Standard Specifications
for the
Design and Construction
of
Water and Wastewater Facilities

August 2011

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Design Specifications
for the
Design and Construction
of
Water and Wastewater Facilities

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SECTION A.1

GENERAL

PART A.1.1 – DETAIL

The design engineer is referred to the "Standard Specifications for the Design and Construction of Water and Wastewater Facilities" for additional details which are a part of a water or sewer utility design. For example, pipe material is detailed in that document.

SECTION A.2

WATER DISTRIBUTION SYSTEMS

PART A.2.1 – SCOPE OF WORK

This section includes design requirements for water distribution systems.

PART A.2.2 – DESIGN STANDARDS

A.2.2.1 REFERENCES

Water system design shall proceed in accordance with the applicable provisions of the Florida Department of Environmental Protection (Chapter 62-555 F.A.C.), regulations of the CITY, the Bay County Health Department, and Recommended Standards for American Water Works Association.

A.2.2.2 SYSTEMS SIZE COMPUTATION

Water distribution systems shall be sized, as a minimum, to deliver the sum of the maximum day demand plus the applicable fire flow rate. Flow demands, in all cases, shall be derived from the projected ultimate development size. The minimum residual design pressure shall be 20 pounds per square inch (psi), at all points in the system, under the stated design conditions. Design computations shall be accomplished by the "Hardy Cross" method,WaterCAD® or other approved by the Public Works Director. A"C" factor of 120 will be assured for all pipes.

Estimation of the average daily flow shall not be less than 300 gallons per day per residence with 3.5 persons per single family residence. Flow demands for commercial, industrial or other special developments shall be established from existing records or by estimated projections, using the best available data.

A.2.2.3 GENERAL

The following requirements shall be incorporated into the design of all water distribution systems:

A. The water distribution system configuration shall be looped wherever possible.

B. If water distribution system cannot be looped, an approved fire hydrant or an approved flush or yard hydrant with a minimum 2-inch outlet must be designed at the end of every dead end main.

C. All water mains shall be placed in public right of ways or in 20-foot utility easements dedicated to the City. All water mains shall be of even sizes.

D. Air release valves shall be specified in all locations that air entrapment could occur.

E. All water distribution system piping shall be ductile iron or C-900 or C-905 PVC, SDR18.

F. All water service lines shall be Type K copper tubing or polyethylene tubing, ASTM D-2239, SDR 9, and PE 3306.

G. Pipes shall be located 36 inches or more below the ground surface.

H. Magnetic locator tape and trace wire shall be buried will all nonmetallic pipe.

I. Plan sheets submitted to CITY for review are required to have a cover sheet, match lines between continuing plans and profiles, and an index sheet or key sheet that shows the entire project with references to the other sheets in the set.

A.2.2.4 FIRE FLOW

The water distribution system and/or water main extensions shall be designed and constructed in accordance with the fire protection requirements of the insurance services office (National board of Fire Underwriters), as stated their publication "Guide for Determination of Required Fire Flow."

As a minimum, fire flows shall meet or exceed the following criteria per Table A.2.1:

Table A.2.1
Air Pressure Standards for Line Testing

Zoning	Fire Flow Rate (GPM)	Residual Pressure (PSI)	Hydrant Spacing (feet)**	Minimum Main Size (Inches)
Residential	500	20	500*	6
Commercial and Apartments (four stories or less)	500 from 2 hydrants concurrently or 1,000 from 1 hydrant	20	500and 250 minimum from the first unit	6
Commercial and Apartments (over four stories)	1,000 from 2 hydrants concurrently	20	500and 250 minimum from the last unit	6

Notes:

* On dead-end streets (permanent or temporary), a fire hydrant shall be located within 250 feet of the farthest corner of each building.

**Hydrant spacing is to be measured along the edge of pavement.

A2.2.5 VALVES

Valves shall **generally** be provided for each direction of pipe branches, loop ends, for fire hydrant stubs, and as required to facilitate operation of the distribution system. Valves must be installed at the end of each line that will be continued in phased construction. Valve spacing shall at a minimum meet the provisions outlined in Tables 2.2 and 2.3 and type of valve to be used is detailed in Table 2.4.

Table A.2.2
Maximum Allowable Length of Water Main Required to be Shut Down for Repair Work

Zoning	(feet)
Residential	500
Multi-family	500
Commercial	500
Other Areas	1,000

Table A.2.3
Maximum Lengths Between Cutoff Valves

Main Type	(feet)
Arterial Mains	1,000
Commercial Districts	500
Residential Districts	800

Table A.2.4
Type of Valve to be Used

Size (of pipe? Valve?)	Type
4 inch through 12 inch	Resilient Wedge Gate Valve
16 inch and above	Butterfly Valve

SECTION A.3

GRAVITY SANITARY SEWERS

PART A.3.1 – SCOPE OF WORK

This section includes design requirements for gravity flow sanitary sewer systems.

PART A.3.2 – DESIGN STANDARDS

A.3.2.1 REFERENCES

Sewer system design shall proceed in accordance with the applicable provisions of the Florida Department of Environmental Protection (Chapter 62-604 F.A.C.), regulations of the CITY, the Bay County Health Department, and the Recommended Standards for Wastewater Facilities (1997 edition or most current edition).

A.3.2.2 SYSTEM SIZE COMPUTATION

Sanitary sewer systems shall be designed to accommodate the goals of local master plans, and as a minimum shall be designed to carry the future anticipated maximum daily flow. This flow shall be determined from the projected ultimate development size. Estimation of the average daily flow shall not be less than 250 gallons per day per residence. Flow demands for commercial, industrial or other special developments shall be established from existing records by estimated projections, using best available data. In addition, the minimum design flows used in computing trunks shall not be less than 250 gallons per ERC per day, or mains shall not be less than 400 gallons per capita per day, where no actual measurements or other pertinent data are available.

The minimum pipe sizes allowed shall be as follows:

A. Main and Trunk – 8inches.

B. Service Lateral Connection within rights-of-way – 6inches

A.3.2.3 GENERAL

The following requirements shall be incorporated into the design of all gravity flow sanitary sewer systems:

A. All wastewater collection/transmission system or component that will become the property and sole responsibility of the city will be designed or constructed inside of any public right-of-way and/or easement which may be used for said purpose.

B. All gravity mains shall be placed in public right of ways or in 20-foot minimum utility easements dedicated to the City. **Note**: Easements greater than 20 feet may be required depending on depth and soil conditions.

C. All gravity mains shall be of even sizes.

D. All gravity sewer piping shall be PVC ASTM D3034, SDR 35, provided, however, that in the event of conflicts ductile iron pipe (DIP), AWWA C150, utilizing Class 350 for piping 12 inches and smaller and Class 250 for 14 inches and above, may be used.

E. DIP will have 40 mil lining with ceramic-filled amine-cured epoxy, Protecto 401 by Indurall or equal as approved by the Public Works Director.

F. Where DIP is used for sanitary sewage, it shall be spirally wrapped with 2-inch dark GREEN vinyl tape. All PVC pipe will be green in color.

G. Magnetic locator tape and trace wire shall be buried will all nonmetallic pipe.

H. Plan sheets submitted to CITY for review are required to have a cover sheet, match lines between continuing plans and profiles, and an index sheet or key sheet that show the entire project with references to the other sheets in the set.

A.3.2.4 MINIMUM SEPARATION

Water and sewer lines including services shall have a minimum lateral separation of 10 feet, and in the case of crossing, a minimum vertical separation of 18 inches shall be maintained.

Where these requirements are not possible the minimum separation allowed shall meet the provisions in Chapter 62-555 F.A.C. Where it is impossible to meet the provisions in Chapter 62-555 F.A.C., the sewer shall be within 20 feet of either DIP or 6 inches thick concrete encasement, centered at the point of crossing.

A.3.2.5 MINIMUM SLOPES

All sewers shall be designed at slopes providing a minimum velocity of 2 feet per second when flowing full. Table 3-1 gives minimum acceptable slopes based on these criteria for a Manning's roughness coefficient ("n") of 0.013:

Table A.3-1
Minimum Acceptable Slopes Based on Manning's Roughness Coefficient

Sewer Size	Minimum Slope (Feet Per 100 Feet)
6"	0.60
8"	0.40
10"	0.28
12"	0.22
14"	0.17
15"	0.15
16"	0.14
18"	0.12
20"	0.11
21"	0.10
24"	0.08
27"	0.067
30"	0.058
36"	0.046

A.3.2.6 DEPTH

The minimum depth of mains will be 6 feet and the maximum depth will be 15 feet unless otherwise required or authorized by the CITY.

A.3.2.7 MANHOLES

Sewer lines shall be installed with straight alignment and grade between junctures. Sewers of 8-inch or greater diameter shall be provided with manholes at all junction points, changes in size, changes of alignment, or changes in slope. Maximum distance between manhole spacing shall be 400 feet. Manholes shall generally be placed on the centerline of minor streets, beyond paving on streets classified as major collectors, arterial roadways, or those with 3 or more thru lanes of traffic, and away from drainage channels.

All manholes in easements will be left a minimum of 18 inches above grade. If within a 100-year flood plain they will be 1 foot above the flood plain elevation. Manholes subject to street flooding will have watertight lids. Manholes in easements will be at the lot line unless otherwise authorized by the CITY.

A.3.2.8 SERVICE LATERALS

The minimum diameter for service laterals shall be 6 inches. Cleanouts shall be provided at the right-of-way line for all service laterals lines. Prior to final inspection of the sewer the stub out will be installed 2 feet above ground level. After final acceptance of the sewer the cleanout shall be installed flush to grade. The minimum depth of the service line at the property line will be 5 feet.

SECTION A.4

SEWAGE FORCE MAINS

PART A.4.1 – SCOPE OF WORK

This section includes design requirements for sanitary sewer force mains.

PART A.4.2 – DESIGN STANDARDS

A.4.2.1 REFERENCES

Sewer system design shall proceed in accordance with the applicable provisions of the Florida Department of Environmental Protection (Chapter 62-604 F.A.C.), regulations of the CITY, the Bay county Health Department, and the Recommended Standards for Wastewater Facilities (1997 edition or most current edition).

A.4.2.2 SIZE AND CAPACITY

Force main systems shall be of adequate size to efficiently transmit the total ultimate peak operational flows, applied by the connected sewage pumping station(s) to the effluent point, but not less than 4 inches in diameter unless approved by the City. This flow shall be determined from the projected ultimate development size. Estimation of the average daily flow shall not be less than 250 gallons per day per residence. Consideration shall be given to possible future connecting pumping stations. Capacity computations shall be coordinated with the proposed pumping system(s), along with any future flow requirements. Force main flow velocity shall not be less than 2 feet per second and no more than 6 feet per second at ultimate design pumping capacity; however, with multiple pumping station systems, or phased developments, the system design shall receive special attention regarding cleaning maintenance. A "C' factor of 120 will be used for all pipes.

A.4.2.3 GENERAL

The following requirements shall be incorporated into the design of all sanitary sewer force main systems:

A. All wastewater collection/transmission system or component that will becomethe property and sole responsibility of the city shall be designed or constructed inside of any public right-of-way and/or easement which may used for said purpose.

B. All force mains shall be placed in public right of ways or in 20-foot minimum utility easements dedicated to the City. **Note**: Easements greater than 20 feet may be required depending on depth and soil conditions.

C. All force mains shall be of even sizes.

D. All force main piping shall be ductile iron or C-900 or C-905 PVC, SDR18.

E. DIP will have 40 mil lining with ceramic-filled amine-cured epoxy, Protecto 401 by Indurall or equal as approved by the Public Works Director.

F. Where DIP is used for sanitary sewage, it shall be spirally wrapped with 2-inch dark GREEN vinyl tape. All PVC pipe will be green in color

G. Magnetic locator tape and trace wire shall be buried will all nonmetallic pipe.

H. Plan sheets submitted to CITY for review are required to have a cover sheet, match lines between continuing plans and profiles, and an index sheet or key sheet that show the entire project with references to the other sheets in the set.

A.4.2.4 MINIMUM SEPARATION

Water and wastewater line including services, shall have a minimum lateral separation of 10 feet, and in the case of crossing, a minimum vertical separation of 18 inches shall be maintained.

Where these requirements are not possible the minimum separation allowed shall meet the provisions in Chapter 62-555 F.A.C.

Where it is impossible to meet the provisions in Chapter 62-555 F.A.C., the sewer will be 20 feet of either DIP or 6 inches thick concrete encasement, centered at the point of crossing

A.4.2.5 AIR AND VACUUM VENTING

Where the force main profile is such that air pockets or entrapment will occur resulting in flow blockage, provisions for air release shall be provided. Where free flow will occur during operation or after pumping stops, combined air release and vacuum relief valve assemblies, or other means, shall be provided. Sizing and location of air and/or vacuum release valves shall be in accordance with the latest manufacturers recommendations.

A.4.2.6 VALVE LOCATIONS

Plug valves shall be installed on all force mains at the pumping station. Branches of intersection force mains shall be provided with appropriate valves such that one branch may be shut down for maintenance without interrupting the flow of the other branches.

When taps are made on an existing force main a plug valve will be required in addition to the tapping valve.

Stubouts on a force main, placed in anticipation of future connections, shall be equipped with a valve to allow such connection without interruption of service.

A.4.2.7 THRUST RESTRAINT

Pressure piping fittings require that adequate means of restraining unbalanced thrust forces is provided in accordance with AWWA Manual M23 and the recommendations of the manufacturer. Thrust restraint may be provided by mechanical devices. Mechanical thrust-restraints devices must be pressure-rated by their manufacturers and must not exert forces that will cause failure when assembled on the pipe or fitting.

A.4.2.8 TERMINAL DISCHARGE

Where force mains enter a gravity system manhole the invert elevation of the force main at the point of connection to the manhole shall not be higher than the crown elevation of the gravity main. Should an elevation drop be required to obtain the outlet connection, it shall not exceed 20feet, and the prior down-slope of the force main shall not exceed 45-degrees. Adequate air venting shall be provided at the profile break-point. In the manhole receiving the force main discharge, all exposed surfaces shall be lined with a cast in HDPE liner or other liner system approved by the CITY. Liners shall be shown, labeled, and dimensioned on the shop drawings submitted for approval to the CITY.

SECTION A.5

SEWAGE PUMPING STATIONS

PART A.5.1 – SCOPE OF WORK

This section includes general requirements for the design and installation of sewage pumping stations.

PART A.5.2 – DESIGN STANDARDS

A.5.2.1 REFERENCES

Pump Station system design shall proceed in accordance with the applicable provisions of the Florida Department of Environmental Protection (Chapter 62-604 F.A.C.), regulations of the CITY, the Bay county Health Department, and the Recommended Standards for Wastewater Facilities (1997 edition or most current edition).

A.5.2.2 GENERAL

Sewage pumping stations shall be sized to accommodate the maximum expected flows from a totally developed contributory area. The minimum pumping capabilities required shall be the product of the peaking factors noted below times the average daily flow rate:

$$Peak\ Factor = \frac{18 + \sqrt{P}}{4 + \sqrt{P}}$$

Where: P is population in thousands.

A.5.2.3 LOCATION

Sewage pumping stations shall be located outside of public rights-of- way, on parcels of land dedicated for that purpose. They shall be placed so as to permit continuous maintenance access, and to prevent damage by flooding.

A.5.2.4 TYPE

Sewage pumps shall be of the oil-filled submersible type.

A.5.2.5 WET WELL DESIGN

A. The wet well shall be sized such that with any combination of inflow and pumping, the minimum cycle of operation for each pump will be not less than 6-minutes and the maximum retention time in the wet well will not average more than 30-minutes.

B. Wet wells shall be vented to the atmosphere. The well shall be provided with an approved aluminum access hatch (one for each pump) which is capable of supporting expected loadings, and sized to allow adequate space for equipment removal and replacement.

C. A CITY approved fall protection system is required of all new stations.

D. The guide rail, guide rail brackets, cable holder, and all bolt and hardware supports shall be 300 series stainless steel.

E. A valved auxiliary bypass shall be provided between the wet well and the discharge force main. The connections shall be Kamlock or approved equal.

F. Wet wells shall be constructed of reinforced concrete manhole riser sections conforming to ASTM Standard C478. The wet wells shall be constructed with reinforced concrete top and base slabs and shall have suitable access covers.

G. Wet wells shall have a maximum of one influent line. When two or more sewers converge at the pump station site, a manhole shall be provided for these lines, and a single discharge line shall be run from a manhole to the wet well.

H. The exterior of each wet well shall be painted with two coats of Koppers (Kop-Coat) "Bitumastic 300-M" or an industry-approved equal, applied in accordance with the manufacturer's directions.

I. The interior of each wet well shall be lined with a cast in HDPE liner or other liner system approved by the CITY.

J. The frame cover and top of slab shall be completed to the grade shown on the plan.

A.5.2.6 PUMPING SYSTEMS

A. Pump systems shall have the minimum capability of pumping the peak design flow against the maximum computed system total dynamic head (TDH).

B. A minimum of two pumps shall be provided. All pumps installed in a station shall be of the same manufacture, electrical rating, inlet/outlet size, horsepower, and impeller size. Approved manufacturers are Wilo-EMU, Flygt or equal approved by the Public Works Director.

C. Pumps shall be capable of handling raw, unscreened sewage and passing spheres of not less than 3inches in diameter.

D. Pump suction and discharge openings shall be at least 4 inches in diameter.

E. Pump motors shall be non-overloading, throughout the entire operating range of the pumps. Thermal overloads shall be provided to shut off pump motor and initiate alarm for motor over temperature condition. The motor shall be NEMA Design B that can provide 120/240 volt single phase for pumps less than 2.5 HP. For pumps 2.5 Hp and larger the motor shall provide 230/460 volt, 3-phase, 60 Htz, with a service factor of 1.15 and "H" class insulation.

F. The pump shall be oil lubricated.

G. The pumps shall have double mechanical seals.

H. The impeller shall be cast iron.

I. The pump manufacturer shall furnish pumps and the electrical control system. The provider's representative shall conduct system start-up services to be performed in the presence of the inspector.

J. System curve and pump performance curves shall be included in construction drawing.

A.5.2.7 PUMP STATION CONTROL SYSTEM

A. Each pumping station control system shall include a liquid level controller, which shall sense the sewage level in the wet well and provide appropriate signals to the logic circuits to produce the required mode of operation for the pumping facilities.

1. Capability shall be provided for manual start-stop control for all pumping units, as well as the normal automatic control from the liquid level sensing and logic circuits.

2. An automatic alternator shall change the starting sequence on each pump cycle.

3. A high and low water level alarm system shall be provided.

4. All pumping stations shall have a high water level alarm light and alarm horn with silencer button remotely mounted on a separate aluminum NEMA 4 Enclosure, 6" by 6" by 6" in size.

5. Each sewage pump shall be provided with an elapsed time meter to indicate pump-running times.

6. Exterior station controls shall be housed within a panel, either pole mounted, or with a freestanding enclosure.

7. At minimum, the panel will be stainless steel of NEMA 3R weather tight construction, with hasp and padlock.

8. Electrical materials and methods shall comply with National Electrical Code requirements.

B. The pump control center shall contain main circuit breaker, an emergency circuit breaker, motor starter, with thermal overload protection for each pump motor, an automatic alternator relay, elapsed time meter for each pump motor, and any other circuitry as required for related equipment.

C. Pumping stations shall also be equipped for and connected with the CITY telemetering system. The necessity for telemetering, whether immediate connection is to be accomplished or controls provided for future accommodation shall be reviewed and approved with the CITY's Public Works Department.

A.5.2.8 STATION DETAILS

A. Positive odor and noise control provisions shall be included in the pumping station design.

B. All pump discharge piping and fittings shall be 125# flanged DIP, AWWA C115 Class 350 up to 24inches. Class 250 shall be used for any piping greater than 24 inches.

C. All valves shall be place in a poured-in-place or a precast concrete vault per Appendix. A, figure 4-5.

D. Pumping station site shall be paved with 4-inch minimum 3,000 psi concrete, reinforced with 6 x 6 – 10/10 wire mesh or fiber glass reinforced. Discharge piping, water service lines and conduits shall be located beneath the slab.

E. The site shall be enclosed with a six foot high chain link fence or privacy fence.

A.5.2.9 VALVES

Eccentric plug valves shall be placed on the discharge line of each pump and the bypass connection to afford pump isolation and bypassing. Check valves shall be located between the plug valves and the pump. Check valves shall be of the rubber flapper type and shall be suitable for the material being handled.

A.5.2.10 EMERGENCY EQUIPMENT

Pumping systems shall be equipped with components permitting emergency operation as defined in the following:

A. Portable generator weather-proof plug receptacles mounted on the exterior of the control panel compatible with CITY generators is required for all pump stations.

B. Additionally, an automatic transfer switch/stationary stand-by generator is required for a pump station with a motor of 150-h.p. or larger.

SECTION A.6

RESIDENTIAL OR SINGLE UNIT GRINDER PUMPING STATIONS

PART A.6.1 – SCOPE OF WORK

This section includes general requirements for the design and installation of grinder pump stations and grinder pumps station systems.

PART A.6.2 – DESIGN STANDARDS

A.6.2.1 REFERENCES

Grinder pump system design shall proceed in accordance with the applicable provisions of the Florida Department of Environmental Protection (Chapter 62-604 F.A.C.), regulations of the CITY, the Bay county Health Department, and the Recommended Standards for Wastewater Facilities (1997 edition or most current edition).

A.6.2.2 GENERAL

A residential or single unit grinder pump station will be allowed only if the City determines the site cannot feasibly be served by the City's gravity system. The City will determine the discharge/connection point of the forcemain into the existing wastewater collection system from the grinder pump station or system of grinder pump stations.

A.6.2.3 LOCATION

Grinder pumping stations shall be located outside of public rights-of- way, on the home owner's property. The grinder pumping station and appurtenance on the home owner's property shall be owned and maintained by the home owner. The City will maintain forcemains from the City's check valve and isolations valve located inside public right-of-way or dedicated utility easement.

A.6.2.4 TYPE

Grinder pump stations shall be simple privately owned pump stations.

A.6.2.5 WET WELL DESIGN

A. The wet well shall be sized to meet the demands of the residents or single unit it serves to provide adequate minimum cycle time of the pumps selected.

B. Wet wells shall be vented to the atmosphere. The wet well shall be provided with an access hatch which is capable of supporting expected loadings, and sized to allow adequate space for equipment removal and replacement.

C. Wet wells shall be constructed of fiberglass or high density polyethylene (HDPE).

D. The wet well will be embedded in adequate concrete ballast to prevent uplift.

E. Wet wells shall have a maximum of one influent line from one residence or single unit.

F. The frame cover or top flange shall be completed to the grade shown on the plan.

A.6.2.6 PUMPING SYSTEMS

A. Pump systems shall have the minimum capability of pumping the peak design flow against the maximum computed system total dynamic head (TDH).

B. The City shall supply the design pressure at the junction point with if the station's or system of stations discharge forcemain connects to an existing City forcemain.

C. A minimum of one pumps shall be provided. Approved manufacturers E-ONE, Barnes, Hydromatic, Liberty or equal approved by the Public Works Director.

D. Pump shall be a minimum of 1 hp.

E. Grinder pumps in the special capital extensions area may require a minimum of 2 hp.

F. Pump discharge forcemain shall be a minimum of 2-inch.

G. Pump motors shall be non-overloading, throughout the entire operating range of the pumps. Motors shall be 120/240 volt single phase for grinder pumps.

H. System curve and pump performance curves shall be provided to the City for approval.

A.6.2.7 PUMP STATION CONTROL SYSTEM

A. Each pumping station control system shall include a control panel, which shall sense the sewage level in the wet well by a float system and provide appropriate signals to the logic circuits to produce the required mode of operation for the pumping facilities.

B. Capability shall be provided for manual start-stop control, as well as the normal automatic control from the liquid level sensing and logic circuits.

C. At a minimum, a high water level alarm system shall be provided. A low level alarm is also recommended.

D. All control panels shall have an alarm light and alarm horn with silencer.

E. Electrical materials and methods shall comply with National Electrical Code requirements.

A.6.2.8 VALVES

A. All valves shall be placed in a prefabricated vault.

B. 2-inch plug or ball valves shall be placed on the discharge line of the pump. Check valves shall be located between the plug valves and the pump.

A.6.2.9 FORCEMAINS

A. Forcemains shall be a minimum of two (2)-inches from each grinder pump station.

B. Forcemains that serve a system of grinder pump stations shall be sized to have a velocity of 2fps under minimum system conditions. Velocity in the forcemains shall be less than 7fps under maximum system conditions.

C. 2-inch plug or ball valve and a 2-inch check valve shall be placed on the City's side of the property line for each grinder pump station.

D. 2-inch clean out shall be placed at the dead end of all forcemains that serve a system of grinder pumps.

E. A line size check valve shall be placed just upstream of the connection to the City's forcemain on all forcemains that serve a system of grinder pumps.

SEGMENT B

Standard Specifications
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SECTION B.1

WATER DISTRIBUTION SYSTEMS

PART B.1.1 – GENERAL

B.1.1.1 SCOPE OF WORK

The CONTRACTOR/DEVELOPER shall supply all labor, equipment, materials and incidentals necessary to install, test and disinfect a water distribution system, including all appurtenances as shown on the drawings and as specified herein.

This work shall include, but not be limited to, the following: DIP, PVC pipe, HDPE pipe, valves, fittings and hydrants; restrained joints required for all types of piping; also all excavation, backfilling, sheeting, slope protection, drainage, concrete work, rip rap, grading, site restoration, erosion control, environmental protection, traffic control, pedestrian protection, and all other work necessary to complete the construction, installation and testing of the water distribution system.

B.1.1.2 SUBMITTALS

At the ENGINEER's option, furnish sworn certificates that all tests and inspections required by the Specifications under which the materials were manufactured have been satisfied.

B.1.1.3 INSPECTION AND UTILITY LOCATION

All pipe and fittings to be installed under this Contract may be inspected at the site of manufacturer for compliance with these Specifications by an independent laboratory selected by the CITY. The manufacturer's cooperation shall be required in these inspections.

Inspections of the pipe may also be made by the ENGINEER or other representatives of the CITY after delivery. The pipe will be subject to rejection at any time on account of failure to meet any of the requirements specified herein, even though sample pipes may have been accepted as satisfactory at the place of manufacture. Pipe rejected after delivery will be marked for identification and will be removed from the job at once.

Water mains and services are the responsibility of the CONTRACTOR/DEVELOPER until such time as the system is deemed accepted by the CITY. Prior to acceptance, the CONTRACTOR/DEVELOPER will be responsible for providing all field utility locations in accordance with utility location standards as established by the American Public Works Association. The CONTRACTOR/DEVELOPER will be responsible for any damages to the water system caused by the installation of any other utilities. The CONTRACTOR/ DEVELOPER will be notified of acceptance in writing after the CITY receives full payment of all applicable fees owed to the CITY, approved as-builts, Florida Department of Environmental Protection Clearance Certification, and other required submittals.

B.1.1.4 CONNECTION TO WORK BY OTHER OR EXISTING LINES

A. For lines installed by others to which piping of the utility extension must connect, the following work shall be performed:

1. Expose buried lines to confirm or determine end connection, pipe material and diameter.

2. Removing the temporary plug provided in the pipe installed under another contract.

3. Furnishing and installing piping and making proper connections.

B. For connection to existing lines to which piping of the utility extension must connect, the following work shall be performed:

1. Expose buried lined to confirm or determine end connection, pipe material and diameter.

2. Furnish and install appropriate piping and make approved connections.

The City of Callaway Public Works Department shall be notified 48 hours prior to any connection to the existing water system, inspection requests, testing, etc.

The CONTRACTOR/DEVELOPER must notify the CITY at least 48 hours before any scheduled water outage. The CONTRACTOR/DEVELOPER shall reimburse the CITY for total cost of all required testing, labor, and lost water due to the outage for emergency water outage or service disconnects, notify the CITY immediately.

PART B.1.2 – PRODUCTS

B.1.2.1 DUCTILE IRON PIPE (DIP) AND FITTINGS

Each length of DIP supplied for the project will be hydrostatically tested at the point of manufacture to 500 psi for duration of 10 seconds per AWWA C151. Testing may be performed prior to machining bell and spigot. Failure of DIP will be defined as any rupture of the pipe wall. Certified test results will be furnished in duplicate to the ENGINEER prior to time of shipment.

All ductile-iron pipe and fittings to be installed under this project will be inspected and tested at the foundry as required by the standard specifications to which the material is manufactured. Furnish in duplicate to the ENGINEER sworn certificates of such tests and their results prior to the shipment of the pipe.

All pipe and fittings will be permanently marked with the following information:

A. Manufacturer, date.

B. Size, type, class, or wall thickness.

C. Standard produced to (AWWA, ASTM, etc).

DIP will conform to AWWA C151 or/and ASTM A193. Pipe will be supplied in standard lengths as much as possible. Thickness design will be per AWWA C150, utilizing Class 350 for piping 12 inches and smaller. For pipe 14" and above, Class 250 may be used except where Class 350 is specified on the plans.

DIP will be by U.S. Pipe and Foundry Company, Inc.; American Cast Iron Pipe Company; pipe divisions of McWane, Inc., or approved equal.

DIP will have rubber-gasket push-on joint or rubber-gasket mechanical joint. Rubber-gasket joints will conform to AWWA C111. Gasket will be of SBR. Restrained joints will be 'Locked-type' joints manufactured by the pipe and fitting manufacturer that utilize restraint independent of the joint gasket. Restrained joints will be suitable for the specified test pressure. Mechanical joint retainer glands as manufactured by EBAA Iron Inc. of Texas can be selected for restraining the mechanical joint of DIP. Push-on restrained joints as manufactured by the pipe supplier or manufacturer may be used subject to the ENGINEER's approval.

The minimum number of restrained joints required for resisting forces at fittings and changes in direction of pipe will be determined from the length of restrained pipe on each side of fittings and changes in direction necessary to develop adequate resisting friction with the soil as shown on the drawings. All fittings for lines 4 inches in diameter and larger will have restrained joints.

Pipe fittings will be ductile iron with pressure rating of 350 psi for 24 inches and smaller piping and 250 psi for 30 inches and larger piping. Fittings will meet the requirements of AWWA C110 or AWWA C153 as applicable. Fittings will have the same pressure rating, as a minimum, of the connecting pipe. Fittings will be manufactured by the same manufacturer of the pipe.

Lining & Coating For All Ductile Iron Pipe (DIP) And Fittings:

All pipe and fittings for potable water service shall have a cement mortar lining and asphaltic seal coat in accordance with AWWA C104 double thickness and be coated on the exterior with a 1.0 mil thick bituminous coat in accordance with AWWA C151.

B.1.2.2 POLYVINYL CHLORIDE (PVC) PRESSURE PIPE

All polyvinyl chloride (PVC) water pipe and fittings will be from a single manufacturer. The supplier will be responsible for the provisions of all test requirements specified in ASTM D3034 and NSF Standard No. 14 as applicable.

PVC pressure pipe sized 4 through 12 inches will conform to the requirements of AWWA C900. All piping will be Class 150 with a Dimension Ratio of 18. The pipe will be PVC 1120 made from PVC compounds Class 12454-A or 12454-B as defined in ASTM D1784. Each pipe length will be marked with the manufacturer's name or trademark, size, material code, pressure class, AWWA designation number and seal of test agency that verified pipe material for potable-water service.

PVC pressure pipe sizes 14 through 36 inches will conform to the requirements of AWWA C905 ASTM D2241. All piping will have a Dimension Ratio of 18. The pipe will be made from PVC compounds Class 12454-A or 12454-B as defined in ASTM D1784. Each pipe length will be marked with the manufacturer's name or trademark, size, material code, pressure class, AWWA reference and seal of test agency that verified pipe material for potable-water service.

2-inch PVC pipe shall be 200 psi (SDR 21) in IPS dimensions manufactured from 1120 PVC resin. Pipe shall have integral wall bells or extruded couplings with gasket seals. Pipe shall be marked with manufacturer's name, size, material code (PVC 1120), pressure rating (200 psi), DR number (DR 21).

PVC pipe and fittings will have bell and spigot push-on joints. The bell will consist of an integral wall section with a solid cross-section elastomeric gasket securely locked in place to prevent displacement during assembly. Installation of elastomeric gasketed joints and performance of the joint will conform to ASTM F477, ASTM D3139.

All fittings and accessories for waterlines will have bell and/or spigot configurations compatible with the pipe.

All fittings for water mains will be cast or ductile iron conforming to AWWA C110 or AWWA C153 as applicable for mechanical joints. All adaptors, fittings and transition gaskets necessary to connect cast or ductile iron fittings to PVC will be furnished.

PVC water lines will be blue in color. Where restrained joints are shown on the Drawings restraining glands will be installed. Restraining glands for PVC pipe will conform to AWWA C111 and be Megalug Series 2000 PV, Series 1500, and Series 2800 by EBAA Iron Sales Inc or equal.

B.1.2.3 HIGH DENSITY POLYETHYLENE (HDPE) PIPE

All HDPE pipe and fittings will be manufactured in strict accordance with AWWA C906 and will be from a single manufacturer who is fully experienced, reputable and qualified in the manufacture of the polyethylene pipe to be furnished. All HDPE pipe and fittings will be supplied by a single distributor who is fully experienced, reputable, and qualified with the distribution of the pipe to be furnished.

