

GUIDELINE
STANDARDS & SPECIFICATIONS
FOR
**WATER & WASTEWATER
UTILITIES**



Pace Water System, Inc
and
Pace Property Finance Authority, Inc.

INTRODUCTION

General

This manual, "Guideline Standards and Specifications for Water, Wastewater and Reuse Water Utilities," is adopted to establish minimum acceptable standards for the design and construction of water distribution and transmission facilities, wastewater collection and transmission facilities and reclaimed water distribution and transmission facilities to be served by the water and/or sewer and/or reclaimed water systems of Pace Water System, Inc. (PWS). The manual is to be used as a guide by Professional Engineers preparing construction plans and specifications for projects to be served by PWS. It is not intended or desired that the guide specifications and standard details be copied for each project. Rather they should be used to establish the quality of construction that is required by PWS. The manual is not intended to cover all circumstances and must be supplemented and/or modified as the situation dictates. Use of these documents for other purposes is strictly prohibited without the express written consent of PWS.

Jurisdiction

This manual shall apply to all proposed systems within the entire franchise area of PWS and any other areas requesting water and/or sewer and/or reclaimed water service water by PWS.

Scope

This manual is divided into four sections. Section 1, "General Requirements and Procedures," presents general guidelines governing submittal review, approval of plans and specifications and construction inspection through project acceptance. Section 2, "Design Standards," provides general design standards for the Professional Engineer and engineer-of-record when designing and preparing plans and specifications for submittal to and review by PWS. Section 3, "Technical Specifications," contains minimum acceptable specifications governing construction of all water, wastewater and reclaimed water improvements which will become the responsibility of PWS. Section 4, "Standard Drawings," contains plans and details associated with typical improvements and may be considered a supplement to the technical specifications.

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SECTION 1



GENERAL REQUIREMENTS AND PROCEDURES

SECTION 1
GENERAL REQUIREMENTS AND PROCEDURES

1.1 GENERAL

The procedures provided herein detail the steps involved for PWS approval of a development that requires water and/or sewer and/or reclaimed water service from PWS. All construction work shall be subject to the approval of the Board of Directors of PWS or their designated representative. Adherence to this procedure is in the best interest of the developer, engineer, PWS, and future customers of PWS to ensure the systems are adequately sized and to minimize operation and maintenance problems in the future.

PWS will work closely with the developer and his engineer to minimize review time. The timely and accurate submittal of all required information is the best assurance of a quick and satisfactory review.

1.2 STATEMENT OF AVAILABILITY

If requested, a "Statement of Water and Sewer and Reclaimed Availability" will be issued to the Owner or Developer requesting service, providing adequate capacity is currently available. The Statement is not a guarantee that capacity will be available when needed. Capacity is guaranteed only upon receipt by PWS of all capacity and impact fees. For commercial site plans, the statement will be provided after submittal of site plans to PWS for review.

1.3 REVIEW FEE

A review fee shall be paid to PWS by all developers in the case of new construction involving facilities to be connected to PWS. The review fee is intended to cover the cost of engineering review of construction plans and specifications by PWS. A review fee will be paid when application for service is requested and it shall be in accordance with the following:

WATER	\$10.00 per ERU*, minimum \$100.00
SEWER	\$10.00 per ERU*, minimum \$100.00
RECLAIMED	\$10.00 per ERU*, minimum \$100.00
WATER & SEWER ONLY	\$15.00 per ERU*, minimum \$150.00
ALL THREE	\$20.00 per ERU*, minimum \$200.00
* ERU = Equivalent Residential Unit = 300 gallons per day for water and sewer demand (See Tap Fee Schedule for further details)	

Additional fees may be required if several reviews for the same project are required based upon inadequate submittals.

1.4 RESPONSIBILITY

The developer shall be responsible for the cost of the permit processing as well as the installation and construction of the water, sewer and reclaimed water facilities on the user's property and from the user's property to the existing system to a point where lines are sufficient in size to supply adequate service approved by PWS.

All customers must pay the water, sewer and/or reclaimed water connection (tap) fee, any impact fees, and provide the means to convey sewage to PWS at their own expense. All connection fees for water, sewer and/or reclaimed water service shall be paid to PWS. These fees are due and payable prior to the connection of any service or tap. PWS will be responsible for the installation of all individual meters for residential customers. All commercial customers are responsible for the tap and accessories. PWS will provide the meter for commercial customers up to and including 1 ½ inch. Larger services are to be installed and paid for by the Owner or Developer under the direct supervision of a representative of PWS.

In the event PWS requires installation of larger facilities than would normally be needed by the developer to provide sewer service, water service, reclaimed water service and fire protection to the development, PWS shall bear the difference in cost of the larger facilities. A written agreement on cost sharing must be prepared in advance of construction. The developer shall provide to PWS such easements, rights-of-way, or rights-of-access to any and all parts of, water, sewer, and/or reclaimed water facilities. Such rights shall be formalized prior to acceptance of the facilities by PWS. The widths shall be as prescribed by PWS. Easements shall be provided at no cost to PWS.

1.5 SUBMITTAL REQUIREMENTS/REVIEW/ACCEPTANCE

A. General

At time of application for service and payment of the review fee, one project location map on tax aerials and 2 sets of plans, specifications, permit applications and design calculations shall be submitted by the developer's engineer to PWS for review. Two certified sets of As-Built record drawings, two copies of the final plat, a one year performance bond, or letter of warranty and a computer disk showing water, sewer and reclaimed water systems shall be submitted to PWS prior to formal acceptance of the system by PWS. The developer shall be responsible for providing the Florida Department of Environmental Protection (F.D.E.P.) a certification of completion that includes the As-Built drawings certified by a professional engineer. Acknowledgment of acceptance of this certification by the F.D.E.P., completion of punch list items, and check-out/inspection of the systems by PWS are required before final acceptance by PWS. Representatives of PWS shall also witness tests of the systems and receive copies

of bacteriological tests. All submittals to PWS shall be signed, dated and sealed by a Professional Engineer registered in Florida.

B. Sale of Taps

Neither water, sewer, nor reclaimed water taps will be sold within the Project until the water, sewer and reclaimed water, systems are accepted by PWS in accordance with paragraph A. above.

C. Acceptance of Water, Sewer and Reclaimed Water Systems

By acceptance of water, sewer and reclaimed water systems, PWS assumes responsibility for operation and maintenance. Where grinder pumps are authorized for single family (simplex units) or commercial (duplex units) units, the property owner is responsible for the cost of installation of the grinder units in addition to the applicable tap and impact fees. Furthermore, the property owner is responsible for operation and maintenance costs. The grinder installation must be in accordance with these Guidelines.

D. Plans and Specifications

1. General

All submitted plans shall be standard size sheet (30" x 42", 24" x 36" or 11" x 17") with title block. Graphic scale(s) shall be provided on each sheet and all lettering shall be 1/8" or larger to permit photographic reproduction. All plans sheets and the title page of submitted specifications must be signed, sealed and dated by the developer's engineer.

2. Master Plan

The entire water, wastewater and reclaimed water systems shall be shown on a single Project Plan and/or Master Plan. This Plan shall indicate the general locations of all mains, manholes, valves, hydrants, services and service laterals with respect to the proposed development improvements and the existing water, wastewater and reclaimed water systems. Main sizes shall be indicated on this Plan.

3. Location Map

A location map shall be provided of the project area and area surrounding to easily identify general location of the project. The map of the area surrounding shall consist of a minimum one-half mile radius and a minimum scale of 1 inch = 2000 feet (shown graphically).

4. Plan and Profile

All shall be drawn in plan and profile. Water and reclaimed water mains may be shown in plan view only.

Whenever possible, on-site water and wastewater systems shall be shown on the same plan sheet. As a minimum, the plan and profile drawings shall include the following information:

- a. General information such as north arrow, names of designer and engineer, revision block with dates, graphic scale(s) and sheet number.
- b. Profile with elevations at 100 foot intervals, or more frequently if required by good design practice.
- c. Development layout with horizontal and vertical controls.
- d. All conflicts with other utility and drainage systems.
- e. All manhole locations, rim elevations, and all invert elevations.
- f. Pipe data including size, lengths, material, and slopes.
- g. Size, type, and locations of fittings, valves, hydrants, air release/vacuum relief, and other related appurtenances.
- h. Limits of pipe deflection.
- i. Limits of special interior coatings.
- j. Limits of special bedding requirements.
- k. Pipe restraint requirements.
- l. Details of connection to existing systems.
- m. Location(s) and general layout of wastewater pumping stations.
- n. Construction notes regarding cover, horizontal and vertical control, special construction requirements, and references to standard and special details.

5. Details

The plans shall include all applicable standard drawings as shown in Section 4 of this manual. Special details shall be prepared by the developer's engineer for aerial and underwater crossings of rivers, streams, canals and ditches. Other special details shall be prepared by the developer's engineer as required.

6. Scale

The master plan shall be prepared at a scale not to exceed 1" to 200'. Plan and profile sheets shall not exceed a scale of 1" to 50' Horizontal and 1" to 5' Vertical. Special details shall be of sufficiently large scale to show pertinent construction information.

7. General Notes

The following General Notes shall be included on all plans submitted to PWS for review:

Contractor shall contact PWS at least 48 hours prior to connection of proposed facilities to existing PWS facilities. PWS personnel shall be present for all taps.

All on-site water and sewer facilities shall be privately owned, operated, and maintained.

Contractor is responsible for adjustment of existing utilities if proposed improvements impact existing utilities.

E. Design Calculations/Permit Documentation

The design of water, wastewater and reclaimed water improvements associated with PWS shall be in compliance with the design standards in Section 2, the specifications outlined in Section 3, and the standard drawings contained in Section 4. Design calculations will be reviewed and approved by PWS prior to action taken on permit documentation. It shall be the responsibility of the developer to obtain and comply with all applicable Federal, State and Local regulatory permits. The developer shall also be responsible for the costs associated with such permitting. The developer shall supply copies of all permit documentation upon request by PWS.

F. Construction Inspection and As-Built Drawings

A PWS designated representative(s) shall periodically inspect all construction subject to these standards and specifications.

After all required improvements have been installed; the developer's engineer shall submit certification to the system that the improvements have been constructed substantially according to approved plans and specifications. Noncompliance with approved plans or specifications or evidence of faulty materials or workmanship shall be called to the attention of the developer or developer's engineer and if not corrected in an expeditious manner, all work on the project may be suspended and/or use of facilities withheld. Laboratory tests may be required when appropriate.

The developer's engineer shall submit two certified printed sets and one electronic copy of As-Built Record Drawings to PWS prior to formal acceptance of improvements by PWS. The developer's engineer shall be responsible for recording information on the approved plans concurrently with construction progress. Record Drawings submitted to PWS as part of the project acceptance shall comply with the following requirements:

1. Drawings shall be legibly marked to record actual construction.
2. Drawings shall show actual location of all underground and above ground water, wastewater and reclaimed water piping and related appurtenances. All changes to piping location including horizontal and vertical locations of utilities and appurtenances shall be clearly shown and referenced to permanent surface improvements. Drawings shall also show actual installed pipe material, class, etc.
3. Drawings shall clearly show all field changes of dimension and detail including changes made by field order or change order.
4. Drawings shall clearly show all details not on original contract drawings but constructed in the field. All equipment and piping relocation shall be clearly shown.
5. Location of all manholes, hydrants, valves, and valve boxes shall be shown. All valves shall be referenced from at least two and preferably three permanent points. One reference point shall be the center line of the roadway. Water and reclaim services shall also be referenced to the nearest lot lines.
6. Sanitary sewer laterals shall be measured from the nearest downstream

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manhole.

7. Dimensions between all manholes shall be field verified and shown. The inflowing and outflowing inverts and grade elevations of all manholes shall be field verified and shown.

Each sheet of the plans shall be signed, sealed and dated by the developer's engineer as being "As-Builts" or "Record Drawings." Construction plans simply stamped "As-Builts" or "Record Drawings" and lacking in above requirements will not be accepted, and will be returned to the developer's engineer. The formal acceptance by the Board of Directors will not be issued until correct "Record Drawings" have been approved.

G. One Year Warranty

A one year warranty of workmanship or performance bond shall be provided to PWS before acceptance.

H. Operation and Maintenance Manuals

At completion of construction (or before) three complete sets of Operation and Maintenance Manuals (O&M) shall be submitted to PWS. PWS will review the O&M manuals for completeness before final system acceptance by PWS.

I. Cost Brakdown

Developer shall submit a cost breakdown of all utility improvements installed prior to acceptance of said improvements.

1.6 LIST OF MATERIALS AND APPROVED MANUFACTURERS

A list of Materials and Approved Manufacturers for the various products specified in this manual is included in Appendix "A". It is the intent of PWS to review and update Appendix "A" as appropriate to ensure efficient operation of the services and facilities under the jurisdiction of this manual. For this purpose, the system shall evaluate technical submittals from interested manufacturers or suppliers at least once every two years.

SECTION 2



DESIGN STANDARDS

SECTION 2
DESIGN STANDARDS

2.1 WASTEWATER COLLECTION SYSTEM - GENERAL REQUIREMENTS AND STANDARDS

A. General

The following minimum requirements are considered acceptable to PWS in the collection of wastewater from domestic and commercial customers.

Deviations from these standards may be allowed by PWS only upon a finding by PWS that, in accordance with sound engineering standards, the granting of deviation will not work to increase the likelihood of a system problem. No deviation will be allowed unless it is clearly noted on the approved construction plans.

All expansion shall conform to the "Master Plan for Wastewater" as maintained and amended by PWS.

When these standards differ from state and/or federal requirements, the more stringent requirement shall apply.

The collection system for wastewater includes the gravity mains, manholes service laterals located within the right of way or easement, lift stations, force mains, and other appurtenances. The system should be designed to provide the collection of wastewater from the customers and for the safe and economical transport to the treatment plant.

B. Standards

1. Environmental Protection Agency and US Public Health Service:

The governing standards of these agencies will be followed when applicable.

2. Florida Department of Environmental Protection:

The wastewater collection system shall conform to the applicable Florida Department of Environmental Protection laws, standards, and rules and regulations for public wastewater collection systems.

3. Plumbing Codes:

The provisions of the Florida Building Code as it pertains to sanitary wastewater collection, service line locations and materials, and backflow prevention devices, except as provided for elsewhere in these criteria, shall apply.

4. Pace Water System, Inc.:

All wastewater collection systems that are to become a part of PWS shall be designed and constructed in accordance with these standards. Materials, installation, and construction methods and procedures shall be in accordance with Sections 3 and 4 of this manual.

2.2 GRAVITY SEWER

A. Location/Future Connection

Gravity sewers shall be located in dedicated rights-of-way or utility easements. Whenever possible, sewers shall be located under pavement in dedicated rights-of-way. All sewers located outside of dedicated rights-of-way shall require a minimum 20-foot easement. Additional easement widths shall be provided when the pipe size or depth of cover so dictate. If a gravity sewer is located adjacent to a road right-of-way, a minimum 10-foot easement shall be provided. Additional easement widths shall be provided if the pipe size or depth of cover so dictate. No gravity sewers shall be placed under retention ponds or other structures. In general, gravity sewers shall not be located along side or rear lot lines. Placement of a gravity sewer along side or rear lot line may be allowed on a case by case basis if such a configuration results in efficient placement and utilization of the sewer system.

Provisions for future connecting mains shall be made by providing appropriate easements and/or extending construction of all wastewater mains to the exterior boundaries of the subdivision where future connections to adjacent subdivisions or lots are anticipated.

B. Design Basis

1. Average Daily Flow:

Required average daily flow for sanitary use in residential areas shall be based on 350 gallons per day per unit (100 gpcpd x 3.5 persons) or as approved by PWS.

The required flow for commercial, industrial, or other nonresidential areas shall be as determined by the Engineer and approved by PWS for each specific instance. Justification for such flows shall be documented within the design calculations.

2. Peak Design Flow:

Gravity sewers shall be designed on the basis of ultimate development maximum rates of flow, which shall be the product of selected peak

factors times the accumulative average daily flow as calculated above. In general, the following minimum peak factors shall be applicable for the range of average daily flow rates.

FLOW RANGE	MINIMUM PEAK FACTOR
Flows to 100,000 GPD	4.0
100,000 GPD to 250,000 GPD	3.5
250,000 GPD to 1,000,000 GPD	3.0
Flows greater than 1,000,000 GPD	2.5

For design average daily flows above 2,000,000 GPD, peaking factors less than 2.5 may be considered if substantiated by extensive data. Under no circumstances shall peaking factors less than 2.0 be allowed.

3. Minimum and Standard Main Size:

Minimum gravity main diameter shall be 8 inches in all areas. Standard sizes of gravity mains used shall have nominal diameters of 8 inches, 10 inches, 12 inches, 15 inches, 18 inches, 21 inches, 24 inches, 30 inches, and 36 inches.

4. Cover:

A minimum cover of 36" inches must be provided where conditions permit.

At road crossings, a minimum separation distance of 30 inches shall be maintained from the bottom of the base to the top of the pipe or the top of the casing when provided.

At buried stream crossings, a minimum cover of 36 inches is required.

5. Slope:

Slopes shall be designed with a hydraulic gradient sufficient to prevent deposition of solids, by developing a minimum velocity of 2.0 feet per second as computed using Manning's formula and an "n" value of not less than .013 while flowing full. The following table establishes the minimum allowable slopes for various size pipes and also indicates their approximate carrying capacity when flowing full at the minimum slope:

Minimum slope allowable shall be:

PIPE SIZE INCHES	MINIMUM SLOPE %	CAPACITY FULL MGD+
8	.4	.5
10	.28	.7
12	.22	1.0
15	.15	1.6
18	.12	2.4
21	.10	3.7
24	.08	4.2
30	.06	6.6
36	.05	10.0

Under special conditions, if full and justifiable reasons are given, slopes slightly less than those required for the 2 feet per second velocity when full may be permitted. Such decreased slopes will only be considered where the depth of flow will be 0.3 of the diameter or greater for design average flow. Whenever such decreased slopes are selected, the engineer must furnish with his report his computations of the depths of flow in such pipes at minimum, average, and peak rates of flow. The selection of the size of pipe shall be determined on the basis of the most desirable flow characteristics obtainable.

In the case of sewers where the slope and volume are such that velocities exceeding 10 feet per second will be realized at design flow, special provision shall be made to protect against erosion.

Where velocities greater than 15 feet per second are attained, special provision shall be made to protect against displacement by erosion and shock.

Full advantage of suitable topography and paralleling of ground slopes shall be made. Minimum slopes should be maintained, particularly with 8" pipe. When depth exceeds 10 feet, check pipe class for strength, and/or specify stricter bedding requirements.

Sewers shall be designed and laid with a uniform slope between manholes.

6. Size Transition and Alignments

Change in pipe shall not occur between manholes:

Increasing Size: When a smaller sewer joins a larger one, the invert of the larger sewer shall be lowered sufficiently to maintain the same hydraulic gradient. An approximate method which may be used for securing this result is to place the 0.8 depth point of both sewers at the same elevation.

Decreasing Size: At times, due to increasing sewer slopes, a reduction in the size of the outgoing sewer from a manhole may be justified. Such a reduction shall not be permitted on sewers 24" in diameter or under.

Vertical separation when crossing other utilities shall be shown.

When crossing under existing paved streets or roads, developer's engineer must determine if open cut will be permitted. If boring will be required, complete details must be shown.

Extra effort should be expended to locate any possible conflict with existing utilities. Allow extra slope through bore and specify minimum and maximum allowable deviations.

The depth of the line shall be sufficient to receive flows by gravity from all buildings and lots to be served. A 36-inch minimum cover is required. Less cover may be considered with special provisions for protection of the pipe. It may be necessary to require a few buildings to pump into the line, by installing privately maintained lift stations.

Privately maintained pump stations for an individual building will be considered when gravity service is not feasible.

Sewers shall be laid with straight alignment between manholes.

In general, horizontal separation between gravity sewers and other utilities shall be as follows:

	REQUIRED HORIZONTAL SEPARATION
WATER MAIN	6 feet
RECLAIMED WATER MAIN	3 feet

7. Additional Requirements for Gravity Main

Main drain and back wash systems for pools and spas and storm drain systems shall not connect to the gravity sewer system.

In general, all sewer extensions for future connections shall terminate at a manhole. PWS may allow such extensions without a terminal manhole on a case by case basis subject to all of the following conditions:

Total sewer extension length shall be limited to 50 feet.

Sewer extension location at the initiating manhole shall be plugged to the satisfaction of PWS.

All such sewer extensions shall be inspected and accepted as part of the future construction phase.

8. Manholes

a. Location

Manholes shall be installed at the end of each gravity sewer; at all changes in grade, size or alignment; at all sewer intersections; and at distances not greater than 400 feet. Minimum depth of a manhole shall be 4 feet.

b. Type

An outside drop pipe shall be provided for a sewer entering a manhole where its invert elevation is 24 inches or more above the manhole invert (i.e., a drop manhole).

Where the difference in elevation between the incoming sewer invert and the manhole invert is less than 24 inches, the manhole invert shall be filleted to prevent solids deposition.

c. Diameter

For sewers 24 inches in diameter and smaller, the minimum inside diameter of manholes shall be 48 inches. For sewers between 24 inches and 36 inches, the minimum inside diameter shall be 60 inches. For sewers larger than 36 inches in diameter, a 72-inch inside diameter manhole shall be provided.

A minimum access cover diameter of 24 inches shall be provided.

d. Flow Channel

The flow channel through manholes shall be made to conform in shape and slope to that of the sewers. No Moor base inverts will be allowed. Flow direction changes in excess of 90 degrees shall not be included in sewer alignments without special consideration. All manholes shall have a flow line elevation drop of 0.1 feet across the manhole. Benching shall be provided which shall have a minimum slope of 2 inches per foot.

9. Service Connection

Service connection shall be through a lateral and miscellaneous appurtenances, all as shown on the approved plans and standard details, to connect the gravity sewer to the house or establishment being served.

Service laterals and fittings shall be a minimum of 4 inches in diameter. All service laterals shall be less than 60 feet in length. Longer laterals may be accepted on a case by case basis. In areas where the right-of-way is wider than 60 feet, the developer shall provide a sewer main on each side of the right-of-way.

Service laterals shall have a minimum slope of 1/8 inch per foot (1.04 percent).

In general, service laterals shall not be allowed to discharge into sanitary manholes unless the manhole is a terminal manhole. A case by case exception to this requirement may be allowed if the lateral discharges at the same elevation as the manhole invert.

A cleanout will be installed at the property line of all service laterals.

10. Grease Traps

All Food Preparation/Service Establishments shall have properly sized outside grease traps. All wastewater flow from the kitchen areas of these establishments must flow through approved grease traps prior to entering PWS Sewer System.

Sizing of a grease trap shall be in accordance with the requirements of Santa Rosa County and/or Florida Department of HRS.

2.3 WASTEWATER FORCE MAINS

A. Locations

Force mains shall be located in dedicated right-of-way or utility easements. When installed in rights-of-way, force mains shall maintain a consistent alignment with respect to the centerline of the road. All force mains located outside of dedicated rights-of-way shall require a minimum 20-foot easement. Additional easement widths shall be provided when the pipe size or depth of cover so dictate. If a force main is located adjacent to a road right-of-way, a minimum 10-foot easement shall be provided. Additional easement widths shall be provided if the pipe size or depth of cover so dictate. In general, force mains shall not be located along side or rear lot lines. Placement of a force main along

side or rear lot line may be allowed on a case by case basis if such a force main configuration results in efficient placement and utilization of the sewer system.

B. Design Basis

1. Velocity and Diameter

At design pumping rates, a flow velocity of at least 2 feet per second shall be maintained. Maximum velocity at design pumping rates should not exceed 8 feet per second. The minimum force main diameter shall be 4 inches.

2. Design Friction Losses

Friction losses through force mains shall be based on the Hazen-Williams formula. In the use of Hazen-Williams formula, the value for "C" shall be 100 for ductile iron pipe and 120 for PVC pipe. "C" values greater than 120 shall not be allowed.

When initially installed, force mains may have a significantly higher "C" factor. The higher "C" factor should be considered only in calculating maximum power requirements and duty cycle time of the motor at the pump station.

3. Design Pressure and Restraint

The force main and fittings, including all restrained joint fittings and thrust blocking, shall be designed to withstand pump operating pressures and pressure surges of two times the normal operating pressure, but not less than 200 psi.

Bearing area of thrust blocks shall be adequate to prevent any movement of the fitting.

4. Termination

Force mains shall not terminate directly into a gravity sewer line. Force mains should enter the sewer system at a point not more than 1 foot above the flow line of the receiving manhole. Force mains shall never enter a manhole from a direction contrary to the direction of flow out of the manhole. See standard details, section 4, for typical drawing.

5. Air Release and Vacuum Relief Valves

Air release valves, or air/vacuum relief valves, shall be provided, as necessary, to prevent air locking and vacuum formation. All such valves

shall be clearly delineated on the force main drawings. The developer's engineer shall submit calculations to PWS justifying the valve sizing.

6. Aerial Crossings

Support shall be provided for all joints in pipes utilized for aerial crossings. The supports shall be designed to prevent overturning and settlement.

Expansion joints shall be provided between the aerial and buried sections of the pipe.

For aerial stream crossings, the impact of flood waters and debris shall be considered. The bottom of the pipe shall be placed no lower than 1 foot above the 100-year flood elevation.

Flanged or mechanical joints shall be used. Pipe and materials shall be ductile iron, minimum class 53. Use of epoxy coated steel pipe may be allowed on a case by case basis.

Underground valves shall be provided at both ends of the crossing so that the section can be isolated for testing or repair. The valves shall be easily accessible and not subject to flooding. An air release/vacuum relief valve may be required at the high point of the crossing.

It shall be the responsibility of the developer to obtain all applicable regulatory permits. When the Aerial Crossing is accomplished by attachment to a bridge or drainage structure, the developer shall meet all requirements of the Agencies who own or have jurisdiction over such structures.

Aerial crossings shall be avoided whenever possible. If there is no feasible alternative aerial crossings may be allowed on a case by case basis.

7. Underwater Crossing

A minimum cover of three feet shall be provided over the pipe. The pipe material shall meet appropriate AWWA Standards of use in submerged conditions.

Valves shall be provided at both ends of the water crossings so that the section can be isolated for testing or repair. The valves shall be easily accessible, and not subject to flooding.

It shall be the responsibility of the developer to obtain all applicable regulatory permits, including dredge and fill permits.

Crossings shall be clearly marked by permanent warning signs placed on the bank identifying the nature and location of the crossing.

8. Valves

Sufficient valves shall be provided on force main systems to facilitate effective isolation of the pipe system for repairs, maintenance and future manifolds. Valves shall be installed at intervals not to exceed 1000 feet. Valves shall be provided where force mains intersect to facilitate isolation of pipe segments.

9. Future Consideration

While designing force main systems, consideration shall be given to possible future connecting pumping stations. If applicable, this requirement shall be reviewed with PWS prior to finalization of the design.

2.4 WASTEWATER PUMP STATIONS

A. Design Basis

1. Design Flows

Design flows shall be based upon the total ultimate development flow from all contributory areas to the pump station. The design average daily flow shall be computed as outlined in Section 2.2 B. 2. The design pumping capability of the station shall be based upon the Peak Design Flow

2. Number of Pumps

For pump stations with an ultimate peak design flow of 1500 GPM or less, a minimum of two pump units shall be provided. Where the peak design flow exceeds 1500 GPM, three or more units shall be provided for in the design of the pump station. If initial flows dictate less than 1500 GPM, only two pumps need be installed initially with provisions provided for future pump(s).

