (2) certified copies of all test reports. This includes all shop tests and field tests. Certified shop test reports for prototype engine-generator sets are unacceptable. The manufacturer's serial number for the actual engine-generator set furnished for this project shall appear on all test reports.

1.06 OPERATION AND MAINTENANCE MANUALS

A. Two (2) preliminary copies of Operation and Maintenance Manuals, prepared specifically for this Project, shall be furnished for each item of equipment furnished under this Contract. The preliminary manuals shall be provided to the Engineer not more than 10 days after the equipment arrives on the project site.

B. The preliminary manuals shall be reviewed by the Engineer prior to the Contractor submitting final copies for distribution to the Owner. Following review of the preliminary copies of the Operation and Maintenance Manuals, one (1) copy will be returned to the Contractor with required revisions noted, or the acceptance of the Engineer noted.

C. Manuals shall contain complete information in connection with assembly, operation, lubrication, adjustment, wiring diagrams and schematics, maintenance, and repair, including detailed parts lists with drawings or photographs identifying the parts. Manuals shall contain all information submitted as part of the shop drawing review process.

D. Manuals furnished shall be assembled and bound in separate volumes, by major equipment items or trades, and properly indexed to facilitate locating any required information. In addition, manuals should be labeled in the front cover with the project, name, equipment description, and manufacturer contract information.

E. Engineer and the Owner shall be the sole judge of the acceptability and completeness of the manuals and may reject any submittal for insufficient information included, incorrect references and/or the manner in which the material is assembled.

F. Following the Engineer's review of the preliminary manuals, the Contractor shall submit five (5) paper copies and two (2) electronic copies of the final Operation and Maintenance Manuals to the Owner. The manuals shall reflect the required revisions noted during the Engineer's review of the preliminary documents, as well as any changes made during installation. Failure of the final manuals to reflect the required revisions noted by the Engineer as well as changes made during installation will result in the manuals being returned to the Contractor. Acceptable final Operation and Maintenance Manuals shall be provided not more than one (1) month after receipt of the Engineer's comments.

1.07 SPARE PARTS

A. Routine maintenance and adjustments shall be performed without the use of special tools or instruments. All spare parts as recommended by the equipment manufacturer shall be furnished to the Owner by the Contractor.

In addition to the manufacturer recommended spare parts, the Contractor shall furnish the following spare parts for each engine-generator set:

No. Required	Description
1	Set of Fuel Oil Particulate Filters
1	Set of Air Filters
1	Set of Lube Oil Filters
1	Set of Fuel Oil/Water Separator Filters
1	Set of Coolant Filters

B. The spare parts shall be packed in containers suitable for long term storage, bearing labels clearly designating the contents and the pieces of equipment for which they are intended.

C. Spare parts shall be delivered at the same time as the equipment to which they pertain. The Contractor shall properly store and safeguard such spare parts until completion of the work, at which time they shall be delivered to the Owner.

D. Spare parts list, included with the shop drawing submittal, shall indicate specific sizes, quantities, and part numbers of the items to be furnished. Terms such as "1 lot of packing material" are not acceptable.

E. Parts shall be completely identified with a numerical system to facilitate parts inventory control and stocking. Each part shall be properly identified by a separate number. Those parts which are identical for more than one size, shall have the same parts number.

F. The dealer shall have sufficient parts inventory to maintain over-the-counter availability of at least 90% of any required part and 100% availability within 48 hours.

1.08 IDENTIFICATION

A. Each engine-generator set shall be identified with the identification name/number indicated on the Drawings (e.g., Generator G1, etc.). A nameplate shall be securely affixed in a conspicuous place on the generator main circuit breaker or output termination box enclosure. Nameplates shall be as specified in Section 16195, Electrical - Identification.

1.09 WARRANTY TERMS

A. The manufacturer's and Dealer's warranty shall in no event be for a period of less than two (2) years or two-thousand (2,000) hours of operation, whichever comes first, from date of delivery of equipment to the project site and shall include repair labor, travel expense necessary for repairs at the jobsite, and expendables (lubricating oil, filters, coolant, and other service items made unusable by the defect) used during the course of repair. Submittals received without written warranties as specified shall be rejected in their entirety.

B. Provided warranty shall cover all equipment included in the scope of supply. This warranty shall include, but is not limited to, the following:

- Engine-generator set and respective auxiliary equipment
- All controls for the engine-generator set

C. Batteries shall be provided with two (2) year full replacement guarantee, and a pro-rated replacement schedule thereafter.

1.10 OIL SAMPLING KIT

A. The generator set supplier shall provide an oil sampling analysis kit which operating personnel shall utilize for scheduled oil sampling. All equipment needed to take oil samples shall be provided in a kit and shall include the following:

1	Sample extraction gun
10	Bottles
10	Postage-paid mailers
1	Written instructions

An additional oil sampling kit shall be made available to the Owner to continue the sampling

when the above specified kit has been depleted. All kits in addition to that specified above shall be at an additional cost to the Owner, if the Owner desires to continue the sampling service.

1.11 PREVENTIVE MAINTENANCE AGREEMENT

A. The engine/generator set supplier shall provide a preventive maintenance agreement using qualified factory trained service personnel, for a period of 2-year minimum. Provide all recommended fluids, dealer labor, travel labor and travel mileage to complete the suggested preventive maintenance as defined in the manufacturer's Operation and Maintenance Manual and as listed below. All parts shall be new and provided by the generator manufacturer. The maintenance agreement shall include the following as a minimum:

1. Check oil level, check oil pressure safety shutdown switches, complete an oil sample analysis, check oil pressure and gauges, and inspect the system for leaks. Change oil and oil filter if required.

2. Check coolant level, inspect/replace cooling system hoses, check high/low temperature alarms and shutdowns, inspect radiator, inspect fan and fan belts (tighten or replace as required). Flush coolant system and replace coolant if required.

3. Inspect the fuel system including fuel pumps and tank(s), check fuel pressure, inspect fuel filters and replace if required, and check for water in fuel storage tank.

4. Check the battery and battery charging system including a voltage test, check and clean battery terminals, check and inspect engine starting system.

5. Inspect and test the generator, check bearing grease and add grease if required, check terminations, and complete a generator winding insulation resistance (i.e. megger test).

6. Check engine control system including overspeed alarms and shutdowns, overcrank alarm, engine starter, circuit breaker and fuses, and test and adjust engine governor.

7. Check and the engine air intake and exhaust systems for leaks and damage. Check air filter and replace if required.

8. Test automatic transfer switch. Check all indicating lights and replace as required.

9. Inspect all components of the generator enclosure including, but not limited to, lights, louvers, fans, doors, etc.

PART 2 -- PRODUCTS

2.01 MANUFACTURERS

A. The equipment covered by this Specification is intended to be standard equipment of proven performance as manufactured by reputable concerns. Equipment shall be designed, constructed and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as shown on the Drawings.

B. Consideration will be given only to the equipment of those manufacturers who have furnished comparable size diesel engine-generator sets for at least two similar installations that have been in regular successful operation for not less than five (5) years.

C. The engine-generator set manufacturers shall be Cummins, Caterpillar, or Kohler. No substitutions shall be permitted. The engine-generator set manufacturer and/or dealer shall be responsible for the entire engine-generator package including the engine-generator set with all accessories and equipment specified herein and all other devices required for a complete and operable system.

2.02 GENERAL DESCRIPTION

A. The engine-generator set shall be rated as specified herein and as indicated on the Drawings. It shall have the capability to operate at its standby rating for the duration of any power outage with all accessories including engine running devices, silencer, radiator, cooling fans, fuel system, and all appurtenances complete as it would be installed in the field.

2.03 ENGINE

A. The engine shall be diesel, 4 cycle, radiator cooled, and shall be turbocharged having an operating speed of 1800 RPM. Engine shall operate on ASTM D-975 Grade No. 2D S15 ultra-low sulfur diesel fuel. Engines requiring any other fuel type are not acceptable.

B. The engine will not be acceptable if the design is a conversion of a naturally aspirated engine to which a turbo-blower has been attached, unless the engine is certified by the manufacturer as having been analyzed and redesigned with ample provisions for increased stresses and bearing or heat loads due to increased pressures and rate of heat liberation.

C. Break mean effective pressure (BMEP) shall not exceed 320 psi at rated load. Brake Horsepower (BHP), and Engine-Generator efficiency shall conform with ASME, IEEE and NEMA standards that electrical energy delivered by the machine is within the minimum certified guaranteed fuel oil consumption rate and evidence that these parameters have been met shall be furnished.

D. Only engine manufacturers' standard ratings shall be acceptable. No dealer special ratings will be acceptable.

E. The specified standby kW rating shall be for continuous electrical service during interruption of the normal utility source, per NEMA standards.

F. Engine speeds shall be governed by an electronic isochronous governor that will sense generator speed and provide accurate load transient correction capability at less than 0.5 percent regulation, from no load to full load generator output.

2.04 ALTERNATOR

A. The alternator shall conform with NEMA and IEEE standards and be rated as indicated on the Drawings. The alternator shall have a UL 2200 listing. The alternator shall be brushless, salient pole, 2/3 pole pitch and synchronous for operation at 480VAC, wye connected, as indicated on the Drawings. The generator shall be capable of delivering 700 SkVA (minimum) at an instantaneous voltage dip of no more than 20% voltage drop.

B. Laminations and windings shall be designed for minimum reactance, low voltage waveform distortion and maximum efficiency.

C. The main stator coils shall be random wound. Insulation shall be Class H, 105 degrees C rise according to NEMA standards. The insulation system shall be made of epoxies and polyesters which are inorganic compounds and shall prevent fungus growth.

D. The rotor shall be dynamically balanced and include amortisseur windings to minimize voltage deviations and heating effects under unbalanced load conditions.

E. Radio interference suppression (both directions) shall be provided in accordance with NEMA and IEEE Standards.

F. The alternator shall have a brushless, permanent magnet generator (PMG) excitation support system to provide input to the automatic voltage regulator to enable the alternator to support 300% of rated current for 10 seconds to allow fault clearing.

G. Waveform deviation shall not exceed 5% from true sine wave. The transient response from no load to full load in one step of the engine-generator set shall not exceed a voltage dip of 35%, a frequency dip of 20%, and shall recover to complete steady state performance within 12 seconds for both voltage and frequency. The transient response from full load to no load in one step shall not exceed a voltage overshoot of 7% and shall recover to steady state performance within 3 seconds. Transient performance shall be in accordance with ISO 8528.

H. The Telephone Influence Factor (TIF) shall be less than 50.

I. The voltage regulator shall be an adjustable, solid-state, three-phase RMS sensing, volts/hertz type. Voltage regulation shall be a minimum of +/-0.25% from no load to continuous rating. The voltage regulator shall provide +/-10% voltage adjustment. The voltage regulator shall be located within the engine control panel.

J. An alternator mounted strip heater shall be furnished and installed as part of the system. The strip heater shall be energized to prevent condensation when the engine generator set is not running.

2.05 CONTROLS

A. Engine-generator monitoring and controls shall be mounted in a single NEMA 1 (gasketed) dust-tight enclosure. A suitable accessible terminal strip having all wires properly identified shall be furnished within the enclosure. The control panel shall be mounted at a height of 4'-8" measured from the center of the panel to the equipment pad or enclosure floor.

B. The control panel shall accept a dry contact input for engine starting from remote locations. The starting and stopping of the engine-generator set shall be initiated through the control panel only. When the engine starts, starting control shall automatically disconnect cranking controls. Four (4) cranking cycles of 10 seconds "ON", 10 seconds "OFF" shall be provided. The starting controls shall prevent re-cranking for a definite time after source voltage has been reduced to a low value, or the four (4) cranking cycles have been reached without a successful start. The automatic engine starting controls shall use industrial rated control type elements throughout, and controls shall have the capability to operate at 50% battery voltage.

C. Speed sensing shall be provided to protect against accidental starter engagement with a moving flywheel. Battery charging alternation output voltage is not acceptable for this purpose.

D. A generator/exciter field circuit breaker with shunt trip device shall be furnished and installed as part of the engine generator set. Shunt trip shall be activated upon engine-generator fault conditions.

E. A main line circuit breaker as specified herein and sized as indicated on the Drawings shall be installed as a load circuit interrupting and protection device in a NEMA 1 (gasketed) dust-tight enclosure. The circuit breaker shall be provided with adjustable long-time, short-time, and instantaneous settings. The circuit breaker shall contain an electronic trip unit with ground fault. It shall operate both manually for normal operation and automatically for protection against overload or short circuits. Generator/exciter field circuit breakers are not acceptable for this service.

The circuit-breakers described above shall be manufactured and tested in accordance with U.L. and NEMA AB1 standards. Their interrupting rating shall be suitable for the available fault current. All electrical ratings shall be suitable for the application.

F. Engine-generator monitoring and control shall be provided using a microprocessor based control panel complete with an LCD display. The devices necessary for automatic starting shall be on the engine and in the engine control panel. The following hardware (minimum) shall be provided on the front of the control panel; the use of the LCD display and keypad to accomplish the same function is not acceptable:

1. Keyed engine control mode switch (Run-Off-Auto)

2. Large, red emergency stop pushbutton

3. Generator voltage adjust potentiometer

4. Generator frequency adjust potentiometer

G. The following parameters (minimum) shall be shown on the LCD display or otherwise be indicated at the control panel:

1. Engine oil pressure

2. Coolant temperature

3. Generator output voltage

4. Generator output current

5. Generator elapsed run time

6. Generator output frequency

7. Engine run

8. Engine fail

9. Low coolant temperature

10. Pre-high engine temperature

11. Pre-low fuel level

12. Engine speed (RPM)

H. The following events (minimum) shall cause an immediate shutdown of the engine-generator set if it operating, or prevent starting if it is not operating. The specific event that causes the

shutdown/prevents starting shall be shown on the LCD display or otherwise be indicated at the control panel. A reset shall be required to clear the fault and allow the unit to operate:

1. Engine coolant high temperature
2. Engine low oil pressure
3. Low fuel level
4. Engine overspeed
5. Engine overcrank
6. Engine tried to start but failed
7. Low coolant level

I. The generator control panel shall have a communication port capable of transmitting all available engine-generator set data via Modbus RTU protocol.

J. The generator control panel shall have Form C dry contacts rated 5A (minimum) at 120VAC/24VDC for the following signals:

1. Engine coolant high temperature
2. Engine low oil pressure
3. Pre-low fuel level
4. Low fuel level
5. Engine overspeed
6. Engine overcrank
7. Engine tried to start but failed
8. Low coolant level
9. Engine fail
10. Engine run

The normally closed (NC) contacts for all of the above signals (except engine run and Pre-low fuel level) shall be wired in series to provide a common "Generator System Failure" alarm for remote indication. Other contacts shall also be wired as a part of this alarm as specified elsewhere herein.

K. The generator control panel shall have provisions to accept remote Start.and Stop commands from the plant control system as shown on the P&ID drawings.

2.06 ENGINE ACCESSORIES

A. Furnish and install the engine with all accessory equipment and appurtenances which are required for proper operation, including the following:

1. Heavy duty dry type air filler with restriction indicator

2. Heavy duty lubricating oil filter, bypass type, with replaceable absorbent-type elements

3. Lubricating oil cooler, water cooled

4. Heavy duty fuel oil filter, spin-on, with non-replaceable absorbent-type elements

5. Fuel oil fuel/water separator

6. Heavy duty crankcase vapor coalescer

7. Radiator mounted fuel cooler to cool recirculated fuel before it is re-deposited into the fuel tank as recommended by the manufacturer.

2.07 MOUNTING

A. Couple the engine and generator together through a flexible, non-backlash type, all metal coupling which overcomes all normal misalignment stresses and transmits full engine torque with ample safety factor. Also provide flexible connections for piping connections.

2.08 COOLING SYSTEM

A. Provide a radiator manufactured of a non-corrosive material mounted on the engine. The radiator core shall be coated with a corrosion resistant coating. Corrosion resistant coating shall be a corrosion resistant baked phenolic coating or similar.

B. Connect the radiator to the engine internal cooling system with flexible piping. Furnish appropriately sized coolant expansion tank for the cooling system.

C. The engine shall be cooled through a radiator sized to continuously maintain safe operation at full load and at 105°F outside ambient air with 50% ethylene glycol coolant. A blower type fan and low noise fan drive and controls shall be furnished. The fan and all rotating members and drive belts shall be guarded and meet OSHA standards. Proof of 105°F ambient temperature capability shall be required.

D. Coolant

1. After the cooling system is flushed and cleaned, provide an initial fill of coolant consisting of 50% ethylene glycol. An anti-corrosion treatment shall be added during the initial fill.

2. The coolant shall meet the requirements of the generator manufacturer including corrosion inhibitors provided in the coolant to protect the engine cooling system.

E. The engine shall be equipped with coolant heaters. Heaters shall be in accordance with the following:

1. Unit mounted thermal circulation type water heaters shall be furnished to maintain engine jacket water temperature as recommended by manufacturer in an ambient temperature of 30°F.

2. The heater shall be of sufficient capacity to keep the coolant at a suitable temperature for trouble-free starting.

3. Each heater shall be provided with a suitable contactor to automatically disconnect the heater when the engine is started.

2.09 ENGINE STARTING AND CHARGING SYSTEM

A. Engine starting batteries shall be sealed, lead-acid type, rated 12 volts, wired for 12V starting batteries shall have adequate capacity for rolling the engine for five (5), ten (10) second cycles without starting, and then operating the control devices in the local generator controls for two (2) hours. The batteries shall be mounted on a suitable non-corrosive rack. Batteries shall have battery cables with lugs and shall be provided with lugs for connection to the battery charger.

B. Battery charger shall be a U.L. 1236 listed, automatic, solid-state battery charger, 20 A (min.) current limited, ±2% voltage regulation, ±10% line voltage variation, automatic float equalizing system, DC voltmeter, and DC ammeter. Provide a Form C unpowered (dry) contact to indicate a low battery alarm condition.

C. In addition, the engine shall be provided with an engine battery charging alternator that automatically changes the starting batteries during engine operation.

2.10 EXHAUST SILENCER

A. Furnish and install an exhaust silencer. Silencers shall be of critical type and sized to produce a high degree of silencing. Reference the sound attenuation requirements specified herein.

B. Connect the silencer to the engine exhaust manifold with a high corrosion and temperature resistant stainless steel flexible convoluted exhaust pipe. Use flange-type connections. Provide a taper-cut tail pipe complete with rain cap to exhaust the gases to the atmosphere.

C. The silencer (if installed inside), exhaust piping, and expansion fittings, including collector box, shall be completely covered with a removable insulation blanket in order to protect operating personnel and to reduce noise. Insulation shall be of composite fiberglass and stainless steel construction capable of withstanding 1200°F continuously. The insulation blankets shall be tailored and custom fabricated to fit the contours of the manifolds. Average weight of the insulating blanket shall be 1.5 psf. Insulation shall conform to MIL-1-16411D, Type II and shall be custom fabricated to fit the contours of the components.

D. The silencer system shall be designed, furnished, and installed to prevent moisture and condensation from corroding the silencer. All exterior components of the exhaust system shall be of 316 stainless steel.

E. Silencer shall be mounted within or exterior to the generator enclosure dependent on generator size and manufacturers standards. Silencers mounted on the outside of the enclosure shall be 316 stainless steel construction on its interior and exterior. Silencers mounted within the generator enclosure shall be painted steel and insulated using a calcium silicate material covered by a brushed aluminum skin.

2.11 WIRING

A. Furnish and install internal wiring in the engine-generator set. All internal wiring between the generator and engine-generator control panel, the on-board power source and all accessories shall be provided.

2.12 AUTOMATIC TRANSFER SWITCH

A. Furnish and install an automatic transfer switch as indicated on the Drawings and specified in Section 16496, Automatic Transfer Switch. The switch and its operation shall be considered to be part of the standby generator system.

2.13 BASE MOUNTED FUEL TANK

A. The generator set shall be supplied with a U.L.-142 listed base mounted fuel tank of sufficient capacity to operate the engine-generator set at full load for a minimum of 24 hours. The tank, painted in a color as selected by the Owner, shall be fabricated from steel with a rupture basin and leak detector system. The alarm and indicator for the leak detection shall be mounted adjacent to the generator control panel and a contact for remote indication of a fuel leak condition shall be provided. This contact shall be wired as part of a common "Generator System Failure" alarm.

B. A level device shall also be furnished and installed to provide a local (generator control panel) and remote indication of pre-low fuel tank level and low fuel tank level. The pre-low fuel tank level shall activate a set of dry contacts for remote alarm indication. The low fuel tank level alarm shall shut down the engine to prevent the fuel level from dropping below the fuel pickup piping in the fuel tank. The pre-low fuel level alarm shall activate when only 6 hours of fuel for full load operation remains in the fuel tank. The remote low fuel tank level alarm shall be wired separate from the "Generator System Failure" alarm.

C. The tank shall be supplied with all necessary fuel supply, return, vent, and fill fittings and a fuel level gauge. The lockable fill port and level gauge shall be easily accessible from outside the enclosure. Provide a valve that automatically closes the fuel fill inlet when the tank level reaches 95% of its capacity. The vent line shall be piped to the outside and be equipped with a fill whistle.

D. The underside of the tank shall not be in contact with the mounting surface (concrete pad).

2.14 WEATHERPROOF ENGINE - GENERATOR ENCLOSURE

A. Furnish and install an outdoor, weather-protective housing. The housing shall be furnished complete with a full sub-base floor resulting in complete enclosure. The enclosure shall be factory-assembled to the engine-generator set base and radiator cowling. Lifting eyes shall be provided. Housing shall provide ample airflow for generator set operation. The housing shall be constructed of 12 gauge (minimum) aluminum or 14 gauge (minimum) galvanized steel, reinforced to be vibration free in the operating mode. The housing shall have hinged side-access doors and rear control panel access door. Each door shall have at least two latch-bearing points. All doors shall be lockable. All steel sheet metal shall be primed for corrosion protection and finish painted in a color as selected by the Owner. Roof shall be peaked to allow drainage of rain water. Unit shall have sufficient guards to prevent entrance by small animals. Batteries shall fit inside enclosure and alongside the engine (batteries under the generator are not acceptable). Unit shall have engine coolant and oil drains piped to outside the unit to facilitate maintenance. Each drain line shall have a valve located near the fluid source.

B. A “Skin-tight” housing shall be provided. No walk-around access is required within the enclosure. Access doors shall be provided so that when opened, adequate working clearance is achieved in front of electrical equipment.

C. Enclosure shall be sound attenuated to provide sound level as specified herein.

D. All hardware (nuts, bolts, screws, washers, etc.) that is installed on the exterior of the generator enclosure shall be stainless steel. Galvanized steel hardware is not acceptable.

E The Contractor shall provide aluminum platform stairs and aluminum handrail shall be furnished at each door as shown on the drawings.

G. Convenience receptacles shall be furnished within the enclosure. Receptacles shall be 125V, 20A, two-pole, three wire grounded type. Reference Section 16141.

I. Conduit and wire shall be in accordance with Sections 16111 and 16123, respectively.

J. All air intake louvers shall be furnished with rain guards or designed to eliminate water intrusion to the interior of the enclosure when the generator is operating at full load (maximum airflow) during rain events.

2.15 SOUND ATTENUATION

A. Extreme care shall be exercised in providing equipment for and setting the engine-generator in place to guard against excessive noise transmission and vibrations. Fasten to the underside of the skids seismically-rated spring type isolators.

B. The engine-generator enclosure shall be designed, furnished, and installed to reduce source noise to 70 dB(A) as measured at seven (7) meters from the enclosure.

PART 3 -- EXECUTION

3.01 INSTALLATION

A. The standby generator system shall be furnished and installed as indicated on the Drawings and as recommended by the equipment manufacturer.

B. The initial filling of the fuel storage tank shall be provided by the Contractor. Fuel tank shall be filled to its full capacity. At the conclusion of all field testing, the Contractor shall fill the fuel storage tank back to its full capacity. Fuel shall be ultra-low sulfur diesel Grade No. 2D S15 in accordance with ASTM D-975. Fuel shall be new and free from contaminants and water.

3.02 SERVICES OF MANUFACTURER'S REPRESENTATIVE

A. The Contractor shall provide the services of a qualified generator manufacturer's factory-

trained technical representative who shall adequately supervise the installation and of all equipment furnished under this Contract. The manufacturer's representative shall certify in writing that the equipment has been installed in accordance with the manufacturer's recommendations. No further testing or equipment startup may take place until this certification is accepted by the Owner.

B. The manufacturer’s technical representative shall perform all startup and field testing of the generator assembly as specified herein.

C. The Contractor shall provide training for the Owner’s personnel. Training shall be conducted by the manufacturer's factory-trained representative who shall instruct Owner’s personnel in operation and maintenance of all equipment provided under this Section. Training shall be provided for two (2) sessions of four (4) hours each. Training shall not take place until after the generator has been installed and tested. Training shall be conducted at times coordinated with the Owner and shall occur during the same week as the training specified in Section 16496 – Automatic Transfer Switch.

D. The services of the manufacturer's representative shall be provided for a period of not less than as follows:

1. One (1) trip of two (2) working days during installation of the engine-generator set.

2. One (1) trip of one (1) working day to perform startup of the engine-generator set.

3. One (1) trip of two (2) working days to perform the field testing of the engine-generator set.

4. One (1) trip of one (1) working day to perform training as specified herein.

E. Any additional time required to achieve successful installation and operation shall be at the expense of the Contractor.

3.03 TESTING

A. All tests shall be performed in accordance with the requirements of the General Conditions and Division 1. The following tests are required:

1. Witnessed Shop Tests

a. None required.

2. Certified Shop Tests

a. Fully test the engine-generator set with all accessories in the manufacturer's

plant before shipment. Tests shall be conducted through the use of balanced, three-phase, dry-type, resistive load banks.

b. Record complete test data for frequency, amperes, volts, power factor, exhaust temperature, coolant temperature, and oil pressure.

c. The manufacturer shall conduct a shop test run of at least six (6) consecutive hours for the set under the following conditions of load, in the following order:

3 hours - full load
1 hour - 3/4 load
1 hour - 1/2 load
1 hour - 1/4 load

d. Fuel, lubricants, and other fluids as required for the shop tests shall be furnished by the manufacturer.

