## SECTION 3 - WASTEWATER SYSTEM

### 3.1 GENERAL WASTEWATER CRITERIA

Department and privately owned gravity Wastewater collection systems, pump stations, and force mains shall be designed to deliver peak flows under the following conditions:

Wastewater systems shall be designed on the basis of an average per capita daily flow of not less than 100 gallons and an average domestic flow of no less than 200 gpd per Equivalent Residential Connection (ERC). On that basis, lateral Wastewater piping shall be designed with capacities when running full of not less than four times the average flow. Trunk lines shall have capacities under the same conditions of not less than 2.5 times the average flow. Special flow assumptions shall be made in each case for Wastewater from commercial and industrial sites. For proposed projects connecting to existing gravity sewer system, the Department may require the Property Owner to design and construct, at no cost to Department, upgrades to existing lift station(s) serving the gravity system. The upgrades may include new pumps, control panel, valves, RTU, an emergency generator, corrosion barrier system, driveway, fence replacement and/or any other components associated with an existing lift station as determined by the Department.

No person shall connect or cause to connect any roof downspout, exterior foundation drain, areaway drain, or other source of surface runoff or groundwater to a building Wastewater service line or building drain which in turn is connected directly or indirectly to any Department Wastewater system without prior approval by the Department. Floor drains in rooms with generators or other equipment with a possibility of a fuel spill shall not be connected directly or indirectly into the sanitary sewer system. Unmetered condensation water from air conditioning units, walk-in coolers, refrigeration units or any other condensation water source cannot connect to the sanitary sewer system unless previously approved by the Department. Dumpster pads or can wash pads with floor drains connecting to the Department's Wastewater collection system shall be designed to minimize surface runoff and to minimize solids to enter into the drain. The pad shall consist of a small-elevated area with the surrounding area to drain away from the pad. The drain shall be equipped with a removable cap or plug with the drain connected to a Department approved Grease Trap (GT) or Oil/Grease Interceptor (OGI) for pretreatment prior to discharge into the Department's Wastewater collection system. Any outdoor can wash pad also requires some type of roof overhang to prevent normal rainfall from entering into the drain area.

Industrial Wastewater from service station wash-racks, lubrication racks, car wash, repair shops or other commercial facility and shop floor drains shall not be connected into the Wastewater collection system without pre-treatment through an adequately-sized Sand/Oil Interceptor (SOI) specifically approved by the Department. The residual Wastewater shall be disposed of separately by the owner. No toxic, hazardous or discharge deleterious to the Wastewater system shall be allowed to be discharged without a WUD approved Pretreatment Permit in accordance with Chapter 5 – Pretreatment Program of the Department's Uniform Policies and Procedures Manual (UPAP). Generally, no cooling tower water shall be discharged into the sanitary sewer system. This will also include any diluting of discharge other than that which meets pre-treatment standards. Wastewater dumping stations are not allowed to be connected (directly or indirectly) to

the Department's Wastewater Collection System. Each commercial facility where foods are prepared, processed or served which generates grease laden waste must include in the plumbing system design a pretreatment assembly. Examples of such facilities, but not limited to, are restaurants, hotel kitchens, hospitals, school kitchens, bars, factory cafeterias, clubs, clubhouses, food take out places, bakeries, stores with food departments or any other food preparation establishment as determined by the Department.

The assembly shall conform to the applicable Plumbing Code and may consist of a flow control device, a Solids Interceptor and a Grease Trap or Oil/Grease Interceptor capable to limit the grease discharge to approximately 100 ppm. The design, sizing and installation of Grease Traps shall conform to the Standard PDI-G101 published by the Plumbing and Drainage Institute, and all other applicable rules and regulations. For the purpose of installation of Grease Traps within PBCWUD Service Area, the device shall be PDI certified as a "PDI Size 50" and utilized for a Maximum Flow Rate of 25 gpm. The Maximum Total Flow Rate for each commercial facility shall be determined using the "PDI Sizing Method". The Grease Trap shall be gas and water tight with non-skid heavy duty cover (minimum 10,000 lbs. load rating). If the "Maximum Flow Rate" exceeds 25 gpm, a full size Oil/Grease Interceptor (minimum capacity 750 Gallon) will be required. The Oil/Grease Interceptor size, design and construction shall be in accordance with this Standard, and all applicable State and Local Building Codes and Health Department regulations, including but not limited to FAC Chapter 64E6.

The Design of the pretreatment assembly shall be the responsibility of the Owner. The Owner shall submit a signed and sealed copy of the flow calculations prior to Service Initiation as required by the Department.

Any Grease Trap or Oil/Grease Interceptor shall be located outside of buildings, preferably in grass areas, minimum 10' from any Department owned facility, but not in traffic areas, parking spaces or walkways unless previously approved by the Department prior to installation. In no case shall any Grease Trap or Oil/Grease Interceptor be placed within any storm retention areas. The rim elevation of the access point shall be designed to prevent any storm water inflow.

The Owner shall operate and maintain the pretreatment devices as required to insure optimum performance and to comply with the Department's discharge parameters.

## 3.2 GRAVITY SEWER DESIGN

(a) Size and Layout:

The minimum allowable size for any Wastewater gravity main other than house service connection shall be 8" in diameter. See detail sheets for service laterals. Upsizing of Wastewater lines to reduce slopes will not be permitted unless justified by calculated flow. In order to facilitate Wastewater service for all properties within the service area, Wastewater gravity mains and force mains shall generally be extended along the full length of all fronting boundaries of a property by the Developer/Owner requesting Wastewater service, and may be required to be extended through the property if another is to be served in the future. The cost associated with upsizing or additional

depth beyond the development's requirements may be subject to a credit **as defined in Chapter 3 of the UPAP.** Wastewater gravity mains shall not be placed in ditches, wetlands or stormwater management areas unless previously approved by the Department.

When a new or existing gravity sewer main is in conflict with a new or existing storm water pipe and the gravity sewer main cannot avoid the storm water pipe due to special circumstances a conflict structure may be accepted. If a conflict structure must be installed its design must meet both Florida Department of Transportation (FDOT) and Palm Beach County Water Utilities Department (WUD) Minimum Design and Construction Standards with prior Department and Florida Department of Environmental Protection (FDEP) approval.

(b) Slopes:

All gravity Wastewater lines shall be designed with hydraulic slopes sufficient to give mean velocities, when flowing full or half-full, of not less than 2 feet per second or more than 5 feet per second, based on an acceptable equation. Slopes shall be calculated using the distance from centerline of manhole to centerline of manhole.

The following minimum grades will be used for design:
(1) 8" gravity mains 0.42%
(2) 10" gravity mains 0.28%
(3) 12" gravity mains 0.22%

A 0.1 foot drop inside the manholes may be used to reduce the minimum slope for an 8" gravity Wastewater from 0.42% to 0.40%. Note: Maximum 2% slope is allowed for 8" pipe.

(c) Increasing Size:

When Wastewater collection lines are increased in size, or when a smaller line joins a larger one, the invert of the larger pipe should be lowered sufficiently to maintain the same energy gradient.

(d) Alignment:

Wastewater collection lines of all sizes shall be designed with uniform slope and alignment between manholes. A 15' distance shall be maintained from top of bank of canals, lakes and structures, unless unavoidable, in which case 10' shall be maintained with C900 polyvinyl chloride pipe (PVC) with prior Department approval. A minimum 10 feet horizontal separation is required to the edge of drainage fabric in exfiltration trenches.

(e) Pipe Material:

PVC ASTM 3034 SDR 26 with PVC SDR 35 fittings and PVC C900 shall be acceptable pipe material for gravity Wastewater lines. Epoxy lined ductile iron pipe (DIP) may be used only with prior Department approval. Unless specific approval is granted, no gravity Wastewater line shall be encased in concrete. PVC gravity lines within Wellfield Zones 1 and 2 shall be C900, DR-18.

The lining for DIP shall be factory applied in accordance with the manufacturer's recommendations and shall be warranted by the pipe manufacturer. Ductile iron pipe shall be polywrapped if buried closer than 10’ to other underground iron/steel pipes and if no other protection is provided. DIP pipe shall be used only if unavoidable and with prior Department approval.

PVC C900 DR18 pipe shall be specified on gravity sewer mains in the following circumstances:

(1) Anytime a wastewater main passes under a potable water main with less than 12" clearance (min. 6" separation is required) No joint within 10' of crossing Potable Water/reclaimed water/storm water lines.
(2) When a Wastewater main passes over a potable water main regardless of separation (min. 12" clearance is required). No joint within 10 feet of crossing potable/reclaimed water/storm water lines with a section of C-900 wastewater main centered on the crossing.
(3) When there is less than 4 feet from finish surface to the invert of the pipe. Four and one half (4 1/2) feet to invert shall be the standard minimum design depth. Less depth is unacceptable unless it is unavoidable and has prior Department approval.
(4) Any time the Wastewater line is separated horizontally (outside wall to outside wall) from a Potable Water Main by less than 10 feet (min. 6 feet is required) or other pipes by less than 5 feet (minimum 3 feet clearance is required).
(5) When the Wastewater line is placed out of a right-of-way, between buildings, under large diameter pipes, culverts, etc., along property lines or in areas subject to heavy landscaping.
(6) Minimum 5 feet (5') length of C900 PVC from each cored invert (i.e., not precast by manhole manufacturer).
(7) Any time a wastewater gravity main passes under or over pipes other than potable water mains with less than 12" clearance.

(f) Wastewater Lines under large storm water pipes:

When a Wastewater main design requires the main to cross under a storm water pipe larger than thirty (30) inches in diameter the Department reserves the right to require the storm water pipe to be redesigned not to exceed thirty (30) inches in diameter. If redesigning the storm water system is not an option then the Wastewater main must be PVC C-900 for gravity sewer main or ductile iron pipe (DIP) for force main. The Department reserves the right to require the main to be located within a steel casing or relocate the main to avoid the storm water pipe crossing.

(g) Wastewater Lines in Wellfields:

New or replacement installation of gravity Wastewater lines in protected zones of a public drinking water wellfield shall be constructed to force main standards. **See SECTION 3.3 – FORCE MAIN CONSTRUCTION** for specific construction materials and testing requirements.

(h) Manholes:

(1) Location:

Manholes shall be installed at the end of each Wastewater system, at every change in grade, size or alignment, at all gravity Wastewater main intersections, and at distances not greater than 400' apart unless prior approval is obtained from the Department for a distance greater than 400'. Gravity Wastewater mains shall have no less than a 90 degree angle to direction of flow between runs. Manholes shall be placed in accessible locations, preferably in pavement, always flush to the surface. Manholes in roadway pavement shall not be located in wheel paths (i.e. structures shall be located centered in the travel lane, crown of road, paved shoulder or off the pavement). Manholes cannot be located within parking spaces or other inaccessible locations. A concrete collar shall be placed around manholes in grassed areas. The design depth of the manhole from rim elevation to invert elevation shall be no less than 4.5' and no more than 16', unless specifically approved by the Department prior to initial plan approval. All Wastewater mains (including stub-outs) shall end with a manhole. In projects that are "phased" either pavement or stabilized road base must be in place over stub-out runs minimum 5' past the end manhole.

(2) Drop Manholes:

An exterior drop pipe shall be provided for a Wastewater run designed to enter a manhole at an invert elevation of 2.4' or more above the outgoing manhole channel invert. There is no limit on the length of an exterior drop pipe. No drop invert shall be in cone section of manhole. In cases where the elevation difference between the inverts is less than 1.8', a drop pipe is not required, but an interior drop channel shall be constructed to guide the flow into the outgoing channel. Manholes with a change in direction of flow of over 45 degrees and manholes with more than two (2) inverts shall have no greater than a 0.5' inside drop. No proposed manhole design is acceptable when an incoming invert is between 1.8’ and 2.4' above the outgoing invert.

When a new gravity sewer main is connecting to an existing manhole that creates a requirement for a drop manhole the existing manhole is to be removed and replaced with a new drop manhole.

No drop manhole can be the last manhole (terminal manhole) before a Department lift station.

(i) Service Connections:

(1) Unmetered sewer gravity services: A collector service connection may not be directed into a manhole, unless approved by the Department prior to initial plan approval. This is permissible only if it is treated as a Wastewater main, i.e. provide elevation, precast hole and flow channel, and no reasonable alternative is available. No service connection shall be made within 5' of any manhole. Wastewater laterals shall be located a minimum of 5’ from water services, hydrants, blow-offs, light poles, power poles, catch basins, walls, fountains or other structures. The allowable length of Department owned service laterals

shall be kept to a minimum not to exceed 75’ without prior Department approval. Private sewer laterals shall not exceed 100’ or current allowable length by Code. All service connections must be leak-free using same methods and materials as for main lines. Cleanouts shall be shown on plans at the property/right-of-way line or other required locations to limit the Department's maintenance and ownership responsibility. Cleanouts ending the Department’s maintenance responsibility shall be installed a minimum of 3’ from back of curb, edge of driveway/pavement. For cleanout installations within a nonexclusive utility easement paralleling a road right-of-way, the cleanout shall be located a minimum of 12” and a maximum of 18” from the right-of-way line. Unless otherwise specified, one cleanout at the property line is required for each wastewater service main connection. An inspection of connection into the Department’s wastewater lateral is required prior to Service Activation. At the time of gravity Wastewater main construction and inspection, the cleanout connection shall be marked with a wooden stake. The required cleanout shall be constructed per the Department’s Typical Cleanout Installation Detail prior to water meter installation. Service connections shall be typically one size smaller than the wastewater main.

(2) Metered sewer flow service force main connections: Design shall include vault, piping, valves, magnetic flow meter rated for submersible service, control panel, power source and easements. By-pass piping may be required to allow for meter service and calibration without service interruption.

## 3.3 FORCE MAIN DESIGN

Department Force mains (FM) shall not be less than 4" ID unless previously approved by the Department and with an ultimate design flow velocity of no less than 2.0 FPS nor greater than 4.0 FPS. When force mains less than 4" in diameter are required due to special circumstances will be approved on a case-by-case basis, with proper justification. Design standards for FMs will be generally the same as for Potable Water mains. FMs shall never enter a manhole from a direction contrary to the direction of flow out of the manhole. All private FMs may enter a road right-of-way with prior approval by the road owner and shall be built to the Department's standards past that point (usually at property line) and a valve shall be placed there to delineate the change in responsibilities and to control the flow.

Design standards for force mains are as follows:

(a) Minimum Cover:

Design minimum cover to finished grade over FM shall be 36". Mains installed at depths of more than 60” without justification and prior Department approval will not be accepted. Pipe is to be designed and installed as level as possible to minimize high points with proposed top of pipe elevations being called out at 100’ intervals on the design plan views prior to the Department approval. Reduced cover requires advance approval.

(b) Minimum Horizontal Separation (Wall to Wall):

(1) 10’ to buildings, exfiltration trenches, roof overhangs, canopies, walls, fountains, and other similar structures.
(2) 10’ to Potable Water lines (6’ minimum may be allowed in special circumstances and only with prior Department approval).
(3) 10' to drainage pipes (3’ minimum may be allowed in special circumstances and only with prior Department approval).
(4) 10’ to electrical conduits and communication conduits (6’ minimum may be allowed in special circumstances and only with prior Department approval).
(5) 6’ minimum to power poles and light poles. (4’ minimum may be allowed in special circumstancess and only with prior Department approval).
(6) 6’ minimum to drainage structures (3’ minimum may be allowed in special circumstances and only with prior Department approval).
(7) 10’ minimum to reclaimed water lines (6’ minimum may be allowed in special circumstances and only with prior Department approval).

(c) Vertical Separation:

Minimum 12” separation between all pipes shall be maintained, with FM crossing under Potable Water mains and reclaimed water mains. However, a minimum of 6" vertical separation is acceptable if it is not possible to maintain 12” when a force main crosses under or over other non-potable water main pipes with a section of force main being PVC C-900 centered on crossing with prior Department approval. A minimum of 6" vertical separation is acceptable when not possible to maintain 12” separation when the force main crosses under a potable water main or when a force main must cross over a potable water main due to existing conditions 12” minimum separation must be maintained with no exceptions. In either case when a force main crosses a potable water main a section of force main being PVC C-900 must be centered on crossing as well as a section of potable water main being ductile iron pipe (DIP) centered on crossing with prior Department approval.

(d) Layout:

FM should be placed in ROW'S whenever possible. Placement of FM on or adjacent to interior property lines or between structures is discouraged and will be approved only when unavoidable. The Department may require the developer to extend the force main across the property for future connections. The cost associated with any upsizing may be subject to a credit as defined in **Chapter 3 of the UPAP.** Use a friction coefficient c=120 for flow calculations and a maximum flow velocity of 3.0 fps to determine proper pipe sizing. Force mains shall not be placed in ditches, wetlands or storm water management areas unless specifically approved by the Department.

When a FM crosses a fence of any material, a wall of any type (panel, concrete block, etc.) or a berm higher than two (2) feet in height the FM is required to be within a steel casing. The casing

is required to extend three (3) feet minimum beyond either side of the berm or ten (10) feet minimum beyond either side of a fence or wall whichever is greater, see Standard Detail 91S.

When a new or existing FM is in conflict with a new or existing storm water pipe and the FM cannot deflect around the storm water pipe due to special circumstances a conflict structure may be required. If a conflict structure must be installed its design must meet both FDOT and WUD Minimum Design and Construction Standards with prior Department and FDEP approval.

