

Chapter amendments approved:	OMPC	Owensboro	Daviess Co.	Whitesville
Re-adoption of Public Improvement Specifications	24-Mar-77	01-Apr-77	20-Apr-77	?
Revised Public Improvement Specifications	18-Apr-81	22-May-81	26-May-81	06-Jul-81
2002 Revised Public Improvement Specifications	08-Aug-02	No action required by legislative bodies		
Revisions to Exhibits 5-3, 5-10, 5-12, 5-13a, 5-13b, 5-14, 5-15	10-Mar-11	No action required by legislative bodies		
Revisions to Public Improvement Specifications and Exhibits 5-10, 5-13a, 5-13b, 5-14, 5-15, 5-18	09-Jan-14	No action required by legislative bodies		
Revisions to Exhibits 5-13a, 5-13b & 5-15	10-Mar-16	No action required by legislative bodies		

5.0 PURPOSE AND DESIGN REQUIREMENTS. The purpose of this chapter is to outline the requirements for proper sanitary sewer pipe sizing, construction, and inspection. Unless the requirement is waived by the Engineer, a complete set of construction plans, project specifications, proposed and anticipated future flows and service area, and design calculations shall be made available to him for review and approval. Design and installation criteria shall conform to the Recommended Standards for Wastewater Facilities - 1990 - or latest edition (Great Lakes-Upper Mississippi River Board of State Public Health and Environmental Managers, commonly referred to as 10 State Standards).

5.0.1 Depth. In general sewers shall be sufficiently deep so as to receive sewage from the first floor of all places served by the sewers and to prevent freezing, but shall not be less than four (4) feet of cover, unless otherwise approved by the Engineer.

5.0.2 Slope. All sewers shall be so designed and constructed to give mean velocities, when flowing full of not less than two (2) feet per second. The following are the minimum slopes, as specified in 10 State Standards: however, slopes greater than these are desirable.

Minimum Slope in Feet

Sewer Size	Per 100 Feet
8 inch	0.40
10 inch	0.28
12 inch	0.22
14 inch	0.17
15 inch	0.15
16 inch	0.14
18 inch	0.12
21 inch	0.10
24 inch	0.08
27 inch	0.067
30 inch	0.058
36 inch	0.046

Sewers shall be laid with uniform slope between manholes. Sewers on 20 percent slope or greater or when specified by the Engineer, shall be anchored securely

with concrete anchors spaced no further than 36 feet center to center.

5.0.3 Sizing. New sewer systems shall be designed on the basis of an average daily per capita flow of sewage of not less than 100 gallons per day. This figure is assumed to cover normal infiltration, but an additional allowance should be made where conditions are unfavorable. Generally, the main, trunk and outfall sewers shall be designed to carry, when running full, not less than 250 gallons daily per capita contributions of sewage, exclusive of sewage or other waste flow from industrial plants.

No public sewer shall be less than eight (8) inches in diameter. All laterals shall have a minimum grade of 1/8"/ft, including all of the portion of the tap within the right-of-way.

5.0.4 Combined Sewers. Expansion of combined sewers into areas that presently have separate sanitary and storm facilities is not allowed. Replacement combined sewers shall be designed to have adequate capacity to handle 25 year frequency storm events, unless alternate storm event evaluations and/or designs are required by the Engineer.

5.1 PIPE AND FITTINGS. Sanitary sewers shall be constructed of materials per the requirements of Chapter 2 "Materials."

5.2 TRENCHES EXCAVATION. Unless specifically directed otherwise by the Engineer, no more than 400 feet of trench in open unpaved areas and 100 feet of trench in existing paved areas shall be opened at any time in advance of the pipe, nor shall more than 100 feet be left unfilled. Watchmen or barricades, safety lighting and other such signs and signals as may be necessary to warn the public of the dangers in connection with open trenches, excavation and other obstructions, shall be provided by and at the expense of the contractor.

When so required or when directed by the Engineer, only one-half of street crossings and road crossings shall be

excavated before placing temporary bridges over the side excavated, for the convenience of the traveling public. All backfilled trenches shall be maintained in such a manner that they will offer no hazard to the passage of traffic. The convenience of the traveling public and property owners abutting shall be taken into consideration. All public or private drives shall be taken into consideration and shall be promptly backfilled or bridged at the direction of the Engineer. Excavated materials shall be disposed of so as to cause the least interference, and in every case the disposition of materials shall be satisfactory to the Engineer.

