



WATER AND SEWERAGE STANDARD TECHNICAL SPECIFICATIONS

INTRODUCTION

The following information provides current policies, procedures and construction requirements of Piedmont Water Company. Any Developer proposing to construct water and/or sewerage facilities that will be owned and/or operated by Piedmont Water Company must meet these minimum standards. These standards are not intended to replace more stringent standards that may be utilized or required by the Developer's design engineer or other pertinent State, County or City rules, regulations, restrictions and codes.

If water and/or sewerage service is required within Piedmont Water Company's service area, the Developer must contact Piedmont Water Company and provide two copies of Preliminary Plans which provide the area to be developed, size of the area to be developed in acres, type of development, number of residential and/or commercial units, and the amount of water and/or sewerage capacity that will be required.

Piedmont Water Company will review the proposed plans and determine if adequate water and/or sewerage capacity is available. Within two weeks of the preliminary plan submittal, Piedmont Water Company will determine if adequate capacity is available within the system or if upgrades will be necessary.

If the Developer proceeds with the project, the following minimum Water and Sewerage Technical Specifications shall be met. The Developer shall provide Piedmont Water Company with three (3) sets of plans and specifications for review and approval prior to proceeding with construction. The Plans and Specifications will be reviewed for conformance with Piedmont Water Company standards and returned to the Developer within 30 days of submittal. The Developer shall revise drawings and resubmit as necessary for Piedmont Water Company approval. The Developer must receive approval of plans and specifications from Piedmont Water Company before construction can proceed. The Developer is also solely responsible for obtaining all other approvals from applicable permitting agencies including all City/County/State/Federal Governmental Departments including the Georgia Department of Natural Resources, Environmental Protection Division before construction can begin. Review of plans and specifications by Piedmont Water Company is only for conformance with Piedmont's minimum standards. Piedmont Water Company

will not be responsible for obtaining approvals from applicable permitting agencies. At the end of construction, the Developer shall provide Piedmont Water Company with two paper copies of "As-Built" drawings including electronic drawings of the constructed facilities.

Piedmont Water Company does not take responsibility for construction methods or safety procedures utilized by the Developer's Contractor.

If Developer's proposed water and/or sewer utilities are to be accepted for ownership and operation by Piedmont Water Company, said utilities must be constructed by Piedmont Water Company or the developer shall provide Piedmont Water Company written certification by a Registered Professional Engineer in Georgia that the proposed utilities were constructed as per the Developer's approved plans. The certifying engineer shall provide on-site resident inspection as necessary to provide said certification. The certification must provide that all constructed facilities were tested and passed all requirements of Piedmont Water Company's construction standards specified herein. If the constructed facilities are certified by a Registered Professional Engineer as meeting these standards, Piedmont water Company will issue the Developer a conditional one (1) year approval. During the conditional one year approval period, the developer will maintain the improvements and make any repairs necessary. At the end of the one year period, Piedmont Water Company will inspect the improvements and provide the developer with the results of the inspection. If repairs are needed to the improvements to meet Piedmont Water Company standards, the Developer is required to make such repairs within 60 days of notification. If Developer does not make required repairs, Piedmont Water Company will not provide final acceptance and future maintenance of improvements and will not allow any more of the developer's connections to be made to the system.

These Standards are effective **March 31, 2012** and are subject to revision at any time. It is the responsibility of the Developer to contact Piedmont Water Company to verify if effective date is current.

PIEDMONT WATER COMPANY
WATER AND SEWERAGE
STANDARD TECHNICAL SPECIFICATIONS

INDEX

DIVISION 1-GENERAL REQUIREMENTS

<u>Section</u>	<u>Title</u>
01095	Definitions and Industry Standards
01300	Submittals

DIVISION 2-SITE WORK

<u>Section</u>	<u>Title</u>
02220	Foundation and Trench Excavation, Bedding, and Backfill
02550	Sanitary Sewers
02715	Water Mains
02732	Sewerage Force Mains

DIVISION 3-CONCRETE

<u>Section</u>	<u>Title</u>
03300	Cast-In-Place Concrete
03411	Precast Concrete

DIVISION 4-MASONRY

<u>Section</u>	<u>Title</u>
04103	Mortar

DIVISION 5-METALS AND COMPOSITES

<u>Section</u>	<u>Title</u>
N/A	N/A

DIVISION 6-WOOD AND PLASTICS

<u>Section</u>	<u>Title</u>
N/A	N/A

DIVISION 7-THERMAL AND MOISTURE PROTECTION

<u>Section</u>	<u>Title</u>
07921	Sealants and Caulking

DIVISION 8-DOORS AND WINDOWS

<u>Section</u>	<u>Title</u>
N/A	N/A

DIVISION 9-FINISHES

<u>Section</u>	<u>Title</u>
09801	Painting

DIVISION 10-SPECIALTIES

<u>Section</u>	<u>Title</u>
N/A	N/A

DIVISION 11-PROCESS EQUIPMENT

<u>Section</u>	<u>Title</u>
11900	Sewerage Submersible Pumping Stations
11925	EONE Pump Stations (Model 2010)
11950	Odor Control System

DIVISION 12-FURNISHINGS

<u>Section</u>	<u>Title</u>
N/A	N/A

DIVISION 15-MECHANICAL

<u>Section</u>	<u>Title</u>
15024	Certification
15040	Cleaning and Testing Pipe and Equipment
15100	Valves

DIVISION 16-ELECTRICAL

<u>Section</u>	<u>Title</u>
16100	Engine Driven Generator Sets

DEFINITIONS AND INDUSTRY STANDARDS**SECTION 01095****1.01 SUMMARY:**

- A. This Section specifies the following:
 - 1. Definitions of certain terms used in these specifications.
 - 2. Information about industry standards cited in these specifications.

1.02 DEFINITIONS:

- A. Regulations: The term "regulations" include laws, ordinances, statues, and lawful orders issued by authorities having jurisdiction, as well as rules, conventions, and agreements within construction industry that control performance of Work.
- B. Installer:
 - 1. The term "installer" means Developer or Developer's contractor or an entity engaged by the Developer, either as an employee, subcontractor or sub-subcontractor, for performance of a particular construction activity including installation, erection, application, and other similar operations.
 - 2. The term "experienced", when used with the term "installer," means having successfully completed not less than five previous projects equal in size and scope to the proposed Project, being familiar with precautions needed for safe operations, and having knowledge of requirements of authorities having jurisdiction.
- C. Testing Laboratories: A "testing laboratory" is an independent entity engaged to perform specific inspections or tests, either at Project site or elsewhere, or to report on and, if required, to interpret results of inspections or tests.

1.03 INDUSTRY STANDARDS:

- A. Applicability of Standards: Except where other Contract Documents include more stringent requirements, applicable industry standards have same force and effect as if fully set forth in these specifications. Such standards are made a part of these specifications by reference.

- B. Publication Dates: Where edition date of referenced industry standard is not specified, comply with edition in effect on date set forth on cover of Project Manual.
- C. Differing Requirements: If Contract Documents require compliance with two or more standards which establish different requirements, confer with Piedmont Water Company prior to proceeding with affected operations.
- D. Abbreviations and Names: Trade association names and titles of general standards are frequently abbreviated. Where such abbreviations are used, they mean recognized name of trade association, organization-producing standard, authority having jurisdiction, or other similar entity.

End of Section

SUBMITTALS

SECTION 01300

1.01 SUMMARY:

- A. This Section specifies procedural requirements associated with Developer's contractor providing submittals to Piedmont Water Company including the following:
 - 1. Contractor's construction schedule.
 - 2. Submittal schedule.
 - 3. Shop Drawings.
 - 4. Product Data.
 - 5. Samples as Required.

- B. Only submittals that have been previously reviewed and accepted by the original design engineer will be accepted by Piedmont Water Company for review.

1.02 SUBMITTAL PROCEDURES:

- A. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.
 - 1. Coordinate each submittal with purchasing, fabrication, testing, delivery, other submittals, and related activities that requires sequential activity.
 - 2. Coordinate transmittal of different submittals involving related elements so processing will not be delayed by need to postpone review of submittals until related submittals are received.
 - 3. Piedmont Water Company reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
 - 4. Transmit each submittal sufficiently in advance of performance of related construction activities to avoid delay.

- B. Processing: Allow Piedmont Water Company personnel sufficient review time so that installation will not be delayed as a result of time required to process submittals, including time for re-submittals.
 - 1. Allow no less than 15 days for Piedmont Water Company's personnel to review; allow additional time if processing must be delayed to permit coordination with subsequent submittals.
 - 2. If Piedmont Water Company requires re-submittal of an item, process subsequent submittal in same manner as initial submittal.

3. Allow 15 days for processing each re-submittal.
 4. Piedmont Water Company is not responsible for delays resulting in failure of the Developer to transmit submittals to Piedmont Water Company personnel sufficiently in advance of Work to permit processing.
- C. Submittal Preparation: Place an identification label or title block on each submittal.
1. Provide an adequate space on label, or beside title block on Shop Drawings, to record Developer's contractor's review and design engineer and approval markings; Include the following information on label or title block: Project name; Name of Engineer; Date; Name of Contractor; Name of supplier; Name of manufacturer; Number of appropriate Project Manual document; Drawing number and detail references; as appropriate.
- D. Transmittal: Include a transmittal form or letter with each submittal. On transmittal, record relevant information and, if appropriate, requests for data. On form or separate sheet, record deviations from these specifications, including minor variations and limitations. Include Developer's contractor's certification that information complies with these specifications.
1. Submittals received from sources other than Developer's Contractor will be returned without action.
- E. Delivery:
1. Mail submittals to:

Piedmont Water Company
P.O. Box 190219
Atlanta, Georgia 31119
 2. If other methods of delivery are used, address submittals to:

Piedmont Water Company
2556 Apple Valley Road, Suite 250
Atlanta, Georgia 30319
Phone: (404)235-0666
Fax: (404)235-4977

1.03 PIEDMONT WATER COMPANY ACTION:

- A. Except for information-type submittals, Piedmont Water Company(PWC) will review and mark submittals to indicate actions taken and instructions to Developer, and then return an appropriate number of copies to Developer.
- B. PWC will affix to submittals a self-explanatory stamp, marked to indicate one of the following:
 - 1. If marked "No Exception Noted," that portion of Work represented by submittal may proceed provided it complies with requirements of Contract Documents; final acceptance will depend on compliance.
 - 2. If marked "Make Corrections Noted," that portion of Work represented by submittal may proceed provided it complies with noted corrections and requirements of Contract Documents; final acceptance will depend on compliance.
 - 3. If marked "Revise and Resubmit," do not proceed with purchasing, fabrication, delivery, or other similar Work activities associated with submittal. Revise submittal in accordance with notations; resubmit without delay.
 - 4. If marked "Rejected" do not proceed with purchasing, fabrication, delivery, or other similar Work activities associated with submittal. Prepare new submittal in accordance with notations; resubmit without delay.
 - 5. If marked "Submit Specified Item," the specified item was not submitted. Resubmit with correct specified item.

1.04 CONTRACTOR'S CONSTRUCTION SCHEDULE:

- A. Within 14 days of date of Commencement of Work, submit to PWC five copies of horizontal bar chart-type construction schedule.
- B. Use a separate time-bar for each significant construction activity.
- C. Provide a separate set of time-bars for each major portion of Work.
- D. Provide a series of continuous vertical lines to identify first working day of each week.
- E. Within each time-bar, identify planned completion percentage in 10 percent increments. As Work progresses, place a contrasting mark in each bar to identify actual percent completion.
- F. Prepare schedule on a sheet, or series of sheets, of stable transparency, or other reproducible media, of sufficient width to show data for entire

construction period.

- G. Coordinate construction schedule with submittal construction schedule.

1.05 SUBMITTAL SCHEDULE:

- A. Not later than date of submission of Contractor's construction schedule, submit to Piedmont Water Company(PWC) three copies of Contractor's schedule of submittals.
- B. Prepare schedule in form of list that identifies each submittal as follows:
 - 1. Brief description of submittal.
 - 2. Number of appropriate Project Manual document.
 - 3. Planned date of submission.
- C. Unless PWC objects to Contractor initial submittal schedule, one copy will be returned to Contractor marked "Action Not Required."
- D. If an event occurs which adversely affects submittal schedule, submit four copies of revised schedule to PWC within five days of event giving rise to change. Unless PWC objects to such revised document, one copy will be returned marked "Action Not Required."

1.06 SHOP DRAWINGS:

- A. Provide six(6) sets of shop drawings including fabrication and installation drawings, setting diagrams, schedules, patterns, templates, and similar documents. As a minimum, indicate the following:
 - 1. Dimensions, including those established by field measurement.
 - 2. Identification of materials.
 - 3. Compliance with specified requirements.
 - 4. Coordination requirements.
 - 5. Product and manufacturer's name, if applicable.
- B. Submit newly prepared documents drawn to accurate scale. Do not reproduce Contract Documents or copy standard information as basis of Shop Drawings; standard information prepared without specific reference to Project will not be considered Shop Drawings.
- C. Collect Shop Drawings into a single submittal for each element of construction.
- D. Highlight, encircle, or otherwise indicate deviations from Contract

Documents.

- E. Except for templates, patterns and similar full-size drawings, submit Shop Drawings on sheets 8 1/2 " x 11", but no larger than 24" x 36".

1.07 PRODUCT DATA:

- A. Product Data includes printed information such as manufacturer's installation instructions, catalog cuts, and standard color charts. As a minimum, include data which documents the following:
 - 1. Manufacturer's printed recommendations.
 - 2. Compliance with recognized industry and trade association standards.
 - 3. Compliance with recognized testing agency standards.
 - 4. Application of testing agency labels and seals.
 - 5. Notation of coordination requirements.
- B. Where special data must be prepared because standard printed data is not suitable for use, submit as "Shop Drawings".
- C. Collect Product Data into a single submittal for each element of construction.
- D. Highlight, encircle, or otherwise indicate deviations from Contract Documents.
- E. If Product Data includes information on materials or options which are not required, mark copies to indicate applicable information.
- F. Unless otherwise specified, submit to PWC six copies of each submittal; two copies will be returned to Developer.
- G. Include manufacturer supplied Operating instruction and Maintenance manuals for each piece of equipment.

1.08 SAMPLES:

- A. Submit Samples which are physically identical to products Contractor proposes to include in Work. Samples include, but not limited to, full- and reduced-size sections of manufactured or fabricated components, cuts or containers of materials, and range-sets showing color, pattern and texture.
- B. Mount, display, or package Samples to facilitate PWC's review. Mark Samples to identify the following:

1. Generic description of Sample.
 2. Sample source.
 3. Product and manufacturer's name.
 4. Compliance with specified requirements.
- C. Submit Samples for PWC's review of shape, arrangement, type, color, pattern and texture, for comparison of these characteristics with other elements, and for subsequent comparison of these characteristics with products delivered and installed.
- D. Unless a greater number is specified elsewhere or needed to illustrate variations in color, pattern, texture or other characteristics inherent in material represented, submit to PWC three sets of samples; either one set will be returned to Developer or, at PWC's option, Developer will be notified of results of PWC's review.

End of Section

FOUNDATION AND TRENCH EXCAVATION, BEDDING AND BACKFILL

SECTION 02220

PART 1 - GENERAL

1.01 QUALITY ASSURANCE:

A. Applicable Standards:

1. General: Current editions or revisions of the following specifications and standards shall apply unless specifically noted otherwise on the Developer’s Design Drawings or specified herein.
2. American Society for Testing and Materials: Comparable standard specifications for the American Society for Testing and Materials, herein referred to as ASTM and the American Association of State Highway and Transportation Officials, herein referred to as AASHTO, are listed below. Where only one specification number is shown, the standard specification for that society shall apply.

<u>ASTM</u>	<u>AASHTO</u>	<u>TITLE</u>
D 698		Moisture-Density Relations of Soils Using 5.5 lb. Hammer and 12 Inch Drop (Standard Proctor).
D 1556	T-191	Density of Soil in Place by the Sand Cone Method.

Other methods will be considered upon written request to Piedmont Water Company. The request must demonstrate a correlation with the above standards.

B. Testing:

1. Qualified soils technicians working under the direct supervision of a registered professional Geotechnical Engineer shall be employed by the Developer’s Contractor for the purpose of identifying soils, checking densities, and classifying soils materials during construction. All costs for this service shall be paid for by the Developer. The Geotechnical Engineer and soils technicians that will be utilized by the Developer shall be submitted to PWC for approval prior to any geotechnical work being performed.
2. Density Tests shall be made as required by these specifications and as recommended by the Geotechnical Engineer to provide verification that the

soils work being performed by the contractor is being compacted to specification requirements.

3. Developer's Contractor shall deliver test results to Piedmont Water Company as soon as possible upon completion of the required tests. Any soils not meet minimum compaction requirements shall be excavated and re-compacted until soils meet minimum standards. Soil compaction testing and results from re-compaction efforts shall also be provided to PWC.

PART 2 - PRODUCTS

Not Applicable.

PART 3 - EXECUTION

3.01 FIELD ENGINEERING:

- A. All field engineering is the responsibility of the Developer's Contractor.

3.02 SPECIAL SAFETY REQUIREMENTS:

- A. The Developer is responsible for meeting all applicable safety requirements.

3.03 EXCAVATION:

- A. Foundation Excavation: Foundation excavation shall be of sufficient dimension to accommodate all forms required to be erected.
 1. Remove all loose material from excavation bottoms and level or grade excavation bottoms to receive foundation materials. All excavations to receive structures or foundations shall be inspected by a Geotechnical Engineer. Any unsuitable or unstable material shall be removed and replaced with suitable material and compacted as directed.
 2. Excavation shall be of sufficient dimensions to accommodate all forms and/or structures required. Walls of excavations shall be sloped to remain stable until backfill is placed.
 3. Retain suitable material from excavation and use for backfill. Material will be classified as suitable or unsuitable by a Soil Technician.
 4. Unsuitable excavated material becomes the responsibility of the Developer's Contractor. Remove and dispose of such material away from site.

5. Perform excavation in a manner and sequence to provide drainage at all times. Temporary drains, ditches, pumps, drainage lines or other equipment to intercept, divert, or remove surface and sub-surface water from the excavation are required.
- B. **Trench Excavation:** Excavation for trenches as stated below to receive gravity or pressure pipe or other utility lines shall be for the proper installation of the utility and shall be at the lines and grades shown on the design Drawings. Trench walls shall be maintained as nearly vertical as possible to an elevation one foot above the top of the utility, not to exceed a vertical height of four feet above the bottom of the trench. Any trench exceeding a height of four feet is to be sloped, benched, or sheeted and shored to maintain the stability of the trench wall. If suitable bearing for the pipe or conduit is not encountered at the depth indicated for trench bottom due to wet or unstable material, such material shall be excavated to depth required and refilled and compacted to proper grade with coarse sand, fine gravel, or other suitable approved material. Where rock is encountered at proper grade for trench bottom, excavation shall extend six (6) inches below proper grade and such excavation shall be refilled and compacted to proper grade with coarse sand, fine gravel, or other suitable approved material. Special requirements relating to specific utilities are as follows:
1. **All Pipe Lines and Conduits:** Excavation shall be open cut and the proper width of the trench one foot above the top of the pipe or conduit shall be such that the clear space between the barrel of the pipe or conduit and trench wall shall not exceed 8 inches on either side of the pipe or conduit. The width of the trench above that level shall be as wide as necessary for sheeting and bracing and the proper performance of the Work.
 2. **Pressure Lines:** Unless otherwise indicated, trenches shall be graded to avoid high points with the necessity of placing vacuum and relief valves in the pressure lines. Trenches shall be of a depth to provide a minimum cover over the top of the pipe of 5'-0" in unpaved areas and 5'-6" in paved areas, or as shown on the drawings, and to avoid interference with other utilities.
- C. **Rock Excavation:** Rock shall be excavated to a depth six inches below the bottom of the pipe.
- D. **Bedding:**
1. **General:** The bottoms of trenches shall be shaped in undisturbed soil or in the bedding required on the Drawings. Minimum acceptable bedding, unless shown otherwise on the plans or specified elsewhere herein, shall consist of uniform contact with undisturbed soil or

compacted bedding material by the pipe barrel, for an arc of a central angle of 90 degrees. The entire bottom of the excavation is to be firm, stable, and at a uniform density, and unless for removal of rock or muck, left undisturbed. Joint holes shall be excavated by hand to the minimum size required for proper installation of the joint so the joint does not carry the weight of the pipe.

2. Muck Areas: After muck or unsuitable material has been removed, the bed of the trench shall be brought back to the line and grade shown on the drawings using a suitable backfill material placed in eight inch lifts and compacted to 98 percent of the maximum dry density as determined by ASTM D 698.
3. Rock Areas: A six inch layer of compacted concrete sand, fine gravel or crushed stone, not larger than 1/4 inch in size, shall be placed above the rock and shaped as required herein to receive the utility.

3.04 BACKFILL:

- A. General: Backfilling operations shall not proceed until all necessary tests, inspections or observations have been performed as required by the applicable utility specification, or unless directed by Piedmont Water Company. All debris, rocks, broken concrete, formwork, etc., shall be removed from the trench and backfill material prior to the start of backfilling operations.
- B. Backfill adjacent to structures shall be placed in eight inch layers (loose measure) and each layer compacted to 96% maximum dry density as determined by ASTM D698, Standard Proctor, except the top twenty four inches which shall be compacted to 100% maximum dry density for areas to support structures or pavements.
- C. Trench backfill shall be placed in uniform six inch layers, loose measure, and compacted the full width of the trench to the percent of maximum dry density as determined by ASTM D 698. This procedure shall be carried out for the full height of the utility plus one foot above the utility. All backfill material shall be free of muck, rock, organic material, broken concrete or other debris.
 1. Placing Backfill Material: Backfill material shall be placed in the trench in such a manner so as not to disturb the alignment of the utility. Under no circumstances shall a bulldozer or other equipment be allowed to push fill material into the trench. The material shall not be dropped on the pipe, but placed in a manner as to allow the pipe to remain in place and to allow for the uniform spreading and compaction of the material. Material shall be placed on both sides of

the utility so that the backfill will have the same elevation on each side during compaction operations.

2. Backfill Above the Utility: After the backfill has reached an elevation one foot above the top of the pipe, operations shall proceed as follows:

- a. Under existing or proposed roads, floor slabs, parking areas, etc., backfill material shall be placed in uniform six inch layers, loose measure and compacted to 96% of the maximum dry density as determined by ASTM D 698, to within two feet of the top of the trench. The top 24 inches shall be compacted to 100% density of the same specification.
- b. In areas where no construction is to take place over the utility, backfill material shall be placed in uniform 8 inch layers, loose measure and compacted to 96% of the maximum dry density as determined by ASTM D 698 for the full depth of the trench.

- D. Moisture Content: Moisture content of backfill material shall be within +or- 2.0% of optimum.

- E. Testing:

1. Qualified soils technicians working under the direct supervision of a Geotechnical Engineer shall be employed by the Developer's Contractor for the purpose of identifying soils, checking densities, and classifying soils materials during construction. Charges for this service will be paid for by the Developer. The Geotechnical Engineer and soils technicians that will be utilized by the Developer shall be submitted to PWC for approval prior to any geotechnical work being performed.
2. Density Tests shall be performed for each lift of material placed and as further recommended by the Geotechnical Engineer to provide verification that the soils work being performed by the contractor is being compacted to specification requirements.
3. Developer's Contractor shall deliver test results to Piedmont Water Company as soon as possible upon completion of the required tests. Any soils not meet minimum compaction requirements shall be excavated and re-compacted until soils meet minimum standards. Soil compaction testing and results from re-compaction efforts shall also be provided to PWC.

End of Section

SANITARY SEWERS

SECTION 02550

PART 1 - GENERAL

1.01 DESCRIPTION:

- A. Work: Work consists of all sanitary sewers and related appurtenances including connections to existing sanitary sewer systems.
- B. Gravity sewer lines shall be designed to carry the peak design flow for the proposed development at 50% flow depth. The developer shall also evaluate downstream infrastructure to determine if the proposed development will require upgrades to existing infrastructure. The developer shall retain the services of a registered engineer for this determination. The developer's engineer shall prepare a report for submittal to Piedmont Water Company for review and approval for downstream infrastructure impacts from proposed development. Piedmont Water Company will then determine what downstream upgrades will be required by the developer.
- C. For design purposes, Developer shall assume a minimum of 350 gpd/residential unit with a minimum peaking factor of 2.5. Developer's engineer may utilize larger peaking factor as necessary. Commercial flows and required peaking factors will be analyzed on a case by case basis.

1.02 QUALITY ASSURANCE:

- A. Applicable Standards: Conform to the following standards:
 - 1. American Water Works Association: Comparable standard specifications for the American Water Works Association, herein referred to as AWWA, and the American National Standards Institute, herein referred to as ANSI, are listed below:

<u>AWWA</u>	<u>ANSI</u>	<u>TITLE</u>
C104	A21.4	Cement-Mortar Lining for Cast-Iron and Ductile-Iron Pipe and Fittings for Water
C110	A21.10	Gray-Iron and Ductile-Iron Fittings, 3 in. through 48 in., for Water and Other Liquids
C111	A21.11	Rubber Gasket Joints for Gray-Iron and

Ductile-Iron Pressure Pipe and Fittings

C150 A21.50 Thickness Design of Ductile-Iron Pipe

2. Standard Specifications for the American Society for Testing and Materials (ASTM).

<u>ASTM</u>	<u>TITLE</u>
A48	Gray Iron Castings
A536	Ductile Iron Castings
A746	Ductile Iron Gravity Sewer Pipe
C32	Sewer and Manhole Brick (Made from Clay or Shale)
C478	Precast Reinforced Concrete Manhole Sections
D2321	Underground Installation of Flexible Thermoplastic Sewer Pipe.
D3034	Type PSM Poly-vinyl Chloride (PVC) Sewer Pipe and Fittings.
D3212	Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.
F477	Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

3. Federal Specification SS-S-00210: Sealing Compound, Preformed Plastic for Pipe Joints.

- B. The Developer’s Contractor shall submit for approval a notarized certification from the supplier that the materials and pipe meet the referenced specifications

1.03 SUBMITTALS:

- A. Test Reports: Submit certifications to Piedmont Water Company.
- B. Shop Drawings: Submit shop drawings on all castings, manholes and piping.

1.04 PRODUCT HANDLING, DELIVERY, AND STORAGE:

- A. Pipe Handling: All pipes shall be inspected for defects as it is unloaded and stockpiled. Pipes shall not be rolled or dropped from the truck or into pipe trenches. Hooks inserted in ends of pipe shall have broad, well padded contact surfaces. Pipe which has been damaged shall be replaced by and at the expense of the Developer's Contractor.
- B. Storage: When pipe is stockpiled, place pipe so that the bell or spigot ends are not supporting the weight of the pipe. Pipe shall be stacked no greater than three feet in height. Only that pipe required for days work shall be placed along the trench line. In no case will pipe be placed or stored in a manner that will create a hazard to traffic.

PART 2 - PRODUCTS

2.01 MATERIALS:

- A. Precast Concrete Manhole: Five inches minimum wall thickness, top section eccentric, all conforming with requirements of ASTM C478.
 - 1. Joint for Precast Manhole Sections: Preformed plastic, Type 1, Rope Form, conforming with requirements of Federal Specification SS-S-00210.
- B. PVC Sanitary Sewer (Gravity) Pipe: ASTM D-3034, SDR 35 with ASTM D3212 joints for all burial depths of less than 15 feet; ASTM D-3034, SDR 26 with ASTM D3212 joints for all burial depths greater than 15 feet and less than 25 feet; Ductile iron pipe for all burial depths greater than 25 feet.
- C. Ductile Iron Pipe: Ductile iron pipe shall conform to requirements of ANSI Standards A21.50, A21.4, A21.11 and ASTM A746.
 - 1. Iron Grade: 60-42-10 minimum.
 - 2. Pipe shall be Class 50 minimum.
 - 3. Pipe Joints: Push-on.
 - 4. Outside Coating: One mil thick bituminous.
 - 5. Inside Coating: Cement lined with asphaltic seal coat per ANSI A21.4.
- D. Castings:

1. Manhole Frames and Covers: Gray iron, Class 35, ASTM A48, heavy duty, designed to withstand 16,000 pound wheel load plus impact, machined bearing surfaces between frame and cover, fully bituminous coating.
 2. Manhole Steps: Type PS1-PF, manufactured by M.A. Industries Inc., Peachtree, Georgia or approved equal design to conform with OSHA standards.
 3. All castings shall be produced in the United States.
- E. Brick: Clay or shale and burned, Grade MS, conforming with requirements ASTM C32.
- F. Adapters: Provide standard manufactured adapters where differing pipe materials join. Submit shop drawings for approval.
- G. Rubber Boots: Provide rubber boots, stainless steel expansion bands and stainless steel pipe clamps for all pipe penetrations into manholes. The rubber boot shall comply with ASTM C923 and ASTM A167. Provide two (2) clamps for 15 inch diameter pipes or larger.

PART 3 - EXECUTION

3.01 SAFETY REQUIREMENTS:

- A. The Contractor is required to comply with all current Federal, State, and Local Safety Codes and Regulations as applicable for his operations.

3.02 CONSTRUCTION - SANITARY SEWERS:

- A. Trench Excavation, Bedding and Backfill: Except as otherwise indicated and specified, shall be accomplished in accordance with Section 02220 of these specifications.
- B. Install PVC sewer pipe per the requirements of ASTM D2321 using Class I bedding, except use GA D.O.T. No.67 stone. Install DIP sewer pipe per the requirements of ANSI/AWWA C150/A 21.50, Type 4 laying condition.
- C. Installation of Pipe: Under no circumstances shall pipe be laid in water, or on rock, or when trench conditions or weather is unsuitable for such work. Each pipe shall be carefully examined before lowering into trench and any defective or damaged pipe shall be immediately

removed from the site. The pipe shall be laid true to line and grade beginning at the lowest elevation on the line, with the spigot end pointing in the direction of flow, and with uniform bearing upon the pipe bed for the full length of its barrel with recesses excavated to accommodate bells and joints. Raising the pipe off pipe bed (bridging) to obtain alignment and grade for the pipe is not allowed. Joints shall be made in strict accordance with pipe manufacturer's recommendations. Full responsibility for the diversion of water from and dewatering of trenches shall be borne by the Developer's Contractor.

All pipe lines constructed across roadways shall be installed inside steel casing with stainless steel casing spacers. Stainless steel casing spacers shall be manufactured by Cascade Waterworks Manufacturing Company of Yorkville, IL. Steel casing shall conform to latest requirements of the Georgia Department of Transportation for size and thickness. All pipe lines constructed across residential drive ways shall be constructed of ductile iron pipe. Pipe lines crossing commercial driveways or other high volume access drives shall also be constructed with steel casing and stainless steel casing spacers.

- D. Construction of Manholes: Place wall sections accurately and with care, using pre-molded joint sealer or rubber gaskets, lubricated and installed in accordance with the manufacturer's recommendations. Any joint which has the gasket torn, displaced or otherwise damaged or incorrectly installed shall be reconstructed, and the gasket replaced if damaged. Any cracking, chipping or other damage to the precast sections, which in the opinion of Piedmont Water Company will endanger the water tightness or soundness of the manhole, will be cause for rejection and replacement of the section.

The manhole frame and cover shall be placed on the top, concentric with the top opening. Brick courses shall be used to adjust the frame to proper finished elevations. Adjustments shall be limited to twelve inches maximum. A grout bed shall be provided for the frame, and the frame shall be secured in place by a grout ring completely around the lower flange and sidewall of the ring, extending to the outside of the precast top section. Unless otherwise shown on the Drawings or directed by the Engineer, the finish elevation of the top of the frame and cover shall be the same as the adjacent pavement in paved areas, flush with the ground surface in lawns, grass plots, etc., and 18 inches above the ground in fields and wooded areas.

Sewers entering the manhole shall terminate at the inside face of the manhole wall, and shall be connected to manhole by means of a

flexible compression sleeve. The compression sleeve shall completely fill the void between the pipe and the manhole wall and clamp securely around pipe forming a water tight joint when subjected to 10 psi hydrostatic pressure. Enclose connections to manholes with concrete.

The invert of the manhole shall be formed of grout or lean concrete as a continuation of the lower half of the arc of the sewers entering the manhole. Where more than one sewer enters the manhole, the inverts shall be formed as smooth curves to their intersection at the center of the manhole where they shall be slightly curved towards the exit sewer. The surface of the grout or concrete outside the valley formed for passage of sewage shall be inclined at a pitch of one in six to the walls of the manhole. All intersections shall be smoothly formed curves to avoid deposition of sewage solids.

1. Testing: All manholes and wetwells shall be leak tested and shown to be water tight.. Prior to testing manholes or wetwells for water tightness, 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. Each manhole shall pass one of the following tests:
 - A. Exfiltration Tests: The manhole, after proper preparation as noted above, shall be filled with water. The maximum allowable leakage shall be eight gallons per foot of depth per 24 hours for 48-inch diameter manholes. Tests shall last a minimum of eight hours. The manholes may be backfilled prior to testing.
 - B. Vacuum Tests: The manhole, after proper preparation as noted above, shall be vacuum tested prior to backfilling. The test head shall be placed at the inside of the tope of the cone section and the compression head inflated to 40 psi to effect a seal between the vacuum base and the manhole structure. Connect the vacuum pump to the outlet port with the valve open. A vacuum of 10-inches of mercury shall be drawn and the vacuum pump shut off. With the valves closed, the time shall be measured for the vacuum to drop to 9-inches. The manhole shall pass if the time is greater than 60 seconds for 48-inch diameter manholes. If the manhole fails the initial test, necessary repairs shall be made with non-shrink grout while the vacuum is still being drawn. Retesting shall proceed until a satisfactory test is obtained. Vacuum

testing equipment shall be equal to that as manufactured by P.A. Glazier, Inc. or equal.

- E. Cleaning, Inspection and Testing: Leakage testing shall conform to items number 1 or number 2. Deflection testing shall conform to item number 3.
1. All sewer pipe lines, upon completion, or at such time as directed, shall be cleaned, inspected and field infiltration or ex-filtration tested. Joints shall sustain a maximum limit of 25 gal./in. of diameter/day/mile of line when field tested by actual infiltration conditions. If ex-filtration testing is requested by the Engineer, the joints shall perform equally well, except that an allowance of an additional 10 percent of total gallons shall be permitted for each additional 2 feet head over a basic 2 feet head above top of pipe. Labor, material and equipment for these tests shall be the Developer's Contractor's responsibility and shall be performed at no additional cost to Piedmont Water Company. Any line not meeting these test requirements shall be corrected by the Developer's Contractor at his expense. The line shall have a true grade and line and shall be entirely clean and ready for use.
 2. All sewer and pipe lines, upon completion, or at such time as directed, shall be cleaned, inspected and field air tested. Air test procedures shall be per UNI-BELL Plastic Pipe Association Publication UNI-B-6 (for low-pressure air testing of installed sewer pipe) recommendations. Follow all safety precautions noted in the test procedures given in ASTM C828. Labor, material and equipment for these tests shall be the Contractor's responsibility at no additional cost to Piedmont Water Company. Any line not meeting these test requirements shall be corrected by the Developer's Contractor at his expense. The line shall have a true grade and line and shall be entirely clean and ready for use.
 3. It is the responsibility of the Developer's Contractor to assure that pipe bedding and backfill is sufficient to limit deflection to no more than 5%. Pipe shall be tested by a "Go-No-Go" mandrel or a sewer ball permitting no greater than maximum 5% deflection. At least 50% of pipe shall be tested with selection of time and location to be made by Piedmont Water Company. All pipe not passing the 5% deflection limitation test shall be removed and replaced. At the discretion of Piedmont Water Company, should deflections be noted and considered

excessive, 100% of pipe in the project may be tested. Labor, materials and equipment for these tests shall be the Developer's Contractor's responsibility at no additional cost to Piedmont Water Company.