2. Field Tests

a. Field tests shall be performed by the generator manufacturer's technical representative. The Contractor shall obtain from the manufacturer and submit a detailed field test plan and procedures documenting the intended field test program.

b. In the presence of the Engineer and Owner, the representative shall inspect, adjust, and test the entire system after installation and leave in good working order. Field tests specific to each generator shall be conducted after the entire engine-generator system is installed including, but not limited to, the following: diesel fuel tanks including leak detection, exhaust silencer, radiators, enclosures, batteries, and all other equipment included in the complete system.

c. Field test the generator enclosure to ensure the enclosure performs as specified herein. The generator enclosure field tests shall include water tests to confirm the enclosure does not leak and that the air intake louvers eliminate water intrusion to the interior of the generator enclosure when the generator is operating at its full load capacity (maximum airflow). A garden hose shall be used to simulate falling rain for this test. Water supply and garden hose will be provided by the Owner for this test.

d. Field test, as far as practicable, all control, shutdown, and alarm circuits. Document the successful completion of these tests as witnessed by the Owner and the Engineer.

e. Generator load tests shall be conducted through the use of balanced, three-phase, dry-type, reactive (0.8 power factor) load banks. Conduct a continuous run test using the load bank without shutdown for the engine-generator set under the following load conditions (in this specific order) and in the presence of the Owner and Engineer:

- 5 hours, full load
- 1 hour, 3/4 load
- 1 hour, 1/2 load
- 1 hour, 1/4 load

Record complete test data for frequency, amperes, volts, power factor, exhaust temperature, coolant temperature, and oil pressure every 15 minutes during the continuous run test. If any failures, malfunctions, and/or shutdowns occur during this test, the problems shall be fixed and the test shall be restarted. The test shall not be considered complete until the generator has operated for eight (8) consecutive hours without any shutdowns under the conditions listed above.

f. After successful completion of the load bank tests, the generator system shall then be operated for a minimum of four (4) hours with plant loads during a time period when the plant is operating at average demand. The same data shall be recorded at 15 minute intervals for this load test as for the load bank test.

h. Demonstrate the system will transfer properly with generator operating.

i. The Contractor shall collect a sample of engine oil from each engine for analysis after the start-up and testing has been completed. The sampling method shall be of the atomic absorption spectrophotometry method and be accurate to within a fraction of one part per million for the following elements:

- Iron
- Chromium
- Copper
- Aluminum
- Silicon
- Lead

The sample shall also be tested for the presence of water, fuel dilution, and coolant.

The oil samples shall be analyzed at an independent laboratory that is not a part of the engine supplier's facility. Immediate notification of critical results shall be provided to the Owner when the analysis shows any critical reading.

j. All fuel, lubricants, and other fluids required to complete all field tests shall be paid for by the Contractor.

3.04 PAINTING

A. Prior to final completion of the work, all metal surfaces of the equipment shall be cleaned thoroughly, and all scratches and abrasions shall be retouched with the same coating as used for factory finishing coats.

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SECTION 16902
ELECTRIC CONTROLS AND RELAYS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall furnish, install, test, and place in satisfactory operation all electric controls and relays as specified herein and indicated on the Drawings.

B. Electrical control and relay systems shall be assembled using NEMA rated components. Components designed and built to International Electrotechnical Commission (IEC) standards are not recognized. Equipment designed, manufactured and labeled in compliance with IEC standards is not acceptable.

C. Reference Section 16000, Basic Electrical Requirements and Section 16195, Electrical Identification.

1.02 CODES AND STANDARDS

A. Products specified herein shall be in conformance with or listed to the following standards as applicable:

1. NEMA 250 – Enclosures for Electrical Equipment

2. UL 508A – Standard for Industrial Control Panels

3. UL-1203 – Standard for Explosion-proof and Dust-ignition-proof Electrical Equipment for use in Hazardous (Classified) Locations.

4. ANSI/ISA 12.12.01-2013 – Nonincendive Electrical Equipment for use in Class I and II, Division II Hazardous (Classified) locations.

1.03 SUBMITTALS

A. In accordance with the procedures and requirements set forth in the General Conditions and Section 01350, Project Document Tracking and Control System, the Contractor shall obtain from the equipment manufacturer and submit the following:

1. Shop Drawings

2. Spare Parts List

B. Each submittal shall be identified by the applicable specification section.

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1.04 SHOP DRAWINGS

A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.

B. Partial, incomplete or illegible submittals will be returned to the Contractor without review for resubmittal.

C. Shop drawings shall include but not be limited to:

1. Product data sheets.

D. The shop drawing information shall be complete and organized in such a way that the Engineer can determine if the requirements of these Specifications are being met. Copies of technical bulletins, technical data sheets from "soft-cover" catalogs, and similar information which is "highlighted" or somehow identifies the specific equipment items the Contractor intends to provide are acceptable and shall be submitted.

1.05 SPARE PARTS

A. All spare parts as recommended by the equipment manufacturer shall be furnished to the Owner by the Contractor. In addition to the manufacturer recommended spare parts, the following spare parts shall be provided for the local control stations:

1. One (1) contact block of each type furnished on the project

2. One (1) indicating light lens of each color furnished on the project

3. One (1) LED lamp of each color furnished on the project

B. The spare parts shall be packed in containers suitable for long term storage, bearing labels clearly designating the contents and the pieces of equipment for which they are intended.

C. Spare parts shall be delivered at the same time as the equipment to which they pertain. The Contractor shall properly store and safeguard such spare parts until completion of the work, at which time they shall be delivered to the Owner.

D. Spare parts lists, included with the shop drawing submittal, shall indicate specific sizes, quantities, and part numbers of the items to be furnished. Terms such as "1 lot of packing material" are not acceptable.

E. Parts shall be completely identified with a numerical system to facilitate parts control and stocking. Each part shall be properly identified by a separate number. Those parts which are identical for more than one size, shall have the same part number.

PART 2 -- PRODUCTS

2.01 CONTROL COMPONENTS

A. Manufacturers

1. Control components shall be manufactured by Eaton, The Square D Company, General Electric, Allen-Bradley, Siemens Energy and Automation, or Engineer approved equal.

B. Pilot Devices

1. General

a. All pilot devices shall be provided with a legend plate. Legend plates shall have a white background and black lettering and indicate the function of the respective pilot device. The text shown on the Drawings or indicated in the specifications shall be used as the basis for legend plate engraving (i.e. HAND-OFF-AUTO, RUN, EMERGENCY STOP, etc).

b. All pilot devices shall be selected and properly installed to maintain the NEMA 250 rating of the enclosure in which they are installed. All pilot devices shall be UL 508 Listed.

c. All pilot devices shall be 30.5mm in diameter, unless otherwise indicated. 22mm devices are not acceptable.

d. Pilot devices for all electrical equipment under this Contract shall be of the same type and manufacturer unless otherwise specified herein or indicated on the Drawings.

e. In Class 1 Division 2 hazardous locations, pilot devices shall be the hermetically-sealed type, constructed in accordance with ANSI/ISA 12.12.01.

2. Pushbuttons

a. Pushbuttons shall be non-illuminated, black in color, and have momentary style operation unless otherwise indicated on the Drawings.

b. Pushbuttons shall have the quantity of normally closed and/or normally open contacts as indicated on the Drawings and as required. In addition to the required contacts, one (1) spare normally open and one (1) spare normally closed contact shall be installed at each pushbutton. Contacts shall be rated for 5A at 250VAC/DC (minimum), but no less than required for the application.

c. Pushbuttons shall be provided with a full guard around the perimeter of the button. Where a lockout style pushbutton is specified or indicated on the Drawings, provide a padlockable guard.

3. Selector Switches

a. Selector switches shall be non-illuminated, black in color, and have the number of maintained positions as indicated on the Drawings and as required. Handles shall be the extended type that provide a greater surface area for operation.

b. Selector switches shall have the quantity of normally closed and/or normally open contacts as indicated on the Drawings and as required. In addition to the required contacts, one (1) spare normally open and one (1) spare normally closed contact shall be installed at each selector switch. Contacts shall be rated for 5A at 250VAC/DC (minimum), but no less than required for the application.

c. Where indicated in the Drawings or Specifications, provide spring return positions.

d. Selector switches shall be provided with an indexing component that fits into the keyed portion of the cutout for the device and prevents the switch from spinning when operated.

4. Indicating Lights

a. Indicating lights shall LED type, with the proper voltage rating to suit the application, and push-to-test feature.

b. Indicating light lens colors shall be as required in equipment specifications and/or as indicated on the Drawings. If lens colors are not indicated, the following colors shall be used:

i. Red - "Run", "On", “Open”

ii. Green - "Off", “Closed”

iii. Amber - "Alarm", "Fail"

iv. White - “Control Power On”

5. Emergency Stop and Tagline Switches

a. Emergency stop switches shall be non-illuminated, red in color, with a minimum 35mm diameter mushroom head. Once activated, switch shall maintain its position and require a manual pull to release/reset.

b. Tagline switches shall have a plunger that activates upon tension from the associated safety cable. Once activated, switch shall maintain its position and require a manual release/reset.

c. Emergency stop and tagline switches shall have the quantity of normally closed and/or normally open contacts as indicated on the Drawings and as required. In addition to the required contacts, one (1) spare normally open and one (1) spare normally closed contact shall be installed at each switch. Contacts shall be rated for 5A at 250VAC/DC (minimum), but no less than required for the application.

C. Relays and Timers

1. General

a. Relays and timers shall be furnished with an integral pilot light for positive indication of coil energization.

b. Relays and timers shall have tubular pin style terminals with matching 11-pin DIN rail mount socket. Spade or blade style terminals are not acceptable.

c. Relays and timers for all electrical equipment under this Contract shall be of the same type and manufacturer unless otherwise specified herein or indicated on the Drawings.

2. Control and Pilot Relays

a. Miniature or "ice-cube" type relays are not acceptable.

b. Relays shall have coil voltage as required to suit the application and/or as indicated on the Drawings.

c. Relays shall be provided with contacts rated for 10A (resistive), minimum, at 120/240 VAC and 28 VDC. Relays shall have 3-pole, double-throw (3PDT) contact arrangement.

3. Time Delay Relays

a. Timers delay relays shall utilize electronic timing technology. Mechanical timing devices are not acceptable.

b. Relays shall have coil voltage as required to suit the application and/or as indicated on the Drawings.

c. Relays shall be provided with contacts rated for 10A (resistive), minimum, at 120/240 VAC and 28 VDC. Relays shall have double-pole double-throw (DPDT) contact arrangement.

d. Time delay ranges shall be as indicated on the Drawings and/or as required to suit the application. Timing range shall be adjustable from the front of the relay. On delay and off delay timer configurations shall be provided as indicated on the Drawings and/or as required to suit the application.

4. Elapsed Time Meters

a. Elapsed time meters shall be non-resettable type with no less than a 4 digit display. Coil voltage shall be as required to suit the application and/or as indicated on the Drawings.

D. Control Terminal Blocks

1. Control terminal blocks shall be assembled on non-current carrying galvanized steel DIN mounting rails securely bolted to the enclosure or subpanel. Terminals shall be tubular screw type with pressure plate that will accommodate wire size range of #22 - #8 AWG.

2. Control terminal blocks shall be single tier with a minimum rating of 600 volts and 20A. Separate terminal strips shall be provided for each type of control used (i.e. 120VAC vs. 24VDC). Quantity of terminals shall be provided as required to suit the application. In addition, there shall be a sufficient quantity of terminals for the termination of all spare conductors.

3. Terminals shall be marked with a permanent, continuous marking strip, with each terminal numbered. One side of each terminal shall be reserved exclusively for incoming field conductors. Common connections and jumpers required for internal wiring shall not be made on the field side of the terminal.

2.02 LOCAL CONTROL STATIONS

A. Local control stations shall be furnished and installed complete with pushbuttons, selector switches, indicating lights, and other devices as indicated on the Drawings.

B. Specific devices installed in local control stations shall be provided in accordance with the requirements specified elsewhere in this Section.

C. In non-hazardous locations, local control stations shall be furnished with the following enclosure type and material of construction, dependent upon the designation of the area in which they are to be installed. Area designations are indicated on the Drawings.

AREA DESIGNATION	**ENCLOSURE TYPE AND MATERIAL**
Indoor Wet Process Area	NEMA 4X, Type 304 Stainless Steel
Indoor Dry Process Area	NEMA 12, Die Cast Zinc
All Outdoor Areas	NEMA 4X, Type 304 Stainless Steel

D. In hazardous locations, local control stations shall be furnished with the following enclosure type and material of construction, dependent upon the classification of the area in which they are to be installed. Area classifications are indicated on the Drawings.

AREA CLASSIFICATION	**ENCLOSURE TYPE AND MATERIAL**
Class I, Division 1, Group D	NEMA 7, Die Cast Aluminum
Class I, Division 2, Group D	NEMA 4X, Type 304 Stainless Steel

E. Non-metallic enclosures, NEMA 7 enclosures, and NEMA 9 enclosures shall be provided with threaded integral conduit hubs. Conduit hubs shall be external to the enclosure.

F. Local control stations for use in non-hazardous locations shall be UL-508 Listed. Local control stations for use in Class 1 Division 1 and Class 2 Divisions 1/2 hazardous locations shall be UL-1203 Listed. Local control stations for use in Class 1 Division 2 hazardous locations shall be in accordance with ANSI/ISA 12.12.01-2013.

G. Provide a nameplate on each local control station in accordance with Section 16195, Electrical Identification. The name and/or number of the equipment associated with each control station shall be engraved on the nameplate, followed by the words "LOCAL CONTROL STATION".

PART 3 -- EXECUTION

3.01 INSTALLATION

A. Local control stations shall be provided in the enclosure type and material of construction required for the area in which it is installed. Reference the requirements in Part 2 herein, and the area designations indicated on the Drawings.

B. All control components shall be mounted in a manner that will permit servicing, adjustment, testing, and removal without disconnecting, moving, or removing any other component. Components mounted on the inside of panels shall be mounted on removable plates and not directly to the enclosure. Mounting shall be rigid and stable unless shock mounting is required otherwise by the manufacturer to protect equipment from vibration.

Component's mounting shall be oriented in accordance with the component manufacturer's and industries' standard practices.

C. Pilot devices shall be properly bonded to the equipment enclosure door where they are installed. If proper bonding cannot be achieved through the locknuts that affix the device in place, a green colored bonding screw shall be provided on the pilot device. The bonding screw shall be bonded to the equipment enclosure through the use of an insulated green bonding conductor.

D. Local control station covers shall be bonded to the local control station enclosure through the use of an insulated green bonding conductor.

E. Wiring to devices at each local control station shall be provided with enough slack to permit the local control station cover to be removed and pulled at least 6 inches away from the enclosure.

F. Terminal strips, relays, timers, and similar devices shall not be installed on the rear of the panel/cabinet doors. Terminal strips, relays, timers, and similar devices shall not be installed on the side walls of panel/cabinet interiors without written permission from the Engineer.

+ + + **END OF SECTION 16902** + + +

SECTION 17000
CONTROL AND INFORMATION SYSTEM
SCOPE AND GENERAL REQUIREMENTS

PART 1 -- GENERAL

1.01 SCOPE

A. The Contractor shall provide, through the services of an instrumentation and control system subcontractor, all components, system installation services, as well as all required and specified ancillary services in connection with the Instrumentation, Control and Information System. The System includes all materials, labor, tools, fees, charges and documentation required to furnish, install, test and place in operation a complete and operable instrumentation, control and information system as shown and/or specified. The system shall include all measuring elements, signal converters, transmitters, local control panels, digital hardware and software, operator workstations, remote telemetry units, signal and data transmission systems, interconnecting wiring and such accessories as shown, specified, and/or required to provide the functions indicated.

B. The scope of the work to be performed under this Division includes but is not limited to the following:

1. The Contractor shall retain overall responsibility for the instrumentation and control system as specified herein.

2. Furnish and install process instrumentation and associated taps and supports as scheduled or shown on the Drawings, unless otherwise noted or supplied by equipment vendors.

3. Provide final termination and testing of all instrumentation and control system signal wiring and power supply wiring at equipment furnished under Division 17.

4. Furnish, install and terminate all special cables (instruments, printers, telemetry, etc.) furnished under Division 17. Furnish and terminate control system communication network cables furnished under Division 17.

5. Furnish and install surge protection devices for all digital equipment, local control panels, remote telemetry units, and instrumentation provided under this Division, including connections to grounding system(s) provided under Division 16.

6. Coordinate grounding requirements with the electrical subcontractor for all digital equipment, local control panels, remote telemetry units, and instrumentation provided under this Division. Terminate grounding system cables at all equipment provided under this Division.

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7. The pump control system, including control panel, programmable pump controller hardware and software, and related field instruments are provided by the pump supplier as detailed in Section 11440 and subject to the requirements of Division 17.

8. Other field instruments including pressure gauges, magmeters and combustible gas detection systems shall be provided under Division 17 and shall provide inputs to the pump supplier's programmable pump controller.

9. Provide system testing, calibration, training and startup services as specified herein and as required to make all systems fully operational.

C. It is the intent of the Contract Documents to construct a complete and working installation. Items of equipment or materials that may reasonably be assumed as necessary to accomplish this end shall be supplied whether or not they are specifically stated herein.

1.02 RELATED ITEMS

A. Field mounted switches, torque switches, limit switches, gauges, valve and gate operator position transmitters, sump pump controls and other instrumentation and controls furnished with mechanical or electrical equipment not listed in the instrument schedule shall be furnished, installed, tested and calibrated as specified under other Divisions.

B. Additional and related work performed under Division 16 includes the following:

1. Instrument A.C. power source and disconnect switch for process instrumentation, A.C. grounding systems, and A.C. power supplies for all equipment, control panels and accessories furnished under Division 17.

2. Conduit and raceways for all instrumentation and control system signal wiring, grounding systems, special cables and communication network cables.

3. Instrumentation and control system signal wiring.

4. Install control system communication network cables.

5. Furnish and install grounding systems for all digital equipment, local control panels, remote telemetry units, and instrumentation provided under Division 17. Grounding systems shall be complete to the equipment provided under Division 17, ready for termination by the instrumentation subcontractor.

6. Termination of all instrumentation and control system signal wiring at all equipment furnished under other divisions of the Specifications.

7. Final wiring and termination to A.C. grounding systems and to A.C. power sources (e.g. panelboards, motor control centers, and other sources of electrical power).

1.03 GENERAL INFORMATION AND DESCRIPTION

A. Where manufacturers are named for a particular item of equipment, it is intended as a guide to acceptable quality and performance and does not exempt such equipment from the requirements of these Specifications or Drawings. In order to centralize responsibility, it is required that all equipment (including field instrumentation and control system hardware and software) offered under this Division shall be furnished and installed by the instrumentation subcontractor, or under the supervision of the instrumentation subcontractor, who shall assume complete responsibility for proper operation of the instrumentation and control system equipment, including that of coordinating all signals, and furnishing all appurtenant equipment.

B. The Contractor shall retain total responsibility for the proper detailed design, fabrication, inspection, test, delivery, assembly, installation, activation, checkout, adjustment and operation of the entire instrumentation and control system as well as equipment and controls furnished under other Divisions of the Specifications. The Contractor shall be responsible for the delivery of all detailed drawings, manuals and other documentation required for the complete coordination, installation, activation and operation of mechanical equipment, equipment control panels, local control panels, field instrumentation, control systems and related equipment and/or systems and shall provide for the services of a qualified installation engineer to supervise all activities required to place the completed facility in stable operation under full digital control.

C. The instrumentation and control system shall be capable of simultaneously implementing all real-time control and information system functions, and servicing all operator service requests as specified, without degrading the data handling and processing capability of any system component.

D. Control system inputs and outputs are listed in the Input/Output Schedule. This information, together with the functional control descriptions, process and instrumentation diagrams, and electrical control schematics, describes the real-time monitoring and control functions to be performed. In addition, the system shall provide various man/machine interface and data reporting functions as specified in the software sections of this Specification.

E. The mechanical, process, and electrical drawings indicate the approximate locations of field instruments, control panels, systems and equipment as well as field-mounted equipment provided by others. The instrumentation subcontractor shall examine the mechanical, process and electrical drawings to determine actual size and locations of process connections and wiring requirements for instrumentation and controls furnished under this Contract. The instrumentation subcontractor shall inspect all equipment, panels, instrumentation, controls and appurtenances either existing or furnished under other

Divisions of the Specifications to determine all requirements to interface same with the control and information system. The Contractor shall coordinate the completion of any required modifications with the associated supplier of the item furnished.

F. The instrumentation subcontractor shall review and approve the size and routing of all instrumentation and control cable and conduit systems furnished by the electrical subcontractor for suitability for use with the associated cable system.

G. The Contractor shall coordinate the efforts of each supplier to aid in interfacing all systems. This effort shall include, but shall not be limited to, the distribution of approved shop drawings to the electrical subcontractor and to the instrumentation subcontractor furnishing the equipment under this Division.

H. The Contractor shall be responsible for providing a signal transmission system free from electrical interference that would be detrimental to the proper functioning of the instrumentation and control system equipment.

I. The Owner shall have the right of access to the subcontractor's facility and the facilities of his equipment suppliers to inspect materials and parts; witness inspections, tests and work in progress; and examine applicable design documents, records and certifications during any stage of design, fabrication and tests. The instrumentation subcontractor and his equipment suppliers shall furnish office space, supplies and services required for these surveillance activities.

J. The terms "Instrumentation", "Instrumentation and Control System", and "Instrumentation, Control and Information System" shall hereinafter be defined as all equipment, labor, services and documents necessary to meet the intent of the Specifications.

1.04 INSTRUMENTATION AND CONTROL SYSTEM SUBCONTRACTORS

A. Instrumentation and control system subcontractors shall be regularly engaged in the detailed design, fabrication, installation, and startup of instrumentation and control systems for water and wastewater treatment facilities, remote telemetry systems for water supply/distribution systems, and remote telemetry systems for wastewater collection systems. Instrumentation and control system subcontractors shall have a minimum of five years of such experience and shall have completed a minimum of three projects of similar type and size as that specified herein. Where specific manufacturers and/or models of major hardware or software products (PLC, HMI software, LAN, etc.) are specified to be used on this project, the instrumentation and control system subcontractor shall have completed at least one project using that specified hardware or software. As used herein, the term “completed” shall mean that a project has been brought to final completion and final payment has been made. Any instrumentation and control system subcontractor that has been subject to litigation or the assessment of liquidated damages for nonperformance on any project within the last five calendar years shall not be acceptable.

B. Acceptable instrumentation and control system subcontractors shall be CITI, LLC; Custom Controls Unlimited, Inc.; M/R Systems, Inc.; Nix, Purser and Associates, Inc.; Piedmont Automation, Inc.; Revere Control Systems; Sunapsys, Inc.; Systems East, Inc.; Transdyn Controls, Inc.; or equal.

1.05 DEFINITIONS

A. Solid State: Wherever the term solid state is used to describe circuitry or components in the Specifications, it is intended that the circuitry or components shall be of the type that convey electrons by means of solid materials such as crystals or that work on magnetic principles such as ferrite cores. Vacuum tubes, gas tubes, slide wires, mechanical relays, stepping motors or other devices will not be considered as satisfying the requirements for solid state components of circuitry.

B. Bit or Data Bit: Whenever the terms bit or data bit are used in the Specification, it is intended that one bit shall be equivalent to one binary digit of information. In specifying data transmission rate, the bit rate or data bit rate shall be the number of binary digits transmitted per second and shall not necessarily be equal to either the maximum pulse rate or average pulse rate.

C. Integrated Circuit: Integrated circuit shall mean the physical realization of a number of circuit elements inseparably associated on or within a continuous body to perform the function of a circuit.

D. Mean Time Between Failures (MTBF): The MTBF shall be calculated by taking the number of system operating hours logged during an arbitrary period of not less than six months and dividing by the number of failures experienced during this period plus one.

E. Mean Time to Repair (MTTR): The MTTR shall be calculated by taking the total system down time for repair over an arbitrary period of not less than six months coinciding with that used for calculation of MTBF and dividing by the number of failures causing down time during the period.

F. Availability: The availability of a non-redundant device or system shall be related to its MTBF and MTTR by the following formula:

$$A = 100 \times (MTBF/(MTBF + MTTR)) \text{ Percent}$$

The availability of a device or system provided with an automatically switched backup device or system shall be determined by the following formula:

$$A = A2 + 1 - ((1-A1) \times (1-A1))$$

where:

A1 = availability of non-redundant device or system
A2 = availability of device or system provided with an automatically switched backup device or system

G. Abbreviations: Specification abbreviations include the following:

A	-	Availability
ADC	-	Analog to Digital Converter
AI	-	Analog Input
AO	-	Analog Output
AVAIL	-	Available
BCD	-	Binary Coded Decimal
CSMA/CD	-	Carrier Sense Multiple Access/Collision Detect
CPU	-	Central Processing Unit
CRC	-	Cyclic Redundancy Check
CRT	-	Cathode Ray Tube
CS	-	Control Strategy
DAC	-	Digital to Analog Converter
DBMS	-	Data Base Management System
DI	-	Discrete Input
DMA	-	Direct Memory Access
DO	-	Discrete Output
DPDT	-	Double Pole, Double Throw
DVE	-	Digital to Video Electronics
EPROM	-	Erasable, Programmable Read Only Memory
FDM	-	Frequency Division Multiplexing
FSK	-	Frequency Shift Keyed
HMI	-	Human Machine Interface (Software)
I/O	-	Input/Output
LAN	-	Local Area Network
LDFW	-	Lead-Follow
MCC	-	Motor Control Center
MTBF	-	Mean Time Between Failures
MTTR	-	Mean Time To Repair
OS	-	Operating System

PAC	-	Programmable Automation Controller
PCB	-	Printed Circuit Board
PID	-	Proportional Integral and Derivative Control
PLC	-	Programmable Logic Controller
PROM	-	Programmable Read Only Memory
RAM	-	Random Access Memory
RDY	-	Ready
RMSS	-	Root Mean Square Summation
RNG	-	Running
ROM	-	Read Only Memory
RTU	-	Remote Telemetry Unit
SPDT	-	Single Pole, Double Throw
ST/SP	-	Start/Stop
TDM	-	Time Division Multiplexing
UPS	-	Uninterruptible Power Supply

H. To minimize the number of characters in words used in textual descriptions on CRT displays, printouts and nameplates, abbreviations may be used subject to the Engineer's approval. If a specified abbreviation does not exist for a particular word, an abbreviation may be generated using the principles of masking and or vowel deletion. Masking involves retaining the first and last letters in a word and deleting one or more characters (usually vowels) from the interior of the word.