Trenches in which pipes are to be laid shall be excavated in open cut to the depths shown on the approved plans, cut sheets or as specified by the Engineer. The minimum allowable trench width shall not be less than the outside diameter of the pipe plus eight (8) inches on each side. Where rock is encountered it shall be removed to a minimum depth of four (4) inches below the pipe bells.

Unless specifically authorized by the Engineer, trenches shall in no case be excavated or permitted to become wider than two (2) feet six (6) inches plus the nominal diameter of the pipe at the level of or below the top of the pipe. If the trench does become wider than two (2) feet six (6) inches at or below the top of the pipe, special precautions may be necessary, such as upgrading the class of pipe installed, as determined by the Engineer. The contractor shall bear the cost of such special precautions as necessary.

All excavated materials shall be placed a minimum of two (2) feet back from the edge of the trench.

Where conditions exist that may be conducive to slides or cave-ins, proper and adequate sheeting, shoring and bracing shall be installed (see Section 5.7) to provide safe working conditions and to prevent damage to work.

5.2.1 Drainage of Excavations. The Contractor shall maintain all excavations free of water. He shall provide all dams, channels, sumps, or other means necessary to keep the excavation entirely clear of water and shall provide and operate pumps or other suitable equipment of adequate capacity for de-watering the excavations. If necessary or so directed by the Engineer, the Contractor shall place crushed stone to maintain a firm, water free excavation bottom and base. Pipe bedding, laying, jointing, and the placing of concrete shall be done in a water-free trench or excavation. Trenches shall be kept free of water during the pipe installation and until the pipeline has been backfilled.

5.3 PIPE BEDDING

5.3.1 Standard Bedding. Except as specified in 5.3.2 through 5.3.4 all sewer pipe, including lateral taps within a public right-of-way or easement, shall, as a standard practice be laid using Standard Bedding. Such bedding (material shall be as specified in Section 2), shall be placed a minimum depth of four (4) inches below the bottom of the pipe barrel and thoroughly tamped along each side of the pipe to a height equal to 0.5 of the pipe diameter. Bell holes shall be provided at each joint. Bedding material shall be brought up to a minimum four (4) inches above the top of the pipe.

5.3.2 Special Subgrade Improvement. When directed by the Engineer, unsuitable materials below the normal trench depth shall be removed to a depth sufficient to provide a layer of crushed limestone (#6, #3, or #57 as specified by Engineer) to support the pipe and prevent settlement. The pipe shall then be laid on Dry Mix Concrete Bedding or Standard Bedding placed over the Special Subgrade Improvement.

5.3.3 Dry Mix Concrete Bedding. In areas where wet mucky soil, unstable soil or "running sand" is encountered or as otherwise directed by the Engineer, sewer pipe shall be laid on Dry Mix Concrete. The concrete shall be minimum 2500 psi 28 day strength Class "B" as per Section 2.1. The cement, sand and stone shall be thoroughly mixed (no water) and placed in the trench, to a minimum depth of four (4) inches below the bottom of the pipe. Dry mix concrete shall be thoroughly tamped along each side of the pipe to a height equal to 0.3 of the pipe diameter. Only enough water shall be added to the concrete, after the pipe is in place, to cause hydration of the cement. After water is added the pipe grade shall be rechecked, adjusted as necessary and the concrete re-tamped along the side. The sewer trench shall be kept water free during pipe laying and until the concrete has set. (See Exhibit 5.1 SD - Section No. 8)

5.3.4 Rock Cut Bedding. If the foundation is in rock the excavation shall be undercut to a depth of four (4) inches below the bottom of the pipe bell. The pipe shall be laid on a bed of granular material to provide continuous support for the lower section of the pipe. Granular bedding shall be #57, #67 or 610's.