(e) Valves and Appurtenances (FM):

Valving of all systems shall be designed to facilitate the isolation of each section of pipeline. All valves 3" or larger shall be gate valves of resilient seat design with right hand closed operation. For valves 16" and larger "Full Bore," eccentric plug valves may be used if approved in advance by the Department. Valves smaller than 24" shall be rated a minimum of 150 psi. Larger valves shall be rated a min. of 200 psi. Combination air release valves are to be located at the high points of the force main (minimum size – 2"). In-Line valves shall be installed at intervals of no greater than 2,000 LF on transmission mains. In-line valves shall be installed for mains 16" and smaller near each side of a canal crossing and/or major road crossing. In all instances, effectiveness of placement shall be the primary criteria in determining valve location. Valves placed in curbs will not be accepted. Clearance of 18" or one pipe diameter, whichever is greater, shall be maintained between all fittings (bells, valves, flanges, etc.).

All valves shall have:

- a standard screw type valve box
- operator nuts centered in the valve box
- mechanical joint or flanged ends

Valve operator nuts located 36" or more below final grade shall be equipped with an approved mechanically connected valve extension. All fittings, bends, crosses, etc., shall have mechanical joint or flanged ends unless previously approved flexible joint restraint system is used. The use of 90 degree bends shall be avoided whenever possible (use two 45 degree bends or wye).

(f) Thrust Restraint:

(1) All bends, tees, crosses, reducers, valves and dead ends shall be restrained through an approved means of mechanical or approved flexible joint restraint. Thrust blocks consisting of poured-in-place concrete having a minimum compressive strength of 2,500 psi after 28 day cure may be utilized with prior approval only if necessary for connections to existing piping system using a tapping sleeve or a cut-in-tee. The size and placement specification for the trust block must be designed by the Engineer of Record and approved by the Department prior to installation. Any line terminated as a construction phase that is a known future extension, shall have a plugged valve placed at the end, and restrained with approved mechanical or flexible joint restraint.

(2) An adequate number of pipe lengths shall be restrained using approved mechanical joint restraints (MJ pipe), flexible joint restraints (DIP push-on joint pipe) or pressure pipe bell restraints (PVC or DIP push-on joint pipe) to handle 150 psi working pressure and 250 psi surge pressure. The restrained pipe lengths shall be designed by a Registered Engineer based upon the soil conditions and shall be shown on the design drawings and record drawings.

(3) If flexible joint restraints are utilized, the following requirements must be met:
- The installation of flexible joint restraints must be witnessed by the Department Construction Coordinator and the Engineer of Record.
- A copy of the material invoice must be available on the job site for review to confirm the shipment of restraining gaskets, etc.
- PVC/DI pipe transitioning from HDPE pipe shall be restrained as a minimum to "inline valve" condition.

## MIN. LENGTH OF PIPE (FEET) TO BE RESTRAINED

(SOURCES: EBAA IRON RESTRAINT LENGTH CALCULATION PROGRAM FOR PVC PIPE, RELEASE 3.1, AND DIPRA THRUST RESTRAINT FOR DUCTILE IRON PIPE, RELEASE 3.2)

| FITTING TYPE | | PIPE SIZE | | | | | | | | 200psi | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 4" | 6" | 8" | 10" | 12" | 16" | 20" | 24" | 30" | 36" | 42" | 48" |
| 90° HORIZ. BEND | | 14 | 20 | 25 | 30 | 35 | 45 | 54 | 62 | 98 | 112 | 124 | 135 |
| 45° HORIZ. BEND | | 6 | 8 | 11 | 13 | 15 | 19 | 22 | 26 | 41 | 46 | 51 | 56 |
| 22.5° HORIZ. BEND | | 3 | 4 | 5 | 6 | 7 | 9 | 11 | 12 | 19 | 22 | 25 | 27 |
| 11.25° HORIZ. BEND | | 1 | 2 | 3 | 3 | 4 | 4 | 5 | 6 | 10 | 11 | 12 | 13 |
| 90° VERT. OFFSET | UPPER BEND | 29 | 41 | 53 | 64 | 74 | 95 | 115 | 134 | 214 | 246 | 276 | 304 |
| | LOWER BEND | 7 | 10 | 13 | 16 | 19 | 25 | 30 | 35 | 57 | 66 | 74 | 83 |
| 45° VERT. OFFSET | UPPER BEND | 12 | 19 | 24 | 29 | 34 | 39 | 48 | 56 | 89 | 102 | 114 | 126 |
| | LOWER BEND | 3 | 4 | 6 | 7 | 8 | 10 | 12 | 15 | 23 | 27 | 31 | 34 |
| 22.5° VERT. OFFSET | UPPER BEND | 6 | 9 | 12 | 14 | 17 | 19 | 23 | 27 | 43 | 49 | 55 | 60 |
| | LOWER BEND | 1 | 2 | 4 | 4 | 4 | 5 | 6 | 7 | 11 | 13 | 15 | 16 |
| 11.25° VERT. OFFSET | UPPER BEND | 3 | 4 | 6 | 7 | 8 | 9 | 11 | 13 | 21 | 24 | 27 | 30 |
| | LOWER BEND | 1 | 1 | 1 | 2 | 2 | 2 | 3 | 3 | 6 | 6 | 7 | 8 |
| PLUG (DEAD END) | | 32 | 45 | 59 | 70 | 83 | 107 | 129 | 151 | 214 | 246 | 276 | 304 |
| IN-LINE VALVE | | 32 | 45 | 45 | 45 | 45 | 55 | 65 | 80 | 110 | 125 | 140 | 155 |
| TEE (BRANCH RESTRAINT) | 4"X ø | 23 | – | – | – | – | – | – | – | – | – | – | – |
| | 6"X ø | 21 | 35 | – | – | – | – | – | – | – | – | – | – |
| | 8"X ø | 18 | 34 | 47 | – | – | – | – | – | – | – | – | – |
| | 10"X ø | 16 | 32 | 46 | 58 | – | – | – | – | – | – | – | – |
| | 12"X ø | 13 | 30 | 44 | 57 | 69 | – | – | – | – | – | – | – |
| | 16"X ø | 7 | 26 | 41 | 55 | 67 | 90 | – | – | – | – | – | – |
| | 20"X ø | 1 | 21 | 38 | 52 | 65 | 88 | 109 | – | – | – | – | – |
| | 24"X ø | 1 | 16 | 34 | 49 | 62 | 86 | 108 | 129 | – | – | – | – |
| | 30"X ø | 1 | 8 | 28 | 44 | 58 | 83 | 106 | 127 | 208 | – | – | – |
| | 36"X ø | 1 | 1 | 22 | 39 | 54 | 80 | 103 | 124 | 206 | 240 | – | – |
| | 42"X ø | 1 | 1 | 15 | 33 | 49 | 77 | 100 | 122 | 205 | 239 | 270 | – |
| | 48"X ø | 1 | 1 | 7 | 27 | 44 | 73 | 97 | 120 | 203 | 238 | 269 | 298 |
| REDUCER (LARGER PIPE RESTRAINT) | 6"X ø | 23 | – | – | – | – | – | – | – | – | – | – | – |
| | 8"X ø | 38 | 25 | – | – | – | – | – | – | – | – | – | – |
| | 10"X ø | 57 | 43 | 24 | – | – | – | – | – | – | – | – | – |
| | 12"X ø | 72 | 60 | 44 | 41 | – | – | – | – | – | – | – | – |
| | 16"X ø | 99 | 90 | 78 | 75 | 45 | – | – | – | – | – | – | – |
| | 20"X ø | 123 | 116 | 107 | 105 | 81 | 45 | – | – | – | – | – | – |
| | 24"X ø | 146 | 140 | 132 | 131 | 111 | 82 | 45 | – | – | – | – | – |
| 200psi | 30"X ø | 209 | 204 | 197 | 188 | 177 | 153 | 116 | 75 | – | – | – | – |
| | 36"X ø | 243 | 236 | 233 | 226 | 217 | 196 | 168 | 135 | 74 | – | – | – |
| | 42"X ø | 273 | 270 | 265 | 259 | 252 | 234 | 211 | 183 | 133 | 72 | – | – |
| | 48"X ø | 301 | 298 | 294 | 289 | 283 | 268 | 249 | 226 | 183 | 131 | 71 | – |

NOTES:

1. THE DATA IN THE ABOVE TABLE ARE BASED UPON THE FOLLOWING INSTALLATION CONDITIONS:
   SOIL TYPE–SAND  TEST PRESSURE–150 PSI/200 PSI  DEPTH OF BURY–3'
   TRENCH TYPE–3  SAFETY FACTOR– 1.5  VERTICAL OFFSET–3'
   MINIMUM PIPE LENGTH ALONG TEE RUN–5'
2. THE RESTRAINED PIPE LENGTHS APPLY TO DUCTILE IRON AND PVC PIPE.
3. ALL JOINTS BETWEEN UPPER AND LOWER BENDS SHALL BE RESTRAINED.
4. RESTRAINED PIPE LENGTHS APPLY TO PIPE ON BOTH SIDES OF VALVES AND FITTINGS.
5. MULTIPLY PIPE LENGTH BY 1.4 FOR POLYETHYLENE ENCASED PIPE.
6. RESTRAINED PIPE LENGTHS EQUAL TO AN "INLINE VALVE" CONDITION ARE REQUIRED AT EACH END OF A TRANSITION FROM HDPE PIPE TO OTHER PIPE MATERIALS.
7. **THE DESIGN ENGINEER IS RESPONSIBLE FOR PROPER SIZING OF RESTRAINT PIPE LENGTHS FOR THE PROJECT.**

**Notes:**

The data in the above table are based upon the following installation conditions:

- Soil Type – Sand
- Test Pressure – 150 psi
- Depth of Bury – 3’
- Trench Type – 3
- Safety Factor – 1.5
- Vertical Off-Set – 3’
- Minimum pipe lengths along tee run – 5’
- The restrained pipe lengths apply to PVC pipe and DIP without polyethylene encasement.
- All joints between upper and lower bends shall be restrained.
- Restrained pipe lengths apply to pipe on both sides of valves and fittings.

The above table shall serve as a general design guide only. It is the Engineer’s responsibility to justify and document any deviations from the pipe lengths specified in the above table.

(g) Force Main Materials:

Force mains greater than 3”, less than or equal to 24” in diameter shall be PVC C900/C-905 SDR 18 Class 150 pipe with epoxy lined ductile iron fittings. PVC force mains shall be marked with one continuous strip of six (6) inch wide, brown coded magnetic tape imprinted with one and onehalf (1 1/2) inch high lettering reading **"Caution Force Main Below",** and located approximately twelve (12) inches above the crown of pipe. The wording shall occur every three (3) feet. When in the judgment of the Department there is a potential for damage to the force main, or cover over pipe is less than 36”, the force main shall be ceramic epoxy lined DIP. Force mains larger than 24” shall be ductile iron lined with approved coating. The lining shall be factory applied in accordance with the manufacturer's recommendations and shall be warranted by the pipe/fitting manufacturer. Unless specific approval is granted, no force main shall be encased in concrete. Flanged ductile iron pipe and fittings is required for exposed installation.

## 3.4 GRAVITY SEWER CONSTRUCTION

(a) Installation:

Gravity Wastewater lines shall be laid accurately to both line and grade. The Department will generally not accept any line laid with a slope varying by more than 15% of its design slope especially for lines laid at minimum gradients. For specific instance the minimum acceptable slope of an 8" line shall be .34% if the design called for .40%. The Department reserves the right to require independent verification of questionable survey results at the Developers/Property Owners expense. Visible leakage, deflections, horizontal misalignment, significant bowing, non-constant slopes between manholes and sagging joints shall each be grounds for rejection of lines. Certified verification by televising of mains and laterals at the Developers/Property Owners expense may be required at the discretion of the Department. A Wastewater lateral connection inspection is required prior to Service Activation. The minimum design depth of a PVC gravity Wastewater line shall be 4.5 feet to invert. PVC C900 pipe shall be placed for all lengths with less than 4.0 feet to

invert in cases where this cannot be met and prior approval is obtained. Trenches and excavations shall be kept dry and stable while work is in progress.

The contractor shall be responsible to ensure that all safety requirements are met. Unsuitable excavated material such as boulders and logs shall be removed from the site. The pipe barrel shall be uniformly supported along its entire length on undisturbed soil or bedding material. Proper bedding shall be supplied if the existing material includes rock, organic material or other sharp or unsuitable material.

(b) Manholes:

Manholes shall be set according to construction plans and standard details, and precast in accordance with approved shop drawings and specification detail drawings accompanying this text. The mix used for the precast shall include calcareous aggregate (minimum CaCO3 content: 65% in large aggregate, 50% in concrete screenings) and shall be certified by the supplier. Certification on the submitted shop drawings is acceptable.

When not using the optional precast concrete or cast-in PP or FRP flow channel, the manhole floor shall have a flow channel made to conform in shape and carrying capacity to that of the Wastewater pipes. Flow channels within the manholes involving changes of direction or slide slopes shall smoothly direct the flow in accordance with detail drawings. The flow Channel may be constructing three possible methods:

- Field constructed concrete channel formed to match inverts and flow direction.
- Precast concrete channel.
- Precast flow channel and benching with integrated inverts, lined with polypropylene or FRP liner poured monolithically with manhole's base section.

All concrete irregularities shall be plastered with cement mortar in such a manner as to give a neat and water-tight job. Manholes shall be core-drilled to provide pipe opening when precast hole is not available. The standard manhole frame height shall be 7". A 4" frame may be used only with prior approval. Approved joint sealant is required at all riser joints with the external Manhole Joint Seals being applied between all precast manhole sections prior to backfilling, see details . The manhole shop drawings shall call out the size of the joint sealant and include a blowup detail showing the exact location of the sealant rings within the tongue and grove area. Structures with any leakage will not be accepted. All new manholes and existing tie-in manholes along with modified existing manholes shall be lined with a Department approved corrosion barrier system. New "Outside Drop Manholes," manholes deeper than 14 feet, last manhole prior to a lift station and manholes with a force main connection shall be lined with an approved solid thermoplastic polypropylene HDPE or RFP cast-in-wall liner. **(See SECTION 3.7 (CORROSION BARRIER/INFLOW PROTECTION SYSTEM for detailed specifications)**. The coating shall be in place prior to Wastewater system lamping and system certification to the Health Department. Manhole top covers must fit flush into the rings with approved inflow protectors installed in all manholes and interceptors both Department owned and privately owned to prevent unmetered water entering the wastewater system.

(c) Inspection and Testing:

Lamping of the completed gravity Wastewater system will be performed after complete backfilling, the laying and compaction of the roadway base, and accurate record drawings are received. The lamping will determine that the lines have been laid to accurate line and grade. At time of lamping, the line shall be clean and dry. A final inspection will be held after the roadway is completed to verify that the system has not been damaged. All lines and appurtenances not meeting specifications or reasonable standards shall be repaired or replaced. The Department may require videotaping of gravity mains and laterals at the Developers/Property Owners expense if substandard installation is suspected or if ground water infiltration/leakage is present. The Developer/Property Owner shall videotape all gravity mains deeper than 16' and the corresponding laterals prior to Wastewater system certification. The corrosion barrier system components shall be inspected and tested as required herein.

(d) Gravity Wastewater Lines and Force Mains in Wellfields:

All new or replacement installations of gravity Wastewater mains in Zone One (1) or Zone Two (2) of a public drinking water wellfield shall be constructed to force main standards. The following are the required minimum design and construction standards for Wastewater system pipe, fittings, coatings and pressure testing criteria within Zones 1 or 2 of a wellfield.

(1) Ductile iron pipes and Fittings for Gravity Wastewater Main and Force Main Application: DIP shall conform to the requirements of ANSI/AWWA C151/A21, 51-86 unless otherwise noted on the plans. Glands for mechanical joints shall be of ductile iron. Fittings shall have mechanical joints or flanged ends unless an approved flexible joint restraint system is used. The fittings shall conform to the requirements of AWWA C-110 or AWWA C-153. Flanged ductile iron pipe shall be "special thickness class 53". Flanged ductile iron pipe and fittings shall have threaded flanges, unless otherwise noted on the drawings, and shall conform to ANSI/AWWA C115/A21, 15-83. All flanges shall be Class 1560, ANSI B16.5. All above grade flanges shall be flat faced unless they are mating up to existing, or otherwise specified, raised flanges. All gaskets shall be full-faced 1/8" red rubber. Joints shall conform to the requirements of ANSI/AWWA C111/A21, 11-85.

(2) PVC Pipe (gasketed joint) and Fittings for Gravity Wastewater and Force Main Application: Pipe 4" or larger in diameter shall conform to the requirements as set forth in AWWA C900/C905 with dimension ratio DR 18. Provisions must be made for contraction and expansion at each joint, or with rubber ring and an integral bell as part of each joint, or by a rubber ring sealed coupling. Clean, reworked material generated from the manufacturer's own pipe production may be used. Fittings shall be cast or ductile iron. Pipe shall have cast iron pipe equivalent outside dimensions. Pipe smaller than 4" in diameter shall conform to Commercial Standard CS 256 and ASTM D-22141. Provisions shall be made for contraction and expansion at each joint, with a rubber ring and an integral bell as part of each joint, or by a rubber ring sealed coupling. Pipe shall be made from SDR 21,

200 psi clean, virgin NSF approved Type I, Grade 1 PVC conforming to ASTM D-1784. Clean reworked material generated from the manufacturer's own pipe production may be used. Fittings for pipe smaller than 4" in diameter shall be PVC.

(3) Coatings: All ductile iron pipe and fittings shall have an epoxy lining and a bituminous coating on the exterior, per AWWA specification C-210. The coating and lining shall be applied in accordance with the manufacturer's recommendations.