All incoming resin will be sampled by the pipe MANUFACTURER for conformance testing against test results supplied by the resin manufacturer. Samples will be taken from the top and bottom of each compartment from every hopper car received. The following conformance tests will be performed on the sample:

A. Melt Flow Index - ASTM D1238

B. Density - ASTM D1505

C. The results of these tests will become part of the manufacturer's permanent quality control records.

The polyethylene pipe manufacturer will provide certification that stress regression testing has been performed on the specific polyethylene resin being utilized in the manufacture of this product. This stress regression testing will have been done in accordance with ASTM D2837 and the manufacturer will provide a product supplying a minimum Hydrostatic Design Basis (HDB) of 1600 psi as determined in accordance with ASTM D2837.

HDPE pipe is a flexible conduit and will be designed to transfer imposed loads to the surrounding embedment medium. The pipe and fittings will be free from all defects including indentations, delaminations, cracks, bubbles, pinholes, inclusions or occlusions which, due to their nature, degree, or extent, detrimentally affect the strength and serviceability of the pipe. Any pipe or fittings with such defects which, in the judgment of the ENGINEER, will affect the strength and serviceability will be repaired or rejected.

HDPE pipe resins will be high molecular weight, high density polyethylene with a cell classification number of 345434C in accordance with ASTM D3350. Pipe materials will meet the requirements of Type III, Class C, Category 5, Grade P34 as defined in ASTM D1248, with a standard grade rating of 1600 psi at 73 degrees F. Clean rework material generated by the manufacturers own production may be used so long as the pipe or fittings produced meet all the requirements of this section. Polyethylene pipe and adaptors will be as manufactured by Performance Pipe, Isco, CSR Polypipe or equal

The polyethylene compound will be suitably protected against degradation by ultraviolet light as required by ASTM D1603. CONTRACTOR/DEVELOPER shall select either Ductile Iron Pipe Size (DIPS) or Iron Pipe Size (IPS) outside dimensions based on matching the inside diameter (ID) of the main line pipe. Pipe shall be furnished in minimum thickness equivalent to DR-11. All polyethylene pipe will meet the requirements of ASTM F714.

The pipe will be joined with butt, heat fusion joints. All joints will be made in strict compliance with the manufacturer's recommendations. Pipe will be furnished in standard laying lengths not exceeding 50 feet.

All high density polyethylene pipe and fittings will be made from the same resin. Fittings will be fully pressure rated to match the pipe SDR pressure rating. All fittings will be molded or fabricated by the manufacturer.

The following will be continuously indent printed on the pipe or spaced at intervals not exceeding 5 feet:

A. Name and/or trademark of the pipe manufacturer.

B. Nominal pipe size.

C. Dimension ratio.

D. The letters PE followed by the polyethylene grade in accordance with ASTM D1248, followed by the hydrostatic design basis in 100's of psi, e.g., PE 3408.

E. Manufacturing standard reference, e.g., ASTM F714.

F. A production code from which the date and place of manufacture can be determined.

Mechanical joint adaptors will be used for connecting polyethylene pipe to other pipe material below ground unless otherwise noted on the drawings. MJ adapters shall be attached to pipe and fittings using butt fusion. MJ adaptors shall conform to the material requirements for HDPE for the work. MJ adaptors shall be Male pattern with a gasket and type 316 stainless steel stiffener ring.

Connection shall utilize a ductile iron transition fitting, lined and coated per the requirements for the work, and sized as required for the HDPE and the other pipe material. Materials of the mechanical joint glands and bolts shall meet the material requirements for this work.

MJ adapters shall be aligned and centered relative to the pipe. MJ adapters should be square with the transition fitting before tightening of bolts.

Bolts shall be tightened using a 'star tightening pattern' and manufacturer's recommendations. Twenty-four hours after first tightening the flange bolts, they must be re-tightened using the same 'star tightening pattern' used above. The final tightening torque shall be as indicated by the manufacturer. Bolts shall not be used to draw other components into alignment.

Transition fittings shall be restrained at connection to other pipe material.

Polyethylene transition adaptors will prevent Poisson effect pull out disjoining in the transition area. Provide protection per the manufacturer's recommendation by installing external joint restraints at unrestrained bell and spigot joints, or by installing an in-line anchor in the HDPE pipeline, or by a combination of both.

B.1.2.4 DRY BARREL FIRE HYDRANTS

Hydrants shall be American Darling or M&H, and shall conform to the AWWA C502 and shall in addition meet the specific requirements and exceptions which follow.

Hydrants shall be designed for a minimum 150 psi service. Hydrants shall be according to manufacturer's standard pattern and of standard size and shall be equipped with 6-inch bell connection, one 4 ½-inch steamer nozzle and two 2 ½-inch hose nozzles, National Standard Thread. Hydrant inlet connections shall have mechanical joints for 6-inch DIP.

Hydrant valve opening shall have an area at least equal to that of a 5 ¼-inch minimum diameter circle and be obstructed only by the valve rod. Each hydrant shall be able to deliver a minimum of 600 gpm through its two 2 ½-inch hose nozzles when opened together with a loss of not more than 2 psi in the hydrant.

Hydrant shall be of the full compression design opening with the water pressure and closing against the water pressure.

Hydrant must open turning operating nut to left (counterclockwise) and must be marked with an arrow and word 'open' to indicate the direction to turn stem to open hydrant.

All internal parts shall be designed for rapid and simple removal employing a compact lightweight wrench (10 pounds or less) that will withdraw all working parts from the base of the hydrant as a unit. Hydrant must be capable of being extended without removing any operating parts.

The main valve assembly shall have a bronze subseat and a bronze seat ring. The threaded bronze subseat of the hydrant shall be an integral part of the boot or elbow valve assembly. The seal between the set ring and seat shall consist of two O-rings located in machined grooves above and below the drainage channel. There shall be a minimum of two exterior drain ports, located 180 degrees apart.

Hydrant operating mechanism shall be housed in a compact seal plate with integral lubrication chamber. An O-ring seal shall be used on the hold down nut to prevent direct condensation or atmospheric contamination entering grease chamber from outside. Downward travel of main valve shall be controlled by a travel stop nut at the top of the hydrant. Hydrant operating mechanism shall be readily available for inspection without removing seal plant from barrel.

The design and construction of the hydrant operating mechanism located at the top of the hydrant shall be such that no part of the operating threads will be in contact with water in the standpipe when the hydrant is in service and O-ring seals shall be used to prevent water under pressure from entering the lubrication chamber. A bronze nut and check nut shall be provided to hold the main hydrant valve on its stem.

Hydrant shall be furnished with a steel chain holder, double steel hose cap chain, steel pumper cap chain, and any other hooks and/or appurtenances required for proper use. Each nozzle cap shall be provided with a Buna-N rubber washer.

All iron work to be set below ground, after being thoroughly cleaned, shall be painted with two coats of asphalt varnish specified in AWWA C502 and iron work to be left above ground shall be shop painted with two coats of red paint of quality to correspond to the present standard of the CITY.

Hydrants shall be hydrostatically tested as specified in AWWA C502.

B.1.2.5 RESILIENT WEDGE GATE VALVES

Approved manufacturers are: American-Darling Valve or M&H Valve.

A. Gate valve specifications:

1. All 4-inch through 12-inch valves in size shall be of the resilient wedge gate type. Valves shall be manufactured to meet all applicable requirements of AWWA C509 or AWWA C515 latest edition. Also UL and FM approved. All valves of this type shall be bubble tight at 200-psi water pressure.

2. Valves shall have non-rising stems open by turning counter clockwise (left) and with 2-inch square operating nut with arrow cast in metal to indicate direction of opening.

3. All buried valves will open counter-clockwise.

4. Internal and external epoxy coating of valve body, including bonnet, per AWWA C550.

5. Gate will be encapsulated with synthetic rubber. It will be bonded and vulcanized in accordance with ASTM B429 Method B.

6. Mechanical joint bell ends per AWWA C111.

7. Each valve shall have the manufacturer's name, pressure rating and year manufactured cast on the body. Prior to shipment from the factory, each valve shall be tested to a hydrostatic pressure of 350 psi.

B. Recommended Valve Placement:

1. In line valves shall be placed every 1,000 linear feet of pipe maximum or placed to isolate sections to keep customer outage to a maximum of 50 customers.

2. Valves shall be provided for each direction of pipe at each tee or cross. Valve placement may be field adjusted by CITY.

3. Valves shall be placed at each end of crossings on streets classified as major collectors, arterial, or roads with 5 or more through lanes.

4. A valve shall be placed at and restrained to the tee for every fire hydrant stub.

B.1.2.6 BUTTERFLY VALVES

Butterfly valves shall only be used on 16-inch water main or larger or where called for on the plans. Butterfly valves and operators will conform to AWWA C504, Class 150B. All buried valves will open counter-clockwise and be especially constructed for buried service. Valves will have a minimum 150 psi pressure rating or higher as noted on the Drawings or in the Specifications and be manufactured by DeZurik, Henry Pratt, Keystone or equal.

Valve seats will be full resilient seats retained in the body or on the disc edge in accordance with AWWA C504. When the resilient seat is attached to the disc, it will be fastened with a one- piece Type 316 stainless steel retaining ring, Type 316 stainless steel Nylock set screws and a mating Type 316 stainless steel ring will be installed in the valve body. Resilient seats will be Hycar or equal. Valve discs will be constructed of cast iron, ASTM A48, Class 40; Ni-resist, ASTM A126, Class B; or ductile iron, ASTM A536, Grade 65-45-12.

The valve body will be constructed of close grain cast iron per ASTM A126, Class B with integrally cast hubs for shaft bearing housings of the through boss-type. Permanently self-lubricating body bushings will be provided and will be sized to withstand bearing loads. Stuffing box of liberal dimensions will be provided at the operator end of the vane shaft.

Packing will be of the self compensating v-type. A sealing element utilizing O-rings will also be acceptable for up to and including 24-inch valves. Packing will be held in place by a bolted corrosion resistant retainer plate or gland; retainer clips are not acceptable.

The valve shaft will be of stainless steel and designed for both torsional and shearing stresses when the valve is operated under its greatest dynamic or seating torque. No reductions of shaft diameter will be allowed except at the operator connection. Any reduction will have a full radius fillet.

Butterfly valve actuator will conform to the requirements of AWWA C504. Gearing for the actuators where required will be totally enclosed in a gear case in accordance with AWWA C504. Actuators will have permanent indicators with raised or engraved marks to show position of the valve disc.

B.1.2.7 TAPPING SLEEVES AND VALVES

Tapping sleeves will be of cast iron, stainless steel, ductile iron, or steel with coated epoxy designated for working pressure not less than 200 psi. Armored end gaskets will be provided for the full area of the sleeve flanges. Sleeves will be as manufactured by A.P. Smith Division of U.S. Pipe; Mueller; Clow, JCM, Smith Blair, Ford, or equal. Nuts and bolts will be Type 304 stainless steel.

Tapping valves will conform to the requirements specified above for Resilient-Seated Gate Valves except that one end will be flanged and one mechanical. Tapping valves will be provided with an oversized opening to permit the use of full-size cutters.

B.1.2.8 VALVE BOXES

All buried gate and butterfly valves will be provided with valve boxes. Valve boxes will be as manufactured by Clow; Mueller; Tyler; Baileyor; or equal and will be a heavy-pattern cast iron, three-piece, telescoping type box with dome base suitable for installation on the buried valves. Inside diameter will be at least 4½ inches. Barrel length will be adapted to the depth of cover, with a lap of at least 6 inches when in the most extended position. Covers will be cast iron with integrally-cast direction-to-open arrow and 'WATER.'

Aluminum or plastic are not acceptable. The upper section of each box will have a top flange of sufficient bearing area to prevent settling. The bottom of the lower section will enclose the stuffing box and operating nut of the valve and will be oval.

B.1.2.9 SERVICE VALVES

All 1-inch or 2-inch water service taps shall be made horizontally to the water main and 1-inch or 2-inch ball valve with square operating nut shall be provided with a valve box.

Valves shall be bronze ball type with FIP inlet and outlet and 2-inch bronze operating nut. The approved models are Ford #B-11-77W and A.Y. McDonald #4134-135. No substitutes are allowed.

B.1.2.10 AIR RELEASE VALVES

Air release valves will be installed to release any small accumulation of air that may collect while pipe is in operation and under pressure.

The small orifice assembly air release valve will automatically release air accumulations from the pipe while under positive pressure. When the valve body fills with air, the float ball will fall to open the small orifice and exhaust the air to atmosphere. When the air has been exhausted, the float ball will be buoyed up and will tightly close the small orifice.

The small orifice assembly will be furnished with cast iron body and cover (ASTM A 126-B). The float ball will be constructed of stainless steel and attached to a stainless steel lever mechanism. A resilient, Buna-N seat will be attached to the lever mechanism for drop-tight closure.

Separate air release valves will be manufactured by APCO; Val-Matic, GA or equal.

B.1.2.11 CORPORATION STOPS AND CURB STOPS

All corporation stops and curb stops for service connections will have standard shop threads conforming to AWWA C800 on inlet end and with required compression joint or coupling for connection to HDPE tubing on the outlet end. Approved manufactures are A.Y. McDonald Mfg. Co., James Jones Corp, Ford, or equal.

B.1.2.12 SERVICE SADDLE & TAPS

PVC pipe with 1-inch taps shall have a service saddle with a double 2-inch wide stainless steel band or strap shall be furnished. The saddle shall be of cast or ductile iron and shall be epoxy, nylon, or PE coated (10 mils minimum). Approved styles are Ford F202 style or equal.

For 2-inch taps on PVC or DIP, a more stable saddle is required. Saddles for these taps shall have either two each stainless steel 2-inch straps or a stainless strap a minimum of 3¼ inches wide. The saddle body shall be cast or ductile iron and shall be coated with epoxy nylon or PE. Approved styles are Ford F202 style or equal.

B.1.2.13 WATER SERVICE PIPING

Service pipe will be HDPE tubing conforming to ASTM D2737 and AWWA C901 or soft, annealed seamless copper tubing conforming to ASTM B88, Type K. The name and trademark of the manufacturer will be stamped along the pipe. If water service lines are HDPE tubing they will be blue in color.

B.1.2.14 BACKFLOW PREVENTERS

Backflow preventers shall be required as detailed in City of Callaway Ordinance 452.

PART B.1.3 – EXECUTION

B.1.3.1 GENERAL

All streets and easements shall be cleared and graded to within 4 inches of the final grade prior to construction of the utility system.

Water mains and service piping shall have minimum of 3 feet of cover and no more than a maximum of 6 feet of cover unless otherwise specified.

Care will be taken in loading, transporting and unloading to prevent injury to the pipe or coatings. Pipe and fittings will not be dropped. All pipe and fittings will be examined before laying and no piece will be installed which is found to be defective. Damage to the pipe coatings will be repaired per manufacturer's recommendations.

If any defective pipe is discovered after it has been laid, it will be removed and replaced with a sound pipe in a satisfactory manner at no cost to the CITY. All pipe and fittings will be thoroughly cleaned before laying, will be kept clean until they are used in the work and when installed or laid, will conform to the lines and grades required.

Materials, if stored, will be kept safe from damage. The interior of all pipes, fittings and other appurtenances will be kept free from dirt or foreign matter at all times.

Pipe will not be stacked higher than the limits recommended by its manufacturer. The bottom tier will be kept off the ground on timbers, rails, or concrete. Stacking will conform to manufacturer's recommendations.

Gaskets for mechanical and push-on joints to be stored will be placed in a cool location out of direct sunlight. Gaskets will not come in contact with petroleum products. Gaskets will be used on a first-in, first-out basis.

B.1.3.2 RESTRAINED JOINTS

Sections of piping designated on the drawings as having restrained joints or those requiring restrained joints shall be constructed using pipe and fittings with restrained 'locked-type' joints and the joints shall be capable of holding with line pressures up to 150 pounds per square inch (psi).

The pipe and fittings shall be as shown for restrained push-on joints or restrained mechanical joints in Section V, in the latest edition of the Handbook of Ductile Iron Pipe, except that mechanical joint DIP retainer glands will be permitted only with the DESIGN ENGINEER's prior approval.

The minimum number of restrained joints required for resisting forces at fittings and changes in direction of pipe shall be determined from the length of restrained pipe on each side of fittings and changes in direction necessary to develop adequate resisting friction with the soil. The formula given in Section IX in the latest edition of Handbook of Ductile Iron Pipe shall be used to determine the minimum requirements.

Bolts and nuts for restrained joints shall be hot dipped galvanized, low alloy, high-strength steel. All-thread rods for restrained joints shall be Type 304 Stainless Steel.

B.1.3.3 PIPE MARKING

All pipelines 4 inches and greater will have identification marking tape. A polyethylene double-safe detectable marking tape will be installed continuously in the backfill along the entire length of all pipe lines for identification and detection purposes. All ductile iron pipelines marking tape will be nondetectable type, but will have all of the design features as specified herein.

The tape will be as manufactured by Thor Enterprises or equal. The polyethylene tape will meet the requirements of ASTM D 1248, Type I Class A, Grade E-1 for polyethylene plastics molding and extrusion materials. The tape will have a minimum tensile strength of 1750 psi, a minimum elongation of 250 percent, not less than 50 gauge solid aluminum core and a nominal thickness of 5 mils. The tape will be composed of 2 mil clear film reverse - printed laminated to aluminum, foil-laminated to 2 mil clear film and reverse-printed. Minimum total thickness 4 mils.

Minimum marking tape widths will be as follows:

Pipe Inside Diameter, Inches	Minimum Tape Width, Inches	No. of Tape strips
4 through 12	4	1
14-20	4	2

The marking tape will be placed in the trench backfill directly above and centered over the pipeline. The marking tape will be installed between 12 and 18 inches above the top of the pipe. The CONTRACTOR/DEVELOPER will exercise care to prevent damage to the polyethylene tape when placing the remaining backfill.

Where the pipeline passes through in a manhole, vault or other underground structure, the polyethylene marking tape will be placed on top of that portion of the pipeline, located inside the structure and will be secured to the pipeline.

Openings for air valves and similar appurtenances will be provided by making an X-shaped cut in the polyethylene and temporarily folding back the film. After the polyethylene is installed over the appurtenance, the slack will be taped securely to appurtenance.

The CONTRACTOR/DEVELOPER will deliver to the CITY 100 feet of the polyethylene marking tape of each color and each width size after construction is completed.

All nonmetallic water mains shall also be laid with a minimum 12-gauge solid copper insulated wire to provide for location by metallic pipe locators. Tracer wire is to be wrapped two times around each joint of pipe. When a splice is required on the tracer wire, a waterproof wirenut shall be used in accordance to manufacturer specifications.

B.1.3.4 DUCTILE IRON PIPE (DIP)

DIP and fittings will be installed in accordance with requirements of AWWA C600, except as otherwise specified herein. A firm, even bearing throughout the length of the pipe will be provided by digging bell holes at each joint and by tamping backfill materials at the side of the pipe to the springline per details shown on the drawings. Blocking will not be permitted.

All pipe will be sound and clean before laying. When laying is not in progress, open ends of the pipe will be closed by a watertight plug or other approved means. Sufficient backfill will be placed to prevent flotation. The deflection at joints will not exceed 75 percent of allowable deflection recommended by manufacturer.

Fittings, in addition to those shown on the drawings will be provided, where required, in crossing utilities which may be encountered upon opening the trench. Solid sleeve closures will be installed at locations approved by the ENGINEER.

The pipe interior will be maintained dry and broom clean throughout the construction period.

When cutting pipe is required, the cutting will be done by machine, leaving a smooth cut at right angles to the axis of the pipe. Cut ends of pipe to be used with a bell will be beveled to conform to the manufactured spigot end. Cement lining will be undamaged. Field cut ends will be sealed with an approved epoxy in accordance with manufacturer's instructions. Cutting of restrained joint pipe will not be allowed, unless approved at specific joints in conjunction with the use of restrainer glands by EBAA Iron or field adaptable restrained joints.

All blow-offs, outlets, valves, fittings, and other appurtenances required will be set and jointed as indicated on the drawings in accordance with the manufacturer's instructions.

All 1-inch taps on DIP shall be saddle taps or other approved tapping methods. Saddles or tapping sleeves shall be used on DIP taps that are 2 inches or greater.

Jointing Ductile-Iron Pipe:

Push-on joints will be made in strict accordance with manufacturer's instructions and AWWA C600. Pipe will be laid with bell ends looking ahead. A rubber gasket will be inserted in the groove of the bell end of the pipe. The joint surfaces will be cleaned and lubricated and the plain end of the pipe will be aligned with the bell of the pipe to which it is to be joined and pushed home.

Mechanical joints will be assembled in strict accordance with the manufacturer's instructions and AWWA C600. Pipe will be laid with bell ends looking ahead. To assemble the joints in the field, thoroughly clean and lubricate the joint surfaces and rubber gasket. Bolts will be tightened to the specified torques. Under no condition will extension wrenches or pipe over handle of ordinary ratchet wrench be used to secure greater leverage.

Bolts in mechanical or restrained joints will be tightened alternately and evenly. Restrained joints will be installed according to pipe manufacturer's instructions.

Fittings shown on the drawings are shown only as an assistance in illustrating a preferred means of installation in specific locations and are not intended to indicate all fittings necessary to effect the installation as shown in plans. The cost of all fittings shall be included in the bid price for furnishing and installing the pipe.

B.1.3.5 POLYVINYL CHLORIDE (PVC) PRESSURE PIPE

No single piece of pipe will be laid unless it is straight. The centerline of the pipe will not deviate from a straight line drawn between the centers of the openings at the ends of the pipe by more than 1/16-inch per foot of length. If a piece of pipe fails to meet this requirement check for straightness, it will be rejected and removed from the site. PVC pipe and fittings will be installed in accordance with requirements of the manufacturer, ASTM D2321, and AWWA C605.

As soon as the excavation is complete to normal grade of the bottom of the trench, bedding will be placed, compacted and graded to provide firm, uniform and continuous support for the pipe. Bell holes will be excavated so that only the barrel of the pipe bears upon the bedding. The pipe will be laid accurately to the lines and grades indicated on the Drawings. Blocking under the pipe will not be permitted. Bedding will be placed evenly on each side of the pipe to mid-diameter and hand tools will be used to force the bedding under the haunches of the pipe and into the bell holes to give firm continuous support for the pipe.

Bedding will then be placed to 12 inches above the top of the pipe. The backfill above the bedding will be placed in 1-foot layers and carefully compacted. Generally the compaction will be done evenly on each side of the pipe and compaction equipment will not be operated directly over the pipe until sufficient backfill has been placed to ensure that such compaction equipment will not have a damaging effect on the pipe. Equipment used in compacting will be approved by the pipe manufacturer's representative prior to use.

When cutting pipe is required, the cutting will be done by machine, leaving a smooth cut at right angles to the axis of the pipe. Cut ends of pipe to be used with a bell will be beveled to conform to the manufactured spigot end.

Precautions will be taken to prevent flotation of the pipe in the trench.

Jointing Polyvinyl Chloride (PVC) Pressure Pipe:

Joints will be made in strict accordance with the manufacturer's instructions. Pipe will be laid with bell ends looking ahead. A rubber gasket will be inserted in the groove of the bell end of the pipe and the joint surfaces cleaned and lubricated. The plain end of the pipe to be entered will then be inserted in alignment with the bell of the pipe to which it is to be joined and pushed home with a come-along or by other means. Check that the reference mark on the spigot end is flush with the end of the bell.

Mechanical joints at valves, fittings and where designated will be in accordance with the AWWA C111 and the instructions of the manufacturer. Suitable PVC to cast iron adaptors will be installed prior to installing fittings. PVC beveled spigot will be cut flush prior to insertion in mechanical joint pipe. To assemble the joints in the field, thoroughly clean the joint surfaces and rubber gasket with soapy water before tightening the bolts. Bolts will be tight to the specified torques. Under no condition will extension wrenches or pipe over handle of ordinary ratchet wrench be used to secure greater leverage.

B.1.3.6 HIGH DENSITY POLYETHYLENE (HDPE) PIPE

All pipe or fittings will be examined before laying and no piece will be installed which is found to be defective. The maximum allowable depth of cuts, scratches or gouges on the exterior of the pipe is 10 percent of wall thickness. The interior pipe surface will be free of cuts, gouges or scratches. Any damage to the pipe will be repaired as directed by the ENGINEER. Blocking under the pipe will not be permitted.

When cutting pipe is required, the cutting will be done by machine, leaving a smooth cut at right angles to the axis of the pipe.

The pipe will be joined by the method of thermal butt fusion, as outlined in ASTM D2657. All joints will be made in strict compliance with the manufacturer's recommendations by a factory qualified joining technician as designated by the pipe manufacturer with a minimum of three years experience with the fusion equipment to be used.

Fittings will be connected to HDPE pipe in accordance with manufacturer's recommendations.

Pipe may be cold (field) bent to a minimum radius of 1.5 times the manufacturer's recommendation. Temporary restraints may be required to maintain the bend while placing the pipe in the trench and placing initial backfill.

Temporary blocks or restraints must be removed before installing final backfill, and any voids must be filled with compacted initial backfill material. All HDPE pipe must be at the temperature of the surrounding soil at the time of backfilling and compaction.

B.1.3.7 DRY BARREL FIRE HYDRANTS

Hydrants shall be installed with uppermost breakaway joint at ground level or at no more than 2 inches above ground level. The Storz connection shall face the nearest access roadway and shall be a minimum of 18 inches above grade. There shall not be any scallop or mound around the hydrant at finished grade.

Hydrant shall be provided with extension kit where necessary to adjust level of breakaway joint.

Connection between hydrant and main shall be straight DIP except as approved by ENGINEER. All joints shall be restrained from the main to the hydrant. Backfill around hydrant shall be compacted to 100% of maximum density as determined by ASTM D698 (Standard Proctor Density). Density testing shall meet the same requirements as backfill under roadway pavement.

B.1.3.8 VALVES

All valves shall be restrained to fittings. All valves and fittings shall be set and jointed to the pipe in the proper locations as specified on the Plan.

B.1.3.9 TAPPING SLEEVES AND VALVES

All tapping valves and sleeves shall be hydrostatically tested prior to the installation of the tap. Tap shall be installed horizontal to the water main. Proper equipment to install the tap shall be on-site prior to starting the tap. The CONTRACTOR/DEVELOPER shall coordinate with the CITY Inspector regarding connection to the existing CITY water system with a minimum of 48 hours notification prior to tie-in. The CITY reserves the right to delay the tap if, in the CITY's opinion, the proper equipment is not on-site. No hand powered tapping is allowed for taps larger than 2 inches.

B.1.3.10 SERVICE VALVES

Valves shall be installed per manufacturer's recommendations and according to the plans and specifications.

B.1.3.11 AIR RELEASE VALVES

Air release valves for use in water mains shall be installed as shown on the plans and specifications. The valves shall be constructed in accordance to the drawing labeled 'air release assembly.'

B.1.3.12 SERVICE SADDLE & TAPS

All service taps shall be installed to manufacturer's recommended procedures. All 1-inch taps will be located at 2:00 or 10:00 on the circumference of the pipe. All 2-inch taps will be located at 3:00 or 9:00 on the circumference of the pipe. All 1-inch taps on DIP shall be saddle taps. All other materials will be tapped with a saddle. Teflon tape for sealing and lubricating will be used on the threads of all corporation stops. All taps shall be made under pressure.

B.1.3.13 WATER SERVICE PIPING

Torque on corporation stops will not exceed manufacturer's recommendations. Allowance for any possible movement in the main will be made by making a half loop in the service piping at the tap and compacting backfill to 100 percent standard proctor ASTM D698 under this loop.

B.1.3.14 WATER METER MANIFOLD

Any manifold greater than 2 inches shall be installed by the CONTRACTOR/DEVELOPER. There shall be a maximum of ten ⅝-inch meters per manifold for ¾-inch services on 2-inch service lines. All water meters must be located in green space (i.e., not under pavement, etc.) and must be located at least 5 feet from all building foundations.

B.1.3.15 PRESSURE TESTS OF WATER DISTRIBUTION PIPING

After installation, the pipe will be tested for compliance as specified herein. Furnish all necessary equipment and labor for the pressure test on pipelines. Submit detailed test procedures and method for ENGINEER's review. In general, testing will be conducted in accordance with AWWA C600. The CONTRACTOR/DEVELOPER must submit his plan for testing to the ENGINEER for review at least 10 days before starting the test.

Pressure pipelines will be subjected to a hydrostatic pressure of 150 psig. This test pressure will be maintained for a minimum of 2 hours. The amount of leakage that will be permitted will be in accordance with the following formula:

$$L = \frac{N(D)\sqrt{P}}{7400}$$

Where: L = allowable leakage rate (gallons per hour)

N = number of joints tested

P = test pressure (psi)

D = nominal pipe diameter (inches)

The CITY will provide a source of supply from the existing treated water distribution system for CONTRACTOR/DEVELOPER's use in filling the lines. An air break will be maintained at all times between the CITY's distribution system and the CONTRACTOR/DEVELOPER's equipment to prevent cross-connection. The line will be slowly filled with water and the specified test pressure will be maintained in the pipe for the entire test period by means of a pump furnished by the CONTRACTOR/DEVELOPER. Provide accurate means for measuring the quantity of water required to maintain this pressure. The amount of water required is a measure of the leakage.

CONTRACTOR/DEVELOPER is responsible for all water cost associated with testing, flushing, and disinfection. Water required by CONTRACTOR/DEVELOPER will be provided at standard billing rates for the volume required.

B.1.3.16 DISINFECTING POTABLE WATER PIPELINES

Before being placed in service and prior to hydrostatic testing, all new water pipelines will be chlorinated in accordance with AWWA C651. The CONTRACTOR/DEVELOPER must submit his plan for testing to the ENGINEER for review at least 10 days before starting the test.

The location of the chlorination and sampling points will be determined by the ENGINEER in the field. Taps for chlorination and sampling will be installed by the CONTRACTOR/DEVELOPER. Uncover and backfill the taps as required.

The general procedure for chlorination will be first to flush all dirty or discolored water from the lines and then introduce chlorine in approved dosages through a tap at one end, while water is being withdrawn at the other end of the line. The chlorine solution will remain in the pipeline for about 24 hours.

Discharge of chlorinated water will comply with all Federal, State, and Local standards. Provide sodium biosulfite for dechlorination prior to discharging.

Following the chlorination period, all treated water will be flushed from the lines at their extremities and replaced with water from the distribution system. All treated water flushed from the lines will be disposed by discharging to the nearest sanitary sewer or other approved means. No discharge to any storm sewer or natural water courses will be allowed. Bacteriological sampling and analysis of the replacement water may then be made by the ENGINEER in full accordance with AWWA C651. Rechlorination will be required, if necessary and the line will not be placed in service until the requirements of the Florida Department of Environmental Projection are met.

SECTION B.2

SANITARY SEWERS

PART B.2.1 – GENERAL

B.2.1.1 SCOPE OF WORK

The CONTRACTOR/DEVELOPER shall furnish, install and test gravity sewer lines, laterals, and appurtenances as shown on the drawings and as required by these Specifications.

PVC pipe or DIP may be used for gravity sewer lines up to a depth of 15 feet. The maximum depth of any gravity sewer shall be 15 feet from top of pipe.

For depths greater than 20 feet, material shall be specifically indicated on the drawings.

Minimum sewer main shall be 8 inches in diameter. In the event of conflict, DIP shall be used for a distance of 10 feet either side of the center of conflict.

PART B.2.2 – PRODUCTS

B.2.2.1 DUCTILE IRON PIPE (DIP) AND FITTINGS

Each length of DIP supplied for the project will be hydrostatically tested at the point of manufacture to 500 psi for duration of 10 seconds per AWWA C151. Testing may be performed prior to machining bell and spigot. Failure of DIP will be defined as any rupture of the pipe wall. Certified test results will be furnished in duplicate to the ENGINEER prior to time of shipment.

All ductile-iron pipe and fittings to be installed under this project will be inspected and tested at the foundry as required by the standard specifications to which the material is manufactured. Furnish in duplicate to the ENGINEER sworn certificates of such tests and their results prior to the shipment of the pipe.

All pipe and fittings will be permanently marked with the following information:

A. Manufacturer, date.

B. Size, type, class, or wall thickness.

C. Standard produced to (AWWA, ASTM, etc).

DIP will conform to AWWA C151 or/and ASTM A193. Pipe will be supplied in standard lengths as much as possible. Thickness design will be per AWWA C150, utilizing Class 350 for piping 12 inches and smaller. For pipe 14 inches and above, Class 250 may be used except where Class 350 is specified on the plans.

DIP will be by U.S. Pipe and Foundry Company, Inc.; American Cast Iron Pipe Company; pipe divisions of McWane, Inc., or approved equal.

DIP will have rubber-gasket push-on joint or rubber-gasket mechanical joint. Rubber-gasket joints will conform to AWWA C111. Gasket will be of SBR

Pipe fittings will be ductile iron with pressure rating of 350 psi for 24 inches and smaller piping and 250 psi for 30 inches and larger piping. Fittings will meet the requirements of AWWA C110 or AWWA C153 as applicable. Fittings will have the same pressure rating, as a minimum, of the connecting pipe. Fittings will be manufactured by the same manufacture of the pipe.