1.06 ENVIRONMENTAL CONDITIONS

A. Instrumentation equipment and enclosures shall be suitable for ambient conditions specified. All system elements shall operate properly in the presence of telephone lines, power lines, and electrical equipment.

B. Inside control rooms and climate-controlled electrical rooms, the temperature will normally be 20 to 25 degrees C; relative humidity 40 to 80 percent without condensation and the air will be essentially free of corrosive contaminants and moisture. Appropriate air filtering shall be provided to meet environmental conditions (i.e., for dust).

C. Other indoor areas may not be air conditioned/heated; temperatures may range between 0 and 40 degrees C with relative humidity between 40 and 95 percent.

D. Field equipment including instrumentation and panels may be subjected to wind, rain, lightning, and corrosives in the environment, with ambient temperatures from -20 to 40 degrees C and relative humidity from 10 to 100 percent. All supports, brackets, interconnecting hardware, and fasteners shall be aluminum, type 316 stainless steel, or

metal alloy as otherwise suitable for chemical resistance within chemical feed/storage areas shown on the installation detail drawings.

PART 2 -- PRODUCTS

2.01 NAMEPLATES

A. All items of equipment listed in the instrument schedule, control panels, and all items of digital hardware shall be identified with nameplates. Each nameplate shall be located so that it is readable from the normal observation position and is clearly associated with the device or devices it identifies. Nameplates shall be positioned so that removal of the device for maintenance and repair shall not disturb the nameplate. Nameplates shall include the equipment identification number and description. Abbreviations of the description shall be subject to the Engineer's approval.

B. Nameplates shall be made of 1/16-inch thick machine engraved laminated phenolic plastic having white numbers and letters not less than 3/16-inch high on a black background.

C. Nameplates shall be attached to metal equipment by stainless steel screws and to other surfaces by an epoxy-based adhesive that is resistant to oil and moisture. In cases where the label cannot be attached by the above methods, it shall be drilled and attached to the associated device by means of stainless steel wire.

PART 3 -- EXECUTION

3.01 SCHEDULE OF PAYMENT

A. Payment to the Contractor for Control and Information System materials, equipment, and labor shall be in accordance with the General and Supplementary Conditions. The schedule of values submitted as required by the General and Supplementary Conditions shall reflect a breakdown of the work required for completion of the Control and Information System. The breakdown shall include sufficient detail to permit the Engineer to administer payment for the Control and Information System as outlined below.

B. The following payment schedule defines project milestones that will be used for establishing maximum partial payment amounts for the Control and Information System. Payment for field instruments, field wiring, fiber optic network cable and similar items will be made in addition to the payment for the scopes of services incorporated into the schedule below.

Task Completed	Maximum Cumulative % Request for Payment
Mobilization	3%
Preliminary Design Review	5%
Approved Submittals	20%
Hardware Purchase (excludes field instruments)	40%
Factory Acceptance Test	60%
Loop Checkout	70%
Control System Start-up and Test	80%
Plant Start-up	90%
Final System Acceptance Test	95%
Final Acceptance	100%

C. Requests for payment for materials and equipment that are not installed on site, but are required for system construction and the factory acceptance test (e.g., digital hardware), or are properly stored as described in the General and Supplementary Conditions and herein, shall be accompanied by invoices from the original supplier to the instrumentation subcontractor substantiating the cost of the materials or equipment.

D. Any balance remaining within the schedule of values for field instruments and other materials installed on the site, or for other materials for which payment is made by invoice, will be considered due upon completion of the Final Acceptance test.

3.02 CLEANING

A. The Contractor shall thoroughly clean all soiled surfaces of installed equipment and materials.

B. Upon completion of the instrumentation and control work, the Contractor shall remove all surplus materials, rubbish, and debris that has accumulated during the construction work. The entire area shall be left neat, clean, and acceptable to the Owner.

3.03 FINAL ACCEPTANCE

A. Final acceptance of the Instrumentation, Control and Information System will be determined complete by the Engineer, and shall be based upon the following:

1. Receipt of acceptable start up completion and availability reports and other documentation as required by the Contract Documents.

2. Completion of the Availability Demonstration.

3. Completion of all specified control system training requirements.

4. Completion of all punch-list items that are significant in the opinion of the Engineer.

B. Final acceptance of the System shall mark the beginning of the extended warranty period.

+ + + END OF SECTION 17000 + + +

SECTION 17030
CONTROL AND INFORMATION SYSTEM SUBMITTALS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall submit for review complete Shop Drawings for all equipment in accordance with the General Conditions and Division 1 of the Specifications. All submittal material shall be complete, legible, and reproducible, and shall apply specifically to this project.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 01300 – Submittals

B. Section 17000 – Control and Information System Scope and General Requirements

1.03 DIGITAL HARDWARE SUBMITTALS

A. Submit system block diagram(s) showing:

1. All equipment to be provided.

2. All interconnecting cable.

3. Equipment names, manufacturer, and model numbers.

4. Equipment locations.

B. Submit information for all digital equipment including, but not limited to, the following:

1. Bill of materials with equipment names, manufacturers, complete model numbers and locations.

2. Catalog cuts, including complete part number breakdown information.

3. Complete technical, material and environmental specifications.

4. Assembly drawings.

5. Mounting requirements.

6. Color samples.

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7. Nameplates.

8. Environmental requirements during storage and operation.

1.04 SOFTWARE SUBMITTALS

A. Software submittals shall include the following as a minimum:

1. Bill of materials with software names, vendors, and complete listings of included software modules.

2. Standard manufacturer's literature describing the products.

3. Description of function of software in Control and Information System.

4. Limitations or constraints of software.

5. Minimum system (processor and memory) requirements.

6. Operation and maintenance requirements.

B. Submit information on the following software:

1. Third-party software, including:

a. Operating system.

b. Operator workstation (SCADA or HMI) software, including all add-in software provided to perform specific functions (alarm dialers, schedulers, backup creation software, etc.).

c. Office-type products, such as spreadsheets, word processors, etc.

d. Database management software.

e. Communication software, including all applicable local and wide area network software.

f. Programmable controller programming software (where applicable).

2. Software configuration, including:

a. Graphic display organization.

b. Database configuration for operator workstations and database management system.

c. Trends.

d. System security.

e. Formats for all reports, including all required calculations.

f. Intercommunications between software products required to implement system functions.

g. Equipment backup configuration and requirements.

C. Control Strategies

1. Provide control strategy documentation that includes control strategy diagrams (block oriented logic and ladder logic diagrams, as appropriate) to describe the control of all processes. The written description shall follow the format of the functional control descriptions contained herein. The control strategy submittals shall contain the following as a minimum:

a. An overall description of the program structure and how it will meet the specified control requirements.

b. A listing of the program.

c. Extensive comments in the listings to describe program steps.

d. Equation and ladder program derivations for all specified control routines.

e. Resource (processor and memory) requirements.

f. A listing of inputs and outputs to the control strategy.

D. Application Software

1. Provide application software documentation that contains program descriptions for the operation, modification, and maintenance of all application programs provided for the digital system.

2. Application software includes all custom routines developed specifically for this project, or pre-written routines used for accomplishing specified functions for this project. This shall include any add-in custom software.

E. Graphic Displays

1. Submit all graphic displays required to perform the control and operator interface functions specified herein.

2. Submit the complete set of graphic displays for review by the Owner and the Engineer at least 60 days prior to commencement of factory testing.

3. Where a large number of graphic displays are required, submit an initial set of example displays for review before the complete set of displays is submitted. This initial set shall include examples of all basic graphic display design features and parameters, and is intended to allow the Contractor to obtain preliminary approval of these features and parameters prior to beginning main graphic display production.

4. The Contractor shall allow for one major cycle of revisions to the displays prior to factory testing and one minor cycle of revisions following factory test. A cycle of revisions shall be defined as all revisions necessary to complete a single set of changes marked by the Engineer and the Owner. Additional corrections shall be performed during start-up as required to accommodate changes required by actual field conditions, at no additional cost to the Owner.

5. Two of the required submittals in each revision cycle shall be full color prints of the entire set of displays. Additional sets may be in black-and-white or gray-scale.

6. Displays shall be printouts of actual process graphics implemented in the system.

1.05 CONTROL PANEL SUBMITTALS

A. Submittals shall be provided for all control panels, and shall include:

1. Exterior panel drawings with front and side views, to scale.

2. Interior layout drawings showing the locations and sizes of all equipment and wiring mounted within the cabinet, to scale.

3. Panel area reserved for cable access and conduit entry.

4. Location plans showing each panel in its assigned location.

B. Submit information for all exterior and interior panel mounted equipment including, but not limited to, the following:

1. Bill of materials with equipment names, manufacturers, complete model numbers and locations.

2. Catalog cuts, including complete part number breakdown information.

3. Complete technical, material and environmental specifications.

4. Assembly drawings.

5. Mounting requirements.

6. Color samples.

7. Nameplates.

8. Environmental requirements during storage and operation.

C. Submit panel wiring diagrams showing power, signal, and control wiring, including surge protection, relays, courtesy receptacles, lighting, wire size and color coding, etc.

1.06 INSTRUMENT SUBMITTALS

A. Submit information on all field instruments, including but not limited to the following:

1. Product (item) name and tag number used herein and on the Contract Drawings.

2. Catalog cuts, including complete part number breakdown information.

3. Manufacturer's complete model number.

4. Location of the device.

5. Input - output characteristics.

6. Range, size, and graduations.

7. Physical size with dimensions, NEMA enclosure classification and mounting details.

8. Materials of construction of all enclosures, wetted parts and major components.

9. Instrument or control device sizing calculations where applicable.

10. Certified calibration data on all flow metering devices.

11. Environmental requirements during storage and operation.

12. Associated surge protection devices.

1.07 WIRING AND LOOP DIAGRAMS

A. Submit interconnection wiring and loop diagrams for all panels and signals in the Control and Information System.

B. Electrical interconnection diagrams shall show all terminations of equipment, including terminations to equipment and controls furnished under other Divisions, complete with equipment and cable designations. Where applicable, interconnection wiring diagrams shall be organized by input/output card. Interconnecting diagrams shall be prepared in a neat and legible manner on 11 X 17-inch reproducible prints.

C. Loop drawings shall conform to the latest version of ISA Standards and Recommended Practices for Instrumentation and Control. Loop Drawings shall conform to ISA S5.4, Figures 1-3, Minimum Required Items.

D. Loop drawings shall not be required as a separate document provided that the interconnecting wiring diagrams required in Paragraph B., above, contain all information required by ISA 5.4.

1.08 OPERATION AND MAINTENANCE MANUALS

A. The Contractor shall deliver equipment operation and maintenance manuals in compliance with Section 01300 - Submittals. Operation and maintenance (O&M) manuals shall consist of two basic parts:

1. Manufacturer standard O&M manuals for all equipment and software furnished under this Division.

2. Custom O&M information describing the specific configuration of equipment and software, and the operation and maintenance requirements for this particular project.

B. The manuals shall contain all illustrations, detailed drawings, wiring diagrams, and instructions necessary for installing, operating, and maintaining the equipment. The illustrated parts shall be numbered for identification. All modifications to manufacturer standard equipment and/or components shall be clearly identified and shown on the drawings and schematics. All information contained therein shall apply specifically to the equipment furnished and shall only include instructions that are applicable. All such illustrations shall be incorporated within the printing of the page to form a durable and permanent reference book.

C. The manuals shall be prepared specifically for this installation and shall include all required cuts, drawings, equipment lists, descriptions, etc. that are required to instruct operation and

maintenance personnel unfamiliar with such equipment. The maintenance instructions shall include troubleshooting data and full preventive maintenance schedules. The instructions shall be bound in locking 3-D-ring binders with bindings no larger than 3.5 inches. The manuals shall include 15% spare space for the addition of future material. The instructions shall include drawings reduced or folded and shall provide the following as a minimum.

1. A comprehensive index.

2. A functional description of the entire system, with references to drawings and instructions.

3. A complete "as-built" set of all approved shop drawings, which shall reflect all work required to achieve final system acceptance.

4. A complete list of the equipment supplied, including serial numbers, ranges, and pertinent data.

5. Full specifications on each item.

6. Detailed service, maintenance, and operation instructions for each item supplied.

7. Special maintenance requirements particular to this system shall be clearly defined, along with special calibration and test procedures.

8. Complete parts lists with stock numbers and name, address, and telephone number of the local supplier.

9. References to manufacturers' standard literature where applicable.

10. Warning notes shall be located throughout the manual where such notes are required to prevent accidents or inadvertent misuse of equipment.

D. The operating instructions shall clearly describe the step-by-step procedures that must be followed to implement all phases of all operating modes. The instructions shall be in terms understandable and usable by operating personnel and maintenance crews and shall be useful in the training of such personnel.

E. The maintenance instructions shall describe the detailed preventive and corrective procedures required, including environmental requirements during equipment storage and system operation, to keep the System in good operating condition. All hardware maintenance documentation shall make reference to appropriate diagnostics, where applicable, and all necessary wiring diagrams, component drawings and PCB schematic drawings shall be included.

F. The hardware maintenance documentation shall include, as a minimum, the following information:

1. Operation Information - This information shall include a detailed description of how the equipment operates and a block diagram illustrating each major assembly in the equipment.

2. Preventive-Maintenance Instructions - These instructions shall include all applicable visual examinations, hardware testing and diagnostic routines, and the adjustments necessary for periodic preventive maintenance of the System.

3. Corrective-Maintenance Instructions - These instructions shall include guides for locating malfunctions down to the card-replacement level. These guides shall include adequate details for quickly and efficiently locating the cause of an equipment malfunction and shall state the probable source(s) of trouble, the symptoms, probable cause, and instructions for remedying the malfunction.

4. Parts Information - This information shall include the identification of each replaceable or field-repairable component. All parts shall be identified on a list in a drawing; the identification shall be of a level of detail sufficient for procuring any repairable or replaceable part. Cross-references between equipment numbers and manufacturer's part numbers shall be provided.

G. Software documentation shall conform to a standard format and shall include, but not be limited to, the following:

1. A program abstract that includes:

   a. Program Name - The symbolic alphanumeric program name.

   b. Program Title - English text identification.

   c. Program Synopsis - A brief text shall be provided that specifies the need for the program, states when it shall be used and functionally describes all inputs, outputs and functions performed. This descriptive text shall be written in a language that is understandable by nonsoftware oriented readers.

2. A program description that shall include, but not be limited to, the following:

   a. Applicable Documents - List all documents (standard manufacturer's literature, other program descriptions, etc.) by section, if practical, that apply to the program. One complete copy of all applicable reference material shall be provided.

b. Input-Output - Identify each input and output parameter, variable, and software element used by the program. State the purpose of all inputs, outputs, and variables.

c. Processing - This section shall contain a description of the overall structure and function of the program. Describe the program run stream and present a detailed description of how the program operates. Describe the timing and sequencing of operations of the program relative to other programs. Describe all interactions with other programs. Processing logic that is not readily described without considerable background information shall be handled as a special topic with references to an appendix or to control strategy document that details the necessary information. Reference shall also be made to an appendix or control strategy document for equation and program algorithm derivations.

d. System Configuration - Describe in detail the system configuration or status required for program implementation, if appropriate.

e. Limitations and Constraints - Summarize all known or anticipated limitations of the program, if appropriate.

f. Storage - Define program storage requirements in terms of disk or RAM memory allocation.

g. Verification - Describe, as a minimum, a test that can be used by the operator to assure proper program operation. Define the required system configuration, input requirements and criteria for successful test completion.

h. Diagnostics - Describe all program diagnostics, where applicable. Descriptions shall list each error statement, indicate clearly what it means, and specify what appropriate actions should be taken.

i. Malfunction Procedures - Specify procedures to follow for recovering from a malfunction due to either operator error or other sources.

1.09 FINAL SYSTEM DOCUMENTATION

A. All documentation shall be delivered to the Owner prior to final system acceptance in accordance with the Contract Documents. As a minimum, final documentation shall contain all information originally part of the control system submittals.

B. If any documentation or other technical information submitted is considered proprietary, such information shall be designated. Documentation or technical information which is designated as being proprietary will be used only for the construction, operation, or

maintenance of the System and, to the extent permitted by law, will not be published or otherwise disclosed.

C. Provide a complete set of detailed electrical interconnection diagrams required to define the complete instrumentation and control system. All diagrams shall be 11 X 17-inch original reproducible prints. All diagrams shall be corrected so as to describe final "as-built" hardware configurations and to reflect the system configuration and control methodology adopted to achieve final system acceptance.

D. Provide system software documentation for the operation and maintenance of all system software programs provided as a part of the digital system. All system software documentation shall be amended as required to delineate all modifications and to accurately reflect the final as-built software configurations.

E. Provide application software documentation that contains program descriptions for the operation, modification, and maintenance of all application programs provided for the digital system.

F. Provide control strategy documentation which shall include control strategy (block oriented or ladder logic) diagrams to describe the control of all processes. Control strategy documentation shall reflect the system configuration and control methodology adopted to achieve final system acceptance. Control strategy documentation shall conform to the submittal requirements listed hereinabove.

G. O&M documentation shall be amended with all final, adjusted values for all setpoints and other operating parameters for Owner reference.

H. The Owner recognizes the fact that not all possible problems related to real-time events, software interlocks, and hardware maintenance and utilization can be discovered during the Acceptance Tests. Therefore, the instrumentation subcontractor through the Contractor shall investigate, diagnose, repair, update, and distribute all pertaining documentation of the deficiencies that become evident during the warranty period. All such documentation shall be submitted in writing to the Owner within 30 days of identifying and solving the problem.

1.10 PROGRAMS AND SOURCE LISTINGS

A. Provide one copy of all standard, of-the-shelf system and application software (exclusive of firmware resident software) on original media furnished by the software manufacturer.

B. Provide one copy of source listings on optical media for all custom software written specifically for this facility, all database files configured for this facility, and all control strategies. All source listings shall include a program abstract, program linkage and input/output data. Comments describing the program flow shall be frequently interspersed throughout each listing.

1.11 SUBMITTAL/DOCUMENTATION FORMAT

A. All drawing-type submittals and documentation shall be rendered and submitted in the latest version of AutoCAD.

B. All textual-type submittals and documentation shall be rendered and submitted in the latest version of Microsoft Word or in Searchable Adobe Portable Document Format (.pdf).

1.12 ELECTRONIC O&M MANUALS

A. Subject to acceptance by the Owner and Engineer, the O&M information may be submitted in part or in whole in an electronic format on optical media.

B. Electronic O&M manuals shall contain information in standard formats (Searchable Adobe PDF, Word, AutoCAD, HTML, etc.) and shall be easily accessible through the use of standard, "off-the-shelf" software such as an Internet browser.

PART 2 -- PRODUCTS

(NOT USED)

PART 3 -- EXECUTION

(NOT USED)

+ + + END OF SECTION 17030 + + +

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SECTION 17040
CONTROL AND INFORMATION SYSTEM TRAINING REQUIREMENTS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. To familiarize the Owner's personnel with the process control system and field instrumentation, training shall be provided as detailed hereunder.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 17000 – Control and Information System Scope and General Requirements

1.03 SUBMITTALS

A. A minimum of 60 days prior to beginning training, submit a detailed training plan describing the following:

1. A listing of all courses to be conducted.

2. Course content.

3. Applicability of each course to management, operations, maintenance, laboratory, etc., personnel.

4. Course schedules.

5. Qualifications and experience of individual(s) providing training.

B. A minimum of 14 days prior to beginning each training course, submit documentation for use by the Owner's personnel during training. The training documentation shall be specific to the particular course, and shall include the following:

1. A listing of all subjects to be covered.

2. Course schedule.

3. Documentation/lesson plans covering all subjects to be covered during the course instruction. Information shall be in a "how to" format, with sufficient background documentation and references to manufacturer literature to provide a thorough and clear understanding of the materials to be covered.

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1.04 GENERAL REQUIREMENTS

A. All costs of providing the training courses shall be borne by the Contractor.

B. As used herein, the term "day" shall mean an eight-hour day, and the term "week" shall mean a five-day, 40-hour week.

C. Training courses, especially those for operator training, may be required to be scheduled during non-standard business hours (i.e., not between the hours of 8:00 am and 5:00 pm) to accommodate the working schedule of the Owner's personnel. No additional compensation will be awarded to the Contractor for training at non-standard hours.

D. All training courses shall complement the experience and skill levels of the Owner's personnel.

E. Training courses shall be structured in order of increasing capability or security levels. The purpose of this requirement is to allow personnel with lesser training requirements or security password levels to drop out of the training at certain times while the training continues for personnel with greater requirements or higher security levels.

F. All training courses shall include lecture as well as "hands on" experience for each of the attending personnel. The Contractor shall provide sufficient equipment for this to be accomplished. For example, training in which the instructor uses the computer and the Owner's personnel passively observe as the instructor demonstrates system functions shall not be acceptable.

G. Unless otherwise specified, all training courses shall be conducted in the Owner's facilities.

H. All training shall be completed prior to system acceptance.

I. Standard manufacturer training courses are acceptable pending approval by the Engineer and Owner.

1.05 SYSTEM SUPERVISOR/ENGINEER TRAINING

A. Provide manufacturer standard training in the use and configuration of the specified operator workstation (HMI or SCADA) software.

B. System supervisor/engineer training shall be performed a minimum of 30 days prior to system startup.

C. Training shall be provided in the following subjects:

1. System overview and capabilities.

2. Database configuration.

3. Graphic display configuration, including linking of data to displays.

4. Alarm configuration and management.

5. System security.

6. I/O driver use and configuration.

7. System backup and recovery.

8. DDE linking, where applicable.

9. System command language.

10. Troubleshooting.

11. System optimization.

12. System startup and shutdown procedures.

13. LAN and WAN communications, as appropriate.

D. The course shall be structured as follows:

1. Fundamentals - One half-day course (minimum) shall be provided for up to eight persons which shall serve as a digital control system familiarization course for project management personnel, engineers, and key operating/maintenance personnel. This course shall be a prerequisite for the advanced course described below in Item 2.

2. Advanced - One half-day (minimum) digital system configuration and operating course shall be provided for up to four persons. The level of training shall be sufficient to familiarize the Owner's personnel with the configuration and application of all system programs. All essential system operating procedures shall be described as required to enable the Owner's personnel to operate the system via the various workstations and local control panels.

1.06 OPERATOR TRAINING

A. Two two-day courses comprised of daily half-day (four-hour) sessions for up to ten persons each shall be conducted to provide instruction in the use of the Control and Information System to monitor and control the facility.

B. Operator training shall include familiarization training covering the Control and Information System. Operators shall be instructed in the names, locations, functions, and basic operation of all items of digital equipment and associated software.

C. Operator training shall cover process and equipment operation both individually and collectively as an operating system. Normal as well as abnormal operating conditions shall be covered, including the response to failure occurrences and system alarms. All operator/system interactions shall be described.

D. Operators shall be trained to instruct other operators and shall be provided with all course materials.

1.07 MAINTENANCE TRAINING

A. A one-day course shall be conducted for at least six persons prior to the start-up of digital equipment at the Owner's plant. Instruction shall be provided in the following:

1. Operating all digital equipment, including system start-up and shutdown procedures.

2. The use of hardware diagnostic routines, test equipment and test procedures as required to enable the Owner's personnel to detect and isolate system faults to the circuit board or module level and to implement repairs by replacing failed circuit boards or modules.

3. Calibration and routine maintenance procedures for all analog and digital equipment.

B. Step by step written procedures shall be provided for all preventive maintenance tasks and for identifying hardware faults to the circuit board or module level for all items of digital equipment.

C. All digital equipment preventive and corrective maintenance training activities shall be limited to the use of commercially available off-the-shelf test equipment and to the use of diagnostic routines and hardware items which are the same as those to be provided as part of the system.

1.08 PUMP CONTROLLER TRAINING

A. One minimum one-day manufacturer standard training course shall be provided in the programming and use of pump controller to implement monitoring and control functions such as those provided for this project. Training shall cover all aspects of the pump controller hardware and software, including specified programming software. This training shall be provided by the pump controller manufacturer or, as directed by the manufacturer, by the authorized distributor engaged by the manufacturer to perform this training.

B. One one-day course of specific training shall be provided by the instrumentation subcontractor in the use and modification of all control strategies provided under this Division.

1.09 GENERAL REFRESHER TRAINING

A. A two-day general refresher training course shall be provided for up to ten persons 3-6 months after final system acceptance. Instruction shall be given in all aspects of the complete instrumentation and control system. Instructor(s) shall be capable of answering questions related to all aspects and details of the complete system.

PART 2 -- PRODUCTS

(NOT USED)

PART 3 -- EXECUTION

(NOT USED)

+ + + END OF SECTION 17040 + + +

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SECTION 17050
TOOLS, SUPPLIES AND SPARE PARTS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall provide tools, supplies, and spare parts as specified herein for the operation and maintenance of the Control and Information System.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 01300 – Submittals

B. Section 17000 – Control and Information System Scope and General Requirements

PART 2 -- PRODUCTS

2.01 TOOLS

A. Provide special tools, other than those normally found in an electronic technician's tool box, required to test, diagnose, calibrate, install, wire, connect, disconnect, assemble and disassemble any digital equipment, instrument, panel, rack, cabinet or console mounted equipment for service and maintenance. This shall include, but not be limited to, the following: connector pin insertion and removal tools, wire crimping tools, special wrenches, special instrument calibrators, indicator lamp insertion and removal tools, etc.

B. Provide tools and test equipment together with items such as instruction manuals, carrying/storage cases, unit battery charger where applicable, special tools, calibration fixtures, cord extenders, patch cords and test leads, which are not specified but are necessary for checking field operation of equipment supplied under this Division.

C. One (1) Portable graphical multimeter with rechargeable battery, test leads, industrial lead set, and carrying case, Fluke Model 289, Simpson, or equal.

D. Furnish one portable 4-20 mA, 24 VDC analog loop signal generator for calibration and testing of analog signal loops. Generator shall be furnished with rechargeable battery pack, test leads, spare battery pack, charger, carrying case and accessories. Signal generator shall be Fluke 787 ProcessMeter, or equal.