5.4 LAYING PIPE. The laying of sewer pipe in finished trenches shall be commenced at the lowest point so that the spigot ends point in the direction of flow (bell pointed upstream). Prior to making pipe joints, all joint surfaces shall be clean and dry and free from gravel or other

extraneous materials. All necessary lubricants or adhesives shall be used as recommended by the pipe manufacturer. No section of pipe shall be brought into position for jointing until the preceding section has been bedded and secured in place.

5.4.1 Line and Grade. Control stakes (vertical and horizontal) shall be set at maximum 100' intervals and at manholes by a licensed land surveyor. The Contractor/ Developer shall use a pipe laser and target for maintaining line and grade. A calibrated survey transit shall be on site to verify line and grade compliance. All adjustments to line and grade must be made by scraping away or filling in under the barrel of the pipe and not by wedging or blocking up any portion of the pipe or striking the pipe in an effort to drive it down.

The Contractor shall be responsible for maintaining grades and elevations as called for on the drawing profiles, and any variances found shall be corrected by the Contractor at his own expense.

All pipe lengths shall be laid with ends abutting and true to line and grade as given by the Engineer. They shall be fitted and matched so that when laid they will form a sewer with a smooth and uniform invert. Supporting of pipe shall be as set out hereinbefore under "Pipe Bedding".

Branches, fittings and specials for sewer lines shall be provided and laid as and where directed by the Engineer or shown on the plans.

Before each piece of pipe is lowered into the trench, it shall be thoroughly inspected to insure it's being clean. Each piece of pipe shall be lowered separately. No piece of pipe or fitting which is known to be defective shall be laid or placed in the lines. If any defective pipe or fitting shall be discovered after the pipe is laid, they shall be removed and replaced with a satisfactory or fitting without additional charge. In case a length of pipe is cut to fit in a line, it shall be so cut as to leave a smooth end at right angles to the longitudinal axis of the pipe and a repair type coupling used as a splicing device.

When laying of pipe is stopped for any reason, the exposed end of such pipe shall be closed with a suitable temporary tight-fitting plug fitted into the pipe bell, so as to exclude earth or other material, and precautions taken to prevent flotation of pipe by runoff into trench. The end of the pipe installed shall be adequately buried to

prevent flotation and adequately marked so that it may be hand dug to prevent damage when re-excavated.

5.5 BLASTING. When it is necessary to use blasting during pipe excavation, the contractor shall follow the procedure as specified hereinbefore in Chapter 3 "Streets", Section 3.4.3.

5.6 OBSTRUCTIONS. In cases where storm sewers, gas lines, water lines, telephone lines, and other utilities, or other underground structures are encountered, they shall not be displaced or damaged. If relocation is necessary, or damage has occurred, the appropriate utility shall be notified immediately. All such lines or underground structures damaged in the construction shall be replaced at the Contractor's/ Developer's expense, unless in the opinion of the Engineer, such damage was caused through no fault of the Contractor.

The Contractor shall notify Kentucky Underground Protection, Inc. (BUD System) and all potentially affected utility companies that are not participating in the BUD System prior to excavation adjacent to their facilities.

The Contractor's attention is further directed to Chapter 1 "Introduction", Section 1.11 for additional requirements.

5.7 SHORING, SHEETING AND BRACING OF EXCAVATIONS. The Contractor shall furnish, place and maintain adequate sheeting and bracing or trench boxes as is necessary to support the sides of the excavation and prevent any movements of earth which could, in any way, diminish the width of the excavation to less than the amount necessary for proper construction, cause damage to the sewer or structure being constructed or to adjacent structures, utilities, pavements or walks, or cause injury to workmen or others through movement of the adjacent earth banks, or to otherwise damage or delay the work. All work shall comply with O.S.H.A. Regulations 29 CFR 1926.650-.652.

Sheeting left in place shall be cut off at least 48 inches below the ground surface. All sheeting, bracing and shoring which is to be removed shall be done in a manner that will not endanger the completed work or other structures. The Contractor shall exercise care to prevent the opening of voids during the extraction process. Any voids created while pulling sheeting shall be immediately filled with flowable fill or fine gravel backfill densified by flushing and jetting of water.

Adequate and proper shoring of all excavations shall be the entire responsibility of the Contractor; however, the Engineer may require the submission of shoring plans (accompanied by supporting computations) for review prior to the Contractor undertaking any portion of the work.