3. Pump Selection

Pump station shall be capable of pumping the peak design flow with the largest pumping unit out of service. Pumps shall be capable of meeting all

system hydraulic conditions without overloading the motors. In addition, a minimum 3 HP motor shall be required. Head capacity curves shall be prepared and submitted to PWS along with the pump station plans. Such curves shall be based upon the friction losses outlined in Section 2.3 B. 2. Head operating capacity curves shall verify that the pumps are operating at peak efficiency and are suitable for the design flow application. Pump and motor selection and head capacity curves shall reflect hydraulic conditions in cases where receiving force main systems are interconnected to additional pumping stations.

Only approved pumps listed in Appendix A shall be utilized for new sewage use. Submersible pumps shall be readily removable and replaceable without dewatering the wet well or disconnecting any piping in the wet well.

Pumps shall be capable of handling raw sewage and passing spheres of at least 3 inches in diameter. Pump suction and discharge openings shall be at least 4 inches in diameter.

4. Design Calculations/O&M Manuals

The developer's engineer shall submit signed, sealed and dated design calculations for all wastewater pump stations. Calculations shall include head capacity curves with copies of manufacturer's pump curves, hydraulic analysis for force main system, operating cycle calculations with wet well sizing, and buoyancy calculations.

5. Accessibility, Flooding, Buoyancy

The pumping station shall be readily accessible by maintenance vehicles during all weather conditions. An all weather access road to the pumping station shall be provided. In a phased development, a stabilized access road may be accepted during the initial phase with paving to be accomplished in the later phase.

Wastewater pumping station structures and electrical and mechanical equipment shall be protected from physical damage by the 100-year flood. Wastewater pumping stations should remain fully operational and accessible during the 25-year flood. The Developer's Engineer shall submit proof of the 100-year flood elevation. Regulations of Local, State and Federal agencies regarding flood plain obstruction shall be considered.

Buoyancy of the pump station structures shall be considered and adequate provisions shall be made for protection. Calculations shall be provided for review as outlined in Section 1.

6. Wet Well Requirements

Wet well shall be minimum 6-foot diameter for pumps 7.5 hp or smaller and 8 feet diameter for pumps larger than 7.5 hp and shall have a minimum 6 feet depth below the lowest invert. Additional depth/diameter shall be provided based on station design and cycle time.

Pumping levels shall be set based upon manufacture's duty cycle recommendations for minimum cycle time.

Pump-off water levels shall provide adequate submergence to preclude pump inlet vortexing, or air binding and shall be based upon manufacturer's recommendation. High level alarm water levels shall not exceed the invert elevation of the lowest influent pipe.

The wet well floor shall have a minimum slope of 1 to 1 to the hopper bottom. The horizontal area of the hopper bottom shall be no greater than necessary for proper installation and function of the pump inlet.

7. Easement Requirements

All pump stations shall be located in dedicated right-of-ways or utility easements. Provisions for future connection to the pump station shall be provided.

8. Site Fencing

Pumping stations shall be enclosed with a fence to discourage the entry of animals and unauthorized persons.

9. Emergency Power

All pump stations shall be provided with properly sized emergency power receptacles and double throw safety switches. In addition, stand-by emergency generators shall be provided at all wastewater pumping stations at critical points (capacity based) in the sewer system. Determination of pump stations at critical points shall be at the direction of PWS. All generators shall be rated and designed to operate the pump stations under design conditions.

10. Site Water Service

All pumping stations shall include a 3/4" water service located no more than ten (10) feet from the wet well. All services shall be provided with a reduced pressure backflow preventer. Services shall be in accordance with the standard details.

Where reclaimed water service is available lift station service shall be reclaimed water.

11. Adjacent Manhole

All pumping stations shall have a manhole adjacent to the wet well for bypass pumping in the event the lift station must be taken off line.

2.5 POTABLE WATER SYSTEM

A. General

The following minimum requirements are considered acceptable to PWS in the distribution of water for domestic consumption and fire protection.

Deviations from these standards may be allowed by PWS only upon a finding by PWS that, in accordance with sound engineering standards, the granting of the deviation will not work to increase the likelihood of a system failure. No deviation will be allowed unless it is clearly noted on the approved construction plans.

All expansion shall conform to the Master Plan for water maintained and amended by PWS.

When these standards differ from state and/or federal requirement, the more stringent requirement shall apply.

The distribution system of a waterworks includes the mains, valves, hydrants, consumer service pipes and meters, and other appurtenances. The system should be designed to provide an adequate supply of water to the consumers and for fire protection at all times.

B. Standards

1. Environmental Protection Agency and U.S. Public Health Service:

The governing standards of these agencies will be followed when applicable.

2. Florida Department of Environmental Protection:

The water distribution system shall conform to the applicable Florida Department of Environmental Protection laws, policies, standards, and rules and regulations for public water systems.

3. Plumbing Codes

The provisions of the Florida Building Code as it pertains to water supply and distribution, service line locations and materials, and backflow prevention devices, except as provided for elsewhere in these criteria, shall apply.

4. Pace Water System, Inc.

All water distribution systems that are to become a part of PWS shall be designed and constructed in accordance with these standards. Materials, installation, and construction methods and procedures shall be in accordance with Sections 3 and 4 of this manual.

C. Location/Future Connection

Water mains shall be located in dedicated right-of-ways or utility easements. When installed in right-of-ways, water mains shall, in general, maintain a consistent alignment with respect to the centerline of the road. All water mains located outside of dedicated right-of-ways shall require a minimum 20-foot easement. Additional easement widths shall be provided when the pipe size or depth of cover so dictate. If a water main is located adjacent to a road right-of-way, a minimum 10-foot easement shall be provided. Additional easement widths shall be provided if the pipe size or depth of cover so dictate. Water mains shall not be placed under any structures. In general, water mains shall not be located along side or rear lot lines. Placement of a water main along side or rear lot line may be allowed on a case by case basis if such a water main configuration results in efficient placement and utilization of the water main network.

Provisions for future connecting mains shall be made by extending construction of all water mains to the exterior boundaries of the subdivision wherever future connections to adjacent subdivisions or lots are anticipated or are required to form an interconnected grid system or reduce the number of dead ends.

D. Design Basis

1. Pressures

The system shall be designed to maintain a minimum pressure of 20 psi at all points in the distribution system under all conditions of flow. The normal working pressure in the distribution system should be approximately 60 psi but not less than 35 psi on the downstream side of a meter. Higher pressures may be required at commercial, industrial and high density residential areas.

2. Diameter of Mains

Only water mains of three (3) inch diameter and larger shall be permitted. Three (3) inch water mains shall be permitted only in cul-de-sac areas with a maximum length of 500 feet of pipe. As a minimum, six (6) inch looped systems shall be required in low density residential projects. In commercial, industrial, and high density residential areas, minimum eight (8) inch looped mains may be required. Larger size mains may be required if necessary to allow the withdrawal of the required fire flow while maintaining the minimum residual pressure.

3. Fire Flow Requirements

Fire flow requirements shall be determined in accordance with state Insurance Services Office and/or Santa Rosa County Regulations.

4. Fire Hydrant Location and Spacing

Fire hydrants shall be located along public right-of-ways preferably at street intersections. A 6-inch gate valve shall be installed between the water main and each fire hydrant. Fire hydrants shall be the dry barrel, breakaway traffic type. Fire hydrants shall be spaced every 1000 ft. along right-of-ways and located throughout the distribution system so that not more than 500 ft. of hose, laid along public right-of-ways, will be required to reach from a fire hydrant to any proposed structure within the area served. Where dead ends occur, a fire hydrant shall be placed at the dead end point. Hydrant spacing in commercial areas shall be at 500-foot intervals.

5. Dead Ends

In order to provide increased reliability of service and reduce head loss, dead ends shall be minimized by making appropriate tie-ins by looping the network whenever practical, as determined by PWS.

Where dead-end mains occur, they shall be provided with a fire hydrant or with an approved flushing hydrant. Flushing devices shall be sized to provide flows which will give a velocity of at least 2.5 feet per second in the water main being flushed. No flushing device shall be directly connected to any sewer.

6. Valves

Sufficient valves shall be provided on water mains so that inconvenience and sanitary hazards will be minimized during repairs. Valves should be located at not more than 500 foot intervals in commercial, industrial and high density residential areas and at not more than 800 foot intervals in all

other areas. Appropriate valving shall also be provided at all areas where water mains intersect to ensure effective isolation of water lines for repair, maintenance or future extension.

7. Aerial or Underwater Crossings

Provisions of Sections 2.3, B. 6. and 7. shall apply. PWS should be consulted before final plans are prepared.

8. Air Relief

At high points in water mains where air can accumulate, provisions shall be made to remove the air by means of hydrants or automatic air relief valves. Automatic air relief valves shall not be used in situations where flooding of the valve box may occur.

9. Water Services

a. Customer Service Lines

Customer service lines shall be provided to all lots within a subdivision. Customer service connections to industrial or commercial lots may be omitted provided approval of PWS is obtained prior to approval of plans and specifications.

All meters shall be adjacent to the property line and readily accessible to PWS meter readers.

Customer service lines shall be limited to 50 feet in length. In areas where the right-of-way is wider than 60 feet, the developer shall provide a water main on each side of the right-of-way.

b. Master Metering

In general individual water meters shall be installed for all users. Under certain conditions master metering may be allowed for shopping centers, malls and similar installations.

c. Meter Installations

All meters 1-1/2" and less will be installed by PWS after payment of applicable fees and charges. The service tap, corp stop, tubing, curb stop and meter box shall be installed by the contractor for commercial sites. All meters less than two inches in size will be installed underground in an approved meter box. Meters two inch and larger shall be installed above ground by the Contractor and shall be Invensys Touch Read, 1000 gal. registration. In general, meters larger than two inches shall be located in a meter easement located adjacent to the public right-of-way.

Size of all meters shall be determined by the developer's engineer and approved by PWS. The developer's engineer shall provide sufficient information on estimated peak flows and low flows so that meter size can be verified. The developer's engineer shall include headlosses through metering device when designing the water system.

d. Cross Connection Control

In accordance with the PWS Cross Connection Control Program (Appendix B), backflow prevention devices shall be installed to protect public water supplies from contamination or pollution by isolating such contaminants or pollutants which could backflow into the public water system.

The selection of an appropriate protective device will be based on the degree of hazard involved and will normally be as described hereinafter. However, PWS shall retain the final decision in individual cases.

The backflow prevention device shall be provided, installed, tested, and maintained by the customer for all commercial connections. Testing shall be performed by an AWWA or ABPA certified backflow tester approved by PWS.

PWS will provide and install a dual check valve assembly for single family residential connections.

Air-Gap Separation: An air gap separation is acceptable in all situations described in this section.

Reduced Pressure Principle Backflow Prevention Device: Will be used in any high risk installation and all commercial installations.

Double Check Valve Backflow Prevention Assembly: Will be used in any moderate risk installation upon approval by PWS.

Detector Check Valve Assembly: Will be used in any low risk installation including all private fire water supply systems.

Dual Check Valve Assembly: Will be used at residential connections only.

2.6 RECLAIMED WATER SYSTEM

A. General

The following minimum requirements are considered acceptable to PWS in the distribution of reclaimed water for non-restricted access public reuse as defined by FDEP.

Deviations from these standards may be allowed by PWS only upon a finding by PWS that, in accordance with sound engineering standards, the granting of the deviation will not work to increase the likelihood of a system failure. No deviation will be allowed unless it is clearly noted on the approved construction plans.

All expansion shall conform to the Reclaimed Water Reuse Master Plan maintained and amended by PWS.

When these standards differ from state and/or federal requirement, the more stringent requirement shall apply.

The distribution system of reclaimed water includes the mains, valves, hydrants, consumer service pipes and meters, and other appurtenances. The system should be designed to provide an adequate supply of reclaimed water to the consumers at all times.

B. Standards

1. Environmental Protection Agency and U.S. Public Health Service:

The governing standards of these agencies will be followed when applicable.

2. Florida Department of Environmental Protection:

The reclaimed water distribution system shall conform to the applicable Florida Department of Environmental Protection laws, policies, standards, and rules and regulations for reclaimed water systems.

3. Plumbing Codes

The provisions of the Florida Building Code as it pertains to reclaimed water supply and distribution, service line locations and materials except as provided for elsewhere in these criteria, shall apply.

4. Pace Water System, Inc.

All reclaimed water distribution systems that are to become a part of PWS shall be designed and constructed in accordance with these standards. Materials, installation, and construction methods and procedures shall be in accordance with Sections 3 and 4 of this manual.

C. Location/Future Connection

Reclaimed mains shall be located in dedicated right-of-ways or utility easements. When installed in right-of-ways, reclaimed water mains shall, in general, maintain a consistent alignment with respect to the centerline of the road. All reclaimed water mains located outside of dedicated right-of-ways shall require a minimum 20-foot easement. Additional easement widths shall be provided when the pipe size or depth of cover so dictate. If a reclaimed water main is located adjacent to a road right-of-way, a minimum 10-foot easement shall be provided. Additional easement widths shall be provided if the pipe size or depth of cover so dictate. Reclaimed water mains shall not be placed under any structures. In general, reclaimed water mains shall not be located along side or rear lot lines. Placement of a reclaimed water main along side or rear lot line may be allowed on a case by case basis if such a reclaimed water main configuration results in efficient placement and utilization of the reclaimed water main network.

Provisions for future connecting mains shall be made by extending construction of all reclaimed water mains to the exterior boundaries of the subdivision wherever future connections to adjacent subdivisions or lots are anticipated or are required to form an interconnected grid system or reduce the number of dead ends.

D. Design Basis

1. Pressures

The system shall be designed to maintain a minimum pressure of 45 psi at all points in the distribution system under design flow. The normal working pressure in the distribution system should be approximately 60 psi but not less than 35 psi on the downstream side of a meter. All design pressures shall be based upon the average supply pressure as determined by PWS. Where the average supply pressure is below 60 psi, the required design meter pressure shall not be lower than 15 psi below the supply

pressure. Design flow shall be determined as the flow rate equal to one-half inch per hour of flow applied to the projected irrigateable area of one-third of the residences in a residential development or to one-third the irrigateable area of any commercial site. The Board may consider variances to this criterion on a case-by-case basis.

2. Diameter of Mains

Only reclaimed water mains of three (3) inch diameter and larger shall be permitted.

3. Dead Ends

In order to provide increased reliability of service and reduce head loss, dead ends shall be minimized by making appropriate tie-ins by looping the network whenever practical, as determined by PWS.

Where dead-end mains occur, they shall be provided with a fire hydrant or with an approved flushing hydrant. Flushing devices shall be sized to provide flows which will give a velocity of at least 2.5 feet per second in the reclaimed water main being flushed. No flushing device shall be directly connected to any sewer.

4. Valves

Sufficient valves shall be provided on reclaimed water mains so that inconvenience will be minimized during repairs. Valves should be located at not more than 800 feet intervals in all areas. Appropriate valving shall also be provided at all areas where reclaimed water mains intersect to ensure effective isolation of reclaimed water lines for repair, maintenance or future extension.

5. Aerial or Underwater Crossings

Provisions of Sections 2.3, B. 6. and 7. shall apply. PWS should be consulted before final plans are prepared.

6. Air Relief

At high points in reclaimed water mains where air can accumulate, provisions shall be made to remove the air by means of hydrants or automatic air relief valves. Automatic air relief valves shall not be used in situations where flooding of the valve box may occur.

7. Reclaimed Water Services

a. Customer Service Lines

Customer service lines shall be provided to all lots within a subdivision. Customer service connections to industrial or commercial lots may be omitted provided approval of PWS is obtained prior to approval of plans and specifications.

All meters shall be adjacent to the property line and readily accessible to PWS meter readers.

Customer service lines shall be limited to 50 feet in length. In areas where the right-of-way is wider than 60 feet, the developer shall provide a water main on each side of the right-of-way.

b. Master Metering

In general individual reclaimed water meters shall be installed for all users. Under certain conditions master metering may be allowed.

c. Meter Installations

All meters 1-1/2" and less will be installed by PWS after payment of applicable fees and charges. The service tap, corp stop, tubing, curb stop and meter box shall be installed by the contractor for commercial sites. All meters less than two inches in size will be installed underground in an approved meter box. Meters two inch and larger shall be installed above ground by the Contractor and shall be Invensys Touch Read, 1000 gal. registration. In general, meters larger than two inches shall be located in a meter easement located adjacent to the public right-of-way.

Size of all meters shall be determined by the developer's engineer and approved by PWS. The developer's engineer shall provide sufficient information on estimated peak flows and low flows so that meter size can be verified. The developer's engineer shall include headlosses through metering device when designing the reclaimed water system.

d. Cross Connection Control

In accordance with the PWS Cross Connection Control Program (Appendix B), reclaimed water service may not be activated unless backflow prevention devices are installed on the potable water service to protect public water supplies from contamination or

pollution by isolating such contaminants or pollutants which could backflow into the public water system.

Only Reduced Pressure Principle Backflow Prevention Devices will be used with reclaimed water.

The backflow prevention device shall be provided, installed, tested, and maintained by the customer. Testing shall be performed by an AWWA or ABPA certified backflow tester approved by PWS.

SECTION 3



GUIDELINE TECHNICAL SPECIFICATIONS

SECTION 3
GUIDELINE TECHNICAL SPECIFICATIONS

3.1 SITEWORK

A. Scope

This section includes clearing and grubbing for all required areas including the disposal of materials, grassing, paving, and clean-up as indicated on the drawings or specified herein.

B. Existing Facilities

During the course of construction, the Contractor shall provide adequate facilities to protect all structures and utilities underground, on the surface, or above ground and shall protect and preserve the Owner harmless against damage and claims for damage resulting from construction activity.

C. Traffic

The Contractor shall provide, erect and maintain effective barricades, danger signals, and signs in locations where required for the protection of the work and the safety of the public. Barricades or obstructions that encroach on, or are adjacent to, public rights-of-way shall be provided with lights that shall be kept burning at all times between sunset and sunrise. The Contractor shall conform to all State and local laws and regulations in the use of streets and highways and shall be responsible for all damages resulting from any neglect or failure to meet these requirements. Watchmen and flagmen shall be provided if necessary. Work shall be arranged to cause a minimum of disturbance to normal pedestrian and vehicular traffic. Unless approval in writing is secured from the Utility Company or Owner, there shall be no interruption of services to present customers.

D. Trees and Shrubs

The Contractor shall clear all construction areas to provide adequate work space. Trees and permanent structures in construction areas shall be removed as indicated or as directed. Removal of valuable trees or shrubs, if required, shall be done in cooperation with the Owner in order that they may be replanted by others.

Privately owned trees and shrubs bordering the construction areas shall be protected from damage and the Contractor shall take full responsibility thereof.

Preservation of trees and other vegetation is of utmost importance. The Contractor shall familiarize himself with the site and shall protect all trees not indicated for removal by the Owner and/or Engineer.

E. Construction on Streets, Right-of-Ways and Easements

All obstructions along pipe lines and street right-of-ways shall be removed and the area cleared as specified to provide adequate space for the work and for control stakes and hubs. Work shall be limited to the area of the street, right-of-way or easement. Survey reference points and bench marks shall not be disturbed.

F. Clearing and Grubbing

Clearing and grubbing shall be performed in right-of-ways, within limit of work lines, in the areas indicated and where required, including ditches, areas where fill will be placed, new street construction and where structures will be erected. It shall include the complete removal and satisfactory disposal of all timber, stumps, brush, weeds, rubbish, pavements, curb and gutter, sidewalks, driveways, and all other obstructions resting on or protruding through the surface of the existing ground. All such material shall be removed to a depth of two feet below finished grade, except as noted otherwise on the plans or as otherwise directed by the Engineer. All timber, logs, stumps, roots, brush, pavement, concrete, and other refuse from clearing and grubbing operations shall be disposed of by removal to a dump area obtained by the Contractor.

G. Pavement Removal and Replacement

The Contractor shall cut and remove all concrete and asphalt street and alley pavement along straight lines and for such width only as is necessary for the excavation of the trench or for new road construction. Payment for asphalt repair will be limited to the width shown on the plans. Existing pavement removed, disturbed or destroyed by the pipe construction work shall be repaired or replaced by methods and materials that will provide a finished pavement at least equal in all respects to the pavement existing before construction commenced. All pavement repair shall be completed within thirty (30) days of cutting unless weather conditions interfere. Minimum pavement repair shall consist of 6 inches of concrete and two inches compacted thickness of Type SI or Type III asphaltic concrete conforming to the latest edition of Florida Department of Transportation "Standard Specifications for Road and Bridge Construction." Concrete shall be placed upon compacted backfill and the street or alley then opened to traffic. After all existing pavement has been sawed or cut along straight lines, surfacing material shall be placed when directed by the Engineer. Until the surfacing material is placed, the surface of the trench shall be maintained in smooth riding condition with all pot holes and depressions filled to surface to the satisfaction of the Owner. Paving work shall not commence until heavy equipment is

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permanently removed from work area and pipework is tested and accepted. Replacement of unauthorized pavement removed shall be at the Contractor's expense.

H. Sidewalk, Driveway and Curb and Gutter Replacement

Existing sidewalks and paved driveways, including curbs and gutter, removed, disturbed or destroyed by construction shall be replaced or repaired. The finished work shall be equal or superior in all respects to the original. Stone, shell or slag driveways shall be repaired or replaced in the same manner. All concrete sidewalks and driveways shall be replaced to the nearest construction joint. Concrete for sidewalks, driveways and curb and gutter shall be 2500 psi. Sidewalks shall be 4 inches thick and driveways shall be 5 inches thick. Unauthorized removal of sidewalk, driveway or curb and gutter material shall be replaced at the Contractors expense.

I. Grassing

All disturbed areas not paved or covered by structures shall be grassed or sodded except as indicated otherwise on the construction plans. Seed and fertilizer shall be applied as specified in the following table.

The mulch material shall be Pangola, peanut, wheat straw, oat straw, Bermuda or Bahia grass hay. The mulch shall be spread at a rate of nine tons per acre and cut into the soil or anchored in a satisfactory manner. Mulch shall be free from undesirable weeds and other undesirable grasses. Where indicated on the plans, emulsified asphalt shall conform to Federal Specification SS-A-674 and shall contain no substances harmful to plant growth. The emulsion shall be homogenous and suitable for spraying without addition of water. Application to seeded areas shall be at the rate of 0.2 gallons per square yard within 24 hours of seeding. The Contractor will be required to repair, at his own expense, any significant damage due to washout, erosion or other causes that occur within 60 days of planting.

SEEDING REQUIREMENTS TABLE

DEC thru FEB	Mix 1A	Seed	Rates per 1,000 Square Feet			
			Fertilizer	Limestone	Maintenance**	
		Pensacola Bahiagrass	25 lbs. per acre	30 lbs.	100 lbs	10 lbs.
		Reseeding Crimson Clover*	30 lbs. per acre	15-10-15		10-10-10
		Bermuda Grass (Unhulled)	25 lbs. per acre			
		Annual Ryegrass	20 lbs. per acre			
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MAR thru AUG	Mix 2A					
		Pensacola Bahiagrass	20 lbs. per acre	30 lbs.	100 lbs.	10 lbs
		Bermuda Grass (Hulled)	20 lbs. per acre	5-10-15		10-10-10
		Brown Top Millet	25 lbs. per acre			
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SEP thru NOV	Mix 3A					
		Pensacola Bahiagrass	25 lbs. per acre	30 lbs.	100 lbs.	10 lbs.
		Reseeding Crimson Clover*	30 lbs. per acre	5-10-15		10-10-10
		Bermuda Grass (Unhulled)	30 lbs. per acre			
		Annual Ryegrass	20 lbs. per acre			

* Requires inoculation

** Maintenance fertilizer shall be applied in early spring following initial establishment of cover

J. Galvanized Steel Fencing, Chain Link

Galvanized steel fencing shall conform to the requirements of ASTM A-392. Fabric shall be No. 9 gauge, with two inch mesh. Top and bottom to be twisted and barbed. Barbed wire shall be three twisted strands of doubled No. 12 gauge wire with No. 14 gauge, 4 point barbs spaced approximately 6" apart on center mounted at 45 degree angle on extension arms extending approximately one foot above top of fabric. End, corner and pull posts shall be 2.875 inches in diameter and a minimum of 5.79 lbs./ft. in weight. Line post shall be 2.375 inches in diameter and a minimum of 3.65 lbs./ft. in weight. Gate post shall be 4.0 inches in diameter. Hinges shall be offset-type, nonlift-off type to allow gate to swing 180 degrees. Top rail and post braces shall be 1.625 inches in diameter and a minimum of 2.27 lbs./ft. in weight. Fabric ties shall be 11 gauge aluminum wire spaced 14" on center to line post and 18" on center to top rails. Top rail couplings shall be not less than 6" long. Latch for gate shall be plunger bar type double latch equipped for locking by padlock. Padlock shall be by Master Lock Company or approved equivalent and shall be master keyed and furnished with minimum of two keys for lock and two keys for the master system.

All materials and workmanship shall be of first class and erection shall be done in a neat workmanlike manner. Line post shall be evenly spaced and on maximum of ten foot centers and at each abrupt change in grade. All posts shall be plumb and properly aligned. All posts shall be set in concrete with top exposed surface of concrete sloped to shed water and to provide a neat appearance. Line post

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holes shall be 36" deep below finish grade with a minimum diameter of 11-inches at the top. Gate and corner post shall be 36" deep below finish grade with minimum diameter of 16 inches at top. All posts shall be set to bottom of hole. Corner posts shall be placed at each horizontal angle point. Corner and pull posts shall have horizontal braces and tie rods on each side extending to the adjacent post. Truss rods shall be mounted diagonally between line post end of brace rail and the base of the terminal post.

Fabric shall be stretched tightly at grade level and shall be attached to terminal or gate posts by a stretcher bar and clips. Attach a bottom reinforcing wire to the bottom of the fabric by means of hog ring type fasteners 24 inches apart and secured at terminal and gate posts with brace bands. Spot paint any areas from which the galvanizing has been abraded with a galvanizing paint approved by the Engineer.

The fence shall be grounded by a Copperweld rod 10 feet long and a minimum of 5/8 inch in diameter, driven vertically until the top of it is approximately six inches below the top of ground. A No. 6 solid copper conductor shall be brazed to the rod and to the fence in such a manner that each element of the fence is grounded. Electrical grounds shall be installed at intervals not exceeding 500 feet and, where a power line passes over the fence, a ground shall be installed immediately below the point of crossing.

K. Cleanup

Debris, unused material, and waste material shall be removed from the site as soon as practicable during construction. Immediately upon completion of backfilling as specified in the Earthwork Section of these specifications, the site shall be cleaned and regraded and all debris and surplus materials removed. Trenches not properly filled and embankments not properly completed shall be refilled or replaced and finally made to conform to the original grade, line and surface. The Contractor shall repair any areas paved or unpaved where settlement occurs.

Paved areas shall be kept clean at all times and left broom clean upon completion of the work.