4. Relation to Water Mains: Sanitary sewers to be laid at least ten (10) feet horizontally from any existing or proposed potable water main and at least eighteen (18) inches minimum vertical distance between potable water and sanitary sewer when crossing each other. When impossible to obtain horizontal and vertical separation as stipulated above, the sanitary sewer is to be constructed of equal or stronger materials (pressure rating) than the water line and pressure tested to assure water tightness prior to backfilling. Also, water and sewer lines shall be ductile iron pipe with joints staggered such that maximum separation between joints exists. The sewer line shall be installed below the water line.
- F. Television Inspection: At the completion of all new sanitary sewer construction completion and before the sewer lines are placed into service, the developer shall employ a contractor specialized in the work of performing internal closed-circuit television inspection of sewer lines to provide a post-installation TV inspection to determine if the sewer lines have been constructed in accordance with PWC standards. Post installation TV inspection shall not be completed until all work, including main line and manhole visual, pressure testing, deflection and leakage testing is complete on a section of line. Post installation TV inspection shall be completed in the presence of the Owner.
1. Submittals: The developer shall provided PWC with a compact color disc(CD) or digital video disc of the video inspection.
 2. Pipe Inspection Camera: The required video shall be produced using a pan-and-tilt, radial viewing, pipe inspection camera that pans ± 275 degrees and rotates 360 degrees. The camera shall be specifically designed and constructed for pipeline inspection and shall be operative in 100% humidity conditions. The camera shall have accurate footage counter that displays on the monitor the exact distance of the camera from the center line of the starting manhole. The camera footage counter shall be accurate to the nearest 1/10 ft. The camera shall have height adjustment so that the camera lens is always centered at one-half the inside diameter, or higher, within the pipeline. The camera shall be provided with lighting adequate to provide a clear picture of the entire periphery of the pipe. The video

camera shall provide the Owner's name, project name, date, line size, line identification and ongoing footage counter. The video produced shall have video quality acceptable to PWC. If video quality is deemed unacceptable by PWC based on industry standards, developer shall re-video the lines and resubmit to PWC for approval.

The TV camera shall be moved through the line in either direction at a moderate rate, stopping when necessary to permit proper documentation of the sewers condition. The camera shall never be pulled at a speed greater than 30 feet per minute. Manual winches, power winches, TV cable and powered rewinds or other devices that do not obstruct the camera view or interfere with proper documentation of the sewer conditions shall be used to move the camera through the sewer line.

3. Television Inspection Logs: Computer printed location records shall be kept by the contractor and shall clearly indicate the location and orientation in relation to an adjacent manhole of each infiltration point or other deficiency observed during the inspection. In addition, other points of significance such as locations and orientations of service connections, unusual conditions, broken pipe, or other pertinent discernible features shall be recorded and copy of records shall be provided to PWC.
4. Digital Photos: All noted defects and lateral connections shall be documented as color digital files and color hard copy printouts. Photo logs shall accompany each photo submitted.
5. Video Recordings: Video recordings shall be provided and shall include an audio track recorded by the inspection technician during the actual inspection work describing the parameters of the line being inspected (i.e. location, depth, diameter, pipe material, etc.) as well as describing conditions, defects and unusual conditions observed during the inspection. Video recording playback shall be at the same speed that it was recorded. Once inspected, the CD's/DVD's shall be labeled and become property of PWC. The video contractor shall have all video and necessary playback equipment readily accessible for PWC's review during the project inspection.
6. Television Inspection Results: Television inspection results will be accepted by PWC when the video and inspection logs show that the sewer lines meet PWC standards.

End of Section

WATER MAINS

SECTION 02715

PART 1 - GENERAL

1.01 DESCRIPTION:

- A. Under this section the Developer's contractor shall furnish, lay or erect, test and place in satisfactory service all cast or ductile iron pipe or polyvinyl chloride (PVC) pressure pipe and appurtenances including all fittings, couplings, gaskets, special fittings, adapters and all accessories at the locations shown on the design drawings or as otherwise directed by Piedmont Water Company's representatives. All PVC water line pipe shall be white in color.
- B. All water mains constructed within road right-of-ways controlled by the Georgia Department of Transportation shall be ductile iron pipe.
- C. All water lines constructed across road ways shall be installed inside steel casing with stainless steel casing spacers. Stainless steel casing spacers shall be manufactured by Cascade Waterworks Manufacturing Company of Yorkville, IL. Steel casing shall conform to latest requirements of the Georgia Department of Transportation for size and thickness. All pipe lines constructed across residential drive ways or underneath parking lots shall be constructed of ductile iron pipe. Pipe lines crossing commercial driveways or other high volume access drives shall also be installed inside steel casing with stainless steel casing spacers.

1.02 REFERENCES:

- A. Section 02220-Foundation and Trench Excavation, Bedding and Backfill

1.03 SUBMITTALS:

- A. This section applies to all interior and/or exterior piping 3-inch diameters and above, below grade and/or located in buildings, vaults or other structures.
- B. The Developer shall submit detailed shop drawings to Piedmont Water Company (PWC) and receive approval of same before any material shall be delivered to the job site. No unapproved materials will be accepted by PWC. Shop drawings shall conform to applicable requirements set forth in the General Requirements.

- C. Detailed drawings shall indicate piping layout in plan and elevations as may be required and shall be completely dimensioned. The drawings shall include a complete schedule of all pipe, fittings, specials, hangers and supports. Special castings shall be clearly detailed showing all pertinent dimensions.

PART 2 - PRODUCTS

2.01 MATERIALS:

- A. PVC water mains 4" diameter and larger shall be polyvinyl chloride(PVC) and shall meet the minimum requirements of AWWA C900. Pipe shall be Pressure Class 150 (DR 18) with outside diameter (OD) dimensions of cast iron pipe. PVC pipe shall bear the National Sanitation Foundation seal of approval and will comply with the requirements for potable water use and for conformance with NSF Standard 61. Certificates of conformance with the foregoing specifications shall be furnished with each lot of pipe supplied.
1. Joints
 - a. Joints shall be made with elastomeric gaskets.
 - b. Bell end pipe using elastomeric gaskets shall meet the requirements of ASTM D 2122.
 - c. Elastomeric gasket couplings shall meet requirements of AWWA C900 (latest revision) for the specified pipe class and shall meet the requirements of ASTM F 477.
 2. All material furnished under this specification shall be inspected and tested prior to shipment for conformance to the requirements of these specifications. The pipe shall be provided with marking on the exterior as specified in AWWA C900. The Developer's contractor shall submit certified copies of all tests performed on each shipment of pipe. The cost of testing and furnishing required test reports of all PVC pipe shall be at the expense of the Developer.
 3. Each length of pipe shall be marked with the manufacturer's name, trade name, nominal size, class, hydrostatic test pressure, manufacturer's standard symbol to signify it was tested, and date of manufacture. Each rubber ring shall be marked with the manufacturer's identification, the size, the year of manufacture and the classes of pipe with which it can be used.
- B. PVC water mains 3" diameter and smaller shall conform to the requirements of ASTM D 2241. Pipe shall be pressure Class 200(SDR 21). PVC plastic extrusion compound shall meet requirements of ASTM D 1784 for Class 12454-B (PVC 1120). Pipe sand couplings shall bear National Sanitation

Foundation Testing Laboratories, Inc. seal of approval for potable water use. Elastomeric gasket couplings shall meet the requirements of ASTM F 477. Provide marking on pipe exterior in accordance with ASTM D 2241.

C. Ductile Iron Pipe:

1. Ductile iron pipe shall be designed in accordance with ANSI Specification A21.50 (latest revision) Thickness Design of Ductile Iron Pipe, using 60,000 psi tensile strength, 42,000 psi yield strength and 10 percent elongation.
2. Ductile iron pipe shall be manufactured in accordance with ANSI Specification A21.51 (latest revision) - Ductile Iron Pipe Centrifugally Cast in Metal Molds or Sand-Lined Molds for Water or Other Liquids, and shall be made of ductile iron having a minimum tensile strength of 60,000 psi, a minimum yield strength of 42,000 psi, and 10 percent minimum elongation.
3. Ductile Iron Pipe shall meet the latest edition of ANSI/AWWA Standard C151.

D. Pipe Coating and Lining:

1. All cast iron and ductile iron pipe and fittings shall have the standard bituminous outside coating.
2. All cast iron and ductile iron pipe shall have cement mortar lining of standard thickness in accordance with ANSI Specification A21.4 (latest revision) - Cement Mortar Lining for Cast Iron Pipe and Fittings for Water. Cement mortar lining for cast iron and ductile iron fittings shall be double the standard thickness under ANSI Specification A21.4 (latest revision). Pipe shall also meet AWWA standard C104 for cement lining.

E. Unless otherwise shown on the drawings, directed or specified, the minimum metal thickness and thickness classes of pipe shall be as listed below:

1. Ductile Iron Pipe:

<u>Pipe Diameter</u>	<u>Class</u>	<u>Metal Thickness in Inches</u>
4" Ductile Iron	350	0.25
6" Ductile Iron	350	0.25
8" Ductile Iron	350	0.25
10" Ductile Iron	350	0.26
12" Ductile Iron	350	0.28

2.02 JOINTS AND FITTINGS:

A. Ductile Iron Fittings:

1. Fittings for ductile iron pipe and PVC pipe shall be ductile iron and shall conform to requirements of AWWA C110 or AWWA C153 and shall be cement mortar lined in accordance with AWWA C104 standard thickness.
2. Joints shall conform to AWWA C111.
3. Fittings shall be mechanical joint unless otherwise specified on the drawings.
4. Gaskets for PVC pipe shall be duct tip transition type compatible with type of pipe used.

B. Flanged Joints:

1. If required, flanged joints shall be bolted with through stud or tap bolts of required size as directed. Ring gaskets of "Cranite," red rubber, asbestos composition or other approved quality shall be used in all flanged joints. The bolts and nuts shall conform in dimensions to the American Standard heavy series. Nuts shall be hexagonal, cold pressed. Bolts and nuts shall be cadmium plated, cold pressed, steel machine bolts, Grade B, conforming to ASTM Standard Specifications, Serial Designation A 307. Cadmium plating shall be by an approved process and shall be between .0003 -.0005 inch thick.

After each joint has been made, all bolts, heads, and nuts shall be coated with two (2) coats of heavy asphaltic or other approved coating.

2. Connecting flanges must be in proper position and alignment and no external force may be used to bring them together properly.

C. Screwed Joints:

If required, screwed joint pipe and fittings shall be put together in accordance with manufacturer's standard instructions. All joints shall be clean and all inside and outside threads shall be painted with an approved pipe joint compound before joining. Pipe joint compounds containing lead will not be permitted. Joints shall be made up tight and shall show no leakage under test.

D. Mechanical Joints:

1. All mechanical joints shall be thoroughly bolted in accordance with the manufacturer's recommendations with Tee Head Bolts and bolts of high strength, heat treated cast iron containing 0.50 copper or high strength low-alloy steel having a minimum yield point strength of 40,000 pounds per square inch and an ultimate tensile strength of 70,000 pounds per square inch. Gaskets and bolts and nuts shall conform to ANSI Specification A21.11 (latest revision) and shall be on neoprene or rubber of such quality that they will not be damaged by the liquid or gases with which they will come into contact. Glands shall be of high strength cast iron.
2. Installation:
 - (a) The successful operation of the mechanical joint specified requires that the spigot be centrally located in the bell and that adequate anchorage shall be provided where abrupt changes in direction and dead ends occur.
 - (b) The surfaces with which the rubber gasket comes in contact shall be brushed thoroughly with a wire brush just prior to assembly to remove all loose rust or foreign material which may be present and to provide clean surfaces which shall be brushed with soapy water just prior to slipping the gasket over the spigot end and into the bell. Soapy water shall be brushed over the gasket prior to installation to remove loose dirt and lubricate the gasket as it is forced into its retaining space.
 - (c) Joint bolts shall be tightened by the use of approved wrenches and to a tension recommended by the pipe manufacturer. When tightening bolts, it is essential that the gland be brought up toward the pipe flange evenly, maintaining approximately the same distance between the gland and the face of the flange at all points around the socket. This may be done by partially tightening the bottom bolt first, then the top bolt, next the bolts at either side and last, the remaining bolts. This cycle shall be repeated until all bolts are within the above range of torques. If effective sealing is not attained at the maximum torque indicated above, the joint shall be disassembled and reassembled after thorough cleaning. Over stressing of bolts to compensate for poor installation shall not be permitted.
3. Where joints are in contact with liquids, bolts and nuts shall be painted with two (2) heavy coats of coal tar paint.

E. Built-In Pipe and Fittings:

Where shown on design drawings or where directed, pipe and fittings shall be carefully built into or supported on concrete or brick masonry. Where pipe or fittings are shown through concrete or brick walls, the pipe or fittings shall be carefully supported and the masonry work poured or built against them. Under no circumstances will blocking out of walls be permitted for pipe insertion later.

F. Expansion Couplings

1. Expansion couplings shall be installed on cast iron and ductile iron piping where shown on the drawings, required or directed. Unless otherwise shown or specified, the pipe couplings shall be of a gasketed short sleeve type, with a diameter to fit the pipe properly.
2. Each short sleeve coupling for joint cast iron pipe shall consist of one cast iron middle ring without pipe stop, two high grade malleable iron followers, two rubber-compound wedge section gaskets and a sufficient number of track head cadmium-plated steel bolts to compress the gaskets properly. The middle ring and followers shall be shop-painted with one coat of a coal tar pitch paint. Couplings shall be equal in all respects to Style 53 Cast Couplings as manufactured by the Dresser Manufacturing Division, Bradford, Pennsylvania.
3. Where expansion couplings are required or shown for joint steel pipe they shall be equal to the Dresser Steel Coupling, Style 38. Dresser Style 62 Reducing Couplings, where needed or shown for joining cast iron pipe to steel pipe of the same nominal size, or when changing the class of pipe, shall be furnished and installed.
4. Where long sleeves are required or shown for tie-ins, pipe closures, settings and cut-ins for eliminating very short pipe fittings or sections of pipe they shall be similar and equal to Dresser Style 40 Long Sleeves.
5. Pipe ends and the surface of the gaskets shall be free from dirt and foreign substances so that the gaskets will seal against a clean surface. The use of soapy water will be allowed to make the installation easier. Bolts shall be tightened diametrically opposite each other and in progression so that the inner rims project an equal distance over the flares of the middle ring at all points. Bolts shall be tightened sufficiently to insure a watertight joint but shall not be

tightened beyond the point of stretching.

G. Pipe Sleeves

Developer's contractor shall furnish and install cast iron wall sleeves or wall pipe as indicated on the drawings where cast iron and ductile iron piping connects with or passes through concrete walls or floors and in locations where small piping and electric wiring and conduits connect with or pass through concrete walls or floors. Wall pipe or sleeves shall be accurately located and securely fastened in place before concrete is poured. All wall sleeves and wall pipes shall have wall collars properly located to be in the center of the wall where the respective pipes are to be installed.

H. Tapping Sleeves

Tapping sleeves shall be stainless steel as manufactured by Ford FAST or approved equal.

2.03 FIRE HYDRANTS

A. Fire Hydrants: Fire hydrants shall be installed as shown on the standard details and as specified herein. All fire hydrants shall meet the requirements of AWWA C 502, and the current standards of Piedmont Water Company. Fire hydrants furnished shall be Mueller Super Centurion A-421; 4 ½" VO, 3 way, open left, 4'-0" burial.

1. Installation: Fire hydrants shall be installed for a minimum of four feet (4') of cover, unless otherwise shown or specified, and shall be jointed as specified for pipe and fittings. The installation of hydrants shall include the installation of extension sections, if required, and shall include the installation of crushed stone drain as shown on the drawing details and/or as specified in these specifications. Fire hydrants shall be secured to the water main by use of a hydrant tee, rodded, with concrete blocking as required.
2. Valve Opening: Valve opening shall be not less than five and one-quarter inches (5-1/4"). Hydrants shall open left.
3. Hose and Pumper Connection: Fire hydrant shall have two (2) hose nozzles with each nozzle two and one-half inches (2- 1/2") in size. Hydrants shall also have one (1) pumper connection, six inches (6") in size.
4. Threads: Threads for hose nozzles shall be "National Standard".
5. Operating Nut: Operating nut shall be five (5) sided, flat surface to be approximately one inch (1") across.

6. Shoe Connection: Shoe connection shall be six inches (6"), furnished with mechanical joint hydrant lead.
7. General Construction: Hydrants shall be compressive type, self-oiling, non-freezing, and provided with a safety flange and coupling.

The operating unit shall be totally sealed away from the hydrant barrel and all working parts shall be continuously and automatically lubricated from a large oil reservoir and packing gland. Drain mechanism shall be simple, positive, and automatic in operation.

The safety flange on barrel and safety coupling on valve stem shall operate to prevent damage to barrel and stem in case of a traffic accident. The force of the impact shall break the flange and spread the coupling. The construction of the flange and coupling shall be such as to permit rapid and inexpensive replacement. They shall be located above the ground line. Fire hydrant shall be so constructed as to permit facing nozzles in any direction at any time without digging up the hydrant or cutting off the water. This shall be accomplished by removing safety flange bolts and revolving the head.

All working parts of the hydrant, including the seat ring shall be removable through the top without digging. Seat rings shall be so shaped and arranged as to be readily removable. Seat rings shall be bronze and shall screw into a bronze bushing in the shoe. An o-ring seal between the shoe and seat ring shall provide a watertight non-wearing, permanent seat between shoe and seat ring. This seal shall always come out with main valve removal.

Hose connections shall be either threaded and locked in place or breach-locked into the hydrant barrel and then caulked with lead to seal them permanently.

PART 3 - EXECUTION

3.01 INSTALLATION OF DUCTILE IRON PIPE:

- A. Proper and suitable tools and appliances for safe and convenient handling and installing of pipe and fittings shall be used. Great care shall be taken to prevent the pipe coating from being damaged, particularly cement linings on the inside of the pipes and fittings. Any damage shall be remedied as directed. All pipe and fittings shall be carefully examined by the Developer's contractor for defects just before installing and no pipe or fitting shall be installed which is defective.

- B. If any defective pipe or fitting is discovered after having been installed, it shall be removed and replaced in a satisfactory manner with a sound pipe or fitting by the Developer's contractor at his own expense. All pipes and fittings shall be thoroughly cleaned before they are installed and shall be kept clean until they are used in the completed work. Open ends of pipe shall be kept plugged with a bulkhead during construction.
- C. Pipe laid in trench shall be laid in line on a firm and even bearing for its full length at depths and grades shown on the plans. All provisions of Section 02220 of these Specifications, pertaining to common and rock excavation and backfill, special bedding and methods of trenching and laying pipe shall apply. Precautions shall be taken against flotation.
- D. Where bends, tees, valves, plugs, and hydrants occur in pressure mains, the Contractor will pour a block of concrete at the bend, tee, valve, plug, or hydrants to prevent movement of the pipe when in use. The block shall consist of Class B (3000 PSI) concrete as specified under Division 3 of these specifications or otherwise directed by the Engineer. The Developer's Contractor may use forms or earth walls to mold the "thrust block;" however, if earth walls are used they shall be cut true to shape with all excess earth removed and the work shall be done in such a manner that no loose earth will become mixed with the fresh concrete. At the end of 24 hours, damp earth may be placed over the concrete to help retain the moisture.
- E. All ductile iron pipe laid underground shall be mechanical joint pipe and fittings or "push-on" type joint cast iron and ductile iron pipe and fittings unless otherwise shown on the drawings or directed by PWC.
- F. All ductile iron water lines laid underground shall have a minimum of 48 inches of cover above the top of the pipe unless otherwise shown on the drawings.
- G. All ductile iron water lines laid under existing sewers, storm drains, culverts, structures, etc., shall have a minimum clearance of 18 inches between the outside wall of the water pipe and the outside surface of the existing pipe or structure. Contractor shall provide adequate structural support for the sewers to prevent excessive deflection of joints and settling on and breaking the water mains. In addition, the length of water pipe shall be centered at the point of crossing so that the joints will be equidistant and as far as possible from the sewer, and both the sewer and the water main shall be constructed of pipe material and subjected to hydrostatic tests, as prescribed in this document. Encasement of the water pipe in concrete shall be investigated on a case by case basis.
- H. All pipes entering buildings or basins, which have more than 3-foot span between wall and original earth and having cover of more than 24 inches of

earth or other material, shall be supported as directed by the Engineer, between structure wall and edge of excavation for the structure in order to prevent breakage from settlement of backfill about the structure.

I. Drilling and Tapping:

1. Wherever required, ductile iron pipes and fittings shall be drilled and tapped to receive drainage or any other piping. All holes shall be drilled accurately at right angles to the axis of any pipe or fitting. Where plugs are drilled, holes shall be at right angles to the face of the plug.
2. Where the size of the pipe to be connected is such as to require bosses for connection and when the pipe wall thickness is too thin to permit the effective length of pipe threads to be utilized as necessary for the size pipe being connected by threads, the Contractor shall furnish such pipe with cast-on bosses suitable for drilling, tapping, and connecting such pipe.
3. All tapping shall be carefully and neatly done by skilled workmen with suitable tools.
4. Where connections are made between new and old water piping the connections shall be made in a thorough and workmanlike manner using proper fittings and specials to suit actual conditions.
5. Cut-ins to existing pipelines shall be done at times agreeable to the Owner upon approval of the Engineer.
6. Existing pipelines that may be cut or damaged during the performance of work under this Section shall be repaired, reconnected and returned to service in equal or better condition in which they were found and in accordance with the requirements of this Specification.

J. Cutting Pipes

1. Whenever pipe requires cutting to fit the lines, the work shall be done in such manner as to leave a smooth end at right angles to the axis of the pipe. When a piece of pipe is cut to fit into the line, no payment will be made of the portion cut off and not used.
2. Whenever existing pipe requires cutting to install new fittings, the work shall be done in such manner as to leave a smooth end at right angles to the axis of the pipe and special care shall be exercised to guard against breaking or splitting the existing piping.

3. All cutting of ductile iron pipe shall be done with a cutting saw. The use of cutting chains or compression tools will not be permitted.

K. Pipe Insulation

All above ground piping and piping in open or grating covered pits and all exposed piping subject to freezing shall be insulated. Insulation shall have a maximum heat loss of 16 BTU/hr. ft.² at an operating temperature of 75°F. Finished insulation shall have a uniform, workmanlike appearance. The insulation system shall be submitted to the Engineer for approval before the insulation work is begun.

- L. Unless otherwise stated install per AWWA C600 (Installation of Ductile Iron Water Mains and their Appurtenances).

3.02 INSTALLATION OF PVC PIPE:

- A. Pipe and accessories shall, unless contrary instructions are received, be unloaded at the point of delivery, hauled to, and distributed at the site of the project by the Contractor. They shall at all times be handled with care to avoid damage. Whether moved by hand, by skidways or hoists, material shall not be dropped or bumped. The interior of all pipe shall be kept free from dirt and foreign matter at all times. In the distribution of material at the site of the work, each piece shall be unloaded opposite or near the place where it is to be laid in the trench.
- B. The Developer's contractor shall be responsible for all material furnished by the developer. All such material that is defective in manufacture or has been damaged in transit or after delivery shall be removed from the job site and replaced at the developer's expense.
- C. Pipe shall be handled in such manner as to avoid damage to the ends. Pipe damaged at such points that cannot be repaired to Piedmont Water Company's satisfaction shall be replaced at the developer's expense.
- D. All pipe shall be laid and maintained to the required lines and grades.
- E. Temporary support, adequate protection and maintenance of all underground and surface utility structures, drain, sewers and other structures encountered in the progress of the work shall be furnished by the Developer's contractor at his own expense. Where the grade or alignment of the pipe is obstructed by existing utility structures such as conduits, ducts, pipes, branch connections to main sewers, or main drains, the obstruction shall be permanently supported, relocated, removed or reconstructed by the

Developer’s contractor in cooperation with the owners of such utility structures. Whenever necessary to determine the location of existing underground utility structures, the Developer’s contractor, after an examination of available records, shall make all explorations and excavations for such purpose as may be directed by PWC. All pipe shall be laid to a minimum depth of cover of 4 feet. The depth shall be measured from the established street grade or the surface of the permanent ground line to the top of the sand "Embedding Material."

- F. The trench shall be dug to the required alignment and depth shown on the contract drawings and only so far in advance of pipe laying as regulations shall permit. The trench shall be braced and drained when necessary.
- G. The clear width of un-sheeted or sheeted trench measure at the horizontal diameter of the pipe shall be as shown on the plans.
- H. Ledge rock, boulders and large stones shall be removed to provide clearance to each side of, and below, all pipe and accessories. This clearance for pipe and accessories shall be as shown on the drawings. Excavations below subgrade in rock or in boulders shall be refilled to subgrade with material approved by PWC and thoroughly compacted. Blasting for excavation will be permitted only after securing approval of PWC and only when proper precautions are taken for the protection of persons and property. The hours of blasting will be fixed by local code. Any damage caused by blasting shall be repaired by the Developer’s contractor at his expense. The Developer’s contractor's procedures and methods of blasting shall conform to all state and local laws and to municipal ordinances.
- I. Polyvinyl chloride (PVC) pipe shall be laid in accordance with the following requirements. The pipe shall be installed in the trench completely embedded by "Embedding Material." The Embedment shall be brought up to the bottom of the pipe and be thoroughly compacted. The "Embedding Material" shall be sand, equal to the "Fine Aggregates" specified below.
 - 1. Fine aggregate shall be natural siliceous sand, consisting of hard, clean, strong, durable and un-coated particles, conforming to the requirements of ASTM Standard Specifications of Concrete Aggregates, Serial Designation C 33, latest revision. The mortar strength developed in such test shall be 90 percent of that developed by standard Ottawa sand tested under identical conditions.
 - 2. Fine aggregate shall have a fineness modules of 2.40 minimum and 3.00 maximum. The fineness modules shall not vary more than 0.10 plus or minus from the sample initially approved. The grading should be within the following limits:

<u>Sieve No.</u>	<u>Cumulative % Retained</u>
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4	0 to 5
8	10 to 25
16	20 to 50
30	40 to 75
50	70 to 95
100	92 to 99

If the available sources of fine aggregate will not yield the above grading, the Engineer will approve modifications in the grading which do not adversely affect the work. However, no individual size should exceed 35 percent and the amount passing the No. 50 sieve should be at least 15 percent.

- J. The balance of backfill above the "Embedding Material" shall not contain rock, stones or boulders larger than 6 inches in its greatest dimension and shall be free from brush or any other perishable or objectionable matter that would prevent proper consolidation or that might cause subsequent settlement.
- K. Satisfactory implements, tools and facilities shall be provided and used by the Contractor for the safe and efficient execution of the work. All pipe and fittings shall be carefully lowered into the trench with suitable equipment in a manner that will prevent damage to pipe and fittings. Under no circumstances shall pipe or accessories be dropped or dumped into the trench. Pipe and accessories shall be inspected for defects prior to their being lowered into the trench. Any defective, damaged or unsound material shall be repaired or replaced as directed by PWC. All foreign matter or dirt shall be removed from the interior and machined ends of pipe and accessories before it is lowered into position in the trench. Pipe shall be kept clean during and after laying.
- L. The ends of pipe to be jointed and the rubber rings shall be cleaned immediately before assembly, and the assembly shall be made as recommended by the manufacturer. The location of field-assembled rings shall be checked with a suitable gauge to verify that rubber rings are in the required position.
- M. Pipe shall not be deflected either vertically or horizontally more than the limits recommended by the manufacturer.
- N. When pipe laying is not in progress, the open ends of installed pipe shall be plugged by approved means to prevent entrance of trench water into the line. When-ever water is present in the trench, a suitable under-drain shall be provided and enough backfill shall be placed on the pipe to prevent floating. Any pipe that has floated shall be removed from the trench and re-

laid as directed by PWC. No pipe shall be laid in wet trench conditions that preclude proper bedding, or on frozen trench bottom, or when, in the opinion of the Engineer, the trench conditions or the weather are unsuitable for proper installation.

- O. A sleeve shall be cast in the wall of rigid structures at the point of entry of pipelines to provide flexibility at the wall. To provide additional flexibility, the pipe at the point of entry shall have a laying length of not more than 6 feet 6 inches.
- P. Where bends, tees, valves, plugs, and hydrants occur in pressure mains, the Contractor will pour a block of concrete at the bend, tee, valve, plug, or hydrant to prevent movement of the pipe when in use. The block shall consist of Class B concrete as specified under Section 3 of these Specifications, and shall be of size and shape as shown on the plans or otherwise directed by PWC. The Developer's contractor may use forms or earth walls to mold the "thrust-block;" however, if earth walls are used they shall be cut true to shape with all excess earth removed and the work shall be done in such a manner that no loose earth will become mixed with the fresh concrete. At the end of 24 hours, damp earth may be placed over the concrete to help retain the moisture.
- Q. Unless otherwise stated install per AWWA C605 (Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water).

3.03 PIPELINE DETECTION MARKING:

Detection tape and wire shall be provided for all pipeline installation.

- A. Detection Tape
 - 1. Minimum of 2" wide.
 - 2. Inert, bonded layer of plastic or mylar with a metallized foil core.
 - 3. Highly resistant to alkalis, acids, or other destructive chemical components encountered in soils.
 - 4. "BLUE" colored and bearing the imprint "CAUTION: WATER LINE BURIED BELOW."
 - 5. Detection tape shall be used on both PVC and DIP installation.
 - 6. Detection tape shall be placed 2' below grade and above the pipe.
- B. Detection Wire
 - 1. Detection wire shall be size # 12 AWG, for PVC pipe only. Detection wire shall be placed within 3" of top of pipe.
- C. The cost of furnishing and installing pipe detection tape and wire shall be

included in the price bid for pipe.

3.04 PRESSURE AND LEAKAGE TEST:

- A. Testing of a section of pipe may be accomplished after seven (7) days elapse time from the installation of the last thrust block in the section. Each section shall be tested by the Developer’s contractor in the presence of PWC representatives and tests shall be continued until all leaks have been made tight to the satisfaction of PWC. Pressure and leakage tests shall be performed in accordance with the latest edition of AWWA Standard C600 and/or C605.
- B. The test pressure of the installed pipe shall be a minimum of 1.5 times the working pressure, but not less than 150 psi, whichever is greater.
- C. Before applying the specified test pressure, all air shall be expelled from the pipe. If hydrants, blow-offs or air release valves are not available at the high places, the Contractor shall make the necessary taps at points of highest elevation before the test is made and insert plugs after the test has been completed.
- D. The specified test pressure shall be applied by means of a pump in a manner satisfactory to PWC. The pressure shall then be observed for any drop for a two(2) hour period.
- E. The specified test pressure shall be re-established, if required to conduct the leakage test. The pressure shall be maintained for a period of two hours. Water shall be supplied to the main during the test period as required to maintain the test pressure as specified. The quantity used, which shall be compared to the allowable quantity, shall be measured by pumping from a calibrated container. This quantity is defined as the leakage. No installation, or section thereof, will be acceptable until the leakage is less than the number of gallons per hours as determined by the formula:

$$L = \frac{SD\sqrt{P}}{133,200}$$

in which,

- L = Allowable leakage, in gallons per hour,
- S = Length of pipe tested in feet
- D = Pipe diameter, in inches, and
- P = Average test pressure during the test, in psi gauge.

- F. All pumps, gauges and measuring devices shall be furnished, installed and operated by the Contractor and all such equipment and devices and their installation shall be approved by the engineer. All pressure and leakage

testing shall be done in the presence of a representative of PWC as a condition precedent to the approval and acceptance of the system.

- G. Where leakage exceeds the allowable limit, as specified herein before, the defective pipe or joints shall be located and repaired. If the defective portions cannot be located, the Developer's contractor shall remove and reconstruct as much of the work as is necessary in order to conform to the specified limits. No additional payment will be made for the correction of defective work, or to damage to other parts of the work resulting from such corrective work.

3.05 DISINFECTION OF WATER MAINS

- A. All new water mains, as well as those taken out of service for inspection, repair or other activities that might lead to contamination of water shall be disinfected before they are placed in or returned to service.
- B. Disinfection of the new mains and the disposal of the heavily chlorinated water, following the disinfection, shall be accomplished in accordance with the latest edition of AWWA Standard C651.
- C. The "tablet method" of disinfection, which consists of placing calcium hypochlorite granules or tablets in the water main as it is being installed and then filling the main with potable water when installation is complete is not allowed.
- D. Before the main is chlorinated, it shall be filled to eliminate air pockets and shall be flushed to remove particulates. A flushing velocity of not less than 2.5 feet/second is usually maintained in pipe sizes less than 24 inches in diameter. For larger diameter mains, an alternative to flushing, such as broom sweeping of the main, is acceptable prior to chlorinating the main.
- E. During disinfection of the water mains, an appropriate cross-connection control device, consistent with the degree of hazard, shall be provided for backflow protection of the active distribution system.
- F. The quality of the water used during the disinfection procedure shall meet the required drinking water standards.
- G. The chlorine solution used for disinfection of water mains shall have a free chlorine residual concentration not less than 25 mg/L. This heavily chlorinated water shall be retained in the main for at least 24 hours, during which time all valves and hydrants shall be operated to ensure disinfection of the appurtenances. At the end of the 24 hour period, the treated water in all portions of the main shall have a residual of not less than 10 mg/L free chlorine. Re-chlorinate if required results are not obtained on all samples.

- H. After the applicable retention period, the heavily chlorinated water must not be disposed in a manner that will harm the environment. Neutralizing chemicals, such as Sulfur Dioxide, Sodium Bisulfite, or Sodium Thiosulfate can be used to neutralize the chlorine residual remaining in the water to be wasted.
- I. Flush all lines until residual is equal to existing system. After final flushing and before the water main is placed into service, water samples shall be collected from the main and tested for microbiological quality in accordance with the Georgia Rules for Safe Drinking Water, Chapter 391-3-5. The laboratory results must show the absence of coliform organisms in the water. Re-flush and re-disinfect the lines, as necessary, until satisfactory bacteriological results are obtained.

3.05.1 DISINFECTION WHEN CUTTING INTO OR REPAIRING EXISTING MAINS

- A. Shall be performed when mains are wholly or partially dewatered;
- B. Shall follow the current AWWA C651 Standards, including trench treatment, swabbing with hypochlorite solution, flushing and/or slug chlorination as appropriate;
- C. Bacteriological testing shall be performed after the repairs are complete. However, depending upon the circumstances, the water main may be returned to service prior to completion of testing to minimize the time the customers are out of service.
- D. Leaks or breaks that are repaired with clamping devices while the main remain full of water under pressure may require no disinfection.

3.05.2 AMOUNT OF CHLORINE NECESSARY FOR DISFECTION

- A. Chlorine required to produce 25 mg/L concentration in 100 feet of pipe by diameter:

Pipe Diameter (inches)	100% Chlorine		1% Chlorine Solution	
	(lbs)	(g)	(gal)	(L)
4	0.013	5.9	0.16	0.6
6	0.030	13.6	0.36	1.4
8	0.054	24.5	0.65	2.5
10	0.085	38.6	1.02	3.9
12	0.120	54.4	1.44	5.4
16	0.217	98.4	2.6	9.8

Note: 1% chlorine solution may be prepared with sodium hypochlorite (contains 5% to 15% available chlorine) or calcium hypochlorite (contains approximately 65% available chlorine by weight). To prepare 1% chlorine solution using calcium hypochlorite, add one (1) pound (454 grams) of calcium hypochlorite in approximately 8 gallons of water.

B. Amounts and types of chemicals advised to be used for neutralizing various residual chlorine concentrations in 100,000 gallons of water

Chlorine Concentration mg/L	Sulfur Dioxide (SO ₂)		Sodium Bisulfate (NaHSO ₃)		Sodium Sulfite (Na ₂ SO ₃)		Sodium Thiosulfate (Na ₂ SO ₃ ·5H ₂ O)	
	lb	Kg	lb	Kg	lb	Kg	lb	Kg
1	0.8	0.36	1.2	0.54	1.4	0.64	1.2	0.54
2	1.7	0.77	2.5	1.13	2.9	1.32	2.4	1.09
10	8.3	3.76	12.5	5.67	14.6	6.62	12	5.44
50	41.7	18.91	62.6	28.39	73	33.11	60	27.22

End of Section

SEWERAGE FORCE MAINS**SECTION 02732****PART 1 - GENERAL****1.01 DESCRIPTION:**

- A. Under this section the Developer's Contractor shall furnish, lay or erect, test and place in satisfactory service all cast or ductile iron pipe or polyvinyl chloride (PVC) pressure pipe including all fittings, couplings, gaskets, special fittings, adaptors and all accessories at the locations shown on the design drawings. All raw sewerage PVC force mains shall be green in color. All PVC force mains transporting "reuse quality" wastewater shall be purple in color.
- B. All force mains constructed within road right-of-ways controlled by the Georgia Department of Transportation shall be ductile iron pipe.
- C. All force mains constructed across road ways shall be installed inside steel casing with stainless steel casing spacers. Stainless steel casing spacers shall be manufactured by Cascade Waterworks Manufacturing Company of Yorkville, IL. Steel casing shall conform to latest requirements of the Georgia Department of Transportation for size and thickness. All force mains constructed across residential drive ways shall be constructed of ductile iron pipe. Force mains crossing commercial driveways or other high volume access drives shall also be installed inside steel casing with stainless steel casing spacers.