(4) Pressure Tests: The test shall be of two (2) hour duration. During the test, the pipe being tested shall be maintained at pressure of not less than 150 psi. All pipes shall be pressure tested in accordance with the current AWWA C-600 Standard with a no leakage tolerance. No more than 500' of gravity Wastewater main or 1000' of force main shall be tested at one time. Pressure tested gravity Wastewater mains and laterals located in wellfield zones 1 and 2 shall be PVC C900 SDR18. The tested portion of the laterals shall end at the "upper" bend using a temporary mechanical joint restrained cap.

(5) Manholes: Manholes shall be precast and coated with an approved corrosion barrier system **(see SECTION 3.7).** Exterior manhole joint seal application is required **(see details).** Manhole inlets and outlets shall be tightly sealed around the sewer pipe and coated to eliminate leakage.

(6) Pipes and manholes with any leakage will not be accepted.

## 3.5 FORCE MAIN CONSTRUCTION

(a) Installation:

Installation of force main pipe and associated fittings shall be in accordance with current AWWA specifications, and manufacturer's requirements for their particular products. All non-DIP mains shall have a minimum of 36" clear cover to finished grade, unless specifically approved otherwise, subject to pipe material limitations. Approved pipe joint restraint shall be required at each fitting involving a change of direction and as specified in plan details.

Approved pipe joint restraint shall be required at each fitting involving a change of direction and as specified in plan details. The contractor shall be responsible to ensure that all safety requirements are met with respect to construction.

All pipes shall be laid in trenches having a dry and stable bottom. Backfill shall be free of boulders and debris. Pipe shall be fully supported along its entire length. Sharp or rocky material encountered in the base shall be replaced with proper bedding. Pipe shall be laid on line and grade as designed. The contractor shall be responsible to ensure that all safety requirements are met.

Changes in pipe alignment may be accomplished using appropriate fittings or through pipe deflection. Pipe deflection at the joint is allowed with ductile iron pipe and with specially designed PVC pipes (see Approved Materials Lists). The deflection shall not exceed 75% of the

Manufacturer's recommended maximum joint deflection. No deflection at the joint is allowed for PVC pipe unless allowed by the pipe manufacturer and does not exceed 75% of the Manufacturer's recommended maximum joint deflection. If joint deflection is not allowed, PVC pipe curvature shall be accomplished by installing appropriate bends.

All valves shall be placed according to plans unless relocation is approved by the Department. As built drawings shall reflect the actual location of all mains and valves. All taps must be at least 18" from a fitting or bell. Force mains shall not be laid in fuel contaminated areas.

All road crossings and pavement cuttings shall be in accordance with the requirements of the particular authority governing the area.

(b) Connection to Existing System:

All connections to existing mains shall be made under the inspection of the Department. Valves on existing mains shall be operated by Department personnel or under direct supervision by the Department.

The Contractor shall confirm the compliance of the existing facilities with the Standards and modify the facilities prior to connection, if required, at no cost to the Department. Using a cut-in tee or a tapping sleeve is an acceptable method of connecting to an existing force main (minimum branch size shall be 4”). Tapping sleeve and valve shall be pressure tested using the test plug on the tapping sleeve prior to tapping the force main. A reverse tap using 45 degree bends only due to preexisting conditions is acceptable only if previously approved by the Department (construction detail required). Temporary in line insertion valves (line stop valves) may be required in order to avoid spillage and limit service interruptions. If service must be temporarily shut off to existing Customers, the Department must have seven (7) business day notice to make necessary notifications. The contractor or developer may be required to assist in notifications. In this event, contractor shall be ready to proceed with as much material preassembled as possible at the site to minimize the length of service interruption.

The Department will postpone a temporary service shut off if the contractor is not ready to proceed on schedule. Such connections may be made at night to minimize effects. No Customer should be without service for more than two (2) hours.

(c) Cleaning:

Foreign material shall be kept out of pipe or cleaned from pipe prior to installation. Upon completion of installation, the mains shall be flushed and the water disposed of without creating a nuisance. The ends of pipe installed during one day shall be capped at the end of each day with a pipe plug to prevent contamination.

(d) Testing:

All force mains shall be pressure tested in accordance with the current AWWA C-600 Standard. Water shall be supplied to the main and pumped to the required pressure, 150 psi. The maximum length of line to be tested as one section will be 2,500 feet. The standard test duration is two (2) hours. The maximum quantity of water that must be supplied into the tested pipe to maintain pressure within 5 psi of the specified test pressure shall not exceed 50% of the applicable AWWA C-600 Standard. There is a "zero" tolerance for pressure tests for force mains and gravity sewers within well for protection zones 1 and 2. Force mains within road rights-of-way and under traffic areas shall be pressure tested after the road base/rock and "tack-coat" is installed, and before the asphalt is installed.

(e) Handling, Abandonment and Disposal of Asbestos - Cement (AC) Pipe:

(1) All cutting, removal and disposal of AC pipe must be performed by a Florida licensed Asbestos Abatement Contractor per applicable local, state and federal regulations.. The Department will make every effort to identify and quantify the location of known AC pipe and material prior to onset of work. If the Contractor during the course of work observes, uncovers, or otherwise becomes aware of the existence of any asbestos-cement pipe, pieces, or material at the site to which the Contractor or any subcontractor, supplier, or other person may be exposed, the Contractor shall immediately notify the Project Engineer and the Department.

(2) On projects designed and/or constructed by the Department, the Contractor shall notify the County's Risk Management and Water Utilities Departments. The Risk Management Department shall promptly consult with the Project Engineer concerning such condition and determine the necessity of the County retaining special consultants or qualified experts. The contractor shall not perform any work near or in connection with the suspect material until receipt of special written instructions from the Risk Management Department. The Contractor will ensure that all subcontractors follow these procedures.

(3) Abandonment – Grouting and/or abandonment in place is not permitted, unless otherwise authorized by the County project coordinator/engineer. Written approval is required. AC pipe to be abandoned in place shall be filled with grout. Abandoned A/C pipe is to be shown on the as-built drawings.

The Grout Mix shall be:

| **Type** | **Pounds** | **Cubic Feet** |
|---|---|---|
| Cement | 340 | 1.73 |
| Sand | 2840 | 17.91 |
| Stone | 0 | 0 |
| Water | 374 | 6.00 |
| Admix/Type B | 13 oz. | |
| Air | 170 + 5.0% | 1.35 |

The slump shall be 6" ± 1 inch; Admix shall meet ASTM C-494 type BD. Alternative mixes will be considered.

## 3.6 HORIZONTAL DIRECTIONAL DRILLING (HDD)

(a) General:

Wastewater design and construction standards shall apply unless noted otherwise. The Department reserves the right to disapprove a horizontal directional drilling installation if the conventional open trench or jack and bore type installation is preferred by the Department, because:

- Excessive number of high/low points
- Excessive depth of pipe is of concern
- A casing is required by the Department to protect the utility pipe
- Future service and main connections to the utility pipe will be negatively impacted by a horizontal directional drilling.

(b) Pipe sizes, pipe material.

The horizontal directional drilled utility main pipe shall be manufacturer approved restraint joint DIP, PVC AWWA C-900 DR14, 200 psi, NSF 61 (4”-12”) or HDPE pipe (SDR 11). If the directional-drilled pipe is to be used as a casing for a small diameter service line (up to 2” diameter), PVC DR18 or HDPE DR 17 pipes are acceptable. Pipe and system components shall be free from voids, cracks, inclusions, and other defects and shall be uniform in color throughout the installation.

(c) Design Requirements.

The Engineer shall inquire with the Department about approval of a horizontal directional drilling procedure for a pipe installation. With the Department’s concurrence, the Engineer shall submit a signed and sealed pilot bore plan for review and approval.

The plan shall be submitted on a 24” x 36” sheet to a maximum 1”=20’ horizontal and 1”=2’ vertical scale (1”=10’ horizontal, 1”=10’ vertical scale preferred).

The plan must show:

- Finished grade and surface improvements
- Locations of drill set-up
- Length of bore
- Deflection and radiuses of the pilot bore
- Field verified locations of existing utilities and underground structures

- Minimum horizontal and vertical clearances from underground structures, conduits, piping systems (the proposed clearances must exceed the Department's standards plus the guidance system accuracy tolerance)
- Pipe size and specifications (including restraining provisions against "pipe shrinkage")
- Proposed pilot bore pipe defection limits shall not exceed 75% of the maximum deflection allowed by the pipe manufacturer
- The drill radius of the final HDD pipe shall be minimum 30 pipe diameters, not exceeding 80% of the max. bending radius as recommended by pipe manufacturer
- Limits of directional bore installation
- Limits of pressure testing
- Connection to existing utilities
- Rights-of-way limits, utility easements and temporary construction easements
- Minimum pipe joint restraints at each end of pipe material transition from HDPE pipe
- Tracer wires
- Isolation valves and/or transition fittings

(d) Preconstruction Meeting.

Upon approval of the pilot drill plan by the Department and obtaining all necessary permits for the directional drilling, the Engineer shall schedule a preconstruction meeting with the Department in accordance with Section 5 - Subsection 5.3 Pre-Construction Requirements of this Minimum Design and Construction Standards. If the construction requires any field welding/fusion of HDPE pipe and/or fittings, a Certificate of Completion of a pipe fitting manufacturer approved training program is required. The Engineer and the Contractors performing the utility work shall attend the meeting. The licensed HDD Contractor shall provide references certifying minimum five (5) years of HDD experience.

(e) Pilot Bore.

The Engineer shall schedule the beginning of work with the Department a minimum of 3 days in advance. The drill path shall be accurately surveyed and plotted to create an "as-built" drawing (same scale as the pilot drill plan).

A high accuracy MGS (Magnetic Guidance System) shall be capable to provide vertical pipe data with a max. + 2% deviation and horizontal pipe location data with max. 2 foot deviation. The data shall be collected at max. 25' intervals. Deviation of more than 2 feet vertically or horizontally from the approved pilot bore plan shall be reported immediately to the project engineer for evaluation. The Engineer shall evaluate the as-built data and confirm the compliance with the design parameters. Deviation beyond approved parameters (depths, deflection radius, separation to other utilities or structures) shall be brought to the attention of the Department. The signed and sealed pilot bore "as-built" drawing shall be submitted to the Department for review and approval if the "as-built" location differs substantially from the design plan.

(f) Pull back of carrier pipe:

Upon approval of the pilot bore location by the Department; the pullback operation of the required carrier pipe shall begin. The Contractor shall select the proper reamer type with the final hole opening to be a maximum of 1.5 times the outside diameter of the largest component system. The open borehole shall be stabilized by means of bentonite drilling slurry. The slurry shall be contained at the entry or the exit side of the bore in pits or holding tanks. The pipe sections shall be butt fused/joined together in accordance with the manufacturer's specifications. The ends of the pipe, gaskets and couplings shall be inspected for cleanliness. Chipped, scratched, scraped, cracked or excessive deformed pipe or couplings shall be rejected. Two approved APWA color coded tracer wires shall be pulled along the sides of the product pipe, and extended to nearest valve boxes (coil min. 3' wire near the surface inside valve box). The installation of the tracer wires is an essential part of the Horizontal Directional Drill process and the contractor shall use all reasonable means and methods to insure that the tracer wires are pulled without breakage. However, accidental tracer wire breakage shall not be a reason to require a repeat directional drill unless specifically required in the project specifications. The pipe shall be elevated to the approximate angle of entry and supported by roller arms or equivalent. Any field welding/fusion of HDPE pipe and fittings may be performed only by personnel certified through a pipe/fitting manufacturer approved training program.

(g) Testing.

Pipe installed using the HDD method shall be flushed and pressure tested using Potable Water. The pressure within the HDPE Pipe test section shall be raised to approx. 160 psi and then allowed to idle for approx. 3 hours in order to allow to stabilize. Additional make-up water/pressure shall be applied during the 3 hour stabilization period only to maintain a minimum 140 psi pressure.

The final phase of the pressure test shall involve applying make-up water/pressure to achieve a test pressure of 150 psi or higher (as required). The test section is then allowed to idle (no make-up water /pressure is added) for a period of 2 hours. After this 2 hour period, make-up water/pressure is applied and measured to reestablish the test pressure. If the measured and added quantity of water is greater than the allowable amount, the pressure test fails. No leakage is acceptable.

Installed services, tees and stub-outs shall be pressure tested together with the main. Pressure test is not required if the installed pipe is intended to be used as a casing. If the pipe successfully passed the pressure test, a connection to the existing pipe system may be performed.

(h) As-Builts:

Certified as-built drawings must be submitted to the Department for review and approval prior to any final certification in accordance with Section 6 - Subsection 6.1 Record Drawings of this Minimum Design and Construction Standards.

## 3.7 CORROSION BARRIER/INFLOW PROTECTION SYSTEM

The system consists of an interior corrosion barrier wall liner, an external manhole joint seal, an inflow protector is required on any public or private manhole, and a cast-in base liner (optional or as specified within this section).

It is the contractor's responsibility to comply with all applicable safety standards and regulations. A safety/maintenance of traffic plan is required (if applicable).

### (a) Mortar/Epoxy Liner For New Manholes, Valve Vaults And Rehabilitation Projects

**Note:** This specification applies to new structures (except wet wells, drop manholes, manholes deeper than 14 feet, last manholes before lift station, and manholes with force main connections) and ***rehabilitation of existing structures. However, the text printed in italics applies to rehabilitation of existing structures only.***

(1) General Requirements:

For installation of systems listed on the applicable approved material list indicate by circling the appropriate name of the manufacturer on the material list. Prior to preconstruction meeting submit a certification stating the applicator is:
(a) Currently approved by the Manufacturer of the specified products.
(b) Licensed and qualified in the application of the specified products.

(2) Quality Assurance:

A preconstruction meeting shall be held prior to start of any restoration and application of corrosion barrier system. The Engineer is responsible for scheduling the meeting. The attendance of the Engineer, Applicator, Underground Contractor, PBCWUD Construction Coordinator and a Representative from PBCWUD Development Improvement Section is required. The attendance of the Applicator may be waived by PBCWUD upon request During the meeting, the process of preparation, application, curing, field inspection and coordination with other work shall be reviewed. The approved specified products shall be applied in accordance with the Manufacturer's recommendations unless noted otherwise in this specification.

Material delivered to the site shall be in Manufacturer's original, unopened containers and packaging, with label clearly identifying product name and Manufacturer, batch and lot number, and expiration date as applicable.

The material shall be protected during storage, handling and application to prevent damage. The liner manufacturer (not installer) shall warrant the corrosion barrier system for minimum five (5) years from the time of:

(a) Acceptance of bill of sale by the Department.
(b) Final payment to the Contractor by the Department (for Department initiated projects).

The liner manufacturer shall warrant the corrosion barrier system for all labor and materials cost necessary to repair or replace the failed application, including related work (permits, bypass piping, pumps, flow monitoring, restoration, and record information).

If installation warranty cannot be obtained from the liner manufacturer, the Department may accept the installer's minimum 5-year labor and material warranty with a performance bond in the amount equal to $3,000 per manhole/vault and $30,000 per lift station wet well. The bond shall be valid for 5-years from the time of the acceptance of Bill of Sale.

(3) Environmental Conditions. Do not apply materials under the following conditions:
- Temperature exceeding the Manufacturer's recommended maximum or minimum allowable.
- Overflowing water condition.

(4) Restoration and Corrosion Barrier System.
Products: Restoration and Corrosion Barrier System Manufacturer must be listed on the Department's Approved Materials List. Materials shall be provided by a single manufacturer.

**(b) Rehabilitation of existing structures only, Hydraulic Cement Mortar: (fast setting mortar used to stop leaks through cracks and holes).**
- Composition: Blend of hydraulic cements and fillers
- Compressive strength: ASTM C-109 1 day 2,400 psi 28 days 5,500 psi
- Tensile Strength, ASTM C-190, 7 days 290 psi, 28 days 575 psi
- Working Time: 45 - 90 seconds at 77° F
- Color: Dark Grey

(c) Restoration Mortar: Low shrinkage, high strength, polymer modified, sprayable microsilica mortar. Composition: Blend of cements, microsilica, thermo-plastic fibers, densifiers, polymer admixtures, and modifiers not to contain calcium *aluminate* cements or aggregates.
- Compressive strength: ASTM C-109, 2 days 3,875 psi, 7 days 4,550 psi, 14 days 5,640 psi, days 6,190 psi
- Flexural strength: ASTM C-78, 7 days 825 psi, days 985 psi
- Tensile strength: ASTM C-190, 7 days 290 psi, days 575 psi
- Shrinkage: ASTM C-157 modified, days - 0.04 percent
- Uniaxial tensile bond strength: ACI 503R, Appendix A: 28 days - greater than 500 psi
- Color: Dark Gray

(d) Corrosion Barrier Topcoat

- Composition: 100 percent solids, modified epoxy sprayable coating
- Thickness: min. of 100 mils in 1 or 2 coats (dry film thickness)
- Number of components: 2
- Finish: Gloss
- Color: White or Gray

(e) Water: Water shall be potable and clean.

(f) Execution.

(1) Examination

(a)Inspect surfaces to receive restoration and corrosion barrier system for leaks, deteriorated concrete, cracks and voids. Notify the Engineer and the PBCWUD Construction Coordinator in writing if surfaces do not meet the minimum conditions as set by the coating Manufacturer. Do not begin surface preparation or application until unacceptable conditions has been corrected. New structures are to be inspected and visibly marked by the PBCWUD Construction Coordinator prior to system application.
(b) Give the PBCWUD Construction Coordinator a minimum of two days in advance notice of completion of surface preparation and start of application. If the application required a Wastewater service shut-down, a minimum 10 day notice is required in order to notify customers.
(c) Before application of each material, surfaces to be sprayed or coated will be inspected by the Engineer and by the PBCWUD Construction Coordinator. Correct defects or deficiencies before application of subsequent material.
(d) Inspection or the waiver of inspection by the PBCWUD Construction Coordinator and or the Engineer of any portion of the work shall not relieve the Contractor of responsibility to perform the work as specified.