Lining for Inside of All Ductile Iron Pipe (DIP) & Fittings:

DIP and fittings shall be lined with a ceramic-filled amine-cured epoxy, Protecto 401 by Indurall or approved equal. The lining thickness shall be 40 mils minimum. Application shall be performed by an applicator approved by the coating manufacturer, in accordance with manufacturer's instructions and under controlled conditions at the applicator's shop or the pipe manufacturer's plant. Applicator shall submit a certified affidavit of compliance with manufacturer's instructions and requirements specified herein.

B.2.2.2 POLYVINYL CHLORIDE (PVC) PIPE

All PVC gravity main and fittings will be from a single manufacturer.

PVC solid wall gravity pipe and fittings shall be Type PSM, PVC SDR 35 with full diameter dimensions and shall conform to ASTM D3034 or ASTM F1760, for sizes 4 through 15 inches and shall conform to ASTM F679 for sizes 18 through 27-in. Straight pipe shall be furnished in lengths according to ASTM D3034 and wyes shall be furnished in lengths of not more than 3 feet. Saddle wyes will not be allowed.

Each pipe length will be marked with the manufacturer's name or trademark, size, material code, and pressure class.

PVC pipe and fittings shall have bell and spigot push-on joints. The bell shall consist of an integral wall section with a solid cross-section elastomeric gasket securely locked in place to prevent displacement during assembly. Installation of elastomeric gasketed joints and performance of the joint shall conform to ASTM F477, ASTM D3139 or ASTM D3212.

All fittings and accessories for gravity sewer lines will have bell and/or spigot configurations compatible with the pipe.

Sewer lines will be green in color.

B.2.2.3 PRE-CAST CONCRETE MANHOLES

A. All material shall be new and unused.

Materials will be examined for compliance with ASTM standards and approved manufacturer's drawings. Additional inspection criteria shall include: appearance, dimensions(s), blisters, cracks and soundness.

Reference to a manufacturer's name and model or catalog number is for the purpose of establishing the standard of quality and general configuration desired. Like items of materials/equipment shall be the end products of one manufacturer in order to provide standardization for appearance, operation, maintenance, spare parts and manufacturer's service. Provide lifting lugs or holes in each precast section for proper handling.

Cement shall conform to ASTM C150, Type II cement or equal. Precast concrete sections shall be properly cured prior to shipping. Precast concrete sections shall not be shipped before concrete has attained 3,000 psi compressive strength.

Mark date of manufacture, name and trademark of manufacturer on the inside of each precast section.

Precast concrete base sections, riser sections, transition top sections, flat slab tops and grade rings shall conform to ASTM C478.

Design precast concrete base and flat slab top for their own weight, weight of soil at 130 pcf, and a live load equal to AASHTO H-20 truck 300 psf loading applied at finished grade.

Bottom slab thickness shall be no less than the riser wall thickness. Construct precast concrete bases as shown on the Drawings. Base, riser and transition top sections shall have tongue and groove joints.

Top section shall be eccentric cone where cover over pipe exceeds 4 feet. Top section shall be a flat slab where cover over top of pipe is 4 feet or less. Top section shall be a plastic lined flat slab where manhole riser sections are to be plastic lined.

Provide integrally cast knock-out panels in precast concrete manhole sections at locations, and with sizes shown on Drawings. Knock-out panels shall have no steel reinforcing.

B. Pipe Connecting Systems:

Connect pipe to manholes using one of the following methods:

1. Grout in place - Precast element shall have a formed, tapered circular opening larger than the pipe outside diameter. Grout shall be non-shrink, waterproof grout. Plastic pipe shall have a waterstop gasket secured to pipe with a stainless steel clamp.

2. Flexible sleeve - Integrally cast sleeve in precast element or install sleeve in a formed or cored opening. Pipe shall be fastened in sleeve with stainless steel clamp(s). Coat stainless steel clamp(s) with bituminous material to protect from corrosion. Flexible sleeve shall be Lock Joint Flexible Manhole Sleeve; Kor-N-Seal connector; PSX Press-Seal Gasket or equal.

3. Compression gasket - Integrally cast compression gasket in precast element. Compression gasket shall be A-Lok or equal.

C. Brick Masonry:

Bricks shall be sound, hard, uniformly burned, regular and uniform in shape and size. Underburned or salmon brick shall not be acceptable. Only whole brick shall be used.

Bricks for channels and shelves shall conform to ASTM C32, Grade SS except that the mean of five tests for absorption shall not exceed 8 percent and no individual brick exceed 11 percent.

Bricks for raising manhole frames to finished grade shall conform to ASTM C62.

Mortar shall be composed of 1 part Portland cement, 2 parts sand, and hydrated lime not to exceed 10-pounds to each bag of cement. Portland cement shall be ASTM C150, Type II; hydrated lime shall conform to ASTM C207.

Sand shall be washed, cleaned, screened, well graded with all particles passing a No. 4 sieve and conform to ASTM C33.

D. Manhole Frame and Covers:

Manhole frames and covers shall be of good quality, strong, tough, even grained cast iron, smooth, free from scale, lumps, blisters, sand holes and defects of any kind which render them unfit for the service for which they are intended. Manhole covers and frame seats shall be machined to a true surface. Castings shall be thoroughly cleaned and subject to hammer inspection. Cast iron shall conform to ASTM A48, Class 30 as a minimum.

Manhole covers shall have a diamond pattern, pickholes and the word 'SEWER' cast in 3-inch letters. Manhole frames and covers shall be suitable for highway traffic, including H20 wheel loads.

E. Manhole Rungs:

Manhole rungs shall conform to ASTM C478 and shall be either of the following types:

Cast aluminum alloy 6061-T6, drop front design, 12 inches wide with an abrasive step surface.

Manhole rungs shall be steel reinforced, copolymer polypropylene, 14 inches wide, M.A. Industries Inc., PF Series or equal. Copolymer polypropylene shall conform to ASTM D4101 Classification PP0344 B33534 Z02. Steel reinforcing shall be 1/2-inch diameter, conforming to ASTM A615, Grade 60 and shall be continuous throughout rung.

F. Jointing Precast Sections:

Seal tongue and groove joints of precast sections with either rubber O-ring gasket or preformed flexible joint sealant. O-ring rubber gaskets shall conform to ASTM C443. Preformed flexible joint sealant shall conform to ASTM C990 and shall be Kent Seal No. 2 by Hamilton-Kent; Ram-Nek by K.T. Snyder Company or equal.

Completed joint shall withstand 15 psi internal water pressure without leakage or displacement of gasket or sealant.

G. Pipe for Drop Manholes:

A drop pipe will be provided for sewer entering a manhole at an elevation of 24 inches or more above the manhole invert. Pipe, tees and bends for use in constructing drop connections to manholes shall be as specified in applicable paragraphs of this Specification.

No drop connection shall be installed in the interior of the manhole unless specifically approved by the CITY. The entire drop connection shall be encased in concrete, per detail.

PART B.2.3 – EXECUTION

B.2.3.1 GENERAL

All streets and easements shall be cleared and graded to within 4 inches of the final grade prior to construction of the utility system.

Care will be taken in loading, transporting and unloading to prevent injury to the pipe or coatings. Pipe and fittings will not be dropped. All pipe and fittings will be examined before laying and no piece will be installed which is found to be defective. Damage to the pipe coatings will be repaired per manufacturer's recommendations.

If any defective pipe is discovered after it has been laid, it will be removed and replaced with a sound pipe in a satisfactory manner at no cost to the CITY. All pipe and fittings will be thoroughly cleaned before laying, will be kept clean until they are used in the work and when installed or laid, will conform to the lines and grades required.

Materials, if stored, will be kept safe from damage. The interior of all pipes, fittings and other appurtenances will be kept free from dirt or foreign matter at all times.

Pipe will not be stacked higher than the limits recommended by its manufacturer. The bottom tier will be kept off the ground on timbers, rails, or concrete. Stacking will conform to manufacturer's recommendations.

Gaskets for mechanical and push-on joints to be stored will be placed in a cool location out of direct sunlight. Gaskets will not come in contact with petroleum products. Gaskets will be used on a first-in, first-out basis.

The method of pipe laying shall be subject to the approval of the ENGINEER. Any gravity main greater than 50 feet in length must be installed using a laser system designed for pipeline installation. The laser shall be capable of an accuracy of +/- 0.05%. Extreme care shall be taken to keep the pipe in exact alignment and elevation. Pipe shall be laid to conform accurately to the lines and grades indicated on the drawings.

No pipe tangent slope shall be less than the minimum slope outlined in the Design Specifications for the CITY of Callaway.

It shall be the CONTRACTOR/DEVELOPER's responsibility to locate all underground utilities in advance of construction, to insure that no conflicts occur with the proposed line and grade. If approved by the ENGINEER, minor changes in the alignment but not the grade will be permitted to avoid underground facilities, provided that straight alignment can be maintained between manholes. However, if a conflict is found between an existing utility and proposed grade, the CONTRACTOR/DEVELOPER is to furnish the Design ENGINEER all pertinent information, so that remedial design can be performed.

Manhole invert elevations shall not deviate more than 0.20 feet from design elevations; manhole top elevations no more than ¼ inch from finished roadway elevation or design elevations if outside of roadway. Centerline of manhole ring and cover shall not deviate more than 18 inches from designed horizontal location.

Surveys and grade stakes:

The CONTRACTOR/DEVELOPER shall be responsible for setting all grade stakes, lines, and levels. The CITY will provide property survey on the construction plans and will establish a benchmark.

A land surveyor registered to practice in the State of Florida shall set all grades and alignment stakes for construction under this project and all costs thereof shall be borne by the CONTRACTOR/DEVELOPER. The requirements for this work to be accomplished by a registered land surveyor may be waived by the ENGINEER in the event the CONTRACTOR/DEVELOPER desires to utilize his own personnel and furnish, in writing to the ENGINEER, satisfactory evidence that his personnel are qualified to set the grade and alignment stakes. The CONTRACTOR/DEVELOPER shall assume all responsibility for the correctness of the grade and alignment stakes. Grade shall be verified at each manhole prior to the installation of additional pipe from that manhole. If a break in grade is detected the CITY shall be notified immediately.

Dimensions of encasement or of cradles shall conform to those shown on the drawings. Each pipe shall be supported on brick at two points to allow minimum thickness of concrete to be placed under pipe. Concrete shall be placed carefully around and over pipe to avoid displacement or floating of pipe. Trench shall be dewatered properly before placing of concrete. Backfill shall not be placed over a concrete cradle or arch until 24 hours after pouring unless authorized by the ENGINEER.

In all cases where sewer mains cross water mains or storm drains with minimum clear distance between top of sewer and bottom of water main or storm drain of less than 18 inches, sewer shall be DIP or 6-inch thick concrete encased PVC ASTM D3034 for a distance of 10 feet to either side of point of crossing. There will be no sewer joint within 10 feet of the water line or storm drain.

All trenches and excavations are to be kept dry and free from water at all times when work is in progress, and at no time is water to run through the sewer or its bedding material.

Existing manholes are to be kept uncovered and accessible at all times. (No stockpiling of materials, debris or equipment on top of the manholes).

Manholes located within an unimproved easement shall be installed with the cast frame and covers a minimum of 18 inches above final finish grade. Manholes located within a landscaped easement shall be installed with the cast frame and cover at finished grade unless otherwise noted on plans. Manholes located within an unpaved roadway shall be installed with the cast frame and cover 12 inches below finished grade.

B.2.3.2 PIPE MARKING

All pipelines 4 inches and greater will have identification marking tape. A polyethylene double-safe detectable marking tape will be installed continuously in the backfill along the entire length of all pipe lines for identification and detection purposes. All ductile iron pipeline marking tape will be nondetectable type, but will have all of the design features as specified herein.

The tape will be as manufactured by Thor Enterprises or equal.

The polyethylene tape will meet the requirements of ASTM D 1248, Type I Class A, Grade E-1 for polyethylene plastics molding and extrusion materials.

The tape will have a minimum tensile strength of 1750 psi, a minimum elongation of 250 percent, not less than 50 gauge solid aluminum core and a nominal thickness of 5 mils.

The tape will be composed of 2 mil clear film reverse - printed laminated to aluminum, foil-laminated to 2 mil clear film and reverse-printed. Minimum total thickness 4 mils.

Minimum marking tape widths will be as follows:

Pipe Inside Diameter, Inches	Minimum Tape Width, Inches	No. of Tape strips
4 through 12	4	1
14 through 20	4	2

The marking tape will be placed in the trench backfill directly above and centered over the pipeline. The marking tape will be installed between 12 and 18 inches above the top of the pipe. The CONTRACTOR/DEVELOPER will exercise care to prevent damage to the polyethylene tape when placing the remaining backfill.

Where the pipeline passes through in a manhole, vault or other underground structure, the polyethylene marking tape will be placed on top of that portion of the pipeline, located inside the structure and will be secured to the pipeline with vinyl adhesive tape.

Openings for air valves and similar appurtenances will be provided by making an X-shaped cut in the polyethylene and temporarily folding back the film. After the polyethylene is installed over the appurtenance, the slack will be taped securely to appurtenance and the cut in the polyethylene will be repaired with adhesive tape.

The CONTRACTOR/DEVELOPER will deliver to the CITY 100 feet of the polyethylene marking tape of each color and each width size after construction is completed.

All nonmetallic mains shall also be laid with a minimum 12-gauge solid copper insulated wire to provide for location by metallic pipe locators. Tracer wire is to be wrapped two times around each joint of pipe. When a splice is required on the tracer wire, a waterproof wirenut shall be used in accordance to manufacturer specifications.

B.2.3.3 DUCTILE IRON PIPE (DIP)

DIP and fittings will be installed in accordance with requirements of AWWA C600, except as otherwise specified herein. A firm, even bearing throughout the length of the pipe will be provided by digging bell holes at each joint and by tamping backfill materials at the side of the pipe to the springline per details shown on the drawings. Blocking will not be permitted.

All pipe will be sound and clean before laying. When laying is not in progress, open ends of the pipe will be closed by a watertight plug or other approved means. Sufficient backfill will be placed to prevent flotation.

The pipe interior will be maintained dry and broom clean throughout the construction period.

When cutting pipe is required, the cutting will be done by machine, leaving a smooth cut at right angles to the axis of the pipe. Cut ends of pipe to be used with a bell will be beveled to conform to the manufactured spigot end. Protecto 401 lining will be undamaged. Field cut ends will be sealed with an approved epoxy in accordance with manufacturer's instructions.

Jointing Ductile-Iron Pipe:

Push-on joints will be made in strict accordance with manufacturer's instructions and AWWA C600. Pipe will be laid with bell ends looking ahead. A rubber gasket will be inserted in the groove of the bell end of the pipe. The joint surfaces will be cleaned and lubricated and the plain end of the pipe will be aligned with the bell of the pipe to which it is to be joined and pushed home.

Mechanical joints will be assembled in strict accordance with the manufacturer's instructions and AWWA C600. Pipe will be laid with bell ends looking ahead. To assemble the joints in the field, thoroughly clean and lubricate the joint surfaces and rubber gasket. Bolts will be tightened to the specified torques. Under no condition will extension wrenches or pipe over handle of ordinary ratchet wrench be used to secure greater leverage.

Fittings shown on the drawings is shown only as an assistance in illustrating a preferred means of installation in specific locations and is not intended to indicate all fittings necessary to effect the installation as shown in plans. The cost of all fittings shall be included in the bid price for furnishing and installing the pipe.

B.2.3.4 POLYVINYL CHLORIDE (PVC) GRAVITY PIPE

No single piece of pipe shall be laid unless it is straight. The centerline of the pipe shall not deviate from a straight line drawn between the centers of the openings at the ends of the pipe by more than 1/16-inch per foot of length. If a piece of pipe fails to meet this requirement check for straightness, it shall be rejected and removed from the site. Laying instructions of the manufacturer shall be explicitly followed.

As soon as the excavation is complete to normal grade of the bottom of the trench, bedding shall be placed, compacted and graded to provide firm, uniform and continuous support for the pipe. Bell holes shall be excavated so that only the barrel of the pipe bears upon the bedding. The pipe shall be laid accurately to the lines and grades indicated on the Drawings. Blocking under the pipe will not be permitted. Bedding shall be placed evenly on each side of the pipe to mid-diameter and hand tools shall be used to force the bedding under the haunches of the pipe and into the bell holes to give firm continuous support for the pipe.

Bedding will then be placed to 12 inches above the top of the pipe. The backfill above the bedding will be placed in 1-foot layers and carefully compacted. Generally the compaction will be done evenly on each side of the pipe and compaction equipment will not be operated directly over the pipe until sufficient backfill has been placed to ensure that such compaction equipment will not have a damaging effect on the pipe. Equipment used in compacting will be approved by the pipe manufacturer's representative prior to use.

When cutting pipe is required, the cutting shall be done by machine, leaving a smooth cut at right angles to the axis of the pipe. Cut ends of pipe to be used with a bell shall be beveled to conform to the manufactured spigot end.

The ENGINEER may examine each bell and spigot end to determine whether any preformed joint has been damaged prior to installation. Any pipe having defective joint surfaces shall be rejected, marked as such and immediately removed from the job site.

Each length of the pipe shall have the assembly mark aligned with the pipe previously laid and held securely until enough backfill has been placed to hold the pipe in place. Joints shall not be 'pulled' or 'cramped.'

Before any joint is made, the pipe shall be checked to assure that a close joint with the next adjoining pipe has been maintained and that the inverts are matched and conform to the required grade. The pipe shall not be driven down to grade by striking it.

Precautions shall be taken to prevent flotation of the pipe in the trench.

When moveable trench bracing such as trench boxes, moveable sheeting, shoring or plates are used to support the sides of the trench, care shall be taken in placing and moving the boxes or supporting bracing to prevent movement of the pipe, or disturbance of the pipe bedding and the backfill. Trench boxes, moveable sheeting, shoring or plates shall not be allowed to extend below top of the pipe.

If trench boxes, moveable sheeting, shoring or plates have been installed below the top of the pipe, they shall be moved slowly taking care not to disturb pipe, bedding or backfill. As trench boxes, moveable sheeting, shoring or plates are moved, pipe bedding shall be placed to fill any voids created and the backfill shall be recompacted to provide uniform side support for the pipe.

Jointing Polyvinyl Chloride (PVC) Gravity Pipe:

Joints shall be made in strict accordance with the manufacturer's instructions. Pipe shall be laid with bell ends looking ahead. A rubber gasket shall be inserted in the groove of the bell end of the pipe and the joint surfaces cleaned and lubricated. The plain end of the pipe to be entered shall then be inserted in alignment with the bell of the pipe to which it is to be joined and pushed home with a come-along or by other means. Check that the reference mark on the spigot end is flush with the end of the bell.

PVC sewer pipe and fittings shall be jointed in accordance with the recommendations of the latest ASTM Standards and detailed instructions of the manufacturer.

All manhole connections shall be as shown on the Drawings except that concrete and mortared connections shall be equipped with an integral O-ring or other sealant such that a positive watertight seal is established.

All fittings shall be furnished by the same manufacturer that furnishes the pipe.

Wye branches shall be furnished and installed and capped as shown on the Drawings or in locations directed by the ENGINEER. Each wye branch shall be provided with a PVC end cap and shall be backed with a piece of wood (2 inches by 4 inches) that extends to a point 3 feet below the finished ground surface.

PVC manhole drops shall be installed as shown on the Drawings. Concrete for encasements shall be 3,000 psi as specified. No backfill shall be placed over this concrete within 16 hours of placing.

Pipe stubs for manhole connections shall not exceed 3.25 feet in length unless directed otherwise by the ENGINEER. Install caps where required.

B.2.3.5 MANHOLE INSTALLATION

Manholes shall be constructed to the dimensions shown on the Drawings and as specified herein. Protect all work against flooding and flotation.

Place base on a bed of 12-inch screened gravel. Set base grade so that a maximum grade adjustment of 8 inches is required to bring the structure to final grade.

Use precast concrete grade rings or brick and mortar to adjust manhole frame and cover to final grade.

Set precast concrete sections plumb with a 1/4-inch maximum out of plumb tolerance allowed. Seal joints of precast sections with either a rubber O-ring set in a recess or preformed flexible joint sealant in sufficient quantity to fill 75 percent of the joint cavity. Fill the outside and inside joint with non-shrink mortar and finish flush with the adjoining surfaces.

Caulk the inside of any leaking joints with lead wool or non-shrink grout to the satisfaction of the ENGINEER. Allow joints to set for 24 hours before backfilling, unless a shorter period is specifically approved by the ENGINEER.

Plug holes in the concrete sections required for handling with a non-shrink grout or non-shrink grout in combination with concrete plugs. Finish flush on the inside. Cut holes in precast sections to accommodate pipes prior to setting precast sections in place to prevent jarring that may loosen the mortar joints. Backfill carefully and evenly around manholes.

Construct pipe connections, including pipe stubs, as specified above. Close or seal pipe stubs for future connections with a gasketed watertight plug.

Grout aluminum manhole rungs into precast sections, on 12-inch centers. Preformed holes in precast sections for rungs during casting. Holes for rungs shall be 1-1/8 inches in diameter and a minimum of 3 ½ inches deep. Grout rungs into precast sections immediately after casting and placing in the curing area, or immediately after coring holes for rungs into base section. Fill holes with grout consisting of Type II cement and mortar sand in a 1 to 1/2 ratio mixed to a putty consistency. Paint those parts of the rungs which are embedded with a heavy coating of zinc chromate or other approved paint.

Preformed holes for steel reinforced polypropylene manholes plastic rungs during casting of the riser and cone sections, using tapered form pins specifically made for preforming rung holes. Drive rungs into preformed holes after concrete has developed a compressive strength of 3,000 psi. Alternatively, cast rungs into precast sections when concrete is placed.

Drilling holes for rungs may be used to accommodate field conditions when approved by the ENGINEER. Drill holes of diameter, spacing and depth required by rung manufacturer.

All rung installation methods shall withstand a pull-out resistance test of 1,500 pounds.

Install only steel reinforced polypropylene plastic rungs in plastic lined precast elements. Seal the joint between the copolymer polypropylene and the PVC plastic with MC-100 Mono-Caulk by Grove International, San Marcos, CA (619-591-0025 or 345-4815) or equal. Note that copolymer polypropylene and PVC cannot be thermally welded due to different melting temperatures. Install only plastic lined, flat slab tops on plastic lined manholes.

Mix mortar only in such quantity as may be required for immediate use. Use mortar before initial set has taken place. Mortar shall be used within 1-1/2 hours and shall be constantly worked with hoe or shovel until used. Anti-freeze mixtures shall not be included in the mortar. Install masonry when the outside temperature is above 40 degrees F unless provisions are made to protect the mortar, bricks and finished work from frost by heating and enclosing the work with tarpaulins or other suitable material. ENGINEER's decision regarding the adequacy of protection against freezing shall be final.

Construct channels and shelves of brick and concrete as shown on the Drawings. Brick lined channels shall correspond in shape with the lower half of the pipe. Set shelf elevation at crown of highest pipe and slope 1-in/ft to drain toward the flow through channel. Construct brick surfaces exposed to sewage flow with nominal 2 inches by 8 inches face exposed (i.e., bricks on edge).

Set manhole covers and frames in a full mortar bed. Utilize bricks or precast concrete grade rings, a maximum of 8 inches thick, to assure frame and cover are set to the finished grade. Set manhole frame and cover to final grade prior to placement of permanent paving.

B.2.3.6 LATERAL INSTALLATION

A lateral connection shall be provided for each platted lot or parcel.

Service connections shall be extended to the property line as shown on the drawings and adequately sealed with plugs or caps prior to beginning exfiltration tests. In each case the end shall be capped, backed with a 2-inch by 4-inch wood post extending to 3 feet below the finished ground surface.

The CONTRACTOR/DEVELOPER shall maintain a record of service connection locations in conjunction with the 'record drawings' and, upon completion of work, shall furnish a copy of record to ENGINEER.

The record shall include:

A. Location of wye branch and end of sewer connection referenced to next downstream manhole of each run.

B. Offset of end of service as referenced from center line of main sewer pipe.

C. Depth at end of service.

D. Distance from service end to nearest lot corner (reference lot corner shall be clearly indicated on the record).

Service connections shall be constructed perpendicular to the sewer, unless otherwise indicated on a straight line and a constant grade of not less than 2 percent and not greater than 100 percent (i.e., 45 degrees from horizontal or vertical).

Riser piping is not acceptable.

Inverts of service connections at property lines shall be established so as to provide a minimum grade of 2 percent to the center of the lot or parcel plus 2 feet vertical with a minimum invert depth of 5 feet, unless otherwise approved on the drawings.

Where service lines are connected to manholes, the invert elevation of the service lines shall match the crown elevation of the manholes discharge main. A shaped invert shall be provided from the wall of the manhole to shaped invert of main sewer.

When installing service connections on existing sewer mains not having wyes and tees, the CONTRACTOR/DEVELOPER may install a tee on PVC mains or install a PVC wye connection and fittings. No tapping saddles or tapping tees shall be used.

B.2.3.7 INFILTRATION

There will be no infiltration.

B.2.3.8 AIR TESTING

Low pressure testing shall be conducted in accordance with the following procedures: Sanitary sewers tested, will not be accepted by the CITY until the sewers meet the criteria stated. The CONTRACTOR/DEVELOPER will provide testing equipment and test supervision. The CONTRACTOR/DEVELOPER in the presence of the ENGINEER will conduct all tests. Generally, the sewers will be tested from manhole to manhole or from manhole to the end of the sewer if there is no manhole at the end. Service connections along the sewer main will be included in the testing.

The test procedure shall be conducted in the following manner:

A. Clean pipe to be tested by a CITY approved method. This step is important because it not only flushes out construction debris, but the water used to flush the ball through the pipe dampens the pipe wall. The rate of air loss through pipe wall permeation can be significant on dry pipes.

B. Plug all pipe outlets with pneumatic plugs having a sealing length equal to or greater than the diameter of the pipe to be tested. The pneumatic plug shall be able to resist internal testing pressures without requiring external bracing.

C. The groundwater level surrounding the section of sewer under testing shall be determined. If the groundwater table is above the pipe, then test pressures shall be increased by the corresponding increment (e.g., if the groundwater table is above the lowest crown of the pipe, the air pressure should be increased 0.43 times each foot of water.)

D. Once the pipe outlet plugs are securely in place, pressurized air is introduced to the system. The air shall be fed through a single control panel with three individual hose connections as follows:

   1. From control panel to pneumatic plugs for inflation in sewer pipe.

   2. From control panel to sealed line for introducing the pressurized air.

   3. From sealed line to control panel. This line will enable continuous monitoring of the air pressure rise in the sealed line.

E. The air shall be introduced slowly to the section of pipe under evaluation until the internal air pressure is raised to 4.0 psig greater than the hydrostatic pressure head created by the existence of groundwater that is over the pipe section.

F. A minimum of 2 minutes shall be provided for the air pressure to stabilize to conditions within the pipe. (This stabilization period is necessary for variations in temperature to adjust to the interior pipe conditions.) Air may be added slowly to maintain a pressure to 3.5 to 4.0 psig for at least 2 minutes.

G. After the stabilization period, when the pressure reaches exactly 3.5 psig, the stopwatch shall be started; and when the pressure reaches 2.5 psig, it is stopped. The portion of the line being tested shall be acceptable if the time in minutes for the air pressure to decrease from 3.5 psig to 2.5 psig is greater than the time shown in Table 2-1.

TABLE B.2-1
AIR PRESSURE STANDARDS FOR LINE TESTING

Pipe Diameter (inches)	Time (minutes)
4	2.0
6	3.0
8	4.0
10	5.0
12	5.5
15	7.5
18	8.5
21	10.0
24	11.5

H. In areas where the groundwater is above the top of the pipe, the test pressures shall be increased by 0.433 per foot of groundwater (e.g., if the groundwater is 11½ feet, the 3.5 to 2.5 pressure drop will be increased by 5 psi; the time then will be measured for a pressure drop from 8.5 to 7.5 psi.)

Alternate Pressure Test

$$T = (0.0850 \times D \times K)/0.003$$

where:

T = minimum time in seconds the air pressure must hold while dropping from 3.5 psig to 2.5 psig

D = pipe diameter in inches

K = 0.000419DL, but not less than 1.0

L = length of line being tested

Example: 10-inch sewer that is 350 feet long

$$T = \frac{0.0850 \times D \times K}{0.003}$$

$$T = \frac{0.0850 \times 10 \times 1.47}{0.003}$$

$$T = \frac{1.2495}{0.003}$$

T = 416.5 seconds

T = 6 minutes and 56.5 seconds

K = 0.000419 x D x L

K = 0.000419 x 10 x 350

K = 1.4665 (say 1.47)

The CONTRACTOR/DEVELOPER shall clean and remove all debris, silt, earth or other material from the sewer prior to testing. The CONTRACTOR/DEVELOPER shall flush the sewer with water. None of this water or debris shall be allowed to enter the existing sewer.

Test plugs will be installed within the pipe at each manhole.

The CONTRACTOR/DEVELOPER shall determine, in a manner suitable to the ENGINEER, the depth of the groundwater above the pipe invert immediately prior to testing the sewer. All gauge pressures in the test shall be increased by the amount of this backpressure due to groundwater submergence.

Air shall be added slowly to the test portion of the pipe until the internal air pressure is raised to 4.0 psig. A stabilization time of 5 minutes will be used to allow entering air to equalize with the temperature of the pipe wall.

If, at any time, prior to acceptance, a portion of the main line or any service laterals are damaged and repaired, additional air tests will be required.

B.2.3.9 CLEANING

At the conclusion of the work, the CONTRACTOR/DEVELOPER shall thoroughly clean the entire pipe by flushing with water or other means to remove all dirt, stones, pieces of wood, or other material that may have entered during the construction period. Debris cleaned from the lines shall be removed from the lowest outlet. Debris or water from the lowest outlet shall not be introduced into the CITY's sewage collection system. If, after this outlet cleaning obstructions remain, they shall be removed.

After the pipe is cleaned and if the groundwater level is above the pipe, or following a heavy rain, the ENGINEER will examine the pipe for leaks. If defective pipes or joints are discovered at this time, the CONTRACTOR/DEVELOPER shall repair them.

All water used in testing and flushing shall be furnished at the CONTRACTOR/DEVELOPER's expense.

B.2.3.10 FINAL TEST AND INSPECTION

Upon completion of the work, the sewer system or selected sections therein shall be subjected to a final test and inspection. All work in the system or sections therein being tested shall be complete, cleaned and ready for use. Tests shall be as specified herein and shall meet all requirements including but not limited to line, grade, cleanliness, infiltration, and workmanship. Deflection testing will be done on all flexible pipe at the direction of the ENGINEER. No pipe deflection will exceed 5%.

The CONTRACTOR/DEVELOPER will provide testing equipment and test supervision. This testing will be done using a mandrel having a diameter equal to 95% of the inside diameter of the pipe. The test shall be performed without mechanical pulling devices. Re-rounders are not allowed.

Inspection of mains shall be by use of a self-contained television system. These facilities shall be provided and operated by the CITY and scheduled through the Public Works Department. All requests for TV inspection shall be in writing 48 hours in advance from the CONTRACTOR/DEVELOPER.

For pipes 15inches in diameter and less, no deflection (dip) will exceed ¾-inch. For pipes greater than 15 inches in diameter there shall be no deflections (dips) greater than 1¼-inch.

A. Sewer within Street Right-of-Ways, Paved Areas, or Areas Subjected to Frequent Vehicular Traffic:

   The CITY will inspect the lines with the television system on two occasions. First inspection shall be completed prior to road base construction. Second inspection shall be performed prior to final acceptance. A third or subsequent inspection if required will be charged to the CONTRACTOR/DEVELOPER at the current rates.

B. Non-Paved Areas and Not Subject to Vehicular Traffic:

   The CITY will inspect the lines with the television system on only one occasion. A second or subsequent inspection if required will be charged to the CONTRACTOR/DEVELOPER at the current rates

SECTION B.3

SEWAGE FORCE MAINS

PART B.3.1 – GENERAL

B.3.1.1 SCOPE OF WORK

The Contractor shall supply all labor, equipment, materials and incidentals necessary to install and test all piping and appurtenances as shown on the drawings, and as specified herein.

This work shall include, but not be limited to, the following: DIP, PVC pipe, air release valves, fittings, and restrained joints. Also all excavation, backfilling, sheeting, slope factor protection, drainage, concrete work, rip rap, grading and all other work necessary to complete the construction, installation and testing of the piping work.

B.3.1.2 SUBMITTALS

Submit shop drawings to the ENGINEER for review showing a complete laying plan of all pipe, including all fittings, adapters, valves and specialty items along with the manufacturer's drawings and specifications indicating complete details of all items. The pipe details shall include pipe class; laying schedule which specifies pipe class, class coding, joints, station limits and transition stations for the various pipe classes; and list of abbreviated terms with their full meaning. The above shall be submitted to the ENGINEER for approval before fabrication and shipment of these items. The locations of all pipes shall conform to the locations indicated on the drawings. In certain cases, a small amount of flexibility in positioning of pipes will be allowed, especially where new pipes will connect to existing piping.

B.3.1.3 INSPECTION AND UTILITY LOCATION

All pipe and fittings to be installed under this Contract may be inspected at the site of manufacturer for compliance with these Specifications by an independent laboratory selected by the CITY. The manufacturer's cooperation shall be required in these inspections. The cost of inspection by an independent laboratory will be borne by the CITY.