1.02 REFERENCES:

- A. Foundation and Trench Excavation, Bedding, and Backfill - Section 02220

1.03 SUBMITTALS:

- A. The Developer's Contractor shall submit detailed shop drawings to the Piedmont Water Company and receive approval of same before any material shall be delivered to the job site. The shop drawing shall have been previously submitted and approved by the original design engineer of the project drawings.
- B. Detailed drawings shall indicate piping layout in plan and elevations as may be required and shall be completely dimensioned. The drawings shall include a complete schedule of all pipe, fittings, specials, hangers

and supports. Special castings shall be clearly detailed showing all pertinent dimensions.

PART 2 – PRODUCTS

2.01 MATERIALS:

All force mains 4" and larger shall be either PVC(C900, DR18) or ductile iron pipe. All force mains smaller than 3" shall be PVC SDR 21 pipe. All raw sewerage PVC force mains shall be green in color. All PVC force mains transporting "reuse quality" wastewater shall be purple in color. All piping placed under roadways, driveways or other vehicular crossings shall either be placed inside steel casing or installed as ductile iron pipe.

- A. PVC force mains 4" diameter and larger shall be polyvinyl chloride(PVC) and shall meet the minimum requirements of AWWA C900. Pipe shall be Pressure Class 150 (DR 18) with outside diameter (OD) dimensions of cast iron pipe. PVC pipe shall bear the National Sanitation Foundation seal of approval and will comply with the requirements for potable water use and for conformance with NSF Standard 61. Certificates of conformance with the foregoing specifications shall be furnished with each lot of pipe supplied.
 1. Joints
 - a. Joints shall be made with elastomeric gaskets.
 - b. Bell end pipe using elastomeric gaskets shall meet the requirements of ASTM D 2122.
 - c. Elastomeric gasket couplings shall meet requirements of AWWA C900 (latest revision) for the specified pipe class and shall meet the requirements of ASTM F 477.
 2. All material furnished under this specification shall be inspected and tested prior to shipment for conformance to the requirements of these specifications. The pipe shall be provided with marking on the exterior as specified in AWWA C900. The Developer's contractor shall submit certified copies of all tests performed on each shipment of pipe. The cost of testing and furnishing required test reports of all PVC pipe shall be at the expense of the Developer.
 3. Each length of pipe shall be marked with the manufacturer's name, trade name, nominal size, class, hydrostatic test pressure, manufacturer's standard symbol to signify it was tested, and date of manufacture. Each rubber ring shall be marked with the manufacturer's identification, the size, the year of manufacture and the classes of pipe with which it can be used.

- B. Polyvinyl Chloride (PVC) pipe, 3" and smaller shall be designed for maximum hydrostatic working pressure of 200 psi at 73°F and shall conform to ASTM D 2241. Pipe shall be pressure Class 200(SDR 21). PVC plastic extrusion compound shall meet requirements of ASTM D 1784 for Class 12454-B (PVC 1120). Pipe sand couplings shall bear National Sanitation Foundation Testing Laboratories, Inc. seal of approval. Elastomeric gasket couplings shall meet the requirements of ASTM F 477. Provide marking on pipe exterior in accordance with ASTM D 2241.
1. The inside surface of each length of pipe shall be free from bulges, dents and tears that result in a variation in diameter of more than 0.20 inch from the diameter of adjacent unaffected portions of the surface.
 2. All material furnished under this specification shall be inspected and tested prior to shipment for conformance to the requirements of these specifications. The Contractor shall submit certified copies of all tests performed on each shipment of pipe. The cost of testing and furnishing required test reports of all PVC and CPVC pipe shall be at the expense of the Contractor.
 3. Each length of pipe shall be marked with the manufacturer's name, trade name, nominal size, class, hydrostatic test pressure, manufacturer's standard symbol to signify it was tested, and date of manufacture. Each rubber ring shall be marked with the manufacturer's identification, the size, the year of manufacture and the classes of pipe with which it can be used.
- C. Ductile Iron Pipe:
1. Ductile iron pipe shall be designed in accordance with ANSI Specification A21.50 (latest revision) Thickness Design of Ductile Iron Pipe, using 60,000 psi tensile strength, 42,000 psi yield strength and 10 percent elongation.
 2. Ductile iron pipe shall be manufactured in accordance with ANSI Specification A21.51 (latest revision) - Ductile Iron Pipe Centrifugally Cast in Metal Molds or Sand-Lined Molds for Water or Other Liquids, and shall be made of ductile iron having a minimum tensile strength of 60,000 psi, a minimum yield strength of 42,000 psi, and 10 percent minimum elongation. Furnish restrained joint fittings & pipe as required on the drawings.

D. Pipe Coating and Lining:

1. All cast iron and ductile iron pipe and fittings shall have the standard bituminous outside coating.
2. All ductile iron pipe shall have cement mortar lining of standard thickness in accordance with ANSI Specification A21.4 (latest revision) - Cement Mortar Lining for Cast Iron Pipe and Fittings for Water. Cement mortar lining for cast iron and ductile iron fittings shall be double the standard thickness under ANSI Specification A21.4 (latest revision).

E. Unless otherwise shown on the drawings, directed or specified, the minimum metal thickness and thickness classes of pipe shall be as listed below:

1. Ductile Iron Pipe:

<u>Pipe Diameter</u>	<u>Class</u>	<u>Metal Thickness in Inches</u>
3" Ductile Iron	350	0.25
4" Ductile Iron	350	0.25
6" Ductile Iron	350	0.25
8" Ductile Iron	350	0.25
10" Ductile Iron	350	0.26
12" Ductile Iron	350	0.28

2.02 JOINTS AND FITTINGS:

A. Ductile Iron Fittings:

1. All fittings shall conform in every respect to ANSI Specification A21.10 (latest revision) - Cast Iron Fittings, 2 inches through 48 inches, for Water and Other Liquids.
2. Unless otherwise shown on the plans, directed or specified, all fittings shall be for pressure rating of 250 psi. No compact fillings are allowed.
3. In general, flanged fittings shall be ANSI pattern using long radius elbows except where space limitations prohibit the use of same. Design of all fittings, whether long or standard pattern, shall be as indicated or dimensioned on the drawings. Special fittings and cast iron and ductile iron wall pipes and sleeves shall conform to the dimensions and details shown on the contract drawings.

B. Joints for Cast Iron Pipe and Fittings and Ductile Iron Pipe and Fittings

1. Mechanical joints shall consist of a bolt joint of the stuffing box type as detailed in ANSI Specification A21.10 (latest revision) and described in ANSI Specification A21.11 (latest revision) - Rubber Gasket Joints for Cast Iron Pressure Pipe and Fittings.
2. Bell and spigot joints shall be the poured joints as detailed in Table 8.1 of ANSI Specification A21.8 (latest revision) or Table 6.1 ANSI Specification A21.6 (latest revision) as applicable for ductile iron and cast iron pipe and in accordance with Table 10.12 (latest revision) for fittings.
3. Flanged joints shall conform to ANSI Specification B16.1 (latest revision) - Cast Iron Flanged Fittings and Flanges, Class 125 and in accordance with Table 10.23 of ANSI Specification A21.10 (latest revision).

Flanged ductile iron pipe approximately twelve (12) inches or less in length shall have flanges cast solidly to the pipe barrel. Flanges on ductile iron pipe longer than twelve (12) inches may be of the screw type. Pipe threads shall be of such length that with flanges screwed home, the end of the pipe shall then be machined to give a flush finish to the pipe and the flange and surface shall be normal to the axis of the pipe. Ductile iron flanges shall be of such design that the flange neck completely covers the threaded portion of the pipe to protect same against corrosion. Where tap or stud bolts are required, flanges shall be drilled and tapped accordingly. All pipe with screw type flanges shall be assembled, faced, and drilled at the point of manufacture, unless otherwise approved by Piedmont Water Company.

4. Push-on joints shall conform to ANSI Specification A21.11 (latest revision) - Rubber Gasket Joints for Cast Iron Pressure Pipe and Fittings. Details of the joint design shall be in accordance with the manufacturer's standard practice such as "Fastite," "Bell-Tite," "Tyton," or equal joints.
- C. All fittings and valves used with PVC pipe shall be the same as specified for cast iron and ductile iron pipe. Only mechanical joint type fittings with duck tip transition gaskets, if required by the manufacturer, will be used.
1. Mechanical joints shall consist of a bolt joint of the stuffing box

type as detailed in USAST Specification A21.10 (latest revision) and described in USAST Specification A21.11 (latest revision) - Rubber Gasket Joints for Cast Iron Pressure Pipe and Fittings.

2. At connections between cast iron fittings and PVC pipe, the connection shall be made with duck tip transition gaskets, if required by the manufacturer. The joint shall be made as provided for mechanical joint cast iron pipe, as specified in paragraph 3.05 B.1. Cost of the duck tip gasket shall be included in the price bid per foot of PVC pipe.

D. Flanged Joints:

1. Flanged joints shall be bolted with through stud or tap bolts of required size as directed. Ring gaskets of "Cranite," red rubber, asbestos composition or other approved quality shall be used in all flanged joints. The bolts and nuts shall conform in dimensions to the American Standard heavy series. Nuts shall be hexagonal, cold pressed. Bolts and nuts shall be cadmium plated, cold pressed, steel machine bolts, Grade B, conforming to ASTM Standard Specifications, Serial Designation A 307. Cadmium plating shall be by an approved process and shall be between .0003 -.0005 inch thick.

After each joint has been made, all bolts, heads, and nuts shall be coated with two (2) coats of heavy asphaltum or other approved coating. No special payment will be made for bolts, nuts, gaskets, or coatings used for flanged joints, but the cost thereof shall be included in the unit price or lump sum bid, as applicable, for flanged joint cast iron pipe and fittings.

2. Connecting flanges must be in proper position and alignment and no external force may be used to bring them together properly.

E. Screwed Joints:

Screwed joint pipe and fittings shall be put together in accordance with manufacturer's standard instructions. All joints shall be clean and all inside and outside threads shall be painted with an approved pipe joint compound before joining. Pipe joint compounds containing lead will not be permitted. Joints shall be made up tight and shall show no leakage under test.

F. Mechanical Joints:

1. All mechanical joints shall be thoroughly bolted in accordance with the manufacturer's recommendations with Tee Head Bolts and bolts of high strength, heat treated cast iron containing 0.50 copper or high strength low-alloy steel having a minimum yield point strength of 40,000 pounds per square inch and an ultimate tensile strength of 70,000 pounds per square inch. Gaskets and bolts and nuts shall conform to ANSI Specification A21.11 (latest revision) and shall be on neoprene or rubber of such quality that they will not be damaged by the liquid or gases with which they will come into contact. Glands shall be of high strength cast iron.
2. Installation:
 - (a) The successful operation of the mechanical joint specified requires that the spigot be centrally located in the bell and that adequate anchorage shall be provided where abrupt changes in direction and dead ends occur.
 - (b) The surfaces with which the rubber gasket comes in contact shall be brushed thoroughly with a wire brush just prior to assembly to remove all loose rust or foreign material which may be present and to provide clean surfaces which shall be brushed with soapy water just prior to slipping the gasket over the spigot end and into the bell. Soapy water shall be brushed over the gasket prior to installation to remove loose dirt and lubricate the gasket as it is forced into its retaining space.
 - (c) Joint bolts shall be tightened by the use of approved wrenches and to a tension recommended by the pipe manufacturer. When tightening bolts, it is essential that the gland be brought up toward the pipe flange evenly, maintaining approximately the same distance between the gland and the face of the flange at all points around the socket. This may be done by partially tightening the bottom bolt first, then the top bolt, next the bolts at either side and last, the remaining bolts. This cycle shall be repeated until all bolts are within the above range of torques. If effective sealing is not attained at the maximum torque indicated above, the joint shall be disassembled and reassembled after thorough cleaning. Overstressing of bolts to compensate for poor installation shall not be permitted.
3. Where joints are in contact with liquids, bolts and nuts shall be

painted with two (2) heavy coats of coal tar paint.

G. "Push-On" Type Joint:

1. Gaskets shall be in accordance with ANSI Specification A21.11 (latest revision) of such quality that they will not be damaged by the liquid or gases with which they will come into contact.
2. The inside of the bell and the outside of the pipe from the plain end to the guide stripe must be wiped clean immediately before assembling the pipe joint. then the rubber gasket shall be inserted into a groove or shaped recess in the bell. Both the bell and spigot ends to be joined shall be wiped again to ensure they are thoroughly clean. A liberal coating of special lubricant furnished by the pipe manufacturer shall be applied to the outside of the pipe from the plain end to the yellow guide stripe and to the inside of the gasket. the plain end shall be centered in the bell and the spigot pushed home. Wherever possible the pipe shall be socketed by hand: however, jacking may be required to push the spigot in place on the larger sizes of pipe. The completed joint shall be permanently sealed and watertight.
3. Pipe shall be securely blocked to prevent lateral movement at every change in direction in accordance with paragraph 3.06D of this section.
4. Whenever the pipe is cut in the field, the cut end shall be conditioned so it can be used in making up a joint by filing or grinding the cut end to remove burrs or sharp edges that might damage the gasket.

H. Built-In Pipe and Fittings:

Where shown on the drawings or where directed, pipe and fittings shall be carefully built into or supported on concrete or brick masonry. Where pipe or fittings are shown through concrete or brick walls, the pipe or fittings shall be carefully supported and the masonry work poured or built against them. Under no circumstances will blocking out of walls be permitted for pipe insertion later.

I. Expansion Couplings

1. Expansion couplings shall be installed on cast iron and ductile iron piping where shown on the drawings, required or directed. Unless otherwise shown or specified, the pipe couplings shall be of a

gasketed short sleeve type, with a diameter to fit the pipe properly.

2. Each short sleeve coupling for joint ductile iron pipe shall consist of one cast iron middle ring without pipe stop, two high grade malleable iron followers, two rubber-compound wedge section gaskets and a sufficient number of track head cadmium-plated steel bolts to compress the gaskets properly. The middle ring and followers shall be shop-painted with one coat of a coal tar pitch paint. They shall be equal in all respects to Style 53 Cast Couplings as manufactured by the Dresser Manufacturing Division, Bradford, Pennsylvania.
3. Where expansion couplings are required or shown for joint steel pipe they shall be equal to the Dresser Steel Coupling, Style 38. Dresser Style 62 Reducing Couplings, where needed or shown for joining ductile iron pipe to steel pipe of the same nominal size, or when changing the class of pipe, shall be furnished and installed.
4. Where long sleeves are required or shown for tie-ins, pipe closures, settings and cut-ins for eliminating very short pipe fittings or sections of pipe they shall be similar and equal to Dresser Style 40 Long Sleeves.
5. Pipe ends and the surface of the gaskets shall be free from dirt and foreign substances so that the gaskets will seal against a clean surface. The use of soapy water will be allowed to make the installation easier. Bolts shall be tightened diametrically opposite each other and in progression so that the inner rims project an equal distance over the flares of the middle ring at all points. Bolts shall be tightened sufficiently to insure a watertight joint but shall not be tightened beyond the point of stretching.

J. Pipe Sleeves

Contractor shall furnish and install ductile iron wall sleeves or wall pipe as indicated on the drawings where cast iron and ductile iron piping connects with or passes through concrete walls or floors and in locations where small piping and electric wiring and conduits connect with or pass through concrete walls or floors. Wall pipe or sleeves shall be accurately located and securely fastened in place before concrete is poured. All wall sleeves and wall pipes shall have wall collars properly located to be in the center of the wall where the respective pipes are to be installed.

PART 3 - EXECUTION

3.01 INSTALLATION OF DUCTILE IRON PIPE:

- A. Proper and suitable tools and appliances for safe and convenient handling and installing of pipe and fittings shall be used. Great care shall be taken to prevent the pipe coating from being damaged, particularly cement linings on the inside of the pipes and fittings. Any damage shall be remedied as directed. All pipe and fittings shall be carefully examined by the Contractor for defects just before installing and no pipe or fitting shall be installed which is defective.
- B. If any defective pipe or fitting is discovered after having been installed, it shall be removed and replaced in a satisfactory manner with a sound pipe or fitting by the Developer's Contractor at his own expense. All pipes and fittings shall be thoroughly cleaned before they are installed and shall be kept clean until they are used in the completed work. Open ends of pipe shall be kept plugged with a bulkhead during construction.
- C. Pipe laid in trench shall be laid in line on a firm and even bearing for its full length at depths (minimum of 4') and grades shown on the plans. All provisions of Section 02200 of these Specifications, pertaining to common and rock excavation and backfill, special bedding and methods of trenching and laying pipe shall apply. Precautions shall be taken against flotation.
- D. Where bends and tees occur in pressure mains, the Developer's Contractor shall pour a block of concrete at the bend or tee to prevent movement of the pipe when in use. The Developer's Contractor shall also provide thrust blocks at all points of unbalanced thrust including adjacent to control and isolation valves if applicable. The thrust blocks shall consist of 3000 psi concrete and as designed by the "Construction Drawings" design engineer. The Developer's Contractor may use forms or earth walls to mold the "thrust block;" however, if earth walls are used they shall be cut true to shape with all excess earth removed and the work shall be done in such a manner that no loose earth will become mixed with the fresh concrete. At the end of 24 hours, damp earth may be placed over the concrete to help retain the moisture.
- E. All ductile iron pipe laid underground shall be mechanical joint pipe and fittings or "push-on" type joint cast iron and ductile iron pipe and fittings unless otherwise shown on the drawings or directed by Piedmont Water Company.
- F. All ductile iron force mains laid underground shall have a minimum of 48 inches of cover above the top of the pipe.

- G. All ductile iron force mains laid under existing sewers, storm drains, culverts, structures, etc., shall have a minimum clearance of 18 inches between the outside wall of the force main and the outside surface of the existing pipe or structure.
- H. All pipes entering buildings or basins, which have more than 3-foot span between wall and original earth and having cover of more than 24 inches of earth or other material, shall be supported as directed by the design Engineer, between structure wall and edge of excavation for the structure in order to prevent breakage from settlement of backfill about the structure.
- I. Drilling and Tapping:
1. Drilling and tapping of cast iron or ductile iron pipe is not allowed. The contractor shall utilize tees or lateral fittings for all connections.
 2. Where connections are made between new and old force mains the connections shall be made in a thorough and workmanlike manner using proper fittings and specials to suit actual conditions.
 3. Cut-ins to existing pipelines shall be done at times agreeable to the Owner upon approval of the Engineer.
 4. Existing pipelines that may be cut or damaged during the performance of work under this Section shall be repaired, reconnected and returned to service in equal or better condition in which they were found and in accordance with the requirements of this Specification.
- J. Cutting Pipes
1. Whenever pipe requires cutting to fit the lines, the work shall be done in such manner as to leave a smooth end at right angles to the axis of the pipe. When a piece of pipe is cut to fit into the line, no payment will be made of the portion cut off and not used.
 2. Whenever existing pipe requires cutting to install new fittings, the work shall be done in such manner as to leave a smooth end at right angles to the axis of the pipe and special care shall be exercised to guard against breaking or splitting the existing piping.

3. All cutting of cast iron and ductile iron pipe shall be done with a cutting saw. The use of cutting chains or compression tools will not be permitted.

K. Pipe Insulation

Where noted on the plans, all above ground piping and piping in open or grating covered pits and all exposed piping subject to freezing shall be insulated. Insulation shall have a maximum heat loss of 16 BTU/hr. ft.² at an operating temperature of 75°F. Finished insulation shall have a uniform, workmanlike appearance. The insulation system shall be submitted to the Engineer for approval before the insulation work is begun.

3.02 INSTALLATION OF PVC PIPE:

- A. PVC pipe shall be installed in accordance with ASTM D 2774 and ASTM D 2321. Pipe and accessories shall be unloaded at the point of delivery, hauled to, and distributed at the site of the project by the Contractor. They shall at all times be handled with care to avoid damage. Whether moved by hand, skidways or hoists, material shall not be dropped or bumped. The interior of all pipe shall be kept free from dirt and foreign matter at all times. In the distribution of material at the site of the work, each piece shall be unloaded opposite or near the place where it is to be laid in the trench.
- B. The Developer's Contractor shall be responsible for all material furnished by him. All such material that is defective in manufacture or has been damaged in transit or after delivery shall be removed from the job site and replaced at the Contractor's expense.
- C. Pipe shall be handled in such manner as to avoid damage to the ends. Pipe damaged at such points that cannot be repaired to Piedmont Water Company's satisfaction shall be replaced at the Developer's expense.
- D. All pipe shall be laid and maintained to the required lines and grades.
- E. Temporary support, adequate protection and maintenance of all underground and surface utility structures, drain, sewers and other structures encountered in the progress of the work shall be furnished by the Developer's Contractor at his own expense. Where the grade or alignment of the pipe is obstructed by existing utility structures such as conduits, ducts, pipes, branch connections to main sewers, or main drains, the obstruction shall be permanently supported, relocated, removed or reconstructed by the Developer's Contractor in cooperation

with the owners of such utility structures. Whenever necessary to determine the location of existing underground utility structures, the Developer's Contractor, after an examination of available records, shall make all explorations and excavations for such purpose as may be directed by the Engineer. All pipe shall be laid to a minimum depth of 4 feet. The depth shall be measured from the established street grade or the surface of the permanent ground line to the top of the sand "Embedding Material."

- F. The trench shall be dug to the required alignment and depth shown on the design drawings (minimum of 4') and only so far in advance of pipe laying as regulations shall permit. The trench shall be braced and drained when necessary.
- G. Ledge rock, boulders and large stones shall be removed to provide clearance to each side of, and below, all pipe and accessories. This clearance for pipe and accessories shall be as shown on the drawings. Excavations below subgrade in rock or in boulders shall be refilled to subgrade with material approved by Piedmont Water Company and thoroughly compacted. Blasting for excavation will be permitted only after securing approval of the design Engineer and only when proper precautions are taken for the protection of persons and property. The hours of blasting will be fixed by local code. Any damage caused by blasting shall be repaired by the Developer's Contractor at his expense. The Contractor's procedures and methods of blasting shall conform to state and local laws and to municipal ordinances.
- H. PVC pipe shall be laid utilizing the classes of bedding required for the various types of soils and conditions encountered. Bedding for PVC pipe shall be in accordance with ASTM D 2321, as amended to date and these Specifications. The pipe shall be installed in the trench completely embedded by "Embedding Material." The Embedment shall be brought up to the top of the pipe and be thoroughly compacted. The "Embedding Material" shall be Class I, Class II, Class III or Class IV as described below.
 - 1. Class I: Angular 1/4 to 3/4 inches graded stone. Latest revision of ASTM C 33 - Gradation #67 (ASTM #67) or #57 (ASTM #57) are acceptable.
 - 2. Class II: Coarse sands and gravels with maximum particle size of 3/4 inches including variously graded sands and gravels containing small percentages of fines, generally granular and non-cohesive, either wet or dry.
 - 3. Class III: Fine sand and clayey (clay filled) gravels, including fine sands, sand-clay mixtures and gravel-clay mixtures.
 - 4. Class IV: Silt, silty clays and clays, including inorganic clays and

silts of medium to high plasticity and liquid limits.

The embedding material shall be used to provide uniform longitudinal support for the pipe. The trench shall be undercut to allow for a minimum of four inches (4") of embedding material. Bell holes shall be excavated in the embedding material to allow for unobstructed assembly of the joint, but care shall be taken to assure that bell hole is no larger than necessary to accomplish proper joint assembly. After joint assembly, embedding material shall be placed around the entire length of pipe and compacted.

The "Initial Backfill" shall consist of thoroughly compacted native soils and shall not contain rock, stone, or boulders larger than 1.5 inches in its greatest dimension and shall be free from brush or any other perishable or objectionable matter that would prevent proper consolidation or that might cause subsequent settlement. Initial backfill shall occur to twelve (12) inches above the top of the pipe.

- I. The balance of backfill above the "Initial Backfill" shall not contain rock, stones or boulders larger than 6 inches in its greatest dimension and shall be free from brush or any other perishable or objectionable matter that would prevent proper consolidation or that might cause subsequent settlement.
- J. Satisfactory implements, tools and facilities shall be provided and used by the Developer's Contractor for the safe and efficient execution of the work. All pipe and fittings shall be carefully lowered into the trench with suitable equipment in a manner that will prevent damage to pipe and fittings. Under no circumstances shall pipe or accessories be dropped or dumped into the trench. Pipe and accessories shall be inspected for defects prior to their being lowered into the trench. Any defective, damaged or unsound material shall be repaired or replaced as directed by Piedmont Water Company. All foreign matter or dirt shall be removed from the interior and machined ends of pipe and accessories before it is lowered into position in the trench. Pipe shall be kept clean during and after laying.
- K. The ends of pipe to be jointed and the rubber rings shall be cleaned immediately before assembly, and the assembly shall be made as recommended by the manufacturer. The location of field assembled rings shall be checked with a suitable gauge to verify that rubber rings are in the required position.
- L. Pipe shall not be deflected either vertically or horizontally more than the limits recommended by the manufacturer.

- M. When pipe laying is not in progress, the open ends of installed pipe shall be plugged by approved means to prevent entrance of trench water into the line. Whenever water is present in the trench, a suitable under drain shall be provided and enough backfill shall be placed on the pipe to prevent floating. Any pipe that has floated shall be removed from the trench and relaid as directed by the design Engineer. No pipe shall be laid in wet trench conditions that preclude proper bedding, or on frozen trench bottom, or when, in the opinion of the design Engineer, the trench conditions or the weather are unsuitable for proper installation.
- N. A sleeve shall be cast in the wall of rigid structures at the point of entry of pipelines to provide flexibility at the wall. To provide additional flexibility, the pipe at the point of entry shall have a laying length of not more than 6 feet 6 inches.
- O. Where bends and tees occur in pressure mains, the Developer's Contractor shall pour a block of concrete at the bend or tee to prevent movement of the pipe when in use. The Developer's Contractor shall also provide thrust blocks at all points of unbalanced thrust including adjacent to control and isolation valves if applicable. The thrust blocks shall consist of a minimum 3000 psi concrete and detailed by the design engineer. The Contractor may use forms or earth walls to mold the "thrust block;" however, if earth walls are used they shall be cut true to shape with all excess earth removed and the work shall be done in such a manner that no loose earth will become mixed with the fresh concrete. At the end of 24 hours, damp earth may be placed over the concrete to help retain the moisture.

3.03 PIPELINE DETECTION MARKING:

Detection tape and wire shall be provided for all pipeline installation.

- A. Detection Tape
 - 1. Minimum of 2" wide.
 - 2. Inert, bonded layer of plastic or mylar with a metallized foil core.
 - 3. Highly resistant to alkalis, acids, or other destructive chemical components encountered in soils.
 - 4. "GREEN" colored and bearing the imprint "CAUTION: SEWER LINE BURIED BELOW."

5. Detection tape shall be used on both PVC and DIP installation.
6. Detection tape shall be placed 2' below grade and above the pipe.

B. Detection Wire

1. Detection wire shall be size # 12 AWG, for PVC pipe only. Detection wire shall be placed within 3" of top of pipe.

3.04 PRESSURE AND LEAKAGE TEST:

- A. Testing of a section of pipe may be accomplished after seven (7) days elapse time from the installation of the last thrust block in the section. Each section shall be tested by the Contractor in the presence of the Piedmont Water Company personnel and tests shall be continued until all leaks have been made tight to the satisfaction of Piedmont Water Company. Pressure and leakage tests shall be performed in accordance with the latest edition of AWWA Standard C600 and/or C605.
- B. The test pressure of the installed pipe shall be a minimum of 1.5 times the working pressure, but not less than 200 psi, whichever is greater.
- C. Before applying the specified test pressure, all air shall be expelled from the pipe. If blow-offs or air release valves are not available at the high places, the Developer's Contractor shall make the necessary taps at points of highest elevation before the test is made and insert plugs after the test has been completed.
- D. The specified test pressure shall be applied by means of a pump in a manner satisfactory to Piedmont Water Company. The pressure shall then be observed for any drop for a two hour period.
- E. The specified test pressure shall be re-established, if required to conduct the leakage test. The pressure shall be maintained for a period of two hours. Water shall be supplied to the main during the test period as required to maintain the test pressure as specified. The quantity used, which shall be compared to the allowable quantity, shall be measured by pumping from a calibrated container. This quantity is defined as the leakage. No installation, or section thereof, will be acceptable until the leakage is less than the number of gallons per hours as determined by the formula:

$$L = \frac{SD\sqrt{P}}{133,200}$$

in which,

L = Allowable leakage, in gallons per hour,

S = Length of pipe tested in feet

D = Pipe diameter, in inches, and

P = Average test pressure during the test, in psi gauge.

- F. All pumps, gauges and measuring devices shall be furnished, installed and operated by the Contractor and all such equipment and devices and their installation shall be approved by the engineer. All pressure and leakage testing shall be done in the presence of a representative of Piedmont Water Company as a condition precedent to the approval and acceptance of the system.
- G. Where leakage exceeds the allowable limit, as specified herein before, the defective pipe or joints shall be located and repaired. If the defective portions cannot be located, the Developer's Contractor shall remove and reconstruct as much of the work as is necessary in order to conform to the specified limits.

End of Section

**CAST-IN-PLACE CONCRETE
SECTION 03300****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Design drawings and general provisions of the Specifications including but not limited to Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section specifies cast-in place concrete, including formwork, reinforcing, mix design, placement procedures, and finishes.
- B. Cast-in-place concrete includes the following:
 - 1. Foundations and footings.
 - 2. Slabs-on-grade.
 - 3. Fill for load-bearing masonry walls.
 - 4. Clear sealer applied to all slabs.
 - 5. Watertight Tanks
- C. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. N/A

1.3 SUBMITTALS

- A. Product data for proprietary materials and items, including reinforcement and forming accessories, admixtures, patching compounds, waterstops, joint systems, curing compounds, dry-shake finish materials, and others if requested by Engineer.
- B. Shop drawings for reinforcement detailing fabricating, bending, and placing concrete reinforcement. Comply with ACI 315 "Manual of Standard Practice for Detailing Reinforced Concrete Structures" showing bar schedules, stirrup spacing, bent bar diagrams, and arrangement of concrete reinforcement. Include special reinforcing required for openings through concrete structures.
- C. Samples of materials as requested by Piedmont Water Company(PWC), including names, sources, and descriptions, as follows:
 - 1. Color finishes.
 - 2. Normal weight aggregates.
 - 3. Vapor retarder/barrier.

- D. Laboratory test reports for concrete materials and mix design test.
- E. Material certificates in lieu of material laboratory test reports when permitted by PWC. Material certificates shall be signed by manufacturer and Developer's contractor, certifying that each material item complies with or exceeds specified requirements. Provide certification from admixture manufacturers that chloride content complies with specification requirements.

1.4 QUALITY ASSURANCE

- A. Codes and Standards: Comply with provisions of the following codes, specifications, and standards, except where more stringent requirements are shown or specified:
 - 1. American Concrete Institute (ACI) 301, "Specifications for Structural Concrete for Buildings."
 - 2. ACI 318, "Building Code Requirements for Reinforced Concrete."
 - 3. Concrete Reinforcing Steel Institute (CRSI) "Manual of Standard Practice."
- B. Concrete Testing Service: Engage a testing agency acceptable to PWC to perform material evaluation tests and to design concrete mixes.
- C. Materials and installed work may require testing and retesting at any time during progress of Work. Tests, including retesting of rejected materials for installed Work, shall be done at Developer's contractor's expense.
- D. Mockup: Cast mockup of size indicated or as required to demonstrate typical joints, form tie spacing, and proposed surface finish, texture, and color. Maintain sample panel exposed to view for duration of Project, after PWC's acceptance of visual qualities.
 - 1. Demolish mockup and remove from site when directed by PWC.

PART 2 - PRODUCTS

2.1 FORM MATERIALS

- A. Forms for Exposed Finish Concrete: Plywood, metal, metal-framed plywood faced, or other acceptable panel-type materials to provide continuous, straight, smooth, exposed surfaces. Furnish in largest practicable sizes to minimize number of joints and to conform to joint system shown on drawings.
 - 1. Use overlaid plywood complying with U.S. Product Standard PS-1 "A-C or B-B High Density Overlaid Concrete Form," Class I.

- B. Forms for Unexposed Finish Concrete: Plywood, lumber, metal, or another acceptable material. Provide lumber dressed on at least two edges and one side for tight fit.
- C. Forms for Cylindrical Columns and Supports: Metal, glass-fiber-reinforced plastic, or paper or fiber tubes that will produce smooth surfaces without joint indications. Provide units with sufficient wall thickness to resist wet concrete loads without deformation.
- D. Pan-Type Forms: Glass-fiber-reinforced plastic or formed steel, stiffened to support weight of placed concrete without deformation.
- E. Form Release Agent: Provide commercial formulation form release agent with a maximum of 350 mg/l volatile organic compounds (VOCs) that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.
- F. Form Ties: Factory-fabricated, adjustable-length, removable or snap-off metal form ties designed to prevent form deflection and to prevent spalling of concrete upon removal. Provide units that will leave no metal closer than 1-1/2 inches to the plane of the exposed concrete surface.

2.2 REINFORCING MATERIALS

- A. Reinforcing Bars: ASTM A 615, Grade 60, deformed.
- B. Welded Wire Fabric: ASTM A 185, welded steel wire fabric.
- C. Supports for Reinforcement: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire fabric in place. Use wire bar-type supports complying with CRSI specifications.
 - 1. For slabs-on-grade, use supports with sand plates or horizontal runners where base material will not support chair legs.
 - 2. For exposed-to-view concrete surfaces where legs of supports are in contact with forms, provide supports with legs that are protected by plastic (CRSI, Class 1) or stainless steel (CRSI, Class 2).

2.3 CONCRETE MATERIALS

- A. Portland Cement: ASTM C 150, Type I.
 - 1. Use one brand of cement throughout Project unless otherwise acceptable to PWC.
- B. Fly Ash: ASTM C 618, Type F.
- C. Normal-Weight Aggregates: ASTM C 33 and as specified. Provide aggregates from a single source for exposed concrete.

1. Local aggregates not complying with ASTM C 33 that have been shown to produce concrete of adequate strength and durability by special tests or actual service may be used when acceptable to Engineer.
- D. Lightweight Aggregates: ASTM C 330.
- E. Water: Potable.
- F. Reinforcement: Provide 6x6x10/10 w.w.m.
- G. Air-Entraining Admixture: ASTM C 260, certified by manufacturer to be compatible with other required admixtures.
1. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the following:
 - a. Air-Tite, Cormix Construction Chemicals.
 - b. Air-Mix or Perma-Air, Euclid Chemical Co.
 - c. Darex AEA or Daravair, W.R. Grace & Co.
 - d. MB-VR or Micro-Air, Master Builders, Inc.
 - e. Sealtight AEA, W.R. Meadows, Inc.
 - f. Sika AER, Sika Corp.
- H. Water-Reducing Admixture: ASTM C 494, Type A.
1. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the following:
 - a. Chemtard, ChemMasters Corp.
 - b. PSI N, Cormix Construction Chemicals.
 - c. Eucon WR-75, Euclid Chemical Co.
 - d. WRDA, W.R. Grace & Co.
 - e. Pozzolith Normal or Polyheed, Master Builders, Inc.
 - f. Metco W.R., Metalcrete Industries.
 - g. Prokrete-N, Prokrete Industries.
 - h. Plastocrete 161, Sika Corp.
- I. High-Range Water-Reducing Admixture: ASTM C 494, Type F or Type G.
1. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the following:
 - a. Super P, Anti-Hydro Co., Inc.
 - b. Cormix 200, Cormix Construction Chemicals.
 - c. Eucon 37, Euclid Chemical Co.
 - d. WRDA 19 or Daracem, W.R. Grace & Co.

- e. Rheobuild or Polyheed, Master Builders, Inc.
 - f. Superslump, Metalcrete Industries.
 - g. PSPL, Prokrete Industries.
 - h. Sikament 300, Sika Corp.
- J. Water-Reducing, Accelerating Admixture: ASTM C 494, Type E.
- 1. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the following:
 - a. Q-Set, Conspec Marketing & Manufacturing Co.
 - b. Lubricon NCA, Cormix Construction Chemicals.
 - c. Accelguard 80, Euclid Chemical Co.
 - d. Daraset, W.R. Grace & Co.
 - e. Pozzutec 20, Master Builders, Inc.
 - f. Accel-Set, Metalcrete Industries.
- K. Water-Reducing, Retarding Admixture: ASTM C 494, Type D.
- 1. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the following:
 - a. PSI-R Plus, Cormix Construction Chemicals.
 - b. Eucon Retarder 75, Euclid Chemical Co.
 - c. Daratard-17, W.R. Grace & Co.
 - d. Pozzolith R, Master Builders, Inc.
 - e. Protard, Prokrete Industries.
 - f. Plastiment, Sika Corporation.