(2) Surface Preparation

(a) Coordinate with the Department's Construction Coordinator any Wastewater service shutdowns, invert plugging, temporary Wastewater pumping arrangements and by-passing of existing facilities.
(b) Place covers over inverts to isolate the structure receiving the surface restoration.
(c) Place masking tape to protect equipment not intended for spraying/coating.
(d) Prepare surfaces in accordance with manufacturer's instructions.
(e) Cleaning: Clean surfaces by water (minimum 3500 psi) or abrasive blasting, or hand or power tools as required to remove all previously applied coatings, unsound concrete, contaminants, dirt, debris, and deteriorated reinforcing steel, laitance, efflorescence, form oils and spoiled concrete.
(f) *Rehabilitation of existing structures only.*
*Inspect cleaned surfaces to identify and mark corroded reinforcing steel, and to locate cracks, leaks, and joints. Replace or treat corroded reinforcing steel, repair cracks and leaks, and treat joints in accordance with manufacturer's instructions and as approved by the Engineer. Refer to ICRI Technical Guideline No. 03730 - Surface Preparation Guidelines for the Repair of*

*Deteriorated Concrete Resulting from Reinforcing Steel Corrosion. Apply approved epoxy putty promptly after cleaning reinforcing steel to protect the steel from contamination and re-rusting.*

(g) *Hydrostatic Leak Correction:*

*(1) Stop visible hydrostatic leaks by application of hydraulic cement mortar, after completion of surface preparation. Mix only 1 to 2 pounds of mortar at a time. Add water to form a viscous mass with consistency of modeling clay. Apply by hand or trowel. Press mixed material firmly into place, starting at top of leak and working downward.*

*(2) Inject flowing leaks using a suitable polymer gel or foam. Be sure to remove any excess or spilled material and clean/saturate the concrete surface with water prior to application of the restoration mortar.*

(h) Prepare surfaces to have a minimum profile of 1/16 inch, with aggregate exposed, then remove the water and any loose material.

(i) Inspect surfaces for soundness.

(j) Saturate all surfaces thoroughly with clean water.

(k) Apply mortar as soon as water sheen is no longer visible (saturated surface dry).

(3) Application of Restoration Mortar

(a) Apply restoration mortar in accordance with manufacturer's instructions, no more than 24 hours after surface preparation.

(b) Apply by one of the following methods:

(1) Low pressure, low volume spray equipment.

(2) Wet mix shotcrete equipment.

(c) Apply uniformly to substrate.

(d) Do not trap air in corners, behind exposed reinforcing steel, or between lifts.

(e) Mortar Thickness: Apply in layers of a minimum thickness of 1/2" and no more than 4" above peaks of existing profile after surface preparation. If material sags or slumps, remove it and replace with new material.

(f) Manhole chimneys constructed with bricks or precast concrete rings shall be completely lined with the mortar mix but not overlap the bottom inside edge of the manhole frame.

(g) Finishing: Finish surface with wood float, sponge float, broom, or brush to produce a textured surface to apply corrosion barrier topcoat.

(h) Remove excess material and overspray promptly.

(i) Hot Weather Application:

(1) Follow manufacturer's instructions to reduce evaporation rate of surface moisture until topcoat can be applied.

(2) If applying mortar under conditions such as high temperatures of mortar, substrate, or air; high winds; and low humidity; alone or in combination; rapid evaporation of surface moisture can occur and cause plastic shrinkage cracking. Apply approved primer/sealer as specified by the coating Manufacturer.

(3) If conditions prevent application of epoxy topcoat or primer**, refer to ACI 305R-91, Figure 2.1.5** to estimate the evaporation rate of surface moisture from the mortar, based on temperatures, relative humidity, and wind velocity. Cover with plastic film or wet burlap to limit evaporation rate to a maximum of 0.1 pounds per square foot per hour.

(j) Cold Weather Application:

Follow manufacturer's instructions for minimum application temperature and minimum number of days to protect from freezing.

(4) Application of Corrosion Barrier Topcoat

(a) Provide mixing and application equipment designed for mixing and spraying epoxy coating.
(b) Apply corrosion barrier topcoat epoxy to all prepared surfaces in accordance with manufacturer's instructions. Manhole chimneys constructed with bricks or precast reinforced concrete rings shall be completely lined with the topcoat but not overlap the bottom inside edge of the manhole frame.
(c) Apply topcoat as soon as possible after finishing of restoration mortar. Follow the manufacturer's instructions for excessive time delays between the mortar application and topcoat application.
(d)Do not allow surface contamination to the finished restoration mortar before application of topcoat.
(e)Topcoat Thickness: Spray at a minimum thickness of 100 mils DFT. Follow the manufacturer's instructions for maximum film thickness per coat and for surface treatment between coats.

(5) Curing of Corrosion Barrier Topcoat

(a) Foot Traffic: Allow a minimum cure time of 24 hours at 70 degrees F.
(b) Chemical Service: Allow a minimum cure time of 6 hours at 70 degrees F.
(c) Curing Conditions:
    (1) Continue to protect system from freezing throughout protection periods specified for cold weather application after application of corrosion barrier topcoat.
    (2) Shelter system from direct impingement of water until 1 to 3 hours after application of topcoat, depending on substrate temperatures, after which cure sufficiently to be undamaged by water impingement or immersion at ordinary velocities.
    (3) Sanitary Sewer Systems: It may be necessary to plug services or main lines temporarily in order to achieve these environmental conditions.
    (4) Immersion Service: Reach a tack-free condition before being immersed.
    (5) Remove any loose debris, plugs, covers and masking prior to inspection.
    (6) Field Quality Control

(a) The Contractor shall hire an independent material testing firm to perform a test and certify the application for minimum thickness of coatings (minimum ½" of restoration mortar for manholes, minimum 1" thickness for wetwells, minimum 100 mils MDFT of epoxy topcoat). The test for the topcoat shall consist of five separate spot measurements (average of three readings each), spaced evenly over each 100 square feet of the area to be tested.

The average of five spot measurements for each such 100 square foot area shall not be less than 100 mils MDFT. No single spot measurement in any 100 square foot area shall be less than 80 mils MDFT. Any one of three readings which are averaged to produce each spot measurement may under-run be a greater amount. The five spot measurements shall be made for each 100 square feet of area as follows:

(1) Perform minimum 1 set of tests for every manhole, and minimum of three (3) 100 square foot areas shall be randomly selected and measured for every wet well.

(2) If the dry film thickness for any 100 square foot area is not in compliance with the average of 100 mils MDFT, then each 100 square foot area shall be tested. Check the application for holidays using recognized testing procedures and equipment, such as "high voltage holiday detector test."

(b) Coated Surfaces will be rejected by the Department if they fail:
(1) To meet the MDFT requirements, or
(2) To stop inflow, infiltration, exfiltration, or
(3) To restore the structural integrity of the reconstructed structure (if applicable), or
(4) To pass the Department's inspections and testing, or
(5) To provide uniform and solid mechanical bonding between the structure's original surface/rehabilitated surface and the cementitious sub-coat and the epoxy top coat. **

(c) Rejected Coated Surfaces: Coated and rejected areas must be identified and marked. To repair and recoat: sand or grind down to substrate, clean, spray with approved primer sealer, and recoat with specified corrosion barrier topcoat. Re-inspection will be required.

(d) The testing firm shall issue a written statement to the Department confirming the compliance of each structure.
(e) The Department may require that additional testing of the liner be performed at the manufacturer's expense any time during the five-year warranty period. Any deficiencies in performance shall be corrected without delay by the manufacturer's contractor at no cost to the Department.

**(b) Thermo-Plastic Protective Cast-In Liner System for New Precast Structures**

(1) Scope of Work.
(a) Furnish and install all labor, materials, equipment, and incidentals required to supply polypropylene, random copolymer (PP-R) concrete protective liner in the precast wet wells, manholes and valve vaults as required and shown on the construction plans and details approved by the Utility.
(b) PPR concrete protective liner shall be designed and installed to protect the precast structure's interior surfaces from chemical attack and microbial corrosion, and to assist in the prevention of ground water infiltration.

A watertight seal between the ring and cover, or access hatch, and the liner, must be incorporated into the design. Only approved precast, reinforced concrete rings shall be used for the transition between the manhole ring and the lined precast structure. A minimum 2" wide polyester-backed liner section or polyisoprene gasket (50-55 durometer) shall extend along the top edge of the top precast section. Additionally, the liner must be sealed at the bottom of the concrete structure's wall with an outward facing, horizontal injection molded or thermo-welded water stop assembly. All

construction joints must be sealed through the use of a 90 degree liner turn back into the inside horizontal plane of the upper and lower construction joint, and sealed with Ramnek, butyl or close cell rubber gasket, or approved equal sealant.

(c) Install the concrete structures in accordance with manufacturer‘s guidelines unless stated otherwise in the specification.
(d) A solid thermo-plastic cast-in liner is required for all new lift station wet wells, manholes deeper than 14 feet, outside drop manholes, last manhole before lift station, and manholes with force main connections.
(e) Flow channels and benching may be lined with PP protective liner and poured monolithically with the base section. Flow channels and bench shall be lined with cast-in FRP protective liner as an acceptable substitution of cast-in thermo-plastic liner only when size and/or configuration of the manhole design will prevent availability of thermo-plastic cast-in liner from the liner manufacturer.
(f) Cone or flat slab may be lined with cast-in FRP protective liner as an acceptable substitution of cast-in thermo-plastic liner only if thermo-plastic cast-in liner is not available for the specified cone design.

(2) Submittals.
(a) The contractors shall submit for review 3 copies of detailed shop drawings for each type of structure to be used on the project. These drawings shall detail the precast structure, per the design specified for the project, and shall show the concrete protective liner‘s placement on the structure‘s interior wall surfaces, at the construction joints, at pipe and other conduit connections, and at the adjustment area between the precast structure and the ring and cover or hatch entrance. The shop drawings must be signed by the contractor installing the structures and the Engineer of Record.

(b) Contractor shall provide, upon request, detailed thermo-welding and weld testing procedures, and supply to the Engineer and or Utility, upon request, a copy of the liner manufacturer’s certification of training for those personnel performing the liner assembly.
(c) The Contractor shall submit a certification from the structure/liner system manufacturer that installed the lined concrete structures that were installed in compliance with the specifications.
(d) Prior to the preconstruction meeting, the Contractor shall submit a copy of the approved material list with circled name of the structure manufacturer. The Contractor and the Engineer of Record must sign the material list.
(e) Certification from the structure/liner system manufacturer approving the Contractor installing the structures.
(f) Contractor‘s occupational license.

(3) Materials.
(a) Physical Properties: The concrete protective liner shall be free of pores, pinholes, voids and foreign bodies. All anchoring studs and/or vertical and horizontal flanges shall be manufactured during the injection/extrusion process in one piece with the sheet. No welding to attach the studs to the sheet or mechanical finishing work is permitted. All

welding rod, profile strips, cap strips and polyester backed transition wrapping shall be manufactured from the same resins by the same manufacturer.

(b) Liner Design: The lining system shall be designed to be repaired or modified at any time during the design life of the system.

(1) Studded PP-R liner sheets shall have a minimum design thickness of 2 mm (.079 inches) and have a minimum of 39 wedge shaped anchoring studs per square foot of liner. Minimum stud height shall be no less than 9 mm (.39 inches) with a minimum length of 14 mm (.55 inches). Anchoring studs must be capable of resisting continuous hydraulic backpressure, to a minimum of 40 feet of hydraulic backpressure, exerted between the interior wall of the concrete structure and the anchoring stud side of the protective liner. Non-studded PP-R cap strips, used to bridge construction joints, shall have a minimum design thickness of 2 mm (.079 inches). Polyester backed non-studded PP-R transition sheets, used for the purpose of bonding PP-R to dissimilar materials, shall be attached to the PP-R sheets during the extrusion process.

(2) Ribbed PP liner sections shall have a minimum thickness of 8mm (0.3") and consist of three (3) or more segments of equal height and radial length that when welded together will form a section which corresponds to the inside diameter of the concrete structure. The outside surface of the ribbed PP liner segment(s) shall incorporate outward facing horizontal returns/flanges to insure adequate anchoring with the precast concrete structure and meeting a pressure test of 1 bar (14.7 psi) or the prescribed ASTM criteria for vacuum testing of concrete sewer manholes. Minimum spacing between each horizontal return/flange to be 1" and maximum spacing between each horizontal return/flange to be 6". Additionally, the outside surface shall incorporate 5 ribs molded on the vertical axis spaced evenly in direct relation to the radial length of the PP liner segment.

(3) If the application or conditions warrant, the Thermoplastic Liner System may be substituted upon approval of the Project Engineer and the Department.

(4) Installation/Quality Control.

(a) The installation of the Thermo-plastic concrete protective liner into precast wet wells, manholes and vaults shall be accomplished only by a precast concrete manufacturer certified by the liner manufacturer with a minimum of five years of manufacturing experience and a minimum of five years of experience in the installation of corrosion resistant thermo-plastic sheet liners in concrete structures. Upon request, the liner installer shall provide written certification that the installation is in accordance with the liner manufacturer installation specifications.

(b) Placement of the liner on forms shall conform to the liner manufacturer written instructions and shall conform to the approved shop drawings and standard details. All shop and field welding shall be performed only by thermo-plastic extrusion welders certified by the liner manufacturer. All field thermo-welding shall additionally be performed only by confined

space trained, and certified personnel. A copy of the thermo-welder‘s certification shall accompany the submittal. All welded joints shall be spark tested prior casting.

(c) Approved sealing gasket, cast-in flexible connection sleeves, cast-in conduit connectors, water stops, manhole adjusting rings, and access covers shall be installed in accordance with the manufacturer specifications, approved shop drawings and standard details.

(d) The precaster shall insure proper quality control procedures in handling of completed structures during loading, transport, and unloading. All structures shall be inspected by the Department‘s Construction Coordinator prior to installation. Any cracks, voids, gaps, or other damage to the liner and the structure shall be each a reason for rejection. Only structures approved by the Department shall be installed for use in the Department service area.

(e) The on-site contractor shall exercise utmost care while handling and installing the approved structures. Structures with any visible damage will not be accepted. The structures shall be installed in accordance with the precaster’s specifications, approved shop drawings and standard detail drawings. Any deviation from the installation specifications must be approved prior to installation by the structure manufacturer, the Engineer of Record and the Department. It is the responsibility of the Engineer of Record to monitor and inspect the installation for conformance with the approved specifications. Only approved miscellaneous materials (rings, sealants, gaskets, sleeves, etc.) shall be used.

(f) At no cost to the Department, the Contractor shall hire an independent material testing firm to perform appropriate testing and certify that the liner is free of ―holidays using recognized testing procedures and equipment, such as ―high voltage holiday detector test. A steel brush shall be used for high voltage testing. A written report from the laboratory is required for each tested structure. If a structure is rejected by the department, the Engineer of Record shall consult the structure manufacturer to obtain guidance to rectify the problem. The Department must approve the proposed solution prior to implementation. Any repair must be performed by a manufacturer‘s approved contractor.

(5) Warranty

The liner manufacturer and the structure manufacturer shall warrant the lined structure for minimum five (5) years from the time of: Acceptance of bill of sale by the Department or final payment to the Contractor by the Department (for Department initiated rehabilitation projects). The warranty shall cover all labor and materials cost necessary to repair or replace the “failed” application, including related work (permits, bypass piping, pumps, flow monitoring, restoration, record information). The structure/liner system shall be considered “failed” if: there is liner delamination, any cracks, voids, or pinholes are detected, there is water infiltration into the structure, the structure failed to pass the Department‘s inspection and testing. The Department may require that additional testing of the liner shall be performed at the manufacturer‘s expense any time during the five year warranty period. Any deficiencies in performance shall be corrected

without delay by the manufacturer‘s contractor at no cost to the Department. Re-inspection and retesting shall be required:

(a) The structure manufacturer’s warranty shall be accountable for protection against water filtration.
(b) The liner manufacturer’s warranty shall be accountable for protection of the concrete structure against chemical attack and microbial corrosion typically found in the wastewater environment.