E. Furnish one portable calibrator capable of measuring DC volts, mV, mA, ohms, frequency, T/C, peak detect and trip detect on its input and simultaneously generate on its output all of the preceding signals plus two-wire simulation, ramp functions, up/down stepping and

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10 point programmability. The calibrator shall be furnished complete with 24 VDC integral battery pack, spare battery pack, test leads, external charger, fuse pack, carrying case and appurtenances. It shall be possible to store and use automatic instrument calibration procedures that are downloaded from Windows-based instrument management software. Calibrator shall be Fluke 789 ProcessMeter, Ametek CL-9000, or equal.

F. A complete computer technician kit in an injection molded or high density polyethylene case. The kit shall be Model JTK-49 Workstation Kit by Stanley Supply Services of Phoenix, AZ, or a computer technician kit of equivalent equipment and value.

2.02 SUPPLIES

A. The Contractor shall provide supplies as specifically required in other Sections of Division 17.

2.03 SPARE PARTS

A. Provide spare parts for items of control and instrumentation equipment as recommended by the manufacturer and in accordance with the Contract Documents.

B. Furnish all spares in moisture-proof boxes designed to provide ample protection for their contents. Label all boxes to clearly identify contents and purpose.

C. The Contractor shall replace all spare parts consumed during installation, testing, start-up, the system availability demonstration, and the guarantee period.

D. Refer to individual digital hardware and instrument sections for additional requirements specific to those devices.

PART 3 – EXECUTION

(NOT USED)

+ + + END OF SECTION 17050 + + +

SECTION 17060
SIGNAL COORDINATION REQUIREMENTS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall conform to the signal coordination requirements specified herein.

B. The Contractor shall be responsible for coordinating signal types and transmission requirements between the various parties providing equipment under this Contract. This shall include, but not be limited to, distribution of appropriate shop drawings among the equipment suppliers, the electrical subcontractor, and the instrumentation subcontractor.

C. Analog signals shall be signals for transmitting process variables, etc. from instruments and to and from panels, equipment PLCs and Control System PLCs and controllers.

D. Discrete signals shall consist of contact closures or powered signals for transmitting status/alarm information and control commands between starters, panels, equipment PLCs, the Control System, etc.

1.02 ANALOG SIGNAL TRANSMISSION

A. Signal transmission between electric or electronic instruments, controllers, and all equipment and control devices shall be individually isolated, linear 4-20 milliamperes and shall operate at 24 volts D.C.

B. Signal output from all transmitters and controllers shall be current regulated and shall not be affected by changes in load resistance within the unit's rating.

C. All cable shields shall be grounded at one end only, at the control panel, with terminals bonded to the panel ground bus.

D. Analog signal isolation and/or conversion shall be provided where necessary to interface with instrumentation, equipment controls, panels, and appurtenances.

E. Non-standard transmission systems such as pulse duration, pulse rate, and voltage regulated shall not be permitted except where specifically noted in the Contract Documents. Where transmitters with nonstandard outputs do occur, their outputs shall be converted to an isolated, linear, 4-20 milliampere signal.

F. The Contractor shall provide 24 V power supplies for analog signals and instruments where applicable and as required inside panels, controls, etc.

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G. Where two-wire instruments transmit directly to the Control and Information System, the instrumentation subcontractor shall provide power supplies at the PLC/controller-equipped control panels for those instruments.

H. Where four-wire instruments with on-board loop power supplies transmit directly to the Control and Information System, the instrumentation subcontractor shall provide necessary signal isolators or shall otherwise isolate the input from the Control and Information System loop power supply. Similar provisions shall be made when a third element such as a recorder, indicator, or single loop controller with integral loop power supply is included in the loop.

1.03 DISCRETE INPUTS

A. All discrete inputs to equipment and Control and Information System PLC/controllers, from field devices, starters, panels, etc., shall be unpowered (dry) contacts in the field device or equipment, powered from the PLC/controller, unless specified otherwise.

B. Sensing power (wetting voltage) supplied by the PLC/controller shall be 24 VDC [120 VAC].

1.04 DISCRETE OUTPUTS

A. All discrete outputs from local control panels and Control and Information System controllers to field devices, starters, panels, etc., shall be 24 VDC [120 VAC] powered (sourced) from the controller [dry contact relay outputs].

B. Controller-powered discrete outputs shall energize 24 VDC pilot relay coils in the field devices, starters, panels, etc. which in turn open or close contacts in the associated control circuit. The 24 VDC relay coil, contacts, and associated control circuitry shall be furnished integral with the field device, starter, panel, etc. by the supplier and contractor furnishing the field device, starter, or panel.

C. Where required or specified herein, discrete outputs from equipment and Control and Information System controllers to field devices, starters, panels, motor operated valves, etc., shall be dry contact or relay outputs.

D. Outputs to solenoid valves shall be 120 VAC, powered from the PLC/controller or control panel unless specified or shown otherwise.

1.05 OTHER DISCRETE SIGNALS

A. Discrete signals between starters, panels, etc. where no 24 VDC power supply is available may be 120 VAC, as long as such contacts are clearly identified in the starter, panel, etc. as being powered from a different power supply than other starter/panel components.

B. Where applicable, warning signs shall be affixed inside the starter, panel, etc. stating that the panel is energized from multiple sources.

C. Output contacts in the starter, panel, etc., that are powered from other locations shall be provided with special tags and/or color-coding. Disconnecting terminal strips shall be provided for such contacts.

D. The above requirements shall apply to all starters and panels, regardless of supplier.

PART 2 -- PRODUCTS

2.01 PILOT RELAYS

A. Pilot relays shall be supplied with the following:

1. 24 VDC or 120 VAC coils, as required.

2. At a minimum, DPDT contacts rated at 5 A, 120 VAC or 28 VDC.

3. Sockets for 24 VDC and 120 VAC relays shall be of different configurations.

4. Clips for attachment to sockets.

5. Indicator lights that glow when the relay coil is powered.

B. Pilot relays shall be as manufactured by Square D, Allen Bradley, Potter & Brumfield, or equal.

PART 3 -- EXECUTION

(NOT USED)

+ + + END OF SECTION 17060 + + +

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SECTION 17070
CONTROL AND INFORMATION SYSTEM TESTING - GENERAL

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall test the Control and Information System as specified herein to demonstrate compliance with the Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 17000 – Control and Information System Scope and General Requirements

B. Section 17071 – Factory Acceptance Test

C. Section 17072 – Field Testing

D. Section 17073 – Final Acceptance Test

1.03 SUBMITTALS

A. For each of the specified tests, submit a test plan to the Engineer at least one month in advance of commencement of the tests. The test plan shall contain the following at a minimum:

1. A schedule of all testing to be conducted.

2. A brief description of the testing to be performed

3. Test objectives.

4. Testing criteria per the Specifications.

5. Check lists and procedures for performing each of the specified tests.

6. Sample test result documentation.

7. Requirements for other parties.

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1.04 GENERAL REQUIREMENTS

A. All system start-up and test activities shall follow detailed test procedures; check lists, etc., previously approved by the Engineer. The Engineer shall be notified at least 21 days in advance of any system tests and reserves the right to have his and/or the Owner's representatives in attendance.

B. The Contractor shall provide the services of experienced factory trained technicians, tools and equipment to field calibrate, test, inspect, and adjust all equipment in accordance with manufacturer's specifications and instructions.

C. The Contractor (or designee) shall maintain master logbooks for each phase of installation, startup and testing activities specified herein. Each logbook shall include signal, loop or control strategy tag number, equipment identification, description and space for sign-off dates, Contractor signature and Engineer signature. Example test documentation specific to each phase of testing shall be approved prior to initiation of that testing, as specified hereinabove.

D. All test data shall be recorded on test forms, previously approved by the Engineer. When each test has been successfully completed, a certified copy of all test results shall be furnished to the Engineer together with a clear and unequivocal statement that all specified test requirements have been met and that the system is operating in accordance with the Contract Documents.

E. The Engineer will review test documentation in accordance with the Contract Documents and will give written notice of the acceptability of the tests within 10 days of receipt of the test results.

PART 2 -- PRODUCTS

(NOT USED)

PART 3 -- EXECUTION

(NOT USED)

+ + + END OF SECTION 17070 + + +

SECTION 17071
FACTORY ACCEPTANCE TEST

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall perform a Factory Acceptance Test on the Control and Information System as specified herein to demonstrate compliance with the Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 17000 – Control and Information System Scope and General Requirements

B. Section 17070 – Control and Information System Testing, General

C. Section 17072 – Field Testing

D. Section 17073 – Final Acceptance Test

1.03 FACTORY ACCEPTANCE TEST

A. The Control and Information System equipment shall not be shipped until the Contractor receives notice of acceptability of the factory tests.

B. Each item of equipment shall be fully factory inspected, calibrated and tested for function, operation and continuity of circuits. Exceptions shall be approved in writing by the Engineer.

C. Each subsystem shall be fully factory tested for function and operation.

D. System performance shall be tested using a fully integrated system, including all software and hardware. To achieve this, the entire control system, including all peripheral devices and all interconnecting cables (field instruments are not included in this requirement), shall be assembled on the factory test floor and the complete operational program loaded and simulated inputs applied.

E. All hardware and software required to perform the specified testing shall be furnished by the Contractor at no additional cost to the Owner.

F. The instrumentation subcontractor shall perform a 100-hour full system test, during which the entire system shall operate continuously without failure in accordance with the requirements of the Contract Documents. If a system component fails during the test, the 100-hour test period shall be restarted after its operation is restored.

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G. The factory testing shall demonstrate all aspects of system sizing and timing including:

1. Monitoring and control scan times at the controller level.

2. Response times at the operator workstation level.

H. The overall system as well as individual component hardware shall be tested under conditions of power failure to ensure proper response as specified herein.

I. Operator Workstation Operation - This demonstration shall provide proof of system operation on an individual subsystem basis first, and then in the expected operating environment. Both normal and abnormal operating modes shall be demonstrated. Operator workstation testing shall include the following:

1. Demonstrate proper operation, under both normal and abnormal conditions of the operator workstation application software (SCADA, remote alarm dial-up, etc.). This shall include demonstration of system on-line diagnostics, fail-over features, reconfiguration operations, system initialization and restart, software fault tolerance, error detection and recovery, communications, and all additional features necessary to assure the successful operation of the system.

2. Demonstrate the standard features of the system. This shall include proof of operation of the process control database generator, the display generator, data storage and retrieval functions, data acquisition and control, trending functions, and reporting functions.

3. Demonstrate the configuration of the system to verify conformance with the Contract Documents. This shall include graphic displays and vectoring, operator interface functions, trending, reports, alarm management, security system configuration, etc.

4. The system shall be operated with data input/output with the PLC/controller and associated panels to prove operation of all workstation functions.

5. The testing in Items 2 and 3 above may be performed concurrently (i.e., the standard and configured features of the system may be demonstrated simultaneously).

J. Controller Operation - All functions comparable to those demonstrated for the operator workstations shall be demonstrated on the Controller. This shall include the following:

1. On-line and off-line diagnostics.

2. For redundant units, fail-over operation and reconfiguration.

3. System initialization and restart.

4. Network communications, including fieldbus communications where required.

5. Non-volatility of memory.

6. Operation of all control logic shall be demonstrated as described herein.

K. Process I/O Simulation - Process input/output simulation for PLC/controllers shall be performed with a manual simulation control panel, a separate programmable logic controller, network-based simulation software, analog signal generators, and/or jumpering of discrete signals between outputs and associated inputs, or some combination of these. Alternate process I/O systems such as plug-in circuit cards or I/O test modules may be utilized subject to approval by the Engineer to provide the specified simulation functions. The simulation system shall provide analog and discrete I/O hardware devices in sufficient quantity to allow complete and thorough testing of the control strategies and functions of the system. The process I/O simulation system shall be used in several ways as follows:

1. To provide a means of communications checkout from the operator workstations through the various levels of software in the PLC/controller and to the process, i.e., the simulation panel. Likewise, a discrete or analog input shall be initiated from the simulation panel and the result monitored at the workstations.

2. Alarm response to discrete status changes or analog value limits shall be verified. Database entries or attributes such as engineering units and conversion equations shall be verified by varying analog inputs.

3. To provide data for use at all levels of the control system at the time of system integration.

L. Control Strategy Testing - Provision shall be made to test all control strategies to prove the integrity of each strategy and the process control language in which it is implemented. For each control strategy, all functions shall be tested individually (where possible) and collectively to verify that the control strategy performs as described herein and as required for overall functionality within the control system.

PART 2 -- PRODUCTS

(NOT USED)

PART 3 -- EXECUTION

(NOT USED)

+ + + END OF SECTION 17071 + + +

SECTION 17072
FIELD TESTING

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall perform field testing on the Control and Information System as specified herein to demonstrate compliance with the Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 17000 – Control and Information System Scope and General Requirements

B. Section 17070 – Control and Information System Testing, General

C. Section 17071 – Factory Acceptance Test

D. Section 17073 – Final Acceptance Test

1.03 GENERAL REQUIREMENTS

A. Control system start-up and testing shall be performed to ensure that all plant processes shall be systematically and safely placed under digital control in the following order:

1. Primary elements such as transmitters and switch devices shall be calibrated and tested as specified in Sections 17600, 17700, and 17800.

2. Each final control element shall be individually tested as specified hereinafter.

3. Each control loop shall be tested as specified hereinafter.

4. Each control strategy shall be tested under automatic digital control as specified hereinafter.

5. The entire control system shall be tested for overall monitoring, control, communication, and information management functions, and demonstrated for system availability as specified hereinafter.

B. System start-up and test activities shall include the use of water, if necessary, to establish service conditions that simulate, to the greatest extent possible, normal operating conditions in terms of applied process loads, operating ranges and environmental conditions.

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C. Each phase of testing shall be fully and successfully completed and all associated documentation submitted and approved prior to the next phase being started. Specific exceptions are allowed if written approval has been obtained in advance from the Engineer.

1.04 CONTRACTOR'S RESPONSIBILITIES

A. The Contractor shall ensure that all mechanical equipment, equipment control panels, local control panels, field instrumentation, control system equipment and related equipment and/or systems are tested for proper installation, adjusted and calibrated on a loop-by-loop basis prior to control system startup to verify that each is ready to function as specified. Each test shall be witnessed, dated and signed off by both the Contractor (or designee) and the Engineer upon satisfactory completion.

B. The Contractor shall be responsible for coordination of meetings with all affected trades. A meeting shall be held each morning to review the day's test schedule with all affected trades. Similarly, a meeting shall be held each evening to review the day's test results and to review or revise the next day's test schedule as appropriate.

C. The Contractor shall ensure that the electrical subcontractor conforms to the start-up, test and sign-off procedures specified herein to assure proper function and coordination of all motor control center control and interlock circuitry and the transmission of all discrete and/or analog signals between equipment furnished by the electrical subcontractor and the control system specified herein.

1.05 FINAL CONTROL ELEMENT TESTING

A. The proper control of all final control elements shall be verified by tests conducted in accordance with the requirements specified herein.

B. All modulating final control elements shall be tested for appropriate speed or position response by applying power and input demand signals and observing the equipment for proper direction and level of reaction. Each final control element shall be tested at 0, 25, 50, 75, and 100 percent of signal input level and the results checked against specified accuracy tolerances. Final control elements, such as VFDs that require turndown limits shall be initially set during this test.

C. All non-modulating final control elements shall be tested for appropriate position response by applying and simulating control signals and observing the equipment for proper reaction.

1.06 LOOP CHECKOUT

A. Prior to control system startup and testing, each monitoring and control loop shall be tested on an individual basis from the primary element to the final element, including the operator workstation or loop controller level, for continuity and for proper operation and calibration.

B. Signals from transducers, sensors, and transmitters shall be utilized to verify control responses. Simulated input data signals may be used subject to prior written approval by the Engineer. All modes of control shall be exercised and checked for proper operation.

C. The accuracy of all DAC's shall be verified by manually entering engineering unit data values at the operator workstation and then reading and recording the resulting analog output data.

D. The accuracy of all ADC's shall be verified using field inputs or by manually applying input signals at the final controller, and then reading and recording the resulting analog input data at the operator workstation.

E. Each loop tested shall be witnessed, dated and signed off by both the Contractor (or designee) and the Engineer upon satisfactory completion.

1.07 CONTROL SYSTEM STARTUP AND TESTING

A. Control system startup and testing shall be performed to demonstrate complete compliance with all specified functional and operational requirements. Testing activities shall include the simulation of both normal and abnormal operating conditions.

B. All digital hardware shall be fully inspected and tested for function, operation and continuity of circuits. All diagnostic programs shall be run to verify the proper operation of all digital equipment.

C. Final control elements and ancillary equipment shall be tested under start-up and steady-state operating conditions to verify that proper and stable control is achieved using local area control panels, motor control center circuits, and local field mounted control circuits. All hardwired control circuit interlocks and alarms shall be operational. The control to final control elements and ancillary equipment shall be tested using both manual and automatic (where provided) control circuits.

D. Signals from transducers, sensors, and transmitters shall be utilized to verify control responses for final control elements. Simulated input data signals may be used subject to prior written approval by the Engineer.

E. Each control strategy shall be tested to verify the proper operation of all required functions. The control system start-up and test activities shall include procedures for

tuning all control loops incorporating PID control modules, and for adjusting and testing all control loops as required to verify specified performance.

F. The control system start-up and test activities shall include running tests to prove that the Instrumentation, Control and Information System is capable of continuously, safely and reliably regulating processes, as required by the Contract, under service conditions that simulate, to the greatest extent possible, normal plant operating ranges and environmental conditions.

G. A witnessed functional acceptance test shall be performed to demonstrate satisfactory performance of individual monitoring and control loops and control strategies. At least one test shall be performed to verify that the control and instrumentation system is capable of simultaneously implementing all specified operations.

H. Each loop and control strategy test shall be witnessed and signed off by both the Contractor (or designee) and the Engineer upon satisfactory completion.

1.08 FACILITY STARTUP COORDINATION

A. Facility start-up shall comply with requirements specified in the Contract Documents and those requirements specified herein. Facility start-up shall commence after all previously described start-up and test activities have been successfully completed and shall demonstrate that the Instrumentation, Control and Information System can meet all Contract requirements with equipment operating over full operating ranges under actual operating conditions.

B. The control system start-up period shall be coordinated with process startup activities and shall be extended as required until all plant processes are fully operational and to satisfy the Engineer that all control system Contract requirements have been fulfilled in accordance with the Contract Documents.

C. The instrumentation subcontractor's personnel shall be resident at the facility to provide both full time (eight hours/day, five days/week) and 24 hours on call (seven days/week) support of operating and maintenance activities for the duration of the start-up period.

D. At least one qualified control systems technician shall be provided for control system startup and test activities (at least two when loop checkout is being performed).

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

+ + + END OF SECTION 17072 + + +

SECTION 17073
FINAL ACCEPTANCE TEST

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall perform the Final Acceptance Test on the Control and Information System as specified herein to demonstrate compliance with the Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 17000 – Control and Information System Scope and General Requirements

B. Section 17070 – Control and Information System Testing, General

C. Section 17071 – Factory Acceptance Test

D. Section 17072 – Field Testing

1.03 AVAILABILITY DEMONSTRATION AND FINAL SYSTEM ACCEPTANCE

A. Upon completion of all control system startup activities and prior to final system acceptance, the Contractor shall demonstrate that the availability of the entire control system, including operation under conditions of digital equipment fail-over, initiated either automatically or manually, shall be not less than 99.8 percent during a 30-day availability test period. The Owner shall be given two (2) weeks notice of the starting date of the 30-day availability test.

B. For purposes of determining availability figures, downtime of each system or portions of each system resulting from the causes specified hereunder will not be considered system failures.

1. Downtime of any network-connected device that is automatically backed-up upon failure shall not be considered a system failure provided that the downtime of the failed component does not exceed 24 hours.

2. Downtime of a CONTROLLER that is not automatically backed-up shall be considered a system failure if the downtime of the failed controller exceeds one (1) hour.

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3. Downtime of a portion of the system resulting from failure of any field sensor shall not be considered a system failure provided that the system operates as specified under this condition.

4. Downtime of the following devices shall not be considered a system failure provided the failed device is repaired within the specified time:

    a. Hard disc (one day)
    b. Workstations (one day)
    c. Communication interfaces (eight hours)
    d. Process control system networks (eight hours)
    e. UPS unit (one day)

5. Total shutdown of a single controller resulting from a software fault shall be considered a system failure.

6. An erroneous command to the process that can be specifically related to a software fault shall be considered as one (1) hour of downtime.

7. The inoperability of any subsystem resulting from a software fault shall be considered a system failure.

8. The failure of the same component more than one time during the 30-day test shall be considered a system failure.

C. If the system fails the 30-day availability test, the 30-day test period shall be restarted after the failed component or software is repaired/replaced and full operation is restored. The system shall be demonstrated for the full 30-day period following the restart.

D. The Contractor shall submit an availability demonstration report that shall state that all system availability requirements have been met.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

+ + + END OF SECTION 17073 + + +

SECTION 17080
QUALITY ASSURANCE

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. It is the intent of these Specifications and Drawings to secure high quality in all materials, equipment and workmanship in order to facilitate operations and maintenance of the facility. The Contractor shall provide equipment and services to meet this intent.

1.02 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. All work shall be installed in accordance with the National Electric Code, National Electric Safety Code, OSHA, State, local and other applicable codes.

1.03 QUALITY ASSURANCE - GENERAL

A. All equipment and materials shall be new and the products of reputable recognized suppliers having adequate experience in the manufacture of these particular items.

B. For uniformity, only one manufacturer will be accepted for each type of product.

C. All equipment shall be designed for the service intended and shall be of rugged construction, of ample strength for all stresses that may occur during fabrication, transportation, and erection as well as during continuous or intermittent operation. They shall be adequately stayed, braced and anchored and shall be installed in a neat and workmanlike manner. Appearance and safety, as well as utility, shall be given consideration in the design of details.

D. All components and devices installed shall be standard items of industrial grade, unless otherwise noted, which shall be of sturdy and durable construction and be suitable for long, trouble-free service.

E. Electronic components shall be de-rated to assure dependability and long-term stability.

F. Printed circuit boards in field mounted equipment shall be suitable for the specified environmental conditions.

G. Alignment and adjustments shall be non-critical, stable with temperature changes or aging and accomplished with premium grade potentiometers.

H. Components of specially selected values shall not be inserted into standard electronic assemblies in order to meet the performance requirements of this specification.

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1.04 OPTIONAL EQUIPMENT

A. Optional or substituted equipment or both requiring changes in details or dimensions required to maintain all structural, mechanical, electrical, control, operating, maintenance or design features incorporated in these Specifications and Drawings shall be made at no additional cost to the Owner. In the event that the changes are necessary, calculations and drawings showing the proposed revisions shall be submitted for approval. The Contractor shall coordinate all changes with other affected trades and contracts and pay all additional charges incurred.

1.05 GUARANTEE

A. The instrumentation subcontractor through the Contractor shall install, maintain and guarantee the Instrumentation, Control and Information System as specified under the General Conditions and Division 1 of the Specifications. Maintenance personnel provided by the instrumentation subcontractor shall instruct the Owner's personnel in the operation, adjustment, calibration and repair of the equipment being serviced. All preventive and corrective activities shall be documented with service reports, which shall identify the equipment being serviced, state the condition of the equipment, describe all work performed and list materials used. A copy of all service reports shall be delivered to the Owner on the day the work is performed.

B. The instrumentation subcontractor shall provide the services of factory-trained service technician(s) at least twice during the guarantee period, for the purpose of performing preventive hardware maintenance.

C. Corrective hardware and software maintenance during the guarantee period shall be performed in accordance with the requirements of Division 1 and, in addition, shall meet the following requirements:

1. Corrective hardware maintenance shall be performed by factory-trained service technician(s) specifically trained to service the digital equipment provided. Technicians possessing suitable training and experience shall be provided to perform corrective maintenance on all other equipment. The hardware service technician(s) shall be available on-site within 24 working hours after notification by the Owner.

2. Corrective software maintenance shall be performed for software provided by the instrumentation subcontractor and incorporated into the system prior to the completion of system commissioning. Software service programmer(s) shall be available for consultation within four business hours and, if required, on-site within 16 business hours after notification by the Owner. Corrective software maintenance shall include the supply, installation and startup of all application software upgrades released during the guarantee period.

3. Corrective hardware and software maintenance performed during the guarantee period shall be performed at no cost to the Owner.

4. As used herein, the term "working hours" shall be defined as those of the treatment facility (seven days per week, 24 hours per day). The term "business hours" shall be defined as the hours between 8:00 a.m. and 5:00 p.m., local time, Monday through Friday; excluding holidays.

5. The guarantee period shall commence upon final acceptance of the completed treatment facility in accordance with the provisions of the Contract Documents.

D. The instrumentation subcontractor shall submit to the Owner a proposed maintenance agreement incorporating the following features:

1. Extension of preventive hardware maintenance services as described above for a period of up to five years from the expiration of the warranty period.

2. Provisions for corrective hardware and/or software maintenance work on a will-call basis for a period of up to five years from the expiration of the warranty period. Corrective maintenance work shall be performed by properly trained personnel as described above.

E. The proposed agreement shall include provisions for payment based upon an annual fee for preventive maintenance and cost plus expenses for corrective maintenance work. The portion dealing with corrective maintenance shall be written to include corrective maintenance caused by actions of the Owner during the warranty period and shall contain clauses for re-negotiation of contract prices based upon changes in recognized economic indicators published by the United States Department of Commerce.

1.06 SHIPPING HANDLING AND STORAGE

A. In addition to shipping, handling and storage requirements specified elsewhere in the Contract Documents, air conditioning/heating shall be provided for storage of all field instrumentation, panels, digital equipment and ancillary devices to maintain temperatures between 20 and 25 degrees C and relative humidity 40 to 60 percent without condensation. The air shall be filtered and free of corrosive contaminants and moisture.

1.07 FABRICATION

A. Fabrication of all equipment shall conform to the codes and standards outlined in this Section, and other portions of the Contract Documents.

B. The Engineer may inspect the fabricated equipment at the factory before shipment to job site. The Contractor shall provide the Engineer with sufficient prior notice so that an

inspection can be arranged at the factory. Inspection of the equipment at the factory by the Engineer will be made after the manufacturer has performed satisfactory checks, adjustments, tests and operations.

C. Equipment approval at the factory only allows the equipment to be shipped to the project site. The Contractor shall provide for the proper storage, installation and satisfactory start-up and operation of the equipment to the satisfaction of the equipment manufacturer, the instrumentation subcontractor, and the Engineer.