2.4 RELATED MATERIALS

- A. Vapor Retarder: Provide vapor retarder that is resistant to deterioration when tested according to ASTM E 154, as follows:
- 1. Water-resistant barrier consisting of heavy kraft papers laminated together with glass-fiber reinforcement and overcoated with black polyethylene on each side.
 - a. Product: Subject to compliance with requirements, provide Moistop by Fortifiber Corporation.
- B. Colored Wear-Resistant Finish: Packaged dry combination of materials consisting of portland cement, graded quartz aggregate, coloring pigments, and plasticizing admixture. Use coloring pigments that are finely ground nonfading mineral oxides interground with cement. Color as selected by Engineer from manufacturers' standards, unless otherwise indicated.

1. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the following:
 - a. Conshake 600 Colortone, Conspec Marketing & Mfg. Co.
 - b. Floorcron, Cormix Construction Chemicals.
 - c. Quartz Tuff, Dayton-Superior.
 - d. Surfex, Euclid Chemical Co.
 - e. Colorundum, A.C. Horn, Inc.
 - f. Quartz Plate, L&M Construction Chemicals, Inc.
 - g. Colorcron, Master Builders, Inc.
 - h. Floor Quartz, Metalcrete Industries
 - i. Lithochrome Color Hardener, L.M. Scofield Co.
 - j. Harcol Redi-Mix, Sonneborn-Chemrex.
 - k. Hard Top, Symons Corp.

- C. Absorptive Cover: Burlap cloth made from jute or kenaf, weighing approximately 9 oz. per sq. yd., complying with AASHTO M 182, Class 2.

- D. Moisture-Retaining Cover: One of the following, complying with ASTM C 171.
 1. Waterproof paper.
 2. Polyethylene film.
 3. Polyethylene-coated burlap.

- E. Water-Based Acrylic Membrane Curing Compound: ASTM C 309, Type I, Class B.
 1. Provide material that has a maximum volatile organic compound (VOC) rating of 350 mg per liter.
 2. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the following:
 - a. Highseal, Conspec Marketing and Mfg. Co.
 - b. Sealco - VOC, Cormix Construction Chemicals.
 - c. Safe Cure and Seal, Dayton Superior Corp.
 - d. Aqua-Cure, Euclid Chemical Co.
 - e. Dress & Seal WB, L&M Construction Chemicals, Inc.
 - f. Masterkure 100W, Master Builders, Inc.
 - g. Vocomp-20, W.R. Meadows, Inc.
 - h. Metcure, Metalcrete Industries.
 - i. Stontop CS1, Stonhard, Inc.

- F. Evaporation Control: Monomolecular film-forming compound applied to exposed concrete slab surfaces for temporary protection from rapid moisture loss.

1. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the following:
 - a. Aquafilm, Conspec Marketing and Mfg. Co.
 - b. Eucobar, Euclid Chemical Co.
 - c. E-Con, L&M Construction Chemicals, Inc.
 - d. Confilm, Master Builders, Inc.
 - e. Waterhold, Metalcrete Industries.

- G. Bonding Agent: Polyvinyl acetate or acrylic base.
 1. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the following:
 - a. Polyvinyl Acetate (Interior Only):
 - 1) Superior Concrete Bonder, Dayton Superior Corp.
 - 2) Euco Weld, Euclid Chemical Co.
 - 3) Weld-Crete, Larsen Products Corp.
 - 4) Everweld, L&M Construction Chemicals, Inc.
 - 5) Herculox, Metalcrete Industries.
 - 6) Ready Bond, Symons Corp.

 - b. Acrylic or Styrene Butadiene:
 - 1) Acrylic Bondcrete, The Burke Co.
 - 2) Strongbond, Conspec Marketing and Mfg. Co.
 - 3) Day-Chem Ad Bond, Dayton Superior Corp.
 - 4) SBR Latex, Euclid Chemical Co.
 - 5) Daraweld C, W.R. Grace & Co.
 - 6) Hornweld, A.C. Horn, Inc.
 - 7) Everbond, L&M Construction Chemicals, Inc.
 - 8) Acryl-Set, Master Builders Inc.
 - 9) Intralok, W.R. Meadows, Inc.
 - 10) Acrylpave, Metalcrete Industries.
 - 11) Sonocrete, Sonneborn-Chemrex.
 - 12) Stonlock LB2, Stonhard, Inc.
 - 13) Strong Bond, Symons Corp.

- H. Epoxy Adhesive: ASTM C 881, two-component material suitable for use on dry or damp surfaces. Provide material type, grade, and class to suit Project requirements.
 1. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the following:

- a. Burke Epoxy M.V., The Burke Co.
- b. Spec-Bond 100, Conspec Marketing and Mfg. Co.
- c. Resi-Bond (J-58), Dayton Superior.
- d. Euco Epoxy System #452 or #620, Euclid Chemical Co.
- e. Epoxitite Binder 2390, A.C. Horn, Inc.
- f. Epabond, L&M Construction Chemicals, Inc.
- g. Concrevice Standard Liquid, Master Builders, Inc.
- h. Rezi-Weld 1000, W.R. Meadows, Inc.
- i. Metco Hi-Mod Epoxy, Metalcrete Industries.
- j. Sikadur 32 Hi-Mod, Sika Corp.
- k. Stonset LV5, Stonhard, Inc.
- l. R-600 Series, Symons Corp.

2.5 PROPORTIONING AND DESIGNING MIXES

- A. Prepare design mixes for each type and strength of concrete by either laboratory trial batch or field experience methods as specified in ACI 301. For the trial batch method, use an independent testing agency acceptable to Engineer for preparing and reporting proposed mix designs.
 1. Do not use the same testing agency for field quality control testing.
 2. Limit use of fly ash to not exceed 10 percent of cement content by weight.
- B. Submit written reports to Engineer of each proposed mix for each class of concrete at least 15 days prior to start of Work. Do not begin concrete production until proposed mix designs have been reviewed by Engineer.
- C. Design mixes to provide normal weight concrete with the following properties as indicated on drawings and schedules:
 1. 4000-psi, 28-day compressive strength; water-cement ratio, 0.44 maximum (non-air-entrained), 0.35 maximum (air-entrained).
 2. 3000-psi, 28-day compressive strength; water-cement ratio, 0.58 maximum (non-air-entrained), 0.46 maximum (air-entrained).
- D. Water-Cement Ratio: Provide concrete for following conditions with maximum water-cement (W/C) ratios as follows:
 1. Subjected to freezing and thawing: W/C 0.45.
- E. Slump Limits: Proportion and design mixes to result in concrete slump at point of placement as follows:
 1. Ramps, slabs, and sloping surfaces: Not more than 4 inches.
 2. Reinforced foundation systems: Not less than 2 inches and not more than 4 inches.
 3. Concrete containing high-range water-reducing admixture (superplasticizer): Not more than 8 inches after adding admixture to site-verified 2-to-3-inch slump concrete.

- 4. Other concrete: Not more than 4 inches.
- F. Adjustment to Concrete Mixes: Mix design adjustments may be requested by Contractor when characteristics of materials, job conditions, weather, test results, or other circumstances warrant, as accepted by Engineer. Laboratory test data for revised mix design and strength results must be submitted to and accepted by Engineer before using in Work.
- G. Fiber Reinforcement: Add at manufacturer's recommended rate but not less than 1.5 lb per cu. yd.

2.6 ADMIXTURES

- A. Use water-reducing admixture or high-range water-reducing admixture (superplasticizer) in concrete, as required, for placement and workability.
- B. Use accelerating admixture in concrete slabs placed at ambient temperatures below 50 deg F (10 deg C).
- C. Use high-range water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs, engineerural concrete, parking structure slabs, concrete required to be watertight, and concrete with water-cement ratios below 0.50.
- D. Use air-entraining admixture in exterior exposed concrete unless otherwise indicated. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having total air content with a tolerance of plus or minus 1-1/2 percent within the following limits:
 - 1. Concrete structures and slabs exposed to freezing and thawing, deicer chemicals, or hydraulic pressure:
 - a. 4.5 percent (moderate exposure); 5.5 percent (severe exposure) for 1-1/2-inch maximum aggregate.
 - b. 4.5 percent (moderate exposure); 6.0 percent (severe exposure) for 1-inch maximum aggregate.
 - c. 5.0 percent (moderate exposure); 6.0 percent (severe exposure) for 3/4-inch maximum aggregate.
 - d. 5.5 percent (moderate exposure); 7.0 percent (severe exposure) for 1/2-inch maximum aggregate.
 - 2. Other concrete not exposed to freezing, thawing, or hydraulic pressure, or to receive a surface hardener: 2 to 4 percent air.
- E. Use admixtures for water reduction and set accelerating or retarding in strict compliance with manufacturer's directions.

2.7 CONCRETE MIXING

- A. Ready-Mixed Concrete: Comply with requirements of ASTM C 94, and as specified.

1. When air temperature is between 85 deg F (30 deg C) and 90 deg F (32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes, and when air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 GENERAL

- A. Coordinate the installation of joint materials, vapor retarder/barrier, and other related materials with placement of forms and reinforcing steel.

3.2 FORMS

- A. General: Design, erect, support, brace, and maintain formwork to support vertical, lateral, static, and dynamic loads that might be applied until concrete structure can support such loads. Construct formwork so concrete members and structures are of correct size, shape, alignment, elevation, and position. Maintain formwork construction tolerances and surface irregularities complying with the following ACI 347 limits:
 1. Provide Class A tolerances for concrete surfaces exposed to view.
 2. Provide Class C tolerances for other concrete surfaces.
- B. Construct forms to sizes, shapes, lines, and dimensions shown and to obtain accurate alignment, location, grades, level, and plumb work in finished structures. Provide for openings, offsets, sinkages, keyways, recesses, moldings, rustications, reglets, chamfers, blocking, screeds, bulkheads, anchorages and inserts, and other features required in the Work. Use selected materials to obtain required finishes. Solidly butt joints and provide backup at joints to prevent cement paste from leaking.
- C. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush plates or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces where slope is too steep to place concrete with bottom forms only. Kerf wood inserts for forming keyways, reglets, recesses, and the like for easy removal.
- D. Chamfer exposed corners and edges as indicated, using wood, metal, PVC, or rubber chamfer strips fabricated to produce uniform smooth lines and tight edge joints.
- E. Provisions for Other Trades: Provide openings in concrete formwork to accommodate work of other trades. Determine size and location of openings, recesses, and chases from trades providing such items. Accurately place and securely support items built into forms.

- F. Cleaning and Tightening: Thoroughly clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, or other debris just before placing concrete. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

3.3 VAPOR RETARDER INSTALLATION

- A. General: Place vapor retarder sheeting in position with longest dimension parallel with direction of pour.
- B. Lap joints 6 inches and seal with manufacturer's recommended mastic or pressure-sensitive tape.

3.4 PLACING REINFORCEMENT

- A. General: Comply with Concrete Reinforcing Steel Institute's recommended practice for "Placing Reinforcing Bars," for details and methods of reinforcement placement and supports and as specified.
 - 1. Avoiding cutting or puncturing vapor retarder/barrier during reinforcement placement and concreting operations. Repair damages before placing concrete.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other materials that reduce or destroy bond with concrete.
- C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcing by metal chairs, runners, bolsters, spacers, and hangers, as approved by design engineer.
- D. Place reinforcement to maintain minimum coverages as indicated for concrete protection. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement operations. Set wire ties so ends are directed into concrete, not toward exposed concrete surfaces.
- E. Install welded wire fabric in lengths as long as practicable. Lap adjoining pieces at least one full mesh and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.

3.5 JOINTS

- A. Construction Joints: Locate and install construction joints so they do not impair strength or appearance of the structure, as acceptable to Engineer.
- B. Provide keyways at least 1-1/2 inches deep in construction joints in walls and slabs and between walls and footings. Bulkheads designed and accepted for this purpose may be used for slabs.

- C. Place construction joints in lieu of control joints in floor slab as shown on drawings. Do not continue reinforcement through sides of strip placements.
- D. Use bonding agent on existing concrete surfaces that will be joined with fresh concrete.
- E. Isolation Joints in Slabs-on-Grade: Construct isolation joints in slabs-on-grade at points of contact between slabs-on-grade and vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
 - 1. Joint fillers and sealants are specified in Division 7 Section "Joint Sealants."
- F. Control Joints in Slabs-on-Grade: Construct contraction joints in slabs-on-grade to form panels of patterns as shown. Use saw cuts 1/8 inch wide by one-fourth of slab depth or inserts 1/4 inch wide by one-fourth of slab depth, unless otherwise indicated.
 - 1. Form control joints by inserting premolded plastic, hardboard, or fiberboard strip into fresh concrete until top surface of strip is flush with slab surface. Tool slab edges round on each side of insert. After concrete has cured, remove inserts and clean groove of loose debris.
 - 2. Control joints in unexposed floor slabs may be formed by saw cuts as soon as possible after slab finishing as may be safely done without dislodging aggregate.
 - 3. If joint pattern is not shown, provide joints not exceeding 16 feet in either direction and located to conform to bay spacing wherever possible (at column centerlines, half bays, third bays).
 - 4. Joint fillers and sealants are specified in Division 7 Section "Joint Sealants."

3.6 INSTALLING EMBEDDED ITEMS

- A. General: Set and build into formwork anchorage devices and other embedded items required for other work that is attached to or supported by cast-in-place concrete. Use setting drawings, diagrams, instructions, and directions provided by suppliers of items to be attached.
- B. Forms for Slabs: Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and contours in finished surfaces. Provide and secure units to support screed strips using strike-off templates or compacting-type screeds.

3.7 PREPARING FORM SURFACES

- A. General: Coat contact surfaces of forms with an approved, nonresidual, low-VOC, form-coating compound before placing reinforcement.

- B. Do not allow excess form-coating material to accumulate in forms or come into contact with in-place concrete surfaces against which fresh concrete will be placed. Apply according to manufacturer's instructions.
 - 1. Coat steel forms with a nonstaining, rust-preventative material. Rust-stained steel formwork is not acceptable.

3.8 CONCRETE PLACEMENT

- A. Inspection: Before placing concrete, inspect and complete formwork installation, reinforcing steel, and items to be embedded or cast in. Notify other trades to permit installation of their work.
- B. General: Comply with ACI 304, "Guide for Measuring, Mixing, Transporting, and Placing Concrete," and as specified.
- C. Deposit concrete continuously or in layers of such thickness that no new concrete will be placed on concrete that has hardened sufficiently to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as specified. Deposit concrete to avoid segregation at its final location.
- D. Placing Concrete in Forms: Deposit concrete in forms in horizontal layers no deeper than 24 inches and in a manner to avoid inclined construction joints. Where placement consists of several layers, place each layer while preceding layer is still plastic to avoid cold joints.
 - 1. Consolidate placed concrete by mechanical vibrating equipment supplemented by hand-spading, rodding, or tamping. Use equipment and procedures for consolidation of concrete complying with ACI 309.
 - 2. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations no farther than the visible effectiveness of the machine. Place vibrators to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to set. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mix to segregate.
- E. Placing Concrete Slabs: Deposit and consolidate concrete slabs in a continuous operation, within limits of construction joints, until completing placement of a panel or section.
 - 1. Consolidate concrete during placement operations so that concrete is thoroughly worked around reinforcement, other embedded items and into corners.
 - 2. Bring slab surfaces to correct level with a straightedge and strike off. Use bull floats or darbies to smooth surface free of humps or hollows. Do not disturb slab surfaces prior to beginning finishing operations.

3. Maintain reinforcing in proper position on chairs during concrete placement.
- F. Cold-Weather Placement: Comply with provisions of ACI 306 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
 - G. When air temperature has fallen to or is expected to fall below 40 deg F (4 deg C), uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F (10 deg C) and not more than 80 deg F (27 deg C) at point of placement.
 1. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
 2. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise accepted in mix designs.
 - H. Hot-Weather Placement: When hot weather conditions exist that would impair quality and strength of concrete, place concrete complying with ACI 305 and as specified.
 1. Cool ingredients before mixing to maintain concrete temperature at time of placement to below 90 deg F (32 deg C). Mixing water may be chilled or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
 2. Cover reinforcing steel with water-soaked burlap if it becomes too hot, so that steel temperature will not exceed the ambient air temperature immediately before embedding in concrete.
 3. Fog spray forms, reinforcing steel, and subgrade just before placing concrete. Keep subgrade moisture uniform without puddles or dry areas.
 4. Use water-reducing retarding admixture when required by high temperatures, low humidity, or other adverse placing conditions, as acceptable to Engineer.
 - I. Concrete slabs shall be finished with the following tolerance: True plane within 1/8" in ten feet as determined by a ten foot straightedge placed anywhere on the slab in any direction.

3.9 FINISHING FORMED SURFACES

- A. Rough-Formed Finish: Provide a rough-formed finish on formed concrete surfaces not exposed to view in the finished Work or concealed by other construction. This is the concrete surface having texture imparted by form-facing material used, with tie holes and defective areas repaired and patched, and fins and other projections exceeding 1/4 inch in height rubbed down or chipped off.

- B. Smooth-Formed Finish: Provide a smooth-formed finish on formed concrete surfaces exposed to view or to be covered with a coating material applied directly to concrete, or a covering material applied directly to concrete, such as waterproofing, dampproofing, veneer plaster, painting, or another similar system. This is an as-cast concrete surface obtained with selected form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch defective areas with fins and other projections completely removed and smoothed.
- C. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike-off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.10 MONOLITHIC SLAB FINISHES

- A. Scratch Finish: Apply scratch finish to monolithic slab surfaces to receive concrete floor topping or mortar setting beds for tile, portland cement terrazzo, and other bonded applied cementitious finish flooring material, and where indicated.
 - 1. After placing slabs, finish surface to tolerances of F(F) 15 (floor flatness) and F(L) 13 (floor levelness) measured according to ASTM E 1155. Slope surfaces uniformly to drains where required. After leveling, roughen surface before final set with stiff brushes, brooms, or rakes.
- B. Float Finish: Apply float finish to monolithic slab surfaces to receive trowel finish and other finishes as specified; slab surfaces to be covered with membrane or elastic waterproofing, membrane or elastic roofing, or sand-bed terrazzo; and where indicated.
 - 1. After screeding, consolidating, and leveling concrete slabs, do not work surface until ready for floating. Begin floating, using float blades or float shoes only, when surface water has disappeared, or when concrete has stiffened sufficiently to permit operation of power-driven floats, or both. Consolidate surface with power-driven floats or by hand-floating if area is small or inaccessible to power units. Finish surfaces to tolerances of F(F) 18 (floor flatness) and F(L) 15 (floor levelness) measured according to ASTM E 1155. Cut down high spots and fill low spots. Uniformly slope surfaces to drains. Immediately after leveling, refloat surface to a uniform, smooth, granular texture.
- C. Trowel Finish: Apply a trowel finish to monolithic slab surfaces exposed to view and slab surfaces to be covered with resilient flooring, carpet, ceramic or quarry tile, paint, or another thin film-finish coating system.

1. After floating, begin first trowel-finish operation using a power-driven trowel. Begin final troweling when surface produces a ringing sound as trowel is moved over surface. Consolidate concrete surface by final hand-troweling operation, free of trowel marks, uniform in texture and appearance, and finish surfaces to tolerances of F(F) 20 (floor flatness) and F(L) 17 (floor levelness) measured according to ASTM E 1155. Grind smooth any surface defects that would telegraph through applied floor covering system.
- D. Trowel and Fine Broom Finish: Where ceramic or quarry tile is to be installed with thin-set mortar, apply a trowel finish as specified, then immediately follow by slightly scarifying the surface with a fine broom.
- E. Nonslip Broom Finish: Apply a nonslip broom finish to exterior concrete platforms, steps, and ramps, and elsewhere as indicated.
 1. Immediately after float finishing, slightly roughen concrete surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Engineer before application.
- F. Colored Wear-Resistant Finish: Apply a colored wear-resistant finish to monolithic slab surface indicated.
 1. Apply dry shake materials for the colored wear-resistant finish at a rate of 100 lb per 100 sq. ft., unless a greater amount is recommended by material manufacturer.
 2. Cast a trial slab approximately 10 feet square to determine actual application rate, color, and finish, as acceptable to design Engineer.
 3. Immediately following the first floating operation, uniformly distribute with mechanical spreader approximately two-thirds of the required weight of the dry shake material over the concrete surface, and embed by power floating. Follow floating operation with second shake application, uniformly distributing remainder of dry shake material with overlapping applications to ensure uniform color, and embed by power floating.
 4. After broadcasting and floating, apply a trowel finish as specified. Cure slab surface with a curing compound recommended by the dry shake material manufacturer. Apply the curing compound immediately after the final finishing.

3.11 MISCELLANEOUS CONCRETE ITEMS

- A. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

3.12 CONCRETE CURING AND PROTECTION

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. In hot, dry, and windy weather protect

concrete from rapid moisture loss before and during finishing operations with an evaporation-control material. Apply according to manufacturer's instructions after screeding and bull floating, but before power floating and troweling.

- B. Start initial curing as soon as free water has disappeared from concrete surface after placing and finishing. Weather permitting, keep continuously moist for not less than 7 days.
- C. Curing Methods: Cure concrete by curing compound, by moist curing, by moisture-retaining cover curing, or by combining these methods, as specified and approved by Engineer.
- D. Provide moisture curing by the following methods:
 - 1. Keep concrete surface continuously wet by covering with water.
 - 2. Use continuous water-fog spray.
 - 3. Cover concrete surface with specified absorptive cover, thoroughly saturate cover with water, and keep continuously wet. Place absorptive cover to provide coverage of concrete surfaces and edges, with a 4-inch lap over adjacent absorptive covers.
- E. Provide moisture-retaining cover curing as follows:
 - 1. Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width with sides and ends lapped at least 3 inches and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
- F. Apply curing compound on exposed interior slabs and on exterior slabs, walks, and curbs as follows:
 - 1. Apply curing compound to concrete slabs as soon as final finishing operations are complete (within 2 hours and after surface water sheen has disappeared). Apply uniformly in continuous operation by power spray or roller according to manufacturer's directions. Recoat areas subjected to heavy rainfall within 3 hours after initial application. Maintain continuity of coating and repair damage during curing period.
 - 2. Use membrane curing compounds that will not affect surfaces to be covered with finish materials applied directly to concrete.
- G. Curing Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces, by moist curing with forms in place for the full curing period or until forms are removed. If forms are removed, continue curing by methods specified above, as applicable.
- H. Curing Unformed Surfaces: Cure unformed surfaces, including slabs, floor topping, and other flat surfaces, by applying the appropriate curing method.

1. Final cure concrete surfaces to receive finish flooring with a moisture-retaining cover, unless otherwise directed.

3.13 SHORES AND SUPPORTS

- A. General: Comply with ACI 347 for shoring and reshoring in multistory construction, and as specified.
- B. Extend shoring from ground to roof for structures four stories or less, unless otherwise permitted.
- C. Remove shores and reshore in a planned sequence to avoid damage to partially cured concrete. Locate and provide adequate reshoring to support work without excessive stress or deflection.
- D. Keep reshores in place a minimum of 15 days after placing upper tier, or longer, if required, until concrete has attained its required 28-day strength and heavy loads due to construction operations have been removed.

3.14 REMOVING FORMS

- A. General: Formwork not supporting weight of concrete, such as sides of beams, walls, columns, and similar parts of the work, may be removed after cumulatively curing at not less than 50 deg F (10 deg C) for 24 hours after placing concrete, provided concrete is sufficiently hard to not be damaged by form-removal operations, and provided curing and protection operations are maintained.
- B. Formwork supporting weight of concrete, such as beam soffits, joists, slabs, and other structural elements, may not be removed in less than 14 days or until concrete has attained at least 75 percent of design minimum compressive strength at 28 days. Determine potential compressive strength of in-place concrete by testing field-cured specimens representative of concrete location or members.
- C. Form-facing material may be removed 4 days after placement only if shores and other vertical supports have been arranged to permit removal of form-facing material without loosening or disturbing shores and supports.

3.15 REUSING FORMS

- A. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-coating compound as specified for new formwork.
- B. When forms are extended for successive concrete placement, thoroughly clean surfaces, remove fins and laitance, and tighten forms to close joints. Align and secure joint to avoid offsets. Do not use patched forms for exposed concrete surfaces except as acceptable to design Engineer.

3.16 CONCRETE SURFACE REPAIRS

- A. Patching Defective Areas: Repair and patch defective areas with cement mortar immediately after removing forms, when acceptable to design Engineer.
- B. Mix dry-pack mortar, consisting of one part portland cement to 2-1/2 parts fine aggregate passing a No. 16 mesh sieve, using only enough water as required for handling and placing.
 - 1. Cut out honeycombs, rock pockets, voids over 1/4 inch in any dimension, and holes left by tie rods and bolts down to solid concrete but in no case to a depth less than 1 inch. Make edges of cuts perpendicular to the concrete surface. Thoroughly clean, dampen with water, and brush-coat the area to be patched with bonding agent. Place patching mortar before bonding agent has dried.
 - 2. For surfaces exposed to view, blend white portland cement and standard portland cement so that, when dry, patching mortar will match surrounding color. Provide test areas at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike-off slightly higher than surrounding surface.
- C. Repairing Formed Surfaces: Remove and replace concrete having defective surfaces if defects cannot be repaired to satisfaction of design Engineer. Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycomb, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning. Flush out form tie holes and fill with dry-pack mortar or precast cement cone plugs secured in place with bonding agent.
 - 1. Repair concealed formed surfaces, where possible, containing defects that affect the concrete's durability. If defects cannot be repaired, remove and replace the concrete.
- D. Repairing Unformed Surfaces: Test unformed surfaces, such as monolithic slabs, for smoothness and verify surface tolerances specified for each surface and finish. Correct low and high areas as specified. Test unformed surfaces sloped to drain for trueness of slope and smoothness by using a template having the required slope.
 - 1. Repair finished unformed surfaces containing defects that affect the concrete's durability. Surface defects include crazing and cracks in excess of 0.01 inch wide or that penetrate to the reinforcement or completely through nonreinforced sections regardless of width, spalling, popouts, honeycombs, rock pockets, and other objectionable conditions.
 - 2. Correct high areas in unformed surfaces by grinding after concrete has cured at least 14 days.

3. Correct low areas in unformed surfaces during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete. Proprietary underlayment compounds may be used when acceptable to design Engineer.
 4. Repair defective areas, except random cracks and single holes not exceeding 1 inch in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose reinforcing steel with at least 3/4-inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials to provide concrete of same type or class as original concrete. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
- E. Perform structural repairs with prior approval of design Engineer for method and procedure, using specified epoxy adhesive and mortar.
- F. Repair methods not specified above may be used, subject to acceptance of Engineer.

3.17 QUALITY CONTROL TESTING DURING CONSTRUCTION

- A. General: The Contractor will employ a testing agency to perform tests and to submit test reports.
- B. Sampling and testing for quality control during concrete placement may include the following, as directed by Engineer.
- 1.d Sampling Fresh Concrete: ASTM C 172, except modified for slump to comply with ASTM C 94.
- e. Slump: ASTM C 143; one test at point of discharge for each day's pour of each type of concrete; additional tests when concrete consistency seems to have changed.
 - f. Air Content: ASTM C 173, volumetric method for lightweight or normal weight concrete; ASTM C 231, pressure method for normal weight concrete; one for each day's pour of each type of air-entrained concrete.
 - g. Concrete Temperature: ASTM C 1064; one test hourly when air temperature is 40 deg F (4 deg C) and below, when 80 deg F (27 deg C) and above, and one test for each set of compressive-strength specimens.
 - h. Compression Test Specimen: ASTM C 31; one set of four standard cylinders for each compressive-strength test, unless otherwise directed. Mold and store cylinders for laboratory-cured test specimens except when field-cured test specimens are required.
 - i. Compressive-Strength Tests: ASTM C 39; one set for each day's pour exceeding 5 cu. yd. plus additional sets for each 50 cu. yd. more than the first 25 cu. yd. of each concrete class placed in any

one day; one specimen tested at 7 days, two specimens tested at 28 days, and one specimen retained in reserve for later testing if required.

2. When frequency of testing will provide fewer than five strength tests for a given class of concrete, conduct testing from at least five randomly selected batches or from each batch if fewer than five are used.
 3. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, evaluate current operations and provide corrective procedures for protecting and curing the in-place concrete.
 4. Strength level of concrete will be considered satisfactory if averages of sets of three consecutive strength test results equal or exceed specified compressive strength and no individual strength test result falls below specified compressive strength by more than 500 psi.
- C. Test results will be reported in writing to Piedmont Water Company, Design Structural Engineer, ready-mix producer, and Developer's Contractor within 24 hours after tests. Reports of compressive strength tests shall contain the Project identification name and number, date of concrete placement, name of concrete testing service, concrete type and class, location of concrete batch in structure, design compressive strength at 28 days, concrete mix proportions and materials, compressive breaking strength, and type of break for both 7-day tests and 28-day tests.
- D. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted but shall not be used as the sole basis for acceptance or rejection.
- E. Additional Tests: The testing agency will make additional tests of in-place concrete when test results indicate specified concrete strengths and other characteristics have not been attained in the structure, as directed by Engineer. Testing agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42, or by other methods as directed.
- F. Watertight Tanks shall be tested for 24 hours. Water shall be allowed to stand in concrete structure for 24 hours prior to the beginning of the 24 hour test period to allow for absorption of water by the surface of the concrete in contact with the water. Accurate and precise measurements of the water level shall be made at the beginning and at the end of the 24 hour test period. The structure shall be filled with water to its maximum depth. The drop in the water surface shall not exceed ¼-inch. During the test period, close observation of the structure will be made for purpose of detecting leakage. If the leakage exceed the specified allowable limits, the point or points of leakage shall be sought out and remedied by the Contractor at no additional cost to the Owner. Repair methods must be approved by the design Engineer.

- 3.18 SEALER
Apply a clear sealer to all concrete slabs that do not receive a floor finish.

END OF SECTION

PRECAST CONCRETE

SECTION 03411

PART 1 - GENERAL

1.01 DESCRIPTION:

- A. The work required under this section consists of all materials, accessories, equipment, tools, and labor required to construct precast concrete standard and drop manholes and underground utility structures, where shown on the drawings.
- B. Manholes and precast underground utility structures shall be constructed of specified materials to the sizes, shapes and dimensions, and at the locations shown on the design plans or as otherwise directed by the design Engineer. The height or depth of the structures will vary with the location, and shall be as directed by the design Engineer. Generally, the height shall be such that the top of the manhole frame will be at the finished grade of the pavement or ground surface for manholes located in pavement, in road or street right-of-ways or in maintained grounds. In these locations the manholes are shown to be near the grade in profile on the drawings. Generally, for manholes located along streams or in open fields, the height above ground shall be no less than three feet. In these locations the manholes are shown to be at this height in profile on the drawings. The invert will be at the designed elevations.

1.02 SUBMITTALS:

- A. The Developer shall submit detailed drawings conforming to the requirements of Section 01300 of these Specifications and shall receive approval of same before any material may be delivered or erected at the jobsite.

PART 2 - PRODUCTS

2.01 MATERIALS:

- A. Concrete, cement, sand and water used in manhole construction shall conform to the applicable requirements of Division 3 of these Specifications. All concrete shall be Class B unless otherwise indicated. Steel reinforcement shall conform to the applicable requirements of Section 03300.
- B. Manhole rims, toe pockets and covers shall be cast iron conforming to the minimum requirements of the latest ASTM Standard Specifications, Serial

Designations A 48, for Class 30 Gray Iron Castings. All castings shall be made accurately to the required dimensions, fully interchangeable, sound, smooth, clean and free from blisters and/or other defects. Defective castings which have been plugged or otherwise treated shall not be used. All castings shall be thoroughly cleaned and painted or coated with a bituminous paint. Each casting shall have its actual weight in pounds stenciled or painted on it in white paint.

- C. Manhole frames shall have a minimum diameter of 20 inches at the top opening and a minimum diameter of 22-3/4 inches at the opening at the base of the frame. The cover shall be a solid lid with a minimum diameter of 22 inches. The height of the frame shall not be less than 6 inches. The frame and cover shall be heavy duty and shall not weigh less than 320 pounds.
- D. Watertight, bolted manhole covers shall be Griffin Foundry Co., Type R, Locking, weighing 315 pounds; Neenah Foundry Co., R-1916-C; or approved equal.
- E. The contact surfaces of all manhole frame and covers shall be machined to provide full perimeter contact.
- F. All sanitary sewer manhole covers shall have the words "Sanitary Sewer" cast on the top in letters two (2) inches high.

PART 3 - EXECUTION

3.01 CONSTRUCTION OF PRECAST CONCRETE MANHOLES:

- A. Precast concrete manholes shall consist of precast reinforced concrete sections, a conical, eccentric, or flat slab top section, and a base section conforming with the typical manhole details as shown on the design drawings.
- B. Precast manhole sections shall be manufactured, tested, and marked in accordance with the latest provisions of ASTM Standard Specifications, Serial Designation C 478.
- C. Joints of the manhole sections shall be of the tongue-and-groove type. Sections shall be joined using O-ring rubber gaskets, flexible plastic gaskets conforming to the applicable provisions of ASTM Standard Specification, Serial Designation C 443, latest revision, or an approved bituminous mastic joint material. In addition, the inside joint shall be sealed with cement mortar using one part portland cement to two parts clean sand, meeting ASTM Standard Specifications, Serial Designation C 144, latest revision.

- D. Each section of the precast manhole shall have not more than two holes for the purpose of handling and laying. These holes shall be tapered and shall be plugged with rubber stoppers or mortar after installation.
- E. Manhole steps conforming to the applicable provisions of ASTM Specification C 478, latest edition, such as aluminum 14967 as manufactured by Alcoa or plastic step manufactured by M.A. Industries, Inc., or equal, shall be factory built into the precast sections.
- F. All standard manholes shall be constructed on concrete bases of the size and minimum thickness, as indicated on the drawings. Bases may be precast or cast-in-place. If cast-in-place, concrete shall be Class A conforming to the requirements of Division 3. If precast, base shall be placed on a six inch crushed stone mat.

Holes in precast bases to receive sewer pipe shall be precast at the factory at the required locations and heights. Knocking out of holes in the field will not be permitted.

- G. Manhole base and inverts shall be constructed of Class B concrete in accordance with details on contract drawings and inverts shall have the same cross-section as the invert of the sewers which they connect. The manhole base and 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.
- H. Brickwork required to complete the precast concrete manhole shall be constructed using 1 part portland cement to 2 parts clean sand, meeting ASTM Specifications, Serial Designation C 144, thoroughly mixed to a workable plastic mixture. Brickwork shall be constructed in a neat and workmanlike manner.
- I. The cast iron frame for the manhole cover shall be set at the required elevation and properly anchored to the masonry. 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.
- J. Masonry work shall be allowed to set for a period of not less than 24 hours. Outside forms, if any, then shall be removed and the manhole backfilled and compacted in the manner provided in Section 02220 of these Specifications. All loose or waste material shall be removed from the interior of the manhole. The manhole cover then shall be placed and the surface in the vicinity of the work cleaned off and left in a neat and orderly condition.

- K. After backfilling has been completed, the excavated area, if located in a street, alley or sidewalk, shall be provided with a temporary surface as provided for under these Specifications.

3.02 DROP MANHOLES:

- A. Where indicated on the plans, a drop manhole shall be constructed as detailed on the design drawings. They shall be similar in construction to the standard manhole except that a drop connection of D.I. pipe and D.I. fittings of the proper size and materials shall be constructed outside the manhole and supported by Class B concrete.

3.03 UNDERGROUND PRECAST CONCRETE UTILITY STRUCTURES:

- A. Precast utility structures shall be manufactured, tested and marked in accordance with the latest provisions of ASTM Standard Specifications, Serial Designation C478 and sub-paragraph 7.2 of ASTM-C478. Further, rectangular precast concrete products shall comply specifically with the requirements set in ASTM- C858 "Standard Specifications for Underground Precast Concrete Utility Structures", and ASTM-C857 "Standard Practice for Minimum Structural Design Loading for Underground Precast Concrete Utility Structures".
- B. Precast utility structures shall be designed conforming to Standard Specifications A.A.S.H.O. H-20 and/or H-20-S-16 for loads imposed upon the structure.

3.04 FIELD INSPECTION:

- A. After completion all manholes will be inspected. The Developer's contractor shall make, at his own expense, all necessary changes, modifications, and/or adjustments required to assure satisfactory operation.