(c) ***Thermo-Plastic Liner Structural Rehabilitation System***

*(1) Scope of Work.*

*(a) Furnish and install all labor, materials, equipment and incidentals required to rehabilitate existing underground structures, such as sewer manholes, sewer lift stations/wet wells, vaults, and underground storage tanks with a minimum 2 mm (.079 inches) High Density Polyethylene (HDPE) thermo-plastic liner inserts.*

*(b)The HDPE liner rehabilitation system shall be designed to protect the interior surface of the rehabilitated structure from acid corrosion, abrasion, and impact; to provide an additional backpressure resistant and flexible barrier to groundwater infiltration; and to add structural integrity to the existing structure.*

*(c) Installation of the liner insert on manholes shall be possible without requiring the removal of any component part of the existing structure or excavation of the site, except for the removal of the existing bench and invert and any loose or corroded materials separated from the structure during the pressure cleaning process. Severely corroded manhole flat top slabs and access chimney may need replacement. Top slab replacement may be necessary for other structure types with accessible top slabs such as lift stations, wet wells or vaults*

*(d) Installation of the liner insert on manholes shall be possible without requiring the removal of any component part of the existing structure or excavation of the site, except for the removal of the existing bench and invert and any loose or corroded materials separated from the structure during the pressure cleaning process. Severely corroded manhole flat top slabs and access chimney may need replacement. Top slab replacement may be necessary for other structure types with accessible top slabs such as lift stations, wet wells or vaults.*

*(e) Liner attachment to existing structure shall be made using a mechanical bond between the studded liner and poured, or pumped in place new concrete.*

*(2) Submittals.*

*The contractor shall submit for review a package that includes the scope of work, detailed shop drawings, the installation instructions of the system installer, the thermo-welding specifications of the liner manufacturer, a copy of the liner thermo-welder’s certification issued by the manufacturer of the liner and a copy of the contractor’s occupational license.*

*(3) Materials.*

*(a) Physical Properties.*

*(1) The HDPE liner shall be free of pores, pinholes, voids and foreign objects. All anchoring studs shall be manufactured during the extrusion process in one piece with the sheet. No welding to attach the studs to the sheet or mechanical finishing work is permitted. Additionally, all welding rod, profile strips, cap strips and polyester backed transition wrap shall be manufactured from the same resins by the same manufacturer.*

*(2) If the application or conditions warrant, the 2 mm Polypropylene, Random Co-Polymer (PP-R) liner system may be substituted upon approval by the project Engineer and the Department.*

*(3) Liner shall be manufactured of virgin materials.*

*(b) Design.*

*(1) Studded HDPE liner sheets used for underground structure rehabilitation shall have a minimum design thickness of 2 mm (.079 inches) and have a minimum of 39 wedge shaped anchoring studs per square foot of liner. Minimum stud height shall be no less than 9 mm (.39 inches) with a minimum length of 14 mm (.55 inches). Installed HDPE liner insert shall be repairable at any time during the life of the system.*

*(2) Transitions from dissimilar materials, such as PVC pipe to HDPE liner, shall be accomplished using a polyester backed HDPE transition wrap.*

*(3) Liner insert shall be constructed with a minimum overall inside dimension six inches less than the original inside dimension of the structure to be rehabilitated. The resulting void will be poured with new concrete. This will provide the method of mechanically anchoring the liner insert and will enhance the structural integrity of the existing manhole. Wall thickness may be increased depending on the shape and depth of the structure or if reinforcing steel needs to be added to the pour.*

*(4) The concrete used to anchor the liner shall be a minimum 4000 psi at 28 days super-plasticized (8 to 10 inch slump) mix design. Concrete will be poured or pumped in place and vibrated to eliminate voids using external vibrators attached to the internal forming system. Internal vibration may also be used depending on structure size and shape.*

*(5) The forming system used to support the liner during the concrete pour shall be capable of bracing the liner against compression that would result from the pouring and vibrating of concrete into the void between the liner's embeds and the existing wall.*

*(6) The extension of existing pipes, the sealing of the pipes back to the liner, the inclusion of an access area sealing system, and the removal and reconstruction of the bench and invert or fillet are included as part of the rehabilitation system.*

*(4) Execution.*

*(a) **Field Set-up and Installation Procedures.***

*(1) Coordinate with the Utility on any flow diversions, pump station shut downs, service interruptions and customer notifications.*

*(2) Set-up confined space safety and operating equipment, check air conditions in the structure, and perform all necessary and required safety procedures.*

*(3) Clean interior surfaces and remove corroded and loose material with a high pressure (3500 PSI) water blaster.*

*(4) Check for through wall leaks and repair if needed with hydraulic cement mortar. Install additional reinforcement steel if necessary.*

*(5) Install flow through by-pass system or employ alternate by-pass method.*

*(6) If required, demolish existing bench and invert, or fillet, and remove debris. Check again for leaks and repair if needed.*

*(7) Insert pre-fabricated HDPE liner insert into structure. Locate pipes and make matching cut-outs for pipes in liner.*

*(8) Utilize either a polyester backed liner or a water reactive compression waterstop material to seal liner to pipes. Thermo-weld all liner joints and spark test all welds.*

*(9) Install sectional bracing form or other forming method inside of liner insert.*

*(10) Install ADEKA P-201 waterstop inside bottom edge of the wall liner.*

*(11) Pour or pump high flow 4000 PSI concrete mix in void between stud side of liner and existing manhole wall; vibrate thoroughly to consolidate concrete; allow to cure.*

*(12) Remove forming system, inspect liner, spark test all field thermo-welds.*

*(13) If required, fabricate new bench and invert channel of fillet in place.*

*(14)If required, the access chimney shall be rebuilt to match Utility specifications.*

*(15) Remove flow through plugs or other method of by-pass system.*

*(16) Install access area sealing system.*

*(17) Cleanup work area.*

*(b) **Quality Control.***

*(1) The fabrication and installation of the HDPE rehabilitation system into existing structures shall be performed only by personnel certified by the manufacturer of the thermo-plastic liner. Liner thermo-extrusion welding shall be performed only by personnel certified by the liner manufacturer.*

*(2) All work shall be supervised and performed by confined space trained and certified personnel. All work shall conform to OSHA safety requirements.*

*(3) The liner and all field welds shall be tested for cracks, voids, and pinholes, the presence of each shall create a reason to reject the structure. At no cost to the Department, the Contractor shall hire an independent material testing firm to perform appropriate testing and certify that the liner is free of "holidays" using recognized*

*testing procedures and equipment, such as "high voltage holiday detector test." A steel brush shall be used for high voltage testing. A written report from the firm is required for each tested structure.*

**(c) Warranty.**

The liner manufacturer shall unconditionally warrant the completed and installed structure for minimum five years from the time of the acceptance of bill of sale by the Department. The warranty shall cover all cost for labor and materials necessary to repair or replace the failed structure/liner system.

The structure/liner system shall be considered "failed" if:

- There is liner delamination
- Any cracks, voids, or pinholes are detected
- There is water infiltration into the structure

If installation warranty cannot be obtained from the liner manufacturer, the Department will accept the installer's minimum 5-year labor and material warranty with a performance bond in the amount equal to $3,000 per manhole/vault and $30,000 per lift station wet well. The bond shall be valid for 5-years from the time of the acceptance of Bill of Sale. The Department may require that additional testing of the liner shall be performed at the manufacturer's expense any time during the five year warranty period. Any deficiencies in performance shall be corrected without delay by the manufacturer's contractor at no cost to the Department. Re-inspection and retesting shall be required.

**(d) Calcium Aluminate Cementitious Structural Rehabilitation and Corrosion Barrier System.**

(1) Scope of Work:

This specification defines the method and material for the application to new sewer concrete structures (except new lift station wet wells, new manholes deeper than 14 feet, new outside drop manholes, last manhole before a lift station, and new manholes with force main connections) and for the rehabilitation of existing sanitary sewer structures (manholes, wet wells, lift stations, large diameter concrete pipe, etc.) utilizing a spray applied calcium aluminate cementitious structural rehabilitation system. The objective is to obtain a dense and durable concrete lining stops/prevents infiltration and that is resistant to biosulfuric acid attack and meets the strength requirements described elsewhere in this specification.

The work covered in this specification consists of furnishing all labor, equipment, materials, and supervision necessary to accomplish the application/ rehabilitation as specified. When complete the lined rehabilitated structure shall:

(a) Provide for a uniformly smooth surface of specified thickness.
(b) Minimize, if not eliminate sources of inflow/infiltration (I/I).
(c) Provide a service life that is supported by documented test analysis.

(2) Contractors Sequence of Operation:

The Contractor's sequence of operation relative to structural rehabilitation shall include, but not be limited to the following:

(a) Eliminate all sources of groundwater infiltration and voids in walls (rehabilitation of existing structure).

(b) Provide a clean, rough sub-surface sufficiently prepared in accordance with the International Concrete Repair Institute (ICRI) Guideline No. 03732 – Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, and Polymer Overlays to a degree further defined in **Section (5) (c)** of this document.

(c) Rehabilitate all interior surfaces including walls, ceilings and floors in accordance with specification and nature of the sub-surfaces.

(d) Provision to "cure" the installed lining material.

(e) Provision to “test” lining and structural rehabilitation materials.

(3) Submittals:

(a) Contractor shall furnish detailed and complete data pertaining to the surfaces of the structure to be rehabilitated, the rehabilitation product, surface preparation and installation to the engineer for approval. The submission of this data shall be made in a timely manner to prevent project delay. At the request of the Engineer, the Contractor shall test for adverse chemical conditions that may hinder overall product performance.

(b) Prior to initiating the work, the Contractor shall submit specific technical data with complete physical properties of the structure to be rehabilitated and the product proposed to be used in the rehabilitation of the structure, as well as a specific plan for sub-surface preparation.

(c) A certificate of "Compliance with Specifications" shall be furnished for all materials supplied. A work plan.

(4) Materials:

(a) Material furnished under this specification shall be a prepackaged mortar mix, including all cement, aggregates, and any required additives. It is the intent of this specification that the Contractor only be required to add the proper amount of potable water so as to produce texture/density suitable for spray application. Do not add Portland cement, other aggregates, or any admixtures whatsoever to material furnished under these specifications. Typical package weights shall not be less than 50 lbs and shall be identical for all material furnished on this project.

(b) The chemical composition of the cement portion as well as the aggregates of the mortar mix shall be as follows:

| A12O3 | CaO | FeO + Fe2O3 | SiO2 |
|---|---|---|---|
| 39-44% | 35-39% | 9-14% | 5-7% |

(c) The design properties of the mortar mix shall be as follows:

| | | |
|---|---|---|
| *Comprehensive Strength (ASTM C109)* | *> 5,500 psi* | 24 hours |
| | > 7,000 psi | 28 hours |
| Flexural Strength (ASTM C348) | > 900 psi | 24 hours |
| | > 1,300 psi | 28 hours |
| Splitting Tensile Strength (ASTM 496) C496) | > 550 psi | 24 hours |
| Bond Strength/Slant Shear (ASTM C886) C882) | > 2,500 psi | 28 hours |
| Shrinkage at 28 days (ASTM 157) | < 0.07% humidity | |
| Freeze/Thaw after 300 Cycles (ASTM 666) | | |

(d) The mortar mix shall be on the Department's **Approved Material List.**

(e) Mortar mix must have at least five (5) years of successful performance in similar applications and be supplied by an ISO 9002 certified manufacturer. Manufacturer's ISO 9002 certificate shall be submitted to engineer and owner.

(f) In addition, the mortar mix shall be designed to withstand long-term exposure to a bacterially corrosive hydrogen sulfide environment that may be expected to produce a pH of 1 on normal Portland Cement concrete or typical brick and mortar surfaces.

(g) Water used in mixing shall be fresh, clean, potable water, free from injurious amounts of oil, acid, alkali, vegetable, sewage and/or organic matter. Water shall be considered as weighing 8.33 pounds per gallon.

(h) Mortar mix shall be stored with adequate provisions for the prevention of absorption of moisture. It shall be stored in a manner that will permit easy access for inspection and identification of each shipment.

(5) Execution:

(a) Sampling and Testing

(1) A recognized independent testing laboratory shall test mortar materials used on the project. The Manufacturer, instead of an independent laboratory, may test project sample specimens, provided the Owner, Engineer, and Manufacturer are in agreement of this testing method prior to project commencement. Specific materials recommended by the Engineer shall then be tested.

(2) The cost of sampling and testing of the mortar mix during placement and the surface to which it is applied shall be borne by the Contractor. Other testing required showing conformance with these specifications shall be the responsibility of the Contractor. Certified test reports and certificates, when so directed, shall be submitted in duplicate to the Engineer and to such other agencies or persons the Engineer may designate.

(3) Any materials failing to meet the requirements of these specifications shall not be incorporated into the work plan.

(b) Qualification of Work Crew

(1) Prior to project commencement, the Contractor must satisfy the Engineer that all Contractor's work crew personnel have performed satisfactory work in similar capacities elsewhere for a sufficient period of time to be fully qualified to properly perform the work in accordance with the requirements of the related specifications.
(2) Foreman shall have verifiable experience with similar work and project conditions.
(3) Nozzlemen shall be qualified by having had similar work experience.

(c) Project responsibilities prior to application of mortar mix shall include the following:
(1) Ensure all sub-surfaces are clean and free of laitance or loose material. **See Section 3.7 (d)** for Inflow and Infiltration Prevention.
(2) Ensure that overhead sub-surfaces have been prepared to a minimum degree of roughness designated as CSP 4 by the International Concrete Repair Institute (ICRI) Guideline No. 03732 – Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, and Polymer Overlays. This reference document explains the means and methods of achieving the minimum designated degree of roughness. The contractor should consider utilizing a higher standard depending upon the surface conditions.
(3) Ensure that sub-surfaces other than overhead have been prepared to a minimum degree of roughness designated as CSP 3 by the International Concrete Repair Institute (ICRI) Guideline No. 03732 – Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, and Polymer Overlays. This reference document explains the means and methods of achieving the minimum designated degree of roughness. The contractor should consider utilizing a higher standard depending upon the surface conditions.
(4) Ensure the operating air pressure is uniform and provides adequate nozzle velocity for proper compaction.
(5) Continuously regulate the water content so that the applied materials consistently achieve proper compaction with a low percentage of rebound and no visible "sag".
(6) Ensure that the installation equipment nozzle is held at the proper distance away from and as nearly perpendicular to the prepared sub-surface as the working conditions will permit to secure maximum material compaction with minimum rebound and no visible "sag".
(7) Follow a sequence routine that will fill corners with adequately compacted material applied at a maximum practicable layer thickness.
(8) Determine necessary operating procedures for placement in confined spaces, extended distances or around unusual obstructions where placement velocities and mix consistency may need to be adjusted.
(9) Direct the crew as to when to start and stop the flow of materials during installation and to immediately stop all work when material is not arriving uniformly at the nozzle.
(10) Ensure that slough pockets are removed and prepared for installation of replacement material.
(11) Bring the installed materials to established finished elevations in a neat and timely manner and within established tolerances.
(12) Applicator's job foreman shall operate the mixing/placing equipment and direct the work of mixing crew personnel. Applicator's work crew shall also maintain proper line pressures throughout the mixing/placing equipment to ensure the necessary consistent

nozzle velocity. Applicator's work crew shall further see that all material fed to the nozzle is uniformly fed through this equipment.

(d) Equipment:

Equipment shall be of spray type and approved by the material manufacturer. Alternate equipment may be utilized provided it meets the performance requirements of the specification. All equipment must also be kept in operating condition and good repair.

(6) Construction Methods:

(a) Surface Preparation

(1) To ensure sufficient bond, all sub-surfaces shall be cleaned and prepared to a degree of roughness as described in **Section (5)** of this specification. Sub-surfaces shall also be thoroughly saturated with water prior to the application of the lining materials. In no instance shall shotcrete be applied in an area where running water exists. It is the intent of this specification that the existing surface be saturated and free of any running water just prior to installation.

(2) If applying to a new structure (concrete, brick, or block construction), the same criteria for sub-surface cleanliness, roughness, and saturation as described on **Section (5) (c)** and are applicable.

(3) All surfaces to be lined shall be saturated with water just prior to lining materials application. If saturation does not occur naturally, it can be accomplished by presoaking all sub-surfaces for a minimum of 24 hours immediately prior to the application of the lining materials.

(b) Operations

(1) The Contractor shall provide all equipment necessary to individually gauge, control, and monitor the actual amounts of all component materials necessary to complete the lining installation. The type of equipment and methods used to gauge, control, and monitor component materials shall be subject to approval by the Engineer and Manufacturer.

(2) All lining materials shall be thoroughly mixed by mechanical means to ensure all agglomerated particles are reduced to original size or removed prior to placement into the application equipment (i.e. the hopper). Each batch of material should be entirely discharged before recharging with fresh material. Mixing equipment shall be cleaned at regular intervals to remove all adherent materials.

(3) The addition of water to the mix shall be in strict accordance with the Manufacturer's recommendations.

(4) Re-mixing or tempering shall not be permitted. Rebound materials shall not be reused.

(c) Protection of Adjacent Surfaces

During progress of the work, adjacent areas or grounds which may be permanently discolored, stained or otherwise damaged by dust and rebound material, shall be adequately protected and, if contacted, shall be cleaned by early scraping, brushing or washing as the surrounds permit.

(d) Inflow and Infiltration Prevention

(1) If inflow or infiltration is observed within the structure after surface preparation is complete, a rapid setting crystalline enhanced hydraulic cement product specifically formulated for infiltration control shall be used to stop minor infiltration flows in accordance with the manufacturer's recommendations. The material shall meet the following requirements:

| | | |
|---|---|---|
| Compressive Strength (ASTM C597B) | 600 psi | (24 hours) |
| | 1,000 psi | (7 days) |
| Bond Strength (ASTM C321) | 30 psi | (1 hour) |
| | 80 psi | (1 day) |

(2) The material shall be Preco Plug, Octocrete, Burke Plug or Engineer approved equal. Where infiltration flows are more severe, pressure grouting may be required. The material for pressure grouting shall be Avanti AV-202, DeNeef or Engineer approved equal installed in accordance with the manufacturer's written instructions.

(3) All materials, labor, equipment, and incidentals required to correct inflow and infiltration conditions will be considered incidental to rehabilitation.

(e) Application of Materials

(1) Mortar mix shall not be applied to a frozen surface or to a surface that may freeze within 24 hours of application. Frozen conditions shall be defined as ambient temperatures of 32 degrees Fahrenheit or below.

(2) Sequence of application may be from bottom to top or vice versa if rebound is properly removed.