Inspections of the pipe may also be made by the ENGINEER or other representatives of the CITY after delivery. The pipe will be subject to rejection at any time on account of failure to meet any of the requirements specified herein, even though sample pipes may have been accepted as satisfactory at the place of manufacture. Pipe rejected after delivery will be marked for identification and will be removed from the job at once.

Force Mains are the responsibility of the CONTRACTOR/DEVELOPER until such time as the system is deemed accepted by the CITY. Prior to acceptance, the CONTRACTOR/DEVELOPER will be responsible for providing all field utility

locations in accordance with utility location standards as established by the American Public Works Association.

The CONTRACTOR/DEVELOPER will be responsible for any damages to the utility system caused by the installation of any other utilities. The CONTRACTOR/DEVELOPER will be notified of acceptance in writing after the CITY receives approved as-builts, Florida Department of Environmental Protection Clearance Certification, and other required submittals.

B.3.1.4 CONNECTION TO WORK BY OTHER OR EXISTING LINES

For lines installed by others to which piping of this utility extension must connect, the following work shall be performed:

A. Expose buried lines to confirm or determine end connection, pipe material and diameter.

B. Removing the temporary plug provided in the pipe installed under another contract.

C. Furnishing and installing piping and making proper connections.

For connection to existing lines to which piping of this Contract must connect, the following work shall be performed:

A. Expose buried lined to confirm or determine end connection, pipe material and diameter.

B. Furnish and install appropriate piping and make proper connections.

The elevation of the force main invert will at no time exceed the crown elevation of the effluent side of the manhole.

The CITY shall be notified 48 hours prior to any connection to the existing sewer system.

PART B.3.2 – PRODUCTS

B.3.2.1 DUCTILE IRON PIPE (DIP) AND FITTINGS

Each length of DIP supplied for the project will be hydrostatically tested at the point of manufacture to 500 psi for duration of 10 seconds per AWWA C151. Testing may be performed prior to machining bell and spigot. Failure of DIP will be defined as any rupture of the pipe wall. Certified test results will be furnished in duplicate to the ENGINEER prior to time of shipment.

All ductile-iron pipe and fittings to be installed under this project will be inspected and tested at the foundry as required by the standard specifications to which the material is manufactured. Furnish in duplicate to the ENGINEER sworn certificates of such tests and their results prior to the shipment of the pipe.

All pipe and fittings will be permanently marked with the following information:

A. Manufacturer, date.

B. Size, type, class, or wall thickness.

C. Standard produced to (AWWA, ASTM, etc).

DIP will conform to AWWA C151 or/and ASTM A193. Pipe will be supplied in standard lengths as much as possible. Thickness design will be per AWWA C150, utilizing Class 350 for piping 12 inches and smaller. For pipe 14 inches and above, Class 250 may be used except where Class 350 is specified on the plans.

DIP will be by U.S. Pipe and Foundry Company, Inc.; American Cast Iron Pipe Company; pipe divisions of McWane, Inc., or approved equal.

DIP will have rubber-gasket push-on joint or rubber-gasket mechanical joint. Rubber-gasket joints will conform to AWWA C111. Gasket will be of SBR. Restrained joints will be 'Locked-type' joints manufactured by the pipe and fitting manufacturer that utilize restraint independent of the joint gasket. Restrained joints will be suitable for the specified test pressure. Mechanical joint retainer glands as manufactured by EBAA Iron Inc. of Texas can be selected for restraining the mechanical joint of DIP. Push-on restrained joints as manufactured by the pipe supplier or manufacturer may be used subject to the ENGINEER's approval.

The minimum number of restrained joints required for resisting forces at fittings and changes in direction of pipe will be determined from the length of restrained pipe on each side of fittings and changes in direction necessary to develop adequate resisting friction with the soil as shown on the drawings. All fittings for lines 4 inches in diameter and larger will have restrained joints.

Pipe fittings will be ductile iron with pressure rating of 350 psi for 24 inches and smaller piping and 250 psi for 30 inches and larger piping. Fittings will meet the requirements of AWWA C110 or AWWA C153 as applicable. Fittings will have the same pressure rating, as a minimum, of the connecting pipe. Fittings will be manufactured by the same manufacture of the pipe.

Lining & Coating For Inside Of All Ductile Iron Pipe (DIP) & Fittings:

DIP and fittings shall be lined with a ceramic-filled amine-cured epoxy, Protecto 401 by Indurall or approved equal. The lining thickness shall be 40 mils minimum. Application shall be performed by an applicator approved by the coating manufacturer, in accordance with manufacturer's instructions and under controlled conditions at the applicator's shop or the pipe manufacturer's plant. Applicator shall submit a certified affidavit of compliance with manufacturer's instructions and requirements specified herein.

B.3.2.2 POLYVINYL CHLORIDE (PVC) PIPE

All PVC force main and fittings will be from a single manufacturer. The supplier will be responsible for the provisions of all test requirements specified in ASTM D3034 and NSF Standard No. 14 as applicable.

PVC pressure pipe sized 4 through 12 inches will conform to the requirements of AWWA C900. All piping will be Class 150 with a Dimension Ratio of 18. The pipe will be PVC 1120 made from PVC compounds Class 12454-A or 12454-B as defined in ASTM D1784. Each pipe length will be marked with the manufacturer's name or trademark, size, material code, pressure class, AWWA designation number and seal of test agency.

PVC pressure pipe sizes 14 through 36 inches will conform to the requirements of AWWA C905 ASTM D2241. All piping will have a Dimension Ratio of 18. The pipe will be made from PVC compounds Class 12454-A or 12454-B as defined in ASTM D1784. Each pipe length will be marked with the manufacturer's name or trademark, size, material code, pressure class, AWWA designation number, and seal of test agency.

PVC pipe and fittings will have bell and spigot push-on joints. The bell will consist of an integral wall section with a solid cross-section elastomeric gasket securely locked in place to prevent displacement during assembly. Installation of elastomeric gasketed joints and performance of the joint will conform to ASTM F477, ASTM D3139.

All fittings and accessories for waterlines will have bell and/or spigot configurations compatible with the pipe.

All fittings for force mains will be cast or ductile iron conforming to AWWA C110 for mechanical joints. All adaptors, fittings and transition gaskets necessary to connect cast or ductile iron fittings to PVC will be furnished.

Force mains will be green in color. Where restrained joints are shown on the Drawings restraining glands will be installed. Restraining glands for PVC pipe will conform to AWWA C111 and be Megalug Series 2000 PV, Series 1500, and Series 2800 by EBAA Iron Sales Inc or equal.

B.3.2.3 HIGH DENSITY POLYETHYLENE (HDPE) PIPE

All HDPE pipe and fittings will be manufactured in strict accordance with AWWA C906 and will be from a single manufacturer who is fully experienced, reputable and qualified in the manufacture of the polyethylene pipe to be furnished. All HDPE pipe and fittings will be supplied by a single distributor who is fully experienced, reputable, and qualified with the distribution of the pipe to be furnished.

All incoming resin will be sampled for conformance testing against test results supplied by the resin manufacturer. Samples will be taken from the top and bottom of each compartment from every hopper car received.

The following conformance tests will be performed by the manufacturer on the sample:

A. Melt Flow Index - ASTM D1238

B. Density - ASTM D1505

C. The results of these tests will become part of the manufacturer's permanent quality control records.

The polyethylene pipe manufacturer will provide certification that stress regression testing has been performed on the specific polyethylene resin being utilized in the manufacture of this product. This stress regression testing will have been done in accordance with ASTM D2837 and the manufacturer will provide a product supplying a minimum Hydrostatic Design Basis (HDB) of 1600 psi as determined in accordance with ASTM D2837.

HDPE pipe is a flexible conduit and will be designed to transfer imposed loads to the surrounding embedment medium. The pipe and fittings will be free from all defects including indentations, delaminations, cracks, bubbles, pinholes, inclusions or occlusions which, due to their nature, degree, or extent, detrimentally affect the strength and serviceability of the pipe. Any pipe or fittings with such defects which, in the judgment of the ENGINEER, will affect the strength and serviceability will be repaired or rejected.

HDPE pipe resins will be high molecular weight, high density polyethylene with a cell classification number of 345434C in accordance with ASTM D3350. Pipe materials will meet the requirements of Type III, Class C, Category 5, Grade P34 as defined in ASTM D1248, with a standard grade rating of 1600 psi at 73 degrees F. Clean rework material generated by the manufacturers own production may be used so long as the pipe or fittings produced meet all the requirements of this section.

Polyethylene pipe and adaptors will be as manufactured by Performance Pipe, Isco, CSR Polypipe or equal

The polyethylene compound will be suitably protected against degradation by ultraviolet light as required by ASTM D1603. CONTRACTOR/DEVELOPER shall select either DIPS or Iron Pipe Size (IPS) outside dimensions based on matching the inside diameter (ID) of the main line pipe. Pipe shall be furnished in minimum thickness equivalent to DR-11. All polyethylene pipe will meet the requirements of ASTM F714.

The pipe will be joined with butt, heat fusion joints. All joints will be made in strict compliance with the manufacturer's recommendations. Pipe will be furnished in standard laying lengths not exceeding 50 feet.

All high density polyethylene pipe and fittings will be made from the same resin. Fittings will be fully pressure rated to match the pipe SDR pressure rating. All fittings will be molded or fabricated by the manufacturer.

The following will be continuously indent printed on the pipe or spaced at intervals not exceeding 5 feet:

A. Name and/or trademark of the pipe manufacturer.

B. Nominal pipe size.

C. Dimension ratio.

D. The letters PE followed by the polyethylene grade in accordance with ASTM D1248, followed by the hydrostatic design basis in 100's of psi, e.g., PE 3408.

E. Manufacturing standard reference, e.g., ASTM F714.

F. A production code from which the date and place of manufacture can be determined.

Mechanical joint adaptors will be used for connecting polyethylene pipe to other pipe material below ground unless otherwise noted on the drawings. MJ adapters shall be attached to pipe and fittings using butt fusion. MJ adaptors shall conform to the material requirements for HDPE for the work. MJ adaptors shall be male pattern with a gasket and type 316 stainless steel stiffener ring.

Connection shall utilize a ductile iron transition fitting, lined and coated per the requirements for the work, and sized as required for the HDPE and the other pipe material. Materials of the mechanical joint glands and bolts shall meet the material requirements for this work.

MJ adapters shall be aligned and centered relative to the pipe. MJ adapters should be square with the transition fitting before tightening of bolts.

Bolts shall be tightened using a 'star tightening pattern.' See manufacturer's recommendations. Twenty-four hours after first tightening the flange bolts, they must be re-tightened using the same 'star tightening pattern' used above. The final tightening torque shall be as indicated by the manufacturer. Bolts should not be used to draw other components into alignment.

Transition fittings shall be restrained at connection to other pipe material.

Provide protection per the manufacturer's recommendation by installing external joint restraints at unrestrained bell and spigot joints, or by installing an in-line anchor in the HDPE pipeline, or by a combination of both.

B.3.2.4 PLUG VALVES

Plug valves shall be of the offset disc type, 1/4 turn, non-lubricated, serviceable (able to be repacked) under full line pressure and capable of sealing in both directions at the rated pressure. The disc shall be completely out of the flow path when open. Plug valves, specified herein, shall be by DeZurik or Keystone.

Valves 24 inches and smaller shall have a minimum 100 percent open port area. Valves larger than 24 inches shall have a minimum 70 percent port area as measured by the percent cross-sectional area of equivalent size (nominal same diameter) pipe. MANUFACTURER shall submit tables showing Cv values versus percent open for ENGINEER's review.

Plug valves shall be capable of passing 'pigging' cleaning equipment (using a Girard or similar cleaning pig of full nominal pipeline diameter) in either direction and manufacturer shall so certify that this may be done without the use of special equipment.

Valves shall be rated at minimum 175 psi W.O.G. (Water, Oil and Gas) working pressure for sizes 4 inches to 12 inches inclusive and at minimum 150 psi W.O.G. working pressure for sizes 14 inches and larger.

All plug valves shall be performance, leakage and hydrostatically tested in accordance with AWWA C504, except as herein modified. At the above rated minimum working pressures, the valves shall be certified by the manufacturer as permitting zero leakage for a period of at least one-half hour with pressure applied to the seating face.

Valve bodies shall be of cast iron, 30,000 psi tensile strength, ASTM A126, Grade B, or of ductile iron, ASTM A536 and of the top entry, bolted bonnet design, cast with integral flanges conforming to the connecting piping. All exposed bolts, nuts and washers shall be zinc or cadmium-plated, except for buried or submerged valves, which shall have Type 316 stainless steel hardware.

The plug shall be completely coated with a hycar compound suitable for use with sewage. The hycar shall be applied at the factory to ensure that the plug is completely coated and then heat-treated to ensure a positive bond. Following this process, bare cast iron shall not be visible nor exposed in the flow area to ensure that the plug is abrasion resistant and suitable for service in raw wastewater.

Valves shall have sleeve type metal bearings and shall be of sintered, oil impregnated permanently lubricated Type 316 ASTM A743 Grade CF-8M in ½ inch to 36 inches valve sizes.

True eccentric action shall be required. Design of the valve shall provide for a rectangular port that allows contact between the welded nickel seat and the plug to occur only in the final 3 degrees of plug movement. Round ported valves as well as other non-eccentric action valves shall not be acceptable. The CITY reserves the right to visit the manufacturing facility to witness the eccentric action of partially assembled valves and to verify size and shape of the port area as well as the welded nickel seat.

The methods of mounting the actuator to the valve shall provide an air gap between the two. Actuator shall clearly indicate valve position and an adjustable stop shall be provided. Construction of actuator housing shall be semi-steel. Hardware on actuators shall be of the same materials as the valves.

Valve and gear actuators for buried shall have seals on the shafts and gaskets on the valve and actuator covers to prevent entry of liquid. Actuator mounting brackets for buried shall be totally enclosed and shall have gasket seals. Exposed nuts, bolts, and washers shall be stainless steel.

Valves and actuators shall be fully manufactured in the USA. Foreign and/or imported components, castings, and assembly shall not be acceptable. Documentation of this requirement shall be furnished upon request.

Plug valves shall be installed so that the direction of flow through the valve and the shaft orientation is in accordance with the manufacturer's recommendations.

B.3.2.5 TAPPING SLEEVES AND VALVES

Tapping sleeves will be of cast iron, stainless steel, ductile iron, or steel with coated epoxy designated for working pressure not less than 200 psi. Armored end gaskets will be provided for the full area of the sleeve flanges. Sleeves will be as manufactured by A.P. Smith Division of U.S. Pipe; Mueller; Clow, JCM, Smith Blair, Ford, or equal. Nuts and bolts will be Type 304 stainless steel.

Tapping valves will conform to the requirements specified in Section 1 Water Distribution System for Resilient-Seated Gate Valves except that one end will be flanged and one mechanical. Tapping valves will be provided with an oversized opening to permit the use of full-size cutters.

A plug valve will also be required at the tapping location on the new force main.

B.3.2.6 AIR RELEASE/VACUUM VALVES

Air release valves will be installed to release any small accumulation of air that may collect while pipe is in operation and under pressure.

The small orifice assembly air release valve will automatically release air accumulations from the pipe while under positive pressure. When the valve body fills with air, the float ball will fall to open the small orifice and exhaust the air to atmosphere. When the air has been exhausted, the float ball will be buoyed up and will tightly close the small orifice.

The small orifice assembly will be furnished with cast iron body and cover (ASTM A 126-B). The float ball will be constructed of stainless steel and attached to a stainless steel lever mechanism. A resilient, Buna-N seat will be attached to the lever mechanism for drop-tight closure. Separate air release valves will be manufactured by APCO; Val-Matic, GA or equal.

B.3.2.7 VALVE BOXES

All buried tapping valves and plug valves will be provided with valve boxes. Valve boxes will be as manufactured by Clow; Mueller; Tyler; Baileyor; or equal and will be a heavy-pattern cast iron, three-piece, telescoping type box with dome base suitable for installation on the buried valves. Inside diameter will be at least 4½ inches.

Barrel length will be adapted to the depth of cover, with a lap of at least 6 inches when in the most extended position. Covers will be cast iron with integrally-cast direction-to- open arrow and 'SEWER.' Aluminum or plastic are not acceptable. The upper section of each box will have a top flange of sufficient bearing area to prevent settling.

The bottom of the lower section will enclose the stuffing box and operating nut of the valve and will be oval.

PART B.3.3 – EXECUTION

B.3.3.1 GENERAL

All streets and easements shall be cleared and graded to within 4 inches of the final grade prior to construction of the utility system.

Force mains shall have minimum of 3 feet of cover and no more than a maximum of 6 feet of cover unless otherwise specified.

Care will be taken in loading, transporting and unloading to prevent injury to the pipe or coatings. Pipe and fittings will not be dropped. All pipe and fittings will be examined before laying and no piece will be installed which is found to be defective. Damage to the pipe coatings will be repaired per manufacturer's recommendations.

If any defective pipe is discovered after it has been laid, it will be removed and replaced with a sound pipe in a satisfactory manner at no cost to the CITY. All pipe and fittings will be thoroughly cleaned before laying, will be kept clean until they are used in the work and when installed or laid, will conform to the lines and grades required.

Materials, if stored, will be kept safe from damage. The interior of all pipes, fittings and other appurtenances will be kept free from dirt or foreign matter at all times.

Pipe will not be stacked higher than the limits recommended by its manufacturer. The bottom tier will be kept off the ground on timbers, rails, or concrete. Stacking will conform to manufacturer's recommendations.

Gaskets for mechanical and push-on joints to be stored will be placed in a cool location out of direct sunlight. Gaskets will not come in contact with petroleum products. Gaskets will be used on a first-in, first-out basis.

B.3.3.2 RESTRAINED JOINTS

Sections of piping designated on the drawings as having restrained joints or those requiring restrained joints shall be constructed using pipe and fittings with restrained 'locked-type' joints and the joints shall be capable of holding with line pressures up to 150 pounds per square inch (psi). The pipe and fittings shall be as shown for restrained push-on joints or restrained mechanical joints in Section V, in the latest edition of the Handbook of Ductile Iron Pipe, except that mechanical joint DIP retainer glands will be permitted only with the ENGINEER's prior approval.

The minimum number of restrained joints required for resisting forces at fittings and changes in direction of pipe shall be determined from the length of restrained pipe on each side of fittings and changes in direction necessary to develop adequate resisting friction with the soil. The formula given in Section IX in the latest edition of Handbook of Ductile Iron Pipe shall be used to determine the minimum requirements.

Bolts and nuts for restrained joints shall be hot dipped galvanized, low alloy, high-strength steel. All-thread rods for restrained joints shall be Type 304 Stainless Steel.

B.3.3.3 PIPE MARKING

All pipelines 4 inches and greater will have identification marking tape. A polyethylene double-safe detectable marking tape will be installed continuously in the backfill along the entire length of all pipe lines for identification and detection purposes. All ductile iron pipelines marking tape will be nondetectable type, but will have all of the design features as specified herein.

The tape will be as manufactured by Thor Enterprises or equal. The polyethylene tape will meet the requirements of ASTM D 1248, Type I Class A, Grade E-1 for polyethylene plastics molding and extrusion materials. The tape will have a minimum tensile strength of 1750 psi, a minimum elongation of 250 percent, not less than 50 gauge solid aluminum core and a nominal thickness of 5 mils. The tape will be composed of 2 mil clear film reverse - printed laminated to aluminum, foil-laminated to 2 mil clear film and reverse-printed. Minimum total thickness 4 mils.

Minimum marking tape widths will be as follows:

Pipe Inside Diameter, Inches	Minimum Tape Width, Inches	No. of Tape strips
4 through 12	4	1
14 through 20	4	2

The CONTRACTOR/DEVELOPER will submit typical samples of the printed marking tape to the ENGINEER for approval prior to installation (minimum length to show repeat of message).

The marking tape will be placed in the trench backfill directly above and centered over the pipeline. The marking tape will be installed between 12 and 18 inches above the top of the pipe. The CONTRACTOR/DEVELOPER will exercise care to prevent damage to the polyethylene tape when placing the remaining backfill.

Where the pipeline passes through in a manhole, vault or other underground structure, the polyethylene marking tape will be placed on top of that portion of the pipeline, located inside the structure and will be secured to the pipeline with adhesive tape.

Openings for air valves and similar appurtenances will be provided by making an X-shaped cut in the polyethylene and temporarily folding back the film. After the polyethylene is installed over the appurtenance, the slack will be taped securely to appurtenance and the cut in the polyethylene will be repaired with adhesive tape.

All nonmetallic mains shall also be laid with a minimum 12-gauge solid copper insulated wire to provide for location by metallic pipe locators. Tracer wire is to be wrapped two times around each joint of pipe. When a splice is required on the tracer wire, a waterproof wirenut shall be used in accordance to manufacturer specifications.

B.3.3.4 DUCTILE IRON PIPE (DIP)

DIP and fittings will be installed in accordance with requirements of AWWA C600, except as otherwise specified herein. A firm, even bearing throughout the length of the pipe will be provided by digging bell holes at each joint and by tamping backfill materials at the side of the pipe to the springline per details shown on the drawings. Blocking will not be permitted.

All pipe will be sound and clean before laying. When laying is not in progress, open ends of the pipe will be closed by a watertight plug or other approved means. Sufficient backfill will be placed to prevent flotation. The deflection at joints will not exceed 75 percent of allowable deflection recommended by manufacturer.

Fittings, in addition to those shown on the drawings will be provided, where required, in crossing utilities which may be encountered upon opening the trench. Solid sleeve closures will be installed at locations approved by the ENGINEER.

The pipe interior will be maintained dry and broom clean throughout the construction period.

When cutting pipe is required, the cutting will be done by machine, leaving a smooth cut at right angles to the axis of the pipe. Cut ends of pipe to be used with a bell will be beveled to conform to the manufactured spigot end. Cement lining will be undamaged. Field cut ends will be sealed with an approved epoxy in accordance with manufacturer's instructions. Cutting of restrained joint pipe will not be allowed, unless approved at specific joints in conjunction with the use of restrainer glands by EBAA Iron or field adaptable restrained joints.

All blow-offs, outlets, valves, fittings, and other appurtenances required will be set and jointed as indicated on the drawings in accordance with the manufacturer's instructions.

Jointing Ductile-Iron Pipe:

Push-on joints will be made in strict accordance with manufacturer's instructions and AWWA C600. Pipe will be laid with bell ends looking ahead. A rubber gasket will be inserted in the groove of the bell end of the pipe. The joint surfaces will be cleaned and lubricated and the plain end of the pipe will be aligned with the bell of the pipe to which it is to be joined and pushed home.

Mechanical joints will be assembled in strict accordance with the manufacturer's instructions and AWWA C600. Pipe will be laid with bell ends looking ahead. To assemble the joints in the field, thoroughly clean and lubricate the joint surfaces and rubber gasket. Bolts will be tightened to the specified torques. Under no condition will extension wrenches or pipe over handle of ordinary ratchet wrench be used to secure greater leverage.

Bolts in mechanical or restrained joints will be tightened alternately and evenly. Restrained joints will be installed according to pipe manufacturer's instructions.

Fittings shown on the drawings is shown only as an assistance in illustrating a preferred means of installation in specific locations and is not intended to indicate all fittings necessary to effect the installation as shown in plans. The cost of all fittings shall be included in the bid price for furnishing and installing the pipe.

B.3.3.5 POLYVINYL CHLORIDE (PVC) PIPE

No single piece of pipe will be laid unless it is straight. The centerline of the pipe will not deviate from a straight line drawn between the centers of the openings at the ends of the pipe by more than 1/16-inch per foot of length. If a piece of pipe fails to meet this requirement check for straightness, it will be rejected and removed from the site. PVC pipe and fittings will be installed in accordance with requirements of the manufacturer, ASTM D2321, and AWWA C605.

As soon as the excavation is complete to normal grade of the bottom of the trench, bedding will be placed, compacted and graded to provide firm, uniform and continuous support for the pipe. Bell holes will be excavated so that only the barrel of the pipe bears upon the bedding. The pipe will be laid accurately to the lines and grades indicated on the Drawings. Blocking under the pipe will not be permitted. Bedding will be placed evenly on each side of the pipe to mid-diameter and hand tools will be used to force the bedding under the haunches of the pipe and into the bell holes to give firm continuous support for the pipe.

Bedding will then be placed to 12 inches above the top of the pipe. The backfill above the bedding will be placed in 1-foot layers and carefully compacted. Generally the compaction will be done evenly on each side of the pipe and compaction equipment will not be operated directly over the pipe until sufficient backfill has been placed to ensure that such compaction equipment will not have a damaging effect on the pipe. Equipment used in compacting will be approved by the pipe manufacturer's representative prior to use.

When cutting pipe is required, the cutting will be done by machine, leaving a smooth cut at right angles to the axis of the pipe. Cut ends of pipe to be used with a bell will be beveled to conform to the manufactured spigot end.

Precautions will be taken to prevent flotation of the pipe in the trench.

Jointing Polyvinyl Chloride (PVC) Pressure Pipe:

Joints will be made in strict accordance with the manufacturer's instructions. Pipe will be laid with bell ends looking ahead. A rubber gasket will be inserted in the groove of the bell end of the pipe and the joint surfaces cleaned and lubricated. The plain end of the pipe to be entered will then be inserted in alignment with the bell of the pipe to which it is to be joined and pushed home with a come-along or by other means. Check that the reference mark on the spigot end is flush with the end of the bell.

Mechanical joints at valves, fittings and where designated will be in accordance with the AWWA C111 and the instructions of the manufacturer. Suitable PVC to cast iron adaptors will be installed prior to installing fittings. PVC beveled spigot will be cut flush prior to insertion in mechanical joint pipe. To assemble the joints in the field, thoroughly clean the joint surfaces and rubber gasket with soapy water before tightening the bolts. Bolts will be tight to the specified torques. Under no condition will extension wrenches or pipe over handle of ordinary ratchet wrench be used to secure greater leverage.

B.3.3.6 HIGH DENSITY POLYETHYLENE (HDPE) PIPE

All pipe or fittings will be examined before laying and no piece will be installed which is found to be defective. The maximum allowable depth of cuts, scratches or gouges on the exterior of the pipe is 10 percent of wall thickness. The interior pipe surface will be free of cuts, gouges or scratches. Any damage to the pipe will be repaired as directed by the ENGINEER. Blocking under the pipe will not be permitted.

When cutting pipe is required, the cutting will be done by machine, leaving a smooth cut at right angles to the axis of the pipe.

The pipe will be joined by the method of thermal butt fusion, as outlined in ASTM D2657. All joints will be made in strict compliance with the manufacturer's recommendations by a factory qualified joining technician as designated by the pipe manufacturer with a minimum of three years experience with the fusion equipment to be used.

Fittings will be connected to HDPE pipe in accordance with manufacturer's recommendations.

Pipe may be cold (field) bent to a minimum radius of 1.5 times the manufacturer's recommendation. Temporary restraints may be required to maintain the bend while placing the pipe in the trench and placing initial backfill. Temporary blocks or restraints must be removed before installing final backfill, and any voids must be filled with compacted initial backfill material.

All HDPE pipe must be at the temperature of the surrounding soil at the time of backfilling and compaction.

B.3.3.7 VALVES

All valves shall be restrained to fittings. All valves and fittings shall be set and jointed to the pipe in the proper locations as specified on the Plan.

B.3.3.8 TAPPING SLEEVES AND VALVES

All tapping valves and sleeves shall be hydrostatically tested prior to the installation of the tap. Tap shall be installed horizontal to the force main. Proper equipment to install the tap shall be on-site prior to starting the tap. The CONTRACTOR/DEVELOPER shall coordinate with the CITY Inspector regarding connection to the existing CITY sewer system with a minimum of 48 hours notification prior to tie-in. The CITY reserves the right to delay the tap if, in the CITY's opinion, the proper equipment is not on-site. No hand powered tapping is allowed.

B.3.3.9 AIR RELEASE/VACUUM VALVES

Air release valves for use in force mains shall be installed as shown on the plans and specifications. The valves shall be constructed in accordance to the drawing labeled 'air release assembly.'

B.3.3.10 PRESSURE TESTS OF FORCE MAINS

After installation, the pipe will be tested for compliance as specified herein. Furnish all necessary equipment and labor for the pressure test on pipelines. Submit detailed test procedures and method for ENGINEER's review. In general, testing will be conducted in accordance with AWWA C600. The CONTRACTOR/DEVELOPER must submit his plan for testing to the ENGINEER for review at least 10 days before starting the test.

Pressure pipelines will be subjected to a hydrostatic pressure of 150 psig. This test pressure will be maintained for a minimum of 2 hours. The amount of leakage that will be permitted will be in accordance with the following formula:

$$L = \frac{N(D)\sqrt{P}}{7400}$$

Where: L = allowable leakage rate (gallons per hour)

N = number of joints tested

P = test pressure (psi)

D = nominal pipe diameter (inches)

The CITY will provide a source of supply from the existing treated water distribution system for CONTRACTOR/DEVELOPER's use in filling the lines. An air break will be maintained at all times between the CITY's distribution system and the CONTRACTOR/DEVELOPER's equipment to prevent cross-connection.

The line will be slowly filled with water and the specified test pressure will be maintained in the pipe for the entire test period by means of a pump furnished by the CONTRACTOR/DEVELOPER. Provide accurate means for measuring the quantity of water required to maintain this pressure. The amount of water required is a measure of the leakage.

CONTRACTOR/DEVELOPER is responsible for all water cost associated with testing, flushing, and disinfection. Water required by CONTRACTOR/DEVELOPER will be provided at standard billing rates for the volume required.

Submit plan for testing to the ENGINEER for review at least 10 days before starting the test.

SECTION B.4

SUBMERSIBLE PUMP STATIONS

PART B.4.1 – GENERAL

B.4.1.1 SCOPE OF WORK

The General CONTRACTOR/DEVELOPER shall furnish, install, test and place in satisfactory operation, as shown on the Plans and specified herein, wet-pit submersible pump(s) complete with all appurtenances, accessories and spare parts as will be required to produce a complete and workable installation.

Sewage pumps shall be Wilo-EMU submersible wastewater pumps as manufactured by Wilo-EMU USA, LLC of Thomasville, Georgia.

B.4.1.2 SUBMITTALS

Copies of all materials required to establish compliance with the specification shall be submitted in accordance with the provisions of the general conditions. Submittals shall include at least the following:

A. Shop drawings showing all important details of construction, dimensions and anchor bolt locations.

B. Descriptive literature, bulletins, and/or catalogs of the equipment.

C. Data on the characteristics and performance of each pump. Data shall include guaranteed performance curves, based on actual certified tests of similar units, which show that they meet the specified requirements for head, capacity, efficiency, NPSHR, and horsepower, except where certified witness testing is requested by the CITY. Curves shall be submitted on 8½ by 11-inch sheets; at as large a scale as is practical. Curves shall be plotted from no flow at shut off head to pump capacity at minimum specified TDH. Catalog sheets showing a family of curves will not be acceptable.

D. Complete wiring diagrams showing in full detail all line voltage wiring and components, and control voltage wiring and components.

E. A drawing showing layouts of the pump control panel for each pumping station.

F. The total weight of the equipment including the weight of the single largest item.

G. A complete bill of materials of all equipment.

H. A list of the manufacturer's recommended spare parts, with the manufacturer's current price for each item. Include o-rings, seals, etc. on the list. List bearings by the bearing manufacturer' name and part number.

I. All submittal data required by the general conditions.

J. Complete motor data.

In the event that it is impossible to conform to certain details of the specifications due to different manufacturing techniques, describe completely all non-conforming aspects.

PART B.4.2 – PRODUCTS

B.4.2.1 PUMPS

The sewage pumping units shall be vertical, non-clogging, centrifugal sewage pumps with bottom inlet and side discharge. The pumps shall be direct driven by integral submersible squirrel cage, electric induction motors. Each pump shall include motor, bearings, quick removal system, anchor bolts and all accessories specified herein.

The volute casing shall be constructed of ASTM A48 Class 35 (or better) cast iron capable of prolonged resistance to raw sewage. Face and drill flanges of suction and discharge connections in accordance with 125 lb. ANSI standard.

All nuts, bolts, washers, and other fastening devices supplied with the pumps shall be 300 series stainless steel. All mating surfaces requiring a watertight seal shall be machined and fitted with Buna-n O-rings. Paper gaskets are not acceptable.

Pump impellers shall be of the solids handling single vane non-clog type. The impeller vane shall be smooth, finished throughout, and shall be free from sharp edges. Pump impellers shall be manufactured from ASTM A48 Class 35 cast iron.

Impellers shall be key driven and securely held to the shaft by a streamlined impeller washer and bolt assembly specifically designed to reduce friction in the suction eye of the impeller. The arrangement shall be such that the impeller cannot unscrew or be loosened by torque from either forward or reverse rotation. Designs based on threaded connection between pump shaft and impeller will not be considered.

The impeller shall be capable of passing a 3-inch solid non-deformable sphere through the bottom of the impeller and through the sides of the impeller. Designs which cannot pass a sphere through the impeller or rely on deforming, cutting or chopping solid materials shall not be acceptable.

The impeller shall be provided with an ASTM A240 duplex stainless steel wear ring which is drive fitted to the suction eye of the impeller. The impeller wear ring shall be hardened to a Brinell hardness of approximately 200.

The casing shall be provided with an AISI 304 stainless steel wear ring which is drive fitted to the bottom suction inlet. The volute wear ring shall be hardened to a Brinell hardness of approximately 300.