L. Erosion Control

The Contractor shall take all measures necessary to control stormwater and erosion during construction. Silt fencing shall be employed in all locations adjacent to Florida Department of Environmental Protection Jurisdictional Wetlands to ensure that sedimentation does not wash from the construction site into the wetlands. Silt fencing and/or hay bales shall be used for sedimentation control in all other locations. Silt fencing is to be constructed in accordance with Florida Department of Transportation specifications contained in the Florida

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3.2 EARTHWORK

A. Scope

This section includes dewatering, excavating, shoring, filling, backfilling, compacting and grading as indicated on the drawings and specified herein.

B. Soil Conditions

The Contractor shall satisfy himself as to the character and amount of different materials and the subsurface conditions to be encountered prior to commencement of work.

C. Underground Facilities

Underground structures and utilities shall be shown on the drawings and located according to the best available records. It shall be the Contractor's responsibility, however, to locate all underground structures and utilities along the line of work in advance of construction so that conflict with existing facilities is avoided. The Contractor shall not hold the Owner accountable for inaccuracies or omissions in the locations of underground facilities.

D. Conflicts

Where conflicts with existing facilities are unavoidable, work shall be performed so as to cause as little interference with existing services as possible. Facilities damaged in the prosecution of the work shall be repaired immediately in conformance with the best standard practices or according to the direction of the owner of such facility, up to and including replacement.

E. Dewatering

Equipment shall be provided and employed to maintain the excavation in a dry condition while construction therein is in progress. Areas to be excavated at any one time shall be limited to those that can be properly dewatered by the equipment in use. The ground adjacent to the excavation shall be sloped to prevent water from running into the excavation. Water from the excavation shall be discharged such that it will not injure or interfere with the normal drainage of the area in which the work is being performed, and will not cause damage to any part of the work or to public or private property. All gutters, drains, inlets, culverts and sewers shall be kept clean and open for surface drainage. Water shall not be directed across pavements except through approved pipes or other means. The Contractor shall obtain permission from the owner of the property involved

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before digging ditches or constructing water courses for the removal of water, and shall provide for discharge of the water without creating a public nuisance. The Contractor shall provide complete standby equipment for use in the event that any portion of the dewatering equipment should fail or not operate acceptably.

F. Shoring

When necessary to protect workmen, banks, adjacent paving, structures and utilities, excavations shall be shored and braced by members of suitable size and arrangement. Shoring, bracing and sheeting shall be removed as excavations are backfilled, in a manner to prevent injurious caving. Where directed by the Engineer, the sheeting shall be left in place in the backfill with proper bracing to provide lateral support.

G. Excavation

1. General

Excavation shall be performed in accordance with all applicable State, County and local regulations. Blasting will be permitted only on an individual case by case basis. Muck and other soft unsuitable material occurring within or below the limits of the structure or other facility shall be completely removed and replaced with approved, suitable material at the Contractor's expense. Excavations carried below depths indicated, without specific direction from the Engineer, shall be backfilled to the proper grade with thoroughly compacted suitable fill, except that in excavations for footings, the concrete shall be extended to the bottom of the excavation all at no additional cost to the Owner.

2. Excavation for Pipework

All excavations shall be made along straight lines by open cut unless otherwise authorized by the Engineer or otherwise shown on the plans. Holes for pipe bells shall be hand-excavated to insure that the pipe rests upon the bottom of the trench for its entire length. If the bottom of the excavation is found to consist of any material that cannot be excavated to give a uniform bearing surface, the material shall be removed to a depth at least six inches below established bottom grade and backfilled to grade with thoroughly compacted sand at the Contractor's expense. Any excavations carried below the depths indicated, without specific direction from the Engineer, shall be backfilled in the same manner at no additional cost to the Owner. Trench width measured at one foot above the top of pipe for all pipe other than that approved for assembly prior to installation in the trench shall be the outside diameter of the pipe plus 16 inches. Where sheeting or shoring is used the allowable width shall be measured between the inside faces of the sheeting or shoring.

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For all pressure line piping approved for complete assembly prior to installation in the trench, the minimum trench width shall be the outside diameter of the coupling or joint plus two inches.

Excavated material to be used for backfill shall be neatly deposited at the sides of the trenches where space is available. Where stockpiling of excavated material is required, the Contractor shall obtain the sites to be used and maintain operations so as to provide for natural drainage and not present an unsightly appearance. Rock, shell, or other base materials for roads and alleys shall be carefully selected and kept separate. Grade and line stakes shall be protected. No excavated material shall be placed on private property without prior consent of the property owner.

3. Dewatering for Pipework

Dewatering, if required, shall be continued during construction to keep the ground water below the level of the backfill at all times until the backfill is completed. Water settling may be approved or required, and shall consist of continuing the well points in service and applying water as directed to the excavation during backfill. Well point holes may be placed in undisturbed pavement only upon approval in writing by the Engineer.

4. Rock Cut for Pipework

Where the grade line of the pipe is in rock cut, initial backfill to a depth of one foot over the pipe shall be with loose, dry earth or sand, compacted in accordance with these specifications. The remaining depth of the trench shall be backfilled using the best available material from the excavation. Excavated rock may be used, provided it is broken into pieces not larger than three inches in size and sufficient fine material is included to fill the voids. No rock material shall be used within the subgrade of the new road beds.

5. Topsoil

Material from the excavations suitable for topsoil shall be deposited in piles separate from other excavated material. Piles of topsoil shall be located so that the material can be used readily for the finished surface grading or as directed by the Owner and shall be protected and maintained until needed. At the option of the Contractor, topsoil material for use in finished grading may be obtained from other locations at the Contractor's expense.

H. Filling and Backfilling

1. General

All fill and backfill shall be free from organic matter such as roots, stumps, trees and refuse or other objectionable material. Except as specified otherwise, fill and backfill shall be placed in layers not more than 12 inches thick and each layer shall be compacted thoroughly and evenly. The moisture content of the fill material shall be such that proper compaction will be obtained. Backfill shall not be placed against concrete within seven days after it has been poured and only when directed by the Engineer. In areas to be grassed, the top three inches shall not be compacted.

2. Backfilling Trenches

The initial backfill shall be carefully deposited on both sides of the pipe at the same time in well compacted six-inch layers to a density not less than 95% of the Modified Proctor Density until enough has been placed to provide a cover of one foot above the bell of the pipe. The remainder of the trench shall be backfilled in well compacted 8-inch layers under roadways and well-compacted 12-inch layers elsewhere. Backfill shall be compacted to a density not less than 95 percent of the Modified Proctor density for trenches under roadways and compacted to a density not less than 90 percent of the Modified Proctor elsewhere, with approved mechanical tampers to the top of the trench. Water settling may be used where approved and shall be used where directed by the Engineer. The top material shall be used last and the surface of the trench restored to its original elevation. Under no conditions is construction debris to be included with the backfill. Excavated material consisting of muck, mud, clay or other unstable material may not be utilized in the backfill.

Where sheeting is withdrawn, all cavities remaining in or adjoining the trench shall be solidly filled and thoroughly compacted. Where sheeting is to remain in place, all cavities behind it shall be backfilled in the same manner as specified for trench backfill. No sheeting that has been driven below the pipe invert may be removed. Before backfilling is completed all sheeting to remain shall be cut off at a line two feet below finished grade.

3. Backfill and Embankment

Compaction of general backfill and embankment shall be accomplished by means of mechanical rollers or other suitable means approved by the Engineer. Each layer or lift of embankment or backfill shall not exceed 12 inches and shall be compacted individually so that upon completion, the backfill or embankment shall have attained a compaction of 95 percent of Modified Proctor Density, ASTM D1557.

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I. Testing

1. Fill

Density of fill under structures and road beds, where permitted or indicated on the drawings, shall be determined by in-place density tests made in accordance with Standard Method ASTM D1556. The in-place densities actually obtained shall equal or exceed 95 percent of laboratory maximum densities at optimum moisture content (Modified Proctor). One test shall be performed for each 2500 square feet per layer of fill placed under each structure or roadway with a minimum of one test per layer for each structure and roadway. In-place density tests for trenches that are not under roadbeds shall be made for each 1000 linear feet of trench, per layer of fill, with a minimum of one test per layer and shall equal or exceed 95 percent of laboratory maximum densities at optimum moisture content (Modified Proctor).

2. Laboratory Tests

Maximum densities at optimum moisture content shall be determined in accordance with Standard Method ASTM D 1557. The test procedure method shall be in accordance with soil type encountered.

3. Procedure

Tests shall be performed by an independent testing laboratory approved by the Engineer and reports of results shall be sent directly to the Engineer. For each test that fails to meet the specified density, one additional test shall be made after additional compaction work is performed. Costs of soil testing shall be paid by the Contractor.

J. Grading

The Contractor shall grade all areas as necessary to maintain proper drainage. Fill shall be brought to finish grades indicated and shall be graded to drain water away from structures. Roadway grading shall include all required grading within the roadway rights-of-way, construction limits and/or limit of work lines as indicated on drawings and/or directed. Grading shall include all excavating, hauling, shaping, sloping, mixing and compacting necessary for the construction, preparation and completion of all embankments, subgrades, shoulders, ditches, slopes, intersections and turn-outs, all in accordance with the required alignment, grade, cross sections and notes shown on drawings.

K. Overall Area Grading for Which No Grades are Indicated

Within the limits of construction and outer limits of clearing and grubbing all holes and other depressions shall be filled, all mounds and ridges cut down, and the area brought to sufficiently uniform contour that the Owner's subsequent mowing operations will not be hindered by irregular terrain. This work shall be done regardless of whether the irregularities were the result of the Contractor's operations or originally existed. Permanent ponds or other permanent water areas, as so designated by the Engineer, will not be required to be filled.

L. Borrow

Should there be insufficient satisfactory material from the excavation to meet the requirement for fill material, approved borrow shall be obtained by the Contractor, at his expense.

M. Excess Material

Excess excavated material and material not suitable for reuse as backfill, shall be immediately disposed of at an off-site location at the Contractor's expense.

3.3 PIPEWORK

A. Gravity Sanitary Sewers

This Section includes furnishing and installing all gravity sanitary sewer lines, manholes, fittings and appurtenances required for a complete system as shown on the drawings and specified herein.

1. Materials

All material shall be free from defects impairing strength and durability and be of the best commercial quality for the purpose specified. It shall have structural properties sufficient to safely sustain or withstand strains and stresses to which it is normally subjected and be true to detail.

All pipework will be inspected upon delivery and such as does not conform to the requirements of these specifications shall be rejected and must be immediately removed from the site by the Contractor. The Contractor shall furnish and provide all labor necessary to assist the Engineer in inspecting the material.

The basis of rejection shall be as specified in applicable ASTM Specifications.

2. Unplasticized Polyvinyl Chloride (PVC)

PVC gravity sewer pipe and fittings shall be unplasticized polyvinyl chloride meeting or exceeding ASTM Specification D3034. Pipe shall be green in color.

Pipe lengths shall not exceed 20 feet and provisions shall be made at each joint to accommodate expansion and contraction providing a maximum SDR ratio of 35 and a minimum "pipe stiffness" $(F/\Delta Y) = 46$ psi at 5% deflection when tested in accordance with ASTM D2412, external loading properties of plastic pipe by paneled plate loads.

Minimum wall thickness shall be:

Diameter	4"	6"	8"	10"	12"	15"
Wall Thickness	.125"	.180"	.240"	.300"	.360"	.437"

All pipe and fittings shall be jointed by means of an integral wall bell and spigot joint and sealed with a rubber ring. The pipe and fittings shall be shipped to the job with a solid cross section rubber sealing ring securely locked in place in the bell. The bell shall consist of an integral wall section of pipe formed into shape and stiffened with two PVC retainer rings, which also serve to securely lock the rubber ring in place. The joint shall be capable of withstanding an internal hydrostatic pressure of 25 psi for one hour with no leakage.

Each length of pipe shall be clearly marked with the following information at intervals of five feet or less:

- a. Manufacturer's name
- b. Nominal pipe size
- c. ASTM specification
- d. National sanitation approval

3. Ductile Iron Pipe

Ductile iron pipe shall meet the requirements of ANSI A21.51, including Addenda A21.51a. Pipe dimensions shall conform to Federal Specification WW-P-421, Class 150. Each pipe shall be conspicuously marked on the outside of the barrel to readily identify it from Cast-Iron. Metal thickness shall conform to ANSI A21.51, Table 51.1, 2-1/2 to 5 feet cover.

- a. Mechanical Joints: ANSI Standard Specification A21.11, Rubber Gasket Joints for Cast-Iron Pressure Pipe and Fittings.

- b. Push-on Joints: ANSI Standard Specification A21.11, Rubber Gasket Joints for Cast-Iron Pressure Pipe and Fittings, Single gasket push-on type.
- c. Flanged Joints: ANSI Standard Specifications B16.1, Cast-Iron Pipe Flanges and Flanged Fittings, 125 pounds. Screwed on flanges, faced and drilled to ANSI Class 125 pound template. The flanged joints shall be assembled by threading plain end pipe and screwing on long hub flanges. The connection shall then be power tightened and refaced across both face of flange and end of pipe. Provide one-sixteenth-inch ring gaskets of red sheet rubber meeting the requirements of Grade I, Table I of ASTM Specification D1330-66, Sheet Rubber Gaskets. Connections shall be made with machine bolts and hexagonal nuts.
- d. Fittings: Fittings shall meet ANSI Standard Specification A21.10, latest, Cast Iron Fittings, 2-inch through 48-inch for Water and Other Liquids. Minimum pressure rating shall be 250 psi.
- e. Coatings for Ductile Iron Pipe: All ductile iron pipe and fittings to be installed underground shall be coated on the exterior with hot-dip coal-tar and conform to all appropriate requirements for seal coat in ANSI/AWWA C104/A21.4. The exterior of all above ground pipe shall receive a coat of rust inhibitor prime compatible with the finish paint schedule. All bolts, nuts, studs and other uncoated parts of joints for underground installation shall be coated with asphalt or coal-tar prior to backfilling.

The interior lining for all ductile iron pipe and fittings shall be factory applied epoxy coating with a minimum dry film thickness of 10 mils. The epoxy coating shall be a Hi-Build Epoxy coating equal to Tnemec, Indurall, or other approved equal. The Hi-Build epoxy shall incorporate a polyamide cured epoxy resin which shall consist of a primer coat and two (2) coats of epoxy.

4. Manholes

Unless otherwise shown on the drawings, manholes shall have an inside diameter of 4 feet and a minimum depth of 4 feet. If the manhole depth equals or exceeds 5 feet, it shall have an eccentric cone section that narrows to 2 feet in diameter at the top. Drop manholes shall be provided when the invert of the influent gravity main exceeds 24 inches above the invert of the manhole.

- a. Precast Concrete Manholes: All manholes shall be of precast concrete construction and shall meet the requirements of ASTM

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C478 (Latest Edition), except as modified herein. The concrete used shall be Type II or approved equivalent with a 28-day strength of 4000 lbs. per square inch.

The vertical walls shall have a minimum thickness of five-inches and shall be reinforced a minimum of 0.12 sq. in. per linear foot. The flat tops on shorter manholes shall be reinforced with No. 6 bars on six-inch centers both ways or as shown on the drawings. The inside diameter of standard manholes shall be 48 inches on the riser sections with an eccentric cone section that narrows to 24 inches inside diameter at the top. The cone section shall be used on manholes with a depth of 5 feet or more and flat top used on manholes less than 5 feet.

The bottom section shall be of monolithic design with a minimum bottom thickness of six-inches. This minimum bottom thickness applies to dog-house manholes as well.

The joints between the sections shall be tongue and groove with the tongue up and the groove down and shall be sealed with round or other flexible type natural rubber joint rings. In addition to the rubber ring gaskets, the interior and exterior voids in the pipe joints shall be sealed with Sauereisen F-121 Underlayment fast setting cementitious grout. No other type of grout may be used on the interior of the manhole. All joints shall be grouted.

The concrete surface finish for manholes shall be free of air holes or voids on both the exterior and interior to facilitate coating.

- b. Manhole Accessories: Manhole steps shall be constructed of 1/2-inch, grade 60, steel rod completely encased in a corrosion-resistant Copolymer, Polypropylene Plastic capable of resisting chemicals and gases encountered in manholes. Each step shall have a vertical load resistance of 400 lbs. and a pull out resistance of 500 lbs. per leg. Each step shall be a minimum of 12 inches wide and each leg shall extend 5 inches from the manhole face and have a 4-inch wall penetration. Steps shall have foot guide lugs and traction cleats and shall be installed on 16-inch centers.

In every instance where pipe enters or leaves a manhole, a fitting shall be provided which will accommodate expansion and contraction of the pipe; release strain on the pipe caused by differential settlement between pipe and manhole; and provide a rubber ring water seal between pipe and manhole. Rubber ring water seals provided shall be Core-N-Siel.

The manhole frames and covers shall be U.S. Foundry No. 170E, Neenah Foundry No. R - 1600 series, Vulcan Foundry Series 1300 or equivalent and shall weigh at least 285 pounds. Solid covers shall be marked "SEWER." Frames for the covers shall be set to grade in a bed of cement mortar. Frames and covers shall be machined or ground at bearing surfaces to seat firmly and prevent rocking. Any set not matching perfectly shall be removed and replaced at no additional cost.

- c. Protective Coatings: The entire interior surface of all concrete manholes shall be coated with a minimum of 25 mils dry film thickness of Sauereisen SewerGlaze F-210 G, Carboline Plastic 140 or approved equivalent per manufacturer's recommendations. Surface preparation and curing time for the plaster coat on manholes prior to applying the coatings shall be in accordance with the manufacturer's recommendations. Factory applied coatings will not be accepted.

- i) Scope

- a) This specification covers the materials and application of an epoxy filler-surfacer, a fast setting cementitious grout, a corrosion-resistant epoxy lining and an elastomeric fiber reinforced urethane chimney seal for protection of municipal wastewater manholes subject to water infiltration, corrosion and erosion. Written approval from, PWS is required for consideration of any products not conforming to the standards and physical properties listed herein.
- b) The products detailed in the specification shall be used to protect new concrete manholes, steel rings and covers, lift stations and other wastewater concrete infrastructure involved in municipal wastewater and collection and treatment.
- c) The scope of work shall include the following:
 - (i) Surface preparation in accordance with Section iii) of this specification.
 - (ii) Filling of all voids and bug holes with an epoxy filler-surfacer.
 - (iii) Grouting of joints and around pipes with a fast setting cementitious grout.
 - (iv) Vacuum testing of the manhole.

- (v) Application of a 25.0 mil thick epoxy corrosion/erosion resistant barrier.
- (vi) Sealing of chimney area in manholes to stop infiltration at frame and grade ring juncture.

ii) Materials

- a) The epoxy filler-surface shall be the Carbolite Sanitile 600 or the Sauereisen 209 high build epoxy filler for sealing and filling porous and irregular cementitious surfaces.
- b) The fast setting cementitious grout shall be the Sauereisen F-121 Underlayment.
- c) The chemical-resistant epoxy linings shall be either the Carbolite Plasite 140S or the Sauereisen SewerGlaze 210G. The linings shall be solvent, VOC and HAPS free epoxy systems designed specifically for protection of concrete in municipal wastewater collection and treatment systems. All epoxy systems must have proven successful applications in the wastewater industry and must have successfully passed the Redner Test.
- d) In manholes, upon completion of cementitious and/or epoxy lining systems on the interior walls, an elastomeric lining composed of fiber re-inforced, asphalt modified urethane shall be applied to the interior of the chimney area from the top of the manhole lid frame and down past the grade ring. The elastomeric lining shall be the Sauereisen F-88 Chimney Seal or approved equivalent.

iii) Area Preparation

- a) Temperature of Working Area – Optimum temperature for handling and applying the materials is 60-80°F. Store material within the 60-80°F range for 48 hours prior to use. At material temperatures below 60°F, the application becomes more difficult and curing is retarded. At temperatures above 85°F material working time is reduced.

Application of epoxy products in direct sunlight and/or with rising surface temperatures may result in blistering of the materials due to expansion of entrapped air or moisture in the concrete.

Concrete surfaces that have been in direct sunlight must be shaded for 24 hours prior to application and remain shaded until the initial set has taken place. When the surface temperatures are rising, it may be necessary to postpone the application or apply during the cooler evening hours.

- b) Surface preparation – All structures to receive specified products must be properly designed and capable of withstanding imposed loads. Steel surfaces must be abrasive blasted in accordance with SSPC-SP6 Commercial Blast Cleaning. Concrete surfaces must be abrasive blasted in accordance with SSPC-SP7 Brush Blast Cleaning to remove all laitance, loose or damaged concrete, oils, greases, chemical contaminants and previously applied coatings or sealers. Suitably prepared concrete should have a uniform surface texture resembling coarse sand paper. The blasting abrasive shall be a low free silica product such as Dupont Starblast or approved equivalent.

iv) Application

- a) All specified products must be installed in strict accordance with installation instructions detailed on manufacturer's product data sheets and other pertinent data, which shall be included as submittal data.
- b) All specified products must be installed by qualified and trained applicators in accordance with Section v) of this specification.

v) Contractor Prequalification

- a) Contractor qualification and training is available from each manufacturer. All contractors must obtain written confirmation from manufacturer's representative or other manufacturer's approved trainer that they are qualified to install the specified products required in this specification and include this written confirmation with their bid proposal.

vi) Clean-up

- a) Consult product data sheets for all information pertaining to clean up of specified products.

vii) Setting/Curing

- a) Setting and curing of specified products shall be in strict accordance with instructions detailed on manufacturer's product data sheets.

viii) Shelf Life

- a) Consult manufacturer for specific details on shelf life and provide documentation that all products are within the shelf life limitations specified by the manufacturer.

ix) Caution

- a) Conform to all warnings on product Material Safety Data Sheets and consult container label caution statements for any hazards in handling these products.

d. Manhole Invert Channels: The manhole invert channels shall be smooth and accurately shaped to a semi-circular bottom conforming to the connecting sewer section. Invert channels and manhole bottoms shall be shaped and smoothed with one to two (1:2) cement-sand mortar of still consistency. Changes in size and grade shall be made gradually and evenly. Moore base inverts will not be allowed.

e. Fiberglass Manhole Specification: Fiberglass reinforced polyester manhole shall be manufactured from commercial grade polyester resin or other suitable polyester or vinyl ester resins with fiberglass reinforcements. Manhole shall be a one piece unit manufactured to meet or exceed all specifications of ASTM D-3753 latest edition as manufactured by LF Manufacturing, Inc. or an approved equal.

i) Resin

- a) The resins used shall be a commercial grade unsaturated polyester resin or other suitable polyester or vinyl ester resin.

ii) Reinforcing Material

- a) The reinforcing materials shall be commercial Grade "E" type glass in the form of continuous roving and chop roving, having a coupling agent that will provide a suitable bond between the glass reinforcement and the resin.

iii) Interior Surfacing Material

- a) The inner surface exposed to the chemical environment shall be a resin-rich layer of 0.010 to 0.020 inch thick. The inner

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surface layer exposed to the corrosive environment shall be with the minimum of two passes of chopped roving of minimum length 0.5 inch (10mm) to maximum length of 2.0 inch (50.8 mm) and shall be applied uniformly to an equivalent weight of 3 oz/ft. Each pass of chopped roving shall be well-rolled prior to the application of additional reinforcement. The combined thickness of the inner surface and interior layer shall not be less than 0.10 inch (2.5mm)

iv) Wall Construction Procedure

- a) After inner layer has been applied to manhole wall shall be constructed with chop and continuous strand filament wound manufacturing process which insures continuous reinforcement and uniform strength and composition. The cone section, if produced separately, shall be affixed to the barrel section at the factory with resin-glass reinforced joint resulting in a one piece unit. Seams shall be fiberglassed on the inside and the outside using the same glass-resin jointing procedure. Field joints shall not be acceptable by anyone except the manufacturer.

v) Exterior Surface

- a) For a UV inhibitor the resin on the exterior surface of the manhole shall have gray pigment added for minimum thickness .125 inches.

vi) Stubouts and Connections

- a) Upon request stubouts may be installed. Installation of SDR PVC sewer pipe must be performed by sanding, priming, and using resin fiber-reinforced hand layup. The resin and fiberglass shall be same type and grade as used in the fabrication of the fiberglass manhole. Insert a-Tee fittings may be requested and installed per manufacturers instructions. Kor-N-Seal boots may be installed by the manhole manufacturer using fiberglass reinforced pipe stubout for Kor-N-Seal boot sealing surface.

vii) Manhole Bottom

- a) Upon request manholes may be required to have resin fiber-reinforced bottom. Deeper manholes may require a minimum of two fiberglass channel stiffening ribs. All fiberglass manholes with a fiberglass bottom will have a minimum 3

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inch anti-floatation ring. Manhole bottom shall be a minimum of ½ inch thick.

viii)Fiberglass Enclosed Invert and Bench Area

- a) Upon request a fiberglass enclosed invert and bench area may be installed in the manhole. The invert will be formed using a non-corrosive material and completely enclosed in a minimum ¼ inch layer of fiberglass chop.

ix) Height Adjustment

- a) Fiberglass manholes must have the ability to be height adjustable with the use of a height adjustment ring. Height adjustment can be made as a field operation without the use of uncured resins or fiberglass layups. Fiberglass manholes must maintain all load and soundness characteristics required by ASTM D3753 after height adjustment has occurred.

x) Fillers and Additives

- a) Fillers, when used, shall be inert to the environment and manhole construction. Sand shall not be accepted as approved filler. Additives, such as thixotropic agents, catalysts, promoters, etc., may be added as required by the specific manufacturing process to be used to meet the requirements of this standard. The resulting reinforced plastic material must meet the requirement of this specification.

xi) Manufacture

- a) Manhole cylinders, manway reducers, and connectors shall be produced from glass fiber-reinforced polyester resin using a combination of chop and continuous filament wound process.

xii)Interior Access

- a) All manholes shall be designed so that a ladder or step system can be supported by the installed manhole.

xiii)Manway Reducer

- a) Manway reducers will be concentric with respect to the larger portion of the manhole diameters through 60 inches. Larger manholes may have concentric or eccentric manway reducer openings.

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xiv)Cover and Ring Support

- a) The manhole shall provide an area from which a grade ring or brick can be installed to accept a typical metal ring and cover and have the strength to support a traffic load without damage to the manhole.

xv) Exterior Surface

- a) The exterior surface shall be relatively smooth with no sharp projections. Hand-work finish is acceptable if enough resin is present to eliminate fiber show. The exterior surface shall be free of blisters larger than 0.5 inch in diameter, delamination or fiber show.

xvi)Interior Surface

- a) The interior surface shall be resin rich with no exposed fibers. The surface shall be free of crazing, delamination, blisters larger than 0.5 inch in diameter and wrinkles of 0.125 inch or greater in depth. Surface pits shall be permitted if they are less than 0.75 inch in diameter and less than 0.0625 inch deep. Voids that cannot be broken with finger pressure and that are entirely below the resin surface shall be permitted if they are less than 0.5 inch in diameter and less than 0.0625 inch thick.

xvii)Repairs

- a) Any manhole repair is subject to meet all requirements of this specification.

xviii) Manhole Length

- a) Manhole Lengths shall be in 6 inch increments +/-2 inches.

xix)Diameter Tolerance

- a) Tolerance of inside diameter shall be +/-1% of required manhole diameter.

xx) Load Rating

- a) The complete manhole shall have a minimum dynamic-load rating of 16,000 lbs. when tested in accordance with ASTM 3753 8.4 (note 1). To establish this rating the complete

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manhole shall not leak, crack, or suffer other damage when load application when loaded to 24,000 lbs.

xxi)Stiffness

- a) The manhole cylinder shall have the minimum pipe-stiffness values shown in the table below when tested in accordance with ASTM 3753 8.5 (note 1).