Existing foundations that are adjacent to and above an excavation shall be supported by shoring, bracing or underpinning as long as the excavation remains open, or thereafter if required to insure the stability of the foundation and structure. The Contractor shall be held strictly responsible for any damage to said foundations.

Even though computations shall determine the size of the various components, no timber sheeting less than two inches in thickness and no timber bracing, cross bracing or struts less than six inches by six inches will be acceptable.

Solid sheeting will be required for wet or unstable material. It shall consist of continuous vertical sheet piling of timber or steel with suitable walers and braces.

Care shall be taken to avoid excessive backfill loads on the completed pipelines. The requirement that the width of the ditch at the level of the crown of the pipe be not more than two feet six inches plus the nominal diameter of the pipe, as set out in Section 5.2, shall be strictly observed.

Trench sheeting shall not be removed until sufficient backfill has been placed to protect the pipe.

All sheeting, planking, timbering, bracing and bridging shall be placed, renewed and maintained as long as is necessary.

5.8 BACKFILLING PIPELINE TRENCHES. All backfilling shall be accomplished in accordance with the specifications described herein.

When directed by the Engineer, or as otherwise needed, the Contractor shall add water to the backfill material or dry out the material, to attain a condition near optimum moisture content (generally between plus 2% and minus 4% of optimal moisture content) to reach maximum density of the material when it is tamped. The Contractor shall obtain compaction of the backfill of at least 95 percent of Standard Proctor (ASTM D 698) density where mechanical tamping of backfill is required.

Before final acceptance, the Contractor will be required to level off all trenches or to bring the trench up to the level of the surrounding terrain. The Contractor shall also remove from roadways, rights-of-way and/or private

property all excess earth or other materials resulting from construction.

In the event that pavement is not placed immediately following trench backfilling in streets and highways, the Contractor shall be responsible for maintaining the trench surface in a level condition at proper pavement grade at all times.

In all cases walking or working on the completed pipelines except as may be necessary in tamping or backfilling will not be permitted until the trench has been backfilled to a point one foot above the top of the pipe. The filling of the trench and the tamping of the backfill shall be carried on simultaneously on both sides of the pipe in such a manner that the completed pipeline will not be disturbed and injurious side pressures do not occur.

5.8.1 Method "A" - Backfilling in Open Terrain.

Backfilling of pipeline trenches in open terrain shall be accomplished in the following manner:

The lower portion of the trench, from the pipe bedding to a point 12 inches above the pipe shall be backfilled with material free from rock and as acceptable to the Engineer. This material shall be placed in six (6) inch layers along each side of the pipe taking care to keep the level of fill on each side of the pipe equal.

Compaction shall be accomplished by hand-tamping or by approved mechanical methods. Upon approval of the Engineer, crushed stone, or fine gravel may be used as backfill in lieu of compacted earth.

The upper portion of the trench above the compacted portion shall be backfilled with material that is free from large rock. Incorporation of rock having a volume exceeding one-half cubic foot is prohibited. Backfilling this portion of the trench may be accomplished by any means approved by the Engineer. The trench backfill shall be heaped over or leveled.

5.8.2 Method "B" - Backfilling Under Sidewalks and Unpaved Driveways. Backfilling of pipeline trenches under sidewalks and unpaved driveways shall be accomplished in the following manner:

The lower portion of the trench from the pipe bedding to a point 12 inches above the top of the pipe shall be backfilled with material free from rock and/or acceptable to the Engineer. This material shall be placed in six (6)

inch layers along each side of the pipe taking care to keep the level of fill in each side of the pipe equal.

Compaction shall be accomplished by hand-tamping or by approved mechanical methods. Upon approval of the Engineer, crushed stone, or fine gravel may be used as backfill in lieu of compacted earth. Flowable fill is also an acceptable backfill material.

The middle portion of the trench, from a point 12 inches above the top of the pipe to a point six (6) inches below the grade line, shall be backfilled with material free from rock and/or acceptable to the Engineer. This material shall be placed and compacted in layers of approximately six (6) inches.

Upon approval of the Engineer, the Contractor may backfill the middle portion of the trench with crushed stone or fine gravel in lieu of materials that require compaction.