(3) Application shall be from an angle as nearly perpendicular to the surface as practicable, with the nozzle held at least 1 foot from the working sub-surface (except in confined control). If the flow of material at the nozzle is not uniform and slugs, sand spots, or wet sloughs result, the nozzleman shall direct the nozzle away from the work until the faulty conditions are corrected. Such defects shall be replaced as the work progresses.

(4) Application shall be suspended if:

(a) Air velocity separates the cement from the aggregate at the nozzle.

(b) Ambient temperature approaches freezing and the newly placed mortar mix cannot be protected and insulated.

(5) The time interval between successive layers of material application must be sufficient to allow “tackiness” to develop but not final set. If final set does occur, this surface shall be prepared in accordance **with Section (5) (c), (6) (a),** of this document in order to provide a sufficient bond with succeeding applications.

(6) Construction joints within a manhole shall be avoided. In the event a construction joint is necessary and approved by the Engineer, it shall be sloped off to a thin, clean, regular edge, at a 45-degree angle. Prior to placement of the adjoining materials, the sloped portion and adjacent applied material shall be thoroughly cleaned as necessary, then moistened and scoured with an air jet.

(7) Nozzleman shall bring the material to an even plane and to well-formed corners.

(8) Manhole chimneys constructed with bricks or precast concrete rings shall be completely lined with the mortar mix but not overlap the bottom inside edge of the manhole frame. After the body coat has been placed, the surface shall be trued with a thin-edge screed to remove high areas and expose low areas. Low areas shall be properly filled with additional material to insure a true, flat surface in accordance with of this document.

(9) For manhole applications, the minimum thickness of the mortar mix shall be a ½-inch cover over all surfaces. For other larger structures (lift stations, wet wells, treatment plant structures, etc.), the minimum thickness of the mortar mix shall be a 1-inch cover over all surfaces.

(f) Curing

(1) If the material has been applied and furnished in accordance to specifications, and it has been determined that the environment is not moist enough for natural curing, the contractor will be required to apply a curing compound to all coated surfaces. Curing compound shall meet the requirements of ASTM C309 and have the approval of the lining material Manufacturer and the Engineer prior to use.

(2) Moist curing may also be used in lieu of curing compound. If moist curing is elected, it should be implemented just after the notice of uniform heat generation of the installed lining. Moist curing can consist of the use of soaker hoses, water sprinklers, or vapor/misting machines. Regardless of delivery method, moist curing should continue for a minimum of 18 hours.

(7) Quality Control:

(a) The installation of the Calcium Aluminate Rehabilitation System into existing structures shall be performed in accordance with the manufacture's recommendation unless noted\ otherwise in this specification. Only personnel certified by the Manufacturer of the cementitious material shall perform the works.

(b) All work shall be supervised and performed by confined space trained and certified personnel. All work shall conform to OSHA safety requirements.

(c) The Cementitious liner shall be tested for cracks, voids, pinholes and delamination, the presence of each shall create a reason to reject the structure. At no cost to the Department, the Contractor shall hire an independent material-testing firm to perform appropriate testing and certify that the thickness of the Cementitious liner is in accordance with these specifications. Minimum 1 (one) test shall be performed per each 2 (two) vertical feet of each structure. Each passing thickness test shall have a minimum of 90% thickness required. The average of all

tests performed for each structure shall be the minimum thickness specified. A written report from the firm is required for each tested structure.

(8) Warranty:
The liner manufacturer (not installer) shall warrant the corrosion barrier system for minimum five (5) years from the time of:

- Acceptance of bill of sale by the Department.
- Final payment to the Contractor by the Department (for Department initiated rehabilitation projects).

The liner manufacturer shall warrant the corrosion barrier system for all labor and materials cost necessary to repair or replace the failed application, including related work (permits, bypass piping, pumps, flow monitoring, restoration, and record information). If installation warranty cannot be obtained from the liner manufacturer, the Department may accept the installer's minimum 5-year labor and material warranty with a performance bond in the amount equal to $3,000 per manhole/vault and $30,000 per lift station wet well. The bond shall be valid for 5years from the time of the acceptance of Bill of Sale.

**(e) New Concrete Structures with Antimicrobial Admixture for Utility-Initiated Capital Improvement Projects**

(1) The following shall apply in addition to ASTM C 478 Standard Specification for Precast Reinforced Concrete Manhole Sections where corrosion resistant concrete is needed to resist microbiologically induced corrosion (MIC) concrete manholes and other structures in sanitary sewers.
(2) Approved antimicrobial additive shall be used to render the concrete uninhabitable for bacteria growth. The liquid antibacterial additive shall be an EPA registered material and the registration number shall be submitted for approval prior to use in the project. The amount to be used shall be as recommended by the manufacturer of the antibacterial additive. This amount shall be added into the concrete mix water to insure even distribution of the additive throughout the concrete mixture. The antibacterial additive shall have successfully demonstrated prevention of MIC in sanitary sewers for ten or more years. The antibacterial shall be used by factory certified precast concrete plants.
(3) Acceptance: Upon the delivery of a structure, the precaster shall certify to the project owner that the correct amount and correct mixing procedure was followed for all antimicrobial concrete.
(4) The precaster shall retain two labeled specimens from each production run. One set shall be retained by the precaster and the other set shall be sent to manufacturer for verification on a random or as needed basis.
(5) Sealing of joints and any field repairs to the precast concrete shall be made using joint grout specifically approved by the antimicrobial additive manufacturer, pre-proportioned and factory packaged that requires the addition of no other components. This repair grout may be used for filling joints, lift holes, damaged areas, benches, and similar.

(6) Product Surface Marking: A color identifier-indicator shall be applied to the interior of each piece and the name of the antimicrobial additive shall be plainly stenciled on the exterior of each piece.

(7) The precaster shall guarantee the structures (all-inclusive labor and materials for a minimum of five (5) years from the date of installation. The warranty shall include complete repair and/or replacement of structures with visible corrosion caused by microbes. Upon notification by utility, the structure manufacturer shall provide within 30 days a repair/replacement plan. The repair/replacement procedure must be acceptable to utility and the repair must be completed within 30 days of utility's acceptance of the above plan. The utility shall have the right to perform the repairs/replacement of the structure as needed and deemed appropriate. If the manufacturer fails to complete his obligations under this warranty, the precast manufacturer shall reimburse the utility within 30 days of receiving an invoice for the work performed within the warranty period.

**(f) FRP/Thermo-Plastic Protective Cast-In Base Liner System for New Precast Structures**

(1) Scope of work.

(a) Furnish and install all labor, materials, equipment, and incidentals required to supply Polypropylene (PP) and/or Fiberglass Reinforced Plastic (FRP) concrete protective liner in the precast manholes flow channels and benching.

(b) PP/FRP concrete protective liner shall be designed and installed to protect the precast structure's interior surfaces from chemical attack and microbial corrosion and to assist in the prevention of ground water infiltration and to provide a flexible watertight seal on pipe connections to the manhole structure.

(c) Install the concrete structures in accordance with the manufacturer's guidelines unless stated otherwise in the specification.

(2) Materials.

(a) Physical properties.

(1) Polypropylene (PP) – 100% Polypropylene Copolymer

(a) Minimum Thickness – 0.12" – 0.20" (3mm – 5mm)

(b) Color – dull mustard/goldenrod

(c) Hardness – 80 Rockwell (R scale)

(1) The prefabricated manhole base liner shall be a one piece construction of unlayered, homogenous composite. Minimum thickness shall be 3mm (0.12") and shall be in lengths and nominal inside diameters corresponding to the precast concrete manhole base section.

(2) The manhole base liner shall include full flow channels with side walls to the crown of the pipe(s); inner bench surfaces shall have a non-skid pattern. Gasketed, watertight bell type pipe connectors and/or sleeves for flexible boot connectors of either PP, FRP, or PVC to suit specific pipe types, alignments and grades and shall be monolithically attached to the manhole base liner channeling and shall extend to the outside profile of the precast concrete Structure. The vertical side wall (skirt) of the manhole base liner representing the inside diameter of the manhole structure shall be in nominal and varied heights from a minimum of 2" (50mm) extending vertically and returning horizontally

to create a flush surface with the top of the first manhole riser joint as per drawing details.

(3) The outer surface of the FRP/PP manhole base liner shall have PP bridges or steel spirals bonded and a coating of multi-faceted aggregate. PP liners shall have perforated "I" beams and multi-faceted PP pellets bonded and/or ribs molded in opposing directions on the vertical axis and waterstop turnbacks on the horizontal axis. Aggregate for FRP liners must be processed sand containing crushed and uncrushed dry and cleaned semi-round particles in the 2mm – 3mm size range. All bonding medium to ensure adequate anchoring with the precast concrete section and meeting a pressure test of 1` bar (14.7 PSI) or the prescribed ASTM criteria for vacuum testing of concrete sewer manholes.

(4) Installation/Quality Control. **See Section 3.7 (b) (4)**

(5) Warranty. See Section 3.7 (b) (5)

(3) Fiberglass reinforced polyurethane composite (FRP)

(a) Minimum Thickness – 0.12" – 0.20" (3mm – 5mm)

(b) Glass fiber – Type E, Min fiber length - 0.625 inches. Content by weight – 10% - 12%

(c) Inert filler content by weight – 10% - 13%

(d)Aggregate bonding medium – processed sand containing crushed and uncrushed dry and cleaned semi-round particles in the 2 – 3mm size range.

(b) Liner Design.

The liner system shall be designed to be repaired or modified at any time during the design life of the system.

## 3.8 UTILITY OWNED PUMP STATION AND PRIVATE WASTEWATER PUMP STATION DESIGN AND CONSTRUCTION

(a) General:

Lift stations serving single-family residential developments shall be owned and Operated by the Department. However, a non-standard, private lift station in a planned development of fewer than 100 units may be approved by the Department. In such cases, covenants must be recorded against the properties being served, providing for private ownership, repair and replacement reserves, operation, and maintenance in perpetuity of such facilities. Such covenants shall be subject to approval of PBCWUD and may not be amended without PBCWUD's approval. A service contract for operation and maintenance shall be in place at all times. The Department shall have the right to require the over sizing of the Department owned lift station to allow other properties to connect to a gravity Wastewater system, subject to cost reimbursement as stated in PBCWUD UPAP Chapter 3. Signed and sealed lift station calculations are required for County dedicated and "private" lift stations. Buoyancy calculations and cycling time calculations are required. For buoyancy calculations, the assumed ground water level shall be the top slab elevation of the wet well. Top slab shall be set at a 100 year storm elevation, or higher. Top slab, secondary concrete pour, soil friction and mechanical equipment shall not be included in "down weight". Minimum (1.1) buoyancy safety factor is required. Operating System Pressure calculations (TDH) for low and high pressure conditions, as applicable, shall be based on field confirmed pressure data

provided by WUD, and shall consider friction losses, static pressure and minor losses. The low and high pressure system curves shall be plotted together with the selected pump curves, and indicate the projected pump operating and efficiency ranges. A current force main pressure "tie-in" letter from PBCWUD shall be included with the lift station calculations. The pressure range provided by PBCWUD shall be used for the initial pump selection/design. The Department may require the installation of a privately owned lift station for single entity owned non-residential developments, and for Multiple Use Planned Developments (MUPD), or equal, with multiple parcel ownerships and recorded comprehensive agreements addressing the ownership, operation, and maintenance responsibilities of the shared Wastewater collection system.

In order to share a privately-owned nonresidential wastewater lift station, a comprehensive cross access/maintenance agreement must be in place to ensure that all parties discharging wastewater into the station are responsible for the maintenance, repair, and any operating costs of the commonly used components up to the connection to the Department's wastewater system.

A separately metered private lift station water service is subject to "combined service" Service Initiation Fees. Private lift station design and construction shall comply with all applicable regulations and requirements. The property owner (owner of the lift station) shall be responsible in perpetuity to maintain, repair and upgrade (as needed) privately owned facilities. Changing sewer system force main pressure conditions may require that equipment must be replaced and/or upgraded.

(b) Type:
The standard Department owned Wastewater lift station shall be a below-ground, submersible pump type. All stations shall be designed for 230/460 volt, 3-phase, 60-cycle electric service. Each pump will have a minimum horsepower rating of 5-horsepower, and will have a speed rating of between 1700 and 1800 RPM. No deviation from these standards will be permitted without the prior approval of PBCWUD Utilities Engineering and Operations & Maintenance Divisions. All electrical components and assemblies shall be UL listed.

(c) Pumps:
(1) General: Only pumps pre-approved by the Department shall be accepted. A certification from the factory authorized pump supplier confirming compliance with these specifications will be required for each pump application prior to the preconstruction meeting. In projects constructed in phases, master lift stations that will have minimal flows for a considerable time shall be equipped with temporary impellers with reduced capacity, though not less than 50% of a permanent pump. The installed electrical equipment, pump housing and motor shall meet the ultimate flow condition. A second set of impellers for full flow conditions will be required to be furnished prior to lift station start-up.

The selected pumps and electrical system must allow for a minimum of one impeller upgrade in the future. Pumps shall comply with NEC Class 1, Group D, Division 1. Two or more Wastewater pumps are required. When only 2 units are provided, each shall be capable of handling the anticipated maximum flow. The capacity of each pump (discharge flow rate) shall not exceed the ultimate peak Wastewater inflow rate by more than 25%. The hydraulic pump efficiency and the

"wire to water" efficiency at operating point under ultimate flow conditions shall be a minimum of 40%. The Engineer shall include in the lift station calculation selection of the best applicable pump from each approved pump manufacturer. The calculation of “wire to water” total efficiency over the anticipated operating range is required. The life cycle power operating cost shall be based on a 10 year pump life expectancy, power cost of $0.12/kWh and average running time of 100 hours/lift station/month. A 3% inflation factor shall be included in calculation.

The utility reserves the right to approve and require the installation of a particular pump based on operating range, horsepower, availability of upgrade impellers for same motor, solid handling capacity, and efficiency values. A 10% or larger difference in total efficiency and/or monthly power operating cost shall be considered significant and relevant for pump selection. The pump and impeller shall pass 3" spherical solids.

The Developer shall ensure that the pumps operate satisfactory under the minimum and maximum pressure conditions at the time of the lift station start up.

For engineering design purposes, the average daily wastewater flow for one Equivalent Residential Connection (ERC) shall be 200 gallons per day. For non-residential projects, the wastewater flow rate of 0.1 gallons per square foot per day may be used. A minimum peaking factor of 2.5 shall apply. In any case, the designing Engineer is responsible for determination of average flow rates and peaking factors.

When a Utility owned lift station is proposed as part of a development project and multiple manufacturers' pumps have been approved by the Utility for utilization in the installation of the lift station, the Engineer of Record shall identify at least one (1) of the approved pumps on the design details for the project.

(2) Guide Rail System: Pumps shall be easily installed and removed by a sliding guide bracket system. The Contractor shall demonstrate easy removal of pumps during the lift station startup. Seal of the pump at the discharge flange shall be accomplished by a single downward linear motion of the pump with the entire weight of the pump guided by two 2" diameter stainless steel guide rails or one 2" stainless steel t-bar guide rail.

Then, pressing against the discharge connection, no part of the pump shall bear directly on the sump floor and no rotary motion of the pump shall be required for sealing. Sealing at the discharge shall insure and guarantee a positive leak-proof system under all operating conditions, and for ease of removal of the pump. No metal-to-metal pump discharge/base elbow seal will be accepted, a base elbow insert may be required. Each base elbow shall be secured to the concrete floor with (4) minimum 10” x 3/4” stainless steel (316) expansion bolts, and a 3/8 “thick stainless steel plate.

The bolts shall be torqued per bolt manufacturer’s specification. Nuts, bolts, or other forms of fastenings may not be used for pump connection; there shall not be a need for personnel to enter the wet well to remove the pumps. Additional support brackets shall be required for guide rails over 20 feet long.

(3) External Parts Materials: All external pump and motor parts shall be resistant to mild corrosive liquids and chemical attack and shall be protected by a factory-applied coating. The design is such that the lifting cover, stator housing, impeller and volute casing are constructed of ASTM A48, Class 30 minimum, gray cast iron. A large bail style lifting handle shall be cast iron or stainless steel and be large enough to hook the pump with a standard hook from heights of 20'.

The interfaces between the major castings shall be machined for metal to metal contact, and shall be additionally protected with circular cross section O-rings. All nuts, bolts, washers, and other fastening devices shall be constructed of stainless steel. Grommet and O-rings are to be oil resistant.

(4) Volutes/Impellers: Volutes and impellers may have adjustable wear rings if the Department determines that the design provides for easy maintenance. No "open" impeller design will be accepted.

(5) Seals:

(a) General: The seals shall require neither maintenance nor adjustment and shall be easily replaceable. Conventional lip seals or double mechanical seals with a single or double spring between the rotating faces, requiring constant differential pressure to effect sealing and subject to opening and penetration by pumping forces, shall not be considered equal to the tandem seal specified. Seals shall not be held in place by the impeller.

(b) Acceptable Seals Systems:

- **Type "A":** The mechanical shaft seal shall be a balanced tandem-type "Enclosed Block" design which locates both upper and lower sets of seal faces in one compact AISI type 316 stainless steel casing. The O-rings used in the Enclosed Block Seal shall be all circular cross section (Viton or Buna-N) material for sealing protection. The seal faces shall be made of high quality silicon-carbide and held in place by two independent sets of eight AISI type 316 stainless steel coil springs immersed in an oil bath. As each set of eight coil springs is equally spaced around the shaft, a balanced spring force is exerted upon the seal faces, which is required if the mechanical seal is to be considered "balanced". They shall be completely isolated from the pumped media on the impeller side.