LENGTH - FT	F/AY - PSI
3 - 6.5	0.75
7 - 12.5	1.26
13 - 20.5	2.01
21 - -25.5	3.02
26 - 35	5.24

xxi)Soundness

- a) In order to determine soundness, apply an air or water pressure test to the manhole test sample. Test pressure shall not be less than 3 psig or greater than 5 psig. While holding at the established pressure, inspect the entire manhole for leaks. Any leakage through the laminate is cause for failure of the test. Refer to ASTM 3753 8.6

xxii)Chemical Resistance

- a) The fiberglass manhole and all related components shall be fabricated from corrosion proof material suitable for atmospheres containing hydrogen sulfide and dilute sulfuric acid as well as other gases associated with the wastewater collection system.

xxiii)Physical Properties

	HOOP DIRECTION	AXIAL DIRECTION
Tensile Strength (psi)	18,000	5,000
Tensile Modules (psi)	0.6×10^6	0.7×10^6
Flexural Strength (psi)	26,000	4,500
Flexural Modules (psi)	1.4×10^6	0.7×10^6
Compressive (psi)	18,000	10,000

xxiv)Test Methods

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- a) All tests shall be performed as specified in ASTM 3753 latest edition, Section 8. Test method D-790 (note5) and test method D-695.

xxv)Quality Control

- a) Each completed manhole shall be examined for dimensional requirements, hardness, and workmanship. All required ASTM 3753 testing shall be completed and records of all testing shall be kept and copies of test records shall be presented to customer upon formal written request within a reasonable time period.

xxvi)Certifications

- a) As a basis of acceptance the manufacturer shall provide an independent certification which consists of a copy of the manufacturer's test report and accompanied by a copy of the test results stating the manhole has been sampled, tested, and inspected accordance with the provisions of this specification and meets all requirements.

xxvii)Fiberglass Bottom

- a) Concrete may be used to form bench area and invert. Also concrete may be used on top of anti-floatation ring and around the reducer section as required for buoyancy.

xxiii)Concrete Bottom

- a) Lower manhole into wet concrete until it rests at the proper elevation, with a minimum of 4 inches of fiberglass manhole inserted into the wet concrete below flow line, then move manhole to plumb. The concrete shall extend a minimum of one foot from the outside wall of the manhole and a minimum of 6 inches above incoming lines. On the inside concrete shall form the bench and invert area and rise a minimum of 4 inches above incoming lines. If required by engineer concrete may be used around reducer section for buoyancy.

xxiv)Backfill Material

- a) Unless shown otherwise on drawings and approved by the engineer, sand, crushed stone, or pea gravel shall be used for backfill around the manhole for a minimum distance of one

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foot from the outside surface and extending from the bottom of the excavation to distance of one foot from the outside surface and extending from the bottom of the excavation to the top of the reducer section. Suitable material chosen from the excavation may be used for the remainder of the backfill. The material chosen shall be free of large lumps or clods, which will not readily break down under compaction. This material will be subject to approval by the engineer.

xxv) Marking and Identification

- a) Each manhole shall be marked on the inside and outside with the following information:
 - (i) Manufacturer's name or trademark
 - (ii) Manufacturer's factory location
 - (iii) Manufacturer's serial number
 - (iv) Total Length

5. Lamp Holes

Lamp holes will not be allowed.

6. Gravity Sewer Service Lateral

The requirements for construction of gravity sewers shall apply for service laterals. Installation shall be in accordance with the Standard Detail drawings. Service laterals and fittings shall be a minimum four (4) inches in diameter with a minimum slope of 1/8 inch per foot. Customer service laterals shall be provided to all lots within a subdivision. All laterals shall terminate at the property line with a cleanout as shown in the Standard Detail Drawings. All sewer laterals shall be marked with an "S" or an arrow "↑" cut into the curb and painted green.

B. Pressure Piping for Wastewater and Non-Potable Water

This section includes furnishing and installing all pressure pipework and appurtenances for wastewater and non-potable water systems complete and fully operable in all respects.

1. Materials

All material shall be free from defects impairing strength and durability and be of the best commercial quality for the purpose specified. It shall have structural properties sufficient to safely sustain or withstand strains and stresses to which it is normally subjected and be true to detail.

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All pipework will be inspected upon delivery and such as does not conform to the requirements of these specifications shall be rejected and must be immediately removed from the site by the Contractor.

The Contractor shall furnish and provide all labor necessary to assist the Engineer in inspecting the material.

The basis of rejection shall be as specified in applicable ASTM & AWWA Specifications.

2. Unplasticized Polyvinyl Chloride (PVC) Pressure Pipe

PVC pipe shall meet AWWA Standard C900 or C905, or ASTM Standard D2241, with minimum designations per the table below. PVC pipe shall be provided with push-on joints with the bell integrally cast into the pipe. PVC pipe shall be installed with elastomeric gaskets meeting ASTM Standard F477.

PVC pipe shall be as manufactured by the Johns-Manville Co., the Ethyl Corp., the Certain-Teed Products Corp., the Clow Corporation or approved equivalent. All sewer force main pipe shall be green in color and all non-potable (reuse) water pipe shall be purple in color.

DIAMETER	REQUIRED STANDARD	DR	OD	Pressure class
2" - 3"	D2241	21	IP	200
4" - 8"	C-900	25	CI	100
10" - 12"	C-900	25	CI	100
14" - 24"	C-905	25	CI	165
30" - 36"	C-905	25	CI	165

Each length of pipe shall be clearly marked with the following information at intervals of five feet or less:

- a. Nominal pipe size and OD base.
- b. Material code designation.
- c. Dimension ratio.
- d. Pressure class or pressure rating.
- e. Manufacturer's name or trademark.
- f. Appropriate AWWA or ASTM designation number.

All fittings for PVC pressure pipe shall be ductile iron mechanical joint meeting the requirements of ANSI/AWWA C153/A21.53-84 ductile iron compact fittings 3 inch through 12 inch for water and other liquids.

3. Ductile Iron Pipe

Ductile iron pipe shall meet the requirements of ANSI A21.51, including Addenda A21.51a. Pipe dimensions shall conform to Federal Specification WW-P-421, Class 150. Each pipe shall be conspicuously marked on the outside of the barrel to readily identify it from Cast-Iron. Metal thickness shall conform to ANSI A21.51, Table 51.1, 2-1/2 to 5 feet cover.

- a. Mechanical Joints: ANSI Standard Specification A21.11, Rubber Gasket Joints for Cast-Iron Pressure Pipe and Fittings.
- b. Push-on Joints: ANSI Standard Specification A21.11, Rubber Gasket Joints for Cast-Iron Pressure Pipe and Fittings, Single gasket push-on type.
- c. Flanged Joints: ANSI Standard Specifications B16.1, Cast-Iron Pipe Flanges and Flanged Fittings, 125 pounds. Screwed on flanges, faced and drilled to ANSI Class 125 pound template. The flanged joints shall be assembled by threading plain end pipe and screwing on long hub flanges. The connection shall then be power tightened and refaced across both face of flange and end of pipe. Provide one-sixteenth-inch ring gaskets of red sheet rubber meeting the requirements of Grade I, Table I of ASTM Specification D1330-66, Sheet Rubber Gaskets. Connections shall be made with machine bolts and hexagonal nuts.
- d. Fittings: All fittings for ductile iron pipe shall be ductile iron mechanical joint meeting the requirements of ANSI/AWWA C153/A21.53-84 ductile iron compact fittings 3 inch through 12 inch for water and other liquids.
- e. Coatings for Ductile Iron Pipe: All ductile iron pipe and fittings to be installed underground shall be coated on the exterior with hot-dip coal-tar and conform to all appropriate requirements for seal coat in ANSI/AWWA C104/A21.4. The exterior of all above ground pipe shall receive a coat of rust inhibitor prime compatible with the finish paint schedule. All bolts, nuts, studs and other uncoated parts of joints for underground installation shall be coated with asphalt or coal-tar prior to backfilling.

- f. The interior lining for all ductile iron pipe and fittings for wastewater shall be factory applied epoxy coating with a minimum dry film thickness of 10 mils. The epoxy coating shall be a Hi-Build Epoxy coating equal to Tnemec, Indurall, or other approved equal. The Hi-Build epoxy shall incorporate a polyamide cured epoxy resin which shall consist of a primer coat and two (2) coats of epoxy.
- g. Linings and Coatings for Ductile Iron Reuse Water Mains: All pipe, valves and fittings for reclaim water shall be cement mortar lined, the lining shall comply with ANSI standard A21.4 (AWWA C104) "Cement-Mortar Lining for Cast Iron Pipe and Fittings for Water." The exterior of buried pipe shall receive a coat of hot-dip coal-tar as specified in ANSI A21.6. The exterior of all aboveground pipe shall receive a coat of rust inhibitor prime compatible with the finish paint schedule. All bolts, nuts, studs and other uncoated parts of joints for underground installation shall be coated with asphalt or coat-tar prior to backfilling.

4. Metallic Tracer Wire

Copper wire (12 gauge) shall be buried directly above all non-metallic pipes no deeper than 18" below ground level. Color of tracer wire shall be blue, green, or purple for water, sewer, or reuse respectfully. All connections to be made with silicone sealed wire nuts.

5. Valves

- a. Gate Valves: Provide gate valves meeting the following requirements.

Gate Valves Two Inches and Larger: Gate valves shall be of the resilient seated wedge type, epoxy coated to AWWA C550, cast iron body design. They shall comply with the American Water Works Association Gate Valve Standard C-509 as latest revised. Valves shall be rated for zero leakage at 200 psi water working pressure and have a 400 psi hydrostatic test for structural soundness. All testing shall be conducted in accordance with AWWA C-509.

Gate valves shall be furnished with type of end connection specified as follows: mechanical joint per AWWA C-111.

All cast iron shall conform to ASTM-A-126 Class B. Castings shall be clean and sound without defects that will impair their

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service. No plugging or welding of such defects will be allowed. Stems shall be manganese bronze having a minimum tensile strength of 60,000 psi, a minimum yield of 20,000 psi. Bolts shall be electro-zinc plated steel with hex heads and hex nuts in accordance with ASTM A-307.

Valves shall be M & H Model 4067-NRS or approved equivalent.

Gate Valves Under Two Inches: Gate Valves under two inches shall be bronze body, threaded ends, non rising stem, solid wedge disc and shall be American Model 3FG or approved equivalent.

6. Non-Potable (Reuse) Water Services

- a. Meter Boxes: Meter boxes shall be furnished and installed by the Developer and shall be “Ametek” standard meter box with plastic reader cover and purple lid stamped (Reuse) or “Non-potable”.
- b. Meters: Meter sizes up to and including 1 ½ ” shall be provided by PWS. Larger size meters and boxes shall be provided by the customer and shall be Invensys Touch Read 1,000 gallon registration, subject to approval by PWS.
- c. Service Clamps: Service clamps shall be Ford Model FS202 stamped “reuse” or “non-potable” or approved equivalent.
- d. Corporation Stops: Corporation stops shall be Ford Model No. F-1004 or approved equivalent. Inlets shall have iron pipe threads and outlets shall have compression connections.
- e. Curb Stops: Curb stops shall be Ford Model No. BRW-41-344 stamped “reuse” or “non-potable” or approved equivalent. Inlets shall have (1 inch) compression connections and outlet shall have ¾” meter swivel out. Valves shall be equipped with padlock eyes or approved equivalent.
- f. Service Tubing: Service tubing shall meet the requirements of ASTM-D-2737, SDR 9. Service tubing shall be polyethylene (PE) meeting ASTM D1248, PE 3408 requirements for polyethylene tubing. It shall be delivered in rolls and cut to required lengths. Tubing shall be “purple” in color.
- g. Service Tees: Service Tees for double services are to be pack joint tees, Ford Model No. T444-444.

7. Valve Boxes

Cast iron valve boxes shall be provided for all underground valve installations. They shall consist of a base covering the operating nut and head of the valve, a vertical shaft, at least 5-1/4 inches in diameter, and a top section extending to a point even with the finished ground surface. Provide a cast iron cover marked "RECLAIM WATER" or "REUSE" as required and placed concentrically over the operating nut. The valve boxes shall be Clow F-2452 screw type valve box, or an approved equivalent.

C. Potable Water Pipework

This section includes furnishing and installing all potable water pipework and appurtenances necessary for a fully operable water system.

1. Materials

All material shall be free from defects impairing strength and durability and be of the best commercial quality for the purpose specified. It shall have structural properties sufficient to safely sustain or withstand strains and stresses to which is normally subjected and be true to detail.

Certified records of material tests made by the manufacturer or by a reliable commercial laboratory shall be submitted to the Engineer.

All pipework will be inspected upon delivery and such as does not conform to the requirements of these specifications shall be rejected and must be immediately removed from the site by the Contractor. The Contractor shall furnish and provide all labor necessary to assist the Engineer in inspecting the material.

The basis of rejection shall be as specified in applicable AWWA and ASTM Specifications.

2. Unplasticized Polyvinyl Chloride (PVC) Pressure Pipe

PVC pipe shall meet AWWA Standard C900 or C905, or ASTM Standard D2241, with minimum designations per the table below. PVC pipe shall be provided with push-on joints with the bell integrally cast into the pipe. PVC pipe shall be installed with elastomeric gaskets meeting ASTM Standard F477.

DIAMETER	REQUIRED STANDARD	DR	OD	Pressure Class
2" - 3"	D2241	21	IP	200
4" - 8"	C-900	25	CI	100
10" - 12"	C-900	25	CI	100
14" - 24"	C-905	25	CI	165
30" - 36"	C-905	25	CI	165

PVC pipe shall be as manufactured by the Johns-Manville Co., the Ethyl Corp., the Certain-Teed Products Corp., the Clow Corporation or approved equivalent. All potable water mains shall be blue or white.

All fittings for PVC pressure pipe shall be ductile iron mechanical joint meeting the requirements of ANSI/AWWA C153/A21.53-84 ductile iron compact fittings 3 inch through 12 inch for water and other liquids.

The working pressure rating for fittings shall be 350 psi. Fittings shall be furnished with an asphaltic outside coating in accordance with ANSI/AWWA C153/A21.53 and cement lined and seal coated with an asphaltic material in accordance with ANSI/AWWA C104/A21.4.

Standard laying lengths shall be 20 feet and randoms shall not be less than 10 feet.

Pipe must be certified as suitable for potable water use by the National Sanitation Foundation (N.S.F.) and marked as follows: NSF-PW.

Each length of pipe shall be clearly marked with the following information at intervals of five feet or less:

- a. Nominal pipe size and OD base.
- b. Material code designation.
- c. Dimension ratio.
- d. Pressure class or pressure rating.
- e. Manufacturer's name or trademark.
- f. NSF approval seal.
- g. Appropriate AWWA or ASTM standard number.

3. Ductile Iron Pipe

Ductile iron pipe shall meet the requirements of ANSI A21.51, including Addenda

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A21.51a. Pipe dimensions shall conform to Federal Specification WW-P-421, Class 150. Each pipe shall be conspicuously marked on the outside of the barrel to readily identify it from Cast-Iron. Metal thickness shall conform to ANSI A21.51, Table 51.1, 2-1/2 to 5 feet cover.

- a. Mechanical Joints: ANSI Standard Specification A21.11, Rubber Gasket Joints for Cast-Iron Pressure Pipe and Fittings.
- b. Push-on Joints: ANSI Standard Specification A21.11, Rubber Gasket Joints for Cast-Iron Pressure pipe and Fittings, Single gasket push-on type.
- c. Flanged Joints: ANSI Standard Specifications B16.1, Cast-Iron Pipe Flanges and Flanged Fittings, 125 pounds. Screwed on flanges, faced and drilled to ANSI Class 125 pound template. The flanged joints shall be assembled by threading plain end pipe and screwing on long hub flanges. The connection shall then be power tightened and refaced across both face of flange and end of pipe. Provide one-sixteenth-inch ring gaskets of red sheet rubber meeting the requirements of Grade I, Table I of ASTM Specification D1330-66, Sheet Rubber Gaskets. Connections shall be made with machine bolts and hexagonal nuts.
- d. All fittings shall be ductile iron mechanical joint meeting the requirements of ANSI/AWWA C153/A21.53 ductile iron compact fittings 3 inch through 12 inch for water and other liquids.

The working pressure rating for fittings shall be 350 psi. Fittings shall be furnished with an asphaltic outside coating in accordance with ANSI/AWWA C153/A21.53 and cement lined and seal coated with an asphaltic material in accordance with ANSI/AWWA C104/A21.4.

Pipe must be certified as suitable for potable water use by the National Sanitation Foundation (NSF) and marked as follows: NSF-PW.

- e. Linings and Coatings for Ductile Iron Water Mains: All pipe, valves, fittings and specials for water shall be cement mortar lined, the lining shall comply with ANSI standard A21.4 (AWWA C104) "Cement-Mortar Lining for Cast Iron Pipe and Fittings for Water." The exterior of buried pipe shall receive a coat of hot-dip coal-tar as specified in ANSI A21.6. The exterior of all aboveground pipe shall receive a coat of rust inhibitor prime compatible with the finish paint schedule. All bolts, nuts, studs and other uncoated

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parts of joints for underground installation shall be coated with asphalt or coat-tar prior to backfilling.

4. Metallic Tracer Wire

Copper wire (12 gauge) shall be buried directly above all non-metallic pipes no deeper than 18" below ground level. Color of tracer wire shall be blue, green, or purple for water, sewer, or reuse respectively. All connections are to be made with silicone sealed wire nuts.

D. Valves, Hydrants, Meters and Miscellaneous Appurtenances

This section includes furnishing and installing complete all equipment and materials necessary for a complete and fully operable system.

1. Materials

All material shall be free from defects impairing strength and durability and be of the best commercial quality for the purpose specified. It shall have structural properties sufficient to safely sustain or withstand strains and stresses to which it is normally subjected and be true to detail.

All pipe work will be inspected upon delivery and such as does not conform to the requirements of these specifications shall be rejected and must be immediately removed from the site by the Contractor. The Contractor shall furnish and provide all labor necessary to assist the Engineer in inspecting the material.

The basis of rejection shall be as specified in applicable ASTM and AWWA Specifications.

2. Valves

a. Gate Valves: Provide gate valves meeting the following requirements.

Gate Valves Two Inches and Larger: Gate valves shall be of the resilient seated wedge type, epoxy coated to AWWA C550, cast iron body design. They shall comply with the American Water Works Association Gate Valve Standard C-509 as latest revised. Valves shall be rated for zero leakage at 200 psi water working pressure and have a 400 psi hydrostatic test for structural soundness. All testing shall be conducted in accordance with AWWA C-509.

Gate valves shall be furnished with type of end connection specified as follows: mechanical joint per AWWA C-111.

All cast iron shall conform to ASTM-A-126 Class B. Castings shall be clean and sound without defects that will impair their service. No plugging or welding of such defects will be allowed. Stems shall be manganese bronze having a minimum tensile strength of 60,000 psi, a minimum yield of 20,000 psi. Bolts shall be electro-zinc plated steel with hex heads and hex nuts in accordance with ASTM A-307.

Valves shall be M & H Model 4067-NRS or approved equivalent.

Gate Valves Under Two Inches: Gate Valves under two inches shall be bronze body, threaded ends, non rising stem, solid wedge disc and shall be American Model 3FG or approved equivalent.

Valves shall be marked with a "V" cut into the curb and painted green, blue, or purple for sewer, water, or reuse respectively.

- b. Check Valves: Provide check valves meeting the following requirements:

Over Three-Inches: The check valves over three-inches (3") shall be iron-body, bronze-mounted, horizontal-swing check with flanged ends. All working parts shall be spring-loaded to prevent slamming. The check valves shall be M & H Fig. 250F, American Darling 50 Line or approved equivalent.

Under Three-Inches: Check valves under three-inches (3") shall be screwed-end, bronze-body, silent check valves as manufactured by Crane Co., No. 34 or approved equivalent.

- c. Air Release and Vacuum Valve: The combination air release and vacuum valve shall be furnished with both a large and small orifice. The valve shall automatically function to release to atmosphere both large and small amounts of air that accumulate in this pipeline. Once the air has been exhausted both the large and small valves shall seat tightly to prevent water leakage. The valve shall also function to admit air into a line, tank, or chamber under emergency conditions or when it is being drained. The valve body and cover shall be of semi-steel; floats of stainless steel; levers of bronze and resilient seats. The air and vacuum valve shall be manufactured by G-A Industries, Inc., Type 1-AV or approved equivalent.

- d. Butterfly Valves: Provide valves conforming to AWWA C504 (latest) with lug wafer type body suitable for use between ANSI 125 or 150 lb. flanges. Disc shall be 316 stainless steel or have a welded nickel edge. Valve shaft shall be supported on three permanently lubricated bronze or on TFE coated stainless steel bearings. The valve seat shall be of Hycar or equivalent. Disc-to-shaft connections shall be 316 stainless steel and securely locked in position. Valves 8 inches and larger shall have a thrust collar of stainless steel. Three shaft seals shall protect bearings from internal and external corrosion. Infinite position levers shall provide manual throttling and locking in any position from open to closed.

Butterfly valves and actuators shall be Figure 632 as manufactured by DeZurick or approved equivalent.

- e. Plug Valves: Plug Valves shall be of the eccentric type utilizing a quarter turn manual operation. The valve construction and performance shall meet or exceed AWWA C504-80 and ANSI B16.1-1975 requirements. Valves shall have a 150 psi minimum pressure rating. The plug valve shall be an M&H Style 820 X-centric valve or approved equivalent. Contractor shall provide a wrench for operating valves.
- f. Hose Bibs: Hose bibs shall be Crane No. 58 or equivalent.
- g. Valve locations shall be marked with a "V" cut into the curb and painted blue.

3. Hydrants

Fire Hydrants: All fire hydrants shall be 5-1/4 inch hydrants with two 2-1/2 inch connections and one pumper connection designed for 150 psi working pressure, and shall conform to the requirements of AWWA C502.

Hydrants shall have mechanical joint inlets, shall be for a 3-foot bury, and shall be breakaway or traffic model, dry barrel type.

Hydrants shall be painted with one coat of red lead and two finish coats of an approved outside paint of fire hydrant red in color or as directed by the Engineer.

The hydrants shall be American Flow Control, American Darling B-84-B; Mueller Co., Centurion A-423; M & H Style No. 129; or approved equivalent.

Flushing Hydrant: All flushing hydrants shall be 2 inch inlet type with one 1-1/2 inch hose nozzle. Flush hydrants shall be Mueller No. 411 or approved equivalent.

4. Water Services

- a. Meter Boxes: Meter boxes shall be furnished and installed by the Developer and shall be "Ametek" Standard Meter Box with Plastic Reader Cover or approved equivalent.
- b. Meters: Meter sizes up to and including 1 1/2" shall be provided by PWS. Larger sized meters and boxes shall be provided by the Customer and shall be Invensys Touch Read 1000 gallon Registration, subject to approval by PWS.
- c. Service Clamps: Service clamps shall be Ford Model FS202 or approved equivalent.
- d. Corporation Stops: Corporation stops shall be Ford Model No. F-1004 or approved equivalent. Inlets shall have iron pipe threads and outlets shall have compression connections.
- e. Curb Stops: Curb stops shall be Ford Model No. B43-342W or approved equivalent. Inlets shall have compression connections and outlet shall have meter swivel nut. Valves shall be equipped with padlock eyes or approved equivalent.
- f. Service Tubing: Service tubing shall meet the requirements of ASTM-D-2737, SDR 9 and shall be listed as having the approval of the National Sanitation Foundation for Water Distribution; and shall have the NSF approval designation stamped on the tubing. Service tubing shall be polyethylene (PE) meeting ASTM D1248, PE 3408 requirements for polyethylene tubing. It shall be delivered in rolls and cut to required lengths.
- g. Service Tees: Service Tees for double services are to be pack joint tees, Ford Model No. T444-444..

5. Valve Boxes

Cast iron valve boxes shall be provided for all underground valve installations. They shall consist of a base covering the operating nut and head of the valve, a vertical shaft, at least 5-1/4 inches in diameter, and a top section extending to a point even with the finished ground surface. Provide a cast iron cover marked "WATER," "SEWER" or "REUSE" as required and placed concentrically over the operating nut. The valve

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boxes shall be Clow F-2452 screw type valve box, or an approved equivalent.

6. Backflow Preventer

Double Check Valve Assembly shall be a complete assembly including two positive seating check valves, tight closing shut-off valves located upstream and downstream of the check valves, and four suitably placed ball-type test cocks. The device shall be bronze construction. The first and second check valves shall be of modular design and they shall be identical, completely removable and interchangeable.

The backflow preventer shall be in full conformance with the American Society of Sanitary Engineering Standard for Double Check Valve Assemblies, ASSE Standard 1015 and with the requirements of the U.S.C. Foundation for Cross-Connection Control.

Double check valve assemblies shall be Watts Model No. 709 or approved equivalent.

Double Detector Check Valve Assembly shall be used on fire protection system supply mains and shall be Watts Model No. 709 DCDA or approved equivalent.

Backflow Preventers on residential water services shall be dual check valve assemblies, ASSE Standard 1024, Watts Model No. 7, or approved equivalent.

Reduced pressure backflow preventers shall be used for hazardous water supply applications. Reduced pressure backflow preventers shall meet ASSE Standard 1013 and shall be Watts Model No. 909 or approved equivalent.

7. Tapping Valves

Tapping valves shall meet the requirements of AWWA C-500 gate valves indicated above and be designed for making taps to existing mains under pressure. Valve, tees, and boring equipment used shall be mutually compatible. Tapping tees unless otherwise indicated shall be constructed of cast or ductile iron with non-corrosive accessories. All stainless steel bodied tees may be used. All nuts and bolts shall be non-corrosive and be compatible with fitting materials.

8. Submittals

The Contractor shall submit a minimum of four (4) copies of catalog data for approval by PWS for materials to be used. Allow two weeks for submittal review. This submittal shall include but not be limited to the following:

- a. Pipe and Fittings
- b. Tubing
- c. Valves
- d. Hydrants
- e. All Service Materials
- f. Casing
- g. Backflow Preventer

E. Installation

This section covers installation of gravity and pressure pipework. Excavation and backfilling shall be in accordance with the preceding, applicable section of these specifications.

1. General

- a. All pipe, fittings, and valves shall be carefully handled at all times to prevent damage to the pipe or other installation on the job site.
- b. At times when pipe installation is not in progress, the open ends of the pipe shall be closed by approved means and shall remain closed until construction on that particular section is resumed, eliminating the possibility of any flow obstructions getting into the pipe.
- c. All joints shall be wiped free of all dirt, sand and foreign material and the pipe shall be carefully examined for defects before installation.
- d. Cutting of pipe for inserting valves, fittings, or closure pieces shall be done in a neat and workmanlike manner without damage to the pipe.
- e. Deviations from the piping location, line and grade indicated on the construction plans shall not be made without the prior approval of the Engineer.