B.4.2.2 SUBMERSIBLE MOTORS

Each pump shall be furnished with a squirrel cage, explosion proof, induction motor enclosed in a watertight housing suitable for use and compatible with all modern variable frequency drive systems.

The motor shall be suitable for dry pit or wet pit installation under full load conditions. Motors shall be certified for variable frequency drive systems without de-rating the motor output power. The motors shall be capable of installation in either the wet pit or dry pit installation without adding or removing any items to the motor's interior or exterior.

The motors shall be oil-filled with moisture resistant NEMA Class H insulation and Class H slot liners and constructed to NEMA B design standards. The copper wound stator shall be triple dipped in epoxy enamel and baked to withstand a temperature of 130 degrees Centigrade as defined in NEMA Standard MG-1. Each winding phase or layer shall be laced with type H glass lined paper. The use of cable ties to restrain windings shall not be allowed. The rotor shall be statically and dynamically balanced after fabrication. The rotor shall utilize aluminum amortisseur bars and short circuit rings. The constructed motor shall be certified for continuous duty with a service factor of 1.15 and [shall be non-overloading for the primary and secondary duty point] – or- [shall be non-overloading over the entire range of the impeller].

Motors shall be capable of sustaining 15 starts per hour (unlimited starts with VFD) at a minimum ambient temperature of 40°C.

Motors shall be capable of uninterrupted operation with a voltage drop of 10%.

The power cables entering the motor housing shall connect to individual terminal pins, which shall separate the incoming service from the pump motor.

The motor shall be cooled via the internally circulated oil by means of a pump/motor shaft mounted oil circulation impeller. The oil/coolant impeller shall be mounted above the upper mechanical seal. Systems that utilize a coolant impeller mounted between the upper and lower mechanical seals shall not be acceptable. The oil circulating through the pump shall provide positive oil lubrication to all the bearings in the pump. The motor/pump oil circulation impeller shall cause the oil to move through and around the stator windings and motor rotor from which it picks up heat. This heat is then directed into the motor heat exchanger that transfers the heat to the pumped liquid. The heat exchanger shall be located below the sealing chamber. It shall be provided with a labyrinth design channel system such that a minimum of 85% of the heat generated by the motor must be conducted through the heat exchanger to the pumped liquid. Cooling systems requiring separate, clean water source or that circulate the pumped sewage through a cooling jacket will not be accepted.

Thermal switches shall be furnished to monitor stator temperatures. The stator shall be equipped with two thermal switches embedded in the end coils of the stator, and spaced directly across from each other in the stator. Thermal switches shall automatically de-energize the motor when its temperature exceeds a preset limit as recommended by the manufacturer.

The pump manufacturer's nameplates shall be engraved or stamped on stainless steel and fastened to the motor casing with stainless steel screws or drive pins.

B.4.2.3 SHAFTS

Pump shafts shall be AISI 420 stainless steel. Carbon steel shafts or shafts with sleeves of any type are not acceptable. The shaft shall be one piece construction without joints or stubs attached.

Multiple row lower bearings for axial thrust and a single row upper bearing for radial thrust shall support the motor/pump shafts. Bearings shall be sized to provide a minimum L-10 life of 50,000 hours anywhere on the flow versus head curve. Thrust bearings shall be restrained from thrust in both directions. Designs that do not protect the pump/motor from thrust in reverse directions shall not be acceptable.

All shafts shall be dynamically balanced and shall be amply sized to minimize shaft deflection. The distance from the lower bearing to the hub of the impeller shall not exceed 2 times the shaft diameter when the shaft diameter is measured at the lowest bearing.

The oil contained and circulated in the motor shall lubricate all pump/motor bearings. Grease lubricated bearings shall not be provided or acceptable.

B.4.2.4 MECHANICAL SEALS

Each pump shall be provided with an enclosed block mechanical seal with the seal housing and spring system constructed of 316 stainless steel. The block seal housing shall be constructed such that it can be dismantled allowing the seal faces and springs to be renewed and the seal system to be put back into service. Cartridge seals constructed such that they cannot be repaired or renewed shall not be acceptable. Both upper and lower seal faces shall be silicon carbide versus silicon carbide.

The seal shall be mounted in a separate and isolated seal chamber. The seal chamber shall be filled with non-conductive lubricating oil as recommended by the manufacturer.

A moisture sensor shall be furnished to sense seal failure for each pump. This sensor shall be wired to the Pump Control Panel and shall activate an alarm light upon seal failure. The moisture sensor probe shall be mounted in the seal chamber and shall be of the conductive type, sensing seal failure above the lower seal, but below the upper seal. Designs which sense seal failure above the upper seal through the use of a float switch are not acceptable.

B.4.2.5 POWER AND CONTROL CABLES

Power and control cables shall be furnished in lengths to run unspliced from the pump to the pump control panel as shown on the Contract Drawings and as specified herein. Cables shall terminate with conductor sleeves that bundle the entire group of strands of each phase to improve termination at the pump control panel. The sleeves shall be provided to confirm that all strands of each conductor is terminated properly. Termination shall be coordinated with the connection to the Pump Control Panel.

Cables shall be of the 'SO' type and shall conform to industry standards for loads. Resistance under submersion against sewage, and be of stranded construction. The cables shall enter the pump through a heavy duty galvanized cast iron entry assembly which shall be provided with an external clamp assembly to protect against tension once secured providing a strain relief function as part of standard construction.

The cables for each pump shall pass through the galvanized cast iron strain relief component and then through a series of stainless steel disks and Buna-n grommet that is sandwiched between the disks to control compression of the grommet. These components shall work to compress the cable jacket by the inner diameter of the grommet while the outer diameter of the grommet seals against the inside surface of the cable entry chamber in the top of the motor.

B.4.2.6 ACCESS HATCHES, GUIDES, AND ACCESSORIES

The hatches shall be securely mounted above the pumps and valves. Hatches shall be of single or double cover construction in the minimum sizes shown on the Drawings. Minimum sizes shown refer to the clear opening available with the hatch doors in the open position. The pump manufacturer shall coordinate the actual size of the hatches to be supplied with the pumps furnished. Covers shall be aluminum ¼-inch diamond pattern plate reinforced on the underside. Channel frame shall be ¼-inch aluminum with full anchor flange around the perimeter.

Cover(s) shall be equipped with heavy stainless steel or forged brass hinges with stainless steel pins and shall pivot so cover does not protrude into the channel frame. Hinges shall be through bolted to the cover with tamper proof stainless steel lock bolts and shall be through bolted to the frame with stainless steel bolts and lock nuts. Cover(s) shall be equipped with compression springs enclosed in telescopic tubes. Upper tube shall be the outer tube to prevent accumulation of moisture, grit and debris inside the tube assembly. Lower tube shall interlock with a flanged support shoe fastened to a formed ¼-inch gusset support plate.

Cover(s) shall be fitted with the required number and size of compression spring operators to afford ease of operation through the entire arc of opening and to act as a check in retarding downward motion when being closed. Cover(s) shall be equipped with a hold-open arm which automatically locks the cover in the open position. A conveniently located handle shall release the cover(s) for closing.

A stainless steel snap lock with fixed turn handle shall be mounted on the underside of the cover. A removable exterior latch handle shall be provided and the latch release shall be protected by a flush gasketed removable screw type plug or equal. Cover(s) shall have a lift handle that is designed to be flush with the walking surface when not in use. Hardware shall be 316 Stainless Steel, including tubes, springs, lifting, mechanism supports and tube caps, support shoes, hold-open arm(s), hinges, hinge pins, safety chains snap lock and lock strike, and all fasteners. Hold-open arm guide(s) shall be manufactured of aluminum or stainless steel.

Factory finish shall be mill finish aluminum with bituminous coating applied to the exterior of frame which will be in contact with concrete. Hatches shall be Type J or JD Exterior Door as manufactured by the Bilco Company, Type THS or THD as manufactured by U.S. Foundry & Manufacturing Corporation, or equal product by Halliday Products or Electric Specialty meeting the detailed requirements of these specifications.

The ASTM A48 Class 35 cast iron discharge base elbow shall be provided to support the full weight of the submersible pump in the installation and provide a leak proof connection in which the pump coupling mates using a conformed Buna-N seal which is held in place by both the combined weight of the cantilevered pump and motor. The hydraulic pressure generated while the pump is in operation shall also aid in the sealing action. The discharge base shall be provided with cast in place base plate and guide pipe retention lugs.

The pump coupling shall be close grained gray cast iron construction. The coupling shall be located between the pump discharge flange and the vertical face of the discharge base. The purpose of the coupling shall be to allow use of a standard ANSI drilled pump-casing flange on the pump. The coupling acts as the intermediate part between the pump and the discharge base. The coupling vertical face is designed to seal against the vertical face of the discharge base using a replaceable Buna-N elastomeric compressible one piece seal that acts as both the discharge face seal and the gasket between the coupling and the pump flange. Wet pit installation designs which utilize the flat face of the pump flange to seal against the discharge base are not acceptable.

Two 304 stainless steel guide rails supported by upper and intermediate brackets of 316 stainless steel shall guide each pump. The guide rails shall consist of standard dimension schedule 40 piping with a minimum diameter of 2 inches and a maximum diameter of 4 inches as shown on the contract drawings. The guide rails shall be supported by a 316 upper guide rail bracket that will be mounted in the opening of the access cover to support and guide the pump/motor into and out of the wet well. Intermediate guide rail brackets will be provided for all installations deeper than 20 feet.

Each pump shall be supplied with a lifting chain of 316 Stainless Steel, rated for 5 times the installed pump and coupling weight. The manufacturer shall provide information on recommended testing parameters that shall keep the lifting system capable of service for the life of the station. Recommendations shall be in written form and shall be discussed during startup training for the installation.

B.4.2.7 SHOP PAINTING

Primer and Finish Paint:

Shop apply to all exterior ferrous surfaces of the pump and motor. Shop apply to exterior and interior surfaces of elbow.

A. Solids by volume: 97%

B. Type: Solvent-free ceramic coating, impregnated with aluminum oxides

C. Total Dry Film Thickness: 400 microns (15 mils) minimum

D. Minimum Adhesion: 15 Newtons per square millimeter (2,175 psi) per ISO 4624.

E. Minimum Impact Resistance: 9 Joules (80 inch-pounds) per ISO 6272.

Surface Preparation:

Prepare all surfaces to receive coating system.

A. Method: Blasting per ISO 12944-4

B. Standard Cleanliness Grade: 2.5

C. Minimum Peak to Valley Height: 70 microns (2.75 mils)

B.4.2.8 WET WELL AND MANHOLE LINERS

Inside the wet well and in the manhole receiving the force main discharge, all exposed surfaces shall be lined with a protective coating manufactured by AGru, Spectrashield, or Poly-Triplex. Liners shall be shown, labeled, and dimensioned on the shop drawings submitted for approval to the ENGINEER.

All concrete shall be sufficiently cured to prevent gaseous formation behind the liner. All wet well or manhole surfaces shall be thoroughly prepared, cleaned, dry and free from all mill-scale, rust, grease, dirt and other foreign matter to assure proper adhesion/installation of the liner.

Wet-well shall be covered with a temporary cover during construction to prevent unplanned or unauthorized entry of persons or objects.

B.4.2.9 PUMP CONTROL SYSTEM (DUPLEX LESS THAN 25 HP)

General:

Pump controller shall be provided for each duplex wastewater pumping station. The controller shall respond to the liquid level float switches to automatically start, and stop pumps to compensate for variations in pump station influent flow. The pump controller shall be constructed in accordance with UL508A by a UL listed manufacturing facility. The panel will have the serialized UL 508A sticker affixed to the inner door.

The pump controller shall be the standard system of the manufacturer as modified for this application. The wet well levels to be used in operation are as shown on the Drawings.

Electrical power to be furnished to the site shall be 120/240 volts, single phase for pumps less than 2.5 hp, 120/208 volts, three phase for pumps rated 2.5-20 hp. The pump control panel shall be service entrance rated. Lightning arrestor and surge capacitor protection shall be provided.

Operation Requirements:

The control panels shall consist of a main circuit breaker and generator breaker with mechanical interlock, an emergency power receptacle, a motor circuit protector and magnetic starter for each pump motor, and 15 ampere, 120 volt circuit breakers as required. A low and high level alarm and pump shut-off shall be accomplished by a float type liquid level control system with all control components mounted in one common enclosure. Control switches shall provide means to operate each pump manually or automatically.

When operated in the automatic mode, the control assembly shall provide means to manually select or automatically alternate the position of the "lead" and "stand-by" pumps after each pumping cycle.

A float type liquid level control system shall continuously monitor wet well liquid level and control operation of the low-level cutoff for the pumps and shall operate off a 24 volt circuit. Provide auxiliary dry contacts as required for remote sensing and control.

Construction:

The electrical control equipment shall be mounted within a pad-lockable NEMA Type 4X deadfront enclosure constructed of not less than 14 gauge 304 stainless steel and shall be equipped with a 3-point latch with all hardware and exterior components constructed of 300 series stainless steel. The enclosure shall be equipped with an inner door and shall incorporate a removable back panel on which control components shall be mounted. Back panel shall be secured to enclosure with collar studs. Interior door shall be provided with locking feature to hold door open. The electrical contractor shall provide three Crouse-Hinds Type "CGB" cable connectors to terminate the motor cables in the control panel. The connectors shall be suitable for a 2" conduit with a neoprene bushing suitable for the cables supplied. Panels shall contain a strip heater as manufactured by Chromolux model 050601102 with a DPDT Thermostat model number 2E158. Panels with reduced voltage starters shall be equipped with a NEMA 4X air conditioning unit as manufactured by Kooltronics Model32KNA4C-4P32R.

All motor branch circuit breakers, motor starters and control relays shall be of highest industrial quality, securely fastened to the removable back panels with screws and lock washers. Back panels shall be tapped to accept all mounting screws. Self-tapping screws shall not be used to mount any component.

A thermal-magnetic air circuit breaker, Type FA as manufactured by Square D Company, or approved equal, shall be furnished for each pump motor, generator and main breaker. All circuit breakers shall be sealed by the manufacturer after calibration to prevent tampering. Each circuit breaker shall be adequately sized to meet the pump motor and station operating conditions. A mechanical disconnect mechanism shall be installed on each circuit breaker to provide a means of disconnecting power to the pump motors.

An open frame, across-the-line, NEMA rated, magnetic motor starter, Class 8536 as manufactured by Square D Company, or approved equal, shall be furnished for each pump motor. All motor starters shall be equipped to provide under-voltage release and overload protection on all three phases. Motor starter contacts shall be easily replaceable without removing the motor starter from its mounted position. Overload reset push-buttons shall be located on the exterior of the control compartment door. Motors above 20HP shall be provided with reduced voltage solid state starters with by-pass contactors as manufactured by Square D type ATS48.

Time delay relays shall be electric type. An emergency power receptacle shall be installed in the bottom or side of the control panel and connected to the line side of the generator breaker. The receptacle shall be Meltric 3728073 with angle adaptor 120/208 volts, three phase and a Russell Stoll # DFM14FRA for 120/240 volts, single phase.

A duplex GFCI utility receptacle providing 120 volts, 60 Hertz, single phase current shall be mounted inside the enclosure. The control panel shall include an adjustable time delay relay to prevent both pumps from starting simultaneously. Relays shall be SQUARE D Type JCK, or approved equal.

Duplex alternators shall be TimeMark 261DXT120 Phase monitors shall be Diversified Electronics Model #SUA-120-ALAU with RB-08 relay socket for 120/240 volts, single phase and # SUA-230-ALAU with RB-08 relay socket for 120/208 volts, three phase.

Print Storage pockets shall be provided on the inside of each panel. Pocket shall be of sufficient size as required to hold all prints necessary to service the equipment. A set of reduced drawings shall be provided for each panel, sized to fit in the storage pocket.

All operating controls and instruments shall be securely mounted on the control compartment door. All controls and instruments shall be clearly labeled to indicate function.

Pump mode selector switches shall be Hand-Off-Auto type to permit over-ride of automatic level control and manual actuation of shutdown of either pump motor. Operation of pumps in manual mode shall bypass all safety shutdown circuits except pump motor overload shutdown. Switches shall be NEMA 4X as manufactured by SQUARE D, or approved equal, providing three switch positions, each of which shall be clearly labeled according to function.

Indicator lamps shall be LED full voltage type and mounted in NEMA 4X (SKP) modules, as manufactured by SQUARE D . Lamp modules shall be equipped to operate at 24 or 120 volt input. Lamps shall be easily replaceable from the front of the control compartment door without removing lamp module from its mounted position.

A six digit, nonreset elapsed time meter shall be connected to each motor starter to indicate the total running time of each pump in "hours" and "tenth of hours." The elapsed time meters shall be Bulletin 705, HK Series as manufactured by Eagle Signal or approved equal.

Refer to the Drawings for additional control requirements. A dry contact shall be provided for each condition which will be directed to the Telemetry Panel (by Others) as shown on the Drawings.

Spare Parts:

The following total number of spare parts shall be furnished for the duplex Pump Control Systems:

A. 10 Indicator light assemblies.

B. 10 control relays of each type furnished.

C. 20 fuses of each type furnished.

D. Sets of thermal overloads for each type furnished.

E. Selector Switches of each type furnished.

A $100.00 allowance per duplex pumping station shall be included in the bid price for additional spare parts to be selected by the OWNER. A spare parts list, including each panel component furnished, shall be submitted with the Operation and Maintenance Manuals. The list shall include Manufacturer's current price, guaranteed for three years from shipment.

SCADA System Interface:

The pump controller shall have a separate terminal strip reserved for signals to and from a Remote Telemetry Unit (RTU). Signals shall be normally-open dry contacts rated 3.0 amperes at 120 volts AC and 24 volts DC. Contacts shall be provided for all of the conditions noted on the Instrumentation Drawings.

Dry contacts shall be received from the RTU for pump run commands and station disable commands as detailed on the Instrumentation Drawings.

Variable Frequency Drives For Phase Conversion:

If a single phase to three phase power converter is required for single phase pump stations, the following requirements shall be met.

The phase converter shall be as manufactured by Ronk Inc. or equal. The phase converter shall be supplied 120/240 volts, single phase and shall produce 120/208 volts, three phase by an auto transformer capacitor type phase converter.

The unit shall be sized to provide 700 percent of motor full load amps for starting and operate motor at 115 percent of full load amps on single phase service.

A complete spare unit of each size provided shall be provided to the CITY. Provide any and all modifications to the control panel and costs associated with providing a complete system.

Level Sensing System:

The mounting hardware, including but not limited to the 316 S.S mounting brackets and level-switch rack, shall be supplied by the pumping equipment supplier/manufacturer. The mounting hardware shall be fabricated in accordance with the details shown on the Drawings, ready for installation in the wet well by others.

Float switches shall be U.L. listed sealed mercury switches in a chemical-resistant polypropylene casing. The float cable shall be a synthetic three wire cable, minimum 19 AWG wire. Temperature rating shall be 0o to 50o C. Contact ratings shall be 250 volts AC or DC and 8 amperes AC, 5 amperes DC. Float switches shall be Flygt Model ENH-10, or equal.

B.4.2.10 PUMP CONTROL SYSTEM (TRIPLEX LESS THAN 25 HP)

General:

A pump controller shall be provided for each triplex wastewater pumping station. The controller shall respond to the liquid level in the wet well as sensed by the floats to automatically start, and stop pumps to compensate for variations in pump station influent flow. The pump controller shall be constructed in accordance with UL508A by a UL listed manufacturing facility. The panel will have the serialized UL 508A sticker affixed to the inner door.

The pump controller shall be the standard system of the manufacturer as modified for this application. The wet well levels to be used in operation are as shown on the Drawings.

Electrical power is to be furnished to the site shall be 480 volts, three phase, 60 hertz.

The control panel shall be service entrance rated. Lightning arrestor and surge capacitor protection (G.E. 9L15ECC001 and G.E. 1918BBB301 or equal) shall be provided.

Operation Requirements:

The control panel shall consist of a main circuit breaker, motor circuit protector and magnetic starter for each pump, and controls for each pump as required. The control panel shall also include circuit breakers for loads as shown on the drawings, and 20 ampere, 120 volt circuit breakers as required. The control system with all associated control components shall be mounted in one common enclosure. Control switches shall provide means to operate each pump manually or automatically. When operated in the automatic mode, the control assembly shall provide means to manually elect or automatically alternate the position of the "lead", "lag" and "stand-by" pumps after each pumping cycle.

Provide auxiliary dry contacts as required for remote sensing and control.

Construction:

The electrical control equipment shall be mounted within a pad-lockable NEMA Type 4X deadfront enclosure constructed of not less than 14 gauge 304 stainless steel and shall be equipped with a 3-point latch with all hardware and exterior components construction of 300 series stainless steel. The enclosure shall be equipped with an inner door and shall incorporate a removable back panel on which control components shall be mounted. Back panel shall be secured to enclosure with collar studs. The electrical contractor shall provide three Crouse-Hinds Type "CGB" cable connectors to terminate the motor cables in the control panel. The connectors shall be suitable for a 2" conduit with a neoprene bushing suitable for the cables supplied. Panels shall contain a strip heater as manufactured by Chromolux model 050601102 with a DPDT Thermostat model number 2E158. Panels with Reduced voltage starters shall be equipped with a NEMA 4X air conditioning unit as manufactured by Kooltronics Model32KNA4C-4P32R.

All motor branch circuit breakers, motor starters and control relays shall be of highest industrial quality, securely fastened to the removable back panels with screws and lock washers. Back panels shall be tapped to accept all mounting screws. Self-tapping screws shall not be used to mount any component.

A thermal-magnetic air circuit breaker, Type FA as manufactured by Square D Company, or approved equal, shall be furnished for each pump motor, generator and main breaker. All circuit breakers shall be sealed by the manufacturer after calibration to prevent tampering. Each circuit breaker shall be adequately sized to meet the pump motor and station operating conditions. A mechanical disconnect mechanism shall be installed on each circuit breaker to provide a means of disconnecting power to the pump motors.

An open frame, across-the-line, NEMA rated, magnetic motor starter, Class 8536 as manufactured by Square D Company, or approved equal, shall be furnished for each pump motor. All motor starters shall be equipped to provide under-voltage release and overload protection on all three phases. Motor starter contacts shall be easily replaceable without removing the motor starter from its mounted position. Overload reset push-buttons shall be located on the exterior of the control compartment door. Motors above 20HP shall be provided with reduced voltage solid state starters with by-pass contactors as manufactured by Square D type ATS48.

Time delay relays shall be electric type. An emergency power receptacle shall be installed in the bottom or side of the control panel and connected to the line side of the generator breaker. The receptacle shall be Meltric 3728073 with angle adaptor 120/208 volts, three phase and a Russell Stoll # DFM14FRA for 120/240 volts, single phase.

A duplex GFCI utility receptacle providing 120 volts, 60 Hertz, single phase current shall be mounted inside the enclosure. The control panel shall include an adjustable time delay relay to prevent both pumps from starting simultaneously. Relays shall be SQUARE D Type JCK, or approved equal.

Triplex alternators shall be TimeMark 261DXT120 Phase monitors shall be Diversified Electronics Model #SUA-120-ALAU with RB-08 relay socket for 120/240 volts, single phase and # SUA-230-ALAU with RB-08 relay socket for 120/208 volts, three phase.

Print Storage pockets shall be provided on the inside of each panel. Pocket shall be of sufficient size as required to hold all prints necessary to service the equipment. A set of reduced drawings shall be provided for each panel, sized to fit in the storage pocket.

All operating controls and instruments shall be securely mounted on the control compartment door. All controls and instruments shall be clearly labeled to indicate function.

Pump mode selector switches shall be Hand-Off-Auto type to permit over-ride of automatic level control and manual actuation of shutdown of either pump motor. Operation of pumps in manual mode shall bypass all safety shutdown circuits except pump motor overload shutdown. Switches shall be NEMA 4X as manufactured by SQUARE D, or approved equal, providing three switch positions, each of which shall be clearly labeled according to function.

Indicator lamps shall be LED full voltage type and mounted in NEMA 4X (SKP) modules, as manufactured by SQUARE D . Lamp modules shall be equipped to operate at 24 or 120 volt input. Lamps shall be easily replaceable from the front of the control compartment door without removing lamp module from its mounted position.

A six digit, nonreset elapsed time meter shall be connected to each motor starter to indicate the total running time of each pump in "hours" and "tenth of hours." The elapsed time meters shall be Bulletin 705, HK Series as manufactured by Eagle Signal or approved equal.

Refer to the Drawings for additional control requirements. A dry contact shall be provided for each condition which will be directed to the Telemetry Panel (by Others) as shown on the Drawings.

Spare Parts:

The following total number of spare parts shall be furnished for the duplex Pump Control Systems:

A. 10 Indicator light assemblies.

B. 10 control relays of each type furnished.

C. 20 fuses of each type furnished.

D. Sets of thermal overloads for each type furnished.

E. Selector Switches of each type furnished.

A $100.00 allowance per duplex pumping station shall be included in the bid price for additional spare parts to be selected by the OWNER. A spare parts list, including each panel component furnished, shall be submitted with the Operation and Maintenance Manuals. The list shall include Manufacturer's current price, guaranteed for three years from shipment.

SCADA System Interface:

The pump controller shall have a separate terminal strip reserved for signals to and from a Remote Telemetry Unit (RTU). Signals shall be normally-open dry contacts rated 3.0 amperes at 120 volts AC and 24 volts DC. Contacts shall be provided for all of the conditions noted on the Instrumentation Drawings.

Dry contacts shall be received from the RTU for pump run commands and station disable commands as detailed on the Instrumentation Drawings.

Level Sensing System:

The mounting hardware, including but not limited to the 316 S.S mounting brackets and level-switch rack, shall be supplied by the pumping equipment supplier/manufacturer. The mounting hardware shall be fabricated in accordance with the details shown on the Drawings, ready for installation in the wet well by others.

Float switches shall be U.L. listed sealed mercury switches in a chemical-resistant polypropylene casing. The float cable shall be a synthetic three wire cable, minimum 19 AWG wire. Temperature rating shall be 0° to 50° C. Contact ratings shall be 250 volts AC or DC and 8 amperes AC, 5 amperes DC. Float switches shall be Flygt Model ENH-10, or equal.

B.4.2.11 PUMP CONTROL SYSTEM (DUPLEX/TRIPLEX LARGER THAN 25 HP)

General:

A pump controller shall be provided for each duplex/triplex wastewater pumping station. The controller shall respond to the liquid level in the wet well as sensed by the bubbler control panel to automatically start, and stop pumps to compensate for variations in pump station influent flow. The pump controller shall be constructed in accordance with UL508A by a UL listed manufacturing facility. The panel will have the serialized UL 508A sticker affixed to the inner door.

The pump controller shall be the standard system of the manufacturer as modified for this application. The wet well levels to be used in operation are as shown on the Drawings.

Electrical power to be furnished to the control panel is 120 volt, single phase, 60 Hz.

Operation Requirements:

The control panels shall consist of a main circuit breaker and controls for each pump as required. The control system with all associated control components shall be mounted in one common enclosure. Control switches shall provide means to operate each pump manually or automatically. When operated in the automatic mode, the control assembly shall provide means to manually elect or automatically alternate the position of the "lead", "lag (triplex only)" and "stand-by" pumps after each pumping cycle.

Provide auxiliary dry contacts as required for remote sensing and control.

Construction:

The electrical control equipment shall be mounted within a pad-lockable NEMA Type 4X, deadfront enclosure, 316 stainless steel enclosure and shall be equipped with a 3-point latch with all hardware and exterior components constructed of 300 series stainless steel. The enclosure shall be equipped with a removable back panel on which control components shall be mounted. Back panel shall be secured to enclosure with collars studs. The enclosure shall be oversized to prevent excess heat building up and provide sufficient space for maintenance and removal of internal control panel equipment. Enclosures larger than 48 inches by 48 inches are to have legs for mounting on concrete pad. Interior door shall be provided with locking feature to hold door open.

All branch circuit breakers and control relays shall be of highest industrial quality, securely fastened to the removable back panels with screws and lock washers. Back panels shall be tapped to accept all mounting screws. Self-tapping screws shall not be used to mount any component.

Time delay relays shall be electric type. The control panel shall include an adjustable time delay relay to prevent both pumps from starting simultaneously. Relays shall be SQUARE D Type JCK, or equal.

Duplex/Triplex alternators shall be TimeMark 261DXT120. The control panel shall operate remote starters as specified herein. Run and failure status and remote start contacts shall be provided as required.

The control diagrams shall be laminated to the inside of the exterior door. Print Storage pockets shall be provided on the inside of each panel. Pocket shall be of sufficient size as required to hold all prints necessary to service the equipment. A set of reduced drawings shall be provided for each panel, sized to fit in the storage pocket.

Operating Controls and Instruments:

All operating controls and instruments shall be securely mounted on the control compartment door. All controls and instruments shall be clearly labeled to indicate function.

Pump mode selector switches shall be Hand-Off-Auto type to permit over-ride of automatic level control and manual actuation or shutdown of either pump motor. Operation of pumps in manual mode shall bypass all safety shutdown circuits except pump motor overload shutdown. Switches shall be NEMA 4X as manufactured by SQUARE D, or equal, providing three switch positions, each of which shall be clearly labeled according to function.

Indicator lamps shall be LED full voltage type and mounted in NEMA 4X (SKP) modules, as manufactured by SQUARE D. Lamp modules shall be equipped to operate at 120 or 24 volt input. Lamps shall be easily replaceable from the front of the control compartment door without removing lamp module from its mounted position.

A six digit, nonreset elapsed time meter shall be connected to each motor starter to indicate the total running time of each pump in "hours" and "tenth of hours." The elapsed time meters shall be Bulletin 705, HK Series as manufactured by Eagle Signal or equal.

Refer to the Drawings for additional control requirements. A dry contact shall be provided for each condition which will be directed to the Telemetry Panel (by Others) as shown on the Drawings.

SCADA System Interface:

The pump controller shall have a separate terminal strip reserved for signals to and from a Remote Telemetry Unit (RTU). Signals shall be normally-open dry contacts rated 3.0 amperes at 120 volts AC and 24 volts DC. Contacts shall be provided for all of the conditions noted on the Instrumentation Drawings.

Dry contacts shall be received from the RTU for pump run commands and station disable commands as detailed on the Instrumentation Drawings.

B.4.2.12 MAIN PANEL (DUPLEX/TRIPLEX 25 HP AND LARGER)

General:

A main panel shall be provided for each triplex wastewater pumping station. The pump controller shall be constructed in accordance with UL508A by a UL listed manufacturing facility. The panel will have the serialized UL 508A sticker affixed to the inner door.

Electrical power is to be furnished to the site shall be 480 volts, three phase, 60 hertz.. The main panel shall be service entrance rated. Reduced voltage solid state starters shall be provided as specified herein.

An air conditioner shall be provided for this panel as specified herein. Panels shall contain a strip heater as manufactured by Chromolux model 050601102 with a DPDT Thermostat model number 2E158. Panels with Reduced voltage starters shall be equipped with a NEMA 4X air conditioning unit as manufactured by Kooltronics Model32KNA4C-4P32R.

Lightning arrestor and surge capacitor protection (G.E. 9L15ECC001 and G.E. 1918BBB301 or equal) shall be provided.

Operation Requirements:

The main panel shall consist of a main circuit breaker, circuit breakers for loads as shown on the drawings, and 20 ampere, 120 volt circuit breakers as required.

Provide auxiliary dry contacts as required for remote sensing and control.

Provide local control panels as shown on the drawings and pump control panels as specified in Paragraph 2.08A.

Construction:

The electrical control equipment shall be mounted within a pad-lockable NEMA Type 4X deadfront enclosure constructed of not less than 14 gauge 304 stainless steel and shall be equipped with a 3-point latch with all hardware and exterior components construction of 300 series stainless steel. The enclosure shall be equipped with an inner door and shall incorporate a removable back panel on which control components shall be mounted. Back panel shall be secured to enclosure with collar studs. The electrical contractor shall provide three Crouse-Hinds Type "CGB" cable connectors to terminate the motor cables in the control panel. The connectors shall be suitable for a 2" or 3" conduit with a neoprene bushing suitable for the cables supplied. The enclosure shall be oversized to prevent excess heat building up and provide sufficient space for maintenance and removal of internal control panel equipment. Enclosures larger than 48 inches by 48 inches are to have legs for mounting on concrete pad. Interior door shall be provided with locking feature to hold door open.

All branch circuit breakers, motor starters and control relays shall be of highest industrial quality, securely fastened to the removable back panels with screws and lock washers. Back panels shall be tapped to accept all mounting screws. Self-tapping screws shall not be used to mount any component.

A thermal-magnetic air circuit breaker, Type FH (25,000 AIC at 480 VAC) as manufactured by Square D Company, or equal, shall be furnished for all circuit breakers. All circuit breakers shall be sealed by the manufacturer after calibration to prevent tampering. Each circuit breaker shall be adequately sized to meet the station operating conditions.

A mechanical disconnect mechanism shall be installed on each circuit breaker to provide a means of disconnecting power to the pump motors.

Time delay relays shall be electric type. A duplex GFCI utility receptacle providing 120 volts, 60 Hertz, single phase current shall be mounted inside the enclosure.

The control panel shall include an adjustable time delay relays to prevent pumps from starting simultaneously. Relays shall be SQUARE D Type JCK, or equal. Phase monitors shall be Diversified Electronics Model #SUA-440-ASA.