End of Section

MORTAR

SECTION 04103

PART 1 - GENERAL

1.01 QUALITY ASSURANCE:

- A. Applicable Standards: Conform to the following Standards:
 - ASTM C91: Masonry Cement.
 - ASTM C144: Aggregate for Masonry Mortar.
 - ASTM C150: Portland Cement.
 - ASTM C207: Hydrated Lime for Masonry Purposes.
 - ASTM C270: Mortar for Unit Masonry.
- B. Tests: Prior to commencing masonry work, prepare current (within the last 6 months) laboratory tests for mortar using materials proposed for use on this Project. Test mortar in accordance with ASTM C270. Prepare separate tests for each type of mortar specified.

1.02 SUBMITTALS:

- A. Test Reports: Submit to Piedmont Water Company two copies of laboratory test reports certifying that each type of mortar meets ASTM C270 requirements.

1.03 PRODUCT DELIVERY AND STORAGE:

- A. Delivery: Deliver materials to Project site dry and in unbroken containers.
- B. Storage: Store materials above ground in waterproof shelters.

PART 2-PRODUCTS

2.01 MATERIALS:

- A. Portland Cement: ASTM C150, Type I or II.
- B. Masonry Cement: ASTM C91.
- C. Lime: ASTM C207, Type S.

- D. Sand: ASTM C144, except comply with gradations outlined below. Manufactured sand is not acceptable.

<u>Sieve Size</u>	<u>Percent Passing</u>
No. 4	100
No. 8	95 to 100
No. 16	60 to 100
No. 30	35 to 70
No. 50	15 to 35
No. 100	2 to 15
No. 200	0 to 2

- E. Water: Potable.

- F. Admixtures:

1. The use of antifreeze compounds, calcium chloride or accelerating compounds is prohibited.
2. All exterior mortar joints shall contain the recommended amount of "Dry-Block" mortar admixture for water repelling and to assure proper bond strength. The required amount shall be as recommended by the manufacturer, Forrer Industries, Inc., Milwaukee, Wisconsin.

PART 3 - EXECUTION

3.01 MORTAR:

- A. General: Bond and impermeability to moisture are the most important considerations in mortar used. Mortar and mortar materials shall conform to the Proportion Specifications of ASTM C270. Prepackaged mortar mixes not permitted. Mix all mortars so that mortar color will match color of approved sample panels if required.
- B. Proportions: Parts by volume. Measurement by shovel not permitted. Measure sand in a damp loose condition. Contractor has the option of using either cement-lime mortar or masonry cement mortar as specified hereinafter.

1. Cement-Lime Mortars:

<u>Mortar Type</u>	<u>Portland Cement</u>	<u>Hydrated Lime</u>	<u>Sand</u>
S	One Part	1/4 to 1/2 part	Not less than 2-1/4 no more than three times sum of volume of cement and lime used.

2. Masonry Cement Mortars:

<u>Mortar Type</u>	<u>Portland Cement</u>	<u>Masonry Cement</u>	<u>Sand</u>
S	1/2 part	One part	4-1/2 Part

- C. Mortar Types: Use Type S for exterior exposed and interior masonry walls.
- D. Mixing Mortar: Mix materials in mechanical batch mixer for a minimum of five minutes. Add mortar color in accordance with manufacturer's printed instructions. Provide uniformity of mix. Thoroughly clean mixer between batches. Mix mortar with sufficient water consistent with workability to provide maximum bond strength. If mortar begins to stiffen from evaporation, retemper mortar immediately by adding water and remixing. Use or discard all mortar within 1-1/2 hours of initial mixing.

3.02 MASONRY GROUT:

- A. Proportions: Parts by volume. Measurement by shovel not permitted.

<u>Portland Cement</u>	<u>Sand</u>	<u>Coarse Aggregate</u>
One part	2-1/2 Parts	1-1/2 Parts (Maximum size 3/8")

- B. Mixing Grout: Mix materials in a mechanical batch mixer for a minimum of five minutes. Add sufficient water to provide a fluid mix.

End of Section

SEALANTS AND CAULKING

SECTION 07921

PART 1 - GENERAL

1.01 SUBMITTALS:

- A. System Selection: Submit name of systems selected for use to Piedmont Water Company (see Part 2 of this Section).
- B. Color Samples: Submit manufacturer's standard palette of sealant and caulking colors in accordance with Section 01300.

1.02 PRODUCT DELIVERY AND STORAGE:

- A. Delivery: Deliver materials to the Project Site in unbroken containers.
- B. Storage: Store materials in accordance with manufacturer's directions.

PART 2 - PRODUCTS

2.01 MATERIALS:

- A. Colors: Colors of sealant and caulking materials selected by Engineer.
- B. Sealant System: Provide one of the following:

<u>Manufacturer</u>	<u>Product</u>
Pecora Corporation	Dynatrol I
Sika Corporation	Sikaflex Ia
Sonneborne Building Products	Sonolastic NP I
Tremco	Dymonic

- C. Caulking Systems:

- 1. Non-Sag: Provide one of the following:

<u>Manufacturer</u>	<u>Product</u>
Pecora Corporation	BC-158
Sonneborne Building Products	Butakauk
Tremco	Tremco Butyl Sealant

- 2. Self Leveling: Federal Specification TT-S-00227, Type I, Class A. Color selected by Engineer.

- D. Primer: Type recommended by sealant and caulking manufacturers.
- E. Back-Up Material: Type recommended by sealant and caulking manufacturers.
- F. Masking Tape: Type recommended by system manufacturers.
- G. Solvents and Cleaning Agents: Types recommended by system manufacturers.

PART 3 - EXECUTION

3.01 AREAS OF APPLICATION:

- A. General: Caulk or seal all joints for a complete and approved installation. Typical locations include, but not limited to, the following:
 - 1. Control and expansion joints in walls.
 - 2. Perimeters of framed openings in walls.
 - 3. Flashings.

3.02 SYSTEM SELECTION:

- A. Sealant System: Use for all exterior work.
- B. Caulking Systems: Use for all interior Work.
 - 1. Non-Sag: Use for joints on vertical surfaces.
 - 2. Self Leveling: Use for joints where concrete floor slab abuts vertical walls.

3.03 PREPARATORY WORK:

- A. Inspection: Examine joint surfaces and report to the Engineer all unacceptable conditions. Commencement of Work constitutes acceptance of joint surface conditions.
- B. Cleaning: Thoroughly clean all joints scheduled to receive sealant and caulking materials. Rake joints to full width and depth. Remove loose particles present or resulting from cleaning operations by blowing out joints with oil free compressed air. Remove all traces of bituminous materials.
 - 1. Porous Surfaces: Clean porous surfaces, such as concrete and masonry by grinding, blast-cleaning, mechanical abrading, acid washing or combination of these methods to provide a clean, sound base surface for sealant and caulking adhesion. Remove form oils by

blast-cleaning. Ensure that concrete is fully cured and free from laitance, loose aggregate and surface treatments. If surface treatments are present, test for adhesion before proceeding with sealing work.

2. Non-porous Surfaces: Clean non-porous surfaces, such as metal and glass, in accordance with system manufacturer's recommendations. Do not use solvents that leaves a residue. Apply and remove solvents with clean, white cloths. Do not allow solvents to air dry without wiping.
- C. Protection: Prior to priming, apply tape to adjacent surfaces. Leave tape in place until tooling operation is complete.

3.04 APPLICATION:

- A. Back-up: Install back-up material to proper depth in joints. Use back-up material of suitable size and shape, so that when compressed (approximately 25%), it will fit in joints as required. When using back-up of hose or rod stock, roll the material into the joint to avoid lengthwise stretching. Do not twist or braid hose or rod stock. Remove all damaged back-up material. Use bond-breaker strip in all joints where sufficient room for back-up material does not exist.
- B. Primer: Prime surfaces in accordance with manufacturer's recommendations, and allow to dry before applying sealing material.
- C. Sealant and Caulking: Follow manufacturer's instructions regarding mixing, pot life and application procedure. Do not apply sealing materials when the temperature of the material, air or substrate is below 45 degrees F. or during wet or humid weather. Apply sealing materials in full bead and force into joint.
- D. Tooling: Tool joints to compress the compound into the joint; however, do not tool self leveling caulking. Except as recommended by the sealing material manufacturer, do not use liquid solutions to moisten tools. Remove masking tape immediately after tooling.

3.05 COMPLETED WORK:

- A. Cleaning: Remove excess sealing materials from adjacent surfaces. Clean surfaces using procedures recommended by the sealing material manufacturer.

End of Section

PAINTING

SECTION 09801

PART 1 - GENERAL

1.01 SCOPE

- A. The Developer's contractor shall furnish all materials, labor, equipment, and incidentals required to provide protective coating systems for the surfaces listed herein and not otherwise excluded.
- B. The work to be performed includes painting by color code all sewage and reuse piping, valving, and fittings as well as all potable water piping, valving and fittings. The work also includes the painting and finishing of interior and exterior exposed items and surfaces such as structural steel, miscellaneous metals, ceilings, walls, floors, doors, frames, transoms, roof fans, guardrails, posts, fittings, valves, equipment, as specified herein or as shown on the drawings. The omission of minor items in the schedule of work shall not relieve the Contractor of his obligation to include such items where they come within the general intent of the specification as stated herein.
- C. The following items shall not be painted:
 - 1. Any code requiring labels, such as Underwriter's Laboratories and Factory Mutual, or any equipment identification performance rating, name, or nomenclature.
 - 2. Any moving parts of operating units, mechanical and electrical parts, such as valve or damper operations, linkages, sinkages, sensing devices, motor and fan shafts, unless otherwise specified.
 - 3. Aluminum handrails, walkways, windows, louvers, and grating, unless otherwise specified herein.
 - 4. Signs and nameplates.
 - 5. Finish hardware.
 - 6. Stainless steel angles, tubes, pipe, etc..
 - 7. Products with polished chrome, aluminum, nickel, or stainless steel finish.
 - 8. Plastic switch plates and receptacle plates.

9. Flexible couplings, lubricated bearings surfaces, insulation, and metal or plastic pipe interior.
10. Galvanized components, except as noted.

1.02 RELATED WORK NOT INCLUDED:

N/A

1.03 REFERENCES:

- A. Steel Structures Painting Council (SSPC).
- B. Metal Ladder Manufacturer's Association - Specification for Ladders and Scaffolding.
- C. UL Requirements for Ladders and Scaffolds.

1.04 SHOP PRIMING:

- A. Furnish all labor, materials, equipment, and incidentals required for the surface preparation and application of shop primers on ferrous metals, excluding stainless steels, as specified herein.
- B. Submit to the design Engineer for approval, as required in the General Conditions, manufacturer's specifications and product data on proposed primers, and detailed surface preparation and application procedures, and recommended dry film thicknesses.
- C. Materials:
 1. Submerged Surfaces: Ferrous metals which will be submerged or subject to splash/spillage shall be sprayed with one (1) coat of TNEMEC Series 66-1211, Epoxoline Primer, at 3.0-5.0 dry mils.
 2. Nonsubmerged Surfaces: Ferrous Metals other than those covered by paragraph C.1, shall be sprayed with one (1) coat of TNEMEC Tneme-Zinc 90-97, Zinc Rich Primer, at 2.5 – 3.5 mils.
 3. Compatibility of Coating Systems: Shop-priming shall be done with primers that are guaranteed by the manufacturer to be compatible with their corresponding primers and finish coats specified herein for use in the field. The finish coats applied in the field shall be from the same manufacturer as those applied in the shop.

D. Surface Preparation and Priming:

1. Submerged surfaces scheduled for priming, as defined above, shall be abrasive blasted in accordance with SSPC-SP10 "Near-White Metal Blast" prior to painting. Prior to blasting, all oils, grease, dust, and foreign matter shall be removed. Weld slag, weld splatter, rough edges, and sharp corners of weld seams shall be ground smooth. All surfaces shall be primed within eight (8) hours of blast cleaning.
2. Nonsubmerged surfaces scheduled for priming, as defined above, shall be abrasive blasted in accordance with SSPC-SP6 "Commercial Blast" prior to painting. Prior to blasting, all oils, grease, dust, and foreign matter shall be removed. Weld slag, weld splatter, rough edges, and sharp corners of weld seams shall be ground smooth. All surfaces shall be primed within eight (8) hours of blast cleaning.
3. All surfaces shall be dry and free of dust, oils, grease, dirt, rust, loose mill scale, and other foreign contaminants prior to painting.
4. Shop-prime in accordance with approved paint manufacturer recommendations.

E. Sampling of Materials*

1. When requested by the Engineer, obtain test samples from material stored at project site or source of supply.
2. Furnish from materials designated by the Engineer:
 - a. One (1) quart - selected at random from sealed, unopened containers.

F. Field Quality Controls

1. Request review by the Engineer, of the first finished room, space, or item of each color scheme required. Correct any areas not meeting the requirements of workmanship specified herein.
2. Use first acceptable room, space, or item as project standard.
3. For spray application, areas greater than 100 sq.ft. shall be required for project standard.

1.05 QUALITY ASSURANCES:

- A. Workmanship shall be performed by skilled workmen thoroughly trained in necessary crafts and completely familiar with specific requirements and methods specified herein.
- B. All materials shall be produced by a single manufacturer.
- C. The following shall be included on labels of all containers:
 - 1. Manufacturer's Name.
 - 2. Type of Paint.
 - 3. Manufacturer's Stock Number.
 - 4. Color.
 - 5. Instructions for reducing and/or thinning, where applicable.
 - 6. Batch codes which indicate date of manufacture.

All paints must have a copy of the Material Safety Data Sheets (MSDS) accompany delivery of all materials.

1.06 SUBMITTALS:

- A. Submit manufacturer's printed literature and other data as required to certify compliance with requirements and systems specified herein.
- B. Schedule of Painting Operations: The Contractor shall submit for approval a complete Schedule of Painting Operations within thirty (30) days after the Notice to Proceed. This schedule is imperative so that the various fabricators may be notified of the proper prime coat to apply. It shall be the Contractor's responsibility to properly notify and coordinate the fabricators' surface preparation and painting operations with these specifications. This schedule shall include for each surface to be painted, the manufacturer's name, the brand name, the volume solids, the coverage, and the number of coats the Contractor proposed to use in order to achieve the specified dry film thicknesses, When the schedule has been approved, the Contractor shall apply all material in strict accordance with the approved Schedule and the Manufacturer's instructions.
- C. Colors are to be selected by design Engineer or Developer, and indicated on Schedule.
- D. Samples:
 - 1. Samples of each finish and color shall be submitted to the design Engineer for approval before any work is started.

2. Such samples when approved in writing shall constitute a standard, as to color and finish only, for acceptance or rejection of the finish work.
3. Rejected samples shall be resubmitted until approved.

1.07 DELIVERY, STORAGE, AND HANDLING:

- A. Deliver all materials to site in original, new, unopened containers, labeled and bearing manufacturer's name and stock number, product and brand name, contents by volume for major constituents, instructions for mixing and reducing, and application instructions.
- B. Provide adequate storage facilities designed exclusively for the purpose of paint storage and mixing. Facility area shall be located away from open flames, be well ventilated, and be capable of maintaining ambient storage temperature of no less than 45 degrees F..
- C. Paint, coatings, reducing agents, and other solvents must be stored in original containers until opened: if not resealable, they must be transferred to UL approved safety containers. Provide proper ventilation, personal protection, and fire protection for storage and use of same.
- D. Comply with requirements set forth by occupational Safety and Health Act (OSHA) for storage and use of painting materials and equipment.

1.08 JOB CONDITIONS:

- A. Environmental Requirements:
 1. Comply with manufacturer's recommendations as to environmental conditions under which coatings systems can be applied.
 2. Do not apply finish in areas where dust is being generated.
- B. Protection:

Cover or otherwise protect finished work of other trades or surfaces not being painted concurrently or not to be painted.

1.09 PRODUCTS:

- A. Acceptable Systems & Manufacturers:
 1. General: Paint products/systems specified are not intended to limit competition, but to establish a standard of quality desired.

Equivalent systems by other manufacturers will be considered by Piedmont Water Company(PWC).

2. All materials specified herein are manufactured by TNE MEC Company, Inc, or Induron Protective Coatings.
3. Equivalent materials of other manufacturers may be substituted on approval of PWC's Representative. Request for substitution shall include manufacturer's literature for each product, giving name, generic type, descriptive information, performance and test data, and evidence of satisfactory past performance. No request for substitution shall be considered that would decrease film thicknesses and/or number of coats or offer a change in the generic type of coatings specified.

1.10 COLOR CODING FOR PIPES AND EQUIPMENT:

- A. When color coding is specified, it shall consist of color code painting and identification of all exposed conduits, through items and pipelines for the transport of gases, liquids and semi-liquids including all accessories such as valves, insulated pipe coverings, fittings, junction boxes, but bars, connectors, and all operating accessories which are integral to the whole functional mechanical pipe and electrical conduit system. See Paint and Color Coding Section attached at the end of this section.
- B. All hangers and pipe support floor stands shall be painted. The system shall be painted up to but not including the flanges attached to the mechanical equipment, nor the flexible conduit connected to the electrical motors. Colors shall be as noted in the Paint and Color Coding Schedule.
- C. All systems which are an integral part of the equipment, that is originating from the equipment and returning to the same piece of equipment, shall be painted between and up to but not including, the fixed flanges or connections on the equipment.
- D. The Color Code establishes, defines, and assigns a definite color for each category of pipe. Pipelines which are not listed on the Schedule of Color Code Paints shall be assigned a color by the Engineer and shall be treated as an integral part of the Contract.
- E. All pipes, equipment, and accessories shall be painted according to Paint Color Coding Schedules attached at the end of this section.

1.11 FABRICATED EQUIPMENT:

- A. Unless otherwise indicated below, all fabricated equipment shall be shop

primed and shop or field finished.

- B. All shop prime coats shall be applied in accordance with requirements of this specification. The Contractor shall remove any prime coats not in accordance with these specifications by abrasive blasting and shall apply the specified prime coat..
- C. Shop-primed surfaces shall be thoroughly cleaned and field touched-up with the specified primer before application of successive coats of paint in the field.
- D. The Developer's contractor shall be responsible for and take whatever steps are necessary to properly protect the shop prime and finish coats against damage from weather or any other cause.
- E. All pumps and motors shall be repainted after installation with specified systems.

If, in the opinion of PWC, a shop applied system does not give the protection quality of other work of similar nature, the Developer's contractor shall apply the coats or coats of paint as directed by the Engineer to accomplish the desired protective quality. PWC may request proof of purchase of specified materials by the Contractor and/or Fabricator if so desired.

Wherever fabricated equipment is required to be abrasive blast cleaned, the Developer's contractor shall protect all motors, drives, bearings, gears, and related equipment from dust contamination. Any equipment found to contain abrasives shall be thoroughly cleaned by Contractor.

- H. Epoxy systems in this specification are specifically formulated to be applied as both shop and field applied systems. All epoxies utilized must have the capability to be shop applied and field touched-up.

1.12 EXTRA PAINT:

- A. Furnish PWC with one (1) clearly marked unopened gallon can or kit, if coating is a catalyzed-type coating, of each type and each color utilized.

1.13 PREPARATION OF SURFACES:

- A. All surfaces to be painted shall be prepared as specified herein and shall be clean and dry before painting.
- B. All metal welds, weld splatter, rough edges, and sharp corners of weld seams shall be ground smooth. All rust, loose scale, oils, grease, and dirt shall be removed by use of approved solvents, power tools, and/or by

abrasive blast cleaning.

- C. All concrete shall be cured a minimum of thirty (30) days prior to any paint applications.
- D. Concrete surfaces shall have been finished as specified in the Section entitled "Cast-in-Place Concrete". Report unsatisfactory surfaces to the design Engineer. Concrete shall be free of dust, oils, tar, and other foreign matter. Structural cracks and defects shall be repaired properly. Submerged concrete surfaces to be painted shall be brush-blasted with abrasive to remove laitance and curing compounds (if utilized) prior to painting. Nonsubmerged concrete surfaces shall be clean and dry prior to painting.
- E. Concrete block surfaces shall be clean and free of oils, dust, laitance, dirt, loose mortar, and excessive moisture. Structural cracks and defects shall be repaired. All surfaces must be completely dry prior to applying any paint.
- F. Galvanized metals requiring paint shall be cleaned by removing all oils, grease, dirt, dust, and foreign matter by solvent cleaning in accordance with SSPC-SPI "Solvent Cleaning" prior to any painting.
- G. Nonferrous metals not to be painted shall be cleaned in accordance with SSPC SPI "Solvent Cleaning".
- H. Gypsum board (or drywall) surfaces shall be dry, flat, free of dust, dirt, grease, oils, powdery residue, wax, soap, and other contaminants prior to any paint applications.
- I. All plastic pipe surfaces shall be clean, dry and lightly sanded prior to any paint applications.
- J. Wood surfaces must be dry, clean, and free of contaminants. Sand rough areas. Seal knots and pitch pockets. Fill cracks and nail holes after primer is dry.
- K. ALL shop-primed and coated surfaces and nonferrous surfaces shall be cleaned prior to application of successive coats. Abraded or corroded areas on shop-coated surfaces shall be cleaned in accordance with SSPC-SP2 & 3 "Hand or Power Tool Cleaning" and than touched-up with the same materials as the shop coat. All shop coated surfaces which are faded, discolored, or which require more than minor touch-up, in the opinion of the Engineer, shall be completely repainted.
- L. Perform preparation and cleaning procedures in strict accordance with manufacturer's instructions for each substrate condition.

1.14 APPLICATION:

- A. No paint shall be applied when surrounding air temperature, as measured in the shade, is below 40 degrees F. No paint shall be applied when the temperature of the surface to be painted is below 40 degrees F.. Paint shall not be applied to wet or damp surfaces, and shall not be applied in rain snow, fog, or mist, or when the relative humidity exceeds 85%. Paint shall not be applied when the substrate temperature is within 5 degrees of the dewpoint. Paint manufacturer's temperatures guidelines printed on product data sheet must be followed.
- B. No paint shall be applied when it is expected that the relative humidity will exceed 85% or that the air temperature will drop below 40 degrees F. within four (4) hours after the application of the paint.
- C. Maintain proper ventilation in area of work to facilitate volatile solvents evaporating from coating materials.
- D. All ingredients in any container of the coating materials shall be thoroughly mixed and shall be agitated often enough during application to keep pigments suspended.
- E. Should thinning be required, use only the type and amounts specified by the coating manufacturer's printed instructions.
- F. Application of coating shall be by brush, roller, or spray and in accordance with manufacturer's recommendations; All material shall be evenly applied to form a smooth, continuous, unbroken coating. Drips, runs, sags, or pinholes shall not be acceptable.
- G. Provide proper application equipment, including ladders, scaffolding, masking materials, and tools to perform work. Ladders and scaffolding shall meet or exceed requirements of UL and the Metal Ladder Manufacturer's Association.

1.15 SYSTEM INSPECTION AND TESTING:

- A. After application of each coating in the specified system and subsequent cure, measure the dry film thickness with a Nordson Magnetic Dry Film Thickness Gauge, or equivalent. Follow standard method for measurement of dry paint thicknesses with magnetic gauges as outlined in Steel Structures Painting Councils (SSPC) SSPC-PA2-73T.
- B. Make as many determinations as needed to insure the specified thickness values in each typical area. To all surfaces having lower dry film thicknesses than specified, apply additional coat(s) at no extra cost to PWC to bring

thicknesses up to specifications.

- C. Masonry, drywall, or other non-metallic surfaces shall be continuously checked with wet-film thickness gauges during application to insure proper dry film thicknesses will be obtained. In addition, square foot coverages need to be monitored to verify proper coverage rates.
- D. Painting Contractor shall permit PWC Representative and/or coating manufacturer representative (as requested by PWC) to inspect his work for conformance to this specification. PWC reserves the right to reject all work that does not comply with this specification.

1.16 CLEAN-UP:

- A. Upon completion, painting Contractor shall clean up and remove from site all surplus materials, tools, appliances, empty cans, cartons, and rubbish resulting from painting work. Site shall be left in a neat, orderly condition.
- B. Remove all protective drop cloths and masking from surfaces not being painted. Provide touch-up around same areas as directed by Owner's Representative.
- C. Remove all misplaced paint splatters or drippings resulting from this work.

1.17 COATING SYSTEM SCHEDULE:

- A. Submerged Metal: All submerged metal surfaces, piping, and mechanical equipment which shall be in contact with sewage, sludge, or other liquids. TNEMEC is indicated but an Induron Protective Coating System is an acceptable alternative.

Surface Preparation: SSPC-SP10 "Near-White Blast Cleaning"

Shop Primer/Field Touch Up/Field Prime Coat:

Series 66 1211 Hi-Build Epoxoline 3.0-5.0 mils.

Intermediate Coat:

Series 69 Hi-Build Epoxoline II 6.0-8.0 mils

Field Finish:

Series 69 Hi-Build Epoxoline II 6.0-8.0 mils

Note: Minimum dry film thickness range would be 15-19 mils

- B. Non-Submerged Metal: For non-submerged metal surfaces subject to moisture, condensation, and splash/spillage of chemicals. Interior

G. Dense Concrete - Non- Submerged, Exterior, Above Grades:

Surface Preparation: Surface must be clean and dry.

1st Coat: Series 52 Theme-Crete 90 sq.ft/gal.

H. Concrete Block - Non-Submerged, Exterior. Above Grade:

Surface Preparation: Surface must be clean and dry.

Filler: Provide two (2) coats of
Series 52 Theme-Crete 90 sq.ft/gal

I. Dense Concrete - Non-Submerged. Interior, Above Grades:

Surface Preparation: Surface must be clean and dry.

1st Coat: Series 66 HB Epoxoline 4.0-6.0 mils
2nd Coat: Series 66 HB Epoxoline 4.0-6.0 mils

J. Concrete - Exterior. Below Grades

To be recommended by paint manufacturer for specific substrate that concrete will be exposed to.

K. Concrete - Submerged Surfaces:

To be recommended by paint manufacturer for specific liquid that concrete will be submerged.

L. Concrete Floors*

Surface Preparation: Acid Etch or Brush-off Blast Cleaning.

*1st Coat: Series 66 H.B. Expoxline 225 sq.ft/gal
2nd Coat: Series 66 H.B. Expoxline 225 sq.ft/gal

*Broadcast silica into wet film and backroll to encapsulate. Size and agularity of silica will determine the degree of anti-slip. (Normally 3 to 4 lbs. of 50 mesh per 100 square feet is adequate.

M. Wood Surfaces - Interior and Exterior*

Surface Preparation: Surface should be clean and dry.

Primer: 36-603 Undercoater 2.0-3.5 mils
2nd Coat: Series 2H Theme-Gloss 2.0-3.5 mils

Finish: Series 2H Tneme-Gloss 2.0-3.5 mils

Note: Series 2H Tneme-Gloss is a high gloss enamel system. If a semi-gloss finish is desired, series 23 Enduratone should be utilized.

N. Mill Coated Pipe - Non-Submerged, Interior/Exterior Exposure:

Surface Preparation: Surface must be clean and dry.

1st Coat:	Series 66-1211 HB Epoxoline Primer	3.0-5.0 mils
2nd Coat:	Series 66-Color HB Epoxoline	4.0-6.0 mils (Optional)
3rd Coat:	Series 73 Endura-Shield II	2.0-4.0 mils

Note: The Series 73 Endura-Shield III should be utilized if mill coated pipe has exterior exposure.

O. Plastic Pipe - Non-Submerged, Interior/Exterior Exposure:

Surface Preparation: Surface must be clean, dry, and lightly sanded prior to paint application.

1st Coat:	Series 66-Color HB Epoxoline	4.0-6.0 mils
Finish:	Series 73 Endura-Shield III	2.0-4.0 mils

P. Gypsum Wallboard (Drywall)*

Surface Preparation: Surface must be clean and dry.

1st Coat:	51-792 PVA Sealer	approx. 300 sq.ft/gal
2nd Coat:	Series 113 H.B. Tneme-Tufcoat	150-220 sq.ft/gal
3rd Coat:	Series 113 H.B. Tneme-Tufcoat	150-220 sq.ft/gal

Q. Insulated Pipe*

Surface Preparation: Surface must be clean and dry.

1st Coat:	Series 6-Color Tneme-Cryl	250 330 sq.ft/gal
2nd Coat:	Series 6-Color	

R. Doors and Frames - (Where Miscellaneous Shop) Primer Exists:

Surface Preparation: SSPC-SP3 "Power Tool Cleaning"

1st Coat:	Standard Manufacturer Primer	
2nd Coat:	Series 135 Chembuild	4.0 mils
3rd Coat:	Series 73-Color Endura-Shield III	2.0-4.0 mils

1.17 COLOR SCHEDULE FOR MECHANICAL, HVAC, PLUMBING, AND ELECTRICAL PIPING AND EQUIPMENT:

A. General Notes and Guidelines:

1. All color numbers and names herein refer to TNEMEC's Master Color Book.
2. Pipe lines, equipment, or other items which are not listed here shall be assigned a color by the design Engineer and shall be treated as an integral part of the project.
3. When color coding is specified or directed by PWC, it shall consist of color code painting and identification of all exposed conduits, through lines and pipelines for the transport of gases, liquids, semi-liquids, including all accessories such as valves, insulated pipe coverings, fittings, junction boxes, bus bars, connectors and any operating accessories which are integral to a whole functional mechanical pipe and electrical conduit systems.
4. All moving parts, drive assemblies, and covers for moving parts which are potential hazards shall be TNEMEC's SC03 Safety Orange (meets ANSI 253.1-1971) color.
5. All safety equipment shall be painted in accordance with OSRA standard Safety Green - TNEMEC's SC07 Safety Green Color.
6. Description of titles (Abbreviated Code on Pipes/Equipment) to be lettered and pipes or equipment will be black or white to contrast with color of pipes and equipment and shall be stencil applied, as shown herein.
7. All in line equipment and appurtenances not assigned another color shall be painted the same base color as the piping. The pipe system shall be painted with the pipe color up to but not including the flanges attached to pumps and mechanical equipment assigned

another color.

8. All conduit shall be painted to match its background surface.
9. Building surface colors shall be painted as scheduled in the Coatings Systems Schedule or as selected by the design Engineer.
10. Doors and frames shall be painted as scheduled in the Coatings Systems Schedule or as selected by the design Engineer.
11. Each major piece of equipment is to be identified by number in accordance with the design Drawings or as directed by the design Engineer.

Painting and Color Coding Schedule

Description and Title	Pipe and Equipment Color	
	<u>Color Name</u>	<u>Tnemec Color #</u>
Reuse Piping, Fittings & Valves	Pantone Purple	522
Potable Water Lines, Fittings & Valves	Dark Blue	SC06
Sewer (Sanitary) Piping, Fittings & Valves	Green	EN07

End of Section

SEWERAGE SUBMERSIBLE PUMPING STATIONS**SECTION 11900****PART 1 - GENERAL****1.01 WORK INCLUDED:**

- A. The section describes submersible centrifugal sewage pump station packages including duplex and triplex pump stations with controls, SST lift out rail assembly, pump station hatches, junction boxes, and all other necessary equipment to make the pump stations complete and operational. Simplex pump stations are not allowed.
- B. Each pump station shall be provided with a SCADA RTU system to match Piedmont Water Company (PWC)'s existing SCADA system. The developer shall provide a minimum allowance of \$9,000 for each SCADA RTU installation. The developer may also be required to install an antenna tower for the RTU transmission. The tower will be determined on a case by case based on the location of the RTU. The cost of the transmission tower is not included in the above allowance. The developer's design engineer shall contact PWC for specifics regarding SCADA system requirements.
- C. Each pump station shall be provided with an onsite generator as specified in Section 16100 of these specifications.
- D. If a pump station will receive flow from a low pressure sewerage system, each pump station shall be equipped with a scrubber system to remove odorous gases from the wet well. The scrubber shall be a ZABOCS Biological Scrubber with a Carbon Polisher as manufactured by Siemens Water Technologies. The scrubber system shall be designed for a wetwell turnover of 20 air changes per hour. The Developer's design engineer shall contact PWC for additional specifics regarding scrubber system design.
- E. If a pump station will receive flow from a low pressure sewerage system, each pump station wetwell shall be constructed of prefabricated fiberglass wetwell as constructed by Containment Solutions or approved equal by Piedmont Water Company. The Developer's design engineer shall contact PWC for additional specifics regarding wetwell design.
- F. If a pump station will receive flow from a conventional gravity sewerage system, then pump station wetwell shall receive a two (2) part epoxy system for corrosion protection. All receiving manholes from force main discharges shall also receive two (2) part epoxy system for corrosion system.

- G. All pump station wetwells shall be a minimum of eight (8) feet in diameter. Pump stations with pumps greater than 50 horsepower shall be a minimum of 10 feet in diameter. Wetwells shall be provided with over-sized square concrete slabs that are a minimum of 4 feet wider than wetwell diameter. Oversized hatches with length equal to wetwell diameter and width equal to minimum of 6 ft shall also be provided.
- H. Precast concrete pump station valve vault shall be provided with check and plug/gate valve installation. Plug/gate valves shall be provided with hand wheel operation. Each valve pit shall also be provided with a surge control valve sized for the pumping rate. The surge valve discharge shall be piped to the pump station wetwell. The surge valve shall be as manufactured by Golden Anderson, Model 625-D. The valve pit shall also be provided with a floor drain with back-water valve and "P" trap encased in concrete and piped with minimum 4" D.I. pipe back to the wetwell. Each pump discharge pipe shall be tapped and provided with a pressure gauge and shutoff valve. Pressure gauge shall be Ashcroft Type 1000, liquid filled, 3 ½" diameter, 0-200 psi. Valve Vault shall be provided with a minimum clearance of 3 feet on either side of the discharge piping. Access steps shall be provided on one side of vault and aluminum access hatch shall be provided for full width of valve vault. Minimum valve vault shall be 6' x 8'.
- I. For design purposes, Developer shall assume a minimum of 350 gpd/residential unit with a minimum peaking factor of 2.5. Developer's engineer may utilize larger flow allocation and larger peaking factor as necessary for type of development. Commercial flows and required peaking factors will be submitted by the developer and approved by PWC on a case by case basis.

1.02 DESCRIPTION:

- A. The Developer's contractor shall, under this item, furnish all of the necessary labor, materials, mechanical and electrical equipment, and services for the proper installation of three sewage pumping stations. The developer's contractor shall be responsible for furnishing the labor and materials for installation of the pumps, including ductile iron discharge piping, valves and valve vault with hatch.
- B. The intent of this Section is to require installations complete in every detail whether or not completely shown or covered by the drawings or specifications. Consequently, the Developer's contractor will be responsible for minor details which the construction may require, or for any special construction or accessories which may be found necessary to properly install, adjust, test, and place in successful and continuous operation a complete installation.

1.03 REFERENCES:

- A. Not Applicable

1.04 SUBMITTALS:

- A. Submit six (6) sets of shop drawings to Piedmont Water Company that include the following:
 - 1. Catalog cut for each pump and all component items.
 - 2. Materials of construction for all items.
 - 3. Complete dimensional drawings for each pump, and all accessories.
 - 4. Dimensioned layout drawings.
 - 5. Foundation requirements, including anchor bolt hole sizes.
 - 6. Pump curves.
 - 7. Efficiency data.

- B. Submit six(6) operating and maintenance instructions that include following:
 - 1. Operation and start-up instructions.
 - 2. Installation assembly, and hookup instructions.
 - 3. Complete spare parts list.
 - 4. Dimensional drawings of all items.
 - 5. Catalog cut for all items.

1.05 QUALITY ASSURANCE:

- A. Factory test pumps, casings, diaphragms, and controls to insure performance at design specifications.

- B. Items specified in Part 2 constitute basis for system performance; provide items as specified, equal, or superior in performance as part of system.

1.06 WARRANTY:

- A. Warrant each pump, and all supplied components to be free from shipping damage and from defects in design, manufacture, and assembly for a minimum period of one year following acceptance by Piedmont Water Company. This warranty shall not alter any other one-year warranties specified elsewhere.

1.07 DELIVERY, STORAGE, AND HANDLING:

- A. Ship each pump, controls, and other supplied items so as to eliminate possibility for damage to machined surfaces, piping connections, openings, operating devices, and moving parts.

- B. Cap or seal inlet and outlet piping connection prior to shipment.
- C. Repair or replace items or components damaged during shipment.