1.08 INSTALLATION

A. All instrumentation and control system installation work, whether new construction or modifications to existing equipment/panels/structures, shall conform to the codes and standards outlined in this Section, and other portions of the Contract Documents.

B. The instrumentation subcontractor shall assign a competent representative who shall provide full time coordination and supervision of all on-site instrumentation and control system construction work from commencement of construction through completion and final acceptance.

C. All labor shall be performed by qualified craftsmen in accordance with the standards of workmanship in their profession and shall have had a minimum of three years of documented experience on similar projects.

D. All equipment and materials shall fit properly in their installations. Any required work to correct improperly fit installations shall be performed at no additional expense to the Owner.

E. All work shall be performed in a neat and workmanlike manner. All hardware and instrumentation shall be installed in accordance with requirements specified herein, in accordance with industry best practices, in accordance with manufacturers' recommendations, and in a manner suitable for ease of operation, inspection, and maintenance. All wiring shall be neatly bundled, run in wireway, and terminated. All spare wiring shall be neatly coiled and clearly labeled at both ends for future use by the Owner. Any work not meeting these requirements shall be corrected at no expense to the Owner.

F. Sufficient common-mode and differential-mode noise rejection shall be provided to insure operation of the plant process control system to meet all specification requirements. General practice shall include:

1. Maintaining crossings between noisy wires and signal wires at right angles.

2. Maintaining separation between noisy wires and signal wires as wide as practical.

3. Grounding all signals, shields and power supplies at the process control unit or local control panel.

4. Providing passive filters on signals with time constant compatible with scan intervals and overvoltage protection.

5. Eliminating cable splices. All splices in instrumentation and control system signal and network cables shall be approved in advance by the Engineer.

6. Providing a floating output for transmitters that have their own power sources.

G. DC and AC power grounding shall be performed in accordance with the digital hardware manufacturer's recommendations as well as all applicable code requirements.

H. The case of each field instrument and control panel shall be grounded in compliance with the National Electric Code.

I. Power wires shall be separated from parallel-running signal wires by the following minimum spacing:

CIRCUIT VOLTAGE (VAC)	MINIMUM SPACING (IN.)
120	12
240	18
480	18
2000 and above	24

J. The Contractor shall provide all required cutting, drilling, inserts, supports, bolts, and anchors, and shall securely attach all equipment and materials to their supports. Embedded supports for equipment furnished under this Division shall be provided and installed as shown specified herein and shown on the Drawings.

K. Following acceptance of the factory tests by the Engineer, and in accordance with the construction schedule, the Contractor shall commence installation of the digital control system hardware. Digital system equipment items shall not be installed, however, until all architectural, mechanical, HVAC and electrical work has been completed in the equipment rooms, MCCs, control rooms and all structural and/or mechanical work has been completed within 50 feet of equipment locations.

L. Upon completion of the above construction work, the Contractor shall request an inspection of the above-named areas. The Engineer will issue a written approval to proceed with delivery and installation only after being satisfied that all work described above has been properly performed. Digital equipment shall remain at the factory site or

storage prior to approval for delivery to the project site. Partial shipments may be required to meet construction schedule requirements.

PART 2 -- PRODUCTS

(NOT USED)

PART 3 -- EXECUTION

(NOT USED)

+ + + END OF SECTION 17080 + + +

SECTION 17100
CONTROL AND INFORMATION SYSTEM HARDWARE, GENERAL

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. The process control system is physically and functionally distributed between controller-equipped control panels, field panels, operator workstations and appurtenances.

B. Although manual control facilities shall be provided adjacent to each final control element or in local control panels, such facilities are for testing, maintenance and local monitoring purposes only and shall not be regarded as backup to the controller-based control system.

C. PLC/controllers may be categorized as either "process PLC/controllers" that are provided by the instrumentation subcontractor or "equipment control PLC/controllers" provided by equipment manufacturers for the operation of their equipment (blowers, centrifuges, chemical systems, filters, etc.). Unless otherwise specified, all PLCs provided under this Contract shall conform to the requirements specified in this Division.

D. Major plant control system digital equipment items are described in the Specifications and shown on the Drawings.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 17121 – Programmable Pump Controllers

B. Section 17180 – Process Control System Networks

1.03 DIGITAL HARDWARE CONFIGURATIONS

A. All discrete and analog data acquisition, pre-processing, storage and process control functions shall be performed at the controller level. Run time and flow accumulations shall be performed at the controller level.

B. No other exceptions will be considered.

PART 2 -- PRODUCTS

2.01 GENERAL SYSTEM HARDWARE REQUIREMENTS

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A. Unless otherwise specified, all hardware shall be rated for industrial use, resistant to shock, vibration, electromagnetic interference, static discharge, and suitable for the environmental conditions described elsewhere in this Division. Commercial or office grade equipment shall not be accepted.

B. Unless otherwise specified, modular construction shall be employed to simplify maintenance and to provide for future hardware expansion. Plug-in, modular PCBs or modules shall be employed for easy removal to permit exposure of circuit wiring, components and test points. Extender boards shall be provided if necessary to permit PCBs to be completely exposed for testing purposes.

C. Keying schemes shall be used to prevent PCB misplacement.

D. The temperature inside each enclosure containing digital hardware (i.e., cabinet, panel or console) shall be continuously monitored and shall generate an alarm to the Owner SCACA system if the temperature rises to an adjustable, preset high temperature.

2.02 DIGITAL SYSTEM FAILURE DETECTION AND FAIL-OVER REQUIREMENTS

A. No degradation in control system performance shall occur when the system is operating in a partial failure or an equipment fail-over mode. Likewise, no degradation of system performance shall occur while a backed-up system component is undergoing preventive or corrective maintenance.

B. All devices connected to the pump controller shall be self-checking and shall report their operational status to the operator workstations as either "normal" or "failed". A graphic display shall be furnished with the control and information system showing this information along with current communication status of each device.

PART 3 -- EXECUTION

3.01 REQUIREMENTS

A. Refer to Section 17000, Part 3.

+ + + END OF SECTION 17100 + + +

SECTION 17121
PROGRAMMABLE PUMP CONTROLLERS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall furnish, test, install and place in satisfactory operation Programmable Pump Controller (Remote Telemetry Unit-based) with all spare parts, accessories, and appurtenances as herein specified and as shown on the Drawings.

B. The Programmable Pump Controller shall be an intelligent, modular unit, capable of both data acquisition and local data processing. It shall monitor and control local equipment in a stand-alone mode as well as being an intelligent node in a distributed system. It shall be based on multiprocessor architecture, in which a co-processor is used for handling on-board input/output channels. To facilitate initial installation, maintenance and future expansion, external input/output modules shall be connected to the basic controller.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 17000 – Control and Information System Scope and General Requirements.

B. Section 17060 – Signal Coordination Requirements.

C. Section 17100 – Control and Information System Hardware – General.

D. Section 17125 – Operator Interface Units.

E. Section 17180 – Process Control System Networks.

F. Section 17190 – Uninterruptible Power Systems.

G. Section 17500 – Enclosures, General.

1.03 TOOLS, SUPPLIES AND SPARE PARTS

A. Tools, supplies and spare parts shall be provided as specified in Section 17050 - Tools, Supplies, and Spare Parts. In addition, the following specific spare parts items shall be provided:

1. One Pump Controller.
2. One of each power supply and special function cards.
3. One of each type and size of I/O expansion module.

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PART 2 -- PRODUCTS

2.01 PUMP CONTROLLERS – GENERAL

A. The instrumentation subcontractor shall furnish Pump Controllers as specified herein and as shown on the Drawings. Pump Controllers shall be provided complete with CPU, power supply, I/O cards, special function cards, instructions, memory, input/output capacity, and appurtenances to provide all features and functions as described herein.

B. Controller shall interface with City of Atlanta SCADA system via cellular modem (provided by others).

1) Coordinate with Owner and provide annotated data exchange look-up tables and other information to allow the Owner to implement efficient data exchange between the pump controller and the City of Atlanta SCADA system. The data exchange table must be submitted for approval.

2) Coordinate IP addresses with Owner.

C. Coordinate with Owner for Owner's graphic standards to be used on pump controller operator interface display screens. Provide graphics meeting these general guidelines for uniformity. At a minimum, all color standards for indications and alarms must be followed.

D. All components of the Pump Controller system shall be of the same manufacturer who shall have fully tested units similar to those being furnished in an industrial environment with associated electrical noise. The processing unit shall perform the operations functionally described herein based on the program stored in memory and the status of the inputs and outputs.

E. Pump Controllers shall be designed to operate in an industrial environment. The Pump Controller shall operate in an ambient temperature range of -10□-60□C and a relative humidity of 5-95 percent, non-condensing. The Pump Controller shall operate on supply voltages of 90-132 VAC at 47-63 Hz or 24 VDC if provided with a battery backup system.

F. Only a single type of processor shall be supplied for all Pump Controllers of a designated type. Memory and processor shall be adequate for all control functions specified. Pump Controller shall be as manufactured or equal to the following:

- Xylem Flygt Multismart Pump Station Manager 3MP RTU Pump Station Manager 3MP RTU

2.02 PROCESSORS

A. The Pump Controller shall be an embedded I/O design with I/O expansion capability. A single chassis shall house processor, memory, embedded I/O circuitry, communications and power supply. LED-type indicating lights shall be provided to indicate processor status. The Pump Controller processor shall monitor the internal operation of the Pump Controller for failure and provide an alarm output. Non-volatile memory in the form of a manufacturer supplied industrial CompactFlash card, SD card or equivalent technology shall be required to maintain the entire current program and firmware of the controller in the event of power loss. The program shall be updated onto the flash memory each time a program changes such as an online edit or tag value is changed. When non-volatile memory (flash memory) is not available for certain controller models as offered by the Pump Controller manufacturer, lithium batteries shall be used to maintain process RAM memory for at least one year in the event of power loss. The lithium battery unit shall be an externally mounted battery assembly with the highest available capacity.

B. The Pump Controller shall be configured with a modern Windows application and programmed with the open standard IEC 61131 compliant programming language. Programs shall be developed and capable of being downloaded directly to the controller using a standard RS-232 interface cable, via Ethernet connection, and remotely through the radio communication network.

C. Pump Controller processors shall be provided with substantial user program, data and logic memory to allow for future expansion of the overall system. Data logging capability shall be provided for user defined faults and events. The total memory used on each processor shall be less than 60% of available memory at project completion.

2.03 COMMUNICATIONS

A. Pump Controller communications shall be provided as specified in Section 17180 – Process Control System Networks.

B. Pump Controller shall provide serial and ethernet communications ports. Pump Controller shall have at least two dedicated serial ports which support RS-232, one RS-485 port and one 10/100Mbps RJ-45 port.

C. The Pump Controller shall be able to support various types of fieldbus communication systems for data links to field instruments (where specified) in addition to connected equipment such as power monitors, VFDs, motor protection monitors, etc. As a minimum, DNP3 over TCP/IP, Modbus TCP/IP, Modbus RTU Master and Slave, TCP/IP Ethernet shall be supported. The Contractor shall coordinate the efforts of the necessary parties (instrumentation subcontractor and equipment suppliers) to accomplish the required device and data table addressing between each Pump Controller and the associated connected equipment.

D. Additional communication modules or protocol gateways may be required to support specific communication protocols required under this Contract and shall be supplied at no extra cost to the Owner.

2.04 INPUT/OUTPUT SUB-SYSTEMS

A. Input/output hardware shall be embedded I/O, expansion plug-in modules in associated I/O backplane/chassis or DIN-rail mounting assemblies. Each unit shall handle the required number of process inputs and outputs plus a minimum of 10 percent active pre-wired spares for each I/O type furnished, plus a minimum of 30 percent spare I/O module space for the addition of future circuit cards or modules.

B. Discrete inputs shall be 24 VDC or 120 VAC signals (integral to the PLC) from dry field contacts. Discrete outputs shall be 24 VDC or 120 VAC outputs sourced from the PLC, or dry relay contacts (2A minimum) as required. Refer to Section 17060 – Signal Coordination Requirements for further details of discrete signal type and voltage requirements. The Pump Controller shall provide momentary and latched outputs as required to interface with motor controls and external devices. Interposing relays shall be provided where required to interface with field equipment. Interposing relays shall be as specified in Section 17550. Electrical isolation shall be provided where required. Maximum density for discrete I/O modules shall be 32 per input module and 16 per output module.

C. Analog input circuits shall be isolated, minimum 10-bit resolution type. Analog input hardware shall be provided as required for all types of analog inputs being transmitted to the Pump Controller. In general, analog input modules shall be capable of receiving 4-20 mA signals. Where required, RTD input modules shall have a minimum resolution of 0.15□C and be capable of accepting signals from 100-ohm Platinum RTD's. Analog outputs shall be coordinated with the receivers but shall generally be isolated 24 VDC 4-20 mA outputs powered from the Pump Controller. Each input/output circuit shall have optical isolation to protect the equipment against high voltage transients. Optical isolation shall be rated at not less than 1500 V RMS. Lightning/surge protection shall be provided as specified in Section 17560 - Surge Protection Devices. Maximum density for analog I/O modules shall be 8 per module.

D. Input/output modules shall be configured for ease of wiring and maintenance. The modules shall be connected to wiring arms that can be disconnected to permit removal of a module without disturbing field wiring. The process interface modules shall be provided with screw-type terminal blocks with barriers between adjacent terminals for connection of field inputs. Terminals shall be suitable for accepting up to and including No. 14 AWG wire. All DC output circuits to the field shall include fuses, either integral or at the terminal strip. Output failure mode shall be selectable so that upon station or communication system failure all outputs shall be placed either in the non-conducting mode or remain as were prior to failure.

E. External power supplies shall be provided with the Pump Controller as required to meet specified installed I/O power requirements plus spares. Power supplies shall be modular units, shall be fully redundant and shall alarm the Pump Controller upon failure. Power

supplies shall have a line regulation of 0.05% and meet the environmental and power requirements specified herein for the Pump Controller.

2.05 REMOTE I/O SUBSYSTEMS

A. Remote I/O shall be provided as designated on the Drawings. Remote I/O shall be either PLC backplane type I/O or field modules as manufactured by the Pump Controller manufacturer. Field modules shall meet the requirements of Subsection 2.04, Input/Output Subsystems. Remote I/O processor or communication modules shall be modular and individually replaceable.

B. Remote I/O shall communicate with the Pump Controller using the Pump Controller manufacturer's standard protocol or an open standard network such as Ethernet IP, Modbus TCP/IP, or equal.

2.06 PROGRAMMING SOFTWARE

A. The Pump Controller programming and configuration software shall be the manufacturer's latest, full-featured version, Windows-based, and shall be fully compliant with IEC 61131-3 standards. The software package shall consist of all programming, configuration, and documentation software needed to place the control and information system in satisfactory operation. The software shall allow on-line and off-line program development and documentation. Pump Controller programming software shall include documentation on optical media.

B. The configuration and programming software shall support communication over the network specified in Section 17180 – Process Control System Networks to implement its functions remotely from an operator workstation. The Owner shall configure their SCADA system to communication with the Pump Controller outside of this contract. Provide all hardware and programming software necessary for the Owner to implement this functionality.

2.07 FUNCTIONALITY

A. The Pump Controller shall provide control of up to 6 pumps, with Manual/Off/Auto modes.
- In Manual control (semi-automatic manual) pump switches off at deactivation setpoint and reverts to Auto mode to prevent accidental pump run on.
- To pump beyond off set point in manual button must be held down (full manual).
- Setpoint adjustment for pump activation/de-activation and level alarms.

B. Pump Alternation including:
- Fixed Lead/Duty
- Alternation
- Alternation N:1 (e.g. 3:1)

- Run most efficient pump, N:1 ratio, e.g. more efficient pump runs for 20 times for each operation of less efficient pump(s)
- Alternation by hours run or start

C. Provision for remote control via SCADA for
- Starting/stopping pumps
- Reset of pump and station faults
- Changing control and alarm setpoints

D. Pump Decommission/Commission
- Decommissioned pump automatically removed from control algorithm, alarms. displays, etc.
- SCADA tag flags decommissioned status

E. Datalogging for up to 7500 user-defined faults and events (process values)

F. 3-phase supply monitoring and supply protection
- Under-voltage
- Over-voltage
- Phase fail
- Phase rotation

G. Energy, power and pump efficiency monitoring
- kW, kVA, power factor, kWH, kVAH calculation for each pump, kVAH calculation for each pump
- pump efficiency calculation (liters or gal per kWH) for each pump) for each pump

H. Motor protection including
- 3-phase over current monitoring for each pump
- Over and Under current trip
- Ground/Earth fault
- Current phase imbalance fault
- I2T fault
- Insulation resistance testing for motor windings
- Values and user-defined fault threshold

I. Flow measurement / calculation

J. Optimization including:
- Maximum off time for any pump
- Maximum pumps permitted to run simultaneously
- Maximum pump starts per hour
- Inter-pump start and stop delays
- Maximum run time for any pump

- Jammed pump detection and clear operation
- Well clean-out functions
- Pump grouping with different configurations for each group

K. Detection and alarm of level device failure

L. Security
- Admin user sets PIN/Password for access to configuration of the unit
- Automatic datalogging of who has entered the configuration menu
- Automatic logging of all unsuccessful login attempts with date/time
- Digital input option, e.g. key switch, for access to configuration menu

PART 3 - EXECUTION

3.01 REQUIREMENTS

A. Pump Controller programming shall make use of the various IEC languages as appropriate to the specific task and shall be performed in a modular style making extensive use of program blocks (subroutines) and program variables to be passed to the program blocks for specific equipment. It is the intent of this requirement to allow for enhanced readability and ease of modification of the program code through the elimination of multiple instances of repeated code for the same function in a "hard-coded" style.

B. Refer to Section 17000, Part 3 for additional requirements.

+ + + END OF SECTION 17121 + + +

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SECTION 17125
OPERATOR INTERFACE UNITS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall furnish, test, install and place in satisfactory operation all operator interface units, with all spare parts, accessories, and appurtenances as herein specified and as shown on the Drawings.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 17000 – Control and Information System Scope and General Requirements

B. Section 17100 – Digital System Hardware Configuration

C. Section 17121 – Programmable Pump Controllers

PART 2 -- PRODUCTS

2.01 OPERATOR INTERFACE UNIT

A. An Operator Interface Unit (OIU) shall be provided to view and change pump controller monitoring and control parameters and to display alarm messages using a graphical user interface. The OIU shall provide the following features as a minimum:

1. Minimum of 10.4- inch diagonal display screen
2. 18-bit color TFT LCD 800 X 600 SVGA display
3. Backlit analog resistive touch screen interface w/ 1 million press actuation rating
4. Backlight w/ min. 50,000 hr life to half brightness
5. Minimum of 512 MB internal storage
6. Minimum of 512 MB RAM application memory
7. Minimum of 80 MB nonvolatile user memory
8. Windows CE Operating System
9. Battery-backed real-time clock
10. Secure Digital (SD) card slot w/ min. 2 GB card
11. One USB 2.0 high-speed Type A host port; one USB 1.0 high-speed Type B device port
12. One 10/100Base-T Auto MDI/MDI-X Ethernet port
13. Windows-based configuration software complete with download cable
14. Operating Voltage: 120 VAC or 24 VDC (internal or via independent power supply)
15. Enclosure Rating: NEMA 12/4X to match the associated PLC cabinet rating

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16. Environment: 0-55□C, 5-95% relative humidity, non-condensing

B. The operator interface unit shall be Allen-Bradley PanelView Plus 7 Standard 1000, MultiSmart Operator Interface, or equal.

PART 3 -- EXECUTION

3.01 REQUIREMENTS

A. The OIU shall be configured to display all pump controller I/O, setpoints, and parameters. All equipment failures shall be alarmed. Pump controller I/O values and operator-entered setpoints shall be displayed with associated units and service descriptions. Menus shall be provided to navigate between screens of different equipment items. Displays shall be arranged in a hierarchical structure with displays for specific equipment items grouped together. Additional functionality shall be as specified elsewhere in this Division.

B. All necessary configuration and programming software shall be provided on optical media and turned over to the Owner.

C. Unless otherwise noted, each OIU shall be mounted between 48 and 60 inches above the floor or work platform.

D. Refer to Section 17000 for additional requirements.

+ + + END OF SECTION 17125 + + +

SECTION 17180
PROCESS CONTROL SYSTEM NETWORKS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall furnish, test, install and place in satisfactory operation IEEE 802.3 Ethernet local area network(s) for communications among plant devices.

B. Local area network shall be provided with all spare parts, accessories, and appurtenances as herein specified.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 17000 – Control and Information System Scope and General Requirements

B. Section 17121 – Programmable Pump Controllers

1.03 TOOLS, SUPPLIES AND SPARE PARTS

A. The following specific spare parts items shall be provided:

1. A termination tool kit shall be provided containing all required tools and consumables for up to 25 connections of each connection type furnished. Termination kit shall be as manufactured by Black Box, Corning Cable Systems, Optical Cable Corporation, or equal.

2. One spare switch of each type furnished under this Contract.

PART 2 -- PRODUCTS

2.01 LOCAL AREA NETWORK (LAN)

A. An IEEE 802.3 Ethernet local area network shall be used for communications between plant devices.

B. Network wiring shall be unshielded, twisted-pair copper cables for connections within buildings. Fiber optic media shall be used for all inter-device communication links extended outside of a building, unless specifically noted. Cables shall be as specified herein.

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C. The Contractor may provide a network configuration different from that shown in the Contract Drawings with written approval of the Engineer, but the Contractor shall coordinate with all affected trades and pay for all additional charges incurred.

D. The Contractor shall supply all hardware, cables, connectors, and software to implement a network as specified herein and shown on drawings.

2.02 INDUSTRIAL ETHERNET NETWORK SWITCHES

A. Except where specifically allowed on the Control System Architecture Drawing, industrial Ethernet network switches shall be provided for each device connected to the process control system network. The switches shall create switched Ethernet networks that conform to the IEEE 802.3 and 802.3u standards using copper wires or optical fibers in a bus, tree or ring network topology as shown on the Drawings. Ethernet network switches shall be modular, rack mounted, or standard DIN-rail mounted within the PLC cabinet or in an adjacent communication cabinet, as shown on the Drawings.

B. Ethernet network switches shall support ring, bus, tree, or point-to-point network topologies. On-line signal monitoring shall be provided to detect and locate impending faults. Ethernet network switches shall be replaceable on-line without disrupting the network. The Ethernet network switches shall be integrated into the in-plant Ethernet network to form a redundant ring network with self-healing communication recovery. Switches shall support the non-proprietary Media Redundancy Protocol (MRP) and Rapid Spanning Tree Protocol (RSTP) in addition to the switch manufacturer's standard redundant ring network protocol, all of which shall provide self-healing communication recovery.

C. Ethernet network switches shall meet the following minimum performance requirements:

Functions:	Modular managed switch with store and forward switching mode, 10 Mbps Ethernet, or 100 Mbps Fast-Ethernet, or gigabit Ethernet support, multi-address capability, auto-crossing, auto-negotiation, auto-polarity. Port speed and duplex auto-negotiation shall be configurable. Each network switch shall manage up to eight (8) ports possible via integrated media modules specified below.
Management:	Simple Network Management Protocol (SNMP) (v1/v2/v3) and Common Industrial Protocol (CIP) support; IGMP filtering and snooping.
Power Requirements:	Redundant 24 VDC power supply
Operating Temperature:	0° - 60°C

Relative Humidity: 10 - 95%

Network Size: Up to 50 nodes in ring structure

Port Type & Quantity: (at each PLC location)

- MAs required; minimum of four eight (48) 10/100Base-TX, twisted pair cable, RJ-45 sockets, 0-100 meters LAN segment
- Two (2) 100/1000Base-FX, multimode fiber optic cables (62.5/125 μm), LC, ST or SC sockets, 0-5000 meters LAN segment

Link Budget: 8 dB @ 1300 nm; 10 dB @ 850 nm

Wavelength: 850 or 1300 nm

D. Acceptable industrial Ethernet network switches shall be as manufactured by Cisco Systems, Hirschmann, Phoenix Contact, Weidmuller, or equal.

2.03 OFFICE-GRADE ETHERNET NETWORK SWITCHES

A. Where specifically called out on the Drawings and where located in a suitable office-type environment (e.g., administration areas), office-grade Ethernet switches shall be provided for connectivity to the process control system network.

B. Office-grade Ethernet switches shall be rack-mounted as shown on the Drawings and shall meet the following specifications:

Functions/Protocol: Same as industrial switches

Power Requirements: Redundant 120 VAC power supply

Operating Temperature: 0° - 40°C

Relative Humidity: 10 - 95%

Port Type & Quantity: (at each location)

- Minimum of twelve (12) 10/100Base-TX, twisted pair cable, RJ-45 sockets, 0-100 meters LAN segment
- Two (2) 100/1000Base-FX, multimode fiber optic

uplinks (62.5/125 μm), LC, ST or SC sockets, 0-500 meters LAN segment

C. Office-grade Ethernet switches shall be Catalyst by Cisco Systems, or equal.

2.04 FIBER OPTIC MEDIA CONVERTERS

A. Fiber optic media converters shall be provided to transform the specific PLC network communications protocol into an optical signal suitable for transmission over the fiber optic cable specified herein. Fiber optic media converters shall be modular, rack mounted, or mounted within the PLC rack.

B. Fiber optic media converters shall meet the following minimum performance requirements:

1.	Input Power:	110/220 VAC or 24 VDC (as required) for stand-alone panel-mounted modules or +5 VDC for PLC rack-mounted modules
2.	Operating Temperature:	0□ - 60□C
3.	Node-to-Node Distance:	6500 feet
4.	Wavelength:	850 or 1300 nanometers
5.	Connector Type:	SC, LC, or ST

C. The PLC/controller manufacturer's standard, rack-mounted fiber optic transceiver may also be used, subject to approval by the Engineer.

D. Port speed and duplex auto-negotiation shall be configurable.

E. Acceptable fiber optic media converters shall be as manufactured by Black Box, Phoenix Contact or equal.

2.05 UNSHIELDED TWISTED PAIR CABLE

A. Unshielded twisted pair cable for drops within buildings shall consist of 4 pair of 24 AWG copper conductors in a flame-retardant jacket. Cable shall be plenum rated (UL 910) and meet EIA/TIA-568 Category 6 specifications. Unshielded twisted pair cable shall be Hyper Grade Extended Distance cable as manufactured by Berk-Tek, Belden equivalent, or equal. Connectors shall be modular RJ-45 plug.