The control diagrams and overload tables shall be laminated to the inside of the exterior door. Print Storage pockets shall be provided on the inside of each panel. Pocket shall be sufficient size as required to hold all prints necessary to service the equipment. A set of reduced drawings shall be provided for each panel, sized to fit in the storage pocket.

The controls shall operate off a 120 volt control circuit. A control power transformer as shown on the drawings shall be provided.

All operating controls and equipment shall be securely mounted on the control compartment door. All controls and instruments shall be clearly labeled to indicate function.

Pump mode selector switches shall be Hand-Off-Auto type to permit over-ride of automatic level control and manual actuation of shutdown of either pump motor. Operation of pumps in manual model shall bypass all safety shutdown circuits except pump motor overload shutdown. Switches shall be NEMA 4X as manufactured by SQUARE D, or equal, providing three switch positions, each of which shall be clearly labeled according to function.

Indicator lamps shall be LED full voltage type and mounted in NEMA 4X (SKP) modules, as manufactured by SQUARE D. Lamp modules shall be equipped to operate at 120 volt input. Lamps shall be easily replaceable from the front of the control compartment door without removing lamp module from its mounted position.

A six digit, nonreset elapsed time meter shall be connected to each motor starter to indicate the total running time of each pump in "hours" and "tenth of hours." The elapsed time meters shall be Bulletin 705, HK Series as manufactured by Eagle Signal or equal.

Refer to the Drawings for additional control requirements. A dry contact shall be provided for each condition which will be directed to the Telemetry Panel (by Others) as shown on the Drawings.

SCADA System Interface:

The main panel shall have a separate terminal strip reserved for signals to and from a Remote Telemetry Unit (RTU). Signals shall be normally-open dry contacts rated 3.0 amperes at 120-volts AC and 24 volts DC. Contacts shall be provided for all of the conditions noted on the Instrumentation Drawings.

Dry contacts shall be received from the RTU for pump run commands and station disable commands as detailed on the Instrumentation Drawings.

Air Conditioner:

The main panel shall be provided with an industrial NEMA 4X rated air conditioner as manufactured by Kooltronics. The minimum BTU/HR shall be 12,000 and the manufacturer shall verify that the unit furnished will operate to maintain the internal equipment with the internal heat gains and exterior heat gains with direct sunlight. Sunshields shall be provided for exterior installations.

The unit shall be provided with a 316 stainless steel enclosure. All hardware shall be 316 stainless steel. The unit shall be provided with a seacoast package for corrosion protection. The unit shall operate on 230 volt, single phase, 60 hertz.

Spare Parts:

The following total number of spare parts based on the main panel and pump control panel shall be furnished for the triplex pump control system:

A. 10 Indicator light assemblies.

B. 10 control relays of each type furnished.

C. 20 fuses of each type furnished.

D. 3 sets of thermal overloads for each type furnished.

E. 3 Selector Switches of each type furnished.

F. 3 printed circuit boards of each type furnished.

G. A $200.00 allowance per triplex pumping station shall be included in the bid price for additional spare parts to be selected to the Owner.

A spare parts list, including each panel component furnished, shall be submitted with the Operation and Maintenance Manuals. The list shall include Manufacturer's current price, guaranteed for three years from shipment.

A. Reduced Voltage Solid State Starters (RVSS):

B. The RVSS shall be mounted within the main panel.

C. The RVSS shall be provided with the following features:

D. In-line and manual by-pass contactors

E. Motor circuit protector

F. Energy saving option

G. Line surge protection

H. Snubber network for noise reduction

I. Common control board

The RVSS shall operate on a power supply of 480 volt, 3-phase, 60 Hz. An Off-Remote selector switch, Normal-Bypass selector switch, run indicator light, failure indicator light, and elapsed time meter shall be mounted on the exterior door.

The RVSS shall be ATS48 Series as manufactured by SQUARE D.

All controls and instruments shall be clearly labeled to indicate function. Pump mode selector switches shall be NEMA 4X as manufactured by SQUARE D, or equal, providing two switch positions, each of which shall be clearly labeled according to function.

Indicator lamps shall be LED full voltage type and mounted in NEMA 4X (SKP) modules, as manufactured by SQUARE D. Lamp modules shall be equipped to operate at 120 volt input. Lamps shall be easily replaceable from the front of the control compartment door without removing lamp module from its mounted position.

A six digit, nonreset elapsed time meter shall be connected to each motor starter to indicate the total running time of each pump in "hours" and "tenth of hours." The elapsed time meters shall be Bulletin 705, HK Series as manufactured by Eagle Signal or equal.

Motor circuit protectors shall be molded case with adjustable thermal-magnetic trip. Motor circuit protectors shall be type FH as manufactured by Square D Company, or equal, and with proper trip settings for the actual motor furnished.

The controls shall operate off a 120 volt control circuit. A control power transformer (750 VA minimum) shall be provided.

A mechanical disconnect shall be installed on each circuit breaker to provide a means of disconnecting power to the pump motors.

An open frame, across-the-line, NEMA rated, magnetic motor-starter, Class 8536 as manufactured by Square D Company or shall be furnished for manual by-pass. All motor starters shall be equipped to provide under-voltage release and overload protection on all three phases.

Motor starter contacts shall be easily replaceable without removing the motor starter from its mounted position. Overload reset push-buttons shall be located on the control compartment door.

A thermal-magnetic air circuit breaker, Type FH (25,000 AIC at 480 VAC) as manufactured by Square D Company, or equal, shall be furnished for the main breaker.

All circuit breakers shall be sealed by the manufacturer after calibration to prevent tampering.

Each circuit breaker shall be adequately sized to meet the pump motor operating conditions.

Refer to the Drawings for additional requirements.

PART B.4.3 – EXECUTION

B.4.3.1 FIELD TESTING

After the installation of the pumps, controls and all appurtenances, and when construction of other units of the pump station will permit, each complete pumping unit will be subject to field tests as specified herein under actual operating conditions.

The field tests shall be made by the CONTRACTOR/DEVELOPER under the direct supervision of a qualified factory trained ENGINEER, and in the presence of, and as directed by the ENGINEER. The CONTRACTOR/DEVELOPER shall provide, calibrate and install all temporary gauges and meters, shall make necessary tapped holes in the pipes, and install all temporary piping and wiring required for the field tests.

The pump manufacturer shall demonstrate that each pump furnished shall pass a minimum 3-inch non-deformable sphere through a field test of the pump impeller clearance. The test shall be a static test with the pump in an OFF status and disconnected from the electrical power service. With the pump held aloft by its chain to the pump station hoist or crane, the pump manufacturer's field technician shall place a hard nominal 3-inch sphere into the pump discharge and through turning the impeller by hand; demonstrate the solids passage through the sphere exiting the bottom pump suction.

Should the pump not pass the free passage test, then the equipment shall be rejected and no compensation for the equipment shall be allowed until the equipment is replaced with equipment of differing manufacture that passes the free passage test.

The field tests shall determine the head, discharge flow and overall efficiency characteristics of each pumping unit and in addition, shall demonstrate that under all conditions of operation each unit:

A. Has not been damaged by transportation or installation.

B. Has been properly installed.

C. Has no mechanical defect.

D. Is in proper alignment.

E. Has been properly connected.

F. Is free of overheating of any parts.

G. Is free of all-objectionable vibration and noise.

H. Is free of overloading of any parts.

B.4.3.2 GUARANTEE

The CONTRACTOR/DEVELOPER shall guarantee the station for 24 months from the date of acceptance that the structure and all equipment will be free from defects in design, materials and workmanship. The lift station manufacturer shall furnish replacement parts FOB factory, for any component proven defective, whether of his or of other manufacturer during the guarantee period, except for those items which are normally consumed in service such as light bulbs, oil, grease, etc.

B.4.3.3 WARRANTY

The equipment manufacturer shall warrant the pumping units being furnished against defects in workmanship and material for a period of 5 years. The warranty shall be in printed form and shall apply to all units furnished, and shall be duplicated into each of the four operation and maintenance manuals submitted.

The warranty shall cover all parts and labor required to repair or replace a defective unit as follows: 100% (0 – 24 months), 50% (24 – 60 months).

The manufacturer's warranty period shall run concurrently with the CONTRACTOR/DEVELOPER's warranty period. No exception to this provision shall be allowed.

B.4.3.4 OPERATING INSTRUCTIONS

Four operating and maintenance manuals complete with spare parts lists for all equipment shall be furnished. The manuals shall be prepared specifically for this installation and shall include all required cuts, drawings, equipment lists, descriptions, etc. that are required to instruct operation and maintenance personnel unfamiliar with such equipment.

A factory representative of all major component manufacturers, who has complete knowledge of their proper operation and maintenance, shall be provided 1 day to instruct representatives of the CITY on proper operation and maintenance. With the permission of the CITY, this work may be conducted in conjunction with the inspection of the installation and test run as provided under Section 4.3.1. If there are difficulties in operation of the equipment due to the manufacture's design or fabrication, additional service shall be provided at no cost to the CITY.

B.4.3.5 TOOLS AND SPARE PARTS

One set of all special tools required for normal operation and maintenance shall be provided. All such tools shall be furnished in a suitable steel tool chest complete with lock and duplicate keys.

The manufacturer shall furnish one set of the following spare parts:

A. Impeller and casing wear rings

B. Mechanical seal or seal repair kit with all seal faces and o-rings

C. Upper and Lower Bearings set

D. O-Ring Set

A written description of each spare part and the storage recommendation shall be provided as directed by the ENGINEER.

B.4.3.6 MISCELLANEOUS

The pump station includes everything to make the station fully operational which includes, but is not limited to, pumps, piping, valves, control panel (which must be furnished by the pump supplier), pad, 304 SS lifting chain, 304 SS guide rails, 304 SS brackets, 2 glycerin filled gauges.

A. Fencing:

The fence and gate bolts shall be cotter pinned to make disassembly difficult. All slabs, equipment, and utilities shall be located within the fenced area at least 3 feet from the fence. A 6-foot perimeter chain link fence shall be installed. This metal fencing shall conform to FDOT standard specification, Section 966, Type 'B' fencing. Privacy fencing may also be used.

B. Driveway and Parking Areas:

Driveways and Parking Areas shall be Class B concrete, a minimum of 6 in. thick and meet all current FDOT specifications. Pavement grade shall be determined in relation to the drainage installations. The station's paved access road shall be at least 14-foot wide and have a slope between 2% and 12%. A paved vehicle turnaround area with a 42-foot outside turning radius to allow a large truck to turn around is required. Sod will be placed in the unpaved areas surrounding the station. Should the plans show a concrete drive and parking area, the drive and parking area will be per the plans.

C. Exceptions:

No exceptions from these specifications will be allowed unless specifically approved in writing by the CITY. The CITY will review submittal data of the pump station manufacturer to facilitate inadvertent exceptions, however, inclusion of exceptions in the submittal shall not satisfy the requirement that it be specifically approved.

SECTION B.5

RESIDENTIAL OF SINGLE UNIT GRINDER PUMPING STATIONS

PART B.5.1 – GENERAL

B.5.1.1 SCOPE OF WORK

The HOMEOWNER shall furnish, install, test and place in satisfactory operation, as shown on the Plans and specified herein, simplex grinder pump station complete with all appurtenances required to produce a complete and workable installation.

B.5.1.2 SUBMITTALS

The HOMEOWNER/Agent shall submit the following information to the City for approval prior to grinder pump station installation.

A. Shop drawings showing all important details of construction, dimensions and ballast locations.

B. Descriptive literature, bulletins, and/or catalogs of the equipment.

C. Data on the characteristics and performance of each pump.

PART B.5.2 – PRODUCTS

B.5.2.1 PUMPS

The grinder pumping units shall be centrifugal or positive displacement sewage pumps with bottom inlet and side discharge. The pumps shall be direct driven by integral submersible motors. Each pump shall include motor, bearings, quick removal system, anchor bolts and all accessories specified herein.

The pump casing shall be constructed of ASTM A48 Class 35 cast iron capable of prolonged resistance to raw sewage.

Pumps shall be manufactured by E-ONE, Barnes, Hydromatic, or approved equal.

B.5.2.2 SUBMERSIBLE MOTORS

Each pump shall be furnished with induction motor enclosed.

The motors shall be oil-filled

Motors shall be capable of sustaining 6starts per hour

The power cables entering the motor housing shall connect to individual terminal pins, which shall separate the incoming service from the pump motor.

Thermal switches shall be furnished to monitor stator temperatures. The stator shall be equipped with two thermal switches embedded in the end coils of the stator, and

spaced directly across from each other in the stator. Thermal switches shall automatically de-energize the motor when its temperature exceeds a preset limit as recommended by the manufacturer.

The motor shall be a minimum of 1 HP and connected to the grinder pump via mechanical seal. The motor shall have a high temperature shutoff that ceases operation of the system and should reset when the motor reaches a safe operating temperature.

B.5.2.3 POWER AND CONTROL CABLES

Power and control cables shall be furnished in lengths to run unspliced from the pump to the pump control panel. Cables shall terminate with conductor sleeves that bundle the entire group of strands of each phase to improve termination at the pump control panel. The sleeves shall be provided to confirm that all strands of each conductor is terminated properly. Termination shall be coordinated with the connection to the Pump Control Panel.

B.5.2.4 ACCESS HATCHES

The wet well shall be provided with an access hatch which is capable of supporting expected loadings, and sized to allow adequate space for equipment removal and replacement

B.5.2.5 WET WELL

A. The wet well shall be installed per all the manufacturers' recommendations unless the recommendations given herein are more stringent.

B. Wet wells shall be constructed of fiberglass or high density polyethylene (HDPE).

C. The installation location shall be excavated and graded such that the top of the pump station well only protrudes from the ground surface a maximum of 4-inches. The depth of the excavation will also allow the station to be installed on approximately 6-inches of compacted level gravel base. The diameter of the excavation will allow for minimum 3-inches clear space around the outer diameter of the station wet well.

D. The finished grade around the pump station shall slope away from the station.

E. Anti-flotation ballast shall be installed around the station we t well per the manufacturers recommendations. While the concrete ballast is being installed, the wet well is to be filled with water to minimized shifting during the pour.

F. Inlet piping shall be installed per the manufactures recommendations. Discharge piping shall be installed using 2-inch pvc or HDPE piping. A 2-inch check valve shall be installed at the property line.

G. The tank shall be backfilled using the native soil originally excavated. The soil shall be compacted in lifts no greater than 12-inches. The disturbed area around the station shall be grassed or sodded.

H. The wet well shall be vented per the local plumbing codes

B.5.2.6 PUMP CONTROL SYSTEM

A. The pump controller shall be the standard system of the manufacturer as modified for this application.

B. Electrical power to be furnished to the site shall be 120/240 volts, single phase.

C. The electrical connections for the station shall be performed according to the manufacturers recommendations and local electrical codes.

D. The control panel shall be installed on the outside of the structure it serves with the connecting cable buried at least 24-inches.

E. Electrical penetrations through the wet well shall be installed watertight such that water cannot flow back into the station.

F. Floats shall provide appropriate signals to the logic circuits to produce the required mode of operation for the pumping facilities.

G. Capability shall be provided for manual start-stop control, as well as the normal automatic control from the liquid level sensing and logic circuits.

H. At a minimum, a high water level alarm system shall be provided. A low level alarm is also recommended.

I. All control panels shall have an alarm light and alarm horn with silencer. .

J. Electrical materials and methods shall comply with National Electrical Code requirements.

B.5.2.7 VALVES

A. All discharge valves shall be operated to the open position

B. Each grinder station shall have a isolation valve and check valve located in a fabricated valve vault on the Homeowner's side property line and on the City's side of the property line.

B.5.2.8 FORCEMAINS

A. The minimum size discharge forcemain shall be 2-inch

B. Forcemains shall be Schedule 80 PVC or HDPE

SECTION B.6

CONCRETE AND CONCRETE REINFORCEMENT

PART B.6.1 – CONCRETE GENERAL

B.6.1.1 SCOPE OF WORK

Furnish all labor, materials, equipment and incidentals required to place all cement and concrete masonry, reinforcing steel, forms, water stops and miscellaneous related items including sleeves, anchor bolts, inserts and embedded items specified under other Sections.

B.6.1.2 SUBMITTALS

Submit to the ENGINEER the following:

A. Concrete mix for each formulation of concrete proposed for use including constituent quantities per cubic yard, water cementitious ratio, type and manufacturer of cement.

B. Placing drawings and bar bending details in conformity with the recommendations of ACI 315.

C. Technical data on all materials and components.

D. Material Safety Data Sheets (MSDS) for all concrete admixtures and curing agents.

E. Sieve analysis of fine and coarse aggregates.

F. Concrete mix for each formulation of concrete proposed for use including constituent quantities per cubic yard, water cementitious ratio, type and manufacturer of cement, and either below.

1. Standard deviation data for each proposed concrete mix based on statistical records.

2. Water cementitious ratio curve for each proposed concrete mix based on laboratory tests. Give average cylinder strength test results at 28 days for laboratory concrete mix designs. Provide results of 7 and 14 day tests if available.

G. Certifications: Certify admixtures used in the same concrete mix are compatible with each other and the aggregates.

B.6.1.3 QUALITY ASSURANCE

If, during the progress of the work, it is impossible to secure concrete of the required workability and strength with the materials being furnished, the ENGINEER may order such changes in proportions or materials, or both, as may be necessary to secure the desired properties. All changes so ordered will be made at the CONTRACTOR/DEVELOPER's expense.

Reinforced concrete will comply with ACI 318 and the recommendations of ACI 350R.

All testing and inspection services required, unless otherwise specified, will be provided and paid for by the CITY. Testing necessary to establish the concrete mixes will be performed by and at the expense of the CONTRACTOR/DEVELOPER. Methods of testing will comply with the latest applicable ASTM standards.

B.6.1.4 DELIVERY, STORAGE AND HANDLING

Reinforcing steel will be shipped and stored with bars of the same size and shape in fastened bundles with durable tags, marked in a legible manner with waterproof markings showing the same designations as shown on the submitted placing drawings. Reinforcing steel will be free from mill scale, loose rust, dirt, grease, or other foreign matter. Store off the ground and protect from moisture, dirt, oil, or other injurious contaminants.

Products will be stored in conformity with the manufacturer's recommendations. Sand, aggregates and cement will be stored or stockpiled in conformity with the recommendations of ACI 301.

PART B.6.2 – CONCRETE PRODUCTS

B.6.2.1 GENERAL

The use of manufacturer's name and model or catalog number is for the purpose of establishing the standard of quality and general configuration desired. Like items of materials will be the end products of one manufacturer in order to provide standardization for appearance, maintenance and manufacturer's service. Materials will comply with this Section and any applicable State or local requirements.

B.6.2.2 MATERIALS

Cement will be domestic Portland cement conforming to ASTM C150. The allowable types of cement for each concrete class are shown in Table 5.1. Air entraining cements will not be used.

Fine aggregate will be washed inert natural sand conforming to the requirements of ASTM C33. Coarse aggregate will be a well-graded crushed stone or washed gravel conforming to the requirements of ASTM C33, size 57. Limits of Deleterious Substances and Physical Property Requirements will be as recommended for severe weathering regions. Water will be potable, clean and free from injurious amounts of oils, acids, alkalis, organic matter, or other deleterious substances.

Concrete admixtures will be free of chlorides and alkalis (except for those attributable to water). When it is required to use more than one admixture in a concrete mix, the admixtures will be from the same manufacturer. Admixtures will be compatible with the concrete mix including other admixtures and will be suitable for use in contact with potable water after 30 days of concrete curing.

Air entraining admixture will comply with ASTM C260. Proportioning and mixing will be in accordance with manufacturer's recommendations.

Water reducing admixture will comply with ASTM C494, Type A. Proportioning and mixing will be in accordance with manufacturer's recommendations.

Admixtures causing retarded or accelerated setting of concrete will not be used without written approval from the ENGINEER. When allowed, the admixtures will be retarding or accelerating water reducing admixtures.

Reinforcing steel bars will be deformed, intermediate grade, steel conforming to ASTM A615 Grade 60. Reinforcing steel spirals for columns will conform to ASTM A82 or ASTM A615 Grade 60. Welded steel wire fabric will conform to ASTM A185. Tie wires for reinforcing steel will be 16 gauge or heavier, black annealed wire.

Precast concrete block bar supports will conform to CRSI - Manual of Standard Practice (MSP) for Precast Concrete Bar Supports.

B.6.2.3 MIXES

Select proportions of ingredients to meet the design strength and materials limits and to produce concrete having proper placability, durability, strength, appearance and other required properties. Proportion ingredients to produce a homogenous mixture which will readily work into corners and angles of forms and around reinforcement without permitting materials to segregate or allowing excessive free water to collect on the surface.

The design of each mix will be based on standard deviation data of prior mixes with essentially the same proportions of the same constituents or, if not available, be developed by independent testing laboratory acceptable to the ENGINEER engaged by and at the expense of the CONTRACTOR/DEVELOPER. Acceptance of mixes based on standard deviation will be based on the modification factors for standard deviation tests contained in ACI 318. Acceptance of mixes based on laboratory tests will be based on strengths greater than the specified design strengths specified in Table 5-1. The water content of the concrete mixes to be used, as determined from the curve, will correspond to strengths 16 percent greater than the specified design strength. The resulting mix will not conflict with the limiting values for maximum water cementitious ratio and net minimum cementitious content specified in Table 5-1.

Provide testing of the proposed concrete mix or mixes to demonstrate compliance with the compression strength requirements in conformity with the above paragraph. Entrained air, as measured by ASTM C231, will be as shown in Table 5-1. Slump of the concrete as measured by ASTM C143, will be as shown in Table 5-1.

Proportion admixtures according to the manufacturer's recommendations. Two or more admixtures specified may be used in the same mix provided that the admixtures in combination retain full efficiency and have no deleterious effect on the concrete or on the properties of each other.

TABLE B.6-2
CEMENT PARAMETERS

Class	Design Strength[1]	Cement ASTM	Cement Content[2]	W/C[3]	WR[4]	Slump Range Inches
A	2,500	Type II	440	0.62 max.	Yes	1-4
B	3,000	Type II	480	0.54 max.	Yes	1-4
F	5,000	Type II	600	0.40 max.	Yes	3.5-5

NOTES:
(1) Minimum compressive strength at 28 day
(2) Minimum cement content in pounds/cubic yards
(3) W/C is Water Cement ratio
(4) WR is water reducing admixture
(5) All Concrete classes will have 3.5 to 5 percent air entrainment.

B.6.2.4 MEASURING, BATCHING, MIXING AND TRANSPORTING CONCRETE

Measuring, batching, mixing and transporting concrete will conform to ASTM C94 and the requirements herein or as otherwise approved in writing by the ENGINEER.

Ready-mixed concrete, whether produced by a concrete supplier or the CONTRACTOR/DEVELOPER will conform to the requirements above. No hand mixing will be permitted.

Admixtures will be dispensed into the batch in conformity with the recommendations of the manufacturer of the admixtures.

Concrete will be mixed until there is uniform distribution of the materials and will be discharged completely before the mixer is recharged. The mixer will be rotated at a speed recommended by the mixer manufacturer and mixing will be continued for at least 1-1/2 minutes after all the materials are in the mixer.

Concrete will be placed within 1-1/2 hours of the time at which water was first added, otherwise it will be rejected. Concrete which has been remixed or retempered, or to which an excess amount of water has been added, will also be rejected.

B.6.2.5 FORMS

Forms will be free from roughness and imperfections, substantially watertight and adequately braced and tied to prevent motion when concrete is placed. No wooden spreaders will be allowed in the concrete.

Wire ties will not be allowed. Metal ties or anchorages which are necessary within the forms will be so constructed that the metal work can be removed for a depth of at least 1 inch from the surface of the concrete without injury to such surface by spalling or otherwise. Forms will be thoroughly cleaned before using and will be treated with oil, or other approved material. All exposed edges of the finished concrete will be chamfered 3/4 inch.

PART B.6.3 – CONCRETE EXECUTION

B.6.3.1 REINFORCING STEEL

Reinforcing steel will be accurately fabricated to the dimensions shown. Bars will be bent around a revolving collar having a diameter of not less than that recommended in ACI 318. All bars will be bent cold.

Unless otherwise shown, splices in reinforcing steel will be lapped in conformity with ACI 318 but not less than 24 diameters. All bar splices will be staggered wherever possible. When splicing bars of different diameters, the length of lap is based on the larger bar.

Splices in welded wire fabric will be lapped not less than 1-1/2 courses or 12-in, whichever is greater. Wire fabric splices will be tied together with wire ties spaced no more than 24 inches on center. Before being placed in position, reinforcement will be thoroughly cleaned of loose mill and rust scale, dirt and other coatings, including ice, that reduce or destroy bond. Where there is a delay in depositing concrete after the reinforcement is in place. Bars will be reinspected and cleaned when necessary.

Reinforcement which is to be exposed for a considerable length of time after being placed will be given a heavy coat of cement grout.

In no case will any reinforcing steel be covered with concrete until the amount and position of the reinforcements have been checked and permission given to proceed by the ENGINEER.

B.6.3.2 FIELD TESTS

Sets of three field control cylinder specimens will be taken by the ENGINEER during the progress of the work, in compliance with ASTM C31. The number of sets of concrete test cylinders taken of each class of concrete placed each day will not be less than one set, nor less than one set for each 150 cubic yards of concrete nor less than one set for each 5,000 square feet of surface area for slabs or walls. One cylinder will be broken at 7 days and two cylinders will be broken and their strengths averaged at 28 days. When the average 28 day compressive strength of the cylinders in any set falls below the specified compressive strength or below proportional minimum 7 day strengths (where proper relation between 7 and 28 day strengths have been established by tests); the ENGINEER may reject the concrete represented by the set of cylinders, may require modification of the concrete and/or require modification of the proportions, water content, or temperature conditions of the design mix to achieve the required strengths.

Cooperate in the making of tests by allowing free access to the work for the selection of samples, providing an insulated closed curing box for specimens, affording protection to the specimens against injury or loss through his/her operations and furnishing material and labor required for the purpose of taking concrete cylinder samples. All shipping of specimens will be paid for by the CITY.

Slump tests will be made in the field by the ENGINEER in conformity with ASTM C143.

Tests for air content will be made in compliance with either the pressure method complying with ASTM C231 or by the volumetric method complying with ASTM C173.

B.6.3.3 INSPECTION AND CONTROL

The batching, mixing, transporting, placing and curing of concrete will be subject to the inspection of the ENGINEER at all times. The CONTRACTOR/DEVELOPER will advise the ENGINEER of his/her readiness to proceed at least 24 hours prior to each concrete placement. The ENGINEER will inspect the preparations for concreting including the preparation of previously placed concrete, the reinforcing steel, and the alignment, cleanliness and tightness of formwork. No placement will be made without the inspection and acceptance of the ENGINEER.

B.6.3.4 CONCRETE APPEARANCE

Concrete mix showing either poor cohesion or poor coating of the coarse aggregate with paste will be remixed. If this does not correct the condition, the concrete will be rejected.

Concrete for the work will provide a homogeneous structure which, when hardened, will have the required strength, durability and appearance. Mixtures and workmanship will be such that concrete surfaces, when exposed, will require no finishing. When concrete surfaces are stripped, the concrete when viewed in good lighting from 20 feet will show no visible defects.

B.6.3.5 PLACING AND COMPACTING

No concrete will be placed until forms, condition of subgrade and method of placement have been approved by the ENGINEER. Before depositing concrete, all debris, foreign matter, dirt and water will be removed from the forms. The contact surface between concrete previously placed and new concrete will be cleaned and brushed with cement paste. Concrete, except as indicated on the Drawings, will not be placed in water or submerged within 24 hours after placing, nor will running water be permitted to flow over the surface of fresh concrete within 4 days after its placing.

Deposit concrete as near its final position as possible to avoid segregation due to rehandling or flowing. Pumping of concrete will be permitted when an approved design mix and aggregate sizes, suitable for pumping, are used. Do not deposit concrete which has partially hardened or has been contaminated by foreign materials.

If the section cannot be placed continuously, place construction joints as specified or as approved. Place concrete for walls using tremie tubes in 12 to 24-inch lifts, keeping the surface horizontal. Do not drop concrete more than 4 feet.

High frequency mechanical vibrators will be used to the extent necessary to obtain proper consolidation of the concrete, but not to move or transport concrete in the forms. Care will be taken to avoid segregation of aggregates by excess vibration. Vibration will continue until the frequency returns to normal, trapped air ceases to rise and the surface appears liquefied, flattened and glistening. Concrete adjacent to forms and around pipe stubs will be carefully spaded or rodded.

B.6.3.6 CURING AND PROTECTION

Protect all concrete work against injury from the elements and defacements of any nature during construction operations.

All concrete will be cured in conformity with ACI 301. Concrete that is to be used for the containment of water will be water cured. Water curing will be by ponding, by continuous sprinkling or by covering with continuously saturated burlap.

Other concrete will be cured by either water curing, sheet material curing or liquid membrane curing compound except that liquid membrane curing compound will not be used on any concrete surface where additional concrete is to be placed or where the concrete surface is to be coated or painted.

Finished surfaces and slabs will be protected from the direct rays of the sun to prevent checking and crazing.

Concrete placed during cold weather will be batched, delivered, placed, cured and protected in compliance with the recommendations of ACI 306R. Salt, manure or other chemicals will not be used for cold weather protection.

Concrete placed during hot weather, will be batched, delivered, placed, cured and protected in compliance with the recommendations of ACI 305R. The temperature of the concrete will be such that it will cause no difficulties from loss of slump, flash set or cold joints. Immediately cover plastic concrete with sheet material during hot weather.

B.6.3.7 STRIPPING AND FINISHING CONCRETE

Forms will not be stripped before the concrete has attained the strength of at least 30 percent of the specified design strength, unless otherwise approved by the ENGINEER. This is equivalent to approximately '100 day-degrees' of moist curing.

Care will be exercised to prevent damaging edges or obliterating the lines of chamfers, rustications or corners when removing the forms or doing any other work adjacent thereto. Clean all exposed concrete surfaces and adjoining work stained by leakage of concrete, to the satisfaction of the ENGINEER.

As soon as forms have been stripped, form ties, if employed, will be removed, and the recess filled to insure complete watertightness. Any defects in the surface of the walls will be chipped out and repaired in a workmanlike manner. Defective concrete where it occurs will be cut to a minimum depth of 1-in, thoroughly roughened and neat cement brushed in. The hole will then be filled with mortar in the proportion of 1 part cement and 2-1/2 parts sand with a minimum of water. Mortar for filling form tie recesses will be mixed to a slightly damp consistency (just short of 'balling'), pressed into the recess until dense, and troweled smooth.

Mortar in larger patches will be applied and allowed to assume a partial set following which it will be struck off flush with the adjoining surface. Patches will be kept moist for several days to assure proper curing.

Concrete to receive dampproofing and concrete not exposed in the finished work will have off-form finish with fins and other projections removed and tie cones and defects filled as specified.

Top surface of slabs will be screened to the established grades and will be a true plane with a tolerance of 1/8 inch when checked with a 10-foot straightedge. The surface will be pitched to drain unless otherwise noted on the Drawings. The surface will be finished to give a smooth, hard, even surface free from high or low spots or other defects. Concrete subject to pedestrian traffic will be given a broom finish. Failure to meet the condition will be cause for removal, grinding, or other correction as directed by the ENGINEER.

B.6.3.8 SCHEDULE

The following Table 5-2 shows the general applications for the various concrete design strengths to be used:

TABLE B.6-3
DESIGN STRENGTH

Class	(psi)	Description
A	2,500	Concrete fill and duct encasement
B	3,000	Concrete overlay slabs and pavements
F	5,000	Precast Concrete

SECTION B.7

BORING AND JACKING

PART B.7.1 – GENERAL

B.7.1.1 SCOPE OF WORK

Furnish all labor, materials, equipment, supplies and incidentals required and install casing pipe and carrier pipe by jacking under the roadways at the locations shown on the Drawings and as specified herein.

Work will be done in strict accordance with the details shown on the Drawings and as specified herein and in accordance with all State and local laws, regulations and requirements.

The work will include, but not be limited to, the following: steel casing pipe, skids, casing seals, coatings, location markers and miscellaneous appurtenances as required to complete the installation.

B.7.1.2 SUBMITTALS

Submit shop drawings to the ENGINEER for review showing a sketch of the jacking pit locations and method proposed for boring and jacking the casing pipe.

B.7.1.3 INSPECTIONS

All pipe and fittings to be installed under this Contract may be inspected at the site of manufacturer for compliance with these Specifications by an independent laboratory selected by the CITY. The manufacturer's cooperation shall be required in these inspections. The cost of inspection by an independent laboratory will be borne by the CITY.

Inspections of the pipe may also be made by the ENGINEER or other representatives of the CITY after delivery. The pipe will be subject to rejection at any time on account of failure to meet any of the requirements specified herein, even though sample pipes may have been accepted as satisfactory at the place of manufacture. Pipe rejected after delivery will be marked for identification and will be removed from the job at once.

PART B.7.2 – PRODUCTS

B.7.2.1 STEEL CASING PIPE

Casing shall be required by all pressure pipes constructed under pavement. Steel casings will be of leak proof construction and will conform to the requirements of ASTM A53 (ASTM A139 Grade 'B') and will be protected inside and outside by a black bituminous coating a minimum of 5 mils thick. Steel casing pipe will have a minimum yield strength of 35,000 psi, will be equipped with grout holes as specified herein, and will be designed to withstand H-20 traffic loading.