PART 2 - PRODUCTS

2.01 EQUIPMENT:

- A. Pumps:
Pumps shall be submersible, centrifugal sewage pumps capable of handling raw unscreened sewage and passing a 3 inch solid. Pumps shall be 1750 rpm, 3 phase. The pumps shall be by Flygt Corporation and the following information shall be provided regarding the pump design:

Flygt Corporation

Description	Number	Flow(gpm)	Head(ft)	Model	HP/Volt/Phase
PS	Duplex/Triplex	(Specify)	(Specify)	(Specify)	(Specify)/480/3

- B. Provide and attach manufacturer's standard corrosion-resistant nameplate permanently inscribed with information including following:
 - 1. Equipment name.
 - 2. Equipment number (Pump Station Location)
 - 3. Manufacturer's name and address.
 - 4. Manufacturer's model and serial numbers.
 - 5. Design or operating conditions (capacity, discharge pressure).
- C. Discharge Connection: The pumps shall be equipped with a sliding bracket, which is an integral part of the pump. The pump volute casing shall have discharge flange firmly connected with the D.I. discharge connection , which when bolted to the wetwell floor and discharge line, will receive the pump discharge connecting flange without the need for adjustment or other appurtenances. Installation of the pump will be by a simple linear downward motion of the pump guided by guide bars described below.
- D. Guide Bars: Lower guide bars holders shall be integral with the pump discharge connection. Two (2) stainless steel guide bars shall be installed for each pump. Guide bars shall be three (3) inch stainless steel, schedule 40, of sufficient length to extend from the lower guide holders on the pump discharge to the upper guide holders. Length shall be determined from drawing details.
- E. Controls: Controls and electrical components shall be housed in completely weatherproof stainless steel metal cabinets (NEMA 4X stainless steel). The cabinets shall be provided with condensate heaters, spare fuses and spare

bulbs of each type that are used in the electrical/control system. The pump manufacturer shall provide pump control equipment with control logic to alternate pumps for even wear. The controller shall be an SC2000 controller with pressure transducer for liquid level sensing. Time delays shall be provided to prevent simultaneous start of more than one pump. The logic shall be provided with a switch for each pump to place a pump in and out of service without disruption of the control logic of the pump station. All 480 Volt circuit breakers in the control panel shall be rated a minimum of 14 KAIC and all 240 Volt and 120 Volt circuit breakers shall be rated a minimum of 10 KAIC.

The control panel manufacturer shall provided contacts for ease in connection for a SCADA system that will be installed outside the control panel. The contractor shall make all connections between the SCADA equipment and the pump controls as required by the SCADA manufacturer.

The control equipment shall include but not be limited to the following equipment:

1. Provide solid state reduced voltage starters for each pump. Starters shall be supplied by pump manufacturer and shall be Square D Altistart, Allen Bradley, Solid State Reduced Voltage.
2. HOA switches
3. Pilot lights
4. Power indicator lights
5. Other lights as required
6. Alarm silence push button
7. Alarm reset button
8. Elapsed time indicators
9. Control transformers – 480V to 120V step-downs shall not be mounted inside the control panel for heat control purposes.
10. Strip heater and thermostat
11. Alarm horn and wiring – 120 Volt
12. NEMA 4X red alarm light and wiring – 120 Volt
13. Phase under voltage monitor with time delay
14. Moisture sensing seal failure relays with indicator
15. Provide alarm outputs for high water alarms and pump trouble for each pump. Coordinate with SCADA unit manufacturer for types of outputs required. (Note: The pump trouble outputs shall not have time delays added).
16. Provide relays for phase failure and phase unbalance protection.
17. Provide lag pump on delay timer relay, 0-60 seconds for each pump, such that the pumps cannot start at the same time.
18. Provide pump failure alarm output for each motor to include motor overload, motor thermal cutout and leak seal failure (fls) conditions.
19. Only the high level and low level alarms shall be wired to the alarm

- horn and red light. Pump failures shall not be wired to the horn and light circuit.
20. Breakers for security lighting, generator block heater, and battery charger. Provide two spare 120V breakers.
 21. Provide terminal blocks for all connections into and out of the panel.
 22. Activation and termination of operation of the pumps shall be by a pressure transducer. Float switches shall be used for high-level alarm and low level only. Two spare float switches and one pressure transducer shall be supplied.
- E. Miscellaneous: Furnish for each pump station, a complete, duplex/triplex pump system including all pumps, junction boxes, controls and alarms, stainless steel mounting rails, valves, stainless steel lifting chains, valve extension stems, and access cover for complete and operable systems. Furnish all stainless steel components which are to be mounted in the wet wells. Furnish an aluminum access cover with a minimum rated load of 300 PSF. Access cover shall be either single leaf or double leaf standard aluminum, with stainless steel cable holder; stainless steel chain hooks and stainless steel upper brackets with stainless steel anchor bolts. Access cover shall have a safety handle to maintain door in open position. Furnish one SST lift out assembly rated at a minimum of four times the lifting weight of the heaviest pump. Furnish one mounting base plate for the pump station which will allow the use of the lift out assembly. Provide an extra impeller and total rebuild kit for each pump.

PART 3 - EXECUTION

3.01 INSTALLATION:

- A. After excavation for the wetwell structure and related appurtenances, backfilling operations shall not proceed until all necessary soils testing, inspections and/or observations have been performed as required by the applicable specifications. All debris, rocks, broken concrete, formwork, etc., shall be removed from the excavated area and backfill material prior to the start of backfilling operations.

All excavated areas of the pump station site and related excavation shall be compacted to 96% maximum dry density or greater as determined by ASTM D698, Standard Proctor. The top twenty four(24) inches of backfill shall be compacted to 100% maximum dry density as determined by ASTM D698, Standard Proctor for all areas that will support structures including by not limited to all concrete slabs, generator, electrical equipment, odor control equipment, wetwell top slab, etc. Backfill material shall be placed in maximum eight(8) inch layers (loose measure) and compacted with each layer tested for compaction requirements.

Where rock is encountered at proper grade for pump station base slab invert, excavation shall extend a minimum of six (6) inches below proper grade and such excavation shall be refilled and compacted (100% max dry density) to proper grade with coarse sand, fine gravel, or other suitable approved material.

If encountered, all muck or other unsuitable material shall be removed and properly disposed of at the contractor's expense. The bed of the excavated area shall be brought back to the required grade as shown on the drawings using a suitable backfill material placed in eight inch lifts and compacted to 100 percent of the maximum dry density as determined by ASTM D 698.

Moisture content of all backfill material shall be within plus or minus 2.0% of optimum. The Contractor is responsible for providing water to the site as required for moisture content and dust control.

The Developer/Contractor shall employ soil's technicians working under the direct supervision of a registered professional Geotechnical Engineer for the purpose of identifying soils, checking densities, and classifying soils materials during construction. Charges for this service will be paid for by the Developer. The Geotechnical Engineer and soils technicians that will be utilized by the Developer shall be submitted to PWC for approval prior to any geotechnical work being performed. Density Tests shall be made as required by PWC's standard technical specifications for backfill compaction testing and as recommended by the Geotechnical Engineer to provide verification that the soils work being performed by the contractor is being compacted to specification requirements. Developer's Contractor shall deliver test results to Piedmont Water Company as soon as possible upon completion of the required tests. Any soils not meet minimum compaction requirements shall be excavated and re-compacted until soils meet minimum standards. Soil compaction testing and results from re-compaction efforts shall also be provided to PWC.

See Technical Section 02220 and Section 02550 for other applicable requirements.

- B. Equipment shall be installed by the Developer's contractor in accordance with manufacturer's installation instructions. Upon installation, all pumps shall be checked by the pump manufacturer's representative for proper rotation, pumping capacity, amperage draw, lack of vibration, and other checks as may be deemed necessary to assure proper operation. All submersible pumps shall be pulled out of and reinstalled in the wet well in the presence of a representative of the OWNER to assure proper clearances for easy removal of the pumps for maintenance. (Provide a minimum of 2 days for start-up for all lift stations).

- C. After installation and testing, the pump manufacturer shall provide a written statement to Piedmont Water Company that all equipment and controls have been properly installed and tested in accordance with the drawings, specifications, and manufacturer's recommendations. The manufacturer shall also provide documentation that all O & M manuals have been provided to Piedmont Water Company.

End of Section

EONE PUMP STATION(Model 2010)

SECTION 11925

PART 1 - GENERAL

1.01 WORK INCLUDED:

- A. The section specifies residential sewage pump stations including complete factory-built and tested Grinder Pump Station(s), each consisting of grinder pump suitably mounted in a basin constructed of high density polyethylene (HDPE), NEMA 6P electrical quick disconnect (EQD), pump removal system, shut-off valve, anti-siphon valve, check valve, each assembled in the basin, electrical alarm panel, and all necessary internal wiring and controls. For ease of serviceability, all pump, motor/grinder units shall be of like type and horsepower throughout the system.

1.02 DESCRIPTION:

- A. The Developer's contractor shall, under this item, furnish all of the necessary labor, materials, mechanical and electrical equipment, and services for the proper installation of each individual pumping station. The contractor shall be responsible for furnishing the labor and materials for installation of the pumps, including force main piping, valves and connections to the mains.
- B. The intent of this Section is to require installations complete in every detail whether or not completely shown or covered by the design drawings or specifications. Consequently, the Developer's contractor will be responsible for minor details which the construction may require, or for any special construction or accessories which may be found necessary to properly install, adjust, test, and place in successful and continuous operation a complete installation.

1.03 REFERENCES:

- A. Not Applicable

1.04 SUBMITTALS:

- A. Submit six(6) sets of shop drawings that include the following:
 - 1. Catalog cut for each pump and all component items.
 - 2. Materials of construction for all items.
 - 3. Complete dimensional drawings for each pump, and all accessories.
 - 4. Dimensioned layout drawings.

5. Foundation requirements, including anchor bolt hole sizes.
 6. Pump curves.
 7. Efficiency data.
- B. Submit operating instructions that include following:
1. Operation and start-up instructions.
 2. Installation assembly, and hookup instructions.
 3. Complete spare parts list.
 4. Dimensional drawings of all items.
 5. Catalog cut for all items.

1.05 QUALITY ASSURANCE:

- A. Factory test pumps, casings, diaphragms, and controls to insure performance at design specifications.
- B. Items specified in Part 2 constitute basis for system performance; provide items as specified, equal, or superior in performance as part of system.

1.06 WARRANTY:

- A. Warrant each pump, and all supplied components to be free from shipping damage and from defects in design, manufacture, and assembly for minimum period of one year following acceptance by Piedmont Water Company. This warranty shall not alter any other one-year warranties specified elsewhere in Contract Documents.

1.07 DELIVERY, STORAGE, AND HANDLING:

- A. Ship each pump, controls, and other supplied items so as to eliminate possibility for damage to machined surfaces, piping connections, openings, operating devices, and moving parts.
- B. Cap or seal inlet and outlet piping connection prior to shipment.
- C. Repair or replace items or components damaged during shipment.

PART 2 - PRODUCTS

2.01 EQUIPMENT:

- A. Pumps:
The pumps shall be a custom designed, integral, vertical rotor, motor driven, solids handling pump of the progressing cavity type with a single mechanical seal. The rotor shall be through-hardened, highly polished, precipitation hardened stainless steel. Plating on the rotor will not be

acceptable due to its tendency to delaminate. The stator shall be of a specifically compounded ethylene propylene synthetic elastomer. The material shall be suitable for domestic wastewater service. Its physical properties shall include high tear and abrasion resistance, grease resistance, water and detergent resistance, temperature stability, excellent aging properties, and outstanding wear resistance. Buna-N is not acceptable as a stator material because it does not exhibit the properties as outlined above and required for wastewater service.

The pumps shall be capable of delivering 15 GPM against a rated total dynamic head of 0 feet (0 PSIG) and 9 GPM against a rated total dynamic head of 138 feet (60 PSIG). The pump(s) must also be capable of operating at negative total dynamic head without overloading the motor(s). Under no conditions shall in-line piping or valving be allowed to create a false apparent head. The pump stations shall be Model 2010 as manufactured by Environment One Corporation.

B. Grinder:

The grinder shall be placed immediately below the pumping elements and shall be direct-driven by a single, one-piece motor shaft. The grinder impeller assembly shall be securely fastened to the pump motor shaft by means of a threaded connection attaching the grinder impeller to the motor shaft. Attachment by means of pins or keys will not be acceptable. The grinder will be of the rotating type with a stationary hardened and ground stainless steel shredding ring spaced in close annular alignment with the driven impeller assembly, which shall carry two hardened type 400 series stainless steel cutter bars.

This assembly shall be dynamically balanced and operate without objectionable noise or vibration over the entire range of recommended operating pressures. The grinder shall be constructed so as to eliminate clogging and jamming under all normal operating conditions including starting. Sufficient vortex action shall be created to scour the tank free of deposits or sludge banks which would impair the operation of the pump. These requirements shall be accomplished by the following, in conjunction with the pump:

1. The grinder shall be positioned in such a way that solids are fed in an upward flow direction.
2. The maximum flow rate through the cutting mechanism must not exceed 4 feet per second. This is a critical design element to prevent jamming and as such must be adhered to.
3. The inlet shroud shall have a diameter of no less than 5 inches. Inlet shrouds that are less than 5 inches in diameter will not be accepted

due to their inability to maintain the specified 4 feet per second maximum inlet velocity which by design prevents unnecessary jamming of the cutter mechanism and eliminates blinding of the pump by large objects blocking the inlet shroud.

4. The impeller mechanism must rotate at a nominal speed of no greater than 1800 rpm.

The grinder shall be capable of reducing all components in normal domestic sewage, including a reasonable amount of “foreign objects,” such as paper, wood, plastic, glass, rubber and the like, to finely-divided particles which will pass freely through the passages of the pump and the 1-1/4” diameter discharge piping.

C. Electric Motor:

As a maximum, the motor shall be a 1 HP, 1725 RPM, 240 Volt 60 Hertz, 1 Phase, capacitor start, ball bearing, air-cooled induction type with a low starting current not to exceed 30 amperes and high starting torque of 8.4 foot pounds. Inherent protection against running overloads or locked rotor conditions for the pump motor shall be provided by the use of an automatic-reset, integral thermal overload protector incorporated into the motor. This motor protector combination shall have been specifically investigated and listed by Underwriters Laboratories, Inc., for the application. Non-capacitor start motors or permanent split capacitor motors will not be accepted because of their reduced starting torque and consequent diminished grinding capability. To reduce the potential of environmental concerns, the expense of handling and disposing of oil, and the associated maintenance costs, oil-filled motors will not be accepted.

D. Mechanical Seal:

The pump/core shall be provided with a mechanical shaft seal to prevent leakage between the motor and pump. The seal shall have a stationary ceramic seat and carbon rotating surface with faces precision lapped and held in position by a stainless steel spring.

E. Tank and Integral Access Way (Model 2010) High Density Polyethylene Construction:

The tank shall be made of high density polyethylene, with a melt index of 2.0 grams/10 minutes or lower to assure high environmental stress cracking resistance. Corrugated sections are to be made of a double wall construction with the internal wall being generally smooth to promote scouring. Corrugations of the outside wall are to be of a minimum amplitude of 1 1/2” to provide necessary transverse stiffness. Any incidental sections of a single wall construction are to be a minimum .250 inch thick. All seams created during tank construction are to be thermally welded and factory tested for

leak tightness. Tank wall and bottom must withstand the pressure exerted by saturated soil loading at maximum burial depth. All station components must function normally when exposed to 150 percent of the maximum external soil and hydrostatic pressure.

The tank shall be furnished with one EPDM grommet fitting to accept a 4.50" OD DWV or Schedule 40 pipe. Tank capacity shall be 47 gallons as shown on Sheet C24 of the contract drawings.

The access way shall be an integral extension of the wet well assembly and include a lockable cover assembly providing low profile mounting and watertight capability. Access way design and construction shall enable field adjustment of station height in increments of 4" or less without the use of any adhesives or sealants requiring cure time before installation can be completed.

The station shall have all necessary penetrations molded in and factory sealed. To ensure a leak free installation no field penetrations shall be acceptable.

All discharge piping shall be constructed of 304 Series Stainless Steel and terminate outside the accessway bulkhead with a stainless steel, 1 1/4 inch female NPT fitting. The discharge piping shall include a stainless steel ball valve rated for 200 psi WOG; PVC ball valves will not be accepted. The bulkhead penetration shall be factory installed and warranted by the manufacturer to be watertight.

The accessway shall include a single NEMA 6P electrical quick disconnect (EQD) for all power and control functions, factory installed with accessway penetrations warranted by the manufacturer to be watertight. Plug-type connections of the power cable onto the pump housing will not be acceptable due to the potential for leaks and electrical shorts. The accessway shall also include a 2-inch PVC vent to prevent sewage gases from accumulating in the tank.

F. Check Valve:

The pump discharge shall be equipped with a factory installed, gravity operated, flapper-type integral check valve built into the stainless steel discharge piping. The check valve will provide a full-ported passageway when open, and shall introduce a friction loss of less than 6 inches of water at maximum rated flow. Moving parts will be made of a 300 series stainless steel and fabric reinforced synthetic elastomer to ensure corrosion resistance, dimensional stability, and fatigue strength. A nonmetallic hinge shall be an integral part of the flapper assembly providing a maximum degree of freedom to assure seating even at a very low back-pressure. The valve body shall be an injection molded part made of glass filled PVC. Ball

type check valves are unacceptable due to their limited sealing capacity in slurry applications.

Each grinder pump installation shall also include one separate check valve of the type detailed in Section 2.08 for installation in the 1 1/4" service lateral between the grinder pump station and the sewer main, preferably next to the curb stop. The separate check valve shall be provided as a separate line item in the bid schedule.

G. Anti-Siphon Valve:

The pump discharge shall be equipped with a factory-installed, gravity-operated, flapper-type integral anti-siphon valve built into the stainless steel discharge piping. Moving parts will be made of 300 series stainless steel and fabric-reinforced synthetic elastomer to ensure corrosion resistance, dimensional stability, and fatigue strength. A nonmetallic hinge shall be an integral part of the flapper assembly, providing a maximum degree of freedom to ensure proper operation even at a very low pressure. The valve body shall be injection-molded from a glass-filled thermoplastic resin. Holes or ports in the discharge piping are not acceptable anti-siphon devices, due to their tendency to clog from the solids in the slurry being pumped.

H. Core Unit:

The Grinder Pump Station shall have cartridge type, easily removable core assembly consisting of pump, motor, grinder, all motor controls, check valve, anti-siphon valve, level control, electrical quick disconnect and wiring. The watertight integrity of each core unit, shall be established by 100 percent factory test at a minimum of 5 PSIG.

I. Controls:

All necessary controls, including motor and level controls, shall be located in the top housing of the core unit. The top housing will be attached with stainless steel fasteners.

Non-fouling wastewater level controls for controlling pump operation shall be accomplished by monitoring the pressure changes in an integral air column connected to a pressure switch. The level detection device shall have no moving parts in direct contact with the wastewater. High-level sensing will be accomplished in the manner detailed above by a separate air-bell sensor and pressure switch of the same type. Closure of the high-level sensing device will energize an alarm circuit as well as a redundant pump-on circuit. For increased reliability, pump ON/OFF and High-level alarm functions shall not be controlled by the same switch. Float switches of any kind, including float trees, will not be accepted due to the periodic need to maintain (rinsing, cleaning) such devices.

To assure reliable operation of the pressure switches, each core shall be equipped with a breather assembly, complete with a suitable means to prevent accidental entry of water into the motor compartment. The grinder pump will be furnished with a 6 conductor 14 gauge, type SJOW cable, pre-wired and watertight to meet UL requirements with a FACTORY INSTALLED NEMA 6P EQD half attached to it.

J. Alarm Panel:

Each grinder pump station shall include a NEMA 4X, UL listed ALARM PANEL suitable for wall mounting. The NEMA 4X enclosure shall be manufactured of thermoplastic to assure corrosion resistance. The enclosure shall include a hinged, lockable cover, padlock, and secured dead front. The enclosure shall not exceed 11.38"W x 13.5"H x 5.63"D.

For each core, the panel shall contain one (1) 15 amp, double pole circuit breaker for the power circuit and one (1) 15 amp single pole circuit breaker for the alarm circuit. The panel shall contain terminal blocks, integral power bus, push to run feature and a complete alarm circuit.

The Alarm Panel shall include the following features: audio & visual alarm, push-to-run switch, and high level (redundant) pump starting control. The alarm sequence is to be as follows:

1. When liquid level in the sewage wet-well rises above the alarm level, visual and audio alarms will be activated. The contacts on the alarm pressure switch will close. The redundant pump starting system will be energized.
2. The audio alarm may be silenced by means of the externally mounted, push-to-silence button.
3. Visual alarm remains illuminated until the sewage level in the wet-well drops below the "off" setting of the alarm pressure switch.

The visual alarm lamp shall be inside a red fluted lens at least 2 5/8" in diameter and 1 11/16" in height. Visual alarm shall be mounted to the top of the enclosure in such a manner as to maintain NEMA 4X rating. For duplex units, in addition to the above, two high level indicator lights shall be mounted behind the access cover.

During a high level alarm condition on a duplex station, the appropriate light will illuminate to indicate which pump core requires servicing. The audio alarm shall be a printed circuit board in conjunction with an 86 dB buzzer with quick mounting terminal strip mounted in the interior of the enclosure. The audio alarm shall be capable of being deactivated by depressing a push-type switch which is encapsulated in a weatherproof silicone boot and mounted on the bottom of the enclosure.

The entire Alarm Panel as manufactured shall be listed by Underwriters Laboratories, Inc.

K. Serviceability:

The grinder pump core unit shall have two lifting hooks complete with nylon lift-out harness connected to its top housing to facilitate easy core removal when necessary. All mechanical and electrical connections must provide easy disconnect capability for core unit removal and installation. A push-to-run feature will be provided for field trouble shooting. All motor control components shall be mounted on a readily replaceable bracket for ease of field service.

L. OSHA Confined Space:

All maintenance tasks for the grinder pump station must be possible without entry into the grinder pump station (as per OSHA 1910.146 Permit-required confined spaces). "Entry means the action by which a person passes through an opening into a permit-required confined space. Entry includes ensuing work activities in that space and is considered to have occurred as soon as any part of the entrant's body breaks the plane of an opening into the space."

M. Safety:

The Grinder Pump shall be free from electrical and fire hazards as required in a residential environment. As evidence of compliance with this requirement, the completely assembled and wired Grinder Pump Station shall be listed by Underwriters Laboratories, Inc., to be safe and appropriate for the intended use. UL listing of components of the station, or third-party testing to UL standard will not be acceptable.

The grinder pump shall meet accepted standards for plumbing equipment for use in or near residences, shall be free from noise, odor, or health hazards, and shall have been tested by an independent laboratory to certify its capability to perform as specified in either individual or low pressure sewer system applications. As evidence of compliance with this requirement, the grinder pump shall bear the seal of NSF International. Third-party testing to NSF standard will not be acceptable.

PART 3 - EXECUTION

3.01 INSTALLATION:

A. Factory Test:

Each grinder pump shall be submerged and operated for 5 minutes (minimum). Included in this procedure will be the testing of all ancillary

components such as, the anti-siphon valve, check valve, discharge assembly and each unit's dedicated level controls and motor controls. All factory tests shall incorporate each of the above listed items. Actual appurtenances and controls which will be installed in the field, shall be particular to the tested pump only. A common set of appurtenances and controls for all pumps will not be acceptable. Certified test results shall be available upon request showing the operation of each grinder pump at two (2) different points on its curve, with the maximum pressure no less than 60 psi. Piedmont Water Company(PWC) reserves the right to inspect such testing procedures with representatives of the Developer, at the GRINDER PUMP MANUFACTURER'S facility.

All completed stations shall be factory leak tested to assure the integrity of all joints, seams and penetrations. All necessary penetrations such as inlets, discharge fittings and cable connectors shall be included in this test along with their respective sealing means (grommets, gaskets etc.).

B. Delivery:

All Grinder Pump units will be delivered to the job site 100 percent completely assembled, including testing, ready for installation. Grinder pump units will be individually mounted on wooden pallets.

C. Installation:

The Developer's Contractor shall be responsible for handling ground water to provide a firm, dry sub-grade for the structure, and shall guard against flotation or other damage resulting from general water or flooding.

The Grinder Pump Stations shall not be set into the excavation until the installation procedures and excavation have been approved by the design ENGINEER.

Remove packing material. Users instructions MUST be given to PWC. Hardware supplied with the unit, if required, will be used at installation. The basin will be supplied with a standard 4" inlet grommet (4.50" OD) for connecting the incoming sewer line. Appropriate inlet piping must be used. The basin may not be dropped, rolled or laid on its side for any reason.

Installation shall be accomplished so that 1" to 4" of access way, below the bottom of the lid, extends above the finished grade line. The finished grade shall slope away from the unit. The diameter of the excavated hole must be large enough to allow for the concrete anchor.

A 6" inch (minimum) layer of naturally rounded aggregate, clean and free flowing, with particle size of not less than 1/8" or more than 3/4" shall be used as bedding material under each unit.

A concrete anti-flotation collar, as shown on the drawings, is required and shall be pre-cast to the grinder pump or poured in place. Each Grinder Pump Station with its pre-cast anti-flotation collar shall have a minimum of three (3) lifting eyes for loading and unloading purposes.

If the concrete is poured in place, the unit shall be leveled, and filled with water, to the bottom of the inlet, to help prevent the unit from shifting while the concrete is being poured. The concrete must be manually vibrated to ensure there are no voids. If it is necessary to pour the concrete to a level higher than the inlet piping, an 8" sleeve is required over the inlet prior to the concrete being poured.

The Developer's CONTRACTOR will provide and install a four (4) foot piece of four inch SCH 40 PVC pipe with water tight cap, to stub-out the inlet for the property owners' installation contractor.

The electrical enclosure shall be furnished, installed and wired to the Grinder Pump Station by the Developer's CONTRACTOR. An alarm device is required on every installation; there shall be NO EXCEPTIONS. It will be the responsibility of the Developer's CONTRACTOR to coordinate with the individual property owner(s) to determine the optimum location for the Alarm Panel.

The Developer's CONTRACTOR shall mount the alarm device in a conspicuous location, as per national and local codes. The Alarm Panel will be connected to the Grinder Pump Station by a length of six (6) conductor 12 gauge type TC cable. The power and alarm circuits must be on separate power circuits. The grinder pump stations will be provided with a minimum of 32' of useable electrical supply cable outside the station, to connect to the alarm panel. This cable shall be supplied with a FACTORY INSTALLED EQD half to connect to the mating EQD half on the core.

D. Backfill requirements:

Proper backfill is essential to the long-term reliability of any underground structure. Several methods of backfill are available to produce favorable results with different native soil conditions. The most highly recommended method of backfilling is to surround the unit to grade using Class I or Class II backfill material as defined in ASTM 2321. Class 1A and Class 1B are recommended where frost heave is a concern, Class 1B is a better choice when the native soil is sand or if a high, fluctuating water table is expected. Class 1, angular crushed stone offers an added benefit in that it doesn't need to be compacted.

Class II, naturally rounded stone, may require more compactive effort, or tamping, to achieve the proper density. If the native soil condition consists of clean compactible soil, with less than 12 percent fines, free of ice, rocks, roots and organic material, it may be an acceptable backfill. Soil must be

compacted in lifts not to exceed one foot to reach a final Proctor Density of between 85 percent and 90 percent. Heavy, non-compactible clays and silts are not suitable backfill for this or any underground structure such as inlet or discharge lines.

If the Developer's Contractor is unsure of the consistency of the native soil, it is recommended that a geotechnical evaluation of the material is obtained before specifying backfill.

Backfill of clean native earth, free of rocks, roots, and foreign objects shall be thoroughly compacted in lifts not exceeding 12" to a final Proctor Density of not less than 85 percent. Improper backfilling may result in damaged access ways. The Grinder Pump Station shall be installed at a minimum depth from grade to the top of the 1 1/4" discharge line, to assure maximum frost protection. The finish grade line shall be 1" to 4" below the bottom of the lid, and final grade shall slope away from the Grinder Pump Station.

E. Start-Up and Field Testing:

1. Pump Stations

The MANUFACTURER shall provide the services of qualified factory trained technician(s) who shall inspect the placement and wiring of each station, perform field tests as specified herein, and instruct the OWNER'S personnel in the operation and maintenance of the equipment before the stations are accepted by PWC.

All equipment and materials necessary to perform testing shall be the responsibility of the INSTALLING CONTRACTOR. This will include, as a minimum, a portable generator (if temporary power is required) and water in each basin.

Upon completion of the installation, an authorized factory technician(s) will perform the following test on each station:

- a. Make certain the discharge shut-off valve is fully open. This valve must not be closed when the pump is operating. In some installations, there may be a valve(s) at the street main that must also be open.
- b. Turn ON the alarm power circuit.
- c. Fill the wet well with water to a depth sufficient to verify the high level alarm is operating. Shut off water.
- d. Turn ON pump power circuit. Initiate pump operation to verify automatic "on/off" controls are operative. Pump should

immediately turn ON. Within one (1) minute alarm light will turn OFF. Within three (3) minutes the pump will turn OFF.

Upon completion of the start-up and testing, the MANUFACTURER shall submit to the design ENGINEER the start-up authorization form describing the results of the tests performed for each Grinder Pump Station. Final acceptance of the system will not occur until authorization forms have been received for each pump station installed and any installation deficiencies corrected.

2. Service Laterals

The contractor shall install pump station service laterals from the pump station to the common force main in the street right-of-ways as shown on the drawings.

Prior to initiation of the pump station startup described above, the contractor shall test each service lateral. Pressure and leakage tests shall be performed in accordance with the latest edition of AWWA Standard C600 and/or C605. The laterals shall be pressurized to 150 psi for a minimum of 2 hours.

All pumps, gauges and measuring devices shall be furnished, installed and operated by the Developer's Contractor and all such equipment and devices and their installation shall be approved by the engineer. All pressure and leakage testing shall be done in the presence of a representative of PWC as a condition precedent to the approval and acceptance of the system.

Where leakage exceeds the allowable limit, as described in Section 02732, the defective pipe or joints shall be located and repaired. If the defective portions cannot be located, the Contractor shall remove and reconstruct as much of the work as is necessary in order to conform to the specified limits. No additional payment will be made for the correction of defective work, or to damage to other parts of the work resulting from such corrective work.

End of Section

Odor Control System

SECTION 11950

PART 1 - GENERAL

1.01 WORK INCLUDED:

- A. The work specified herein shall include designing, furnishing and installing all equipment and materials necessary to provide the Owner with a completely operational Biological Odor Control System and Carbon Polishing System. The system shall be a completely packaged two-stage(minimum), biological absorption/adsorption system of UNITARY CONSTRUCTION. The Contractor shall be responsible for providing a complete Odor Control System, that shall include, but not be limited to FRP vessel, nozzles, two independent stages of inorganic treatment media, moisture controls, nutrient supply system, air supply fan, ducting, dampers, and all necessary accessories. A carbon polisher system shall be provided for each biofilter system. Equipment shall use English units of measurement.

1.02 DESCRIPTION:

- A. Multi-Stage Package System: The Supplier shall furnish and install a complete "once-through two-stage", pre-piped, wired, and packaged UNITARY CONSTRUCTION odor control system, including two integral treatment stages, exhaust fan, valves, fittings, ductwork, and all other equipment and accessories as specified to provide a complete and functioning system. The biological treatment stage shall utilize a granular inorganic media to facilitate absorption and adsorption of odor compounds. The polishing stage shall utilize a granular media that shall be specifically designed to adsorb odorous compounds with the ability to support biological degradation of the compounds. The first stage shall operate with an independently controlled irrigation system to maintain optimum wetted conditions to support unique microbial growth for biological destruction of the odorous compounds and removal of toxic metabolites. Systems using any type of organic media and systems using a single inorganic media shall not be acceptable. A carbon polisher system shall be provided for each biofilter system.
- B. Design Basis The mechanical, structural, process and electrical design has been based on a ZABOCS® odor control system manufactured by Siemens Water Technologies, Poway, California.
- C. Specified Manufacturer: Siemens Water Technologies, Poway, California or pre-approved equal.

- D. The intent of this Section is to require installation complete in every detail whether or not completely shown or covered by the drawings or specifications. Consequently, the Contractor will be responsible for minor details that construction may require, or for any special construction or accessories which may be found necessary to properly install, adjust, test, and place in successful and continuous operation a complete installation.

1.03 REFERENCES:

- A. PS 15-69: National Bureau of standards Voluntary Product Standard "Custom contact molded Reinforced Polyester Chemical Resistant Process Equipment".
- B. ASTM D-883: "Definition of Terms Relating to Plastics"
- C. ASTM D-2583: "Test for Indentation Hardness of Rigid Plastics by Means of Barcol Impressor."
- D. ASTM D-2563: "Recommended Practice for Classifying Visual Defects in Glass Reinforced Plastic Laminate Parts."
- E. ASTM D-4097-82: "Standard Specifications for Contact Molded Glass Fiber Reinforced Thermoset Resin Chemical Resistant Tanks."

1.04 SUBMITTALS:

- A. The Contractor shall submit six (6) sets of complete Shop Drawings for the System, together with all piping, ductwork, valves, and control for review by the ENGINEER including the following:
- B. Shop Drawings: The Contractor shall submit the following information for approval before equipment is fabricated:
1. Drawings of system showing assemblies, arrangements, piping, electrical, mounting details, equipment outline dimensions, fitting size and location, motor data, operating weights of all equipment and sufficient information to allow the ENGINEER to check clearances, connections, and conformance with the specifications.
 2. Materials of construction of all equipment.
 3. Manufacturer's catalog data, operating literature. Specifications, performance data, and calibration curves for exhaust fan and auxiliary components.
 4. Complete instrumentation, control, logic and power wiring diagrams in sufficient detail to allow installation of the instrumentation, controls, and electrical components.
 5. Manuals: Furnish manufacturer's installation, operation and

maintenance manuals, bulletins, and spare parts lists

- B. Submit six (6) copies of operating instructions that include following:
1. Operation and start-up instructions.
 2. Installation assembly, and hookup instructions.
 3. Complete spare parts list.
 4. Dimensional drawings of all items.
 5. Catalog cut for all items.

1.05 QUALITY ASSURANCE:

- A. **Manufacturer:** The products furnished under this section shall be by a manufacturer who has been regularly engaged in the design and manufacture of the equipment and who has a minimum of 5 years experience in design, fabrication and testing of odor control systems. Demonstrate to the satisfaction of the ENGINEER that the quality is equal to equipment made by those manufacturers specifically named herein. Any manufacturer whose main business is FRP manufacturing shall not be accepted as a supplier of the complete system.
- B. **Inspection and Testing Requirements:** The ENGINEER reserves the right to reject delivery of any or all pieces of equipment found, upon inspection, to have any or all of the following: blisters, chips, crazing, exposed glass, cracks burned areas, dry spots, foreign matter, surface porosity, sharp discontinuity or entrapped air at the surface of the laminate. Any item that does not satisfy the tolerances as below shall be rejected:

Defect	Inside Surface	Outside Surface
Blister	None	Max. dimensions: 1/4" diameter by 1/8" high; Max density: 1 per sq. ft.; Min. separation: 2" apart
Chips	None	Max. dimension of break: 1/4" and thickness no greater than 10% of wall thickness; Max. density: 1 per sq. ft.
Crazing	None	Max. length: 1/2"; Max. density: 5 per sq. ft.; Min. separation: 2"
Cracks	None	None
Exposed Glass	None	None
Scratches	None	Max. length: 1"; Max. depth: 0.010"

Burned Areas	None	None
Surface Porosity	None	None
Foreign Matter	None	None
Sharp Discontinuity	None	None
Pits	Max. 1/8 inches, dia. by 1/32 inches deep; Max: 10 per ft ²	Max. 1/8" dia. by 1/16" deep; Max: 10 per sq. ft.
Dry Spot	None	2 sq. in. per sq. ft.
Entrapped Air	None at the surface 1/16 inches and 10 per square in. max	1/8" and 4 per sq. in. or 1/16" and 10 per sq. in. within laminate

- C. The Engineer reserves the right to be present at the fabricators facility for visual inspection of equipment to be supplied.
- D. Upon completion of the installation, each piece of equipment and each system shall be tested for satisfactory operation without excessive noise, vibration, overheating, etc. Compliance shall be based on the equipment manufacturer's specifications and all applicable costs and standards. All equipment must be adjusted and checked for misalignment, clearances, supports, and adherence to safety standards.
- E. The Contractor shall be responsible for the successful startup and testing of the odor control facility. The Contractor shall provide all necessary facilities, manpower, tools, instrumentation, and laboratory testing services required during this phase of the work.