2. Pipe Laying Procedures

- a. Gravity Flow Piping: Gravity flow piping shall be installed to the line and grade indicated on the construction drawings. Before

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lowering the pipe into the ditch the bottom of the ditch shall be graded so that when the pipe rests on the ditch bottom it will have a uniform bearing for its entire length. Bell holes shall be dug for bell placement. The pipe shall be carefully examined for defects and the inside cleaned. After placing the pipe in the ditch, the ends shall be wiped free from all dirt, sand and foreign material. The joints shall then be made in accordance with the recommendations of the pipe manufacturer.

Installation of pipe shall proceed in an upstream direction with bells facing in the direction of laying. All pipe reaches will be inspected for straightness. No bows or dips, either horizontally or vertically, will be accepted. A full circle of light must be readily seen when looking from one end of a pipe through to the other end.

- b. Pressure Piping: Pressure piping shall be installed in strict accordance with the manufacturer's printed instructions. Before lowering the pipe into the trench the bottom of the trench shall be graded so that when the pipe rests on the trench bottom it will have a uniform bearing for its entire length. The pipe shall be carefully examined for defects and the inside cleaned. After placing the pipe in the trench, the ends shall be wiped free from all dirt, sand and foreign material. The joints shall be made in accordance with the recommendations of the pipe manufacturer.

Suitable concrete reaction or thrust blocks shall be applied on all lines (except those having screwed or flanged joints), at all tees, plugs, caps, and bends deflecting 22-1/2 degrees or more, or movements shall be prevented by attaching metal rods or straps approved by the Engineer. Unless otherwise directed, the pipe shall be laid with bell ends facing in the direction of laying. Whenever it is necessary to deflect the pipe from a straight line, either in the vertical or horizontal plane, to avoid obstruction, to plumb stems, or where long radius curves are permitted, the degree at deflection shall be as recommended by the manufacturer of the pipe.

The minimum cover for pipe will be 30-inches unless otherwise indicated on the approved plans. The depth of cover shall be measured from the established street grades or the surface of the permanent improvement to the top of the barrel of the pipe. At street intersections or where the new pipe lines cross existing underground lines at the approximate same depth as the new line, the cover shall be increased and the new line laid below existing lines or structures. Where the existing lines or structures are of sufficient depth that the new lines when laid will have 6-inches of

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separating earth between them and other pipe or structure and 30-inches cover, the new lines may be laid above the existing lines.

- c. Sub-Surface Explorations: Whenever necessary to determine the location of existing pipes, valves, or other underground structures, the Contractor shall examine all available records and shall make all explorations and excavations for such purpose. Where the locations of existing utilities are furnished by the Owner, they should be considered approximate only. The Contractor is responsible for locating and protecting all existing utilities whether shown on the drawings or not shown.
- d. Protecting Underground and Surface Structures: Temporary support, adequate protection and maintenance of all underground and surface utility structures, drains, sewers, and other obstructions encountered in the progress of the work shall be furnished by the Contractor at his own expense under the direction of the Engineer.
- e. Construction Equipment: Mechanical equipment may be used for trenching and excavating. However in places where the operation of same will cause damage to trees, shrubbery, pavements or existing structures, above or below ground, hand methods shall be employed. Where a main is installed along paved streets only rubber-tired equipment will be allowed for excavation and backfilling; the use of bulldozers or equipment on tracks will not be permitted. The Contractor will be responsible for any damage done to paved streets or lawns. Either air hammers or concrete saws should be used for cutting concrete pavement.
- f. Unsuitable Conditions: No pipe shall be laid or manholes placed in water or unsuitable soils conditions. Unsuitable soil, as determined by the Engineer, shall be removed or replaced with an approved material.
- g. Trench Water: At times when pipe laying is not in progress, the open ends of pipe shall be closed by approved means, and no trench water shall be permitted to enter the pipe.

h. Setting Valves and Boxes:

Valves and Fittings: Gate valves and pipe fittings shall be set and jointed to new pipe in the manner heretofore specified for cleaning, laying and jointing pipe.

Valve Boxes: Cast-iron valve boxes shall be firmly supported and maintained, centered and plumb, over the wrench nut of the gate

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valve and box cover flush with the surface of the finished pavement or at such other level as may be directed.

- i. Cutting Pipe: Cutting of pipe for inserting fittings or closure pieces shall be done in a neat and workmanlike manner without damage to the pipe.
- j. Dewatering: The Contractor shall provide all necessary pumps to dewater the site properly, shall provide all labor and materials required to keep any open excavation dewatered during construction; and shall provide all necessary sheeting, bulkheads, drains, etc., so that construction operations may be performed under dry conditions. Discharge from pumps must be led to natural drainage channels, to drains, or to storm sewer.
- k. Service Pipe: Service pipe shall have a minimum depth of 30 inches at all highway crossings and 18 inches elsewhere. The requirements for trenching and backfilling shall apply. Removal of pavements or sidewalk will not be permitted for water service lines. They may be installed by jacking, boring or pushing under sidewalks.
- l. Plugging Dead Ends: Standard plugs shall be inserted into the bells of all dead ends of pipes, tees, or crosses, and spigot ends shall be capped. Plugs or caps shall be jointed to the pipe or fittings in the appropriate manner.
- m. Concrete Encasement and Specials: Provide concrete pipe encasements or special pipe supports as shown on the drawings or directed by the Engineer. Various pipe supports shall be as worked out in the field to suit local conditions and emergencies. Where, in the opinion of Engineer, pipe covering is inadequate, concrete encasement for protection shall be provided in accordance with the details on the approved drawings. Concrete encasements shall be made using concrete with a 28-day strength of 2000 psi and shall be to the dimensions indicated on the construction plans and as required by the applicable Department of Transportation or Public Health regulations. All other concrete needed to build and protect the pipe work shall be used at the direction of the Engineer.
- n. Separation of Water Mains and Sewers: Water mains or sewer mains that are laid in the vicinity of each other shall meet the horizontal and vertical separations specified and shown in the Standard Details sections.

- o. Backfilling: Backfill material shall be free from rocks or boulders or any other objectionable material and shall be placed in the trench and compacted simultaneously on both sides of the pipe for the full width of the trench, and to an elevation level with ground on either side to densities indicated previously in these specifications.
- p. Repaving: Pavement removal where required in the construction of this project shall be done by the Contractor in a workmanlike manner. Care must be taken to make the saw cut in a straight line so the patch will be neat.

Asphalt paving shall be replaced as described in the applicable section of the specifications and in accordance with the standard detail drawings. Concrete driveways and pavement shall be replaced using concrete with high early strength so that traffic may be resumed quickly. Concrete must be finished to conform with existing pavement.

- q. Clean-Up: Before final inspection and acceptance, the Contractor shall clean ditches, shape shoulders, and restore all disturbed areas, including street crossing, grass plots, to as good a condition as existed before work started. All trenches shall be leveled, and loose material removed from pavement gutters and sidewalks, employing hand labor, if necessary.

3. Anchorage of Bends, Tees, and Plugs

- a. Thrust Backing Placement: Reaction or thrust backing shall be placed on all pipe lines two-inches in diameter or larger at all tees, plugs, caps and at bends deflecting 22-1/2 degrees or more, or movement shall be prevented by attaching metal rods or straps as approved by the Engineer.
- b. Materials for Thrust Backing: Reaction, or thrust backing shall be of concrete that has a 28-day compressive strength of not less than 2000 psi. Reaction backing will be placed in accordance with the details on the approved construction plans and standard details.

Backing shall be placed between solid ground and the fitting to be anchored. The backing shall, unless otherwise directed, be so placed that the pipe and fitting joints will be accessible for repairs. No extra payment will be made for this material but shall be included in the unit price bid for the various sizes of pipe.

In some cases, the Engineer may direct the Contractor to provide backing using cables and "deadman" anchors where the soil conditions will not support the normal concrete type as described above.

F. Testing and Inspection

1. General

During construction and at the completion of the work, the Contractor shall make such tests as required in these specifications or as may be directed by the Engineer. The Engineer will observe the tests, but the Contractor shall furnish all apparatus required and shall pay all costs connected therewith unless otherwise stated in these specifications. Defective work shall be repaired immediately at the Contractor's expense.

In general, tests shall conform to usually accepted testing practices for the specific type and class of test. All data, observations and results will be carefully recorded, and the System Engineer will be furnished two signed copies of all data and reports. Project acceptance may be held contingent on receipt of satisfactory test reports.

All new construction shall be secured prior to acceptance by PWS. Valves between new systems and existing systems that are not yet accepted shall be closed while unattended, ie. nights, weekends, and holidays.

2. Hydrostatic Tests of Pressure Pipework

- a. Pressure During Test: After the pipe has been laid and backfilled as specified, each valved section of newly laid pipe shall, unless otherwise specified, be subjected to a hydrostatic pressure equal to the pressure rating of the pipe being tested but not less than 150 psig. The Contractor shall record the testing by the use of a pressure recording gauge and after all testing is complete, the recordings shall be turned over to the Engineer for his files.
- b. Duration of Pressure Test: The duration of each pressure test shall be at least 2 hours.
- c. Procedure: Each section of pipe shall be slowly filled with water and the specified test pressure, measured at the lowest point of elevation, shall be applied by means of a pump connected to the pipe in a satisfactory manner. The pump, pipe connection, gauges, meter and all necessary apparatus shall be furnished by the Contractor. The test shall be applied to each valved section in order to check the leakage through all valves.

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- d. Expelling Air Before Test: Before applying the specified test pressure, all air shall be expelled from the pipe. To accomplish this, taps shall be made, if necessary, at points of highest elevation, and afterwards tightly plugged.
- e. Definition of Leakage: Leakage is defined as the quantity of water to be supplied into the newly laid pipe, or any valved section of it, necessary to maintain the specified leakage test pressure after the pipe has been filled with water and the air expelled.
- f. Permissible Leakage: Suitable means shall be provided by the Contractor for determining the quantity of water lost by leakage under normal operating pressure. No pipe installation will be accepted until or unless this leakage (evaluation at specified pressure) is less than the figures stated below:

Pipe Size	gal=s/1000'/24 hrs.	gal=s/1000'/1 hr.
2"	3.8 gal.	0.16 gal.
3"	5.7 gal.	0.24 gal.
4"	7.6 gal.	0.32 gal.
6"	11.4 gal.	0.47 gal.
8"	15.2 gal.	0.63 gal.
10"	18.9 gal.	0.79 gal.
12"	22.7 gal.	0.95 gal.

- g. Variation From Permissible Leakage: Should any test of combined sections of pipe laid disclose leakage greater than the specified limit, the Contractor, shall, at his own expense, locate and repair the defective joints until the leakage is within the specified allowance.
- h. Water for Testing: Water for testing shall be provided by the owner at no cost to the Contractor
- i. Time for Making Test: Pipe may be subjected to hydrostatic pressure, inspected, and tested for leakage at any convenient time after partial completion of backfill. The Contractor may test the system with joints exposed or with backfilling complete at his option, however, not more than 300 feet of trench may be open at

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any time. The Engineer and the Utility Company shall be notified at least 24 hours before beginning testing.

3. Tests of Gravity Pipework

- a. Inspection: It is imperative that all sewers and manholes be built practically watertight and that the Contractor adheres rigidly to the specifications for material and workmanship. After completion, the sewers, or sections thereof, will be tested and gauged and if infiltration is above allowable limits specified, the sewer will be rejected.

On completion of each section of sewer, or such other time as the Engineer may direct, the section of sewer is to be cleaned, tested and inspected. All repairs shown necessary by the tests are to be made, broken or cracked pipe replaced, all deposits removed and the sewers left true to line and grade as herein specified, or shown on the plans, entirely clean and ready for use. Each section of the sewer between manholes is to show from either end on examination, a full circle of light. Each manhole or other appurtenance to the system shall be of the specified size and form, be watertight, neatly and substantially constructed, with the top set permanently to exact position and grade.

- b. Air Testing: Air testing shall be an acceptable method of leakage testing. The requirements and procedures for air testing shall conform to the following specifications:

- i) Scope: Work under this section shall consist of furnishing all labor and materials and performing air tests for leakage on all sewer lines installed.

Defective work as indicated by tests specified herein shall be corrected immediately and the defective sections shall be retested.

The cost of air testing shall be included in the unit price bid for pipe and manholes. The Contractor shall furnish all equipment required for all tests.

- ii) Responsibility: The Contractor shall furnish all the necessary equipment and be responsible for conducting all air tests. In addition, the Contractor is responsible for any necessary repair work on sections that do not pass the test.

The Engineer and/or Inspector shall witness all air tests and verify the accuracy and acceptability of the equipment utilized.

- iii) Safety: All temporary pneumatic plugs shall be installed and braced in such a manner that blowouts are prevented. No internal pressure of more than 9 psig will be permitted on the sewer mains.

All pressurizing equipment used for air testing shall include a regulator or relief valve set no higher than 9 psig to avoid over-pressurizing and displacing temporary plugs.

- iv) Equipment: Either mechanical or pneumatic plugs may be used. All plugs shall be designed to resist internal testing pressures without the aid of external bracing or blocking. However, the Contractor should internally restrain or externally brace the plugs to the manhole wall as an added safety precaution throughout the test.

To facilitate test verification by the inspecting Engineer, all air used shall pass through a single, aboveground control panel.

The aboveground air control equipment shall include a shut-off valve, pressure regulating valve, pressure relief valve, input pressure gauges and a continuous monitoring pressure gauge having a pressure range from 1 to at least 10 psi. The continuous monitoring gauge shall be no less than 4 inches in diameter with minimum divisions of 0.10 psi and an accuracy of ± 0.04 psi.

Two (2) separate hoses shall be used to: (1) Connect the control panel to the sealed line for introducing low-pressure air and (2) a separate hose connection for constant monitoring of air pressure build-up in the line.

If pneumatic plugs are utilized, a separate hose shall also be required to inflate the pneumatic plugs from the aboveground control panel.

- v) Line Preparation: During sewer construction all service laterals, stubs, and fittings shall be properly capped or plugged so as not to allow for air loss during testing. All caps, plugs, and short pipe lengths shall be restrained with bracing stakes or clamps.

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- vi) Test Procedure: Low pressure air shall be slowly introduced into the sealed line until the internal air pressure reaches 4.0 psig greater than the average back pressure of any groundwater above the pipe. After a constant pressure of 4.0 psig is reached, the air supply shall be throttled to maintain that internal pressure for at least two (2) minutes. This is required to permit the temperature of the entering air to equalize with the temperature of the pipe wall.

When temperatures have been equalized and the pressure stabilized at 4.0 psig (greater than the average groundwater back pressure), the air hose from the control panel to the air supply shall be shut-off. The continuous monitoring pressure gauge shall then be observed while the pressure is decreased to no less than 3.5 psig (greater than the average groundwater back pressure). At a reading of 3.5 psig, or any convenient pressure reading between 3.5 psig and 4.0 psig (greater than the average groundwater back pressure), timing shall commence with a stop watch on this section of line being tested.

If the time shown in Table 1, for the designated pipe size length, elapses before the air pressure drops 0.50 psig; the section undergoing test shall have passed. The test will be discontinued on this section of line once the prescribed time has elapsed.

If the pressure drops 0.50 psig before the appropriate time shown in Table 1 has elapsed, the air loss rate shall be considered excessive and this section of line has failed the test.

If the section fails to meet these specifications, the Contractor shall determine at his own expense the source, or sources of leakage, and he shall repair or replace all defective material and/or workmanship to the satisfaction of the Engineer. The extent and type of repair which may be allowed, as well as results, shall be subject to the approval of the Engineer. Upon completion of this work, this section of line shall be retested and meet the requirements of the air test.

- c. Deflection Testing: All PVC sewer lines shall be tested for diametric deflection following installation. A "Go-No-Go" type mandrell will be an acceptable deflection testing device. The

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maximum diametric deflection allowable will be 5% of the pipe base inside diameter as defined in ASTM Specification D-30-34. Deflection testing will be performed prior to asphalt paving after all improvements including road base are in place.

TABLE 1

SPECIFICATION TIME REQUIRED FOR A 0.5 PSIG PRESSURE DROP FOR SIZE AND LENGTH OF PIPE INDICATED FOR Q=0.0015

1 Pipe Dia. (In.)	2 Minimum Time (Min:Sec)	3 Length for Minimum Time (Ft.)	4 Time for Longer Length (Sec)	SPECIFICATION TIME FOR LENGTH (L) SHOWN (MIN:SEC)							
				100 Ft.	150 Ft.	200 Ft.	250 Ft.	300 Ft.	350 Ft.	400 Ft.	450 Ft.
4	1:53	597	.190 L	1:53	1:53	1:53	1:53	1:53	1:53	1:53	1:53
6	2:50	398	.427 L	2:50	2:50	2:50	2:50	2:50	2:50	2:51	3:12
8	3:47	298	.760 L	3:47	3:47	3:47	3:47	3:48	4:26	5:04	5:42
10	4:43	239	1.187 L	4:43	4:43	4:43	4:57	5:56	6:55	7:54	8:54
12	5:40	199	1.709 L	5:40	5:40	5:42	7:08	8:33	9:58	11:24	12:50
15	7:05	159	2.671 L	7:05	7:05	8:54	11:08	13:21	15:35	17:48	20:02
18	8:30	133	3.846 L	8:30	9:37	12:49	16:01	19:14	22:26	25:38	28:51
21	9:55	114	5.235 L	9:55	13:05	17:27	21:49	26:11	30:32	34:54	39:16
24	11:20	99	6.837 L	11:24	17:57	22:48	28:30	34:11	39:53	45:35	51:17
27	12:45	88	8.653 L	14:25	21:39	28:51	36:04	43:16	50:30	57:42	46:54
30	14:10	80	10.683 L	17:48	26:43	35:37	44:31	53:25	62:19	71:13	80:07
33	15:35	72	12.926 L	21:33	32:19	43:56	53:52	64:38	75:24	86:10	96:57
36	17:00	66	15.384 L	25:39	38:28	51:17	64:06	76:55	89:44	102:34	115:23

SOURCE: Recommended Practice for Low-Pressure Air Testing of Installed Sewer Pipe by UNI-Bell Plastic Pipe Association

- d. Manhole Testing: All manholes shall be tested by one (1) of the following methods:
 - i) Manhole Exfiltration Test- All manholes constructed shall be watertight and show no visible sign of infiltration, and shall be tested in accordance with this Specification. The test shall be conducted by the Contractor in coordination with and at the direction of the Engineer. All incoming and outgoing sewer lines shall be plugged and the manhole filled with water to a level above the highest section joint. If the water level drop exceeds 1/8" per vertical foot of manhole depth in 5 minutes, the manhole shall have failed the test.

- ii) Manhole Vacuum Test – The test shall be conducted by the Contractor in coordination with and at the direction of PWS. The manhole shall be tested, after assembly, as follows: All pipe opening shall be sealed by installing suitable plugs that completely isolate the manhole structure; any other openings, such as lifting holes, shall be permanently sealed. A suitable vacuum pump shall be connected to the manhole, and a vacuum of 10” of Hg drawn. The pump shall then be isolated from the manhole by valving, and the test period begun. The test shall be successful if the vacuum remains at 9” of Hg or greater according to the following table:

<u>Manhole Diameter</u>	<u>Time Minimum (sec)</u>
48”	60
60”	75
72”	90

All manholes which fail the test or that have visible leaks, even if they pass the test, shall be repaired or replaced at the expense of the Contractor until the manholes pass the test, to the complete satisfaction of the Engineer. Manholes which have any visible leaks will not be accepted. (Ref. ASTM C1244-02)

4. Chlorination of Water Distribution Facilities

- a. Disinfection: After the water distribution system has been hydrostatically tested to the satisfaction of the Engineer and the Utility Company, it shall be disinfected in accordance with AWWA Specification C-651, which provides for contact with a 50 ppm solution of chlorine remaining for twenty-four hours, with the chlorine residual of at least 10 ppm.
- b. Chlorinating Valves and Flushing Hydrants: In the process of chlorinating water pipe, all valves or other appurtenances shall be operated while the pipe line is filled with the chlorinating agent.
- c. Final Flushing and Test: Following chlorination, all treated water shall be thoroughly flushed from the newly laid pipe line at its extremities until the replacement water throughout its length shall, upon test, both chemically and bacteriologically, be approved by the Florida Department of Environmental Protection. The Contractor shall be responsible for arranging for the Test Samples.

- d. Repetition of Procedure: Should the initial treatment, in the opinion of the Engineer, prove ineffective, the chlorination procedure shall be repeated until confirmed tests show that the water sampled conforms to the requirements stated above.
- e. No flushing of new lines will be permitted without 48 hours prior notification to PWS.

3.4 CONCRETE

A. Scope

Provide all labor, materials, equipment and services of every nature necessary to complete all cast-in-place concrete work shown on the site work drawings and herein specified, subject to the terms and conditions of the Contract. These specifications shall not apply to concrete used for construction of buildings.

B. Responsibilities and Cooperation

- 1. The Contractor shall be held responsible for all material meeting all requirements as herein specified, for the adequacy of all formwork, and for all workmanship.
- 2. The Contractor shall cooperate with all other trades, whether or not in his control, in permitting the forming and setting of sleeves, inserts, bolts, hangers, opening, or any other items that may be necessary.
- 3. The Contractor shall cooperate fully with the Engineer or his duly appointed representative. The Engineer shall be notified sufficiently in advance of all pours in order that he, or his representative, may inspect and approve the placement of all reinforcing steel, formwork, and the concreting operation.
- 4. Comply with provisions of following codes, specifications and standards, except where more stringent requirements are shown or specified:
 - a. ACI 302 "Guide for Concrete Floor and Slab Construction".
 - b. ACI 318 "Building Code Requirements for Reinforced Concrete".
 - c. Concrete Reinforcing Steel Institute, "Manual of Standard Practice".
 - d. ACI 350R "Concrete Sanitary Engineering Structures".
- 5. Employ, at Contractor's expense a testing laboratory acceptable to Engineer to perform material evaluation tests and to design concrete mixes.

6. Materials and installed work may require testing and retesting, as directed by Engineer, at anytime during progress of work. Allow free access to material stockpiles and facilities. Tests, not specifically indicated to be done at Owner's expense, including retesting of rejected materials and installed work, shall be done at Contractor's expense.

C. Materials

(All references to ASTM or other specifications indicate the latest edition.)

1. Portland Cement

ASTM C150, Type IS (MS) or IS-A (MS or Type II (the C₃A content of the cement shall not be less than 8 percent).

2. Concrete Aggregate: ASTM C33.

- a. Fine Aggregate: Natural sand. All sand shall react to ASTM Colorimetric Test for Organic Matter, with a color not darker than the standard referenced color of ASTM C40.

- b. Coarse Aggregate: Crushed stone, gravel, or other approved material (slag shall not be used) having clean, hard, durable uncoated particles. Maximum size of aggregate shall pass through a 3/4" screen, except the maximum size aggregate for concrete in pile caps, footing, slabs-on-grade, or concrete with no reinforcing, may be 1-1/2". All to be graded from coarse to fine within limits required by ASTM C33. Dust or other fine particles in excess of 2% will not be permitted.

3. Water

Clean and free from deleterious substances.

4. Metal Reinforcing

- a. Bars shall be new conforming to ASTM A615, Grade 60. All reinforcing shall be bent cold and shall be free from scale, oil, dirt and structural defects. Fabrication shall be done in accordance with ACI Standard Practices. Store bars at least 6" above the ground. Submit 3 copies of mill tests of all steel before shipment is made.

- b. Welded Wire Fabric: ASTM A185.

- c. Wire for tying bars shall be 16 gage annealed iron wire.

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- d. Accessories shall be chairs, bolsters, etc., standard with the fabricator and shall be sufficiently strong to maintain bars in position. Stainless steel or plastic tip accessories shall be used where accessory support is in the same plane as face of concrete surfaces which will remain exposed to view.

5. Premoulded Expansion Joints

ASTM D1751 or D1752 sizes to be as shown.

6. Joint-Sealing Materials

ASTM D1850 or Fed. Spec. SS-S-1401, except that all joints exposed to the weather shall be sealed with material conforming to Fed. Spec. SS-S-1401.

7. Concrete Admixtures

- a. Water Reducing Admixture: "Eucon WR-75" by the Euclid Chemical Company, "Pozzolith 200N" by Master Builders of "Plastocrete" by Sika Chemical Corporation. The admixture shall conform to ASTM C494, Type A, and not contain more chloride ions than are present in municipal drinking water.
- b. Water Reducing, Retarding Admixture: "Eucon Retarder-75" by the Euclid Chemical Company, "Pozzolith 100 XR" by Master Builders or "Plastiment" by Sika Chemical Corporation. The admixture shall conform to ASTM C494, Type D, and not contain more chloride ions than are present in municipal drinking water.
- c. High Range Water Reducing Admixture (Superplasticizer): "Eucon 37" by the Euclid Chemical Company or "Sikament" by Sika Chemical Corporation. The admixture shall conform to ASTM C494, Type F or G, and not contain more chloride ions than are present in municipal drinking water.
- d. Non-Chloride Accelerator: "Accelguard 80" by The Euclid Chemical Company or approved equivalent. The admixture shall conform to ASTM C494, Type C or E, and not contain more chloride ions than are present in municipal drinking Water.
- e. Air Entraining Admixture: Conforming to ASTM C260.
- f. Calcium Chloride: Calcium chloride or admixtures containing more than 0.1% chloride ions are not permitted.

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g. Certification: Written conformance to above mentioned requirements and the chloride ion content will be required from the admixture manufacturer prior to mix design review by the Engineer.

8. Forms

a. Plywood complying with U.S. Product Standard PS-1 "B-B (Concrete Form) Plywood", Class I, exterior grade or better, mill-oiled and edge-sealed shall be used for all formwork which will be in contact with all poured concrete, except as otherwise specified. Standard board lumber may be used for concrete below grade.

b. Form ties for walls shall be 1" breakback, crimped snap ties.

9. Curing and Sealing Compound

"Super Floor Coat" or "Super Pliocure" by The Euclid Chemical Company or "Masterseal 66" by Master Builders. The compound shall conform to Federal Specification TT-C-800A, 30% solids content minimum, and have test data from an independent laboratory indicating a maximum moisture loss of 0.030 grams per sq. cm. when applied at a coverage rate of 300 sq. ft. per gallon. Manufacturer's certificate required.

10. Curing and Hardening Compound

"Eucosil" by the Euclid Chemical Company or "Curetox" by Toch Brothers. The compound shall be a sodium silicate type.

11. Bonding Compound

"Euco Weld" by The Euclid Chemical Company or "Weldcrete" by the Larsen Company. The compound shall be polyvinyl acetate, rewettable type.

12. Epoxy Adhesive

"Euco Epoxy #463 or #615" by the Euclid Chemical Company or "Sikadur Hi-Mod" by Sika Chemical Corporation. The compound shall be a two (2) component, 100% solids, 100% reactive compound suitable for use on dry or damp surfaces.

13. Epoxy Grout

High strength grout by The Euclid Chemical Company or approved equivalent.

14. Non-Shrink Grout

"Euco NS" (non-metallic) by the Euclid Chemical Company or "Masterflow 713" by (non-metallic) Master Builders. The grout shall conform to CRD-C-621-80, "Corps of Engineers Specification for Non Shrink Grout".