The inside diameter of the casing pipe will be at least 2 inches greater than the largest outside diameter of the carrier pipe, joints, or couplings, for carrier pipe less than 6 inches in diameter The inside diameter of the casing pipe will be at least 4 inches greater than the largest outside diameter of the carrier pipe, joints, or couplings, for carrier pipe 6 inches and over in diameter. It will, in all cases, be large enough to allow the carrier pipe to be removed subsequently without disturbing the casing pipe or roadway subgrade.

In the event that steel casing pipe wall thickness is not shown on the drawings, the following wall thicknesses shall be used as show in Table 6-1

TABLE B.7-2
CASING PIPE THICKNESSES

Casing Pipe Inside Diameter (inches)	Casing Pipe Wall Thickness (inches)
6-16	0.250
18-20	0.312
22-24	0.375
26-28	0.437
30-34	0.500
36-38	0.562
40-50	0.625
52-58	0.750
60-78	0.813

Field and shop welds of the casing pipe shall conform to the American Welding Society standard specifications.

B.7.2.2 PVC CASING PIPE

PVC casing pipe is permitted only for service lines less than or equal to 1 inch. The PVC casing pipe will be 2-inch Class 200 PVC pipe.

B.7.2.3 CARRIER PIPE

All carrier pipe joints within the casing pipe will be restrained or harnessed. All potable water carrier pipe and sewer carrier pipe shall be ductile iron meeting the specifications of Sections 1, 2, and 3 of these standards.

PART B.7.3 – EXECUTION

B.7.3.1 GENERAL

Notify the CITY at least 7 days in advance of the planned start of work within the roadway right-of-way and notify either the CITY, County or FDOT as required by permit in advance of planned work in their right-of-way.

Jacking pit subgrades will be kept continuously free from ground and surface waters during jacking operations. Additional groundwater controls may be ordered on short notice and will be implemented as directed. Observed water levels prior to construction are to be below the invert elevation of the jacking pits. Groundwater control along and at the face of the jacking casing will include chemical grout stabilization as required.

B.7.3.2 INSTALLATION

Excavate jacking pit and provide excavation supports as required. Excavation support will extend a sufficient depth below the invert of the steel casing pipe to resist any pressure developed by the soil outside the jacking pit. Excavation support will extend at least 3 feet, 6 inches above existing grade.

Furnish a level concrete slab at the bottom of the jacking pit. Steel rails or beams will be embedded in the concrete slab for placement and alignment of each piece of casing pipe or carrier pipe during installation operations. Furnish, install and remove, to the extent required, thrust blocks or such other provisions as may be required in driving the casing pipe or carrier pipe forward.

Maintain proper alignment and elevation of the casing pipe consistently throughout the jacking operation. Tolerances for installation of the casing pipe will be as follows:

A. Elevation: to grade or a maximum of 9 inches below grade.

B. Plan Location: plus or minus 1-foot.

Jacking operations for the casing pipe will be continuous and precautions will be taken to avoid interruptions which might cause the pipe to 'freeze' in place. Dewatering through the casing pipe during construction will not be permitted.

Carrier pipe will be supported within the casing pipe so that pipe bells do not rest directly on the casing. The load of the carrier pipe will be distributed along the casing by the method of support as shown on the Drawings and as specified herein.

Steel casing pipe sections will have beveled ends with a single v-groove and will be full penetration butt welded on the outside of the casing in accordance with the applicable portions of AWWA C206 and AWS D7.0 for field welded water pipe joints. All joints of the steel casing will be butt welded prior to being subjected to the jacking operation. The welded joints will be wire brushed and painted with bitumastic enamel coating in accordance with AWWA C203. Permalok joints are also acceptable.

Jacking will be performed in a manner to prevent voids from developing outside the jacking sleeve. A jacking shield will be used to minimize the amount of voids produced during excavating in the forward end of the jacking sleeve. Voids which occur will be filled with cement grout.

Furnish and install, and later remove to the extent required, thrust blocks or other provisions for backing up the jacks employed in driving the casing pipe forward.

Immediately following the jacking operation, pressure grout the jacked section to fill all voids existing outside of the jacked casing. Grouting will be from the interior of the casing through the grouting holes.

After the casing pipe has been completely installed, thoroughly clean the interior of the casing pipe and remove all excess material leaving a smooth interior throughout.

Install casing vents as detailed on the Drawings. Casing vents will be installed with vent piping directed toward the edge of the right-of-way unless otherwise shown on the Drawings.

The exit pit will be excavated up to the casing pipe. Excavation support will be provided as required. Sufficient room will be provided to continue installation of carrier pipe, fittings and all necessary connections to the system.

The carrier pipe will be installed within the casing using skids. Carrier pipe will be installed from the jacking pit end of the casing. Each joint will be thoroughly checked prior to being inserted into the casing.

Upon completion of installation of the carrier pipe inside the casing pipe, provide suitable restrained caps or plugs at each joint outside the end of the casing pipe and hydrostatically test the carrier pipe to 150 psi for 30 minutes. There will be no allowable leakage. Remove the carrier pipe from the casing and remake leaking joints. Repeat hydrostatic test until there are no leaks in the carrier pipe within the casing.

Fill void between casing pipe and carrier pipe completely with sand in one continuous uninterrupted operation in a manner to prevent the occurrence of any voids between the casing pipe and the carrier pipe.

B.7.3.3 SITE RESTORATION

At the conclusion of all jacking operations, remove excavation support systems for jacking pits. If withdrawal should damage or disturb the roadway subgrade, leave supports in place and cut off 36 inches below finished grade.

Following pipe installation and backfill operations, restore the profile of the right-of-way to its original condition. Install sodding or seeding to match existing, as required.

Remove all equipment, supplies, excess excavation materials and miscellaneous items associated with the jacking operation and leave the site in a clean and tidy condition.

SECTION B.8

HORIZONTAL DIRECTIONAL DRILLING

PART B.8.1 – GENERAL

B.8.1.1 SCOPE OF WORK

The CONTRACTOR/DEVELOPER shall furnish all labor, equipment, and materials necessary to install pipelines by horizontal directional drilling (HDD) at the locations shown on the plans.

The work of this section includes all labor, machinery, construction equipment and appliances required to perform in a good workmanlike manner all directional boring and HDPE carrier pipe installations.

The directional boring scope shall include, but not be limited to steerable directional boring equipment, operator control cabin, mud plant, entry and exit pits, pumps, hoses, and other equipment, sheeting, location signs as required, miscellaneous appurtenances to complete the entire work as shown on the plans and restoration. Directional boring operations shall be performed within the right-of-way and/or easements shown on the plans.

B.8.1.2 SUBMITTALS

CONTRACTOR/DEVELOPER will submit to the ENGINEER a Frac-out and Surface Spill Contingency Plan for the installation of pipelines using HDD. The plan shall be submitted to the ENGINEER prior to construction. The CONTRACTOR/DEVELOPER shall submit letter signed by an authorized representative of CONTRACTOR/DEVELOPER, confirming that the plan will be followed.

Submit written documentation of HDD superintendent and key personnel experience and daily logs and records in accordance with requirements listed below. Daily logs and records shall be provided to the ENGINEER by noon on the day following the shift for which the data or records were taken.

After the completion of the work submit record drawings of the location and depth of the HDD.

B.8.1.3 PERFORMANCE REQUIREMENTS

The drilling equipment shall be capable of advancing through the geologic conditions to be encountered at the site, as anticipated by the CONTRACTOR/DEVELOPER. The drilling fluid shall be designed for the geologic conditions to be encountered at the site, as anticipated by the CONTRACTOR/DEVELOPER.

The drilling system shall include a fluid pump and separation plant that can achieve the rates of drilling fluid pumping, spoil separation, and slurry cleaning required by

the CONTRACTOR/DEVELOPER to achieve planned production rates for the soils. Shaker screens and hydrocyclones may be required for efficient separation of spoils.

The CONTRACTOR/DEVELOPER is advised that the separation plant must fit within the allowable work areas shown on the plans.

All spoil and slurry must be contained in trucks, tanks, approved recirculation pits, or other containers at all times. Dumping of spoil or slurry on the ground, discharge into sanitary or storm sewers, or discharge into water bodies will not be permitted. All spoils will be transported and disposed of off-site at an approved disposal facility that meets all State of Florida and local requirements.

The pipeline shall be installed using the radii of curvatures and entry and exit angles shown on the drawings, unless deviations are approved in writing by the ENGINEER. Pipe rollers and lifters will be required to help the transition of the carrier pipe into the bore.

Surface settlement or heave of utilities and other features above the HDD centerlines and within the zone influenced by the HDD construction shall be limited to values that avoid damage. The CONTRACTOR/DEVELOPER shall repair any damage resulting from settlement or heave caused by HDD activities at no additional cost to the CITY. The CONTRACTOR/DEVELOPER shall grout any voids caused by or encountered during drilling.

The pipe will be certified by the CONTRACTOR/DEVELOPER as meeting all requirements of the specifications. The fabricated pipe will be pressure-tested by the CONTRACTOR/DEVELOPER prior to pullback and after installation is completed.

B.8.1.4 QUALITY ASSURANCE

The CONTRACTOR shall have at least 5 years of demonstrated successful experience installing pipelines using the horizontal directional drilling process on at least two projects with similar diameters, installation lengths, and ground and groundwater conditions. CONTRACTOR must be licensed in the State of Florida as an underground utility contractor for a minimum of 4 years. These projects shall include individual bore lengths of at least 500 ft under similar soil conditions. The CONTRACTOR shall demonstrate successful completion of at least three projects where HDPE pipe was installed with horizontal directional drilling techniques. The CONTRACTOR shall furnish evidence of successful experience, including project owner, project name, location, diameter, length, depth, ground conditions, any problems encountered and how resolved, and any claims and how resolved. CONTRACTOR/DEVELOPER's representative with address and telephone number shall be provided. Alternatively, the CONTRACTOR/DEVELOPER shall provide letter confirming that the CONTRACTOR/DEVELOPER has met pre-responsibility criteria determination for this project.

The CONTRACTOR shall employ skilled, experienced superintendent(s) and personnel. The superintendent(s) shall have at least 5 years of successful experience using the HDD process, on at least five projects with similar diameters, pullback length, and ground conditions. The projects shall include individual bores of at least 500 feet in length.

The CONTRACTOR shall furnish resumes of the superintendent(s) and key personnel. Personnel experience records shall include project names, locations, pullback lengths, ground conditions, pipe materials, project description, project OWNER, ENGINEER, and references with names, addresses, and telephone numbers. The superintendent listed in the submittal shall be on site during all construction related activities required for the HDD installation.

Daily logs and records shall be maintained by the CONTRACTOR/DEVELOPER and shall include drilling lengths, location of drill head, drilling fluid pressures and flow rates, drilling fluid losses, inadvertent returns, drilling times required for each pipe joint, any instances of retraction and re-drilling of the pilot bore or segments thereof, and any other relevant observations, including any observed settlement, heave, frac-outs, or surface spills. The downhole annular drilling fluid pressures shall be measured and recorded throughout the pilot hole drilling. These records shall be maintained and provided daily to the ENGINEER. The position of the drill head shall be continuously tracked and recorded by a downhole wire line tracking locator system, and shall be supplemented by a 'TruTracker' or equivalent tracking system installed between the entry point and the exit point. The coordinates of the surface wire grid system shall be surveyed and recorded. A plot of actual locations of the bore path shall be maintained and updated daily, or more frequently, as directed by the ENGINEER.

The CONTRACTOR/DEVELOPER shall immediately notify the ENGINEER, in writing, when any significant problems are encountered. All surveying equipment used for downhole surveying and tracking of the bore path and drill head shall be inspected and calibrated by the equipment manufacturer prior to use. Proof of this inspection and calibration shall be provided to the ENGINEER prior to commencement of drilling operations.

PART B.8.2 – PRODUCTS

B.8.2.1 HIGH DENSITY POLYETHYLENE (HDPE) PIPE

All potable water and force mains installed by horizontal directional drill shall be HDPE pipe meeting the specifications of Sections 1 and 3 of these standards.

B.8.2.2 WATER

The CONTRACTOR/DEVELOPER shall secure a suitable source of water, and shall be responsible for purchasing, transporting, storing, and disposing of any water required.

B.8.2.3 DRILLING FLUIDS

The CONTRACTOR/DEVELOPER shall select drilling fluid mixture proportions to ensure continuous circulation, bore stability, reduce drag on the pipe, and completely fill the annular space between the bore and the pipe to control settlement. Management and disposal of drilling fluids shall be the CONTRACTOR/DEVELOPER's responsibility. Drilling fluids shall not be disposed of on-site or discharged to sanitary or storm sewers, or the water way.

B.8.2.4 DRILL PIPE

The CONTRACTOR/DEVELOPER shall provide high quality drill pipes that have been inspected and determined to be adequate for the project requirements. Bent, racked, or fatigued drill pipes shall not be used. Threads must be in good condition. The length of each drill pipe shall be measured and recorded.

PART B.8.3 – EXECUTION

B.8.3.1 GENERAL

The CONTRACTOR/DEVELOPER shall provide adequate control of surface water and drilling fluids drainage and runoff, and provide silt fences, hay bales, and wattles to prevent surface water or drilling fluids from being transported off-site.

The CONTRACTOR/DEVELOPER shall follow all requirements of the Frac-Out and Surface Spill Contingency Plan as submitted and approved and shall control operational pressures, drilling mud weights, drilling speeds, and any other operational factors required to avoid hydrofracture fluid losses to formations, and control drilling fluid spillage. This includes any spillages or returns at entry and exit locations or at any intermediate point. All inadvertent returns or spills shall be promptly contained and cleaned up. The CONTRACTOR/DEVELOPER shall maintain on-site mobile spoil removal equipment during all drilling, pre-reaming, reaming, and pullback operations and shall be capable of quickly removing spoils. The CONTRACTOR/DEVELOPER shall immediately notify ENGINEER of any inadvertent returns or spills and immediately contain and clean up the return or spill

The drawings show existing buried utilities that are believed to be near the directional drill alignment. There is no guarantee that these utilities are located as shown or that other utilities are not present. It will be the CONTRACTOR/DEVELOPER's responsibility to locate all nearby utilities or other potential subsurface obstructions that may interfere with the work.

The CONTRACTOR/DEVELOPER shall notify 'One Call' system to request marking of utilities that subscribe to One Call, and shall individually notify all other known or suspected utilities to request marking of these utilities. The CONTRACTOR/DEVELOPER shall confirm that all requested locates are made prior to commencing drilling operations. CONTRACTOR/DEVELOPER shall make all diligent efforts to locate any unmarked or abandoned utilities using all available information, maps, and drawings. The CONTRACTOR/DEVELOPER shall visually confirm and stake all existing lines, cables, or other underground facilities including exposing all crossing utilities and utilities within 10 feet laterally of the centerline of designed drilled path.

The CONTRACTOR/DEVELOPER shall control drilling practices to prevent damage to existing utilities and make a diligent effort to locate surface evidence of any other potential subsurface obstructions, such as piers and piles. The CONTRACTOR/DEVELOPER shall be responsible for all losses and repairs occasioned by damage to underground utilities resulting from drilling operations.

B.8.3.2 HORIZONTAL DIRECTIONAL BORING

The capacity of the directional drilling system used by the CONTRACTOR/DEVELOPER shall be adequate to install the specified pipeline. The pumps used by the CONTRACTOR/DEVELOPER shall be adequate to supply the required flow rate and pressures at the anticipated drilling fluid viscosity at all times. Drilling speeds shall not exceed pump capacity.

At all times during the pilot bore the CONTRACTOR/DEVELOPER shall provide and maintain a bore tracking system that is capable of accurately locating the position of the drill head in the x, y, and z axes. The CONTRACTOR/DEVELOPER shall record these data at least once per drill pipe length or every 30 feet.

CONTRACTOR/DEVELOPER shall monitor and record x, y, and z coordinates relative to an established surface survey benchmark, from downhole survey data using downhole wireline system. Tru-tracker energized surface grid, or equivalent, shall be installed and used to supplement the wireline system. The grids shall be surveyed to establish horizontal and vertical position to 0.1-foot accuracy. The data shall be continuously monitored and recorded at least once per drill pipe length.

Deviations between the recorded and design bore path shall be calculated and reported on the daily log. If the deviations exceed tolerances specified elsewhere, such occurrences shall be reported immediately to the ENGINEER. The CONTRACTOR/DEVELOPER shall undertake all necessary measures to correct deviations and return to design line and grade.

Drilling fluid pressures and flow rates shall be continuously monitored and recorded by the CONTRACTOR/DEVELOPER. The pressure shall be monitored at the pump. These measurements shall be made during pilot bore drilling, reaming, and pullback operations.

Maximum allowable drilling speeds shall be calculated by the CONTRACTOR/DEVELOPER for pilot boring and each reaming pass and shall not be exceeded for pilot boring or reaming passes. Measurements shall be taken every 30 feet or 30 minutes, whichever is more frequent.

The CONTRACTOR/DEVELOPER shall measure and record drilling fluid viscosity and density at least three times per shift with at least 2 hours between readings, using calibrated Marsh funnel and mud balance. These measurements shall be included in daily logs submitted to the ENGINEER. The CONTRACTOR/DEVELOPER shall document modifications to the drilling fluids, by noting the types and quantities of drilling fluid additives and the dates and times when introduced. The reason for the addition of drilling fluid additives or other modifications shall be documented and reported.

Entry and exit points shall be as shown on the Drawings, unless otherwise approved in writing by the ENGINEER. The CONTRACTOR/DEVELOPER shall employ licensed, experienced surveyors to locate the entry and exit points, and to establish horizontal and vertical datum for the bore and the pipe layout and fabrication areas.

Drill entrance and exit angles shall be as shown on the Contract Plans and Drawings, unless otherwise approved in writing by the ENGINEER. The pilot bore shall follow the design path of the bore shown on the Drawings.

Horizontal and vertical deviations shall be less than plus or minus 2 feet from the design path centerline. The CONTRACTOR/DEVELOPER shall continuously monitor horizontal and vertical position and record the position at least once per drill pipe length, or at 30 feet. The radius of curvature shall not be less than that shown on the Drawings. The radius of curvature shall be calculated over the distance of three drill pipe sections.

The location of the entry and exit points shall be as shown on the Drawings. The CONTRACTOR/DEVELOPER shall be solely responsible for all work necessary to correct excessive deviations from line and grade, including redrilling, redesigning connections, and acquiring additional easement, at no additional cost to the CITY and without schedule extension.

The pilot bore shall be pre-reamed and reamed using equipment and methods submitted to the ENGINEER. The CONTRACTOR/DEVELOPER shall completely ream the bore to the final diameter prior to pullback.

The CONTRACTOR/DEVELOPER shall notify the ENGINEER immediately in the event that any obstruction is encountered that prevents further advancement of the drill pipe, or pullback of the pre-reamer, reamer, and/or pipe. The CONTRACTOR/DEVELOPER shall make all diligent and reasonable efforts to advance past the object by drilling slowly through the object, pulling back, and drilling along a new bore path that avoids the object, or excavating and exposing and removing the object, and all other reasonable attempts to continue the bore.

The CONTRACTOR/DEVELOPER shall notify the ENGINEER or proposed measures to attempt to advance past the object, prior to initiating the attempt.

If the CONTRACTOR/DEVELOPER attempts to pullback and re-drill, the CONTRACTOR/DEVELOPER shall adhere to line and grade tolerances established in this specification section, unless the ENGINEER approves variance, in writing, prior to the CONTRACTOR/DEVELOPER's attempt to re-drill. The CONTRACTOR/DEVELOPER and ENGINEER shall investigate the cause and together determine an appropriate response.

Appropriate response may include revisions to equipment or methods, retraction and re-drilling of a portion of the bore, or abandonment of the hole. If abandonment is deemed necessary, the CONTRACTOR/DEVELOPER shall recover, to the extent practicable, any drill pipe, product pipe, and tools in the bore, and properly abandon the bore by contact grouting unless otherwise directed in writing by the ENGINEER.

If the bore is abandoned, the CONTRACTOR/DEVELOPER shall be allowed to begin a second attempt to install the pipeline at an alternate location subject to approval, in writing, by the ENGINEER. The CONTRACTOR/DEVELOPER shall take all reasonable actions to complete the installation with minimal delays.

The extra costs and payments associated with encountering a confirmed obstruction shall be negotiated between the CITY and CONTRACTOR/DEVELOPER, based on reasonable time and materials provided that the obstruction could not have reasonably been anticipated by the CONTRACTOR/DEVELOPER. No additional compensation or time shall be granted for bores exceeding the tolerances specified herein.

The CONTRACTOR/DEVELOPER shall remove all equipment, materials, drilling fluids, muck, waste, and debris from the site and restore the site to its original condition upon completion of the installation. Restoration and demobilization shall be completed by the CONTRACTOR/DEVELOPER within 7 days of the completion of the pipeline installation.

The CONTRACTOR/DEVELOPER shall visually monitor for settlement or heave before and during drilling and grouting operations.

The CONTRACTOR/DEVELOPER shall perform hydrostatic water pressure test in accordance with Sections 1 and 3 of these standards prior to pipe pullback.

B.8.3.3 PIPE PULL BACK

The pipe shall be installed by pulling it into the reamed bore path in a continuous operation, behind a final reaming tool selected by the CONTRACTOR/DEVELOPER. The pipe shall be isolated from excessive torsional and axial stresses by a swivel device.

All measurements shall be made, recorded, and submitted on the daily logs during final reaming and pipe pullback. The maximum pull (axial tension force) exerted on the HDPE pipelines shall be measured continuously and limited to the maximum allowed by the pipe manufacturer so that the pipe or joints are not overstressed. A factor of safety over the maximum allowable is not required.

The pipelines shall be adequately supported during installation so as to prevent overstressing or buckling. The CONTRACTOR/DEVELOPER shall provide adequate support/rollers along the stringing area to support the required length of the HDPE pipe for each bore. Such support/rollers shall be spaced at a maximum of 60 feet on centers, and the rollers be comprised of a non-abrasive material arranged in a manner to provide support to the bottom and bottom quarter points of the pipeline allowing for free movement of the pipeline during pullback. The pipe layout area shall be cleared of all large stones, construction debris, or other foreign objects that could damage the piping during pullback.

The leading end of the pipe shall be closed during the pullback operation. Each length of pipe shall be inspected and cleaned as necessary to be free of debris immediately before joining.

The CONTRACTOR/DEVELOPER shall at all times handle the HDPE pipe in a manner that does not overstress or otherwise damage the pipe. Vertical and horizontal curves shall be limited so that wall stresses do not exceed 50% of yield stress for flexural bending of the HDPE pipe.

If the pipe is buckled or otherwise damaged due to CONTRACTOR/DEVELOPER's acts or omissions, the damaged section shall be removed and replaced by the CONTRACTOR/DEVELOPER at his expense. The CONTRACTOR/DEVELOPER shall take appropriate steps during pullback to ensure that the HDPE pipe will be installed without damage.

The HDPE pipe shall be filled with water as it enters the bore to reduce pullback loads and to ensure that adequate internal pressure is maintained at all points to counter balance collapse pressures. The CONTRACTOR/DEVELOPER shall monitor and inspect pipe rollers and method for suspending pipe at entry during the pullback operation to avoid damage to the pipe.

The CONTRACTOR/DEVELOPER shall cease operations if the pipe is damaged and shall remove the pipe from the bore and repair the pipe using the manufacturer's recommended procedure or replace the damaged pipe before resuming installation. Damage to the pipe resulting from installation, contact grouting, or grouting of the annulus is the responsibility of the CONTRACTOR/DEVELOPER, including costs for replacement and labor and materials. To confirm no damage to the pipe, upon completing of pullback and grouting, the CONTRACTOR/DEVELOPER shall perform the following test on the completed pipeline:

A sphere or pig, 1 inch less in diameter than the internal diameter of the product pipe, which is capable of allowing water to pass through it, complete with a pulling cable on either side of sphere or pig, shall be pulled through the entire length of the pipeline. If the pig or sphere cannot pass through the pipe, it shall be considered collapsed and damaged. Check manufacturer's tolerance and fuse bead size.

After the carrier pipe is completely pulled through the bore, a sufficient relaxation period as recommended by the pipe manufacturer shall be provided before the final pipe tie-in. The CONTRACTOR/DEVELOPER shall conduct a final hydrostatic test of the installed pipeline. The CONTRACTOR/DEVELOPER shall repair any defects discovered during the test, and repeat until the pipe passes the test.

B.8.3.4 ANNULAR SPACE AND CONTACT GROUTING

The CONTRACTOR/DEVELOPER shall grout the annular space between the bore and the outer diameter of the HDPE pipe prior to the pig test. Grouting shall be completed within 48 hours of completion of the final hydrostatic test. The grouting operations shall ensure that the annulus is filled with grout for at least the first 100 feet from entry point and the last 100 feet before exit point.

Grouting may be accomplished using one or more of the methods described below, or an alternative submitted by the CONTRACTOR/DEVELOPER, subject to ENGINEER's approval. The CONTRACTOR/DEVELOPER shall ensure that the annulus does not provide a preferential pathway for seepage regardless of the method(s) used and shall ensure that settlements shall not cause damage to existing utilities, roadways or structures.

Tremie pipes shall be inserted into the borehole, for at least 100 feet from both entry and exit ends after the pipe pullback is completed to grout the annular space between borehole and pipe, or any other voids created or encountered above the borehole.

Tremie grout pipes shall be not less than 1-1/4 inch and not more than a 2-inch diameter Schedule 40 PVC, and shall be inserted at the crown and at two locations 60 degrees from the crown. Grout will be injected in sufficient volume to completely fill the annulus as the tremie pipes are withdrawn. Grouting pressures shall be carefully controlled and monitored to avoid applying excessive pressure to the pipe and to avoid heave or hydrofracture. The pipes shall be filled with water during grouting to counterbalance grouting pressures and to avoid excessive heat of hydration as the grout sets that could damage the pipes.

Mix grout into drilling fluids and inject with drilling fluid as pipe is pulled back final 100 feet to grout annulus at entry side. Grout shall be mixed into drilling fluid recirculation/distribution system and shall be injected as drilling fluid as pipe is pulled back final 100 feet. The grout mixture shall satisfy performance requirements of drilling fluid before set and requirements of annulus grout after set. Retarding agents may be incorporated into grout mixture to allow sufficient time to complete pipe pullback before initial grout set. The exit side annulus shall be grouted by inserting a tremie pipe into the bore annulus for at least 100 feet from the exit end as described above. Grout/drilling fluid injection pressures shall be less than pressures that could result in collapse of the pipe or hydrofracture of the surrounding soil.

SECTION B.9

EXCAVATING, BACKFILLING AND COMPACTING FOR UTILITIES

PART B.9.1 – GENERAL

B.9.1.1 SCOPE OF WORK

Work under this section includes clearing and grubbing, excavation, backfill, compaction, pavement removal and replacement, site restoration and cleanup for construction of underground pipelines, pumping stations and their related structures. Pipe materials and pipeline construction are covered in other appropriate sections of these Specifications.

B.9.1.2 SITE CONDITIONS

The CONTRACTOR/DEVELOPER will not enter or occupy private land except by notarized permission of the landowner.

The CONTRACTOR/DEVELOPER will examine the site and review any available test borings or undertake his own soil borings prior to submitting his bid, taking into consideration all conditions that may affect his work. The CITY and ENGINEER will not assume responsibility for variations of sub-soil quality or conditions at locations other than places shown and at the time the investigation was made.

Structures and pipelines will be located substantially as indicated on the drawings, but the ENGINEER reserves the right to make such modifications in locations as may be found desirable to avoid interference with existing structures or for other reasons. Where fittings are noted on the drawings, such notation is for the CONTRACTOR/DEVELOPER's convenience and does not relieve him from laying and jointing different or additional items where required.

The attention of the CONTRACTOR/DEVELOPER is drawn to the fact that during excavation at the Project site, the possibility exists of the CONTRACTOR/DEVELOPER encountering various water, chemical, electrical, or other lines not shown on the Drawings. The CONTRACTOR/DEVELOPER will exercise extreme care before and during excavation to locate and flag these lines so as to avoid damage to the existing lines. The CONTRACTOR/DEVELOPER will repair the line at no cost to the CITY, should damage occur to an existing line.

It is the responsibility of the CONTRACTOR/DEVELOPER to ensure that all utility or other poles, the stability of which may be endangered by the close proximity of excavation, are temporarily stayed in position while work proceeds in the vicinity of the pole and that the utility or other companies concerned be given reasonable advance notice of any such excavation by the CONTRACTOR/DEVELOPER.

This cost will be borne by the CONTRACTOR/DEVELOPER and will be included in the cost for the project.

All trees and shrubs will be adequately protected by the CONTRACTOR/ DEVELOPER with boxes and otherwise and in accordance with ordinances governing the protection of trees. No excavated materials will be placed so as to injure such trees or shrubs. Trees or shrubs destroyed by negligence of the CONTRACTOR/DEVELOPER or his employees will be replaced by him with new stock of similar size and age, at proper season and at the sole expense of the CONTRACTOR/DEVELOPER, and maintained until established.

Beneath trees or other surface structures, where possible, pipelines may be built in short tunnels, backfilled with excavated materials, except as otherwise specified, or the trees or structures carefully supported and protected from damage.

Any fence, or part thereof, that is damaged or removed during the course of the work will be replaced or repaired by the CONTRACTOR/DEVELOPER and will be left in as good a condition as before the starting of the work. The manner in which the fence is repaired or replaced and the materials used in such work will be subject to the approval of the ENGINEER. The cost of all labor, materials, equipment, and work for the replacement or repair of any fence will be deemed included in the appropriate Contract Item or items, or if no specific Item is provided therefore, as part of the overhead cost of the work, and no additional payment will be made therefore. Private fences removed from within the Right-of-Way will be replaced as described above at the Right-of-Way line.

B.9.1.3 SUBMITTALS

CONTRACTOR/DEVELOPER shall obtain approval of the ENGINEER for fill materials prior to the date of anticipated use of such material.

B.9.1.4 SAFETY PRECAUTIONS

All open excavations will be adequately safeguarded by providing temporary barricades, caution signs, lights, and other means to prevent accidents to persons, and damage to property. The CONTRACTOR/DEVELOPER will, at his own expense, provide suitable and safe bridges and other crossings for accommodating travel by the public and workmen.

Open pits, trenches, unpaved streets, debris, or other obstructions due to construction that will prevent the normal flow of traffic during an extended construction stoppage, for any reason, will be minimized. In the event an extended construction stoppage is found to be necessary, CONTRACTOR/DEVELOPER will, at his own expense, provide normal traffic flow during extended construction stoppage.

Precautions will be exercised at all times for the protection of person and property. The safety provisions of applicable laws, building and construction codes will be observed. The CONTRACTOR/DEVELOPER will comply with the U.S. Department of Labor Safety and Health Regulations for construction promulgated under the Occupational Safety and Health Act of 1970 (PL 91-596), and under Section 107 of the contract Work Hours and Safety Standards Act (PL-54), except where state and local safety standards exceed the federal requirements and except where state safety standards have been approved by the Secretary of Labor in accordance with provisions of the Occupational Safety and Health Act, will be complied with.

The CONTRACTOR/DEVELOPER will keep at the site, at each location where work is in progress, a completely equipped first aid kit and will provide ready access thereto at all times when people are employed on the work.

All excavation, trenching and related sheeting, bracing, etc., will conform to the requirement of the Florida Trench Safety Act (C5/5B2626) which incorporates by references, OSHA's excavation safety standards (29 CFR 1926.650 subpart P).

B.9.1.5 SHORING, SHEETING AND BRACING

Construct and maintain sheeting and bracing as required to support the sides of excavations, to prevent any movement which could in any way diminish the width of the excavation below that necessary for proper construction, and to protect adjacent structures.

For trench sheeting for pipes, no sheeting is to be withdrawn if driven below mid-diameter of any pipe, and no wood sheeting will be cut off at a level lower than 1 foot above the top of any pipe unless otherwise instructed by the ENGINEER. If during the progress of the work the ENGINEER decides that additional wood sheeting should be left in place, he may instruct the CONTRACTOR/DEVELOPER in writing. If steel sheeting is used for trench sheeting, removal will be as specified above, unless written approval is given for an alternate method of removal.

All sheeting and bracing not left in place will be carefully removed in such a manner as not to endanger the construction or other structures, utilities, existing piping, or property. Unless otherwise approved or indicated on the drawings or in the Specifications, all sheeting and bracing will be removed after completion of the substructure, care being taken not to disturb or otherwise injure the finished masonry. All voids left or caused by withdrawal of sheeting will be immediately refilled with sand by ramming with tools especially adapted to that purpose, by watering or otherwise as may be required.

The right of the ENGINEER to instruct sheeting and bracing left in place will not be construed as creating any obligation on his part to issue such instructions, and his failure to exercise his right to do so will not relieve the CONTRACTOR/DEVELOPER from liability for damages to persons or property occurring from or on the work occasioned by negligence or otherwise, growing out of a failure on the part of the CONTRACTOR/DEVELOPER to leave in place sufficient sheeting and bracing to prevent any caving or moving of the ground.