The upper portion of the trench shall be temporarily backfilled and maintained with crushed stone or gravel until such time as the sidewalk is constructed or the driveway surface is restored.

5.8.3 Method "C" - Backfilling Under Streets, Roads and Paved Driveways. Backfilling of pipeline trenches under streets, roads and paved driveways shall be accomplished in the following manner:

The lower portion of the trench, from the pipe bedding to a point eight (8) inches (10 inches for streets classified above local street) below the bottom of the pavement or concrete sub-slab, shall be backfilled with crushed stone, fine gravel or DGA. Flowable fill is also an acceptable backfill material.

The upper portion of the trench, from a point eight (8) inches (10 inches for streets classified above local streets) below the bottom of the pavement or concrete sub-slab up to grade, shall be backfilled with a base course of dense graded aggregate or crushed stone, suitable to the Engineer. At such time that pavement placement is accomplished the excess base course shall be removed as required.

Backfilling with compacted soil or jetted soil backfill may be allowed for development of new streets or roadways, if specifically approved by the Engineer. Acceptable soil for backfill and adequate time for settling and drying of backfill will be required.

5.9 TESTING OF LINES. The testing of sewage force mains and gravity sewers shall be accomplished in accordance with the procedure listed hereinafter.

5.9.1 Sewage Force Mains. On all projects involving the installation of sewage force mains, the finished work shall comply with the provisions listed below, or similar requirements that will insure equal or better results:

- a. Hydrostatic testing Force mains shall be tested by performing a hydrostatic test. The force main shall be completely filled with water and subjected to an internal pressure of 100 psi or twice the surge plus operating pressure, whichever is greater, not to exceed 125 percent of the maximum pressure rating for the pipe, measured at the downstream end. The pressure shall be held for a period of two (2) hours. During the test, leakage from the force main shall be measured. The maximum allowable leakage shall be $\frac{1}{2}$ gallon per inch diameter per 1,000 feet of pipe per hour.
- b. Where practicable, pipelines shall be tested between line valves or plugs in lengths of not more than 1500 feet.
- c. Pipelines shall be tested before backfilling at joints except where otherwise required by necessity, local ordinance, or public convenience.
- d. Duration of test shall be not less than two hours where joints are exposed and not less than 24 hours where joints are covered.
- e. Where leaks are visible at exposed joints and/or evident on the surface where joints are covered, the joints shall be re-caulked, re-poured, bolts re-tightened or re-laid, and leakage minimized, regardless of total leakage as shown by test.
- f. All pipe, fittings and other materials found to be defective under test shall be removed and replaced at the Contractor's expense.
- g. Lines that fail to meet tests shall be repaired and re-tested as necessary until test requirements are complied with.
- h. Where nonmetallic joint compounds are used, pipelines should be held under normal operating pressure for at least three (3) days before testing.

5.9.2 Gravity Sanitary Sewer Lines. On all projects involving installation of sanitary sewer lines, the finished work shall comply with the provisions listed below or similar requirements that will insure equal or better results.

After the new sewer system has been installed, and prior to final inspection, the Contractor shall clean out the entire system by pushing through each individual line in the system, from manhole to manhole, appropriate tools for the removal of any and all dirt, debris and trash from the lines.

During or subsequent to the final inspection, the Engineer will inspect each individual line, from manhole to manhole, either by use of televisions, lights or other means at his disposal to determine whether the completed lines are true to line and grade as shown on the plans.

All lines or sections of lines that are found to be laid improperly, contain broken or leaking sections of pipe, not properly jointed, or are obstructed in such a manner that they cannot be satisfactorily corrected otherwise, shall be removed and replaced at the Contractor's expense.

The Contractor shall lay sewer lines so as to generally be water tight, including house connections. In no case shall the rate of leakage exfiltration or infiltration average more than 200 gallons per inch pipe diameter per 24 hours per mile of sewer. Any locations of visible leakage shall be replaced or repaired as otherwise approved by the Engineer. The length of the main sewers shall be used in making the foregoing computation even though the house connections (from the main sewer to the property line) should be in place and included as a part of the system when infiltration is measured.