1.06 WARRANTY:

- A. The Contractor and Manufacturer shall warrant all supplied components to be free from shipping damage and from defects in design, manufacturer, assembly, and construction for a minimum period of one (1) year following acceptance by the OWNER. This warranty shall not alter any other one-year warranties specified elsewhere in the Contract Documents. Contractor shall warrant the whole system, both in material and workmanship for a period of one year from the day of beneficial startup.

1.07 DELIVERY, STORAGE, AND HANDLING:

- A. Ship each piece of equipment, controls, and other supplied items so as to eliminate possibility for damage to machined surfaces, piping connections, openings, operating devices, and moving parts.

- B. Cap or seal inlet and outlet piping connections prior to shipment.
- C. Repair or replace items or components damaged during shipment.

PART 2 - PRODUCTS

2.01 EQUIPMENT:

A. GENERAL:

The CONTRACTOR shall provide an odor control system as specified which shall treat in a single pass the odorous air from the contaminated areas. The system shall be designed for continuous, automatic operation and also be capable of manual operation. Access manways shall be provided to allow access to the internals of the system. The system shall be designed to withstand a temperature up to 120°F. Each multi-stage packaged FRP system shall be of UNITARY CONSTRUCTION, as specified elsewhere. The module and all accessories shall be factory mounted, piped, and wired to the maximum extent possible. A carbon polisher system shall be provided for each biofilter system. Due to shipping constraints, the Contractor shall load the biofilter media and/or the carbon media at the job site. The systems shall be provided

B. DESIGN AND PERFORMANCE CRITERIA

The system shall be capable of removing foul air at a rate no lower than the rate shown below in the below table.

Foul air removed from the facility will have an average and peak concentration of hydrogen sulfide (H₂S) and design air flow rate as listed in the following table:

System I.D.	Air Flow Rate	Ave Inlet H ₂ S Conc.	Peak H ₂ S Conc.
ZB(Zabocs)- with RJC(Carbon)	20 x wetwell & MH volume per hour in cfm	200 ppm	800 ppm

The odor control system shall demonstrate the following performance when operating under design flow conditions listed above.

INLET
1-10 ppm H₂S
Greater than 10 ppm H₂S

OUTLET
0.1 ppm H₂S
1% of inlet

The pressure drop across the odor control system shall not exceed 5.0 in.w.c. at the maximum air flow rate specified above.

C. MULTI-STAGE FRP PACKAGED BIOLOGICAL ABSORPTION/ADSORPTION SYSTEM:

1. General:

The gas treatment system shall be a TWO-STAGE, ONCE THROUGH BIOLOGICALLY ACTIVE ODOR REMOVAL SYSTEM OF UNITARY CONSTRUCTION, designed to remove minimum of 99% of H₂S vapor in a single pass. The system shall consist of a humidifier, one biological gas conditioning/treatment stage, and one vertical gas polishing stage in series. After humidification, the first stage shall facilitate biological destruction of odor compounds absorbed by the liquid in the system and adsorbed on the inorganic media. The biological section shall include a spray header to distribute liquid evenly over the media. The complete treatment vessel shall be fabricated of premium grade FRP.

- a. The air shall enter the vessel through the humidification section. After humidification, the first treatment stage shall contain Biodagene™ media specifically designed to support biological growth for degradation of odor compounds. This stage shall provide absorption of odors from the air stream. The second polishing stage shall contain Siemens Water Technologies' virgin carbon media specifically designed to adsorb odor compounds and to support biological degradation of those compounds. This stage shall provide final removal of odors to the specified level. Overall media depth shall be a minimum of 48 inches.
- b. The first stage of media shall be wetted with fresh potable or re-use make-up water.
- c. The overall system size, including the fan, controls, and appurtenances shall not exceed the dimensions shown on the contract drawings. Access manways shall be provided to allow access to the system internals. As a minimum, access manways shall be provided between the treatment stages. A portion of the system top shall be removable for access to the top of the second stage.
- d. The system shall be included with all piping, valves, and internals. The material of construction of internals shall be as follows:

Packing Media Support:	HDPE and FRP
Liquid Distributor:	PVC
Spray Nozzles:	PVC
Humidifier Nozzles:	316 SS
- e. The system shall have all components pre-mounted and piped on the unitary constructed system. The system shall be shipped as a single piece.

2. **Materials of Construction:**

The vessel and accessories shall be contact molded manufactured in accordance with NBS PS 15-69, ASTM D 4097 for contact molding. Any material of construction other than FRP with premium grade resin will not be allowed.

Resin used in the system liner shall be a premium vinyl ester type such as Hetron 922 by Ashland Chemicals, Derakane 411 by Dow Chemical, Vipel F010 by AOC, or approved equal. The resin shall be reinforced with an inner veil of a suitable synthetic organic fiber such as Nexus 111-00010.

Reinforcement: Glass fiber reinforcement used shall be commercial grade corrosion resistance borosilicate glass.

- All glass fiber reinforcement shall be Type C, chemical grade, Type E electrical grade.
- Surfacing veil shall be 10 mil Nexus 111-00010 or equal.
- Mat shall be Type "E" (electrical grade) glass, 1 1/2 oz. per sq. ft with a nominal fiber length of 1.25 ± 0.25 inches, with a silane finish and styrene soluble binder.
- Continuous glass roving, used in chopper gun spray-up applications shall be type "E" grade with chrome or silane coupling agent.
- Alternate layers of mat and woven roving used for reinforcement.

Miscellaneous:

- Stainless Steel: Unless otherwise specified, all fasteners, and metal attachments, such as anchors, brackets etc shall be ANSI 316SS.
- Gaskets: Unless otherwise specified, all gaskets shall be EPDM.

3. **Fabrication**

General: Fabrication shall be in accordance with NBS PS 15-69, ASTM D 3299 and ASTM D-4097. All non molded surfaces shall be coated with resin incorporating paraffin to facilitate a full cure of the surface. All cut edges, bolt holes, secondary bonds shall be sealed with a resin coat prior to the final paraffinated resin coat. All voids to be filled with a resin paste.

Corrosion Liner: The inner surface of all laminates shall be resin rich and reinforced with one NEXUS 111-00010 with a minimum thickness of 10 mils. The interior corrosion layer shall consist of two layers of 1 1/2 oz. per sq. ft. chopped strand mat. If the application is by chopper gun spray up the glass fiber shall be 1/2 to 2 in length. The total corrosion liner thickness shall be a minimum of 100 mils and have a

resin to glass ratio of 80/20. All edges of reinforcement to be lapped a minimum of one inch.

Structural Laminate: Structural laminates shall consist of alternating layers of 1-1/2 oz per sq. ft mat or chopped glass and 24 oz per sq. yard woven roving applied to reach a designed thickness. Actual laminate sequences shall be per the laminate tables shown on fabrication drawings. The exterior surface shall be relatively smooth and shall have no glass fibers exposed. The exterior shall be surface coated with gel coat containing ultra violet light inhibitors

4. Accessories:

Air inlet, air outlet, spray headers, baffles, media support, drain and all connections shown on the drawings shall be provided by the manufacturer. Tie down lugs shall be integrally molded into the walls of the vessel. All external bolts shall be 316SS and designed for the specified loads. Interior fasteners shall be of corrosion resistant materials such as PVC or FRP.

Neoprene Pad: A 1/4" thick, 60 durometer neoprene rubber sheet must be placed underneath the vessel.

5. Exhaust Fan:

General. Fan shall be centrifugal design manufactured of FRP with a radial blade wheel. The wheel shall be statically and dynamically balanced. The fan inlet shall be slip type and the fan outlet shall have a flanged nozzle. The fan will be provided with a neoprene shaft seal.

Fan shall be supplied with a TEFC motor with 1.15 service factor suitable for three-phase, 60 Hz, 480 volt service. The fan shall be direct driven. The motor shall be inverter-duty, suitable for use with a VFD.

Performance. The fan shall be sized to handle the pressure drop through the inlet ductwork, the biofilter system, the interconnecting ductwork and the carbon polisher with stack. The fan shall be tested and rated in accordance with AMCA and shall bear the AMCA seal.

The fan shall be similar in design as provided in the following example specifications:

Exhaust Fan Design Requirements, System I.D.	ZB-7000 with RJC-600	ZB-8010 with RJC-1000
Air Flow Rate, cfm	445	800
S.P. up to System Inlet, in. WC	2.0	2.0
Pressure Drop through Biofilter System, in WC	3.0	3.0
Pressure Drop through Interconnecting Duct, in WC	1.0	1.0
Pressure Drop through Carbon Adsorber/Stack, in WC	5.0	5.0
Total Pressure Drop, in. WC	11.0	11.0
Motor HP	3.0	5.0

Sound Enclosure: Provide sound enclosure manufactured premium vinylester fiberglass reinforced plastic. Enclosure will have sound dampening material affixed to the internal walls of the vessel and reduce the noise from the fan. Sound enclosure shall be easily disassembled to allow access to the fan for maintenance and service.

Fan shall be manufactured by New York Blower, Hartzell, or equal.

D. Instrumentation and Control Systems:

The electrical control panel shall provide electrical control for the exhaust fan and water addition system. A 120 VAC, 1-phase power supply and a 480 VAC, 3-phase power supply shall be supplied to the panel to power the system.

The control panel enclosure shall be of fiberglass construction and rated NEMA 4X. The panel shall be mounted to the system assembly and factory tested to full operation with all other components prior to shipment.

The panel shall have the following components or capabilities:

1. Fan switch (ON-OFF).
2. Push-to-test button for water valve.
3. Timer relay for on/off control of water valve.
4. Blower VFD
5. Nutrient Pump (ON-OFF-AUTO)

The water control cabinet shall be constructed from a NEMA 12 rated FRP cabinet with all internal piping SCH 80 PVC. The cabinet shall be

mounted to the system assembly. The cabinet shall contain the following components:

1. Pressure reducing valve.
2. Nutrient Pump.
3. Irrigation solenoid valve.
4. Valve for pre-humidification
5. Irrigation system pressure gauge.

Water pressure regulator, solenoid valve, and rotameter shall be provided for control of water application rates. These components shall be mounted in the water control cabinet. The water control cabinet shall be insulated inside and equipped with a thermostatically controlled fan-driven heater to maintain a stable temperature. Contractor shall heat trace and insulate all the exposed outside piping on the biofilter unit.

E. Accessories:

Water Flow Control: The direct reading rotameter shall be a variable area type with a Teflon float, EPR "O" rings, and PVC fittings. The rotameter shall be of the same size as the pipe in which it is installed. The rotameter shall have a direct reading scale.

Water Distribution System. The first media stage shall be equipped with an independent water distribution system. The system shall be designed to irrigate the top of the first media bed with complete and even coverage via spray nozzles.

Nutrient Addition. A nutrient containment and metering system shall be provided with the system. Nutrients supplied as a coating to the support media shall not be allowed.

F. Piping:

All make-up water and drain piping shall be SCH 80 PVC. The Contractor shall insulate and heat trace all external piping.

G. Nutrient Reservoir:

The Nutrient Reservoir shall be integrated into the system sump. Loose external tanks shall not be allowed. Nutrient tank shall be heat traced and insulated per manufacturer's recommendations.

H. Carbon Polisher

Description: Furnish all labor, materials, equipment and incidentals required to install a carbon polisher system for each biofilter system as detailed on the following pages.

Design Criteria: The carbon adsorber vessel should be similar in design to the following example specifications:

RJE Model No.	RJC-600	RJC-1000
Vessel Diameter, ft	3.5	4.5
Vessel Straight Side Height, ft	5.5	5.5
Wall Thickness, in	0.25	0.25
Internal Positive Pressure, in. WC	+15	+15
Maximum Operating Temperature, °F	150	150
Carbon Bed Depth, ft.	3.0	3.0

1. Material of Construction

The vessel shall be fabricated from premium grade vinyl ester resin FRP construction.

Resin used in fabrication shall be a premium vinyl ester resin such as Hetron 922 by Ashland Chemical, Derakane 411 by Dow Chemical, or approved equal. The resin shall be reinforced with an inner veil of a suitable synthetic organic fiber such as Nexus 111-00010.

Reinforcement: Glass fiber reinforcement used shall be commercial grade corrosion resistant borosilicate glass.

Fabrication:

- a. General: Fabrication shall be in accordance with NBS PS 15-69, ASTM D 3299 and ASTM D-4097. All non-molded surfaces shall be coated with resin incorporating paraffin to facilitate a full cure of the surface. All cut edges, bolt holes, secondary bonds shall be sealed with a resin coat prior to the final paraffinated resin coat.
- b. Corrosion Liner: The inner surface of all laminates shall be resin rich and reinforced with one NEXUS 111-00010 with a minimum thickness of 10 mils. The interior corrosion layer shall consist of two layers of 1 1/2 oz. per sq. ft. chopped strand mat. The total corrosion liner thickness shall be a minimum of 100 mils.
- c. Structural Laminate: Structural laminates shall consist of alternating layers of 1-1/2 oz per sq. ft mat or chopped glass and 24 oz per sq. yard woven roving applied to reach a designed thickness. The exterior shall be surface coated with white gel coat containing ultra violet light inhibitors.

Fittings: The vessel shall be fitted with the following fittings:

<u>Description</u>	<u>Type</u>	<u>Qty.</u>
Gas Inlet	Flanged	1
Gas Outlet	Flanged	1
Drain	NPT	1
Pressure Tap	NPT	2
Carbon Sample	NPT	3

2. Carbon Adsorber Vessel Accessories:

- Differential Pressure Gauge - A Series 2000 differential pressure gauge as manufactured by Dwyer Instruments shall be provided to continuously monitor the pressure drop across the carbon bed. The differential pressure gauge shall be isolated with isolation valves and shall be mounted on the vessel.
- Carbon Sample Probes - Each vessel shall have three (3) 1" diameter sample probes per bed which shall extend into the bed a minimum of twelve inches. The sample probes shall be blocked off with a ball valve constructed of PVC.
- Grounding Rod - A stainless steel rod shall be provided to adequately ground each carbon bed. Rods shall be grounded via a 10-gauge wire.
- Carbon Support Grating and Screen - Each adsorber vessel shall be furnished to accommodate a single bed of activated carbon having an average depth of three feet. The carbon bed shall be supported on a polypropylene screen through an FRP support grating system. The screen and the support system shall be removable through the top cover. The support system shall consist of removable grating. Pall rings or other dumped packing media as a means of carbon support will not be acceptable. The support system shall be designed to withstand a load of at least 150 lbs/ft² with a minimum deflection of 1/4" under all conditions.
- Access Manways or Removable Top - The vessel shall have a completely removable top or a 24" diameter access manway.
- Exhaust Stack - The adsorber shall be provided with a straight outlet with rain cap, to prevent rain water from entering into the system.

- Anchor Bolts - The Carbon Adsorber shall be provided with properly sized epoxy HILTI anchor system.
 - Equipment Tags - The vessel shall be provided with an I.D. Tag with the following minimum information: Carbon Type, Vessel Dimensions, Date of Manufacture, and Design Conditions.
3. Activated Carbon Media: The activated carbon shall be virgin, pelletized, derived from high grade bituminous coal, vapor phase type, suitable for the control of sewage odors. The carbon shall have the following specifications:

Iodine Number, mgI ₂ /g	1050 min
MPD,mm	3.9-4.1
Apparent Density,g/cc	0.46-0.52
Hardness No.	95 min
Butane Activity	26 min
H ₂ S Capacity, gH ₂ S/cc**	0.30 min

** The H₂S breakthrough capacity is determined using ASTM standard method D6646-01. Prior to testing, the test sample should be completely humidified by exposing the sample to a flow of humid air (>85% RH) for at least 4 hours. Testing is accomplished by passing a moist (85% RH) stream of air containing 1 vol. % H₂S and the selected concentration of CO₂ through a 1 inch diameter tube with a nine-inch deep bed of closely packed carbon at a rate of 1,450 cc/min and monitoring to a 50 ppmv H₂S breakthrough. The results are reported as grams of H₂S adsorbed per cc of carbon.

PART 3 - EXECUTION

3.01 INSTALLATION & STARTUP:

- A. The contractor shall install all equipment in accordance with manufacturer's installation instructions.
- B. The services of a factory representative shall be provided to insure proper installation and start-up of the system. The manufacturer shall provide a minimum of sixteen hours for inspection of the installation and training of the Owner's staff in operation of the system. The Manufacturer shall make any changes to the system that may be necessary to meet the specified performance under inlet conditions as specified.

- C. After installation and testing, the manufacturer shall provide a written statement to the Owner & Engineer that all equipment and controls have been properly installed and tested in accordance with the drawings, specifications, and manufacturer's recommendations.

End of Section

CERTIFICATION
SECTION 15024

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Certification in writing shall be furnished by the Developer to Piedmont Water Company for the following:
 - 1. Conformance with design Drawings and Specifications.
 - 2. Hydrostatic and operational testing and inspection of process piping and equipment.
 - 3. Hydrostatic and operational testing and inspection of utility piping and equipment.
 - 4. Lubrication of all mechanical equipment as required by the manufacturer.
 - 5. Leak test of all drainage and vent systems.
 - 6. Potable water system sterilization.
 - 7. Manufacturer's certification of equipment Shop Drawings which show dimensions, give pump or other performance curves, instrumentation, and electrical data.
 - 8. Certification of operational tests for controls installed under applicable Section 15 sections.
 - 9. Certification that relief and safety equipment has been installed and tested as required.

1.02 SUBMITTALS

- A. Equipment and System Certification: When the work of this Section is completely installed, balanced and in permanent operating condition, the Developer's Contractor shall submit written certification in six copies to Piedmont Water Company that all systems and/or items of equipment are installed in accordance with Drawings, specifications and manufacturer's recommendations and that safety and operating controls are functioning properly.
- B. Test Reports: Tests of mechanical systems required and specified under the work of Division 15 shall be logged, certified, and submitted to Piedmont Water Company in the manner described in above.

PART 2 - PRODUCTS
Not applicable.

PART 3 - EXECUTION
Not applicable.

CLEANING AND TESTING OF PIPE AND EQUIPMENT

SECTION 15040

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. This Section specifies the general procedures to be followed in cleaning and testing piping and fluid handling equipment.
- B. Developer’s Contractor shall furnish all labor, tools, and equipment required for this work.
- C. Piedmont Water Company shall be notified in advance of equipment/system cleaning and testing.
- D. Cleaning method, test medium and test pressure are defined for each service on the attached Cleaning and Testing Index. See Part III of this Specification for complete description of cleaning methods and test procedures.

1.02 REFERENCES

- A. Industry standards governing this work of the latest issue at the date of this specification release, except as otherwise noted:
 - 1. American National Standards Institute (ANSI) and American Water Works Association (AWWA):

ANSI B31.1	Power Piping.
ANSI B31.3	Chemical Plant and Petroleum Refinery Piping.
ANSI/AWWA C600/C605	Standard for Installation of Cast Iron water Mains.
AWWA B300	Standard for Hypochlorites.
AWWA B301	Standard for Liquid Chlorine.
AWWA B303	Standard for Sodium Chlorite.
AWWA C651	Standard for Disinfecting Water Mains.
 - 2. Federal Specifications and Standards (FS):

FS BB-C-120B	Chlorine, Technical: Liquid.
FS O-C-114B & Amd.-2	Calcium Hypochlorite, Technical.
FS O-S-602E	Sodium Hypochlorite Solution.

1.03 SUBMITTALS

- A. The proposed testing procedures, including test medium and pressure, line segments and equipment included in the test, methods of isolating test from rest of system, and pressure monitoring techniques, shall be approved by the Piedmont Water Company's Representative prior to commencement of the test.
- B. A detailed report of pressure tests on piping and equipment shall be forwarded in duplicate to Piedmont Water Company. This report shall show date of test, lines tested, test medium, length of time test pressure was held, pressure drop or rise, and extent of venting or re-pressurizing.
- C. The Developer's Contractor may submit a test procedure or cleaning specification in lieu of this Specification to Piedmont Water Company for approval. Any deviations from this Specification must be approved in writing by Piedmont Water Company before any such deviation is instituted.

PART 2 - PRODUCTS

2.01 GENERAL

- A. Detergents, solvents, and other cleaning materials shall be compatible with the materials of fabrication of the systems in which they are used. They shall not adversely affect the materials or mechanisms in the systems and they shall be acceptable to equipment manufacturers. Detergents, solvents, and other cleaning agents shall also be compatible with the process streams to be handled by the systems in which they are used.
- B. Materials in blinds, gaskets, bolts, etc. used in isolating segments of systems shall be compatible with the systems being cleaned and/or tested.

PART 3 - EXECUTION

3.01 CLEANING

- A. General:
 - 1. The Developer's Contractor shall provide and install necessary temporary connections, strainers and other equipment to thoroughly clean the piping systems before start up. The Developer's Contractor shall dispose of cleaning agents and remove temporary connections and strainers after cleaning is complete.
 - 2. Piping shall be cleaned just prior to installation and/or plant start up whenever possible. Cleaned piping material shall be protected

against contamination by sealing open ends with clean plastic sheet or metal foil.

3. Cleaning procedures will be approved by Piedmont Water Company or their designated Representative, and completed to their satisfaction.

B. Cleaning Methods:

1. Cleaning Method "A":

a. Prior to erection:

- 1) Hammer, brush, etc., to loosen sand, dirt, scale, or other contaminants when necessary.
- 2) Blow with air, or hose with clean water, and visually inspect for contaminants.
- 3) On pipes stored before erection, dry and seal the ends to prevent contamination during storage.

- b. After erection thoroughly flush the system with clean water or steam to remove all foreign material and blow free of water with dry oil-free air.

2. Cleaning Method "B":

- a. Carefully handle during fabrication and installation to avoid all unnecessary contamination of these lines.
- b. Thoroughly flush with clean water after installation.
- c. Purge with dry, oil-free air until lines are completely dry before placing in service.

3. Cleaning Method "C":

- a. The entire system shall be cleaned only with dry oil-free air, or with inert gas if explicitly specified.

4. Cleaning Method "D":

a. Prior to erection:

- 1) Surface clean as required.
- 2) Blow with air, or hose with potable water and visually inspect for contaminants.
- 3) Dry and seal ends of pipes stored before erection to

prevent contamination during storage.

- B. After erection:
- 1) Flush system thoroughly with potable water at following rates for sufficient time to ensure thorough cleaning:
 - 3 inch pipe size 300 gpm
 - 4 inch pipe size 400 gpm
 - 6 inch pipe size 750 gpm
 - 8 inch pipe size 1000 gpm
 - 10 inch pipe size 1500 gpm
 - 12 inch pipe size 2000 gpm
 - 2) Flush system prior to making connection to interior potable water system.
- C. Cleaning Vessels and Large Equipment: Clean each vessel separately. If the vessel or equipment is large enough to have a manhole, use clean water to wash down all the internal surfaces. Leave the bottom open for trash and dirt to drain through. If the vessel is too small for flushing through a manhole, connect clean water to the inlet and flush with a continuous flow of water in the same direction the flow would be if in service. The vessel should be full of water in order to have the maximum turbulence. Shut off the flow to allow to drain. With the drain still open, allow more water to enter the vessel for a short time to flush any remaining trash from the bottom.
- D. Resealing Systems: After each section of piping and equipment has been flushed clean, remove all strainers in the system. Reconnect all vessels, equipment, and piping and reinstall control valves, safety valves, controllers, rupture discs, orifice plates, and other instruments and fittings with new gaskets, thread lubricant, etc. If a subsequent pressure test is required, it may be necessary to leave some such items out of the system until after completion of the pressure test. For systems which must be hydrostatically tested and dried, the hydrostatic test may be conducted prior to cleaning and drying.

3.02 TESTING

- A. General:
1. Equipment such as vessels, heat exchangers, pumps, compressors, and the like shall be isolated during testing of the piping system. Retest of equipment which has been shop tested is not required unless the equipment has been damaged or disassembled during

shipment or erection. The test pressure for such a retest shall not exceed the shop test pressure and Piedmont Water Company shall determine whether or not a retest is required. Inclusion of the equipment in the testing of piping systems shall not be done without approval of Piedmont Water Company.

2. Test pressure shall be as agreed to by Piedmont Water Company. Final test pressure for each test shall be maintained for a sufficient length of time to facilitate a complete inspection of all joints and connections, but no less than that specified by the applicable testing procedure. When it is necessary, for practicality, to include a vessel or other equipment, the test pressure shall not exceed the allowable cold limit of the equipment.
3. Detected leaks shall be repaired. Piping systems shall be retested if revisions or repairs are made in piping or pressure equipment.
4. Since the risk of failure, with the attendant possibility of injury, is appreciably greater during testing, all safety measures required by codes or ordinances applicable to the situation shall be taken.
5. Equipment or piping to be pressure tested shall not be insulated, covered, painted or concealed prior to test. Compression joint underground piping may be backfilled prior to pressure test except that joints shall remain exposed until after the test. Tie rods, clamps, etc., shall be in place and fastened.
6. These tests shall not be used to establish pressure ratings.
7. Protect all piping and equipment against over-pressure collapse from vacuum and hydraulic shock during the filling, testing, and draining procedures. Seats of iron valves shall not be subjected to a pressure in excess of the maximum cold working pressure of the valve. Pressure tests against other closed valves shall not exceed the manufacturer's cold pressure limit. Note that where significant differences in elevation exist, there is a risk of over-pressure in the lower portions of the system in order to attain test pressure in the upper portion of the system.
8. Apply test pressure only after the system and test medium are at approximately the same temperature, preferably not less than 60 F. Note that some applicable codes require testing above a specified minimum temperature. Water temperature shall not exceed 125 F.
9. Test, including the inspection of all joints, shall be made to the satisfaction of Piedmont Water Company's Representative. Following the completion and approval of the test, restore all components of the system to normal operating condition. This includes removing the temporary provisions installed for the test.

B. Preparatory Work:

1. Remove from the system all pumps, turbines, traps, shock arresters,

expansion joints, instruments, control valves, safety valves, rupture discs, filters, orifice plates, etc., which might be damaged by the test, or are designated by Piedmont Water Company's Representative. Also remove all items such as orifice plates which might trap air in a system to be hydrostatically tested. Disconnect all instrument supplies.

2. Open but do not backseat all valves including bypass valves. Lines containing check valves shall have the source pressure on the upstream side.
3. Clean system prior to testing.
4. Systems may be separated into sub-systems for testing if such action will expedite or simplify the testing.
5. During hydrostatic testing of lines with spring hangers designed for fluids lighter than water, travel stops or locks shall be installed on the hangers, or temporary solid rod supports must be provided during the entire time the line is filled with water to support its additional weight and prevent overloading the springs. Also provide temporary supports where required to prevent over stressing supports other than spring hangers. When tests are completed, remove temporary supports, locks, stops, etc., and set supports for their original load.

C. Testing Methods:

1. Test Procedure T1 (Hydrostatic Test):
 - a. Only filtered water shall be used as test media.
 - b. No hydrostatic testing shall be done when the ambient temperature is 40 F or lower unless special cold weather provisions are approved by the Owner.
 - c. Provide vents and drains as required.
 - d. All lines shall be thoroughly cleaned before testing. See Article 3.01 for cleaning procedures.
 - e. Items which are not to be subjected to the hydrostatic test shall be either removed or blanked off. Short sections of piping removed to permit the installation of blinds or blanks shall be tested separately.
 - f. The test pump hook-up for hydrostatic test shall permit applying the pressure gradually under close control. A valve shall be provided for isolating the piping from the pressure source during the test period. The system should be filled with water through a low connection point, care being taken that air is completely vented so that there are no air pockets remaining. The pressure shall be applied gradually and held at the specified value for the time required to visually check each weld, connection, joint, flange, etc., but not less than a minimum of one hour. Test readings may be taken at the lowest point of the line or system of lines with static head added to the minimum hydrostatic test pressure. Care shall be taken to insure that at no point a dangerous over-pressure is experienced.

- g. The hydrostatic test shall be considered satisfactory if no visible leakage, cracks or other signs of distress are discovered on the piping or at any joints. There is no requirement for minimum pressure drop during the test period; however, the cause of any pressure loss other than that due to temperature change or similar reasons shall be justified to the satisfaction of Piedmont Water Company's Representative.
- h. Minor leaks in screwed or flanged joints may be repaired with-out retesting subject to the approval of Piedmont Water Company's Representative.
- i. Any welded joint found leaking shall be repaired in accordance with the original welding procedure and completely retested.
- j. After completion of hydrostatic testing, the system shall be completely drained at all low points in such a way as to accomplish thorough flushing of the system. Test blinds, temporary supports, test equipment, etc., shall be removed, and any valves, orifice plates, short sections of piping, miscellaneous in-line equipment or instruments that were removed prior to testing shall be re-installed and the line left ready for service. New gaskets shall be used when re-installing flanged items.
- k. Care shall be taken to insure the complete removal of all water from the line or system after testing. If there is any danger of contamination or freezing, blowing out the fluid with air is necessary.

2. Test Procedure T2 (Pneumatic Test):

- a. All combustible liquids and gases shall be purged from systems prior to pneumatic testing. This is an absolute necessity.
- b. Use only clean, dry, oil-free air. Plant air supply may be used if available and satisfactory.
- c. Pressurize line with air, make a preliminary check at not more than 25 psig. Increase the pressure gradually in steps which allow sufficient time for the piping to equalize strains. When pressure given in Testing and Cleaning Index is reached, isolate line.
- d. If pressure drop is not acceptable, all joints shall be soap tested to locate leaks.
- e. When soap test is complete, steps one and two shall be repeated until pressure drop is acceptable.
- f. Systems to be used for combustible gases and liquids shall be thoroughly purged with inert gas or the fluid which will be used in the system in accordance with NFPA 54.

3. Test Procedure T3 (Leak Test for Drains and Vents - Piping and Equipment):
 - a. Fill the system with water and visually inspect for leaks.
 - b. No pressure shall be applied by pump, by supply line, or other external source. The test crew shall be responsible for filling the system at a rate low enough to prevent pressurizing due to restricted outflow of air.
 - c. The test will be considered completed when Piedmont Water Company, or their designated Representative, is satisfied that all joints are reasonably tight.

4. Test Procedure T4 (vacuum Test):
 - a. The piping system shall be evacuated to one inch Hg Abs. and held for one hour with pressure rise not to exceed one inch Hg.
 - b. If pressure rise exceeds one inch Hg, the system may be pneumatically tested per Test Procedure T2 above, to a test pressure not exceeding 15 psig to locate leaks. Upon repair, repeat the vacuum test.
 - c. The test will be considered complete when Piedmont Water Company, or their designated Representative, is satisfied that all joints are tight.

5. Test Procedure T5 (Leak Test for Interior Sanitary and Storm Drainage Systems):
 - a. Make tests as may be required by local plumbing authority, in addition to those specified, at no additional cost to Piedmont Water Company.
 - b. Make tests on concealed piping before piping is closed-in.
 - c. Make air test by attaching air compressor or testing apparatus to suitable opening, close all other inlets and outlets to system and force air into system until there is uniform gauge pressure of five psi or sufficient to balance a column of mercury ten inches in height. Hold pressure without introduction of additional air for a period of at least 15 minutes. Test every joint with soap suds while system is under air pressure.
 - d. Make water test in lieu of air test of soil and waste piping. Test piping either in its entirety or in sections. Do not make water test during cold weather until temporary heat is available. Close all openings except highest one and fill system with water to point of overflow, if test is applied to entire system. Close all openings except highest one in section under test and fill section to point of overflow, if system is tested in sections.
 - e. Test at least the upper ten feet of next preceding section so no joint or pipe in building (except the uppermost ten feet of system) is

- submitted to test of less than ten foot head of water, if system is tested in sections. Leave water in system or in portion under test for at least 15 minutes before inspection starts. Inspect joints for visible leakage.
- f. Make final test of system after all plumbing fixtures have been set and their traps filled with water. Introduce into entire system pungent, thick smoke. Close openings when smoke appears at stack openings on roof. Build up pressure equivalent to one inch water column and maintain for 15 minutes before starting inspection.
 - g. Take apart, clean and remake any joints not tight under test.
 - h. Furnish gauges, pumps, compressors and instruments necessary for above tests.
6. Test Procedure T6 (Hydrostatic Test for Exterior Potable Water System and Exterior Fire Water Distribution System):
- a. Backfill trench between joints before testing to prevent movement of pipe. Do not cover joints.
 - b. Test piping when thrust blocks are sufficiently hardened.
 - c. Fill piping with water 24 hours prior to testing in a manner to remove all air.
 - d. Test all new yard piping hydrostatically for two hours.
 - e. Measure amount of leakage in piping at the specified test pressure by pumping from a calibrated container. Amount of leakage at the joints shall not exceed two quarts per hour per 100 gaskets or joints irrespective of pipe diameter.
 - f. Increase amount of allowable leakage by one fluid ounce per inch valve diameter per hour for each metal seated valve isolating the test section. Increase amount of allowable leakage an additional five ounces per minute if dry barrel hydrants are under pressure.
 - g. Apply test pressure to stabilize system:
 - 1) Increase test pressure in 50 psi increments until final test pressure is attained.
 - 2) Inspect system after each increase in pressure, checking for protrusion or extrusion of the gasket, leakage or other factors likely to affect continued use of the pipe line.
 - 3) Do not increase pressure to next increment until joint has stabilized.
 - 4) Maintain final test pressure for one hour, then decrease pressure to zero psi.
 - 5) Slowly increase pressure to final test pressure and maintain for one hour while inspection is made, then decrease pressure slowly to zero psi.

3.03 INSPECTION

- A. Piedmont Water Company(PWC) reserves the right to make any inspections. The Developer's Contractor shall give the PWC Representative free access to his work, and whenever requested, shall furnish him with full information as to progress of the work and its various parts at place of fabrication or on the job site. Such inspection shall not relieve the Developer's Contractor from full responsibility for the quality and correctness of his work.
- B. If the Specification, PWC Representative's instructions, ordinances, law, or any other public authority require any special tests or approval, the Developer's Contractor shall give the PWC Representative timely notice of his readiness for inspection. If the inspection is by an authority other than the PWC Representative, the PWC Representative shall be informed as to the place and date fixed for such inspections.
- C. Inspections shall be made in accordance with the American Standard Code for Pressure Piping, ANSI B31.3 (Petroleum Refinery Piping, Code) unless another code is specifically applicable to the system being tested.

End of Section

VALVES

SECTION 15100

PART 1 - GENERAL

1.01 WORK INCLUDED:

- A. This Section specifies valves used with piping systems.

1.02 RELATED WORK:

- A. Pipe and Pipe Fittings: Section 15060.

1.03 QUALITY ASSURANCE:

- A. Provide new, standard catalogued, full weight, full length, scale-free valves and accessories.
- B. All valves to conform to American Water Works Association Standards for water and wastewater valves, except as herein noted, or shown on the drawings.

1.04 REFERENCES:

- A. ANSI B16.10: Face-to-Face and End-to-End Dimensions of Ferrous Valves.
- B. AWWA C504: Class 150B Butterfly Valves
- C. MSS:
 - 1. SP-6: Standard Finishes for Contact Faces of Pipe Flanged and Connecting End Flanges of Valves and Fittings.
 - 2. SP-61: Pressure Testing of Steel Valves.
 - 3. SP-67: Butterfly Valves.
 - 4. SP-70: Cast Iron Gate Valves, Flanged and Threaded Ends.
 - 5. SP-71: Cast Iron Swing Check Valves, Flanged and Threaded Ends.
 - 6. SP-80: Bronze Gate, Globe, Angle and Check Valves.
 - 7. SP-82: Valve Pressure Testing Methods.

8. SP-84: Steel Valves - Socket Welding and Threaded Ends.

1.05 SUBMITTALS:

- A. Submit list of valves proposed for project and submit to Engineer for review.
- B. Submit catalog cuts and descriptive information for all valves showing dimensions, materials of construction, chemical and physical properties of materials, operational data, and rated design pressure.
- C. Submit sources of all materials.

PART 2 - PRODUCTS

2.01 SPECIAL MATERIAL REQUIREMENTS:

- A. General Construction:
 - 1. Conform to MSS standards including following:
 - a. Valve Facings: MSS SP-6.
 - b. Testing: MSS SP-61, SP-82.
 - c. Gate Valves: MSS SP-70, SP-80.
 - d. Check Valves: MSS SP-71, SP-80.
 - 2. Provide valves having full line size end connections.
 - 3. Provide valves fully compatible in materials and operation with fluid conveyed in piping.
 - 4. Provide flanged end ferrous valves having dimensions conforming to ANSI B16.10.
- B. Valve manufactures and model numbers have been specified in individual service specifications as a basis for selection. Valves submitted as equal to those specified will be considered subject to review by the Engineer. Valve materials and manufacture to be of U.S. (domestic) origin.
- C. Gate Valves: Valves shall conform to AWWA C509 for resilient seated gate valves, iron body, with bonded epoxy coating conforming to AWWA C550. Valves shall be designed for 200 psi working pressure and 400 psi hydrostatic test pressure. Valves shall be iron body, bonded epoxy, and shall have non-rising bronze stem, and shall be wrench operated. Valves shall open by turning counter-clockwise. Operating nuts shall be standard two inches square. Suitable stem guides shall be provided,

where required. Valves shall be furnished with mechanical joint suitable for connection to pipe into which it will be installed for buried service. Gate Valves shall be as manufactured by Mueller, Val-Matic or M&H.