The CONTRACTOR/DEVELOPER will construct the cofferdams and sheeting outside the neat lines of the foundation unless indicated otherwise to the extent he deems it desirable for his method of operation. Sheeting will be plumb and securely braced and tied in position. Sheeting, bracing, and cofferdams will be adequate to withstand all pressures to which the structure will be subjected. Pumping, bracing, and other work within the cofferdam will be done in a manner to avoid disturbing any construction of the masonry enclosed. Any movement or bulging which may occur will be corrected by the CONTRACTOR/DEVELOPER at his own expense so as to provide the necessary clearances and dimensions.

Drawings of the cofferdams, sheeting and bracing and design computations will be submitted to the ENGINEER and construction will not be started until such drawings are received. The drawings and computations will be prepared and sealed by a Registered Professional Engineer in the State of Florida and will be in sufficient detail to disclose the method of operation for each of the various stages of construction, if required, for the completion of the substructures.

B.9.1.6 CONTROL OF WATER

CONTRACTOR/DEVELOPER will hold himself responsible for all damage done to his work by heavy rains or floods and he will take all reasonable precautions to provide against damages by building such temporary dikes, channels, or shoring to carry off storm water as the nature of the work may require.

The CONTRACTOR/DEVELOPER will construct and place all pipelines, concrete work, structural fill, screened gravel and gravel base course in-the-dry. All trenches and excavations are to be kept dry and free from water at all times when work is in progress and at no time is water to run through the pipeline(s) or structure excavations. The CONTRACTOR/DEVELOPER will maintain the water level below the proposed bottom of excavation. For purposes of this Contract, 'in-the-dry' is defined as within minus 4 to plus 2 percentage points of the optimum moisture content of the soil.

The CONTRACTOR/DEVELOPER will, at all times during construction, provide and maintain proper equipment and facilities to remove promptly and dispose of properly all water entering excavations and keep such excavations dry so as to obtain a satisfactory undisturbed subgrade foundation condition until the fill, structure, or pipes to be built thereon have been completed to such extent that they will not be floated or otherwise damaged by allowing water levels to return to natural elevations.

Pipe and masonry will not be laid in water or submerged within 24 hours after being placed. Water will not flow over new masonry within 4 days after placement. In no event will water rise to cause unbalanced pressure on structures until the concrete or mortar has set at least 24 hours. The CONTRACTOR/DEVELOPER will prevent flotation of the pipe by promptly placing backfill.

Dewatering will at all times be conducted in such a manner as to preserve the natural undisturbed bearing capacity of the subgrade soils at proposed bottom of excavation. Wellpoints may be required for pre-drainage of the soils prior to final excavation for some of the deeper in-ground structures, or piping, and for maintaining the lowered groundwater level until construction has been completed to such an extent that the structure, pipeline, or fill will not be floated or otherwise damaged. Wellpoints will be surrounded by suitable filter sand and no fines will be removed by pumping. Pumping from wellpoints will be continuous and standby pumps will be provided. Once abandoned, wellpoint holes will immediately be backfilled with FDOT No. 89 stone from bottom to top or flowable fill meeting the requirements of FDOT Section 145, or as approved by the ENGINEER.

The CONTRACTOR/DEVELOPER will furnish all materials and equipment and perform all work required to install and maintain the drainage systems he proposes for handling groundwater and surface water encountered during construction of structures, pipelines, and compacted fills.

The CONTRACTOR/DEVELOPER will provide for the disposal of the water removed from the excavation in such manner as will not cause injury to public health or private or public property or to any portion of the work completed or in progress, to the surface of the streets, or cause any impediment to the reasonable use of the site by other contractors.

As part of his request for review of a dewatering system, the CONTRACTOR/ DEVELOPER will demonstrate the adequacy of the proposed system and wellpoint filter sand by means of a test installation. Discharge water will be clear, with no visible soil particles in a one quart sample. Continuous pumping will be required as long as water levels are required to be below natural levels.

In the event that it is found that the water in a trench cannot be lowered by industry standards, i.e., well points and pumps; and if it is recognized by the CONTRACTOR/DEVELOPER that it is not feasible to dewater the trench, an alternate construction method may be proposed.

The CONTRACTOR/DEVELOPER will dewater the trench for a minimum of 10 calendar days prior to submitting any alternate method of dewatering which will exhaust all standard means of dewatering.

Complete details, specifications, manufacturer's descriptive literature, installation lists and any other pertinent data regarding the alternate method(s) will be submitted as an alternate by the CONTRACTOR/DEVELOPER to the ENGINEER for review within 10 days of the time that the CONTRACTOR/DEVELOPER anticipates using such alternate method.

The alternate method may be used, so long as the work is performed in a manner which, in the opinion of the ENGINEER and CITY, conforms to the method and procedure as set forth in the information supplied by the CONTRACTOR/DEVELOPER in his original application for use of an alternate method. The ENGINEER may revoke the alternate method if at any time, in his opinion, the work is not conforming to any applicable portion of these specifications. All alternate methods proposed for dewatering will be at the CONTRACTOR/DEVELOPER's expense.

B.9.1.7 DUST CONTROL

If, in the opinion of the CITY or the ENGINEER it is necessary to control dust during construction period, the CONTRACTOR/DEVELOPER shall furnish and spread water or calcium chloride at points where dust is a nuisance, or as directed by the ENGINEER, at no additional cost to the CITY.

B.9.1.8 NOISE CONTROL

The CONTRACTOR/DEVELOPER will eliminate noise to as great as extent as practicable at all times. Air compressing plants will be equipped with silencers and the exhaust of all gasoline engines or other power equipment will be provided with mufflers. The CONTRACTOR/DEVELOPER will strictly observe all local regulations and ordinances covering noise control.

Except in the event of an emergency, work will be done within the regular working hours.. If the proper and efficient prosecution of the work requires operations during the night, the written permission of the CITY will be obtained before starting such items of the work.

B.9.1.9 SILTATION AND EROSION CONTROL

During construction operations, the CONTRACTOR/DEVELOPER shall install and maintain temporary erosion control features to the extent necessary to prevent pollution of streams and lakes, detrimental effects on public or private property adjacent to the construction or damage to work on the Project. Additional erosion control devices may be requested by the ENGINEER to protect the property described above. This shall be done immediately when directed by ENGINEER.

The CONTRACTOR/DEVELOPER shall attempt to limit the surface areas of erodible earth exposed by clearing and grubbing, excavation or filling operations.

Temporary features may include, but not be limited to, temporary grassing, sodding, mulching, sandbagging, slope drains, sediment basins, sediment checks, artificial coverings or berms. All CITY, County, State and Federal ordinances will be complied with.

PART B.9.2 – PRODUCTS

B.9.2.1 GENERAL

Satisfactory soil materials are defined as those complying with American Association of State Highway and Transportation Officials (AASHTO) M-145, soil classification Groups A-1, A-2-4, A-2-5 and A-3.

Unsatisfactory soil materials are those defined in AASHTO M-145 soil classification Groups A-2-6, A-2-7, A-4, A-5, A-6, and A-7 along with peat and other highly organic soils.

Materials will be furnished as required from offsite sources and hauled to the site.

B.9.2.2 STRUCTURAL FILL

Structural fill material will be satisfactory soil material consisting of medium to fine grain sized sand, free of organic, deleterious and/or compressible material. Rock in excess of 3 ½ inches in diameter will not be used in the fill material. Amount of material passing No. 200 sieve will not exceed 15 percent.

B.9.2.3 LIMEROCK BASE COARSE

Limerock will not contain cherty or other extremely hard pieces, or lumps, or balls or pockets of sand material in sufficient quantity as to be detrimental to the proper bonding, finishing or strength of the limerock base.

Gradation and Size Limits: At least 97 percent (by weight) of the material will pass a 3 ½-inch sieve and the material will be graded uniformly down to dust. The fine material will consist of dust of fracture. All crushing or breaking up which might be necessary in order to meet such size requirements will be done before the material is in place.

B.9.2.4 SELECT COMMON FILL

Select common fill material will be satisfactory soil material containing no more than 15 percent by weight finer than No. 200 mesh sieve. It will be free from organic matter, muck, marl, and rock exceeding 3 ½ inches in diameter. Select common fill will not contain broken concrete, masonry, rubble or other similar materials.

Material falling within the above specification, encountered during the excavation, may be stored in segregated stockpiles for reuse. All material which, in the opinion of the ENGINEER, is not suitable for reuse will be spoiled as specified herein for disposal of unsuitable materials.

B.9.2.5 BEDDING ROCK

Bedding rock will be washed and graded limerock or shell. This material will be graded to meet FDOT No. 89 stone gradation requirements.

B.9.2.6 CLEARING AND GRUBBING

Remove vegetation such as trees, shrubs and grass, which interferes with construction excepting certain trees and shrubs which are designated to remain undisturbed. All shrubbery, ornamental trees and other such plantings including those within construction area shall be fully protected. If it becomes necessary to remove any grass, shrubbery or planting to accomplish the work, it shall be satisfactorily replaced before the work will be accepted. All areas disturbed during construction shall be restored to a condition equal to or better than that existing prior to beginning the work.

B.9.2.7 PAVEMENT AND SIDEWALK REMOVAL AND REPLACEMENT

Pavement, which is to be removed for open-cut trenching, shall be cut vertically with a power-driven friction saw prior to removal. The surface shall be scored to sufficient depth to provide uniform, straight break lines. All removal of pavement shall conform to local, County, State or Federal requirements where applicable. Under no condition shall pavement be cut with a trenching machine, power shovel or backhoe. Width of cut of pavement or sidewalk shall be 2 feet wider than top of trench, one foot on each side of trench. In the event that trench excavation becomes wider than initial cut, pavement or sidewalk shall be re-cut to at least one foot back from all edges of actual excavation by the CONTRACTOR/DEVELOPER at his own expense.

Pavement, driveway or sidewalk material shall be separated from other excavated materials and shall not be placed in backfill, but shall be satisfactorily disposed of by the CONTRACTOR/DEVELOPER. Base materials shall be subject to the review of the ENGINEER.

Where trenches will be in paved streets but not repaved for more than 36 hours, temporary patching of asphalt will be required as follows: 1½ inches of asphaltic concrete over 12 inches of stabilized sub-grade and will be provided for the entire time between pavement removal and final repaving. 'Street closed to Through Traffic' signs and 'Detour' routes shall be indicated and maintained by the CONTRACTOR/DEVELOPER when job is located in a public street or way. Signing shall be provided in accordance with OSHA regulations and the State of Florida Manual of Traffic Control.

All pavement and sidewalk removed shall be replaced with base and surface materials which conform as closely as possible in thickness and quality to materials removed with a minimum pavement and pavement base replacement consisting of 1½ inches of Type S- 3 asphaltic concrete surface with a 3½-inch sand asphalt hot mix (500 lb. stability) or 6-inch soil cement base (7-day 300-psi compressive strength minimum) or 6-inch lime rock base.

All painted street markings and other traffic control devices shall be restored to former conditions. Use Safety Coatings Co. Roadrunner Traffic marking paint and Ferro Co. glass spheres or approved equal. Pavement with traffic control devices and sidewalks shall be replaced as soon as practicable after compaction of backfill.

Workmanship and materials shall be in accordance with best standard practice for work of this type, and shall conform to the requirements of the latest issue of the FDOT Road and Bridge Manual.

Pipe crossings and installations along all State highways shall be made in accordance with details shown on the Plans and in full compliance with State Department of Transportation requirements. All materials and workmanship shall conform to Florida DOT specifications.

All necessary barricades, detours, lights and other protective measures shall be provided for protection of both pedestrians and vehicular traffic and shall conform to Florida DOT specifications. Final cleanup along State rights-of-way and inspection of repaired sections of State pavement shall be subject to the approval of the local maintenance engineer for the Florida DOT.

B.9.2.8 CURB AND GUTTER REMOVAL AND REPLACEMENT

Curb or curb and gutter removal, where required in construction of this work, shall be held to a minimum. Curb and gutter material to be removed shall be carefully separated from trench excavation material and shall be satisfactorily disposed of by the CONTRACTOR/DEVELOPER.

The CONTRACTOR/DEVELOPER shall replace all curb or curb and gutter, which has been removed. Curb or curb and gutter shall be replaced as soon as possible after backfill is placed and compacted and shall be a duplicate in all respects to original construction. Workmanship shall be in accordance with the controlling agency (CITY, County, and State).

B.9.2.9 RESTORATION OF ROADWAY CROSSINGS AND DRIVEWAY CROSSINGS

Clay, marl, shell or similar roadways and driveways that are crossed or traversed by trenches shall be restored to existing conditions prior to excavation. The CONTRACTOR/DEVELOPER may reclaim existing material, or he may furnish and compact new material. There will be no additional compensation for this type of restoration unless specifically called for in the Special Provisions or on the Bid Proposal.

Final and complete restoration of crossings in existing public roadways shall be completed not more than 36 hours subsequent to the pavement removal. All street markings are to be in place 7 days after final paving.

B.9.2.10 EXCAVATION

All excavation, backfill and grading necessary to complete the work will be made by the CONTRACTOR/DEVELOPER and the cost thereof will be included in the contract price. Material will be furnished as required from offsite sources and hauled to the site.

A. Common Excavation:

Machine excavation shall be carried to a depth above final pipeline grade that will allow final grading as indicated on the Plans. Care shall be taken to not excavate below required depth. If excavation is carried below required depth, over cut depth shall be backfilled select material (sand) furnished at CONTRACTOR/DEVELOPER's expense and compacted to provide pipe support at least equal to that of original material.

CONTRACTOR/DEVELOPER may, at his option, elect to over cut trench and backfill (sand). If CONTRACTOR/DEVELOPER so elects, depth of over cut shall be such that a minimum of 6 inches of compacted backfill material will result under lowest projection of pipe bell. No additional payment will be made for this over cut or for furnishing and placing of the required backfill material.

The CONTRACTOR/DEVELOPER shall exercise sound construction practices in excavating and maintaining the trench so no damage will occur to any foundation structure, pole line, pipeline or other facility because of sloughing of slopes or from any other cause. If, as a result of excavation, there is a disturbance of ground that endangers other property, the CONTRACTOR/DEVELOPER shall immediately take remedial action at his own expense. No act of the CITY or his representatives shall in any way affect liability of the CONTRACTOR/DEVELOPER for damages, expenses or costs that may result from trench excavation.

Trees, stumps and roots within limits of trench excavation shall be removed to a depth of at least 12 inches below bottom of trench. Stump and root holes shall be refilled to existing grade and compacted. No stumps, roots or organic matter of any description shall remain under concrete slabs or footings.

B. Trench Requirements:

Excavation for all trenches required for the installation of pipes and electrical ducts will be made to the depths indicated on the drawings. Excavate trench to provide a minimum of 36-inch clear cover over the pipe bell unless otherwise noted on the drawings. Excavate in such manner and to such widths as will give suitable room for laying the pipe or installing the ducts within the trenches, for bracing and supporting and for pumping and drainage facilities. The trench width at the top of the pipe will not exceed the allowable as determined by the depth of cut and indicated on the drawings.

Rock will be removed to a minimum 4- or 6-inch clearance around the bottom and sides of all the pipe or ducts being laid as shown on the drawings.

The bottom of the excavations will be firm and dry and in all respects acceptable to the ENGINEER. Excavate unsatisfactory soil material from the bottom of the trench to a depth determined by the ENGINEER and replace with rock bedding.

Where pipe are to be laid in bedding or encased in concrete the trench may be excavated by machinery to, or just below, the designated subgrade provided that the material remaining in the bottom of the trench is no more than slightly disturbed.

Where the pipes or ducts are to be laid directly on the trench bottom the lower part of the trenches will not be excavated to the trench bottom by machinery. The last of the material being excavated will be done manually in such a manner that will give a flat bottom true to grade so that pipe or duct can be evenly and uniformly supported along its entire length on undisturbed material or bedding rock. Bell holes will be made as required manually so that there is no bearing surface on the bells and pipes are supported along the barrel only.

C. Bedding:

Pressure pipe will have suitable fill (as determined by the ENGINEER), rock, or shell bedding to springline of pipe, and 4 to 6 inches below the invert depending on diameter as shown on the drawings.

Rock or shell bedding will be placed in maximum lift thicknesses of 4 to 6 inches with each lift compacted using mechanical equipment to a minimum of 95 percent of the maximum dry density as determined by AASHTO T-180.

Rock or shell bedding may be used under certain circumstances as a drain for groundwater control, subject to the approval of the ENGINEER. The CONTRACTOR/DEVELOPER will take all precautions necessary to maintain the shell or rock bedding in a compacted state and to prevent washing, erosion or loosening of this bed.

Rock or shell bedding is not required for pipe support where suitable fill material is available. The top 6 inches will be compacted using mechanical equipment to a minimum of 95 percent of the maximum dry density as determined by AASHTO T-180.

PART B.9.3 – EXECUTION

B.9.3.1 BACKFILLING

Backfilling over pipes will begin as soon as practicable after the pipe has been laid, jointed, and inspected and the trench filled with suitable bedding material.

All backfilling will be prosecuted expeditiously and as detailed on the drawings.

Any space remaining between the pipe and sides of the trench will be packed full by hand shovel with selected earth, free from stones having a diameter greater than 1 ½ inches and thoroughly compacted with a tamper as fast as placed, up to a level of one foot above the top of the pipe.

Compact to 95 percent maximum density per AASHTO T-180 in layers not to exceed 4 inches up to the centerline of the pipe from the trench bottom. The filling will be carried up evenly on both sides with at least one man tamping for each man shoveling material into the trench.

The remainder of the trench above the compacted backfill, as just described above, will be filled and thoroughly compacted with select common fill with mechanical equipment. Compact select common fill in 6-inch layers to 95 percent maximum density per AASHTO T-180.

B.9.3.2 TESTING

The CONTRACTOR/DEVELOPER will demonstrate the adequacy of backfill compaction by performing density testing of the completed trench. Density testing will be performed at three depths for each test location: surface, mid-depth, and near maximum trench depth. The character of the backfill material will be observed during the excavation for density testing to determine conformance with the specifications. Testing will be performed by an independent testing laboratory qualified to perform such tests and approved by the ENGINEER. All testing will be witnessed by the ENGINEER. The test will be repeated until satisfactory results are obtained. The CONTRACTOR/DEVELOPER will be charged for all retests.

One test will be performed within the first 500 feet of pipe installed. This test will be used as an initial evaluation of the compaction methods being used. Beyond the initial 500 feet, one test will be performed in each 1,000 foot section of pipe installed or fraction thereof. Testing will progress as each 1,000 foot section is completed.

The location of the test within each section will be selected by the ENGINEER. Testing which indicated that unacceptable material has been incorporated into the backfill, or that insufficient compaction is being obtained will be followed by expanded testing to determine the limits of the unacceptable backfill.

If normal testing within a test section indicated unacceptable backfill, the ENGINEER may require additional testing within the same test section to determine the limits of unacceptable backfill/compaction. The costs associated with this expanded testing will be borne by the CONTRACTOR/DEVELOPER. Unacceptable backfill/compaction within the limits established by the testing will be removed and replaced by the CONTRACTOR/DEVELOPER at no additional cost to the CITY.

Testing beyond the normal frequency or expanded testing required which is requested by the ENGINEER or CITY, and approved by the CITY, will be at the CITY's expense.

B.9.3.3 DISPOSAL OF SURPLUS MATERIAL

Transport from CITY's property and legally dispose of. Any permit required for the hauling and disposing of this material beyond CITY's property will be obtained prior to commencing hauling operations.

Suitable excavated material may be used for fill if it meets the specifications for select common fill and is approved by the ENGINEER. Excavated material so approved may be neatly stockpiled at the site where designated by the CITY/ENGINEER provided there is an area available where it will not interfere with the operation of the facility nor inconvenience traffic or adjoining property owners.

B.9.3.4 CLEANUP AND RESTORATION

A. General:

Cleanup is an essential part of the work. As the work progresses and is completed, the CONTRACTOR/DEVELOPER shall clean site of all signs of operation. This cleanup shall be done as promptly as practicable and shall not be left until the end of construction period. No part of the work shall be considered complete and no payment will be made until cleanup is completed. The running end of the pipe will not advance more than 700 feet beyond cleanup within CITY and public right-of-way (does not apply to developer property). In addition to the 700-foot requirement, all areas disturbed over 30 days shall be cleaned up. Failure to meet this requirement is reason to stop the job.

Included in cleanup is protection of road shoulders, ditch banks, and other natural or artificial slopes subject to rapid erosion. Except where soil-cement riprap is shown, this protection shall be by grassing and mulching. A satisfactory stand of grass shall be obtained by sodding or seeding over entire work site.

B. Sodding:

The CONTRACTOR/DEVELOPER will furnish all labor, materials, equipment and incidentals required to prepare lawn bed and install sodding as shown on Drawings and as specified herein.

Sod will be laid in all ditch areas and slopes that are steeper than 1 vertical to 3 horizontal. Sod will be pinned down for stabilization in these areas.

Sod shall be of firm texture having a compacted growth and good root development as approved. Sod will be certified to meet Florida State Plant Board specifications, absolutely true to varietal type and free from weeds or other objectionable vegetation, fungus, insects and disease of any kind. Before being cut and lifted the sod will have been mowed three times with the final mowing not more than a week before cutting into uniform dimensions. Sod will be harvested, delivered, and installed within a period of 72 hours. Fertilizer will be a complete fertilizer, the elements of which are derived from organic sources. Fertilizer will be a standard product complying with state and federal fertilizer laws. Superphosphate will be composed of finely ground phosphate rock as commonly used for agricultural purposes containing not less than 20 percent available phosphoric acid.

Areas to be sodded will be cleared of all rough grass, weeds and debris and the ground brought to an even grade as approved. The soil will then be thoroughly tilled to a minimum 8-inch depth. Superphosphate at a rate for bidding purposes of 5 pounds per 1000 square foot, if needed and complete fertilizer at a rate of 16 pounds per 1000 square foot will be evenly distributed over entire area and cross-disced in to a depth of 4 to 6 inches. The areas will then be brought to proper grade, free of sticks, stones, or other foreign matter over 1 inch in diameter or dimension. The surface will conform to finish grade, less the thickness of sod, free of water-retaining depressions, the soil friable and of uniformly firm texture.

During delivery, prior to planting and during the planting of the lawn areas, the sod panels will at all times be protected from excessive drying and unnecessary exposure of the roots to the sun. All sod will be stacked during construction and planting so as not to be damaged by sweating or excessive heat and moisture. After completion of soil conditioning as specified above, sod panels will be laid tightly together so as to make a solid sodded lawn area. On mounds and other slopes, the long dimension of the sod will be laid perpendicular to the slope. Immediately following sod laying the lawn areas will be rolled with a lawn roller customarily used for such purposes and then thoroughly watered. Bring the sod edge in a neat, clean manner to the edge of all paving and shrub areas. Top dressing with approved, clean, weed free, sand may be required at no additional cost to the CITY if deemed necessary by the ENGINEER.

On slopes greater than 3:1, sod will be laid using staggered joints and secured using staking, pegging or other approved methods. Sod will be installed with the length perpendicular to the slopes.

The CONTRACTOR/DEVELOPER will produce a dense, well established lawn. The CONTRACTOR/DEVELOPER will be responsible for the repair and resodding of all eroded or bare spots until project acceptance. Repair sodding will be accomplished as in the original work except fertilizing may be omitted. Sufficient watering will be done by the CONTRACTOR/DEVELOPER to maintain adequate moisture for optimum development of the lawn areas. Sodded areas will receive no less than 1.5 inches of water per week.

Lawn areas planted under this Contract and lawn areas outside the designated areas damaged by CONTRACTOR/DEVELOPER's operations will be repaired at once by proper sod bed preparation, fertilizing and resodding, in accordance with these specifications.

C. Seeding:

The CONTRACTOR/DEVELOPER will furnish all labor, materials, equipment and incidentals required to prepare lawn bed and seed those areas shown on Drawings and as specified herein. Areas to be seeded will be all areas disturbed during construction that do not require sodding.

Seed will be from same or previous year's crop; each variety of seed will have a percentage of germination of not less than 90, a percentage of purity no less than 85, and will not have more than 1 percent weed content.

Straw mulch will be comprised of threshed straw of oats, wheat, barley, rye, or hay that is free from noxious weeds, mold, or other objectionable material. The straw mulch will contain at least 50 percent by weight of material 10 inches or longer. Straw will be in an air-dry condition suitable for placement with blower equipment.

Wood fiber mulch for use with Hydroseeding, will be a specially processed cellulose fiber containing no growth or germination inhibiting factors. It will be manufactured in such a manner such that after addition and agitation in slurry tanks with water, the fibers in the material become uniformly suspended to form a homogeneous slurry. When sprayed on the ground, the material will allow absorption and percolation of moisture. Each package of the cellulose fiber will be marked by the MANUFACTURER to show the air dry weight content and not contain in excess of 10 percent moisture. Woodfiber mulch will be applied at a rate of 2,000 pounds per acre.

Seed and mulch tackifier will be provided. Tackifier will be specifically manufactured for use as a seed and mulch tackifier and will contain no growth or germination inhibiting factors. Tackifier will be delivered to the site in the MANUFACTURER's containers. Tackifier will be applied in accordance with MANUFACTURER's instructions.

Apply seed uniformly with a cyclone seeder, cultipacker seeder, or hydroseeder. Apply half the seed in one direction and the remainder at right angles to the first seeding. After seeding, the seeded area will be protected from erosion using mulch and a tackifier. If hydroseeding is used, mulch and tackifier may be included in the seed slurry.

The surface of areas to be temporarily seeded will be roughened. The application of fertilizers is not required for temporary seeding.

The CONTRACTOR/DEVELOPER will keep all seeded areas watered and in good condition, reseeding all seeded areas if and when necessary until a good, healthy, uniform growth is established over the entire area seeded and will maintain all seeded areas in an approved condition until provisional acceptance. A satisfactory stand will be defined as a section of 10,000 square feet or larger that has: No bare spots larger than 3 square feet. No more than 10 percent of total area with bare spots larger than one square foot. Not more than 15 percent of total area with bare spots larger than 6-inch square.

SECTION B.10

GENERAL INFORMATION

PART B.10.1 – CONSTRUCTION PHOTOGRAPHS

B.10.1.1 REQUIREMENTS INCLUDED

The CONTRACTOR will employ competent photographer to take construction record photographs periodically during course of the Work..

B.10.1.2 VIDEO TAPING REQUIRED

The transmission main route will be videotaped by the CONTRACTOR/DEVELOPER prior to start of construction to thoroughly document pre-project conditions and videotaped near the time of project closeout to thoroughly document final conditions. Two copies of the pre-construction video will be submitted to the CITY prior to commencement of construction, and one copy of post construction video will be submitted to the CITY prior to project closeout.

Tape will, when viewed, show in the image, ¼ of the trench fronting all properties and ¾ on the image will be of the property.

The taping will be done so as to show the trench and property in an oblique view (30°).

Coverage will include, but not be limited to, all existing driveways, sidewalks, curbs, ditches, streets, landscaping, trees, culverts, catch basins, headwalls, retaining walls, fences, visible utilities, and all buildings located within the zone of influence. Of particular concern, are any existing faults, fractures, defects or other imperfection exhibited by the above-mentioned surface features. Audio description will be made simultaneously with the support video coverage.

Engineering plans will be referenced, by stationing, in the audio on the tapes. If visible, house numbers will also be mentioned in the audio.

A record of the contents of each tape will be supplied on a run sheet identifying each segment in the tape by location, i.e., street or easement, viewing side, traveling direction, engineering stationing, house or lot number, and all referenced by tape counter numbers.

B.10.1.3 PHOTOGRAPHY REQUIRED

Provide a minimum of two photographs taken for each day of any field work. Photographs should be properly labeled with the date and locations (station #)

Provide photographs taken prior to the cutoff date for each scheduled application for payment.

The CONTRACTOR/DEVELOPER will pay costs for specified photography and prints. Parties requiring additional photography or prints will pay photographer directly.

B.10.1.4 PRINTS

A. Color:

1. Paper: Single weight, color print paper.
2. Finish: Smooth surface matte finish.
3. Size: 8-inch x 10-inch.

B. Identify each print on back, listing:

1. Name of Project and City of Callaway Project Number
2. Orientation of View
3. Date and time of exposure

Consult with the ENGINEER at each period of photography for instructions concerning views required.

Each print will be inserted in a separate, archival type, nonglare, three-hole punched photo protector. Provide one suitable size 3-ring binder for each set of prints. Binders will be provided in sufficient quantity to hold all photographs taken for the duration of the contract. Each binder will be labeled by engraving on the front and spine with the project name.

PART B.10.2 – PROJECT COMPLETION CHECKLIST

Project Name:

Sewer	Date Obtained	Date Completed
Pressure Air Test		
Inspect All Manholes		
Obtain Record Drawings		
Record Drawings Sent Out		
Schedule TV Prior to Paving		
Construction Tap Letter, if Requested		
Confirm All Manholes are Raised		
Schedule Final TV		
Compaction Requirements		
Easements Verified		
Obtain FDEP Clearance Certification		
Developer, ENGINEER, CONTRACTOR/DEVELOPER Certification		
Home Owners Association Document		
Letter of Acceptance		

Water	Date Obtained	Date Completed
Pressure Test		
Bacterial Samples (1)		
Bacterial Samples (2)		
Obtain Record Drawings		
Record Drawings Sent Out		
Confirm All Valves are Up		
Construction Tap Letter, if Requested		
Compaction Requirements		
Easements Verified		
Developer, ENGINEER, CONTRACTOR/DEVELOPER Certification		
Home Owners Association Document		
Letter of Final Acceptance		

SECTION B.11

RECORD DRAWINGS

PART B.11.1 – GENERAL

During construction, the CONTRACTOR/DEVELOPER shall employ a Registered Land Surveyor, licensed in Florida, who shall keep an accurate record of the **actual locations**, dimensions, and elevations of the **finished work**; especially those items which will subsequently be concealed or inaccessible. Prior to the approval of the final payment, the CONTRACTOR/ DEVELOPER's Registered Land Surveyor shall submit to the ENGINEER and the CITY a complete set of record drawings. The Land Surveyor shall certify on each sheet of the record drawings that all improvements have been constructed to the grades, elevations and locations shown on the as-built drawings and are located within the easements, rights-of-way and property boundaries shown on the record prints.

The Land Surveyor shall sign and seal all copies of the record drawings. All record drawing preparation shall be incidental to performance of the total contract and no additional compensation will be allowed.

B.11.1.1 DATUM

All as-built drawing will be drawn to the state plan e coordinate system. The horizontal datum shall be HPGN with the 1990 Florida horizontal adjustment, units in U.S. Survey Feet. If elevations are represented the vertical datum shall be specified using NAVD 1988.

B.11.1.2 ADDITIONAL REQUIREMENTS OF RECORD DRAWINGS

A. Three ties required for location of all sewer and water valves 1½-inch diameter or larger.

B. Ties from property corners are required locating all water/sewer service stub outs.

C. Show all measurements from edge of pavement to Force & Water Mains in 100-feet intervals. Preferred permanent objects are listed in their order of preference: manholes, curb inlet covers, building corners, property corners, power poles, hydrants, trees, (18-inch diameter or greater).

D. Complete the pump station record design data table.

E. Sewer Profiles should be shown on record drawings or the following information will be provided in the plan view:

1. Top of Manhole elevation.

2. Pipe invert data.

3. Tangent slope and distance.

4. Pipe size and material.

5. Designate in a circle chart for each lot, the length and distance from the downstream manhole, the distance to nearest lot corner and the depth below natural grade +/-0.25 feet to the invert of each service lateral.

6. Note any changes or variations from approved construction plan by lining out original design data and showing inspector-approved data above.

B.11.1.3 SUBMISSION OF RECORD DRAWINGS

Record submission for preliminary review procedure:

A. Submit one set of paper copies and one computer disk/CD of record drawing for review to the ENGINEER and the CITY.

B. Upon receiving above stated record material required, the assigned ENGINEER will review for data and formatting compliance then return to CONTRACTOR/DEVELOPER for revisions if found necessary within 10 business days.

After the preliminary submittal has been approved to be in compliance, the following shall be submitted to the CITY:

A. Two bound copies formatted 24-inch x 36-inch/D size

B. One computer disk/CD containing completed digital file of the record drawing conforming to the specifications.

B.11.1.4 PUMP STATION DATA TABLE

Please refer to Table 10-1 and the next page.

TABLE B.11-1
CITY OF CALLAWAY PUMP STATION RECORD DESIGN DATA

PUMP DATA	VALUE	WET WELL DATA	VALUE
ID		ID	
CAPACITY		TYPE	
SHUT_HEAD		BTM_ELEV	
DSGN_HEAD		LEAD_OFF_EL	
DSGN_FLOW		LEAD_ON_EL	
HIGH_HEAD		LAG_ON_EL	
YR_INST		LAG_OFF_EL	
RATED_PWR		INIT_LEVEL	
ON_OFF		TOP_OF_SLAB_EL	
TDH		DIAMETER	
STATIC_HEAD		YR_INST	
DISCHARGE_PIPING		VOLUME_REQD *	
DISCHARGE_PIPING_MATERIAL			
PUMP_MANUFACTURER			
PUMP_MODEL_NO.			
PUMP_IMPELLER_MODEL_NO.			
PUMP_IMPELLER_SIZE			
PUMP_RPM			
SUPPLY_VOLTAGE			
MOTOR_HP			
* Submit Calculations for Volume & Cycle Times			