D. Concrete

1. Ready-Mixed Concrete

All concrete for this project shall be ready-mixed either central plant mixed or transmit mixed. Equipment, mixing methods and materials must conform to ASTM C94 and application ASTM Standards as indicated under Materials. If directed by the Engineer, the Contractor shall employ an independent testing laboratory to inspect the mixing plant to insure conformance with ASTM C94.

2. Concrete Compressive Strengths

All concrete for foundations, retaining walls and slabs on grade shall achieve a compressive strength of 3,000 psi at 28 days.

3. Design Mix

a. All mix designs shall be proportioned in accordance with Section 4.4 (trial batches) of ACI 318-83. The concrete manufacturer, immediately after the award of this contract, shall have the mix designs prepared and shall submit them to the Engineer for approval. If trial batches are used, an independent laboratory, approved by the Engineer, shall be used. Concrete mixes shall be designed in accordance with ACI 211.1, "Recommended Practice for Selecting Proportions for Normal and Heavyweight Concrete".

b. If trial batches are used, the proposed mix design shall achieve an average strength 1200 psi greater than the specified strength ($f=c$). The laboratory shall prove each design mix by breaking two test cylinders at seven days and two cylinders at 28 days in conformance with ASTM - C39. The seven-day compressive strength must be in excess of 80% of the 28-day strength in excess of 115% of the specified 28-day strength for these test cylinders. The laboratory shall submit test reports to Contractor (2), Engineer (1), structural engineer (1), and concrete manufacturer (1).

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- c. The concrete design mixes will be reviewed and approved after seven-day test cylinder results, if Contractor's time schedule requires.
- d. The minimum cement content of all 3,000 psi concrete shall be 470 lbs. per cu. yd.

4. Field Testing

The Contractor shall have an independent testing laboratory conduct tests and submit reports promptly to the Engineer on the following field testing of concrete, without additional cost to the Owner.

- a. Four standard test cylinders shall be made at the job site for each 50 cubic yards, or fraction thereof, of each class of concrete placed each day. The procedures of sampling, making, curing and testing shall be in strict accordance with ASTM C172, C31, C192, and C39, latest editions, respectively, and shall be properly identified as to date, time, placement location, and slump. Slump tests shall be made at the same time cylinders are made in conformance with ASTM C143. Samples shall be made by the laboratory only.
- b. Two cylinders are to be tested at seven days and two cylinders at 28 days, unless otherwise directed. Laboratory shall submit one copy of report directly to the Engineer and two copies to the Contractor.
- c. The strength level shall be considered satisfactory so long as the averages of all sets of three consecutive strength test results equal or exceed the specified strength $f=c$, and no individual test result falls below the specified strength $f=c$ by more than 500 psi.
- d. The testing service will make additional tests of in-place concrete when test results indicate the required strength level has not been achieved and other characteristics have not been attained in the structure, as directed by the Engineer. The testing service may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C42, or by other methods as directed. Contractor shall pay for such tests conducted, and any additional testing as may be required, when unacceptable concrete is verified.

5. Concrete Quality

- a. Air Content: All concrete exposed to freezing and thawing and/or required to be watertight shall have an air content of 4.5% to 7.5%.

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- b. Water-Cement Ratio: All concrete subjected to freezing and thawing shall have a maximum water-cement ratio of 0.50.
- c. Slump: All concrete containing the high range water reducing admixture (superplasticizer) shall have a maximum slump of 8" unless otherwise approved by the Engineer. The concrete shall arrive at the job site at a slump of 2" or 3", be verified, then the high range water reducing admixture added to increase the slump to the approved level. All other concrete shall have a maximum slump of 3" for slabs and 4" for other members.
- d. Admixture usage: All concrete shall contain the specified water reducing admixture or water reducing, retarding admixture and/or high range water reducing admixture (superplasticizer). All thin concrete slabs, less than 8" in thickness, placed at air temperatures below 50 degrees F shall contain the specified non-chloride accelerator. All concrete required to be air entrained shall contain an approved air entraining admixture. When air temperature exceeds 85 degrees F and/or placing and humidity conditions dictate, the Engineer may require or approve the use of the water reducing, retarding admixture.

E. Formwork

- 1. Design and construction of formwork shall be in accordance with ACI 347-78. Forms shall be sufficiently strong to carry the dead weight of the concrete as a liquid without deflection, and tight enough to prevent leakage of mortar. Wood forms shall be thoroughly cleated together with corrosion resistant devices. Bevel strips shall be provided in form angles and in corners of boxes for chamfering of all corners. If any forms show bulge or deflection, which in the opinion of the Engineer is excessive, the concrete shall be removed and the work shall be rebuilt.
- 2. Before reinforcing is placed, the inside of wood forms for all exposed concrete shall be coated with plastic coating. Wood forms for concrete that will not be exposed shall be coated with form oil or plastic coating, or shall be thoroughly wetted.
- 3. Forms shall not be removed until members have acquired sufficient strength to safely support their own weight, or any weight that will be applied.
- 4. Where soil permits, excavation for footings shall be formed to exact dimensions of footings. Where soil does not permit straight and true

excavations, the sides of the footings shall be formed. Bottom of all footings excavations to be mechanically tamped prior to placing concrete.

F. Reinforcement

1. Placing

- a. Metal reinforcement shall be accurately placed in accordance with the plans and shall be adequately supported and secured in position. Use concrete or clay brick for supporting reinforcement in slabs-on-grade and footings, when reinforcing is bars. Remove supports as pour progresses. Where welded wire fabric is used, pull up reinforcing to center of member as concrete pour progresses.
- b. Unless otherwise shown, all bars shall lap at least 24 diameters. Lap all welded wire fabric at least one full mesh and tie.
- c. All slabs-on-grade shall be at least 4" thick, and shall be reinforced with 6 x 6 W1.4 x W1.4 welded wire fabric unless otherwise indicated.

2. Protection

Unless otherwise indicated, reinforcement shall have the following concrete protection:

Footings:	3" clear, sides and bottom
Walls:	2 1/2" clear, top, bottom, sides
Slabs:	2" clear, top 3" clear, bottom

G. Placing Concrete

- 1. Concrete shall be conveyed to the place of final deposit by methods that will prevent separation or loss of the materials. Equipment for shuting concrete shall be of such size and design as to insure a practically continuous flow of concrete at the delivery end.
- 2. Concrete shall be deposited as near as possible in its final position to avoid segregation due to handling or flowing. No concrete that has partially hardened or has been contaminated by foreign materials shall be deposited in the work nor shall retempered concrete be used, unless approved by the Engineer. Concrete in walls shall be poured with the use of a tremie and shall not be dropped more than 8 feet.

3. When concreting is once started, it shall be carried on as a continuous operation until the placement of the section has been completed. The top surface shall be generally level. When construction joints are necessary, they shall be made as approved by the Engineer.
4. Where conditions make consolidating difficult or where reinforcement is congested, the specified high range water reducing admixture (superplasticizer) must be used. The concrete shall be plastic at all times and flow readily into the space between the bars.
5. Concrete shall be placed with the aid of mechanical vibrating equipment, placed in the concrete at the point of deposit, and in strict accordance with ACI 309, "Recommended Practice for Consolidation of Concrete". Lower frequency vibrators may be used with "flowing" concrete.
6. Where not practical in the opinion of the Engineer to use a mechanical vibrator, concrete shall be thoroughly compacted by puddling with suitable tools during the placing.
7. When air temperature has fallen or is expected to fall below 40 degrees F, heat all water and aggregates uniformly before mixing so that the concrete at point of placement will have a temperature of not less than 50 degrees F nor more than 80 degrees F. Use only the specified non-chloride accelerator. Calcium chloride or admixtures containing more than 0.1% chloride ions are not permitted.

H. Curing and Protection

1. All concrete shall be kept continuously moist and above 50 degrees F for seven days after placement. The temperature requirement may be reduced to three days if high early strength concrete is used.
2. All slabs shall be cured with the specified curing and hardening compound. The compounds must be applied immediately after final finishing.

I. Finishing Concrete

1. General

If after the removal of forms there is any excessive honey-combing or other imperfections, the member shall be repaired by removal and replacement at no extra cost to the Owner.

2. Cast-in-Place Concrete

Except as otherwise specified, all fins and projections shall be removed and small voids filled by dry pack method. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt and loose particles. Dampen concrete surfaces and apply the specified bonding compound. Place dry pack after the bonding compound has dried. Mix dry pack consisting of one part portland cement to 2 2 parts fine aggregate passing a No. 16 mesh sieve, using only enough water as required for handling and placing. Compact dry-pack mixture in place and finish to match adjacent concrete. Keep patched areas continuously moist for not less than 72 hours. Hand-rub all vertical surfaces above finish grade.

3. Finish for Sidewalks and Exterior Slabs

The surface of the concrete shall be screeded and shall then be hand-finished with a wood float to produce a smooth, gritty surface. Edges and joints shall be rounded with an edger to a radius of 1/4". Scored joints shall be provided at 5 to 6 feet on centers unless otherwise shown. Expansion joints shall be provided at 30-foot intervals. Texture shall be approved by the Engineer from sample panels.

J. Construction Joints

Joints not indicated on the plans shall be approved by the Engineer as to location so as to least impair the strength of the structure. Where a joint is to be made, the surface of the concrete shall be thoroughly cleaned and all laitance removed, by sandblasting if necessary. (Waterstops shall be installed in center of wall or slab at all construction joints. In addition,) Vertical joints shall be thoroughly wetted and slushed with a coat of neat cement grout immediately before placement of new concrete. All reinforcement shall be continued across or through construction joints.

K. Waterstops

Waterstops shall be either of those described below at the Contractor=s option.

1. Made of polyvinyl chloride and of sub-zero grade, Plastigrip, Type W-6, as manufactured by Progress Unlimited, Inc., New York, or approved equivalent.

Polyvinyl chloride waterstops shall be 9" x 1/2" minimum and shall be produced from a compound, the base resin of which shall be virgin PVC. The compound shall not contain any reclaimed material whatsoever.

The waterstop shall have the following properties:

2,000 psi min. tensile strength ASTM D412-51T

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350% min. elongation	ASTM D412-51T
-35 degrees F min. low temperature brittleness	ASTM D746-57T
65-75 shore >A= durometer hardness	ASTM D676-59T
0.15 max. water absorption.....	ASTM D570-59T

Splicing one section of waterstop to another shall be made by pressing the pieces to be joined against a metal plate heated to 420 degrees + 15 degrees F. The heated pieces shall then be immediately pressed together until cool. Speed is important at this point. The same technique shall be used in making all T=s, crosses, X=s and other fittings required. All splices and special connection pieces shall be spliced in a manner such that any cross-section shall be dense, homogenous and free of all porosity. All finished splices shall have a tensile strength of not less than 75% of the unspliced material.

2. Permeable grout tubes shall be composed of a reinforcing spiral, inner fiber membrane and an outer protective synthetic membrane. The tube shall be completely permeable for the injected sealing materials and impermeable for cement particles. The tubes shall be equal to INJECTO as distributed by De Neef America, Inc.

All materials shall be delivered to the site in undamaged, unopened packings bearing the manufacturer=s original labels.

The polyurethane grout shall have the ability to react with water and will expand up to ten (10) times in volume.

The accelerator shall be able to control the reaction time from one (1) minute to one (1) hour.

After reaction, the polyurethane grout shall form a flexible, closed cell polyurethane foam.

Mixing and handling of the chemical grout and the accelerator, which are not toxic and non-hazardous under normal conditions, shall be in accordance with the recommendations of the manufacturer and all applicable safety codes, and shall be performed in such a manner as to minimize hazard to personnel. It is the responsibility of the Contractor to provide appropriate protective measures to insure that chemicals or foam produced by said chemicals are under the control of the Contractor at all times.

Plastic or metal mixing tanks shall be used. Tanks of concrete or wood should not be used.

Hand operated, air driven or electrical positive displacement pumps can be used. Pressure of 150 to 250 psi is adequate.

The permeable grout tubes are required at all formed joints in concrete walls and slabs which separate habitable spaces, machinery, and equipment areas from ground water or from water filled tanks, basins, flumes, manholes, etc. It shall also be placed in vertical joints in tank walls and in other joints as shown on the drawings.

Submit manufacturer=s instructions on placement of tubes and data on sealing materials for approval by Engineer.

L. Load Tests

In addition to all testing as previously specified, load tests, as directed by the Engineer, may be required at the expense of the Contractor if there is evidence of faulty workmanship or violations of these specifications.

Load tests shall be conducted as indicated in Chapter 20 of ACI Code 318-83.

M. Repair of Defective Areas

1. With prior approval of the Engineer as to method and procedure, all repair of defective areas shall conform to ACI 301, Chapter 9, except that the specified bonding compound must be used.
2. All structural repairs shall be made with prior approval of the Engineer as to method and procedure, using the specified epoxy adhesive and/or epoxy mortar.

3.5 MASONRY

A. Work Required

Work under this Section consists of furnishing all material, labor, and equipment necessary to construct all masonry units specified or shown to be constructed on the construction drawings.

B. Materials

1. Concrete Blocks

Concrete blocks used shall be hollow concrete masonry block with plain facing and shall comply with ASTM C-90-75 Grade N, Type 1, for load-bearing type and ASTM C-129, Type 1, for non load-bearing type. Samples of the block proposed for use shall be submitted to the Engineer

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for approval. Certificates of specifications compliance shall be furnished. Interior walls shall be 6"-thick standard concrete block in lieu of the 8" block used for the exterior walls, except where shown on the construction plans. Chipped or broken block shall not be used.

2. Wall Reinforcing

Wall reinforcing for block walls shall be No. 8 "Dur-O-Wal", extra heavy, galvanized or approved equivalent, wholly contained within the block thickness. Splices shall be made in the middle third of the wall span between vertical supports in exterior walls. Splices are to be lapped a minimum of 6", and corners shall be arranged as shown in the "Dur-O-Wal" catalog. Ends shall be anchored 3" into all columns and vertical wall supports.

3. Mortar Materials

The materials used in mortar for masonry work shall be type "M" or type "S", and shall comply with current requirements of the following specifications:

- Mortar for Unit Masonry ASTM C270
- Masonry Cement..... ASTM C91
- Portland Cement..... ASTM C150, Type II
- Hydrated Lime ASTM C207
- Aggregate..... ASTM C144

PROPORTION BY VOLUME			
Mortar Type	Portland Cement	Masonry Cement Type II	Hydrated Lime or Lime Putty
M	1	---	1/4
	1		---
S	1	---	Over 1/4 to 1/2
	1/2	1	---

Damp loose aggregate not less than 2 1/4 or more than three times the sum of the volumes of the cements and lime used.

All mortar shall be thoroughly mixed and retempering will not be permitted. All mortar that shows evidence of having obtained its initial set must be washed. All mortar used throughout must be the same kind.

Provide clean, sharp, well graded aggregate free from injurious amounts of dust, saline, alkaline, organic, or other deleterious substances. If requested by the Engineer, the Contractor may be required to furnish certified test reports from an independent laboratory certifying the analysis of the aggregate and its suitability for the intended purpose. The water used for mortar shall be potable water.

C. Construction

1. Concrete Block

Concrete block walls and partitions shall be of staggered joint construction, built plumb and true to dimensions shown on the drawings with running bond pattern with full mortar coverage on the vertical and horizontal surfaces, vertical joints shoved tight. All horizontal joints in exposed work, unless otherwise specified, shall be raked. All joints in walls to receive plaster or stucco shall be struck off flush with the face of the blocks. Particular care shall be exercised in laying block to maintain wall plumb and true with smooth, uniform joints 3/8" thick. At all points of juncture of walls and wall to partitions, all masonry shall be properly bonded and anchored with wall reinforcement.

2. Wall Joint Reinforcement

Unless otherwise noted, joint reinforcement shall be placed every third bed joint (24 inches c-c) in walls and in every first and second bed joint above openings. In the first bed joint above openings, the reinforcement shall be continuous, and in the second bed joint, the reinforcement shall extend two feet beyond each side of the opening before splices are made to insure continuity, and corners shall be formed by cutting the inside bar and bending. Reinforcement shall not pass through vertical masonry control joints.

3. Building Openings

The Contractor shall build in all metal door frames, access doors, frames, beams, lintels, thimbles, brackets, anchor bolts, or other items. All bearing plates, etc., or work to be built-in by the Contractor shall be done in a careful manner and all anchors, etc., drawn tight and made secure without masonry spalls.

4. Execution

Special care shall be exercised during the course of construction, and all block units with chipped faces or edges shall be discarded. All external

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corners and openings shall be protected by corner guards, if necessary, against harm after walls are in place. Such protective measures shall remain intact.

3.6 LIFT STATION

A. General

Work under this Section applies to all sewage lift stations within the wastewater collection system project. Lift stations shall include wetwell, valve box, pumps, control panel, electrical service, control system, guide rails and all appurtenances or other items required to provide a fully operational system.

The installation shall comply with all local, state, and federal laws and ordinances applicable to electrical installation and with the regulations of the latest edition of the published National Electrical Code where such regulations do not conflict with those laws and ordinances. The contractor shall obtain all permits, and after completion of the work, shall furnish the Engineer a certificate of final inspection and approval from the applicable local inspection departments.

At completion of the work, three (3) copies of written operation and maintenance manuals and certified pump curves shall be furnished to the System Engineer.

B. Non-Clog Submersible Pump Stations

The Contractor shall supply two non-clog submersible pumps per lift station. Operating conditions for each lift station are given in the construction plans on the lift station detail sheets. Each pump shall be suitable for installation in a wetwell. Pumps shall be capable of passing a minimum 3" solid. Pumps shall be manufactured such that they employ a guide rail type system with a permanently mounted discharge elbow to allow removal and installation of pumps without entering wetwell. Each pump shall have a three-phase, 60 cycle motor, with a maximum motor speed of 1800 RPMs. Approved pump manufacturers are listed in Appendix A. Only pumps as provided by the manufacturer's listed in Appendix A will be allowed. Substitute pumps will not be accepted.

C. Motors And Pumps

The following description is intended to be a standard of construction for pumps and motors, approved equivalents will be accepted.

1. Pump Construction: The pumps shall be vertical vortex-type submersible pumping units designed and constructed to pump sewage, storm water, heavy sludge and other fibrous materials without injurious damage during operation. The design shall be such that the lifting cover, stator housing, volute casing and impeller are constructed of ASTM 48, Class 30 gray

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cast iron. The volute shall be of the center discharge design and shall be fitted with ANSI 125 lb. flanges and tested to Hydraulic Institute standards at 150% of shut-off head. The interfaces between the major castings are machined and fitted with BUNA-N O-RINGS. All nuts, bolts, washer and other fastening devices coming into contact with the sewage will be constructed of 316 stainless steel.

The impeller shall be of non-clog design, double shrouded with a smooth, long thoroughfare having no acute angles. The wear ring system shall be constructed of series 400 stainless steel with a Brinell Hardness of 200-310. The system shall provide efficient sealing between the volute and impeller.

The pump shall be provided with a balanced tandem mechanical seal cartridge. The seal case shall be constructed of 316 stainless steel with all seal faces and springs immersed in oil. Both sets of faces (both upper and lower sets) shall be tungsten-carbide silver-soldered to stainless steel retainers. Seal faces shall be self-aligning, positively driven, and each is held by separate spring systems. The construction shall be such that no spring is exposed to the pumped media and no handling of the seal faces can occur during removal or replacement of the seal.

The pump and motor shaft shall be of Series 400 stainless steel with a Brinell hardness of 200. The shaft shall be designed such that the diameter of the shaft where it passes through the lower seal is of sufficient size such that the maximum shaft deflection due to axial and radial thrust loads of .16 mm. The shaft shall not extend more than 2-1/2 times its diameter below the nearest support bearing and shall be supported by double row lower and single row upper ball bearings with a B-10 life of 50,000 hours, minimum.

Each pump shall be supplied with a universal coupling, ANSI 125 cast iron, which bolts to the pump discharge flange and accepts the discharge elbow provided by the pump manufacturer. Seal of the pump at the discharge flange shall be accomplished by a simple downward linear motion of the pump with the entire weight of the pump guided to and pressing against the discharge connection; no part of the pump shall bear directly on the sump floor, and no rotary motion of the pump shall be required for sealing. Sealing at the discharge shall be effected by a replaceable rubber seal form fitted to the machine discharge coupling to insure and guarantee a positive leakproof system and for ease of removal of the pump.

2. Motors: The pump motor shall be integral to the pump for submersible or dry pit operation. The squirrel cage induction type motor shall be of Class F insulation, NEMA B design, class H slot liners with a service factor of

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1.15. The dual voltage copper wound stator, which will allow field changeability of voltage, shall be triple dipped in epoxy enamel to withstand a heat rise to 155°C as defined in NEMA standard MG-1. The NEMA starting code shall be G or less. The rotor shall be constructed of laminated steel plates with poured aluminum shoring bars. The rotor shall be both statically and dynamically balanced. All castings shall be machine fit utilizing metal to metal contact. All machine fits shall be additionally protected with BUNA-N O-RINGS.

The motor power cable shall be of adequate length to reach the control panel without splices or strain and allowing a minimum of 10' of slack of the SJO type insulated cable with a double jacketed protection system, neoprene outside, synthetic rubber inside, exceeding industry standards for oil, gas and sewage resistance. Individual conductors shall be of the type RUM.

The power cable will enter the pump through a Vellums type cable entry constructed of cast alloy metal and galvanized for corrosion resistance. The heavy duty cable entry with strain relief shall be provided with an integral rubber grommet to protect against leakage once the cable is secured. The power cable leads shall be connected to terminals on an isolated terminal board. The terminal board shall be connected to terminals on an isolated terminal board. The terminal board shall be constructed of Bake-o-lite and will include individually o-ringed brass lugs on both upper and lower side of the terminal board. The terminal board shall be totally isolated from the motor using small BUNA-N O-RINGS fitted to the terminal board and mating with the machine terminal board housing in the motor. This system will prevent moisture from entering the motor should leakage occur through the cable entry.

All items required for manufacturer's warranty shall be provided. Motors and pumps shall be designed to be non-overloading at any point on the curve. Pumps shall also be designed to run dry or shall provide protection to the motor in the event of dry operation. Pumps and motors shall have a five-year warranty. Those manufacturers who have oil filled motors shall supply oil-filled motors where available. Where oil filled motors are not available, the manufacturer shall certify (non-clog submersible pump stations and duplex grinder stations) motor is capable of continuous duty in air or provide cooling jacket or other cooling means.

Where available moisture sensor probes and indicators and heat sensor probes and indicators shall be provided whether standard supply or optional.

D. Wet Well And Valve Box

1. Precast Concrete Wet Well

The lift station wet well shall be of precast concrete construction and shall meet the requirements of ASTM C-76 Wall C, and ASTM C 478, (latest edition), except as modified herein. The concrete used shall be Type II or approved equivalent with a 28-day strength of 4000 lbs. per square inch.

The vertical walls shall have a minimum thickness as indicated in the construction plans and shall be reinforced with a minimum of 0.12 sq. in. per linear foot. The inside diameter for each lift station is also shown on the lift station information chart in the construction plans.

The bottom section shall be of monolithic design with a minimum bottom thickness of 12 inches or as shown on the detail sheet and shall be reinforced as shown in the construction plans.

The joints between the section shall be tongue and groove with the tongue and the groove down and shall be sealed with round or other flexible type natural rubber joint rings. In addition to the rubber ring gaskets, the interior and exterior voids in the pipe joints shall be sealed with water proof joint sealant installed in strict accordance with the manufacturer's recommendations. The concrete surface finish inside and out shall be free of voids and air holes to facilitate coatings.

2. Wet Well Accessories

Access hatches shall be adequately sized and manufactured of aluminum by US Foundry, Inc., or approved equivalent. Hatches located in potential traffic areas shall be rated appropriately for traffic bearing.

Pumps shall employ a guide rail type system with a permanently mounted discharge elbow to allow removal and installation of pumps without entering the wetwell. Guide rails to be stainless steel. Stainless steel lifting bails are required for all newly installed pumps. Piping and discharge elbow to be ductile iron. All other miscellaneous fittings and fasteners to be stainless steel.

3. Valve Box

The valve box is to be of masonry construction or poured in-place concrete as indicated on plans, and equipped with an aluminum, US Foundry, Inc. access hatch, or approved equivalent. (Traffic Model hatches may be required depending on location). Surface grouting shall be supplied inside and out.

4. Manhole

A manhole shall be placed adjacent to the wet well and located within the site fencing. Manhole shall be utilized for bypass pumping if wet well has to be taken offline.

5. Protective Coatings

The entire interior surface of the wet well and valve box shall be coated with a minimum of 50 mils dry film thickness with Sauereisen Sewergraze F-210G or approved equivalent. Surface preparation and curing time for the coatings shall be in accordance with the manufacturer's recommendations and shall be cured prior to delivery to the job site.

E. The Following Describes the Operation of a Duplex Pump Station

The operation of the panel shall be when the wetwell level reaches the second lowest float (lead float) one pump shall come on, after a time delay, and start pumping the station down. A sealing circuit using the float relays shall keep the pump running until the level in the wetwell reaches the bottom float (stop float). Once the stop float is hanging down, the pump shall turn off and the alternator shall toggle to cause the other pump to become lead. If the level rises to the third lowest float (lag float), whichever pump is the lag pump will come on. If the level continues to rise, the top float (high alarm) will energize a light and horn and alarm key personnel through the SCADA System.

F. Lift Station Electrical Specifications

The electrical portion consists of the electrical service/meter box, main fusible disconnect, generator transfer switch/receptacle, control panel, float controls, telemetry unit, conduit and wiring, and supports.

1. Electrical Service Meter

The electrical service/meter for all lift stations shall be 3 phase, 4 wire, 60 cycle. The contractor shall be responsible for providing the service and coordination with the power company and for obtaining all permits. In the event of overhead power lines, the contractor shall provide a service mast

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(including weatherhead) and wooden pole and coordinate its location with PWS.

2. Main Fusible Disconnect

The main fusible disconnect switch shall be heavy duty, NEMA 3R rating, 3 pole, 4 wire, similar to Square D Class 3110. Fuses shall be rated according to pump size and incoming voltage and be Class R. The enclosure shall be supplied with a lockable hasp. The load side of the disconnect shall have multiple lugs per phase to prevent double lugging of power, lighting and surge arrestors wires.

3. Lightning Arrestor/Surge Suppressor

Lightning Arrestor shall be a LA603 for three phase motors, manufactured by Delta Lightning Arrestors, Inc., and shall be installed per wiring diagrams at the Main Fusible Disconnect with Myers hubs.

Surge Protector similar to “SDL3DI-F,” manufactured by Surge Suppression, Inc., shall be installed per wiring diagrams with Myers hubs at the Main Fusible Disconnect. The unit shall be internally fused.

Wiring for the lightning arrestor and surge protector shall be mounted on the bottom of the main disconnect and shall be easily detachable.

4. Generator Transfer Switch/Receptacle

Generator transfer switch shall be comprised of a separate NEMA 3R rating, 4 pole, double throw, non-fusible switch sized for the application. The enclosure must have a lockable hasp and lock on provisions similar to square D Class 3140,.

Generator receptacle shall be 4 pole, similar to Appleton Model AJA1044-RS or AJA2044-RS, sized for application. The receptacle shall be mounted for easy access when the generator is plugged in. The receptacle may be mounted in the double throw switch enclosure or in a separate Nema 3R enclosure. Receptacle shall be no less than 2 feet above the ground.