- **Type "B":** Each pump shall be provided with a tandem mechanical shaft seal system. The upper of the tandem set of seals shall operate in an oil chamber located just below the stator housing.

This set shall contain one stationary silicon carbide ring and one positively driven rotating carbon ring and shall function as an independent secondary barrier between the pumped liquid and the stator housing.

The lower of the tandem set of seals functions as the primary barrier between the pumped liquid and the stator housing. This set shall consist of a stationary ring and a positively driven rotating

ring both of which shall be silicon carbide. Each seal interface shall be held in contact by its own spring system.

(6) Shaft Bearings: The oversized pump shaft is to be one piece. No couplings or shaft extensions shall be allowed. The shaft material shall be AISI type 420 stainless steel. No carbon steel shafts or shaft sleeves shall be allowed. The bearings shall be all spherical ball rolling type angular contact with minimum 40,000 hour L10 life throughout the pump curve. Bearings shall be permanently lubricated.

The upper bearing shall be a single row ball bearing, the lower bearing is to be a double row thrust ball bearings and shall be further protected by a short shaft overhang, which limits deflections of the shaft.

(7) Pump Motors: Pump motors shall be housed in a water tight casing constructed of ASTM A48, Class 30 minimum, gray cast iron, and shall have moisture resistant Class F insulated copper windings. Motors shall have cooling characteristics suitable to permit continuous operation in totally, partially, or non-submerged conditions.

Motors shall be able to withstand 10 starts per hour, voltage fluctuations of + 10% of name plate rating and shall be of NEMA design B rated at 155 degrees Celsius maximum. Pump motors shall have a minimum 1.15 service factor. All pumps/motors shall have a stainless steel data plate. Soft starters are required for pumps 20 HP and larger.

(8) Cable Entry/Terminal Board: The electric cable entry to the motor shall be watertight and have strain relief. Epoxy cable entry is not acceptable. The power and control cables shall enter the motor housing through an isolated chamber that is completely isolated from the stator chamber.

The Hypalon power and control cable jackets shall be sealed via a compressible Buna-N grommet flanked by washers forming the first isolation point of the assembly. The cables shall be terminated on brass terminal lugs of the terminal board thereby sealing the cable entry chamber completely from the stator housing to the extent that any and all moisture that happens to find its way into the cable entry chamber is trapped there. The terminal board shall be designed to short out in the event that moisture has found its way into the cable entry chamber, thus signaling that the motor must have service. Cables shall be sized to permit voltage conversion without replacing the cable.

(9) Service: Pump suppliers shall have adequate repair/service facilities and parts inventories to ensure parts delivery within 24 hours and efficient repair of all equipment supplied. The pump supplier shall provide a reference list of existing installations upon request.

(10) Warranty: Pump manufacturer shall have a minimum of 5 years of experience in submersible pump manufacturing and service. Pump and motor assembly shall have a minimum 5-year warranty covering 100% of all parts and labor. The warranty shall include the provision of a suitable temporary pump if a permanent repaired or new pump cannot be installed within 72 hours of initial service request. The pump shall be picked up for repair from and turned to utility at a location designated by utility. Utility shall pull the pump and install it in the lift station upon

delivery. The pump manufacturer shall provide the warranty for the complete pump and motor assembly. The warranty period shall commence at the time of the first permanent service activation discharging Wastewater into the lift station or at the time of lift station start up, whichever applies. The Department will not accept operation and maintenance responsibility for a "dry" station, that is, a station in which there is no flow. **See Part (j) of this Section** for lift station acceptance procedures.

(d) Controls: A pump control system is required. The “high water” alarm float and approved level transmitter are to be located where their functionality will not be affected by the flows into the wet well, or by any installed equipment. For new lift station installations, the “high water” float elevation shall be set at a minimum of 6 inches below the lowest influent level. The wet well capacity shall be designed to provide a minimum of 6 inches vertical separation between fluid level set points for the level transducer. Provision shall be made in the control system to automatically alternate the pumps in use. A control panel with a remote transmitting unit (RTU) is required for each station, compatible with the Department's telemetry system. Any installed panel shall have a UL 508 serialized label “Enclosed Industrial Control Panel.” A shop drawing for the control panel is required prior to preconstruction meeting. The control panel builder shall pre-test the panel for functionality prior to shipment to the site. (See "Standard Details" for specifications).

(e) Valves and Piping**:** A gate valve is required on the discharge line of each pump with a pressure gauge on the discharge side of the gate valve, installed with a double strap saddle. A check valve is required between the pump and gate valve. Only resilient seated gate valves shall be used in force mains. Gate valves shall be right hand close operation, check valves shall have an external weight arm; no springs will be permitted.

A 4" or 6" tee and valve with 4" or 6" companion flange and plug shall be installed on the pumpstation discharge (FM) as an emergency by-pass. The emergency by-pass connection with an aluminum male cam-lock with cover shall be the same size as the pump discharge, and shall be accessible above ground level. A gate valve located between valve vault and emergency by-pass connection is required.

(f) Wet Wells: The minimum diameter wet well is 72 inches. For pumps 25 hp and larger, a minimum 96 inches diameter wet well is required. The maximum depth shall be 22’ unless approved in advance by the Department. For lift stations serving less than 200 residential units, the Department may require the installation of an odor control system if a long cycling time, or close proximity of the lift station to occupied structures may create an odor control problem.

The effective capacity of the wet well, or utilized capacity, shall provide a holding period not to exceed 15 minutes for the design average flow. The pump’s controls shall be designed to start pumps no more frequently than once every 10 minutes. The underground structures for the lift stations shall be precast unless otherwise specifically approved.

The wall openings shall be precast whenever possible. Aluminum access covers are required for wet wells and valve vaults. Pump numbers (1, 2) shall be painted on the underside of the excess covers (red color, 12” size, stencil required). A Fall Protection device is required for the wet well

top opening. The device must be installed by the manufacturer or by a Contractor licensed by the manufacturer. External manhole joint seals must be applied between all wet well barrel joints.

The wet well shall be certified by the supplier that calcareous aggregate is used in the concrete mix (minimum CaCO3 content: 65% in large aggregate, 50% in concrete screenings). Certification on the submitted shop drawings is acceptable. The wet well floor shall have a minimum slope of oneto-one to the intake. A corrosion barrier system is required for the interior of the wet wells and valve vault. New wet wells shall be lined with approved solid thermoplastic cast in liner. Valve vaults and rehabilitation wet wells shall be lined with an approved corrosion barrier system.

Pumps, valves, piping, rails, etc., shall not be coated with the corrosion barrier system. Where operation continuity is important, consideration should be given to dividing the wet well into two sections, suitably interconnected, to facilitate repairs and cleaning (or providing a bypass). All metal hardware in the wet well shall be stainless steel. Wet wells with any leakage will not be accepted.

(g) Power Supply: Standby power receptacles shall be provided and installed on the driveway side of the control panel. All lift stations shall be equipped for auxiliary generator power supply. The following plug and receptacle, as manufactured by Russellstoll, shall be used:

- 240-volt service, JRS 1034, HR Receptacle
- 480-volt service, JRS 2034, HR Receptacle

Phase monitors shall be provided at all pumping stations. A service entrance Fused Disconnect Switch is required between power meter and control panel. The maximum length of the electrical conduit from nearest transformer/ handhole to the lift station control panel shall be 50 feet. The power supply feed to the lift station shall be located within a utility easement and must be shown on record drawings.

Electric power and control systems must be in conformance with all local Codes, Ordinances, and National Electric Code requirements. Minimum two 20 feet long grounding rods are required. Power sources and feeders are to be shown on the as-built drawings. Permanent power is required in order to conduct a formal lift station startup.

(h) Portable, trailer mounted diesel powered by-pass pumps and portable, trailer mounted skid mounted generator sets (56 – 400 kW).

(1) General
For projects with more than one proposed PBCWUD owned wastewater pump station, the developer/property owner shall provide at no cost to County, one portable, trailer mounted diesel powered by-pass pump, subject to features and specifications as stated herein. The unit shall be transferred to County by a Bill of Sale prior to a lift station start-up, or sewer system certification for the project, whichever comes first.

The by-pass pumps and generator sets shall be selected from the WUD Approved Material List. The By-Pass Pumps and Generator units shall comply with the latest addition of the National Electric Code, all applicable local, state and federal codes, and be listed by Underwriters Laboratories (UL). The complete sets shall be warranted to be free from defect in materials and workmanship under normal use and service for a period of minimum one year from the date of equipment acceptance by the County. In addition to the equipment and features listed herein, the products shall be equipped with and warranted for all standard equipment and accessories as supplied by the manufacturer for the selected models. The products shall be completely assembled, tested at the factory and ready for operation (with engine oil and coolant) prior to delivery to the County. One set of spare filters (fuel and oil), a shop manual (service, parts), electrical wiring schematics and operating manual are required (hard copy and electronic copy)

(2) Portable Trailer Mounted By-Pass Pumps

The pumping unit shall be diesel powered, handle 3" solids and consist of a direct drive 6" centrifugal type pump, self-priming (vacuum assisted). The pump's mechanical seals shall be designed for indefinite "dry" run time. The turbocharged, liquid cooled six cylinder diesel engine, 1800 rpm, shall comply with all Environmental Protection Agency (EPA) emission standards and most current TIER rating ("Final TIER 4"). A coolant bottle, low coolant shut down, 12V starter, heavy duty wet cell battery, and a battery charging alternator are required. The battery shall be stored on a tray in a protective box. The engine shall be fitted with drain lines (with Camlocks) for engine oil and coolant, plumbed to the exterior. A battery on/off switch is required to eliminate current drain. A sub-base double wall double wall aluminum fuel tank shall have a leak detection system (primary wall to double wall containment). The fuel capacity shall correspond to minimum 24 hour run time at full load. The tank shall be internally baffled for strength, completely welded and leak proof. The tank's filler neck cap shall be equipped with lock wings for a pad lock. A manual fuel gauge and fuel level sender to the control center (warning and shut down) is required. The engine, pump, control panel, exhaust silencer, battery and an automatic 12V on-board float battery charger (5 Amp) shall be mounted within a weather proof, marine grade aluminum enclosure with powder coat finish on interior and exterior walls. The enclosure shall be insulated with sound attenuation foam. The insulation shall be resistant to high temperatures, fuel and oil. The noise level is not to exceed 71 db(A) at 23 feet. Rubber vibration dampers shall isolate the engine from the "critically silenced" enclosure. The enclosure shall have hinged access doors with lock wings for pad locks. Interior document holder is required. All hardware (including hinges) shall be stainless steel. The exhaust pipe shall not extend vertically or horizontally through the enclosure, and shall terminate with an aluminum rain cap. Minimum one grab handle is required at the rear on each side of the enclosure. Internally mounted, dual florescent timed lights are required. The 6" suction and 6" discharge connections shall terminate with camlocks. A 30 feet suction hose and a 30 feet 4" discharge hose are required. Two 6" by 4" hose adapters and a 4"discharge female Camlock/ male hose adapter are required. There shall be no openings in the enclosure or frame to prevent animal access. A weather protected digital controller shall be back lit with LED indicators for alarm, ready (manual and auto), running, voltage, engine speed, warnings. Push buttons shall be provided for menu navigation for manual/auto start, engine start/stop, alarm cancel/reset, diagnostic information and warnings. The electrical controls shall include wiring for floats, remote start capabilities to an external Automatic Transfer Switch (not included) or SCADA.

The by-pass pump set shall be mounted on a FDOT approved, low profile double axle trailer (single axle trailer will be considered on a case by case basis) with hydraulic brakes equipped with a reverse dump valve. A 3" pintle ring towing connection is mandatory. All necessary safety chains, heavy duty fenders (to support a 250 lbs person), DOT lighting package (LED) with a County compatible 6-pin hitch receiver or adapter, a heavy duty tongue fitted one hand cranked gear operated jack stand (with stand shoe), sized to match the unit's weight, are required. Two rear hand cranked gear operated jack stands are required. Wheels shall have tubeless tires, stainless steel valve stems, and marine grade galvanized tire rims. The steel frame shall be coated with RHINO TUFF-GRIP lining (or approved equal) for corrosion protection and shall have no holes. The overall unit length shall not exceed 15 feet, unless specifically preapproved

(3) Portable, Skid Mounted or Trailer Mounted Generator Set (56 - 400 kW).
The generator shall be powered by a turbocharged, liquid cooled diesel engine (1800 rpm, four cylinders up to 120 kW, six cylinders for 140-400 kW generators). The engine shall comply with all EPA emission standards and most current TIER ratings. A coolant bottle, low coolant shut down, 12V starter, heavy duty wet cell battery, and a battery charging alternator are required. The battery shall be stored on a tray in a protective box. The engine shall be fitted with drain lines (with Camlocks) for engine oil and coolant, plumbed to the exterior. A battery on/off switch is required to eliminate current drain. An automatic 12V on-board float charger (5 Amp) is required. A subbase double wall aluminum fuel tank is required, and shall have a leak detection system (primary wall to double wall containment). The fuel capacity shall correspond to minimum 24 hour run time at full load. The tank shall be internally baffled for strength, completely welded and leak proof. The tank's filler neck shall be extended to the outside of the enclosure, and the cap shall be equipped with lock wings for a pad lock. A manual fuel gauge and fuel level sender to the control center (warning and shut down) is required. Complete generator set, including the engine, generator, control panel, exhaust silencer, battery and battery charger shall be mounted within a weather proof, marine grade aluminum enclosure with powder coat finish on interior and exterior walls. The enclosure shall be insulated with sound attenuation foam. The insulation shall be resistant to high temperatures, fuel and oil. The noise level is not to exceed 71 db(A) at 23 feet. Rubber vibration dampers shall isolate the engine from the frame. The enclosure shall have hinged access doors with lock wings for pad locks. Interior document holder is required. All hardware (including hinges) shall be stainless steel. The exhaust pipe shall not extend vertically or horizontally through the enclosure, and shall terminate with an aluminum rain cap. Minimum one grab handle is required at the rear on each side of the enclosure. Internally mounted, dual florescent timed lights are required. There shall be no openings in the enclosure or frame to prevent animal access (anti-rodent protection brushes shall be installed in all openings if unavoidable). A digital controller (protected by a top hinged, pad lock lockable weather proof cover with "stay" supports) shall be back lit with LED indicators for alarm, ready (manual and auto), running, warning, load. Push buttons shall be provided for menu navigation for manual/auto start, engine start/stop, alarm cancel/reset, diagnostic information and warnings. An exterior "Low fuel alarm circuit" is required for connection to SCADA or lift station alarm light. The electrical controls shall include wiring for remote start capabilities and for an external Automatic Transfer Switch. Depending on application location and generator size (150 kW and larger), an Automatic Transfer Switch assembly may be required.

The generator shall have class "H" insulation and be of the latest commercial type. Design shall include PMG (Permanent Magnet Generator) excitation with a digital voltage regulator, soft-startramp on initial start-up, Auto/Manual mode, overvoltage shutdown, and VAR/PF controller. A three position AC output selection switch and an automatic off-switch to facilitate output voltage change are required.

Two power output cables (100A and 200A rated, respectively), four conductor, minimum 30 feet long, shall be hardwired to the breaker lugs (with a cable strain relief) behind hinged, pad lock lockable, safety switch protected, weather proof access doors. The cable plugs shall be Thomas and Betts Russellstoll JPS 1034 (100A) and JPS 2034 HR (200A). The cables shall be stored in aluminum pad-locking storage trays located under the generator unit and over the fuel tank.

The following output voltages are required for generators up to 120 kW:
120/240V high leg delta – 360 Amp
120/208V – 460 Amp
277/480V – 180 Amp

For generators 140 – 240 kW, the output voltages shall be:
120/240V high leg delta – 721 Amp
120/208V – 832 Amp
277/480V – 360 Amp

For generators 250 – 400 kW, the output voltages shall be:
120/240V high leg delta - 1203 Amp
120/208V – 1388 Amp
277/480V – 602 Amp

Convenience receptacles 20 A (GFCI protected) and 20 A (breaker protected) are required.

All wiring shall be color coded and protected through plastic loom or a solid conduit, and rubber grommets when passing through metal intersections. Connections must be soldered and use heat shrink material. A separate breaker shall be provided for each circuit to prevent all circuits from being "live" at the same time.

The portable generator set shall be mounted on a DOT approved, low profile double axle trailer (single axle trailer will be considered on a case by case basis) with hydraulic brakes equipped with a reverse dump valve. A 3" pintle ring towing connection is mandatory. All necessary safety chains, heavy duty fenders (to support a 250 lbs person), DOT lighting package with a County compatible 6-pin hitch receiver or adapter, a heavy duty tongue fitted one hand cranked gear operated jack stand (with stand shoe), sized to match the unit's weight, are required. For single axle trailers, two rear hand cranked gear operated jack stands are required. Wheels shall have tubeless tiers, stainless steel valve stems, and marine grade galvanized tire rims. The steel frame shall be coated with RHINO TUFF GRIP (or approved equal) for corrosion protection and shall

have no holes. The overall length of the set shall not exceed 15 feet, unless specifically preapproved.

(4) Skid Mounted Generator Set
All applicable engine/generator set specifications and requirements as listed above shall apply. The steel skid shall be coated with RHINO TUFF GRIP (or approved equal). The fork lift openings shall be oversized for easy handling. Rubber foot pads for bottom of skid generators are required.