2.06 FIBER OPTIC CABLE

A. Fiber optic cable shall conform to the following specifications:

1.	Fiber Type:	Graded Index (GI) Multimode
2.	Fiber/Cladding Diameter:	62.5/125 microns
3.	No. Fibers:	12, Color-coded

4.	Cable Construction:	Loose Tube w/ Ripcords
5.	Filling:	Water Swellable Dry Block
6.	Armored:	No
7.	Central Member:	Dielectric (Kevlar)
8.	Rating:	Gigabit Ethernet
9.	Bandwidth:	200/500 MHz-km at 850/1300 nm
10.	Maximum Attenuation:	3.5 dB/km at 850 nm; 1.5 dB/km at 1300 nm
11.	Application Type:	Direct-burial/Conduit/Aerial
12.	Sheath:	UV Resistant
13.	Max. Tensile Load:	600 lb (2700 N) installation; 200 lb (890 N) long term
14.	Minimum Bend Radius:	7 in (17.4 cm) under maximum tensile load; 4.6 in (11.6 cm) unloaded (installed)
15.	Operating Temperature:	-40 to 70 degrees C
16.	Operating Relative Humidity:	0-100%

B. Fiber optic cable shall be ALTOS All Dielectric Loose Tube Optical Cable as manufactured by Corning Cable Systems, the Extended Performance Fiber Optic Cable Series as manufactured by Phoenix Digital, Inc., Belden equivalent, equivalent system by Optical Cable Corporation, or equal.

C. Upon entering a cabinet, panel or console, loose tube fiber optic cable shall be broken out using fan-out kits and terminated in a fiber optic patch panel. All individual fibers shall be terminated and all connections shall be tested. Tight buffered cable shall then be routed to the individual destinations as needed (or loose tube cable for runs to other buildings). Cabinet-mounted patch panels shall be Cabinet-Mounted Interconnect Center (C-MIC) as manufactured by Corning Cable Systems, equivalent by Black Box, Inc., Optical Cable Corporation, or equal.

D. Where cable is required to be routed to numerous, separate destinations within a building, loose tube cable shall be broken out immediately upon entering the building, all individual fibers terminated in a patch panel, and tight buffered, plenum rated cable shall be routed to the individual destinations. Building patch panels shall be Wall-Mountable Interconnect Center (WIC) or Premises Interconnect Center (PIC) as manufactured by Corning Cable Systems, equivalent by Black Box, Inc., Optical Cable Corporation, or equal.

E. Fiber optic cable for installation within buildings shall comply with all applicable fire and building safety codes for such applications.

F. Fiber optic cable shall utilize mechanically spliced, field installable, SC, LC, or ST compatible connectors. Connections shall have a typical loss of 0.35 dB or better and shall provide stable optical performance after numerous rematings. Connections shall utilize physical contact terminations utilizing UV or heat cured adhesive. Where applicable, field terminations shall use a simple procedure requiring minimal training.

PART 3 -- EXECUTION

3.01 REQUIREMENTS

A. The destination of all network data cables (both copper and fiber) leaving an enclosure, patch panel, or building shall be labeled at each end using industry-standard wire markers.

B. Refer to Section 17000, Part 3 of the Specifications for additional requirements.

+ + + END OF SECTION 17180 + + +

SECTION 17190
UNINTERRUPTIBLE POWER SYSTEMS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall furnish, test, install and place in satisfactory operation all uninterruptible power systems, with all spare parts, accessories, and appurtenances as herein specified and as shown on the Drawings.

B. One UPS shall be provided for each programmable logic controller (PLC), pump controller, or remote telemetry unit (RTU) and its appurtenant equipment provided under this Contract. However, courtesy receptacles in controller and RTU cabinets shall not be powered by the UPS.

C. UPSs shall be mounted in or near enclosures containing digital hardware, unless otherwise specified or shown on the Drawings, as follows:

1. UPSs for control panels containing PLCs or pump controllers shall be mounted either within the cabinet or in an adjacent cabinet of suitable environmental rating.

2. UPSs for RTUs shall be mounted within the RTU cabinet.

3. Where the UPS is mounted within a dedicated enclosure, that enclosure shall be properly sized for heat dissipation and all other applicable requirements as specified in Section 17500 and its subordinate Sections.

4. Where the UPS is mounted within the PLC/controller or RTU cabinet, it shall not interfere with access to other equipment or wiring within the panel (i.e., it shall not be necessary to move or remove the UPS to remove or service other panel-mounted equipment). For floor-mounted cabinets with bottom wiring access (including those cabinets with legs), the UPS shall be placed on a dedicated shelf within the cabinet.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 17000 – Control and Information System Scope and General Requirements

B. Section 17100 – Control and Information System Hardware, General

C. Section 17121 – Programmable Pump Controllers

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1.03 SUBMITTALS

A. The Contractor shall submit UPS sizing calculations for all UPS's furnished under this Contract in accordance with Section 17030 - Control and Information System Submittals.

PART 2 -- EQUIPMENT

2.01 UNINTERRUPTIBLE POWER SYSTEMS

A. Each UPS shall consist of a freestanding UPS module and battery modules as required to meet backup run time requirements.

B. UPSs shall be true on-line type. Each UPS shall be sized to match the maximum power requirements of the associated digital equipment, control panel power supplies and accessories. Under normal operation, the AC power shall be converted to DC. The DC power from the battery charger shall supply an inverter and maintain the battery module at full charge. The AC output from the inverter shall be fed to the associated digital equipment power supply unit and/or other equipment power supplies as appropriate. Upon loss of the AC supply, the inverter shall continue to supply normal power to the device, drawing DC from the batteries.

C. An automatic bypass switch shall be provided on UPSs of greater than 2 kVA capacity. The transfer switch shall be of the solid state, make-before-break type and shall automatically transfer load from the inverter to the AC line in the event of an inverter malfunction. The total transfer time shall be 5 milliseconds or less. The transfer switch shall be provided with a manual override.

D. A manually operated maintenance bypass switch shall be provided for each UPS installation to allow hardware to be powered while the UPS is removed for maintenance. The bypass switch shall be the make-before-break type to ensure continuous power to the associated PLC or controller.

E. Loss of AC power shall be monitored on the line side of the UPS and reported via normally closed (fail safe) unpowered contacts to the associated PLC/controller/RTU.

F. Each UPS shall meet the following requirements:

1. Input voltage shall be 117 VAC, single phase, 60 Hz.

2. Voltage regulation shall be +/-5 percent for line and load changes.

3. The output frequency shall be phase-locked to the input AC line on AC operation and shall be 60 hertz +/-0.5 percent when on battery operation.

4. The batteries shall be of the sealed, lead acid or lead calcium gelled electrolyte type, or VRLA absorbed glass mat (AGM) type. The battery modules shall have a minimum full load backup time of 30 minutes for PLC-based control panels, and 45 minutes for remote telemetry units.

5. A status monitoring and control panel shall be provided and shall include the following:

   a. Status indicating lights for both normal and abnormal conditions.

   b. Individual alarm contacts that shall close upon loss of the AC line, low battery level or operation of the static transfer switch. Contacts shall be wired to the closest discrete input subsystem. Alternatively, an RS-232 or USB port shall provide UPS status to an operator workstation. All required interface software and hardware shall be provided.

   c. Circuit breaker for the AC input.

6. Sound absorbing enclosure.

7. EMI/RF noise filtering.

8. Surge protection shall be provided on the AC input circuit, which shall have a UL TVSS clamping voltage rating of 400 V with a <5 ns response time.

G. UPS systems shall be Model GXT2 as manufactured by Liebert, equivalent by Powerware, MGE UPS Systems, GE Digital Energy, or equal.

PART 3 -- EXECUTION

3.01 REQUIREMENTS

A. Refer to Section 17000, Part 3 of the Specifications.

+ + + END OF SECTION 17190 + + +

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SECTION 17500
ENCLOSURES, GENERAL

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall furnish, test, install and place in satisfactory operation the control enclosures, with all spare parts, accessories, and appurtenances as specified herein and as shown on the Drawings.

B. Control enclosures shall be assembled, wired, and tested in the instrumentation subcontractor's own facilities, unless specified otherwise. All components and all necessary accessories such as power supplies, conditioning equipment, mounting hardware, signal input and output terminal blocks, and plug strips that may be required to complete the system shall be provided.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 17000 – Control and Information System Scope and General Requirements

B. Section 17100 – Control and Information System Hardware, General

C. Section 17510 – Cabinets and Panels

D. Section 17520 – Field Panels

E. Section 17550 – Panel Instruments and Accessories

F. Section 17560 – Surge Protection Devices

G. Section 17600 – Unpowered Instruments, General

H. Section 17700 – Powered Instruments, General

I. Section 17900 – Schedules and Control Descriptions, General

J. Refer to Division 16 for additional requirements for cable, circuit breakers, disconnect switches, etc.

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1.03 GENERAL INFORMATION AND DESCRIPTION

A. The cabinet itself and all interior and exterior equipment shall be identified with nameplates. The equipment shall be mounted such that service can occur without removal of other equipment. Face mounted equipment shall be flush or semi-flush mounted with flat black escutcheons. All equipment shall be accessible such that adjustments can be made while the equipment is in service and operating. All enclosures shall fit within the allocated space as shown on the Drawings.

B. Either manufacturer-standard or custom cabinetry may be furnished subject to the requirements of the Contract Documents and favorable review by the Owner.

C. Due consideration shall be given to installation requirements for enclosures in new and existing structures. The Contractor shall examine plans and/or field inspect new and existing structures as required to determine installation requirements and shall coordinate the installation of all enclosures with the Owner and all affected contractors. The Contractor shall be responsible for all costs associated with installation of enclosures, including repair of damage to structures (incidental, accidental or unavoidable).

1.04 TOOLS, SUPPLIES AND SPARE PARTS

A. Tools, supplies and spare parts shall be provided as specified in Section 17050 - Tools, Supplies and Spare Parts. In addition, the spare parts items shall be provided as specified in the individual cabinet and panel specification sections (17510, 17520).

PART 2 -- PRODUCTS

2.01 TERMINAL BLOCKS

A. Terminal blocks shall be assembled on non-current carrying galvanized steel DIN mounting rails securely bolted to the cabinet subpanel. Terminals shall be of the screw down pressure plate type as manufactured by Phoenix Contact, Weidmuller, Wieland, Square D, or equal.

B. Power terminal blocks for both 120 VAC and 24 VDC power shall be single tier with a minimum rating of 600 volts, 30 amps.

C. Signal terminal blocks shall be single tier with a minimum rating of 600 volts, 20 amps.

PART 3 -- EXECUTION

3.01 FABRICATION

A. Enclosures shall provide mounting for power supplies, control equipment, input/output subsystems, panel-mounted equipment and appurtenances. Ample space shall be provided between equipment to facilitate servicing and cooling.

B. Enclosures shall be sized to adequately dissipate heat generated by equipment mounted inside the panel. If required, one or more of the following shall be provided to facilitate cooling:

1. Louvered openings near the bottom and top (NEMA 12 cabinets only).

2. Thermostatically controlled, low noise internal air blowers (initial setpoint 75□F) to circulate air within the enclosure, maintaining a uniform internal temperature.

3. Thermostatically controlled, low-noise cooling fans to circulate outside air into the enclosure, exhausting through louvers near the top of the cabinet (NEMA 12 cabinets only). Air velocities through the enclosure shall be minimized to assure quiet operation.

4. All openings in cabinets and panels shall be fitted with dust filters.

C. Enclosures shall be constructed so that no screws or bolt heads are visible when viewed from the front. Punch cutouts for instruments and other devices shall be cut, punched, or drilled and smoothly finished with rounded edges.

D. The temperature inside each enclosure containing digital hardware (i.e., cabinet, panel or console) shall be continuously monitored and shall generate an alarm to the nearest PLC if the temperature rises to an adjustable, preset high temperature. This thermostat shall be independent and separate from the thermostat used to control the temperature in the enclosure described above. Enclosure interior temperature alarm shall be displayed on the HMI.

E. Intrusion alarm switches shall be provided on all enclosures containing digital hardware and shall generate an alarm to the Owner's SCADA system when any enclosure door is opened.

F. Terminals shall be marked with a permanent, continuous marking strip. One side of each terminal shall be reserved exclusively for field incoming conductors. Common connections and jumpers required for internal wiring shall not be made on the field side of the terminal. Subject to the approval of the Engineer, a vendor's pre-engineered and prefabricated wiring termination system will be acceptable.

G. Wiring within cabinets, panels, and consoles shall be installed neatly and shall comply with accepted standard instrumentation and electrical practices. Power, control and

signal wiring shall comply with Division 16 of the Specifications, except that the minimum wire size for discrete signal wiring may be 16 AWG, and for analog wiring may be 18 AWG. For each pair of parallel terminal blocks, the field wiring shall be between the blocks.

H. Separate terminal strips shall be provided for each type of power and signal used within each cabinet. Where applicable, terminal strips for different voltages of discrete signal wiring shall also be separated. Terminal strips shall be labeled as to voltage and function.

I. All wiring shall be bundled and run open or enclosed in vented plastic wireway as required. Wireways shall be oversized by a minimum of 10%; overfilled wireways shall not be acceptable. All conductors run open shall be bundled and bound at regular intervals, not exceeding 12 inches, with nylon cable ties. Care shall be taken to separate electronic signal, discrete signal, and power wiring.

J. Spare field wiring shall be bundled, tied, and labeled as specified above, and shall be neatly coiled in the bottom of the cabinet.

K. All installed spare I/O hardware shall be wired along with live I/O wiring to the field wiring terminal blocks within the cabinet. Where space for spare I/O modules has been provided with the PLC/controller backplane or DIN-rail mounting system, corresponding space for wiring, surge protection, and terminations shall be furnished within the cabinet.

L. A copper ground bus shall be installed in each cabinet and shall be connected to the building power ground.

M. Interior panel wiring shall be tagged at all terminations with machine-printed self-laminating labels. Labeling system shall be Brady TLS 2200 Printer with TLS 2200®/TLS PC Link™ labels, or equivalent system by Seton or Panduit. The wire numbering system and identification tags shall be as specified in Section 16123 - Building Wire and Cable. Field wiring terminating in panels shall be labeled in accordance with the requirements of Section 16123. Where applicable, the wire number shall be the ID number listed in the input/output schedules.

N. Wires shall be color coded as follows:

Equipment Ground - GREEN

120 VAC Power - BLACK
120 VAC Power Neutral - WHITE

120 VAC Control (Internally Powered) - RED
120 VAC Control (Externally Powered) - YELLOW

24 VAC Control - ORANGE

DC Power (+) - RED
DC Power (-) - BLACK
DC Control - BLUE

Analog Signal – BLACK/WHITE or BLACK/RED

O. Enclosures shall be provided with a main circuit breaker and a circuit breaker on each individual branch circuit distributed from the panel. Main breaker and branch breaker sizes shall be coordinated such that an overload in a branch circuit will trip only the branch breaker but not the main breaker.

P. Enclosures with any dimension larger than 36 inches shall be provided with 120-volt duplex receptacles for service equipment and LED service lights. Power to these devices shall be independent from the PLC power supply and its associated uninterruptible power system.

Q. Where applicable, enclosures shall be furnished with red laminated plastic warning signs in each section. The sign shall be inscribed "WARNING - This Device Is Connected to Multiple Sources of Power". Letters in the word "WARNING" shall be 0.75 inch high, white.

R. The interconnection between equipment and panel shall be by means of flexible cables provided to permit withdrawal of the equipment from the cabinet without disconnecting the plugs.

3.02 PAINTING/FINISHING

A. All steel enclosures shall be free from dirt, grease, and burrs and shall be treated with a phosphatizing metal conditioner before painting. All surfaces shall be filled, sanded, and finish coated by spraying a 1-2 mil epoxy prime coat and smooth, level, high grade textured finish between flat and semi-gloss shine. The colors shall be selected by the Owner from a minimum of six color samples provided. Refer to Division 9 for additional requirements.

B. Materials and techniques shall be of types specifically designed to produce a finish of superior quality with respect to adherence, as well as impact and corrosion resistance.

C. Panels fabricated from stainless steel shall not be painted.

D. Panels fabricated from non-metallic materials (e.g., FRP) shall be gel-coated and shall not be painted.

3.03 INSTALLATION

A. Refer to Section 17000 for additional requirements.

+ + + END OF SECTION 17500 + + +

SECTION 17510
CABINETS AND PANELS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall furnish, test, install and place in satisfactory operation the cabinets and panels, with all spare parts, accessories, and appurtenances as specified herein and as shown on the Drawings.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 17000 – Control and Information System Scope and General Requirements

B. Section 17100 – Control and Information System Hardware, General

C. Section 17500 – Enclosures, General

D. Section 17900 – Schedules and Control Descriptions, General

PART 2 -- PRODUCTS

2.01 CABINETS AND PANELS

A. Cabinets and panels shall be formed or welded construction, reinforced with Unistrut, Powerstrut, or equal to facilitate mounting of internal components or equipment. Sufficient access plates and doors shall be provided to facilitate maintenance and testing of the cabinet's equipment. Doors shall be removable. Cabinets and panels with any dimension 36 inches or greater shall be provided with removable lifting lugs designed to facilitate safe moving and lifting of the panel during installation. All doors shall be fitted with common-keyed locks.

B. Cabinets and panels shall be minimum 14 USS gauge. Cabinets and panels with any dimension greater than 36 inches shall be 12 USS gauge.

C. Cabinets and panels located inside buildings but located in areas other than climate controlled (heated and air conditioned) electrical or control rooms, shall be as a minimum 316 stainless steel NEMA 4X construction, or as specified or shown on the Drawings for hazardous area classification (Class, Division, Group), or submersible (NEMA 6) applications. Epoxy coated cast copper-free aluminum construction shall also be acceptable for NEMA 4, 6 and 7 applications. Cabinets located in storage/feed areas for

062317BR

chlorine or other applicable corrosive chemicals shall be of non-metallic construction, rated NEMA 4X, and fully compatible with the associated chemical.

D. Cabinets and panels within climate controlled (heated and air-conditioned) electrical or control rooms shall be all steel fully enclosed NEMA 12 units with gasketed doors.

E. Cabinets and panels shall have doors on the front and shall be designed for front access. NEMA 12 cabinets shall be fitted with three-point door latches. Doors for NEMA 4X cabinets shall be all stainless steel with three-point latches. Door hardware on NEMA 4X cabinets located in chemical storage/feed areas shall be non-corrosive in that environment.

F. Panels and cabinets located outside fence-secured areas shall be fitted with padlock-able latch kits.

G. All cabinets and panels shall be provided with drawing pockets for as-built panel drawings. One copy of the appropriate panel as-built drawings shall be furnished and left in the pocket of each panel.

H. Panels with any dimension greater than 36 inches that contain a pump controller or programmable controller (PLC) shall be provided with a folding laptop programmer shelf on the inside of the door. When deployed, the laptop shelf shall not be greater than 48 inches above finished floor. Laptop shelf shall be fitted to door with factory applied weld-studs. Weld discoloration and enclosure penetrations will not be accepted.

I. Unless otherwise noted, panel-mounted control devices (OIUs, hand switches, etc.) requiring operator access shall be mounted between 48 and 60 inches above the floor or work platform.

J. Cabinets and panels shall be prefabricated cabinets and panels by Hoffman or Saginaw Control and Engineering (SCE). The Contractor may optionally provide cabinets that are custom-fabricated by the instrumentation subcontractor or by a reputable panel fabrication shop acceptable to the Engineer.

PART 3 -- EXECUTION

3.01 REQUIREMENTS

A. Refer to Section 17500 for additional requirements.

+ + + END OF SECTION 17510 + + +

SECTION 17520
FIELD PANELS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall furnish, test, install and place in satisfactory operation the field panels, with all spare parts, accessories, and appurtenances as specified or shown.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 17000 – Control and Information System Scope and General Requirements

B. Section 17500 – Enclosures, General

C. Section 17900 – Schedules and Control Descriptions, General

PART 2 -- PRODUCTS

2.01 FIELD PANELS

A. Field panels for outdoor service shall be suitable for wall or pipe mounting. Panels shall have the following features:

1. Type 316L stainless steel NEMA 4X construction unless located in chlorine environments. Chlorine environment shall be nonmetallic NEMA 4X construction.

2. Hinged and foamed-in-place continuous gasketed door(s). Door material shall match enclosure and shall have piano hinge(s) and three-point latches.

3. Field panels located outside fence-secured areas shall be fitted with staple and hasp. Provide padlock and coordinate keying with Owner.

4. Thermal insulation and thermostatically controlled space heaters where required to prevent condensation or maintain environmental conditions for installed components.

5. External sun shields or shades constructed of the same materials as the associated enclosure, unless otherwise specified. Sun shield or shade shall be fitted to enclosure supports and not to enclosure. Sun shield or shade shall have a slightly

062317BR

sloped top to shed water and shall extend past the front of the enclosure by at least 6 inches and extend down the side and back of enclosure.

6. All external sample/process piping, including valves and appurtenances, shall be insulated with weather-proof insulation and heat-taped to prevent freezing. Heat taping shall be thermostatically controlled and self-regulating and shall adjust its heat output to the temperature of the lines. Heat tape shall be powered from a GFCI circuit from within panel, unless otherwise shown or specified.

B. Field panels shall be adequately sized to house instruments, power supplies, surge protection, and appurtenant equipment required for operation. Sufficient space shall be provided for servicing instruments without removal of equipment from the enclosure.

C. Field panels shall be as manufactured by Hoffman, Saginaw Control and Engineering (SCE), or equal.

PART 3 -- EXECUTION

3.01 REQUIREMENTS

A. Refer to Section 17500 for additional requirements.

+ + + END OF SECTION 17520 + + +

SECTION 17550
PANEL INSTRUMENTS AND ACCESSORIES

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall furnish, test, install and place in satisfactory operation the panel instruments and accessories, with all spare parts, accessories, and appurtenances as specified herein and as shown on the Drawings.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 17000 – Control and Information System Scope and General Requirements

B. Section 17100 – Control and Information System Hardware, General

C. Section 17500 – Enclosures, General

D. Section 17900 – Schedules and Control Descriptions

1.03 GENERAL INFORMATION AND DESCRIPTION

A. All equipment mounted on the face of a panel shall conform to the same NEMA rating specified for the panel construction.

1.04 TOOLS, SUPPLIES AND SPARE PARTS

A. Tools, supplies and spare parts shall be provided as specified in Section 17050 - Tools, Supplies and Spare Parts. In addition, the following specific spare parts items shall be provided:

1. Five of each type of interposing relay provided under this Contract.

PART 2 -- PRODUCTS

2.01 ELECTRONIC INDICATORS

A. Electronic indicators shall be 3.5- or 6-digit, as appropriate, with 0.56" high red LED display. Indicators shall be provided with nameplate and scale calibrated to match the calibration of the primary element. The unit shall be designed primarily for use with 4-20 mA current loop signal circuits. Indicator operating voltage shall be 115 VAC 10%, 60 Hz. Indicator controls shall include three (3) front-panel pushbuttons for modifying

062317BR

alarm values and other indicator setup. Two (2) form-C relays shall be provided for each indicator. Relay contact outputs shall be rated 5A, 120/240 VAC, resistive load. Where required, a regulated and isolated 24 V excitation power supply shall be provided. Indicators shall be suitable for indoor or outdoor service as required and shall have the same NEMA enclosure rating as the associated enclosure. Indicators shall be Red Lion Model IMP or APLCL, or equal.

2.02 SIGNAL CONVERTERS

A. Signal converters shall be provided as required to provide control functions and to interface instrumentation and controls, equipment panels, motor control centers and other instrumentation and controls supplied under other Divisions to the controls provided herein.

B. General Requirements – Converters shall be of the miniature type, utilizing all solid-state circuitry suitable for mounting within new or existing cabinetry. Where sufficient cabinet space is not available, sub panels or supplemental enclosures shall be provided. Power supply shall be 120V, 60 hertz where required by the converter. Repeatability shall be 0.1% of span, deadband shall be 0.1% span, maximum. Where specific converters are not listed but are required to interface with the process control system, they shall comply with the general requirements stated herein.

C. Current to Current Isolators – Current to current isolators shall be furnished where necessary to provide an isolated current loop, calculations or signal amplification between the plant process control system and instrumentation and control loops. Isolators shall be sized such that resistance of existing loops shall not exceed maximum rated resistance. Isolators shall be as manufactured by AGM, Moore Industries, Rochester Instrument Systems (RIS), Phoenix Contact, Weidmuller, Acromag, or equal.

D. Voltage to Current Transducers – Voltage to current (or current to voltage) transducers shall convert a voltage signal of one magnitude to a 4-20 milliamp DC current signal. The output current shall be directly proportional to the input signal voltage. Transducers shall be sized such that loop resistance does not exceed maximum rated resistance. Transducers shall be as manufactured by AGM, Moore Industries, Rochester Instrument Systems (RIS), Phoenix Contact, Weidmuller, Acromag, or equal.

E. Frequency to Current Transducers – Frequency to current transducers shall convert pulse-rate and pulse-duration signals to 4-20 mA, 24 VDC analog signals. Converters shall include field-adjustable input frequency range. Converter power shall be 120 VAC, 60 hertz. Transducers shall be sized such that loop resistance does not exceed maximum rated resistance. Transducers shall be suitable for signal transmission via leased telephone lines. Transducers shall be Series 5100 as manufactured by AGM, or equivalent by Moore Industries, Rochester Instrument Systems (RIS), Phoenix Contact, Weidmuller, Acromag, or equal.

F. Current to Frequency Transducers – Current to frequency transducers shall convert 4-20 mA, 24 VDC analog signals to pulse-rate and pulse-duration signals. Converters shall include field-adjustable output frequency range. Converter power shall be 120 VAC, 60 hertz. Transducers shall be sized such that loop resistance does not exceed maximum rated resistance. Transducers shall be suitable for signal transmission via leased telephone lines. Transducers shall be Series 5016 as manufactured by AGM, Moore Industries, Rochester Instrument Systems (RIS), Phoenix Contact, Weidmuller, Acromag, or equal.