5. Control Panel

The control panel shall be supplied by the pump manufacturer representative to provide single source responsibility. The control panel shall be constructed by a manufacturer approved by Pace Water System. Components shall be as specified herein. It will be the panel manufacturer’s responsibility to ensure all components and wiring are

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sized for the application. Wiring shall be similar to diagram contained at the back of this section.

Control panel component specifications

Starters shall be Square D 8536 series with melting alloy thermal overload relays and 1 normally open auxiliary contact for telemetry system. NEMA rating shall be sized for application.

Motor Breakers shall be Square D Mag Guard motor circuit protector with adjustable instantaneous trip sized for application.

HOA and Push-Button Switches shall be corrosion resistant Type SK Square D 9001 series. HOA switches shall have an extra NO contact for telemetry auto mode status.

Elapse Time Meters shall be hours times .01 with visual run indication, 120 vac, and shall be an Engler model 711-0017.

Indicator Lights shall be corrosion resistant Type SK Square D 9001 series with transformer style LEDs. The high level indicator shall have a red lens. The seal failure shall have amber lenses.

Alternator shall be 120 vac, X-wired, 8 pin octal socket mount. Shall include a toggle switch for Lead Pump 1, Lead Pump 2, or Auto and include visual indication. The unit shall be a Timemark 261DXT-120, ATC ARB120 ACA or approved equivalent.

Phase Monitor shall monitor phase loss, low voltage, and phase reversal with automatic reset. Shall be 8 pin socket mount with normal and failure indications. The adjustment and indicator lights shall be on top of case for easy access and viewing. Shall be rated for application and similar to Timemark 257 or ATC SLA series. Each phase wire shall be fused.

Relays shall be socket-mounted, octal base minimum 2 pole with visual indication. The unit shall be an Omron MK, or ATC KAA series.

Time Delay Relays shall be 8 pin octal socket mounted 120 volts, 0 to 60 seconds. The unit shall be a Timemark 320-120-60, ATC TUC-120-AK-060, or approved equivalent.

Float Control Transformer shall be Square D 120v/24 vac, 50 VA fused on both primary and secondary voltages.

External Alarm Light shall have a clear bulb suitable for outdoor use and be mounted as shown on the detail. Alarm light assembly shall be an

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Appleton model VA1050G-A with a red globe and a protective cage. The flasher component shall be similar to SSAC FS127 or ATC ETN-120-HFT-75.

Horn shall be vibrating time horn suitable for outdoor use, similar to Federal Signal 350-120. An automatic re-arm silencing circuit shall be used as specified in the enclosed schematics.

Control and Receptacle Breakers shall be 20 amp Square D QOU series.

Receptacle shall be 20 amp ground fault interrupter located on inner door panel.

Control Voltage Transformer (480 volt system only) shall be Square D 480v/120 vac, 3 KVA rated for outdoor use. It shall be fused on both primary and secondary voltages and shall be mounted externally of the control panel.

Power Distribution Block and Neutral Block shall have multiple connections on the secondary side and shall be sized for application. Block shall have a touch safe cover.

Relay Sockets shall be DIN mounted 300v or 600v rating with screw terminals.

Terminal Blocks shall be box lug type with no more than 2 wires per screw.

Seal Failure Relay shall be an 8 pin octal socket mount DPDT with a sensitivity adjustment from 470 ohms to 10 k ohms. Shall be ATC SPM-120 AAA-10K.

Softstarter (if required) shall be Benshaw RBD series (or latest design) and shall be sized for application. Installation shall be wired according to the manufacturer's recommendation using isolation contactors, in-line fuses, fault relays, overload relays, and shorting contactor. In the event that softstarters are needed, they will be incorporated into the schematics supplied herein. A thermostatically controlled 8 inch fan with vent shall be provided. One maintenance diagnostic analyzer will be required for each panel. It is the developers responsibility to contact the power company for starter requirements at each lift station location. Soft starters will be required for all motors of 20 HP and above for 240v or 40 HP for 480v.

Control Panel Enclosure shall be NEMA 4 stainless steel with lockable hasp and hinged doors, as manufactured by Hoffman. Minimum size of

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enclosure shall be 36x36x12. Enclosure shall have an inner door where the switches, time meters, alarm indicator light, and receptacle are mounted. The inner door will be cut to allow access to the motor breakers and control and receptacle breakers without opening the door. The pump data and schematics shall be mounted on the inside of the outer door and sealed to prevent fading. Switches, indicator lights, time meters, and breakers shall be labeled with phenolic material. Enclosure shall have a stainless steel drip shield and quick disconnect release clamps. No penetrations shall be made into the top of the enclosure. Any side penetrations made into the panel shall be watertight and shall be installed with a Meyers Hub.

Wiring shall be installed in a workman-like manner, in accordance with the National Electrical Code. Control wiring shall be #14 awg red stranded wire. Power wiring shall be black stranded sized for application. Wire duct shall be used on sub-panel with other wiring to be wrapped within five inches. With the exception of the pump wiring, all wires outside of panel shall be terminated with terminal blocks. Control wires and terminals shall be numbered relating to schematics. Sufficient room shall be provided for incoming power.

6. Sump Level Controls

Sealed float type mercury switches shall be supplied to control sump level and alarm signal. Four normally open seal float type mercury switches shall be supplied. The mercury tube switches shall be sealed in a solid polyurethane float for corrosion and shock resistance. The support wire shall have heavy Neoprene jacket and a weight shall be attached to the cord above the float to hold switch in place in the sump. Weight shall be above the float to prevent sharp bends in the cord when the float operates under water. Three float switches shall be used to control level. One for all stop, one for start lead, and one for start lag pump. A fourth switch shall be provided for high level alarm.. Suitable float cable shall be furnished for float level adjustment. No pipe mounted switches are allowed. The float and pump cables shall be hung on a sturdy, stainless steel hanger. The hanger shall have a minimum of 6 hooks and be provided by the pump manufacturer. The floats shall be mounted so that pumps or inflow does not impede operation.

The brackets and hooks for the power cords and floats in the lift station shall be separate. The bracket for incoming power shall be adjacent to the control panel.

Float cables shall be marked (near the cable hanger) with color-coded tape, as follows:

Red:	Alarm.
White:	Start Lag.
Blue:	Start Lead.
Black:	Pumps off.

7. Conduit and Wiring

All conduit and wiring shall meet or exceed local, state, and national codes and be installed by a qualified electrician. PVC conduit may be used. No solid wire shall be used. A minimum 10 foot ground rod shall be installed and physically connected to each panel by a minimum 4 awg bare copper wire. Any side entrance conduits shall use Myer type weather-proof hubs.

a. Wet well conduit and junction box:

Minimum conduit size shall be 2". Wiring within the conduits shall not exceed 50% of the field capacity. The PVC conduits shall be installed from the wet well to a minimum (size as required) 12" x 12" x 6" PVC junction box (one conduit per pump and one for float cables). Two (2) 2" PVC conduits shall be installed from the junction box to the control panel (one for pump power, one for floats). Seal-offs shall be used between the junction box and control panel and from the junction box to the wet well. Non-hardening putty shall be used into the wet well seal-offs and insul-foam shall be used on the control panel seal-off. Wiring from the control panel shall be stranded THHN minimum 14 awg. Pump power wires shall be sized for application. The junction box shall contain box lug type terminal blocks sized for application. A corrosion inhibitor shall be used on each wire.

G. Supports

Enclosure supports shall be made of 1/4" thick aluminum. Enclosures shall be arranged for a neat appearance, per diagrams.

H. Check Valve & Piping

A non-clog check valve or approved equivalent shall be provided in the discharge piping of each pump to prevent backflow. Piping within the wet well shall be one continuous piece of Flanged Ductile Iron Pipe. Connections shall be made by the use of flanges or solid sleeves. See the plans for valve box details.

I. Telemetry (SCADA)

The Remote Terminal Unit (RTU) will be provided by Pace Water System. Pace Water System will terminate wires between the RTU and the Pump Control Panel. Pace Water

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System will also program the RTU and the Central Unit and do startup and testing on the RTU. Pace Water System will also provide the antenna, mast, tower, and antenna cable.

The Contractor shall be responsible for erecting the Pace Water System provided antenna tower, mounting the RTU enclosure, conduit, wiring, and grounding. The Contractor shall meet with Pace Water System's telemetry technicians to coordinate installation. The Contractor/Developer will be charged a lump sum fee of a predetermined price for the SCADA System addition.

1. Wire and conduit

A one inch PVC conduit shall be installed between the control panel and RTU as shown on plans. The following are the wires and cables needed in the conduit: 3 each #12 THHN stranded colored Black, White, and Green; 8 each 2c16 unshielded cable; 1 each #6 bare copper for grounding of RTU enclosure and mast to ground rod

RTU DESCRIPTION For information purposes, the following is provided: The RTU shall include an Allen Bradley Micrologix 1000 model programmable controller. The radio modem shall be Model 4000 manufactured by Teledesign Systems, Inc. The RTU shall be radio linked to the existing SCADA system Central Unit at the Wastewater Plant. The RTU shall be manufactured exactly like existing units for simplicity.

1. Inputs and outputs

Digital Inputs:

- a. Power Fail Alarm. From relays through phase failure relay, 24vac relay, and power to the RTU
- b. High Level Alarm. From high level alarm relay
- c. Pump 1 Run. From auxiliary contact on starter
- d. Pump 2 Run. From auxiliary contact on starter
- e. Pump 1 Auto Mode. From contact on HOA switch
- f. Pump 2 Auto Mode. From contact on HOA switch
- g. Intrusion status. From micro-switch on panel door

Digital Outputs:

- a. Pump 1 Disable. Normal closed contact wired for hand and auto modes.
- b. Pump 2 Disable. Normal closed contact wired for hand and auto modes.

Analog Inputs and Outputs:
None required at this time.

2. Controls

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The controls for the lift station pumps will be with floats and relays provided in the Pump Control Panel. Operators shall be able to manually disable each pump from the Central Unit. The computer will alarm when a pump is manually disabled.

3. Indications

The SCADA system will indicate daily and monthly number of starts and runtimes per pump based on a pump run contact. These totals will update and monitored continuously at the RTU since most pumps are on for less than two minutes. Also, a simultaneous runtime will be indicated based on these run contacts. Daily time will start at midnight.

4. Reports

Each morning, before 7:00 am, the computer will print out a lift station summary report that will include the lift station name and number of starts per pump, daily, and monthly runtimes per pump and simultaneous runtimes of the previous day.

For stations over 1200 gpm, the operators shall use this report to determine flow rates and totals for the pump station. Flow rates will be computed based on a yearly certified flow test for each pump.

5. Displays

The computer screens will include the lift station reports, an alarm screen, a lift station master screen, and an individual screen for each lift station. The alarm screen shall indicate the specific alarm, the time and date, and when and if the alarm is acknowledge. The operator shall manually delete all cleared alarms. The summary screen will include a flow chart style block diagram of all lift stations and include each pump's run status and a common alarm. The operator shall be able to use a mouse pointer to select the individual lift station screen by pointing to an icon on that lift station. The individual screens shall contain all information provided to that lift station.

6. Alarms types

- a. Communications Failure. Generated by computer when communications is lost to the RTU for x minutes
- b. Power Failure. RTU has loss of power, phase failure detected or loss of control and 24vac power
- c. High Level Alarm. Lift station wet well has a high level alarm

- d. Pump 1 Excessive Number of Starts. Computer generated when number of starts exceeds X amounts per hour
 - e. Pump 1 Excessive Runtime. Computer generated when runtime exceeds X minutes.
 - f. Pump 2 Excessive Number of Starts. Computer generated when number of starts exceeds X amounts per hour
 - g. Pump 2 Excessive Runtime. Computer generated when runtime exceeds X minutes
 - h. Pump 1 Disabled. Computer generated when operator has manually disabled pump
 - i. Pump 2 Disabled. Computer generated when operator has manually disabled pump
- Note: X = adjustable set point. Each pump shall have its own adjustable set points.

7. Alarm annunciation

- a. Local annunciation (by computer) first.
- b. Wait X minutes – call first pager.
- c. If not acknowledged in X minutes, call next pager on calling list.
- d. Repeat as necessary until alarm has been acknowledged.
- e. Pager numbers and call list shall be able to be easily changed.

The following will be the pager alarm codes:

222-XX-Y-Z			
XX	CODE	Y	Z
LS #	1	RTU	Communications
	2	Wet Well	Power Failure
	3	Pump 1	High Alarm
	4	Pump 2	Excessive Number of Starts
	5		Excessive Runtimes

Example: A code of 2221123 is lift station number 11 has a wet well high level alarm.

In addition, the operator shall be able to call in to the computer and retrieve all current acknowledged and unacknowledged alarms. The operator must provide a specific operator code and pin number to access the computer remotely.

J. Water Service

All lift stations to be maintained by PWS shall have installed a 3/4" non-metered water service complete with a reduced pressure backflow prevention device and hose bibb. Installation shall be as shown in the standard details. Water service may be reclaimed water when available.

K. Start-Ups

Forty-eight (48) hour notice shall be provided to all parties prior to all lift station start-ups with no exception. The following parties shall be present at the start-ups: Contractor, PWS, Pump Supplier, and Developer's Engineer.

The startup shall include the pump manufacturer providing a certified test of each pump to include pump model, serial number, pump head pressures, pump flow rates, and pump curves.

Additionally, all stations shall be pre-tested by the Developer and the Developer's representative to ensure that the pumps are operating correctly prior to calling PWS for an official start-up. Only one (1) lift station start-up shall be provided. Additional start-up visits due to lift station failure or excessive punch list items will be at the expense of the Developer and will be billed at \$500.00 for each additional visit.

L. Submittals

The Contractor shall submit a minimum of five (5) copies of catalog data for approval by the Engineer for materials to be used. Submittal shall include, but not be limited to the following:

1. Wet Well
2. Hatches
3. Pumps
4. Motors
5. Level Controls
6. Electrical Control Panel
7. Valves
8. Piping

3.7 GRINDER INSTALLATIONS

A. General

Grinder installations shall only be approved for privately owned, operated, and maintained lift stations.

B. Residential Grinders

Single pump grinders may be approved for single family detached units (houses and trailers). The Homeowner is responsible for the complete cost of the grinder system including the electrical service, the grinder unit, the force main to the main in the public right-of-way, the plumbing connection to the house, the

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abandonment of the septic tank, operation of the grinder station and maintenance of the grinder station. The Homeowner shall employ a licensed electrician and a qualified plumber for the work.

The homeowner is responsible for the design of the system such that it is capable of pumping into the wastewater collection or transmission system.

C. Commercial Grinders

All privately owned, operated, and maintained multi-family and commercial units shall be served by duplex grinder installations. The Owner/Developer is responsible for the complete cost of the grinder system including the electrical service, the grinder unit, the force main to the main in the public right-of-way, the plumbing connection to the structure and the abandonment of the septic tank. The Owner/Developer shall employ a licensed electrician and a qualified plumber for the work.

The grinder lift station service connection shall be as shown in Section 4 - Standard Drawings. The Utility will not own, operate, or maintain the grinder units external to the establishment.

D. Road Bores

If a road bore is required for a single family detached residence, it shall be installed by PWS at no additional cost to the resident, with the exception of a four lane highway. Road bores required for multi-family developments or commercial development shall be installed by the Developer at their cost. All road bores shall be in accordance with Section 3.8 and the standard details.

E. Permits

All permits for grinder installations shall be obtained by the Homeowner/Owner/Developer.

F. Pavement

No pavement in right-of-ways of Santa Rosa County shall be cut without permit.

3.8 PIPE BORING, DRILLING, JACKING AND PUSHING

A. General

The work described in this section includes the installation of gravity sewer, force mains and service laterals by boring, drilling, jacking, moleing or pushing as required below or as indicated on the plans.

B. Installation Types and Requirements

1. Gravity Sewer Mains- Where indicated on the plans, gravity sewer mains shall be installed by sledding through steel casing. The steel casing shall be installed by boring, jacking, and drilling methods.
2. Sewer Force Mains & Water Mains- Where indicated on the plans, sewer force main and water main shall be installed by directional bore using high density polyethylene pipe. Alternatively, the contractor may install the force main as described above for gravity sewer mains.
3. Service Laterals- Laterals crossing streets shall be installed without open cutting of asphalt roads. Open cutting for service lateral installation will be allowed only on a case by case basis in areas where the Engineer deems other methods impractical. Service laterals may be installed by boring or accupunch type methods. Solvent weld joints may be utilized. Laterals shall be air tested with gravity main.

C. Products

1. Steel Casing- The steel casing shall be seamless or electric resistance-welded tubing for sizes under 24-inch O.D. and standard double-submerged arc-weld for sizes over 24". The casing shall be installed by either jacking or boring at the option of the contractor.

All casing used for boring and bridge crossing shall be wrought steel ASTM A-53, Grade B, with a minimum yield strength of 35,000 psi. Bore casing shall have an exterior protective coating of Coal-Tar Enamel in accordance with AWWA C204. Ends shall be free from splits or other rough edges which might damage the carrier pipe. Bridge crossing casing exterior shall be painted with two (2) coats of rust prohibiting paint, light gray.

The following table shall be used for determining minimum casing size.

CASING SIZE VERSUS CARRIER SIZE				
STEEL CASING	MINIMUM WALL THICKNESS		CARRIER PIPE I.D.	
Diameter	Highway	Railroad	Gravity	Pressure*
10"	.188"	.188"	N/A	4"
12"	.188"	.188"	4"	6"
14"	.250"	.250"	6"	8"
16"	.250"	.250"	8"	10"
18"	.250"	.250"	10"	10"
20"	.250"	.250"	12"	12"
24"	.250"	.281"	14"	14"
24"	.250"	.281"	16"	16"
30"	.312"	.312"	18"	18"
30"	.312"	.344"	20"	20"
36"	.312"	.406"	24"	24"
42"	.375"	.469"	30"	30"
48"	.500"	.532"	36"	36"
60"	.500"	.563"	42"	42"
72"	.625"	.625"	48"	48"

** Use next larger casing for mechanical joint pipe.*

D. Execution

1. Boring and Jacking:

Boring shall be performed to alignment and grade as shown on the construction drawings.

The earth and/or rock augers shall not exceed the O.D. (outside diameter) of the steel casing by more than 1/4 of an inch. The boring and insertion of the steel casing shall be performed with equipment capable of simultaneous operations.

Every effort shall be made to avoid loss of earth.

Excavation material shall be removed from the casing as excavation progresses and no accumulation of such material within the casing shall be permitted.

Upon completion of the boring operations, all voids around the outside face of the casing shall be filled by grouting. Grouting equipment and material shall be on the job site before boring operations are started in order that grouting around the bored casing may be started immediately after the boring operations have finished.

The allowable tolerance as to grade and alignment of the installed casing shall not exceed 1/10 of a foot per hundred feet of casing length.

The Contractor shall be responsible for protecting any underground utilities and for any damage resulting to located utilities.

The Contractor shall be fully responsible for producing a sound, tight installation, true to line and grade. Gravity pipe shall be skidded through the casing on redwood or pressured treated, stainless-steel tied skids. Skids shall also be installed to prevent floating.

2. Installation Details:

Prior to the start of the boring operation, the Contractor shall submit the following details to the Engineer when requested:

- a. Boring pit bracing.
- b. Casing boring head.

Only workmen experienced in boring operation shall perform the work.

3. Drilling and Jacking for Conduit:

Metallic conduit shall be installed under existing pavement by approved boring and jacking methods.

Jacking or drilling pits shall be at least 5 feet from the edge of any type of any pavement, measured from the site of the pit nearest to the pavement.

Jacking:

If the grade of the pipe at the jacking end is below the ground surface, suitable pits or trenches shall be excavated for the purpose of conducting the jacking operations and for placing end joints of the pipe. Such work shall be sheeted securely and braced in a manner to prevent earth cavings and to provide a safe, stable work area.

Heavy duty jacks suitable for forcing the pipe through the embankment shall be provided. In operating jacks, even pressure shall be applied to all

jacks used so that pressure will be applied to the pipe uniformly around the ring of the pipe.

A suitable jacking frame or backstop shall be provided. The pipe to be jacked shall be set on guides properly braced together, to support the section of the pipe and to direct it in the proper line and grade.

The whole jacking assembly shall be placed so as to line up with the direction and grade of the pipe. In general, embankment material shall be excavated just ahead of the pipe and material removed through the pipe and the pipe forced through the embankment with jacks, into the space thus provided.

The excavation for the underside of the pipe, for at least 1/3 of the circumference of the pipe, shall conform to the contour and grade of the pipe. A clearance of not more than 2 inches may be provided for the upper half of the pipe. This clearance is to be tapered off to zero at the point where the excavation conforms to the contour of the pipe.

The distance that the excavation shall extend beyond the end of the pipe depends on the character of the material, but it shall not exceed 2 feet in any case. This distance shall be decreased if the character of the material being excavated makes it desirable to keep the advance closer to the end of the pipe.

The pipe, preferably, shall be jacked from the low or downstream end. Lateral or vertical variation in the final position of the pipe from the line and grade established by the Engineer will be permitted only to the extent of 1 inch in 10 feet, provided that such variation shall be regular and only in one direction and that the final grade or flow line shall be in the direction indicated.

If the Contractor desires, he may use a cutting edge of steel plate around the head end of the pipe extending a short distance beyond the end of the pipe with inside angles or lugs to keep the cutting edge from slipping onto the pipe.

When jacking of pipe is once begun, the operation shall be carried on without interruption, insofar as practical, to prevent the pipe from becoming firmly set in the embankment.

Any pipe damaged in jacking operations shall be removed and replaced by the Contractor at his expense.

Immediately after jacking is complete and the carrier or encasement pipe is accurately positioned and approved for line and grade, the clearance

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space between the pipe and soil shall be completely filled by pressure grouting for the entire length of the installation.

The pits and trenches excavated to facilitate jacking operations shall be backfilled immediately after the jacking of the pipe has been completed.

Pipe Sled- Where carrier pipe is sledged through steel casing, the Contractor shall install wood skids to support the pipe. There shall be two sets of skids for each pipe section. Skids shall be minimum five (5) feet long and attached to carrier pipe with metal bands. Skids shall be pressure treated lumber.

3.9 DIRECTIONAL BORING

A. GENERAL

The work described in this section includes the installation of water main, force mains and service laterals by directional boring as required below or as indicated on the plans.

B. INSTALLATION TYPES AND REQUIREMENTS

1. The extent of directional boring is shown on the drawings.
2. The work included in this section covers the installation of carrier pipe by the directional boring (trenchless installation) method as described herein, within the limits indicated on the drawings. In general, include bore pit, pilot hole (as required), drilling fluids, carrier pipe, removal and disposal of drilling fluids and soil cuttings, soil reports as required by jurisdictional agencies beyond those already provided by the Owner, siltation and sediment control, and all other work required to install the carrier pipe as specified herein and as shown on the drawings.
3. The Contractor will furnish all labor, equipment, materials and supplies and will perform all work necessary to provide Owner with a complete, finished crossing via horizontal directional drilling.
4. The proposed alignment length, profile and grade to which the water main shall be installed are noted on the applicable drawings. This profile indicates the minimum grade to which the pipe will be installed.

C. SUBMITTALS

1. The Contractor shall prepare a drilling plan indicating equipment proposed for each location, pull-back forces anticipated and shall verify that the DR of the pipe specified is adequate to withstand the anticipated pull-back

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forces in addition to the earth, line and groundwater loads.

2. Technical data of equipment to be utilized.
3. Prior to approval, submit the names of supervisory field personnel and historical information of directional boring experience.
4. Submit MSDS (Material Safety Data Sheets) information for the drilling slurry compounds.
5. Disposal Plan The plan shall describe the Contractor's plans for disposal of the drilling fluid and the names, addresses and telephone numbers of any and all subcontractors who will be performing any portion of the disposal activities. At a minimum the plan shall include
 - a. Disposal method,
 - b. Disposal hauler(s),
 - c. Disposal locations,
 - d. Estimated quantity to be disposed,
 - e. Type of vehicle hauling drilling fluids,
 - f. Signed statement that all hauling equipment (ie., vehicle, tanker, dump truck, trailer, etc.) meets all requirements of state agencies, and
 - g. Letter from proposed disposal site(s) accepting material.
6. Erosion Control Plan The erosion control plan shall be submitted prior to the preconstruction conference. It shall be a written, detailed plan for the accomplishment of acceptable erosion control on the project. The plan shall describe all necessary temporary measures to be implemented for preventing soil erosion from the construction site until permanent erosion control and finished surfaces are installed. The plan shall comply with all state and local requirements.
7. Pipe Connection Procedures The Contractor shall submit pipe connection procedures to the Engineer prior to connecting any pipe. For plastic (HDPE) pipe, the Contractor shall submit the pipe manufacturer's representative's written approval of his procedures.

D. QUALITY ASSURANCE

1. Crossings must conform to applicable requirements of all utility companies affected, State Highway Department and environmental agencies.
2. Qualifications The Contractor shall be thoroughly experienced in the type construction contemplated herein.

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3. The Contractor must demonstrate expertise in trenchless methods by providing a list of five references for whom similar work has been performed with the last two years. Two of the references shall be from projects where the SAME SIZE OR LARGER pipe than the largest carrier pipe specified in the contract documents was successfully installed at a linear distance greater than or equal to the longest bore required by the contract documents. The references shall include a name and telephone number where contact can be made to verify capability. The subcontractor must provide documentation showing successful completion of the projects used for reference. Conventional trenching experience will not be considered applicable.
4. Pipe Manufacturer's Quality Control The pipe manufacturer shall have an on going Quality Control program for incoming and outgoing materials. High-density polyethylene (HDPE) resins for manufacturing of pipe shall be checked for density, melt flow rate, and contamination. These incoming resins shall be approved by NSF before being converted to pipe. Pipe shall be checked for outside diameter, wall thickness, length, roundness, and surface finish on the inside and outside and end cut.
5. Fittings Manufacturer's Quality Control The fitting manufacturer shall have an on-going quality control program for incoming and outgoing materials. Molded fittings shall be inspected for voids and knit lines. All fabricated fittings shall be inspected for joint quality and alignment. All fabricated fitting welds shall be made using a Data Logger. A record of the temperature, pressure and graph of the fusion cycle shall be maintained by the fitting manufacturer.

E. PRODUCT DELIVERY, STORAGE, AND HANDLING

1. The pipe and fitting manufacturer shall package products for shipment in a manner suitable for safe transport on commercial carriers. When delivered, a receiving inspection shall be performed, and any shipping damage reported to the pipe and fittings manufacturer. Pipe and fittings shall be handled, installed, and tested in accordance with manufacturer's recommendations and the requirements of this specification.
2. Deliver and store materials within limits of rights-of-way and/or property lines.
3. The Contractor shall be responsible for securing all project materials and shall bear the cost of replacing any materials which may become misplaced or stolen.

F. JOB CONDITIONS

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1. The Contractor shall be held fully responsible for protecting against surface subsidence, damage, or disturbance of adjacent property and facilities from his construction methods.
2. Each directional boring crew shall have a reasonable proportion of experienced men. A superintendent and/or engineer experienced in directional boring methods and techniques, and who represents the boring contractor, shall be present at all times while work is proceeding. He shall also be responsible for the frequent checking of line and grade, if needed.
3. Contractor shall be held responsible for the coordination and scheduling of all construction work.