(i) Fenced Enclosures: All lift stations shall be enclosed by a 6' high chain link fence with a 12' wide double gate centered on the wet well. Black vinyl coating is required for fence fabric, all posts, braces, rails and accessories. Decorative fencing or landscaping may be used in addition to the chain link fence. This is at the developer's/successor's discretion and maintenance responsibility and must be approved by the Department prior to installation. Approved hedges shall be installed a minimum of 5' from the fence.

Wire mesh fencing shall be constructed of 9-gauge wire with a maximum 2" mesh of chain linked steel hot dip galvanized after weaving. Top and bottom selvages are to be barbed. Line posts shall be 2 ½" Schedule 40 galvanized steel pipe. Corner and gate posts shall be 3" Schedule 40 galvanized steel pipe. A truss rod with turnbuckle is required from top of each gate post to the bottom of the next adjacent post.

Post spacing shall be equidistant with maximum 8'-0" spacing. Fencing shall be 6'-0" high, fitted with top rail, mid-height horizontal brace and a bottom rail. The top rail couplings are to be positioned over posts.

Fabric shall be continuous from corner post to corner post or corner post to gate post and shall be supported on stretcher bars at each corner of gate post. Fabric ties shall be located at maximum 8" spacing.

Top and bottom rails and rail braces shall be fabricated of 1-5/8" Schedule 40 galvanized steel pipe. Gate frames (2" Schedule 40 galvanized pipe) shall be full height of fencing, have horizontal bracing and gate fabric shall be sized to fit within the frame. Fabric shall be installed with stretcher bars.

Gates shall be double, providing for minimum 12'-0" clear opening between gate posts and shall be fitted with a lockable latch. Concrete line post footings shall be a minimum of 36" deep by 12" diameter. Corner and gate posts footings shall be minimum 40" deep by 12" diameter.

(j) Site Selection and Layout:

Direct vehicle access shall be provided for maintenance purposes. An easement or right-of-way of sufficient size is necessary for access (typically 20' wide). A platted lift station easement or exclusive Palm Beach County Utility Easement will be required for the lift station property. The

minimum required dimensions of the lift station property shall be 30’ x 40’. Additional property may be required at the Department’s discretion.

The exterior top of the wet well shall be designed at or above the one hundred (100) year flood elevations and not be more than 1' above the road grade adjacent to the station and in no case shall be at a lower elevation than the adjacent road. The driveway shall be no less than 30' in length from the edge of the ultimate right-of-way road pavement to the gate with a maximum grade of 3%.

The layout of the station should be such as to provide easy access without interference between control panel and truck access. Six-inch (6") thick concrete pad (broom finish required) shall be poured over 6” compacted rock base. The concrete pad shall be tied to the wet well top and valve vault top using #6 rebars. The concrete pad shall extend 12" beyond fenced area. (See detailed drawings).

The site for a lift station shall be selected:

- To be easily accessible (preferably not from a major collector or arterial road).
- To allow for unobstructed data transmission from the RTU to the nearest base station.
- To provide minimum 30’ separation from the lift station fence line to any residential buildings.
- Not to be located under overhead power lines, cables, etc.
- Not to cause a “Line of Sight” problem near intersections.
- To be outside of “Clear Zones” for traffic safety.
- The door of the Control Panel shall not face west or south unless unavoidable (north (preferred) and east are acceptable).

The base station locations are:

(1) Southern Region Water Reclamation Facility at Hagen Ranch Road, approximately two miles north of Atlantic Avenue. Service area: south of Lantana Road, north of Clint Moore Road.
(2) Water Utilities Department Administrative Complex near Pinehurst Drive and Forest Hill Boulevard, West Palm Beach. Service area: north of Lantana Road, south of Roebuck Road, and east of State Road 7.
(3) Water Treatment Plant #9 at 22438 SW Seventh Street, Boca Raton (1/2 mile south of Palmetto Park Road, 1/2 mile east of State Road 7). Service area: south of Clint Moore Road
(4) “Twenty Mile Bend” on SR 880 near intersection with SR 80. Service area: north of SR80, west of SR 7, and all stations north of Roebuck Road.

The Department reserves the right to reject a proposed site for a pump station if any existing or future structures could affect the functioning of the RTU.

Only sod is permitted within five (5) feet of a lift station fence. Acceptable sod types are floratam and bermuda with other types of sod being permitted with prior Department approval. Only hedges with a non-aggressive root system can be within any WUD lift station easement. Types of hedges permitted are listed in Standard Detail 48S

(k) Water Service:
A 1½" unmetered Potable Water service shall be installed to each Department owned lift station site. PVC Male/Female adapters are not acceptable. The service line shall terminate with a Reduced Pressure Principle Backflow Prevention Assembly. The Developer shall be responsible for the initial testing and certification of the assembly prior to the lift station start-up. The Backflow Prevention Assembly shall be located so that it may not interfere with panel opening and not to create a tripping hazard.

(l) Lift Station Acceptance Procedure:
The lift station components shall be pre-tested by the contractor prior to the start-up meeting with PBCWUD. A representative of the Department's Operations and Maintenance Divisions shall be present at final inspections/start-up of a lift station. The following will be the basis of a Department-owned lift station acceptance:

(1) The pumps are reasonably pumping on the design-pumping curve. Revised pumps, electrical systems, and/or impellers may be required if the force main system conditions changed since the initial approval of the pump design.
(2) The design amperage is not being exceeded.
(3) The telemetry unit is functioning properly. (Copy of RTU Start-Up Report is required).
(4) The station is functioning as designed.
(5) The station was built in accordance with these standards.
(6) Completed lift station checklist (diskette and hard copy) must be submitted to the Construction Coordinator prior to the lift station start-up.
(7) Legal documents are submitted.
(8) Copy of the latest electric utility bill is submitted.
(9) A copy of blackflow prevention assembly testing and certification is submitted.
(10) Wet well and valve vault are coated with approved corrosion barrier system and the coating tested and certified.
(11) Contractor shall demonstrate that pumps can be easily removed from wet wells.
(12) Title and minimum (1) year parts and labor warranty to the portable pump station backup unit set shall be provided.
**Note:** The unit shall be delivered to a location as specified by the Department.
(13) Manufacturer's "Start-Up Report" (Disk and a Paper Copy) is submitted.
(14) Completed "Notice of Acceptance" is submitted.
(15) Complete Operation, Maintenance, Repair and Service Manuals for Lift Station equipment, by-pass pumps and generators (if applicable). One (1) hard copy and one (1) electronic copy (CD) are required.
(16) Two (2) copies of pump and panel shop drawings are submitted.
(17) "Full Load" Test Certification is provided for the generator.
(18) Bill of Sale for the back-up pumping unit.

(19) The control panel is properly UL labeled.
(20) The provided pump station back-up pumping unit is delivered to a location as specified by the Department.

Upon final inspection of a lift station by the Department's Construction Coordination Section and Operations & Maintenance (O&M) Division personnel, and upon the satisfactory correction of any deficiencies detected at said inspection, the Chief Construction Coordinator shall notify the Development Improvements Section and confirm that the Bill of Sale has been submitted and accepted.

Upon the receipt of the Bill of Sale or lift station acceptance, whichever is later, and the receipt of a copy of the latest electric utility bill from the developer, Development Improvements Section shall notify the electric utility to transfer the account to the Department. Copies of the notification letter shall be sent to O&M, Finance/Accounting and to the developer. The unconditional labor and material warranty period for the lift station (five years for the corrosion barrier system, five years for lift station pump and motor assemblies, and one year for all other components) shall commence at the time of first permanent Service Activation discharging Wastewater into the lift station.

The warranty for the Department initiated lift station rehabilitation projects shall begin at the time of final payment to the Contractor by the Department and shall cover all materials and labor associated with the rehabilitation project, including but not limited to, site restoration, flow by-passing, and temporary power.

During said warranty period, Developer also agrees to reimburse the Department for any repairs/replacements (on warranty items) performed by the Department under any emergency basis. Emergency is defined as any event occurring, which would potentially endanger the safety or welfare of the public. Department Inspector and O&M personnel shall be present at the private lift station startup.

A “private” lift station start-up report shall be submitted to the Department prior to request of Sewer System Certification. The start-up report shall include as a minimum date of startup, pump manufacturer, pump model, impeller, horsepower, start-up pressure, and pumping rate.

## SECTION 3.9 - WASTEWATER SYSTEM STANDARD DETAILS LISTING

**GENERAL**

1SA OIL/GREASE INTERCEPTOR
1SB OIL/GREASE INTERCEPTOR POLYETHEYLENE/FIBERGLASS STRUCTURE DETAIL
2SA SAND/OIL INTERCEPTOR
2SB SAND/OIL INTERCEPTOR POLYETHEYLENE/FIBERGLASS STRUCTURE DETAIL
3S GREASE TRAP
4S POTABLE WATER MAIN, WASTEWATER MAIN & STORM SEWER CONFLICT
5S POTABLE WATER/FORCE MAIN PRESSURE PIPE CONFLICT
6S OPEN CUT PIPE INSTALLATION - NON-THOROUGHFARE ROAD
7S OPEN CUT PIPE INSTALLATION - THOROUGHFARE ROAD
8S WASTEWATER TRENCH DETAIL
9S WASTEWATER SYSTEM STANDARD CUT IN DETAILS
10S PRESSURE TEST CRITERIA FOR GRAVITY WASTEWATER MAIN IN WELL FIELD AND FORCE MAIN
11SA TYPICAL CLEANOUT INSTALLATION
11SB CLEANOUT INSTALLATION DETAIL BETWEEN TOWNHOME DRIVEWAYS
12S TYPICAL WASTEWATER SERVICE CONNECTIONS

**GRAVITY SEWER MANHOLES WITHOUT CAST-IN WALL LINER**

13S STANDARD MANHOLE
14S SHALLOW MANHOLE
15S DROP CONNECTION PRECAST MANHOLE
16S INVERT FLOW CHANNELS
17S GRAVITY SEWER MANHOLE FRAME & COVER

**GRAVITY SEWER MANHOLES WITH CAST-IN WALL LINER**

18SA STANDARD MANHOLE WITH CAST-IN LINER
18SB NEW MANHOLE CUT INTO EXISTING GRAVITY SEWER MAIN DETAIL
19S SHALLOW MANHOLE WITH CAST-IN LINER
20S OUTSIDE DROP MANHOLE WITH CAST-IN LINER
21S PIPE TO MANHOLE CONNECTION - TYPE "A"
22S PIPE TO MANHOLE CONNECTION - TYPE "B"
23S PIPE TO MANHOLE CONNECTION - TYPE "C"
24S PIPE TO MANHOLE CONNECTION FOR CORE DRILLED INVERT
25S PIPE TO DROP MANHOLE CONNECTION - LOWER INVERT
26S BASE MANHOLE SECTION WATERSTOP DETAIL
27S TURN BACK JOINT INSTALLED PRIOR TO CAST
28S TURN BACK JOINT INSTALLED AFTER CAST

**GRAVITY SEWER MANHOLES WITH CAST-IN WALL LINER & BASE LINER**

29S STANDARD MANHOLE WITH CAST-IN LINER & BASE LINER
30S SHALLOW MANHOLE WITH CAST-IN LINER & BASE LINER
31S OUTSIDE DROP MANHOLE WITH CAST-IN LINER & BASE LINER
32S MANHOLE BASE SECTION
33S FLOW CHANNEL/PIPE CONNECTION TO NEW CAST-IN BASE LINER

## SECTION 3.9 - WASTEWATER SYSTEM STANDARD DETAILS LISTING (cont'd)

34S FLOW CHANNEL/PIPE CONNECTION TO EXISTING CAST-IN BASE LINER
35S PIPE TO MANHOLE CONNECTION DETAIL - TYPE "A" (GASKET)
36S PIPE TO MANHOLE CONNECTION DETAIL - TYPE "B" (BOOT)

### FORCE MAINS

37S CONNECTION OF PRIVATE FORCE MAIN UNDER 4" IN DIAMETER
38S TYPICAL FORCE MAIN GATE VALVE SETTING AND CUT-IN DETAIL
39S FORCE MAIN AIR RELEASE VALVE & VAULT OUTSIDE OF ROAD RIGHT-OF-WAY, NON TRAFFIC AREAS
40S FORCE MAIN AIR RELEASE VALVE AND MANHOLE IN PAVED AREAS AND ROAD RIGHT-OF-WAY
41S MECHANICAL THRUST RESTRAINT - MINIMUM PIPE LENGTHS (FORCE MAINS)
42S TYPICAL THRUST BLOCKS FOR PRESSURE PIPING
43S FORCE MAIN ENTERING MANHOLE
44SA WASTEWATER MAIN CASING INSTALLATION DETAIL
44SB WASTEWATER MAIN SPLIT CASINGCASING INSTALLATION DETAIL
45S TYPICAL FORCE MAIN AERIAL CANAL CROSSING- SINGLE PIPE (SINGLE PILES)
46S FAN GUARD/PILE CAP DESIGN - SINGLE PIPE (SINGLE PILES)

### LIFT STATIONS

47S TYPICAL LIFT STATION SITE PLAN DETAIL
48S TYPICAL LIFT STATION SITE PLAN NOTES
49SA TYPICAL LIFT STATION SECTION WITH CAST-IN LINER
49SB TYPICAL LIFT STATION DROP PIPE DETAIL AND NOTES
49SC TYPICAL LIFT STATION VALVE VAULT PRESSURE TRANSMITTER DETAIL AND NOTES
50S LIFT STATION TOP SLAB
51S LIFT STATION WITH 2" CONDUIT CONNECTION
52S LIFT STATION WETWELL SETTING TREMIE POUR DETAIL
53S LIFT STATION STANDARD ALUMINUM COVER AND PUMP CABLE RACK
54S HOSE CONNECTION WITH RP BACKFLOW PREVENTER FOR LIFT STATION WATER SERVICE
55S FENCE AND GATE DETAIL
56S LIFT STATION ELECTRICAL RACK FOR GENERATOR RECEPTACLE ON LEFT SIDE
57S LIFT STATION ELECTRICAL RACK FOR GENERATOR RECEPTACLE ON RIGHT SIDE
58S CONTROL PANEL INSTALLATION NOTES
59S CONTROL PANEL - INTERNAL PANEL LAYOUT FOR MOTORS SMALLER THAN 20 HP
60S CONTROL PANEL - INTERNAL PANEL LAYOUT FOR MOTORS 20 HP AND LARGER
61S LIFT STATION CONTROL PANEL INNER DOORS FOR MOTORS SMALLER THAN 20 HP
62S LIFT STATON CONTROL PANEL INNER DOORS FOR 20 HP MOTORS AND LARGER
63S ELECTRICAL PANEL SPECIFICATIONS (SHT 1 OF 3)
64S ELECTRICAL PANEL SPECIFICATIONS (SHT 2 OF 3)
65S ELECTRICAL PANEL SPECIFICATIONS (SHT 3 OF 3)
66S CONTROL PANEL - BILL OF MATERIALS
67S CONTROL PANEL - 240V & 480V PANELS NOTES
68S LIFT STATION ELECTRICAL SCHEMATIC (SHT 1 OF 3)
69S LIFT STATION ELECTRICAL SCHEMATIC (SHT 2 OF 3)
70S LIFT STATION ELECTRICAL SCHEMATIC (SHT 3 OF 3)

## SECTION 3.9 - WASTEWATER SYSTEM STANDARD DETAILS LISTING (cont'd)

71S LIFT STATION ELECTRICAL SCHEMATICS WITH SOFT STARTERS (SHT 1 OF 3)
72S LIFT STATION ELECTRICAL SCHEMATICS WITH SOFT STARTERS (SHT 2 OF 3)
73S LIFT STATION ELECTRICAL SCHEMATICS WITH SOFT STARTERS (SHT 3 OF 3)
74S LIFT STATION CONTROL PANEL ELECTRICAL RISER
75S REMOTE TELEMETRY UNIT SPECIFICATIONS (SHT 1 OF 5)
76S REMOTE TELEMETRY UNIT SPECIFICATIONS (SHT 2 OF 5)
77S REMOTE TELEMETRY UNIT SPECIFICATIONS (SHT 3 OF 5)
78S REMOTE TELEMETRY UNIT SPECIFICATIONS (SHT 4 OF 5)
79S REMOTE TELEMETRY UNIT SPECIFICATIONS (SHT 5 OF 5)
80S RTU WIRING DIAGRAM/PLC ANALOG INPUT WIRING DIAGRAM
81S TYPICAL LIFT STATION (SECTION)
82S LIFT STATION LOW PROFILE CONTROL PANEL INNER DOORS FOR MOTORS 15 HP AND SMALLER
83S LIFT STATION STANDALONE RTU PANEL LAYOUT TO BE USED WITH LOW PROFILE CONTROL PANEL
84S LIFT STATION EQUIPMENT LAYOUT #1 WITH LOW PROFILE CONTROL PANEL
85S LIFT STATION EQUIPMENT LAYOUT #2 WITH LOW PROFILE CONTROL PANEL
86S LIFT STATION EQUIPMENT LAYOUT #3 WITH LOW PROFILE CONTROL PANEL

### MISCELLANEOUS

87S TYPICAL WASTEWATER SERVICE INSTALLATION FOR VACUUM SEWER
88S RIP-RAP INSTALLATION DETAIL
889S LANDSCAPE AND ROOT BARRIER DETAIL
90S FORCE MAIN AIR RELEASE VALVE W/VENTED AIR ENCLOSURE
91S WASTEWATER MAIN CROSSING FENCE, WALL OR BERM CASING DETAIL
92S WASTEWATER MAIN CONFLICT STRUCTURE DETAIL

# WASTEWATER SYSTEM

# STANDARD DETAILS SHEETS 1S – 92S