- D. Provide extension operators for valves where required and as indicated on Drawings.
- E. Where indicated and required, provide cast iron valve boxes with minimum 6 inch diameter removable covers and stem or shaft extension operators with "T-handles" for operation of direct buried valves in underground piping.
- F. Safety and Relief Valves:

Surge Relief Valve: The Sewerage Surge Relief Valve shall function to prevent high pressure surge in the pipeline. When the pipeline is under normal operating pressure, the valve shall be closed tightly. If the pipeline pressure rises above the set point of the relief valve, the valve shall open quickly to dissipate the overpressure. Once the overpressure condition has been dissipated, the relief valve shall close at a controlled rate of speed.

The valve shall be of a long radius elbow configuration. The valve disc shall be held in the closed position due to the action of externally mounted springs when the pipeline is under normal working pressure. If the pipeline pressure, acting on the valve disc, overcomes the spring force the valve will open. The pipeline pressure at which the valve opens (i.e. relief set point) shall be adjustable by varying the spring tension. The valve shall remain open as long as the line pressure exceeds the relief set point. When pipeline pressure drops below the relief set point, the spring force shall close the valve. The rate of closure shall be adjustable by the action of an oil-hydraulic cylinder and flow control valve.

The main valve body, cover and disc shall be constructed of cast iron (ASTM A126-B) and shall very nearly resemble a long radius elbow. The center to face dimensions shall be equal to a standard long radius elbow fitting.

The valve body shall contain a bronze (optional-stainless steel) seat ring. The valve disc shall contain a resilient, replaceable seat ring of Thiokol treated leather or nylon held in place by a bronze (optional-stainless steel) follower ring. The disc shall be attached to a stainless steel stem guided by bronze bearings through a length not less than the valve diameter. A rod wiper shall be included for removal of solids adhering to the stem as the stem enters the bearings.

The stem shall be attached to externally mounted spring(s). The relief setting shall factory set. The spring load shall be generated by compressing the spring(s). Tensioned spring(s) are not acceptable. The springs shall be enclosed in steel enclosures and shall be provided with spring position indicators. Exposed springs are not acceptable.

A hydraulic cylinder assembly shall be attached to the stem. The cylinder assembly shall be of bronze B-62. An oil reservoir and flow control valve shall be provided with the valve.

Surge relief valves shall be as manufactured by GA Industries of Mars, Pennsylvania: 2"inch size and shall be their Fig. 625-D (2"-8").

Low Pressure System & Reuse Main Line Air Release/Vacuum Valves: Air release and vacuum valves shall be 1" size and shall be a type that will release air and prevent the formation of a vacuum for wastewater applications. The valves shall automatically release air from the lines when the lines are being filled with water, and shall admit air into the lines when water is being withdrawn in excess of the inflow. It shall also allow accumulating air to escape while the line is in operation and under pressure. Valves shall be cast iron body, stainless steel float and stainless steel for all other interior metal parts. Valves shall be equipped with an inlet valve, drain valve, and back washing accessories. Valves shall be Valmatic Model 302BW or equal.

G. Drip Field Control Valves:

1. Air Release Valve: The drip field air release valves shall incorporate a kinetic air release valve and automatic air release valve in one single body. The kinetic air release valve shall release air at high flow rates during the filling process and admit air into the line during the draining process. The kinetic air release valve will function only as long as the line is not under pressure. The valve shall be rated at a test pressure of 350 psi. The valve shall be Barak Model D-040 as manufactured by Netafim. The valves shall be supplied by the drip pipe manufacturer.
2. Control Valve: Drip Field Control valves shall be the size of the influent piping shown on the drawings for each individual field. The valves shall be pressure reducing/remote controlled. The valves shall be a direct sealing diaphragm valve activated by the dripline pressure. The valve shall have a "Galit" relay assembled on the main line valve, converting the remote pressure command carried by 8 mm control tubing from the control panel located in the effluent pump station building. The contractor shall install the 8 mm tubing from each control valve to the control panel through

a 3" PVC conduit as provided in the details of the drawings. The valves shall be Model 61PR-(Size)-I-F. RC utilizing "Galit" relay by Netafim. The valves shall be supplied by the drip pipe manufacturer.

H. Eccentric Plug Valves

General. All eccentric, permanently lubricated plug valves shall be of the tight-closing, rubber seat type. Valves shall be bubble-tight at the full rated pressure in either direction. Valves shall be suitable for throttling service and/or operation after long periods of inactivity. Valves shall have a minimum of five years service experience. Valves shall be rated for direct bury or duty as shown on the drawings.

Body. All bodies shall be constituted of cast iron ASTM A-126, Class B. Flanges shall fully conform to the drilling and thickness requirements of ANSI B16.1, Class 125. Body wall thickness shall conform to AWWA C504-80.

Plug. Balanced type, cast iron, ASTM A-126, Class B or ASTM A-436 (Ni-Resist) or Ductile Iron ASTM A-536.

Port Area. Passage size shall be at least 80% of the full port area on all sizes for minimum pressure drop. Valve must be capable of passing the same solids requirements as the pump specifications.

Body Seat. Seating surfaces shall meet the requirements of AWWA C509-80.

Bearings. Upper and lower bearings shall be stainless steel, permanently lubricated.

Packing. U-cup or V-type, self-adjusting, wear compensating. Packing shall be replaceable without removing the valve bonnet or plug.

Rating. Valves shall be rated 150 lb. WOG or 400 lb. WOG as required.

Proof of Design. A proof-of-design test using the parameters of AWWA C504 will be required. Valves being supplied must be of the same materials as those passing this test.

Testing. All valves shall be leak tested to their full rating prior to shipment.

Actuator. Actuator mechanism must be fully isolated from line media.

Manufacturer: Plug valve manufacturer shall be by Dezurik.

I. Fire Meters & Valves

All developments utilizing fire protection systems shall install separate potable and non-potable fire lines. The installation shall install a common master meter vault at the property line at a location approved by PWC and the applicable Fire Marshall. All valve and metering systems shall meet all Federal, State & Local regulations.

The master meter vault shall house dual metering lines for both the potable water and non-potable fire line meters and valves. All piping within the vault shall be flanged. The vault shall be precast concrete sized to house all meters and valves within the vault. The width of the vault shall be sized to

provide a minimum clearance of 2 feet from the largest outside diameter flange of each pipeline/meter/valve to the vault wall. The length of the vault shall be sized to provide 2 feet clearance on either end of the vault wall to the nearest flange fitting. The precast concrete vault shall include a concrete floor and the vault height shall have a minimum depth of 6 ft from vault bottom to inside bottom of vault concrete slab. The vault shall be bedded on a minimum of 12" deep of #57 stone and shall be designed and provided with anti-flotation means. The meter vault shall include a locking aluminum access hatch with minimum size of 36" square included manhole steps embedded in vault wall. Vault shall be water tight and shall be provided with lift off vault top (with lifting lugs) for easy removal for access/removal of valves in the future. All pipe penetrations with vault wall shall be provided with double link seals sealed with non-shrink grout.

The potable water line within the vault shall include as a minimum, a direct read AMCO C3000 Compound Meter w/ 60 w ERT w/ ILC. The upstream side of the compound meter shall include an isolation gate valve and strainer. The downstream side of the meter shall include a Romac 400 Dismantling Joint and Febco 850 NRS NRS double check backflow preventor. All gate valves shall have hand wheel operators.

The non-potable fire line within the vault shall include as a minimum, a direct read DCDA Combraco 3000 SS OSY Compound Meter w/ Post Adaptor & Indicator Post w/ 60 w ERT w/ ILC. The upstream and downstream sides of the meter shall include isolation gate valves. The downstream side of the meter shall include an FDC Assembly. All gate valves shall have hand wheel operators.

All meters shall include direct read radio transmitters compatible with PWC's existing equipment.

Developer shall provide shop drawings to PWC for proposed meters, vault, radio compatible equipment, etc for prior approval before installation.

PART 3 - EXECUTION

3.01 INSTALLATION:

- A. General requirements:
 - 1. Locate and install valves as indicated on Drawings and for immediate accessibility for operation.
 - 2. Point stems up wherever possible; where not possible, point stems in horizontal position.

3. Point stems down only where indicated or where no other position is possible.
 4. For chain operators, set bottom of chain loop at three feet above operating level, with S-hook for securing chain out of aisle or access area.
 5. Connect valves to piping in accordance with general fitting installation requirements of Section 15060 and Drawings.
 6. Install chain wheels or extension stems to permit ease of operation on valves where valve center lines are located more than 7'-0" above access level; do not use chain wheels on threaded end valves.
 7. Cover all valve outlets not connected to piping system with end closure, such as plug, capped nipple, or blind flange.
 8. Locate all valves at cooling towers directly against or close to tower nozzles unless physical interferences prevent proper operation.
 9. Install extension stems on valves located in trenches and on underground valves to within 4 inches below cover plate or trench cover if operating handles are more than 2'-0" below cover.
 10. Install valve boxes on frequently operated valves installed underground.
 11. Where manual valves are used with locally mounted flow indicators, locate valves at same operating level as instrument and so that instrument can be readily observed.
 12. Seal weld connections of threaded gas valves to non-threaded steel pipe.
 13. Use male thread adaptors to install threaded valves in copper pipe.
- B. Lubricate appropriate valves as required after installation, using approved lubricants.
- C. Relief Valves:
1. Where relief valve discharge is of non-hazardous nature, pipe directly to drain.
 2. Where relief valve is used in process or steam service, extend

discharge pipe 10'-0" above any working level within radius of discharge point or extend above roof; where required, provide minimum ½ inch drain at low point of discharge and pipe to drain system.

3. Except as indicated, do not install pipe between vessel or line and relief valve inlet.
4. Install relief valves in vertical position.
5. Brace and support outlet piping so that excessive stress on relief valve is avoided and so that removal of relief valve can be accomplished without temporarily supporting discharge piping.
6. Install discharge piping to avoid pockets; provide weepholes as required.

3.02 FIELD QUALITY CONTROL:

- A. Examine and test valves after installation for:
 1. alignment,
 2. tightness,
 3. operability, and
 4. proper orientation in pipe.
- B. Correct or reinstall all valves revealed by inspection of Owner's representative to be improperly installed.

End of Section

SECTION 16100

ENGINE DRIVEN GENERATOR SETS

PART 1 - GENERAL PROVISIONS AND REQUIREMENTS

1.01 GENERAL DESCRIPTION

This specification defines the requirements for emergency or standby Diesel Generator Sets. The generator sets shall consist of an engine directly coupled to an electric generator, together with the necessary controls and accessories to provide electric power for the duration of any failure of the normal power supply. The generator sets shall have the following characteristics:

Sewerage Pump Station

Rating	XX kW (Determined by Electrical Engineer)
Voltage	480/277
Phase	3
Connection	Y
Wire	4
Hertz	60
Power Factor	0.8

The generator set shall be capable of starting and running the loads shown on electrical design drawings without exceeding the maximum voltage and frequency variations specified herein, or the maximum temperature limitations of the engine and generator. The generator set shall be capable of starting all the non-inductive load (10 kW) first, and then the lead (XX) HP pump. The second pump is not required to be started by the generator. The pump motor shall be started with time delay by RVSS motor starters.

1.02 QUALITY AND EXPERIENCE

All materials and parts of the generator set shall be new and unused. Each component shall be of current manufacture from a firm regularly engaged in the production of such equipment. Units and components offered under these specifications shall be covered by the manufacturer's standard warranty on new machines, a copy of which shall be included in the submittal.

1.03 WARRANTY

The warranty specified in paragraph 1.02 shall be two years minimum from date of acceptance, not to exceed thirty (30) months after date of shipment.

1.04 PARTS AND SERVICE

Generators shall be accepted only for engine driven generator sets which can be

properly maintained and serviced without causing Piedmont Water Company either to carry expensive parts stock or to be subjected to the inconvenience of long periods of interrupted service because of lack of available parts. The developer shall specify the nearest location of permanent parts outlets from which parts may be obtained.

1.05 OPERATION AND MAINTENANCE INFORMATION

The system supplier shall furnish six(6) sets of operating, maintenance and parts manuals covering all components for the generator set system. The supplier shall also instruct Piedmont Water Company in operation and maintenance of the unit.

1.06 VIBRATIONS

The system shall be free of injurious torsional and bending vibrations within a speed range from 10% below to 10% above synchronous speed.

1.07 GUARDS

The system shall be adequately guarded both physically and electrically for protection of operating personnel.

PART 2 - ENGINE

2.01 GENERAL DESCRIPTION

The engine shall be of the internal combustion type equipped to operate on No. 2 diesel fuel.

2.02 ENGINE POWER RATING

The rated net horsepower of the engine at the generator synchronous speed, with all accessories, shall not be less than the specified kW for each generator. The horsepower rating shall take into account generator efficiency and all parasitic losses such as fan, battery charger, etc. The generator set shall be capable of producing the required KW (without overload) for the duration of the power outage (standby rating), under the following ambient conditions:

Altitude, feet elev).	(Determined from actual site
Ambient temperature range, °F	0-100
Humidity at max. ambient temp. %	80

2.03 FUEL AND OIL CONSUMPTION

Accompanying the supplier's bid, the bidder shall supply fuel and oil consumption estimates based on engine manufacturer's data, a copy of which shall be included in the submittal.

2.04 GOVERNOR (ENGINE SPEED CONTROL)

The engine shall be equipped with a suitable governor to maintain frequency within limits, as specified below, by controlling engine and generator speed.

Type: isochronous

Stability: 1/4% maximum steady state frequency variation at any constant load from no load to full load.

Regulation: 1/4% maximum frequency deviation between no-load steady state and full-load steady state.

Transient: 5% maximum frequency dip on most severe motor starting condition. See paragraph 1.01.

Transient: 2 seconds maximum recovery time for maximum motor start.

The manual speed adjusting control shall be mechanical or electrical if located on the generator set or electrical if located in a remote control panel.

2.05 ENGINE CRANK-START SYSTEM

The engine shall be electric start, provided with a solenoid energized motor, with either positive engagement or clutch drive to the engine.

Lead-calcium batteries shall be furnished to provide power to the engine cranking motor. The batteries shall be designed for operation at a minimum ambient temperature of 0 °F.

The voltage shall be as required by the engine manufacturer.

The batteries shall be capable of a minimum of four crank cycles (rolling) of the specified prime mover and have sufficient current available for "break-away" currents for the particular engine used at the specified worst case temperature.

A float type battery charger, compatible with the batteries selected, shall be furnished which shall maintain the starting batteries at full charge. Battery chargers for 25 kW - 200 kW shall be a 5 amp charger, 10 amp chargers for 230 kW - 800 kW, and 20 amp chargers for 900 kW - 2250 kW generators. The charging system shall permit charging from either the normal or the emergency power source. It shall have a high rate and low rate charging system. A voltmeter shall indicate the charge rate and the circuit will be protected by either fuses or circuit breakers. The charger or charging circuit shall be so designed that it will not be damaged during the engine cranking, achieved, for example, by a current limiting charger or a crank disconnect relay. It shall also be capable of recharging a discharged battery in 12 hours while carrying normal loads. The charger shall be rated 24 VDC and a minimum of 10 amps. It shall be mounted on the generator set near the starting batteries and NOT in the Automatic Transfer Switch enclosure.

2.06 ENGINE COOLING SYSTEM

The engine shall be liquid cooled. The type of liquid cooling system shall be a unit mounted radiator. The radiator capacity shall be suitable for operation in the ambient temperature specified in paragraph 2.02, plus the air temperature rise across the engine.

2.07 AIR SUPPLY/EXHAUST SYSTEM

- A. Cleaner: An air cleaner and silencer shall be furnished as recommended by the engine manufacturer and shall be located and mounted as recommended by the engine manufacturer.
- B. Exhaust: An exhaust system of suitable size, configuration and material in accordance with engine manufacturer's recommendations shall connect the exhaust outlet of the engine to the silencer. The type of silencer shall meet the requirements of engine manufacturers and shall be critical grade silencing type.

The exhaust system and silencer shall be of such size that back pressure on the system will not exceed the back pressure permitted by the manufacturer's recommendation. A flexible connection shall be mounted at the engine exhaust outlet and the discharge end of the exhaust line shall be protected against entry of precipitation. Screening or suitable lagging shall protect piping within reach of personnel. All exhaust piping shall be gas tight.

2.08 ENGINE PROTECTIVE DEVICES

The following engine protective devices shall be provided, and an indicating light shall be supplied for use with each device specified.

Alarm system for high water temperature and low oil pressure.

Automatic engine shutdown for high water temperature and/or low oil pressure.

Combination alarm and shutdown system for high water temperature and low oil pressure.

Engine overspeed automatic shutdown device.

Engine failed to start indicator light (overcrank).

Alarm for low coolant level.

A shunt trip and under-voltage trip shall be incorporated to cause the circuit breaker to open simultaneously with any automatic shutdown of the engine.

2.09 FUEL SUPPLY FOR ENGINE

- A. Main Fuel Storage Tank: A dual wall sub-base fuel storage tank with sufficient fuel capacity to allow the unit to operate continuously for 72 hours or 1000 gallons, whichever is greater, shall be skid mounted and shall be complete with all piping and fittings connected. The tank shall be constructed of aluminized steel with all access ports and vents located on the top horizontal surface. The tank shall be U.L. listed and tested and no galvanized material shall be used in the tank or system. The tank shall be furnished with faucet valve located in the supply pipe of the tank and a check valve incorporated to ensure prime is maintained. The tank shall be vented to atmosphere. The tank shall be pressure and load tested according to U.L. 142 and shall be U.L. listed. The tank shall be capable of supporting the weight of the generator, isolator, and enclosure, and shall have four lifting eyes capable of lifting the entire generator set package. Low level and leak detector float switches shall be provided, both wired to control panel alarm lights, and a tank mounted fuel gauge. Location and installation of the fuel storage shall be in accordance with applicable government, insurance restrictions, and local building code.

The generator fuel storage tank shall be completely filled with fuel by the Developer before start-up of the lift station.

- B. Main Fuel Delivery System: A system shall be supplied to deliver an adequate amount of fuel to the engine from the storage tank. Pipe sizes shall be no smaller than the minimum recommended by the engine manufacturer to avoid fuel flow restriction. The engine supply and return line shall be equipped with a length of flexible fuel lines, unions and gate valves. No copper lines are acceptable.

The system shall include an engine driven transfer pump of sufficient lift and capacity to deliver fuel at the maximum required rate from the storage tank to the engine. A check valve shall be furnished in supply line at engine.

PART 3 - GENERATOR

3.01 DESCRIPTION

The generator shall meet all requirements of NEMA MG-1, Part 22, in design, performance and factory test procedures. The regulator shall be factory wired and tested with the generator. The generator shall have the characteristics and ratings required by paragraph 2.10.

3.02 EXCITATION SYSTEM

The generator shall be equipped with a permanent magnet generator (PMG) excitation system. Both the PMG and the rotating brushless exciter shall be mounted outboard of the bearing. The system shall supply a minimum short circuit support current of 300% of the standby rating for 10 seconds. The rotating exciter shall use a three phase full wave rectifier assembly with hermetically sealed silicon diodes protected against abnormal transient conditions by a multiplate

selenium surge protector.

3.03 CONSTRUCTION

The insulation system of both the rotor and stator shall be of NEMA Class H materials and shall be synthetic and non-hygroscopic. Field windings shall be on the rotor, and the rotor core shall be shrunk-fit and keyed to the shaft. The stator winding shall be of 2/3 pitch design to eliminate the third harmonic. Units rated above 1500 kW or 601 volts or higher shall be form wound.

The temperature rise of both the rotor and the stator shall be in accordance with the applicable sections of NEMA MG-1-22, BS-5000 part 99, or CSA C22.2, for the type of service intended. The generator shall be self-ventilated.

3.04 CONDUIT BOX

Load connections shall be made in the front-end mounted junction box. The generator construction will allow connection to the load through the top, bottom or either side of the junction box.

The conduit box shall contain two compartments: one to house the rotating rectifier and PMG, and the other to house the connection area and regulator. This is to separate the rotating elements from the load connection and voltage regulator adjustments.

3.05 VERIFICATION OF PERFORMANCE

All performance and temperature rise data submitted by the bidder shall be the result of the actual test of the same or duplicate generators. Temperature rise data shall be the result of full load, 0.8 power factor heat runs at the rated voltage and hertz. All performance testing shall be done in accordance with MIL-STD-705 and/or IEEE Standard-115.

3.06 EFFICIENCY

The generator efficiency shall be determined in accordance with NEMA MG-1, paragraph 22.44. All test results shall be submitted to the Engineer for approval.

PART 4 - VOLTAGE REGULATION

The generator shall be equipped with a voltage regulator to maintain voltage within limits as specified below:

Stability: 1/2% maximum voltage variation at any constant load from no load to full load.

Regulation: 1% maximum voltage between no load steady state and full load steady state.

Transient: 20% maximum voltage dip in most severe motor starting condition.

See paragraph 1.01.

Transient: 2 seconds maximum voltage recovery time with application or removal of 0.8 P.F. full load.

The regulator shall be a solid state type using transistors or SCR's. The unit shall include volts/hertz underspeed protection, 3 phase RMS sensing, and overexcitation protection. The regulator shall also provide loss of sensing protection, regulator current limit, temperature protection and an engine unloading circuit. EMI suppression shall be provided meeting MIL-STD-461B, part 9 standards.

PART 5 - GENERATOR FULL MAIN LINE CIRCUIT BREAKER

A generator main circuit breaker shall be provided. The interrupting capability shall be greater than the generator short circuit capability, but not less than 30,000 symmetrical amperes at 480 volts. The breaker continuous current trip rating shall be selected to provide overload protection for the generator. Main circuit breaker shall have GFCI protection per NEC.

The breaker shall be provided with a shunt trip device. The generator starting circuit battery system will be used as the power source for the shunt trip circuit. The shunt trip coil voltage shall be suitable for use on the starting circuit.

The breaker shall include 3 normally open and 3 normally closed auxiliary contacts.

The breaker shall be a Square D Type MA, or alternate as manufactured by General Electric, [Merlin Gerin](#) or Eaton/Cutler-Hammer.

PART 6 - AUTOMATIC START AND STOP CONTROLS

6.01 GENERAL DESCRIPTION

Automatic starting and stopping controls shall be furnished to start the engine automatically when the normal electric power fails or falls below specific limits and to stop the engine automatically after the normal power supply resumes. The signal for starting or stopping the engine shall be from an external auxiliary contact. The controls shall be capable of operating at 50% of normal DC system supplied voltage.

6.02 ENGINE CRANKING CONTROL

Crank control and time delay relays shall provide at least four(4) cranking periods. Each cranking period shall be at least 7 seconds, and the cranking attempts shall be separated by appropriate rest periods. A sensing device shall automatically disconnect the starting circuit when the engine has started. If the engine has not started at completion of the starting program, the over-cranking signal shall so indicate. The engine starting controls shall be locked out and no further starting

attempts shall take place until the over-cranking device has been manually reset.

6.03 SELECTOR SWITCH

A selector switch shall be incorporated in the automatic engine start and stop controls. It shall include an "off" position that prevents manual or automatic starting of the engine, a "manual" or "handcrank" position that permits the engine to be started manually by the pushbutton on the control cabinet and run unloaded; an "automatic" position which readies the system for automatic start or stop on demand of the automatic load transfer switch or a programmed exerciser.

6.04 MANUAL TEST OPERATION

It shall be possible to start the engine manually and run it unloaded by a manual pushbutton on the control cabinet that causes the engine to start, run and stop through the automatic start and stop controls.

PART 7 - INSTRUMENTATION

7.01 INSTRUMENTS AND CONTROLS

The following engine and generator instruments and controls shall be furnished and installed:

A.C. ammeter

A.C. voltmeter

Voltage adjusting rheostat

Battery Voltage Meter

Governor speed adjusting control

Water temperature gauge

Oil Pressure gauge

Manual start/stop control

Manual-Off-Auto mode switch

Voltmeter/ammeter phase selector switch

Generator "Run" Status Dry Contacts

Common Alarm Dry Contacts

Elapsed time meter

Panel lights

Indicator lights for engine alarm

All wiring and interconnections shall be in accordance with commercial electrical standards.

7.02 LOCATION

All of the foregoing instruments, lights and controls shall be mounted in a control panel on the generator set. All instrumentation must be isolated from engine generator set vibration.

In addition, a "generator ready" light, a start/stop control, and an audible alarm and alarm light shall be provided in a generator **remote annunciator** panel to be remotely wall mounted. The audible alarm and alarm light shall operate for any of the engine or generator alarms provided on the local control panel. Cable between the local and remote control panels shall be provided.

7.02 CONTROL PANEL DESIGN

All instruments, controls and indicating lights shall be properly identified. All wires shall be individually identified and must agree with wiring diagrams provided.

Terminals on all terminal blocks shall be individually identified.

PART 8 - ACCESSORIES

8.01 ENCLOSURE

The enclosure shall be weatherproof, sound attenuating, outdoor enclosure. The enclosure shall be 14 gauge steel construction. The enclosure shall include two(2) single access doors per side. The finish shall be painted standard alkyd enamel. Piedmont Water Company will make the determination if the enclosure shall be sound attenuated for a commercial installation or residential installation. Enclosures for commercial installations shall be rated 75 dBA @ 7 meters from the enclosure. Enclosures for residential installations shall be rated 65 dBA @ 1 meter from the enclosure. Exhaust roof dress cap, silencer mounting brackets, exhaust system assembly including the above mentioned silencer shall be designed to go inside the enclosure with flex, elbow and rain cap. Finish shall be painted standard alkyd enamel. Oil and water drains are extended to the exterior of the enclosure, each with identifying nameplate.

The enclosure shall be provided with the following electrical accessories:

- Junction boxes for battery charger and jacket water heater connection.

- Connection for low alarm, high alarm, leak alarm, and fuel fill pump switch.

8.02 BLOCK HEATER

An engine block heater shall be provided shall be provided to keep the engine coolant at a temperature of 85° F with the ambient temperature at the minimum specified paragraph 2.02. The heater shall be suitable for operation at 208 volts AC, single phase. No internal elements of the heater shall be inside the engine.

8.03 CONTROL PANEL HEATER

A heater shall be provided in the control panel to keep the interior of the panel above 40° F when at the minimum ambient temperature specified in paragraph 2.02. The heater shall be operated by a thermostat, and shall be suitable for operation at 120 volts ac, single phase. Manufacturers using control panels with modules that are environmentally sealed and that are not subject to moisture and can operate accurately in temperatures of -40 degrees F to 158 degrees F are not required to use control panel heaters.

8.04 CATWALK

All generators sitting on fuel tanks must have a steel or aluminum "Catwalk" all the way around the unit for service. The "catwalk" shall also include steps for access to the "catwalk".

PART 9 - AUTOMATIC TRANSFER SWITCH

9.01

A. GENERAL

1. The automatic transfer switch shall be rated for total normal and emergency system transfer for use on a 480 or 230 VAC, 3 phase, 4 wire system.
2. Each automatic transfer switch shall consist of a power transfer module and a control module, interconnected to provide complete automatic operation. The automatic transfer switch shall be mechanically held and electrically operated by a single-solenoid mechanism energized from the source to which the load is to be transferred. The switch shall be mechanically interlocked to ensure only one of two possible positions, normal and emergency.
3. All main contacts shall be of silver composition. The operating transfer time in either direction shall not exceed one-sixth(1/6) of a second.
4. All contacts, coils, springs and control elements shall be conveniently removable from the front of the transfer switch without major disassembly or disconnection of power conductors.
5. Automatic transfer switches utilizing components of molded-case circuit breakers, contactors, or parts thereof which have not been intended for continuous duty or repetitive load transfer switching are not acceptable.

6. The current rating shall be a continuous rating when the switch is installed in an unventilated enclosure, and shall conform to NEMA temperature rise standards. Designs which require cabinet ventilation are unacceptable and do not meet this specification.
7. The automatic transfer switch shall conform to the requirements of NEMA Standard ICS-2-447 and Underwriters' Laboratories UL-1008 and shall be listed as follows:
 - For use in emergency systems in accordance with Articles 700, 701, and 702 of the National Electrical Code.
 - Rated in amperes for total system transfer including control of motors, electrical discharge lamps, electrical heating and tungsten filament lamp loads as referred to in Paragraph 30.9 of UL-1008.

9.02 CONTROL

Sensing and control logic shall be solid-state. Interfacing relays shall be industrial control grade plug-in type with dust covers

All phases of the normal shall be monitored line-to-line. Close differential voltage sensing shall be provided. The pickup voltage shall be fields adjustable from 85% to 100% of nominal and the dropout voltage shall be adjustable from 75% to 95% of the pickup value. The transfer to emergency will be initiated upon reduction of normal source to 85% of nominal voltage and retransfer to normal shall occur when normal source restores to 95% of nominal.

The following time delays shall be provided:

- A time delay to override momentary normal source outages. The time delay shall be field adjustable from 0.5 to 6 seconds and factory set at 1 second.
- A time delay on retransfer to normal source. The time delay shall be automatically bypassed if the emergency source fails and normal source is available. The time delay shall be field adjustable from 0 to 30 minutes and factory set at 5 minutes.
- An unloaded running time delay for emergency generator cool down. The time delay shall be field adjustable from 0 to 5 minutes and factory set at 5 minutes.
- A time delay on transfer to emergency. The time delay shall be field adjustable from 0 to 5 minutes for controlled timing of load transfer to emergency, and factory set at zero.

The following features and accessories shall be provided:

- Independent single phase voltage and frequency sensing of emergency source. The pickup voltage shall be adjustable from 85% to 100% of nominal. Pickup frequency shall be adjustable from 90% to 100% on nominal. Transfer to emergency upon normal source failure when emergency source voltage is 90% or more of nominal and frequency is 95% or more of nominal.
- A contact that closes when normal source fails and one that opens when normal source fails, rated 10 Amps, 120V ac.
- A white signal light to indicate when the automatic transfer switch is connected to the normal source. A yellow signal light to indicate when the automatic transfer switch is connected to the emergency source.
- Two auxiliary contacts that are closed when the automatic transfer switch is connected to normal and two auxiliary contacts that are closed when the automatic transfer switch is connected to emergency. Rated 10 Amps, 120 volts, 60 Hz. AC.
- A test switch to momentarily simulate normal source failure.
- Reset switch to manually bypass time delay on retransfer to normal. A permissive start/stop feature to provide for start/stop of the generator from a remote site regardless of the presence of normal utility power.

The automatic transfer switch shall be mounted in a NEMA 4X for outdoor installations.

9.03 CONSTRUCTION AND PERFORMANCE

The automatic transfer switch shall be of double throw construction operated by a reliable electrical mechanism momentarily energized. There shall be a direct mechanical coupling to facilitate transfer in 6 cycles or less.

The normal and emergency contacts shall be mechanically interlocked such that failure of any coil or disarrangement of any part shall not permit a neutral position.

For switches installed in systems having ground fault protective devices, and/or wired so as to be designated a separately derived system by the

NEC, a 4th pole shall be provided. This additional pole shall isolate the normal and emergency neutrals. The neutral pole shall have the same withstand and operational ratings as the other poles and shall be arranged to break last and make first to minimize neutral switching transients. Add-on or accessory poles that are not of identical construction and withstand capability are not acceptable.

The contact structure shall consist of a main current carrying contact, which is a silver alloy with a minimum of 50% silver content. The current carrying contacts shall be protected by silver tungsten arcing contacts on all sizes above 400 Amps.

The transfer switch manufacturer shall submit test data for each size switch required for this project, showing that it can withstand fault currents of the magnitude and the duration necessary to maintain the system integrity. Minimum UL listed withstand and close into fault ratings shall be as follows:

Any Molded Case Breaker*:

Size (Amps)	(RMS Symmetrical)
Up to 200	10,000
201 - 260	35,000
261 - 400	35,000
401 - 1200	50,000
1201 - 4000	100,000

Specific Coordinated Breaker*:

Size (Amps)	(RMS Symmetrical)
Up to 150	30,000
151 - 260	42,000
261 - 400	50,000
401 - 800	65,000
801 - 1200	85,000
1201 - 4000	100,000

Current Limiting Fuse*:

Size (Amps)	(RMS Symmetrical)
Up to 4000	200,000

*All values 480 volt, RMS symmetrical, less than 20% power factor.

Note: Actual necessary current withstand ratings for this project may be higher than the minimums listed above. Refer to electrical design plans for exact requirements.

The automatic transfer switch manufacturer shall certify sufficient arc interrupting capabilities for 50 cycles of operation between a normal and emergency source that are 120 degrees out of phase at 480 volts, 600% of rated current at .50 power factor. This certification is to ensure that there will be no current flow between the two isolated sources during switching.

All relays shall be continuous duty industrial type with wiping contacts. Customer interface contacts shall be rated 10 amperes minimum. Coils, relays, timers and accessories shall be readily front accessible. The control panel and power section shall be interconnected with a harness and keyed disconnect plugs for maintenance. See Electrical Drawings for consumer interface contacts information.

Main and arcing contacts shall be visible without major disassembly to facilitate inspection and maintenance.

A manual handle shall be provided for maintenance purposes with the switch de-energized. An operator disconnect switch shall be provided to defeat automatic operation during maintenance, inspection or manual operation.

Switches composed of molded case breakers, contactors or components thereof not specifically designed as an automatic transfer switch will not be acceptable.

To afford the advantage of a single source of supply to the owner, the automatic transfer switch shall be supplied by the manufacturer of the engine generator set and covered under the same warranty program.

PART 10 - INSTALLATION, ASSEMBLY AND TESTING

10.01 TESTS

Certified laboratory test data on a switch of the same design and rating shall be provided by the automatic switch manufacturer to confirm the following switching abilities:

- Overload and endurance at 480 VAC or 230 VAC per Tables 21.2, 23.1 and 23.2 of UL-1008.
- Temperature rise tests after the overload and endurance tests to confirm the ability of the transfer switches to carry their rated current within the allowable temperature limits of the insulation in contact with current-carrying parts.
- Withstand current tests per Paragraph 25 of UL-1008 for 100,000 amperes rms symmetrical, at rated voltage and an X/R ratio of 6.6

Standard Technical Specifications - Engine Driven Generator Sets
when used with current limiting fuses.

- No welding of contacts. Transfer switch must be operable by the normal means after the withstand current tests.
- Dielectric tests at 1960 volts, rms, minimum after the withstand current test.

- The complete automatic transfer switch shall be tested as to ensure proper operation of the individual components and correct overall sequence operating transfer time, voltage, frequency and time delay settings are in compliance with the specification requirements.

- The complete automatic transfer switch shall be subjected to a dielectric strength test per NEMA standard ICS 1-109.21, after the withstand current test.

- The control panel shall meet or exceed the voltage surge withstand capability in accordance with ANSI/IEEE Standard C37.90a, latest edition, and the impulse withstand voltage test in accordance with proposed NEMA Standard ICS 1-109.

10.02 ASSEMBLY DRAWINGS AND WIRING DIAGRAMS

Copies of installation drawings and complete wiring diagrams and interconnections shall be furnished to the engineer.

10.03 MOUNTING

The mounting of the generator set shall be sufficiently rigid to maintain alignment and to minimize the engine and generator stresses. The floor loading shall not exceed 5000 lbs. per sq. ft. A suitable number of spring type, vibration, rubber type, and fiberglass isolators shall be inserted between the engine generator set and the floor.

10.04 VENTILATION REQUIREMENTS

The bidder shall submit with his submittal an estimate of air flow requirements for cooling and combustion, plus an estimate of heat rejection of the engine and generator when operating at 100% load. These estimates shall be based on manufacturer's data.

10.05 ACCEPTANCE TEST

The extent of testing shall be at the discretion of Piedmont Water Company. The completed generator set shall be tested at 1.0 P.F. for a period of one hour at full load prior to shipment to the job site. In addition, the generator set supplier shall include in his price the cost of an on site, full load test (using portable resistive type load banks or building load or combination thereof) for a minimum of four hours in the presence of a representative of the owner and/or engineer before final

acceptance.

10.06 MANUFACTURER

The generator set shall be manufactured by Katolight, Onan, or Olympian Caterpillar.

****END OF SECTION****