G. Integrators – Integrators shall be provided as interchangeable plug-in modules with zero and span adjustment available on the front plate of the units. Output shall range from 0 to 0.1 through 0 to 10 pulses per second. Accuracy shall be $\pm$ 0.1% of input span. Integrators shall convert linear analog signals to pulse rate and provide a solid-state output. Integrators shall be as manufactured by AGM Electronics, Moore Industries, Rochester Instrument Systems (RIS), Phoenix Contact, Weidmuller, Acromag, or equal.

H. Electronic Switches (Alarm Relays) – Electronic switches shall be furnished with a calibrated dial for adjusting set points. The input to the switch shall be 4-20 mADC, and the set point shall be adjustable over the full range. Unless otherwise noted, the dead band shall be fixed at less than 2 percent of span. The set point stability shall be $\pm$0.1% per degree F. The repeatability shall be $\pm$0.1% of span. The units shall be furnished with SPDT relays rated at 10 amperes at 115 VAC. Electronic switches shall be as manufactured by AGM, Moore Industries, Rochester Instrument Systems (RIS), Phoenix Contact, Weidmuller, Acromag, or equal.

I. RTD to Current Signal Converters – RTD to current signal converters shall convert a 3-wire RTD input signal to an isolated 4-20 mADC output signal. Each converter shall operate from a 120 VAC power source. Accuracy shall be 0.10 percent of span or better. Calibrated span of each converter shall be as indicated on the instrument list. The Contractor shall coordinate calibration of the signal converters with existing RTD elements. The signal converters shall be furnished in the manufacturer's standard enclosure for installation in an existing indoor electrical cabinet. Signal converters shall be as manufactured by AGM, Moore Industries, Rochester Instrument Systems (RIS), Phoenix Contact, Weidmuller, Acromag, or equal.

J. Interposing Relays – Where required to interface between motor control centers, equipment controls, and control panels, interposing relays and associated control wiring circuitry shall be furnished and installed to provide the monitoring and/or control functions specified herein. Interposing relays shall be small format type, DPDT, minimum 10 amp, 120 VAC contact rating. Relay coils shall be 120 VAC or 24 VDC as required. Relays shall have a flag indicator to show relay status, a pushbutton to allow manual operation of the relay, and an internal pilot light to indicate power to the coil. Relays shall be as manufactured by Square D, Potter & Brumfield, Allen-Bradley, or equal.

K. Timing Relays – Timing Relays (TR) shall be the general-purpose plug-in type, Type JCK as manufactured by Square D Company, Cutler-Hammer/Westinghouse Electric Corporation equivalent, Allen-Bradley equivalent, or equal. Timing relays shall be electronic type with 120 VAC coils unless otherwise specified or indicated on the Drawings. Timers shall be provided with a minimum of two SPDT timed output contacts and instantaneous contacts where required. Contact ratings shall be the same as for interposing relays as specified above.

L. Intrinsically Safe Relays and Barriers – Intrinsically safe relays and barriers shall be provided where required to interface with equipment such as float level switches that are located in NFPA-classified hazardous areas. Intrinsically safe relays and barriers shall be FM approved and shall be manufactured by Pepperl and Fuchs, Crouse Hinds, Square D, or equal.

2.03 TOTALIZERS

A. Totalizing counters shall be provided for flush panel, spring-clip mounting. Face dimensions of the totalizing counters shall be no larger than 1-1/8-inches high by 2-inches wide. Totalizing counters shall contain eight digits. Height of the digits shall not be less than 5/32-inch. Numerals shall be white on a black background. The counter shall be non-resettable and shall be totally compatible for operation on the pulses supplied by the associated instrument or integrator. The totalizing counter shall be capable of a maximum count rate of 25 counts/second.

B. Legend plates shall be provided for each of the totalizing counters with white letters on a black background with legends as specified below.

C. Totalizing counters shall be manufactured by Kessler-Ellis, or equal.

2.04 ACCESSORIES

A. Control operators such as pushbuttons (PB), selector switches (SS), and pilot lights (PL) shall be Cutler-Hammer/Westinghouse Type E34, Square D Company Type SK, or equal. Control operators shall be 30.5 mm, round, heavy-duty, oil tight NEMA 4X corrosion resistant.

B. Pushbuttons shall be non-illuminated, spring release type. Pushbuttons shall include a full guard. Panic stop/alarm pushbuttons shall be red mushroom type with manual-pull release. Selector switches shall be non-illuminated, maintained contact type. Pilot lights shall be of the proper control voltage, push-to-test LED type with light lens colors as specified below.

Color	Function
Red	Running (Open)

Green	Stopped or Off (Closed)
Amber	Fault
White	Other

C. Control operators shall have legend plates as specified herein, indicated on the Drawings, or otherwise directed by the Engineer. Legend plates shall be plastic, black field (background) with white lettering. Engraved nameplates shall be securely fastened above each control operator. If adequate space is not available, the nameplate shall be mounted below the operator.

D. Control operators for all equipment shall be as specified herein and of the same type and manufacturer unless otherwise specified or indicated on the Drawings.

E. Alarm horns shall be general-purpose type, panel-mounted, and shall be suitable for indoor or weatherproof service, as required. Power supply shall be either 115 VAC or 24 VDC. Horns shall be capable of producing 100 dB at 10 feet and shall have adjustable volume. Horns shall be Vibratone series as manufactured by Federal Signal Corporation, McMaster-Carr equivalent, Edwards Signaling Company equivalent, or equal.

F. Alarm beacons shall be general-purpose type, panel-mounted, and shall be suitable for indoor or weatherproof service, as required. Power supply shall be either 115 VAC or 24 VDC. Beacons shall be Model 225 Electraray Rotating Warning Light by Federal Signal, or equal.

PART 3 -- EXECUTION

3.01 REQUIREMENTS

A. Refer to Section 17500 for additional requirements.

+ + + END OF SECTION 17550 + + +

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SECTION 17560
SURGE PROTECTION DEVICES

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall furnish, install and place in satisfactory operation the surge protection devices (SPDs) as specified herein and as shown on the Drawings.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 17000 – Control and Information System Scope and General Requirements

B. Section 17100 – Control and Information System Hardware, General

C. Section 17500 – Enclosures, General

D. Section 17900 – Schedules and Control Descriptions, General

1.03 GENERAL INFORMATION AND DESCRIPTION

A. All surge protectors of each type provided under this Contract shall be furnished by a single manufacturer.

1.04 TOOLS, SUPPLIES AND SPARE PARTS

A. Tools, supplies and spare parts shall be provided as specified in Section 17050 - Tools, Supplies and Spare Parts. In addition, the following specific spare parts items shall be provided:

1. Three of each type of surge protection device provided under this Contract.

PART 2 -- PRODUCTS

2.01 SURGE PROTECTION, GENERAL

A. All electrical and electronic elements shall be protected against damage due to electrical transients induced in interconnecting lines from lightning discharges and nearby electrical systems.

B. Manufacturer's Requirements: All surge protection devices shall be manufactured by a company that has been engaged in the design, development, and manufacture of such

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devices for at least 5 years. Acceptable manufacturers shall be Phoenix Contact, Edco, Transtector, Weidmuller, or equal.

C. Surge protection device installations shall comply with UL 94, the National Electric Code (NEC), and all applicable local codes.

D. Surge protection devices shall be installed as close to the equipment to be protected as practically possible.

E. Device Locations: As a minimum, provide surge protection devices at the following locations:

1. At any connections between ac power and electrical and electronic equipment, including panels, assemblies, and field mounted analog transmitters.

2. At both ends of all analog signal circuits that have any portion of the circuit extending outside of a protecting building.

3. At both ends of all copper-based communication cables which extend outside of a building, including at field instruments and the field side of analog valve position signals.

4. On all external telephone communication lines.

2.02 AC POWER PROTECTION

A. Surge protection device assemblies for connections to AC power supply circuits shall:

1. Be provided with two 3-terminal barrier terminal strips capable of accepting No. 12 AWG solids or stranded copper wire. One terminal strip shall be located on each end of the unit.

2. Have a nonflammable enclosure that meets or exceeds UL 94 V0 flammability requirements. The surge protection device shall be provided with provisions for mounting to interior of equipment racks, cabinets, or to the exterior of freestanding equipment.

3. Be constructed as multistage devices consisting of gas tube arrestors, high energy metal oxide varistors, or silicon avalanche suppression diodes. Assemblies shall automatically recover from surge events, and shall have status indication lights.

4. Comply with all requirements of UL 1449, latest edition.

5. Be able to withstand a peak surge current of 10,000 amps based on a test surge waveform with an 8-microsecond rise time and a 20-microsecond exponential decay time, as defined in UL 1449.

6. Have the following characteristics:

    a. Maximum Continuous Operating Voltage: 150VAC
    b. Maximum Operating Current: 20 amps
    c. Ambient Temperature Range: -20 degrees C to +65 degrees C
    d. Response Time: 5 nanoseconds

2.03 ANALOG SIGNAL CIRCUIT PROTECTION

A. Surge protection device assemblies for analog signal circuits shall:

1. Have four lead devices with DIN Rail mounting.

2. Have a nonflammable enclosure that meets or exceeds UL 94 V0 flammability requirements.

3. Be constructed as multistage devices consisting of gas tube arrestors and silicon avalanche suppression diodes. Gas tube arrestors and diodes shall be separated by a series impedance of no more than 20 ohms. Assemblies shall automatically recover from surge events.

4. Comply with all requirements of UL 497B.

5. Be able to withstand a peak surge current of 10,000 amps based on a test surge waveform with an 8-microsecond rise time and a 20-microsecond exponential decay time, as defined in UL 1449.

6. Limit line-to-line voltage to 40 volts on 24VDC circuits.

7. Have the following characteristics:

    a. Maximum Continuous Operating Voltage: 28VDC
    b. Ambient Temperature Range: -20 degrees C to +65 degrees C
    c. Response Time (Line-to-Line): 5 ns

2.04 COMMUNICATION CIRCUIT PROTECTION

A. Surge protection devices for copper-based data communication circuits shall:

1. Be designed for the specific data communication media and protocol to be protected (i.e. telephone, serial, parallel, network, data highway, coax, twinaxial, twisted pair, RF, etc.).

2. Provide protection of equipment to within the equipment's surge withstand levels for applicable standard test wave forms of the following standards:

   a. IEC 60-1 / DIN VDE 0432 part 2
   b. CCITT K17 / DIN VDE 0845 part 2
   c. IEEE C62.31

3. Have a nonflammable enclosure that meets or exceeds UL 94 V0 flammability requirements.

4. Provide automatic recovery.

PART 3 -- EXECUTION

3.01 REQUIREMENTS

A. Refer to Section 17500 for additional requirements.

+ + + END OF SECTION 17560 + + +

SECTION 17600
UNPOWERED INSTRUMENTS, GENERAL

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. The instrumentation subcontractor shall furnish, install, test and place in operation process instrumentation (flow elements, pressure switches, etc.) as scheduled herein together with all signal converters, transmitters, isolators, amplifiers, etc. to interface all instrumentation, panels, controls and process equipment control panels with the process controls as shown on the Drawings and as specified. The Contractor may elect to install primary elements (flowmeters, etc.) on process lines provided that the instrumentation subcontractor provides full on-site supervision during installation. Mounting of associated transmitters, indicators, power supplies, brackets and appurtenances shall be provided as specified herein and shown on the Drawings.

B. It is the intent of the Contract Documents that all process taps, isolation valves, nipples, penetrations, embedded instrumentation supports, conduit, wiring, terminations, and the installation of process instrumentation on process lines shall be provided under this Contract. The instrumentation subcontractor shall supervise installation of equipment provided under this Division where installation is provided by others.

C. Tapping and connections for primary process sensors shall be sized to suit each individual installation and the requirements of the instrument served. The Contractor shall ensure that the location, supports, orientation and dimensions of the connections and tapping for instrumentation furnished under this Division are such as to provide the proper bracing, the required accuracy of measurement, protection of the sensor from accidental damage and accessibility for maintenance while the plant is in operation. Isolation valves shall be provided at <u>all</u> process taps.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 17000 – Control and Information System Scope and General Requirements

B. Section 17500 – Enclosures, General

C. Section 17698 – Instrumentation and Control System Accessories

D. Section 17700 – Powered Instruments, General

E. Section 17800 – Analytical Instruments, General

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F. Unpowered instruments furnished with mechanical equipment shall be furnished, installed, tested and calibrated as specified elsewhere in the Contract Documents.

1.03 TOOLS, SUPPLIES AND SPARE PARTS

A. Tools, supplies and spare parts shall be provided as specified in Section 17050.

B. In addition to the above requirements, the instrumentation subcontractor shall provide spare parts as specified in individual instrument specification sections.

PART 2 -- PRODUCTS

2.01 GENERAL

A. Unless otherwise specified, instruments shall be provided with enclosures to suit specified environmental conditions. Field-mounted devices shall be rugged and mounted on walls or pipe stanchions.

PART 3 -- EXECUTION

3.01 INSTALLATION

A. Equipment shall be located so that it is accessible for operation and maintenance. The instrumentation subcontractor shall examine the Drawings and Shop Drawings for various items of equipment in order to determine the best arrangement for the work as a whole and shall supervise the installation of process instrumentation supplied under this Division.

B. Field equipment shall be wall mounted or mounted on two-inch diameter pipe stands welded to a 10-inch square 1/2-inch thick base plate unless shown adjacent to a wall or otherwise noted. Materials of construction shall be aluminum or 316 stainless steel. Instruments attached directly to concrete shall be spaced out from the mounting surface not less than 1/2-inch by use of phenolic spacers. Expansion anchors in walls shall be used for securing equipment or wall supports to concrete surfaces. Unless otherwise noted, field instruments shall be mounted between 48 and 60 inches above the floor or work platform.

C. Embedded pipe supports and sleeves shall be Schedule 40, Type 316 stainless steel pipe, ASA B-36.19, with stainless steel blind flange for equipment mounting as shown on the Drawings.

D. Materials for miscellaneous mounting brackets and supports shall be 316 stainless steel construction.

E. Pipe stands, miscellaneous mounting brackets and supports shall comply with the requirements of Division 5 of the specifications.

3.02 ADJUSTMENT AND CLEANING

A. The instrumentation subcontractor shall comply with the requirements of Division 1 of these Specifications and all instrumentation and control system tests, inspection, and calibration requirements for all instrumentation and controls provided under this Contract and specified herein. The Engineer, or his designated representative(s), reserves the right to witness any test, inspection, calibration or start-up activity. Acceptance by the Engineer of any plan, report or documentation relating to any testing or commissioning activity specified herein shall not relieve the Contractor of his responsibility for meeting all specified requirements.

B. The instrumentation subcontractor shall provide the services of factory trained technicians, tools and equipment to field calibrate, test, inspect and adjust each instrument to its specified performance requirement in accordance with manufacturer's specifications and instructions. Any instrument which fails to meet any Contract requirements, or any published manufacturer performance specification for functional and operational parameters, shall be repaired or replaced, at the discretion of the Engineer, at no cost to the Owner. The Contractor shall bear all costs and provide all personnel, equipment and materials necessary to implement all installation tests and inspection activities for equipment specified herein.

C. At least 60 days before the anticipated initiation of installation testing, the Contractor shall submit to the Engineer a detailed description, of the installation tests to be conducted to demonstrate the correct operation of the instrumentation and control system.

D. Field instrument calibration requirements shall conform to the following:

1. The instrumentation subcontractor shall provide the services of factory trained instrumentation technicians, tools and equipment to field calibrate each instrument supplied under this Contract to its specified accuracy in accordance with the manufacturer's specification and instructions for calibration.

2. Each instrument shall be calibrated at 0, 25, 50, 75 and 100 percent of span using test instruments to simulate inputs and read outputs. Test instruments shall be rated to an accuracy of at least five (5) times greater than the specified accuracy of the instrument being calibrated. Where applicable, such test instruments shall have accuracy’s as set forth by the National Institute for Standards and Technology (NIST).

3. The instrumentation subcontractor shall provide a written calibration sheet to the Engineer for each instrument, certifying that it has been calibrated to its published specified accuracy. The Contractor shall submit proposed calibration sheets for various types of instruments for Engineer approval prior to the start of calibration.

This sheet shall include but not be limited to date, instrument tag numbers, calibration data for the various procedures described herein, name of person performing the calibration, a listing of the published specified accuracy, permissible tolerance at each point of calibration, calibration reading as finally adjusted within tolerance, defect noted, corrective action required and corrections made.

4. If doubt exists as to the correct method for calibrating or checking the calibration of an instrument, the manufacturer's printed recommendations shall be used as an acceptable standard, subject to the approval of the Engineer.

5. Upon completion of calibration, devices shall not be subjected to sudden movements, accelerations, or shocks, and shall be installed in permanent protected positions not subject to moisture, dirt, and excessive temperature variations. Caution shall be exercised to prevent such devices from being subjected to overvoltages, incorrect voltages, overpressure or incorrect air. Damaged equipment shall be replaced and recalibrated at no cost to the Owner.

+ + + END OF SECTION 17600 + + +

SECTION 17650
PRESSURE GAUGES

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall furnish, test, install and place in satisfactory operation the pressure gauges, with all spare parts, accessories, and appurtenances as herein specified and as shown on the Drawings.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 17000 – Control and Information System Scope and General Requirements

B. Section 17600 – Unpowered Instruments, General

C. Section 17698 – Instrumentation Accessories

PART 2 -- PRODUCTS

2.01 PRESSURE GAUGES

A. All gauges shall be designed in accordance with the ASME B40.1 entitled, "Gauges, Pressure, Indicating Dial Type - Elastic Element".

B. All gauges shall be direct reading type. Snubbers shall be provided on all gauges. Gauge full-scale pressure range shall be selected such that the maximum operating pressure shall not exceed the approximately 75% of the full-scale range.

C. Features

1. Mounting: ½” NPT, lower stem mount type
2. Accuracy: 0.5% full scale
3. Case: Solid front, black phenolic material
4. Dial: White background and black letters
5. Glass: Shatterproof
6. Blow-out protection: Back
7. Pressure element: stainless steel bourdon tube
8. Movement: Stainless steel, Teflon coated pinion gear and segment
9. Gaskets: Buna-N

D. Liquid-filled or equivalent mechanically-damped gauges shall be used if the gauges are installed with pumps, or where gauges are subjected to vibrations or pulsation. Filling fluid shall be silicone unless oxidizing agents such as sodium hypochlorite are present, where halocarbon shall be used.

E. Gauge size shall be 2" for line sizes up to 3" and 4½" for line sizes of 4" or greater.

F. Diaphragm seals and isolating ring seals shall be furnished in accordance with the requirements specified under Section 17698 - Instrumentation and Control System Accessories.

G. The complete gauge assembly and appurtenances shall be fully assembled and tested prior to field mounting. A ½" isolation stainless steel ball valve shall be provided for each gauge assembly.

H. Pressure and vacuum gauges shall be Ashcroft Duragauge Model 1279, Ametek-U.S. Gauge Division, H.O. Trerice Co., WIKA Instrument Corporation, or equal.

PART 3 -- EXECUTION

3.01 REQUIREMENTS

A. Refer to Section 17600, Part 3.

+ + + END OF SECTION 17650 + + +

SECTION 17670
LEVEL SWITCHES (SUSPENDED FLOAT TYPE)

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall furnish, test, install and place in satisfactory operation the float level switches, with all spare parts, accessories, and appurtenances as herein specified and as shown on the Drawings.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 17000 – Control and Information System Scope and General Requirements

B. Section 17600 – Unpowered Instruments, General

PART 2 -- PRODUCTS

2.01 LEVEL SWITCHES (SUSPENDED FLOAT TYPE)

A. Level switches of the direct acting float-operated design shall be comprised of a hermetically sealed, approximately 5-inch diameter plastic casing float, containing microswitches and flexibly supported by means of a heavy neoprene or PVC jacket, with three conductor cable a minimum of 20 feet in length. Unless otherwise specified, media specific gravity is 0.95 to 1.05. Microswitches shall be one normally open and one normally closed, 5A-115V AC capacity. Float hangers and supports shall be provided as shown on the installation detail drawings. Float switches shall be Model ENM as manufactured by Flygt, or equal.

PART 3 -- EXECUTION

3.01 REQUIREMENTS

A. Refer to Section 17600, Part 3 of the specifications.

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SECTION 17700
POWERED INSTRUMENTS, GENERAL

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. The instrumentation subcontractor shall furnish, install, test and place in operation powered process instrumentation (flow elements, level transmitters, etc.) as scheduled herein together with all signal converters, transmitters, isolators, amplifiers, etc. to interface all instrumentation, panels, controls and process equipment control panels with the process control system as shown on the Drawings and as specified. Powered instruments are those instruments that require power (120 VAC or 24 VDC loop power) to operate. The Contractor may elect to install primary elements (flowmeters, etc.) on process lines provided that the instrumentation subcontractor provides full on-site supervision during installation. Mounting of associated transmitters, indicators, power supplies, brackets and appurtenances shall be provided as specified herein and shown on the Drawings.

B. It is the intent of the Contract Documents that all process taps, isolation valves, nipples, penetrations, embedded instrumentation supports, conduit, wiring, terminations, and the installation of process instrumentation on process lines shall be provided under this Contract. The instrumentation subcontractor shall supervise installation of equipment provided under this Division where installation is provided by others.

C. Tapping and connections for primary process sensors shall be sized to suit each individual installation and the requirements of the instrument served. The Contractor shall ensure that the location, supports, orientation and dimensions of the connections and tapping for instrumentation furnished under this Division are such as to provide the proper bracing, the required accuracy of measurement, protection of the sensor from accidental damage, and accessibility for maintenance while the plant is in operation. Isolation valves shall be provided at <u>all</u> process taps.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 17000 – Control and Information System Scope and General Requirements

B. Section 17500 – Enclosures, General

C. Section 17600 – Unpowered Instruments, General

D. Section 17698 – Instrumentation and Control System Accessories

E. Section 17800 – Analytical Instruments, General

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F. Powered instruments furnished with mechanical equipment shall be furnished, installed, tested and calibrated as specified elsewhere in the Contract Documents.

1.03 TOOLS, SUPPLIES AND SPARE PARTS

A. Tools, supplies and spare parts shall be provided as specified in Section 17050.

B. In addition to the above requirements, the instrumentation subcontractor shall provide one remote handheld configuration device for communication with all "smart" instruments furnished under this Contract. The devices shall be capable of performing configuration, test, and format functions from anywhere on the 4-20 mA signal loop for a particular transmitter or by direct connection. The configuration device shall be Fischer & Porter Model 50HC1000, Rosemount Model 375, or equal.

PART 2 -- PRODUCTS

2.01 GENERAL

A. All instrumentation supplied shall be the manufacturer's latest design. Unless otherwise specified, instruments shall be solid state, electronic, using enclosures to suit specified environmental conditions. Microprocessor-based equipment shall be supplied unless otherwise specified. All instruments shall be provided with mounting hardware and floor stands, wall brackets, or instrument racks as shown on the Drawings, or as required.

B. Equipment installed in a hazardous area shall meet Class, Group, and Division as shown on the Drawings, to comply with the National Electrical Code.

C. All field instrumentation for outdoor service shall be provided with enclosures which are suitable for outdoor service, as follows:

1. Where the manufacturer's enclosures are suitable for outdoor service, they shall be provided with instrument sunshades. Sunshades shall be Style E as manufactured by O'Brien Corporation, or equal. Where possible, these instruments shall be mounted in a north facing direction.

2. Where the manufacturer's standard enclosures are not suitable for outdoor service, instruments shall be mounted in Field Panels in accordance with Section 17520, Field Panels, or may be furnished with Vipak instrument field enclosures as manufactured by O'Brien Corporation, equivalent by Intertec, or equal. It shall not be necessary to provide the manufacturer's NEMA 4 or 4X enclosures for instruments that will be subsequently mounted in separate field panels.

D. All instruments shall return to accurate measurement without manual resetting upon restoration of power after a power failure.

E. Unless otherwise shown or specified, local indicators shall be provided for all instruments. Where instruments are located in inaccessible locations, local indicators shall be provided and shall be mounted as specified in Subsection 3.01 (B) herein. All indicator readouts shall be linear in process units. Readouts of 0-100% shall not be acceptable (except for speed and valve position). Isolated outputs shall be provided for all transmitters.

F. Unless otherwise specified, field instrument and power supply enclosures shall be 316 stainless steel, fiberglass or PVC coated copper-free cast aluminum NEMA 4X construction.

G. Where separate elements and transmitters are required, they shall be fully matched, and unless otherwise noted, installed adjacent to the sensor. Special cables or equipment shall be supplied by the associated equipment manufacturer.

H. Electronic equipment shall utilize printed circuitry and shall be coated (tropicalized) to prevent contamination by dust, moisture and fungus. Solid-state components shall be conservatively rated for long-term performance and dependability over ambient atmosphere fluctuations. Ambient conditions shall be -20 to 50 degrees C and 20 to 100 percent relative humidity, unless otherwise specified. Field mounted equipment and system components shall be designed for installation in dusty, humid, and corrosive service conditions.

I. All devices furnished hereunder shall be heavy-duty type, designed for continuous industrial service. The system shall contain products of a single manufacturer, insofar as possible, and shall consist of equipment models that are currently in production. All equipment provided, where applicable, shall be of modular construction and shall be capable of field expansion.

J. All non-loop-powered instruments and equipment shall be designed to operate on a 60 Hz AC power source at a nominal 117 V, plus or minus 10 percent, except where specifically noted. All regulators and power supplies required for compliance with the above shall be provided. Where equipment requires voltage regulation, constant voltage transformers shall be supplied.

K. All analog transmitter and controller outputs shall be isolated, 4-20 milliamps into a load of 0-750 ohms, unless specifically noted otherwise. All switches shall have double-pole, double-throw contacts rated at a minimum of 600 VA, unless specified otherwise.

L. Materials and equipment used shall be UL approved wherever such approved equipment and materials are available.

PART 3 -- EXECUTION

3.01 INSTALLATION

A. General

1. Equipment shall be located so that it is accessible for operation and maintenance. The instrumentation subcontractor shall examine the Drawings and shop drawings for various items of equipment in order to determine the best arrangement for the work as a whole and shall supervise the installation of process instrumentation supplied under this Division.

2. Electrical work shall be performed in compliance with all applicable local codes and practices. Where the Contract Documents do not delineate precise installation procedures, API RP550 shall be used as a guide to installation procedures.