G. SAFETY

1. All drilling equipment must have a permanent, inherent alarm system capable of detecting an electrical current. The ground system shall be equipped with an audible alarm to warn the operator when the drill head nears electrified cable.
2. All crews shall be provided with grounded safety mats, heavy gauge ground cables with connectors, and hot boots and gloves.
3. All supervisory personnel must be adequately trained and have direct supervisory experience in directional boring.

H. MATERIALS

1. Drilling fluid shall be a gel-forming colloidal fluid consisting of at least 10% of high-grade bentonite, which is totally inert and contains no environmental risk, or equal.
2. Carrier Pipe
 - a. Pipe and fittings shall be high-density polyethylene manufactured from NSF approved PLEXCO P34CH compound, PE 3408, or equal.
 - b. Pipe shall meet AWWA C-906, PE Pressure Pipe and Fittings 4@ B 53@ for Distribution and be marked with the NSF-pw logo.
 - c. Hydrostatic design stress (HDS) shall be 800 psi at 73.4°F with a minimum pipe DR of 9 and operating pressure of 200 psi at 73.4°F.

- d. Pipe and fittings shall be produced by the same manufacturer from identical materials meeting the requirements of this specification.
 - e. Molded fittings shall meet the requirements of ASTM D-3261 and this specification. At the point of fusion, the outside diameter and minimum wall thickness of fitting butt fusion outlets shall meet the outside diameter and minimum wall thickness specifications of ASTM F-714 for the same size of pipe.
 - f. Pipe shall be manufactured in accordance with ASTM F-714, ASTM D-3035, or the applicable dedicated service specification. Print line markings shall include a production code from which the location and date of manufacture can be identified. Upon request, the manufacturer shall provide an explanation of his production code.
 - g. Pipe Marking
 - i) HDPE bore pipe and fittings conveying wastewater must be marked as prescribed by ASTM F714. Pipe markings will include nominal size, OD base (ie 12" ductile iron pipe sizing, DIPS), dimension ratio, pressure class, WPR, ASTM F714, manufacturer's plant and extrusion line. Pipe shall be green in color, or shall be black with three coextruded green stripes for its full length at 120E.
 - ii) HDPE bore pipe and fittings conveying potable water must be marked as prescribed by AWWA C906 and NSF. Pipe markings will include nominal size, OD base (ie 12" ductile iron pipe sizing, DIPS), dimension ratio, pressure class, WPR, AWWA-C906, manufacturer's name, manufacturer's production code including day, month, year extruded, and manufacturer's plant and extrusion line; and optional NSF logo. Pipe shall be blue in color or shall be black with three coextruded blue stripes for its full length at 120E.
3. Butt fusion Fittings HDPE fittings shall be PE 3408 HDPE, Cell Classification of 345464C as determined by ASTM D3350-99, and approved for AWWA use. Butt fusion fittings shall have a manufacturing standard of ASTM D3261. Molded and fabricated fittings shall have a pressure rating equal to the pipe unless otherwise specified in the plans. Fabricated fittings are to be manufactured using Data Loggers. Temperature, fusion pressure and a graphic representation of the fusion cycle shall be part of the Quality Control records. All fittings shall be suitable for use as pressure conduits, and per AWWA C906, have nominal

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burst values of three and one-half times the working pressure rating of the fitting.

4. Transition Fittings Terminate all HDPE pipe with fusion welded HDPE/PVC mechanical joint adapter with stainless steel stiffeners.

I. EQUIPMENT

1. Directional Drilling Equipment

- a. General: The directional drilling equipment shall consist of a directional drilling rig of sufficient capacity to perform the bore and pull back the pipe, a drilling fluid mixing, delivery and recovery system of sufficient capacity to successfully complete the installation, a drilling fluid recycling system to remove solids from the drilling fluid so that the fluid can be reused (if required), a magnetic guidance system or walk over system to accurately guide boring operations, a vacuum truck of sufficient capacity to handle the drilling fluid volume, trained and competent personnel to operate the system. All equipment shall be in good, safe condition with sufficient supplies, materials and spare parts on hand to maintain the system in good working order for the duration of this project.
- b. Drilling Rig: The directional drilling machine shall consist of a hydraulically powered system to rotate and push hollow drilling pipe into the ground at a variable angle while delivering a pressurized fluid mixture to a guidable drill (bore) head. The machine shall be anchored to the ground to withstand the pulling, pushing and rotating pressure required to complete the installation. The hydraulic power system shall be self-contained with sufficient pressure and volume to power drilling operations. Hydraulic system shall be free of leaks. Rig shall have a system to monitor and record maximum pullback pressure during pullback operations. There shall be a system to detect electrical current from the drill string and an audible alarm which automatically sounds when an electrical current is detected.
- c. Drill Head: The drill head shall be steerable by changing its rotation and shall provide necessary cutting surfaces and drilling fluid jets.

J. GUIDANCE SYSTEM

1. General An electronic walkover tracking system or a Magnetic Guidance System (MGS) probe or proven gyroscopic probe and interface shall be

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used to provide a continuous and accurate determination of the location of the drill head during the drilling operation. The guidance shall be capable of tracking at all depths up to fifty feet and in any soil condition, including hard rock.

It shall enable the driller to guide the drill head by providing immediate information on the tool face, azimuth (horizontal direction), and inclination (vertical direction). The guidance system shall be accurate and calibrated to manufacturer's specifications of the vertical depth of the borehole at sensing position at depths up to fifty feet and accurate to 2-feet horizontally.

2. Components The Contractor shall supply all components and materials to install, operate, and maintain the guidance system.
3. The guidance System shall be of a proven type, and shall be set up and operated by personnel trained and experienced with the system. The operator shall be aware of any geo-magnetic anomalies and shall consider such influences in the operation of the guidance system.

K. JOINING METHODS

1. Butt fusion joining Plain end pipe and fittings shall be made using butt fusion. The butt fusion procedures shall be in accordance with the manufacturer or the PPI. The fusion equipment operator shall receive training using the recommended procedure. The Contractor shall be responsible to verify that the fusion equipment is in good operating condition and that the operator has been trained within the past twelve months. The fusion equipment shall be equipped with a Data Logger. Records of the welds (heater temperature, fusion pressure, and a graph of the fusion cycle) shall be maintained for five (5) years. Fusion beads shall not be removed.
2. Mechanical Joining Polyethylene pipe and fittings may be joined together using flanges or mechanical joint adapters. These fittings shall be made from PE 3048 HDPE, with a Cell Classification of 345464C as determined by ASTM D3350-99. Flanged and MJ adapters shall have a manufacturing standard of ASTM D3261. They shall have a pressure rating equal to the pipe unless otherwise specified on the plans.
3. Electrofusion couplings Polyethylene pipe and fittings may be joined using approved electrofusion couplings. Fittings shall be PE 3408 HDPE, Cell Classification of 345464C as determined by ASTM D3350-99. Electrofusion fittings shall have a manufacturing standard of ASTM F1055. Fittings shall have a pressure rating equal to the pipe unless otherwise specified on the plans. All electrofusion fittings shall be suitable

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for use as pressure conduits, and per AWWA C906, have nominal burst values of three and one-half times the working pressure rating of the fitting.

L. EXECUTION

1. The Contractor shall be responsible for setting all grade stakes, lines, and levels.
2. Coordinate the locations of underground utilities with appropriate companies. Advise Engineer immediately if conflict exists.
3. Contractor shall operate and maintain all equipment as required to keep the work free from excessive spoil and environmental risks.
4. Install siltation fences, sediment barriers, etc., as required to prevent offsite sedimentation.
5. The Contractor shall perform the necessary general earthwork operations as required for the directional drilling and pipe pulling operations.
6. The Contractor shall be responsible for restoring all areas impacted by contractors work effort to pre-work conditions. The Contractor shall be responsible for constructing all means of temporary access to the designated work sites and shall be liable for all damages caused as a result of the work.

M. INSTALLATION

1. Installation shall be in a trenchless manner producing continuous bores.
2. The tunneling system shall be remotely steerable and permit electronic monitoring of tunnel depth and location.
3. Tunneling must be performed by a fluid-cutting process (high pressure-low volume) utilizing a liquid clay, i.e., bentonite. The clay lining will maintain tunnel stability and provide lubrication in order to reduce frictional drag while the pipe is being installed. In addition, the clay fluid must be totally inert and contain no environmental risk.
4. The Contractor must also have a mobile vacuum spoils recovery vehicle on site to remove the drilling spoils from the access pits. The spoils must then be transported from the job site and be properly disposed of. Under no circumstances will the drilling spoils be permitted to be disposed of into sanitary, storm, or other public or private drainage systems.

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5. Mechanical, pneumatic, or water-jetting methods will be considered unacceptable due to the possibility of surface subsidence.
6. After an initial bore has been completed, a reamer will be installed at the termination pit and the pipe will be pulled back to the starting pit. The reamer must also be capable of discharging liquid clay to facilitate the installation of the pipe into a stabilized and lubricated tunnel.
7. The Contractor shall provide all material, equipment, and facilities required for directional drilling. Proper alignment and elevation of the borehole shall be consistently maintained throughout the directional drilling operation. The method used to complete the directional drill shall conform to the requirements of all applicable permits.
8. The entire drill path shall be accurately surveyed with entry and exit stakes placed in the appropriate locations within the areas indicated on drawings. If Contractor is using a magnetic guidance system, drill path will be surveyed for any surface geo-magnetic variations or anomalies.
9. Contractor shall place silt fence between all drilling operations and any drainage, well-fields, wetland, waterway or other area designated for such protection necessary by documents, state, federal and local regulations. Additional environmental protection necessary to contain any hydraulic or drilling fluid spills shall be put in place, including berms, liners, turbidity curtains and other measures. Fuel may not be stored in bulk containers within 200 feet of any water body or wetland.
10. Readings shall be recorded after advancement of each successive drill pipe, (no more than 15') and the readings plotted on a scaled drawing of 1"= 5', both vertical and horizontal. Access to all recorded readings and plan and profile information shall be made available to the Engineer, or his representative, at all times. At no time shall the deflection radius of the drill pipe exceed the deflection limits of the carrier pipe as specified herein.
11. A complete list of all drilling fluid additives and mixtures to be used in the directional operation will be submitted to the Engineer, along with their respective Material Safety Data Sheets. All drilling fluids and loose cuttings shall be contained in pits or holding tanks for recycling or disposal, no fluids shall be allowed to enter any unapproved areas or natural waterways. Upon completion of the directional drill project, the drilling mud and cuttings shall be disposed of by the Contractor at an approved dumpsite.
12. The pilot hole shall be drilled on bore path with no deviations greater than 5% of depth over a length of 100-feet. In the event that pilot does deviate

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from the bore path more than 5-feet of depth in 100-feet, Contractor will notify Engineer and Engineer may require Contractor to pullback and re-drill from the location along bore path before the deviation. In the event that a drilling fluid fractures, inadvertent returns or returns loss occurs during pilot hole drilling operations, Contractor shall cease drilling, wait at least 30 minutes, inject a quantity of drilling fluid with a viscosity exceeding 120 seconds as measured by a Marsh funnel and wait another 30 minutes. If mud fracture or returns loss continues, Contractor will discuss additional options with the Engineer and work will then proceed accordingly.

13. Flange/MJ Adapter Installation Flanges/MJ Adapters shall be attached to pipe and fittings using butt fusion. The flanges/MJ adapters shall be aligned and centered relative to the pipe. Flanges/MJ adapters should be square with the valve or other flange before tightening of bolts. Bolts should not be used to draw flanges into alignment. Bolt threads shall be lubricated, and flat washers shall be used under flange nuts. Bolts shall be tightened using a Astar tightening pattern. See manufactures recommendations. Twenty-four hours after first tightening the flange bolts, they must be re-tightened using the same Astar tightening pattern used above. The final tightening torque shall be as indicated by the manufacturer.
14. On each day butt fusions are to be made, the first fusion of the day shall be a trial fusion. The trial fusion shall be allowed to cool completely, then fusion test straps shall be cut out. The test strap shall be 12" or 30 times the wall thickness in length (minimum) and 1" or 1.5 times the wall thickness in width (minimum). Bend the test strap until the ends of the strap touch. If the fusion fails at the joint, a new trial fusion shall be made, cooled completely and tested. Butt fusion of pipe to be installed shall not commence until a trial fusion has passed the bent strap test.
15. Socket and saddle fusions shall be tested by a bent strap test as described by the pipe manufacturer. The pipe manufacturer shall provide visual guidelines for inspecting the butt, saddle and socket fusions joints.
16. The Contractor shall be liable for retrieving or sealing any pipe that becomes lodged in the drill hole.

N. PIPE PULLING OPERATIONS

1. The full length of the pipe to be installed shall be laid out, welded and tested in one complete unit before being pulled back through the drilled hole. Once started, pipeline pullback shall be continuous unless approved otherwise in writing by the Owner or Owner's designated representative.

2. The pulling head shall be designed by the Contractor to withstand the continuous tensile pull stresses with intermittent sudden occasional surges. The Contractor shall be responsible for determining the pulling loads.
3. The pipe shall be continuously lubricated with a bentonite slurry and the assembled pipeline shall be laid on rollers, or other apparatus, to facilitate pullback and prevent damage to pipe.
4. The Contractor shall continue pull back until 10 linear feet (minimum) of pipe is above ground for the purpose of pipe inspection.
5. A blind flange shall be bolted to the fusion welded flange and the pipe shall be marked and buried with a minimum cover of 36-inches. Connections will require the removal of the blind flange and a flanged ductile iron adapter shall be bolted to the fusion welded flange suitable for the transitional material. Provide restrained joints or Megalug joint restraint as required.

O. TESTING

1. The HDPE main shall be included in the hydrostation testing requirements for entire system.

P. DAMAGED OR IMPROPERLY INSTALLED PIPE

1. If the pipe is damaged before installation, or does not meet the specifications, it shall be replaced at no expense to the Owner. If the pipe is damaged during installation by the Contractor's operations, placed at the improper grade or line, or cannot be advanced because of an unseen obstruction or any other reason, it shall, at the discretion of the Engineer, be retrieved or abandoned in place and the void filled with concrete by pressure grouting as soon as possible. If it becomes necessary to drill another hole, an alternate installation shall be made as directed by the Engineer. The Contractor shall re-drill the hole and furnish all additional labor and materials required to complete the job as indicated on the plans and specifications at no additional cost to the Owner. The cost for retrieval or abandonment of pipe shall be at the expense of the Contractor. No additional payment shall be made for pipe which is retrieved, abandoned, or damaged beyond use, including dewatering, excavation, drilling, backfilling, etc.
2. Sections of pipe having been discovered with cuts or gouges in excess of 10% of the pipe wall thickness shall be cut out and removed. The undamaged portions of the pipe shall be rejoined using one of the joining methods allowed in the Section.

SECTION 4



STANDARD DETAILS

APPENDIX A



APPENDIX A

- I. Approved Submersible Lift Stations
 - A. Davis-EMU
 - B. Fairbanks Morse
 - C. Hydromatic (less than 40 Hp only)

APPENDIX B



**CROSS-CONNECTION
CONTROL PROGRAM
MAY 26, 2000**

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AUTHORITY

Florida Safe Drinking Water Act, Sections 403.850-430.864 Florida Statutes. Florida Administrative Code, Chapter 17-22.107 part 4, subpart b: "Community water supply systems are required to establish a routine Cross-Connection Control Program for the purpose of detecting and preventing cross-connections that create or have the potential to create an imminent and substantial danger to the public health by and from contamination due to the cross-connection. Upon detection of a prohibited cross-connection both community and non-community water systems shall either eliminate the cross-connection by installation of an appropriate backflow prevention device acceptable to the Department (D.E.R.) or discontinue service until the contaminant source is eliminated. Such program shall be developed utilizing accepted practices of the American Water Works Association guidelines as set forth in AWWA manuals m14, "Backflow Prevention and Cross Connection Control", and "Cross-Connections and Backflow Prevention" 2nd Edition.

DEFINITIONS

Air Gap Separation - An unobstructed vertical distance through the free atmosphere between the lowest opening from any pipe or faucet supplying water to a tank plumbing fixture, or other device and the flood rim of the receptacle, and shall be at least double the diameter of the supply pipe measured vertically above the flood level rim of the vessel. In no case shall the gap be less than one (1) inch. This gap shall also be above the established 100 year flood level.

Atmospheric Vacuum Breaker - A backflow prevention device which is operated by atmospheric pressure in combination with the force of gravity. The unit is designed to work in a vertical plane only. The moving part consists of a poppet valve, which must be carefully sized to slide in a guided chamber and effectively shut-off the reverse flow of water when a negative pressure exists.

Auxiliary Water Supply - Any water supply on or available to the premises other than the purveyor's approved public potable water supply. These auxiliary water supplies may include water from another purveyor's public potable water supply or any natural source(s) such as a well, spring, river, stream, harbor, etc., or "used waters" or "industrial fluids". These waters may be polluted, contaminated or may be objectionable and constitute an unacceptable water source over which the water purveyor does not have sanitary control.

Backflow - The flow of water or other liquids, mixtures, or substances into the distribution pipes of a potable supply of water from any source or sources other than its intended source.

Back Pressure - Backflow caused by a pump, elevated tank, boiler or other means that could create pressure greater than the supply pressure.

Back Siphonage - Backflow due to a negative or subatmospheric pressure within a water system.

Backflow Prevention Device - A device to counteract back pressure or prevent back siphonage.

Backflow Prevention Device - Approved - The term approved backflow prevention device shall mean a device that has met the requirements of AWWA-C-506, Hersey BSG, or approved equal.

Containment - A method of controlling potential and/or confirmed cross-connections by installation of a double check assembly or a reduced pressure principle backflow prevention device.

Cross-Connection - Any physical arrangement whereby a public water supply system is connected directly or indirectly, with any other water supply system, sewer, drain, conduit, pool, storage reservoir, plumbing fixture, or other device which contains or may contain contaminated water, sewage, or other waste or liquid of unknown or unsafe quality which may be capable of imparting contamination to the public water supply system as a result of backflow. Bypass arrangements, jumper connections, removable sections, swivel or change-over devices, or any other temporary or permanent devices through which or because of which backflow could occur are considered to be cross-connections.

Double Check Valve Assembly - An assembly composed of two single, independently acting check valves, including tightly closing shutoff valves located at each end of the assembly and suitable connections for testing the water tightness of each check valve.

Health Hazard - Any condition, devices, or practices in any water supply system or in its operation which create or may create a danger to the health and well being of the water consumer.

Isolation - A method of controlling potential and/or confirmed cross-connections by installation of an air gap separation or a vacuum breaker.

Pressure Vacuum Breaker - A pressure vacuum breaker is similar to an atmospheric vacuum breaker except that the checking unit "poppet valve" is activated by a spring. This type of vacuum breaker does not require a negative pressure to react and can be used on the pressure side of a valve.

Public Water Supply - Any system or water supply intended or used for human consumption or other domestic use, including source, treatment, storage, and distribution where water is furnished to any community, collection or number of individuals, or is made available to the public for human consumption or domestic use, but excluding supplies serving one single family residence.

Reduced Pressure Principle Backflow Prevention Device - A device incorporating two or more check valves and an automatically operating differential relief valve located between the two check valves, two shutoff valves and equipped with necessary appurtenances for testing. The device shall operate to maintain the pressure in the zone between the two check valves, less than the pressure of the public water supply side of the device even at cessation of normal flow. In case of leakage of either check valve, the differential relief valve shall operate to maintain this reduced pressure by discharging to the atmosphere. When the inlet pressure is two pounds per square inch or less, the relief valve shall open to the atmosphere, thereby providing an air gap in the device. This air gap shall also be above the 100 year flood level.

RESPONSIBILITY

(A) Pace Water System, Inc., is responsible for the protection of its public potable water distribution system from backflow of contaminants or pollutants through any water service connection. If, in the judgement of the System, an approved backflow prevention device is required at the water service connection to any of its customers premises for the safety of the users of the water system, the System shall give notice in writing to the customer that an approved backflow prevention device shall be installed at the customer's expense.

(B) Failure, refusal, or inability on the part of the customer to meet the System's time schedule for installation of said device or devices shall constitute grounds for discontinuance of water service until such device or devices have been properly installed. Any licensed plumber may install the proper device in the correct manner. (Call 994-5129 if additional information is needed.)

(C) Compliance testing after initial installation of a backflow prevention device shall be performed by the System.

(D) In the event of any known or suspected accidental pollution or contamination of the consumers or the System's potable water system, the consumer shall promptly take steps to confine any further spread of pollution or contamination and shall immediately notify the System of the situation (telephone number 994-5129, 24 hours).

POLICY

(A) All premises having an auxiliary water supply which is not or may not be of safe bacteriological or chemical quality and which is not acceptable as an additional source to the Pace Water System shall have an approved air gap separation or an approved reduced pressure principle backflow prevention device installed in order to protect the public water supply against backflow.

(B) For all premises where there is water or substances that could be objectionable but not hazardous to health if introduced into the public water system the public water system shall be protected by an approved air gap separation, an approved double check valve assembly, or an approved vacuum breaker.

(C) For all premises where there is any material dangerous to health which is handled in such a fashion as to create an actual or potential hazard to the public water system, the public water system shall be protected by an approved reduced pressure principle backflow prevention device. Examples of premises where these conditions have been found to exist include sewage treatment plants, sewage pumping stations, chemical manufacturing plants, hospitals, mortuaries and plating plants.

(D) For all premises where there are "uncontrolled cross-connections," either actual or potential, the public water system shall be protected by an approved air gap separation or an approved reduced pressure principle backflow prevention device.

(E) For all premises where security requirements or other prohibitions or restrictions make it impossible or impractical to perform a complete in-plant cross-connection survey, the public water system shall be protected with an approved air gap separation or an approved reduced pressure principle backflow prevention device.

(F) For all premises more than two stories high (excluding basements), the public water system shall be protected by an approved double check valve assembly.

(G) All backflow prevention devices shall be installed at a location designated by the Pace Water System, Inc. Generally, this will be immediately on the customers side of the meter. If circumstances make this location impractical, then the backflow prevention device may be placed further downstream from the meter. However, any piping between the meter and the backflow prevention device must be either exposed or readily accessible for inspection.

(H) The following types of facilities shall normally require the designated backflow prevention devices. This list is presented as a guideline and should not be construed as being final or complete. Each case will be judge on its own merit.

FACILITIES REQUIRING BACKFLOW PREVENTION DEVICES

A.G. - Air Gap Separation

R.P. - Reduced Pressure Principle Backflow Prevention Device

D.C. - Double Check Valve Assembly

V.B. - Vacuum Breaker (type to be designated)

Type of Facility

Type of Protection

Car Wash	A.G. or R.P.
Chemical Plant	A.G. or R.P.
Film Lab or Development	A.G. or R.P.
Food or Beverage Processing Plant	D.C.
Hospitals, Clinics, and Medical Buildings	A.G. or R.P.
Ice Cream & Dairy Products	A.G. or D.C.
Irrigation Systems	D.C. or V.B.
Irrigation Systems (with chemical feed)	A.G. or R.P.
Laboratories	A.G. or R.P.

Laundries or Dry Cleaners	D.C.
Machine Tool Plants (health hazard)	A.G. or R.P.
Machine Tool Plants (no health hazard)	D.C.
Metal Plating Plants	A.G. or R.P.
Morgues, Mortuaries or Autopsy Facilities	A.G. or R.P.
Multi Storage Buildings	A.G. or D.C.
Packing Houses	A.G. or R.P.
Paper Product Plants	A.G. or R.P.
Pesticide & Herbicide Exterminations	A.G. or R.P.
Petroleum Processing Plants	A.G. or R.P.
Petroleum Storage Plant or Yard (health hazard)	A.G. or R.P.
Petroleum Storage Plant or Yard (no health hazard)	D.C.
Pharmaceutical or Cosmetic Plants	A.G. or R.P.
Piers, Docks or Waterfront Facilities	A.G. or R.P.
Power Plants	A.G. or R.P.
Premises with Water Recirculating Systems and Pumps (health hazard)	A.G. or R.P.
Premises with Water Recirculating Systems and Pumps (no health hazard)	R.P. or D.C.
Premises having Boiler, Cooling Systems or Hot Water Heating Systems where Chemical Water Conditioners are used	A.G. or R.P.
Premises having Storage Tanks, Reservoirs, Ponds, etc.	A.G. or R.P.
Radioactive Material Plants	A.G. or R.P.
Sand and Gravel Plant	D.C.
Schools with Laboratories	D.C.
Swimming Pools	A.G. or R.P.
Sewage Pumping Stations (health hazard)	A.G. or R.P.

Stations (no health hazard)	D.C.
Sewage Pumping Stations (outside hose bibs only)	V.B.
Sewage Treatment Plants	A.G. or R.P.
Veterinary Establishments	A.G. or R.P.
Waterfront Property with Buildings	A.G. or D.C.

INSPECTION

(A) The Pace Water System, Inc. shall conduct inspections of customers premises where suspected cross-connections or potential cross-connections may exist. Customers shall be notified in advance of the inspections and the reason for the inspections. Should any cross-connections or potential cross-connections be detected, the customer shall be notified in writing of the appropriate type of backflow prevention device to be installed. Refusal by a customer to allow an inspection shall be considered prima facia evidence of the existence of cross-connections, thereby requiring the installation of an approved reduced pressure principle backflow prevention device or the disconnection of service.

(B) For existing facilities, a survey of the customers water system shall be conducted. Such surveys need not be a detailed inspection of the location or disposition of water lines, but can be confined to establishing the water use on the premises; the existence of any cross-connections; the availability of auxiliary water supplies; the availability of pollutants, contaminants and other liquid, solid or gaseous substances that may be used industrially for stabilization of water supplies and other procedures for determining the degree of health hazard.

(C) All new services shall be classified at the time of application to indicate the degree of hazard anticipated and hence the type of device required. This information shall be given to the applicant in writing. Any later change in water usage may require a change in the type of device. If no realistic evaluation of the proposed water uses can be determined, the consumer, architect, engineer or other appropriate individual should be advised in writing that eventually circumstances may require the installation of additional backflow protection of the water supply serving the premises.

(D) All water customers of the System shall be required to notify the System in writing or by phone of any changes in their water usage. These changes will be evaluated to determine if there is an increase in the potential health hazard and if such increase requires the installation of a device. If a device is already in place it will be determined if this device is adequate or if a different type is required.

RECORDS

Appropriate records shall be maintained by the System of all potential and confirmed cross-connections. Installations and tests of backflow prevention devices shall be recorded and filed for future reference.

MAINTENANCE

(A) Routine testing of backflow prevention device(s) shall be performed by the System. The frequency of testing will be dependent upon the type of device installed and the potential health hazard involved. The cost of this test will be the customer's responsibility.

(B) Customers will be notified in advance of the date and approximate time that any testing will be performed. It will be necessary to shut off the water service for a period not exceeding fifteen (15) minutes and every effort will be made to schedule tests to suit the customer's convenience. If the customer's operations cannot permit any interruption of service it will be the customer's responsibility to have two approved backflow prevention devices installed in parallel so that one may be used while the other is being tested. Bypasses around backflow prevention devices are expressly forbidden.

(C) If any devices tested are found to be faulty, the customer will immediately be notified and will be required to have the device promptly repaired or replaced at his expense. In high hazard situations, it may be necessary to terminate service until a properly operating device is in place. The customer should notify the system as soon as any faulty device has been corrected so that it may be re-tested.