B. Equipment Mounting and Support

1. Field equipment shall be wall mounted or mounted on two-inch diameter pipe stands welded to a 10-inch square by 1/2-inch thick base plate unless shown adjacent to a wall or otherwise noted. Materials of construction shall be aluminum or 316 stainless steel. Instruments attached directly to concrete shall be spaced out from the mounting surface not less than 1/2-inch by use of phenolic spacers. Expansion anchors in walls shall be used for securing equipment or wall supports to concrete surfaces. Unless otherwise noted, field instruments shall be mounted between 48 and 60 inches above the floor or work platform.

2. Embedded pipe supports and sleeves shall be schedule 40, 316 stainless steel pipe, ASA B-36.19, with stainless steel blind flange for equipment mounting as shown on the Drawings.

3. Materials for miscellaneous mounting brackets and supports shall be 316 stainless steel construction.

4. Pipe stands, miscellaneous mounting brackets and supports shall comply with the requirements of Division 5 of the specifications.

5. Transmitters shall be oriented such that output indicators are readily visible.

C. Control and Signal Wiring

1. Electrical, control and signal wiring connections to transmitters and elements mounted on process piping or equipment shall be made through liquid-tight flexible

conduit. Conduit seals shall be provided where conduits enter all field instrument enclosures and all cabinetry housing electrical or electronic equipment.

3.02 ADJUSTMENT AND CLEANING

A. General

1. The instrumentation subcontractor shall comply with the requirements of Division 1 of these Specifications and all instrumentation and control system tests, inspection, and calibration requirements for all instrumentation and controls provided under this Contract and specified herein. The Engineer, or his designated representative(s), reserves the right to witness any test, inspection, calibration or start-up activity. Acceptance by the Engineer of any plan, report or documentation relating to any testing or commissioning activity specified herein shall not relieve the Contractor of his responsibility for meeting all specified requirements.

2. The instrumentation subcontractor shall provide the services of factory trained technicians, tools and equipment to field calibrate, test, inspect and adjust each instrument to its specified performance requirement in accordance with manufacturer's specifications and instructions. Any instrument which fails to meet any Contract requirements, or any published manufacturer performance specification for functional and operational parameters, shall be repaired or replaced, at the discretion of the Engineer, at no cost to the Owner. The Contractor shall bear all costs and provide all personnel, equipment and materials necessary to implement all installation tests and inspection activities for equipment specified herein.

3. At least 60 days before the anticipated initiation of installation testing, the Contractor shall submit to the Engineer a detailed description, of the installation tests to be conducted to demonstrate the correct operation of the instrumentation supplied hereunder.

B. Field Instrument Calibration Requirements

1. The instrumentation subcontractor shall provide the services of factory trained instrumentation technicians, tools and equipment to field calibrate each instrument supplied under this Contract to its specified accuracy in accordance with the manufacturer's specification and instructions for calibration.

2. If the manufacturer's recommendations require calibration, each instrument shall be calibrated at 0, 25, 50, 75 and 100 percent of span using test instruments to simulate inputs and read outputs. Test instruments shall be rated to an accuracy of at least five (5) times greater than the specified accuracy of the instrument being calibrated. Where applicable, such test instruments shall have accuracy’s as set forth by the National Institute for Standards and Technology (NIST).

3. The instrumentation subcontractor shall provide a written calibration sheet to the Engineer for each instrument, certifying that it has been calibrated to its published specified accuracy. The Contractor shall submit proposed calibration sheets for various types of instruments for Engineer approval prior to the start of calibration. This sheet shall include but not be limited to date, instrument tag numbers, calibration data for the various procedures described herein, name of person performing the calibration, a listing of the published specified accuracy, permissible tolerance at each point of calibration, calibration reading as finally adjusted within tolerance, defect noted, corrective action required and corrections made.

4. If doubt exists as to the correct method for calibrating or checking the calibration of an instrument, the manufacturer's printed recommendations shall be used as an acceptable standard, subject to the approval of the Engineer.

5. Upon completion of calibration, devices calibrated hereunder shall not be subjected to sudden movements, accelerations, or shocks, and shall be installed in permanent protected positions not subject to moisture, dirt, and excessive temperature variations. Caution shall be exercised to prevent such devices from being subjected to overvoltages, incorrect voltages, overpressure or incorrect air. Damaged equipment shall be replaced and recalibrated at no cost to the Owner.

6. After completion of instrumentation installation, the instrumentation subcontractor shall perform a loop check. The Contractor shall submit final loop test results with all instruments listed in the loop. Loop test results shall be signed by all representatives involved for each loop test.

+ + + END OF SECTION 17700 + + +

SECTION 17701
MAGNETIC FLOW METERS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall furnish, test, install and place in satisfactory operation the magnetic flow meters, with all spare parts, accessories, and appurtenances as herein specified and as shown on the Drawings.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 17000 – Control and Information System Scope and General Requirements

B. Section 17700 – Powered Instruments, General

PART 2 -- PRODUCTS

2.01 MAGNETIC FLOW METER SYSTEMS

A. Magnetic flow meter systems shall include a magnetic flow tube and a microprocessor-based "smart" transmitter that is capable of converting and transmitting a signal from the flow tube. Magnetic flow meters shall utilize the characterized field principle of electromagnetic induction, and shall produce DC signals directly proportional to the liquid flow rate.

B. Each meter shall be furnished with a 316 stainless steel or carbon steel metering tube and carbon steel flanges with a polyurethane, ceramic, neoprene, hard rubber, or Teflon liner as required by the application and/or as specified herein. Liner shall have a minimum thickness of 0.125 inches. The inside diameter of the liner shall be within 0.125 inches of the inside diameter of the adjoining pipe. Liner protectors shall be provided on all flow tubes.

C. The flow tube shall be provided with flush mounted electrodes.

D. Grounding rings shall be provided for both ends of all meters.

E. All materials of construction for metallic wetted parts (electrodes, grounding rings, etc.) shall be minimum 316 stainless steel, but shall be compatible with the process fluid for each meter in accordance with the recommendations of the manufacturer.

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F. Flow tube shall be rated for pressures up to 1.1 times the flange rating of adjacent piping. System shall be rated for ambient temperatures of -30 to +65□C. Meter and transmitter housings shall meet NEMA 4X/IP66 requirements as a minimum. When meter and transmitter are located in classified explosion hazard areas, the meter and transmitter housings shall be selected with rating to meet the requirements for use in those areas. Where the flow tube is subject to submergence through installation in a meter vault or similar location, the flow tube assembly shall be rated NEMA 6P/IP68 and electronics shall be factory sealed against moisture intrusion. The use of field kits for modifying NEMA 4/4X/IP66 flow tubes to submergence duty shall not be acceptable. The associated transmitter shall be located in an area not subject to submergence.

G. The transmitter shall provide pulsed DC coil drive current to the flow tube and shall convert the returning signal to a linear, isolated 4-20 mA DC signal. The transmitter shall utilize "smart" electronics and shall contain automatic, continuous zero correction, signal processing routines for noise rejection, and an integral LCD readout capable of displaying flow rate and totalized flow. The transmitter shall continuously run self-diagnostic routines and report errors via English language messages.

H. The transmitter's preamplifier input impedance shall be a minimum of 10^9-10^{11} ohms which shall make the system suited for the amplification of low-level input signals and capable of operation with a material build up on the electrodes.

I. The transmitter shall provide an automatic low-flow cutoff below a user configurable low flow condition (0-10%). The transmitter's outputs shall also be capable of being forced to zero by an external contact operation.

J. Each flow tube shall be factory calibrated and assigned a calibration constant or factor to be entered into the associated transmitter as part of the meter configuration parameters. Manual calibration of the flow meter shall not be required. Meter configuration parameters shall be stored in non-volatile memory in the transmitter. An output hold feature shall be provided to maintain a constant output during configuration changes.

K. The transmitter shall be capable of communicating digitally with a remote configuration device via a frequency-shift-keyed, high frequency signal superimposed on the 4-20 mA output signal. The remote configuration device shall be capable of being placed anywhere in the 4-20 mA output loop. The remote configuration device shall be as specified under Section 17700. A password-based security lockout feature shall be provided to prevent unauthorized modification of configuration parameters.

L. Accuracy shall be 0.30% of rate over the flow velocity range of 1.0 to 10.0 m/s (3.0 to 33 ft/sec) and 0.5% between 0.1 m/s and 1.0 m/s (1-3 ft/s). Repeatability shall be $\pm$ 0.1% of rate; minimum turndown shall be 100:1. Minimum required liquid conductivity shall not be greater than 5 uS/cm. Maximum response time shall be adjustable between 1 and 100 seconds as a minimum. Transmitter ambient temperature operating limits shall be -10 to +50□C. Power supply shall be 115 VAC, 60 Hz.

M. Flow tubes shall be 150-lb flange mounted unless otherwise noted. The cables for interconnecting the meter and transmitter shall be furnished by the manufacturer. Transmitter shall be mounted integrally on flow tube, wall, or 2-inch pipe mounted as shown in the Drawings and/or as specified.

N. Magnetic flow meter systems shall be Model 8750W with optional high accuracy as manufactured by Rosemount, or equivalent by ABB, Endress + Hauser, Foxboro, Krohne, Siemens, Toshiba or equal.

PART 3 -- EXECUTION

3.01 REQUIREMENTS

A. Ground magnetic flow meter flow tubes and grounding rings in strict accordance with the manufacturer's recommendations.

B. Refer to Section 17700, Part 3, for further requirements.

+ + + END OF SECTION 17701 + + +

Notes to Specifier:

i) Meter should be sized for a minimum of 3 ft/s where possible and in no case less than 1 ft/s. Meters should be sized for 5 - 10 ft/s velocities in pipes when used with the following process fluids:

- Primary Sludge
- RAS
- WAS
- Thickened Sludge

This will help prevent or reduce buildup of grease and oil on the electrodes.

ii) Classified areas should be specified in the instrument schedule for each meter.

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SECTION 17749
SUBMERSIBLE LEVEL (PRESSURE) SENSORS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall furnish, test, install and place in satisfactory operation the submersible level (pressure) sensors, with all spare parts, accessories, and appurtenances as herein specified and as shown on the Drawings.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 17000 - Control and Information System Scope and General Requirements

B. Section 17700 - Powered Instruments, General

PART 2 -- PRODUCTS

2.01 SUBMERSIBLE LEVEL (PRESSURE) SENSORS

A. Submersible level (pressure) sensors shall consist of a pressure-sensing probe assembly with a depth cable molded directly to the probe body. Sensing probe housing shall be fabricated of titanium or 316 stainless steel. The depth support cable shall be polyurethane and shall contain a Kevlar strength member, a vent tube, and conductors for electrical power and signal.

B. The sensor shall contain an encapsulated pressure sensing element which is electrically and physically isolated from the media via a ceramic or titanium isolation diaphragm. The pressure sensing connection shall be protected from damage by a removable acetal nose cone or equivalent guard.

C. Each submersible level transducer shall be provided with a NEMA 4X termination/junction box and aneroid bellows to prevent moisture from entering the vent tube.

D. Sensor specifications shall be as follows:

1.	Sensor Rating:	NEMA 6 (IP68), loop-powered
2.	Output Signal:	4-20 mA, 2-wire design
3.	Accuracy:	$\pm$ 0.2% of set span
4.	Long Term Stability:	$\pm$ 0.1% F.S./year
5.	Zero Offset and Span Setting:	$\pm$ 0.25% F.S., max.

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6.	Operating Temperature:	-20 to +60 degrees C
7.	Compensated Temperature:	-2 to +30 degrees C
8.	Overpressure Limits:	At least 2x full scale range
9.	Cable Length:	As required

E. Submersible level (pressure) sensors shall be WaterPilot Model FMX 21 by Endress & Hauser, equivalent by Druck, KPSI, Devar, Flygt, or equal.

PART 3 -- EXECUTION

3.01 REQUIREMENTS

A. Refer to Section 17700, Part 3 of the Specifications.

+ + + END OF SECTION 17749 + + +

SECTION 17851
SINGLE POINT GAS MONITORING SYSTEMS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall furnish, test, install and place in satisfactory operation the single point gas monitoring systems with all spare parts, accessories, and appurtenances as herein specified and as shown on the Drawings.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 17000 - Control and Information System Scope and General Requirements

B. Section 17800 - Analytical Instruments, General

1.03 TOOLS, SUPPLIES AND SPARE PARTS

A. One spare sensor of each type used shall be provided.

B. Calibration equipment as recommended by the manufacturer and a one-year supply of calibration gas for each gas measured shall be provided to field-calibrate the gas monitoring systems.

PART 2 -- PRODUCTS

2.01 GENERAL

A. Gas monitoring systems shall include a sensor to monitor specified gas and a microprocessor-based transmitter that is capable of accepting, converting and transmitting signals from the sensor. The complete gas monitoring system including sensor, transmitter, and accessory equipment shall be supplied by a single manufacturer. One system shall be provided per gas per location.

2.02 SENSORS

A. All sensors shall sample and monitor the atmosphere without the aid of pumps or other mechanical devices. Sensors and associated enclosures shall be classified as Class 1, Division 1, Group C and D as specified by the National Electric Code. Sensors shall be mounted with non-corrosive hardware as shown in the Drawings and/or as recommended by the manufacturer.

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1. Combustible Gas Sensor - The combustible gas sensor shall be the infrared (IR) type. It shall be immune to poisoning by hydrogen sulfide and silicone. The IR combustible sensor shall be capable of calibration without gas and shall be capable of performing a full calibration by zero adjustment only. The IR sensor shall allow detection of an above 100% LEL condition (over-range). The IR sensor shall not contain a flashback arrestor / frit.

2. Electrochemical (Toxic and Oxygen) Sensor – Sensors to detect toxic gases and oxygen shall be of the electrochemical type and shall not require the periodic addition of reagents.

B. Sensors shall be contained in sensor modules mounted externally to the main enclosure. All sensor modules shall have the capability of replacement while the unit is under power (hazardous areas) without the need for tools.

C. Sensor modules shall contain all relevant sensor information within the module so that the module may be calibrated off site. This information shall include sensor manufacturer date, gas type, gas range, calibration data, and default relay parameters. The sensor module shall not require a battery or power source to store this data.

D. Then sensor shall be capable of being mounted remotely from the transmitter. The allowable distance from the remote mounted sensor to the transmitter shall be a minimum of 100 feet. The enclosure for the combustible gas sensor shall be classified as Class I, Division 1, Groups A, B, C & D.

2.03 TRANSMITTER

A. The transmitter shall be classified as Class I, Division 1, Groups B, C & D. The transmitter shall have a digital readout to indicate the gas type being monitored and the concentration of gas present. The display shall sequentially show the gas type and gas concentration. The transmitter shall have normal, alarm, and fault indicating lights. Alarm level set points shall be adjustable by means of a hand held infrared controller.

B. Transmitters shall have the following specifications:

1.	Temperature Range:	-40°C to +60°C
2.	Drift:	Zero drift, <5% per year Span drift, <10% per year
3.	Accuracy:	±1% Full scale or 2ppm, typical ±2% Full scale or 2ppm, (O_2, CO) ±3% Full scale (<50% LEL combustibles)

		±5% Full scale (>50% LEL combustibles) ±10% Full scale or 2ppm (non-CO toxics)
4.	Response Times:	<12 sec., for 20% change (oxygen and toxics) <30 sec., for 50% change (oxygen and toxics) <8 sec., for 50% change (combustibles) <20 sec., for 90% change (combustibles)
5.	Humidity:	15%-95% relative humidity, non-condensing
6.	Sensor Life:	2 years (oxygen and toxics) 3 years (combustibles)
7.	Power:	90 - 130 VAC, 50-60 Hz (internal power supply)
8.	Signal Output:	4-20 mA 2-wire current sink 4-20 mA 3-wire current source
9.	Relay Contacts:	Rating, 5 amp @ 220 VAC; 5 amp @ 30 VDC

C. Calibration shall be performed by a hand-held infrared controller. It shall not be necessary to open the monitor enclosure to perform calibration or adjustment of the unit. With the exception of a monthly check and recalibrations, no periodic maintenance shall be necessary.

D. Gas monitoring systems shall be by Draeger, Ultima X Series as manufactured by MSA Instruments, equivalent by Scott, or equal.

2.04 ALARM AND MONITORING PANEL

A. Alarm and monitoring panel shall accept input from combustible gas monitor transmitter and provide display of gas concentration level and audible and visual alarm at pre-set gas levels. Panel shall operate on 120V ac with battery backup. Panel shall provide digital outputs on high gas level for remote alarm. Alarm and monitoring panel shall be REGARD-1 as manufactured by Draeger, or equal.

PART 3 -- EXECUTION

3.01 REQUIREMENTS

A. Refer to Section 17800, Part 3 of the specifications.

+ + + END OF SECTION 17851 + + +

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SECTION 17900
SCHEDULES AND CONTROL DESCRIPTIONS, GENERAL

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall furnish, test, install and place in satisfactory operation all hardware and software required to provide the Control And Information System as specified herein and as shown on the Drawings.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 17910 – Instrument Schedule

B. Section 17950 – Functional Control Descriptions

+++ END OF SECTION 17900 +++

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SECTION 17910
INSTRUMENT SCHEDULE

PART 1 GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall furnish, test, install and place in satisfactory operation all instrumentation as herein specified and as shown on the Drawings.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 17900 – Schedules and Control Descriptions

B. Section 17920 – Control System Input/Output Schedule

C. Section 17950 – Functional Control Descriptions

PART 2 INSTRUMENT SCHEDULE (ATTACHED)

+++ END OF SECTION 17910 +++

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DIVISION 17 INSTRUMENT LIST

Pressure Gauges - 17650

Tag	Service Description	Range/Setpoint	Size	P&ID	Comment
PI-101	Dry Weather Pumps Discharge Pressure	-	-	I-003	0-100 psi
PI-103	Wet Weather Pump P-03 Discharge Pressure	-	-	I-003	0-100 psi
PI-104	Wet Weather Pump P-04 Discharge Pressure	-	-	I-003	0-100 psi
PI-105	Wet Weather Pump P-05 Discharge Pressure	-	-	I-003	0-100 psi

Level Switches (Suspended Float Type) - 17670

Tag	Service Description	Range/Setpoint	Size	P&ID	Comment
LSH-116	Ball Float Switch	-	-	I-003	Class 1, Division 2 Service; Provide 80 feet cable minimum

Magnetic Flow Meters - 17701

Tag	Service Description	Range/Setpoint	Size	P&ID	Comment
FE-131	Dry Weather Flow Magnetic Flowtube	-	8"	I-003	IP68, Class 1, Division 2 Service
FIT-131	Dry Weather Flow Magnetic Flow Transmitter	-		I-003	0-1,000 gpm, Remote mounted, Provide 150 feet cable, minimum
FE-132	Wet Weather Flow Magnetic Flowtube	-	14"	I-003	IP68, Class 1, Division 2 Service
FIT-132	Wet Weather Flow Magnetic Flow Transmitter	-		I-003	Remote mounted, Provide 150 feet cable minimum

Single Point Gas Monitoring System - 17851

Tag	Service Description	Range/Setpoint	Size	P&ID	Comment
AE-210	Wetwell Combustible Gas Sensor	-	-	I-003	Class 1, Division 1 Service
AIT-210	Wetwell Combustible Gas Transmitter	-	-	I-003	Remote mounted, Provide 80 feet cable minimum

SECTION 17950
FUNCTIONAL CONTROL DESCRIPTIONS, GENERAL

PART 1 GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall furnish, test, install and place in satisfactory operation all equipment as herein specified and as shown on the Drawings. THE CONTRACTOR SHALL BE RESPONSIBLE FOR FURNISHING COMPLETE FUNCTIONING SYSTEMS AS DESCRIBED HEREIN.

B. Together with the control system input/output schedule, the equipment specifications (including functional descriptions for local equipment control panels), and the Drawings, the functional control descriptions describe the required operation, monitoring, and control of the facilities included in this Contract.

C. THE FUNCTIONAL DESCRIPTIONS CONTAIN REQUIREMENTS FOR FURNISHING AND INSTALLING LABOR AND MATERIALS THAT MAY NOT APPEAR ELSEWHERE IN THE CONTRACT DOCUMENTS.

D. All equipment and services required in equipment local control panels provided to implement the monitoring and control functions described herein or in the process input/output schedules shall be provided by the Contractor through individual equipment suppliers.

E. Unless specifically stated otherwise, all interconnected wiring between all instruments, panels, controls, and other devices listed in the functional descriptions as required to provide all functions specified herein shall be furnished by the electrical subcontractor under Division 16. The electrical subcontractor shall provide all cable and conduit required to carry all signals listed in the process input/output schedules. Special cables that are required for interconnection between sensors or probes and transmitters or signal conditioners shall be furnished with the instrumentation devices by the equipment supplier.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 01520 – Maintenance of Utility Operations During Construction

B. Section 17900 – Schedules and Control Descriptions, General

C. Section 17910 – Instrument Schedule

D. Section 17920 – Control System Input/Output Schedule

PART 2 FUNCTIONAL CONTROL DESCRIPTIONS, GENERAL

2.01 DEFINITIONS

A. RUNNING status signals shall be from auxiliary contacts provided with the motor control equipment (i.e., starter, VFD, SCR, etc.).

B. AUTO status signals shall be defined as HAND-OFF-AUTO switch in the AUTO position or process control system in AUTO (versus MANUAL).

C. FAIL status signals shall be defined as motor overload and/or any other shut down mode such as overtorque, overtemperature, low oil pressure, high vibration, etc.

D. READY status signal shall be defined as all conditions, including equipment control power, satisfied to permit remote control of the equipment.

2.02 CONVENTIONS

A. Operator workstation graphic display symbols and indicator lights on all MCC's, control panels, starter enclosures, etc. shall conform to the following color convention:

Condition	Color
Running/On/Open	Red
Auto/Ready	White
Stopped/Off/Closed	Green
Fail/Alarm	Amber
Generic Status	Blue or White

2.03 PROCESS CONTROL

A. Where setpoints, operating limits, and other control settings are provided by the functional descriptions, these settings shall be initial settings only and shall be used for assistance in the initial startup of the plant. All such settings shall be fully adjustable and, based on actual operating conditions, the instrumentation subcontractor shall make all necessary adjustments to provide smooth, stable operation at no additional cost to the Owner.

B. Provision shall be made in controller logic to suppress nuisance alarms and control actions by the following means:

1. For alarms and control actions derived from analog input signals, use adjustable time delays and deadbands.

2. For alarms and control actions derived from discrete input signals, use adjustable time delays.

3. Initial settings for time delays shall be 10 seconds (range 0-120 seconds). Initial settings for deadbands shall be 5% of span (range 0-100%).

4. Equipment that is started or stopped manually by the operator shall start or stop immediately, with no time delay.

C. All setpoint control shall be by PID control algorithms. Where only proportional control is specified, tuning constants shall be used to reduce the Integral and Derivative functions to zero. All setpoints, sequence times, sequence orders, dead bands, PID tuning parameters, controller delay timers, variable speed operating range limits, and similar control constants shall be accessible and alterable from the operator workstations.

D. Unless otherwise specified, all equipment shall automatically restart after a power failure utilizing adjustable start delay timers in controller logic. Unless otherwise specified, all control strategies shall be based upon automatic restart after a power failure and shall return to a normal control mode upon restoration of power.

E. The controller shall be capable of receiving initial run-time values for existing and proposed equipment. Initial run-time shall not automatically be assumed to be zero.

F. A control discrepancy alarm shall be generated through the controller for any drive, motor, etc. for which a command has been issued, but for which the controller is not receiving a confirming status signal (e.g., start command with no run feedback). The failure shall be logged.

G. An instrument failure alarm shall be generated for any instrument which is generating a signal that is less than 4 mA or greater than 20 mA.

H. Unless otherwise specified in an individual control description, an instrument failure or control discrepancy alarm shall cause the control strategy to maintain last values and to generate an alarm. Manual initiation of the automatic control strategy shall be required.

I. A control program that controls multiple pieces of equipment shall not be prevented from running because not all of the equipment is in AUTO. If equipment within an equipment chain is required to be running for program operation and it is running in HAND or MANUAL, then the program shall run and control the other equipment that is in AUTO.

J. All controller wait states (internal time delays, etc.) after an operator action shall be displayed on the operator workstation.

+++ END OF SECTION 17950 +++

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SECTION 17950A
PUMP STATION 1 FUNCTIONAL DESCRIPTION

PART 1 GENERAL

1.01 SCOPE

DRAWING: I-103

A. PROCESS OVERVIEW

1. Woodward Way Pump Station 1 contains five submersible pumps, two motor-operated valves, and assorted instrumentation and other equipment as listed below.

2. The submersible pumps, pump control panel and pump controls are provided as a package under Division 11. Instrumentation provided under Division 17 shall provide inputs to the pump controller.

B. CONTROL EQUIPMENT

1. Submersible pumps P-01, 02, 03, 04, 05 are provided under Division 11.

2. Motor-operated valves are provided under Division 15.

3. A pump control panel and control system are provided under Division 11.

4. Magnetic flowmeters on Sanitary Force Mains 1 and 2 (FE/FIT-131, 132) are provided under Division 17 to measure pump station discharge.

5. A sump pump in the Valve Vault Dry Well sump with vendor control panel is provided under Division 11.

6. A float switch provided under Division 17 and mounted in the Valve Chamber monitors High Level and provides a discrete signal to the pump control panel for alarm.

7. A combustible gas detection system provided under Division 17 monitors combustible gas levels in the pump station wet well and transmits a signal to the pump control panel for indication and alarm on High Combustible Gas Level. A manufacturer's combustible gas sensor panel provides local indication and alarm.

8. A generator package provided under Division 16 provides emergency power backup for the submersible pumps.

C. CONTROL OPERATIONS

1. The small pumps discharge to Sanitary Forcemain 1 (dry weather flows). Dry weather flows are measured by magmeter FE/FIT-131. Provide an analog output linear to flow to the pump controller.

2. The large pumps discharge to Sanitary Forcemain 2 (wet weather flows). Wet weather flows are measured by magmeter FE/FIT-132. Provide an analog output linear to flow to the pump controller.

3. Monitor the level of combustible gas in the pump station wet well and transmit an analog signal linear to gas level to the combustible gas sensor panel for local alarm. The combustible gas sensor panel shall retransmit the analog signal to the pump controller for remote alarm. Provide a discrete output from the combustible gas sensor panel to the pump controller for a Gas Detector Fail condition.

PART 2 PRODUCTS

(Not Used)

PART 3 EXECUTION

(Not Used)

+ + + END OF SECTION 17950A + + +