On all projects involving the installation of gravity sewers, the finished work shall comply with the provisions listed below, or similar requirements that will insure equal or better results:

a. Deflection test. Deflection tests shall be performed on all flexible pipe. The test shall be conducted after the final backfill has been in place at least 30 days to permit stabilization of the soil-pipe system. All jetting activity shall be completed prior to deflection testing. No pipe shall exceed a deflection of five (5) percent. A properly sized, manufactured mandrel shall be used for deflection test. It shall have a diameter not less

than 95% of the nominal inside diameter of the pipe, depending on which is specified in the ASTM Specifications. The pipe shall measure in compliance with ASTM D 2122. The test shall be performed without any mechanical pulling devices.

b. Air test. Low Pressure Air test shall be performed for all gravity sewer lines. The internal pressure applied shall be at least four (4) psi greater than the maximum pressure that may be exerted by groundwater above the invert of the pipe at the time of the test. However, the internal air pressure in the line shall not be allowed to exceed eight (8) psi. When groundwater pressure is believed to possibly exceed four (4) psi, in the opinion of the Engineer, the Contractor shall also conduct infiltration tests. The air tests shall be performed in accordance with the current Unibell Standard as shown in Exhibit 5-17.

c. Infiltration test. If, in the opinion of the Engineer, the air test may not be conclusive due to groundwater pressure, the Engineer may require infiltration tests to be performed by the Contractor in addition to the air test.

d. Vacuum test. Vacuum testing of manholes may be required by the Engineer, when concerns exist about possible infiltration due to high groundwater and/or deep manholes, manhole construction or manhole installation. Vacuum testing shall be done in accordance with ASTM C1244-93 (current edition). Where practical, testing shall be performed prior to backfilling around the structure. If testing is performed following backfilling, proper determination of groundwater elevation shall be completed and appropriate adjustment made for vacuum testing pressure.

e. Leakage. Regardless of test results, all visible leaks shall be corrected.

5.10 STEEL CASING PIPE. Steel casing pipe for highway or railroad crossings shall be bored and/or jacked in place. All joints between lengths shall be solidly welded with a smooth non-obstructing joint inside.

After the pipe has been installed in the casing pipe, inspected and tested, both ends of the cover pipe shall be sealed completely with concrete or and EPDM elastomeric membrane, in a manner acceptable to the Engineer.

5.10.1 JACK AND BORE CONSTRUCTION. All encasement pipes shall be installed at locations and to the line and grade as shown on the Plans. Encasement pipes shall be steel seamless pipe and shall be new material, with a minimum yield of 35,000 psi. All steel pipe shall conform to requirements of ASTM A53-B and A139. Pipe thickness shall be as follows:

Casing pipe size	min. thickness (under hwy)
14" & under	0.250"
16" to 22"	0.375"
24" to 36"	0.500"

All joints in the encasement pipe shall be welded. Weldings of the steel casing pipe shall be solidly butt-welded with a smooth non-obstructing joint inside and conform to all specifications as required by American Welding Society (AWS). The casing pipe shall be installed without bends. All welders shall be qualified as prescribed by AWS requirements.

Carrier pipes installed inside casing pipes shall be centered throughout the length of the casing pipe. This shall be accomplished by the installation of polyethylene pipeline spacers attached to the carrier pipe in such a manner as to prevent the dislodging of the spacers as the carrier pipe is pulled or pushed through the casing pipe. Spacers shall be of such dimensions to provide: full supportive load capacity of the pipe and contents; such thickness to allow installation and/or removal of the pipe; allowance of no greater than $\frac{1}{2}$ inch movement of the carrier pipe within the casing pipe after the pipes are installed. All pipe spacers shall be fastened and installed per manufacturer's specifications. They shall be located immediately behind each bell and at a maximum spacing dimension as follows:

Carrier Pipe Size	Maximum spacing
10" & under	7'
12" to 26"	10'

The materials and spacing to be used shall

The void between the carrier pipe and the steel casing pipe shall be thoroughly sealed by filling with a waterproofing bitumastic compound until a tight sealed is obtained. An ethylene propylene diene monomer (EPDM) elastomeric membrane shall be wrapped around the end of the encasement pipe in three layers and securely bound to the casing and carrier pipe barrel with stainless steel bands. The EPDM membrane shall be a minimum 0.045 inches thick and have a tear resistance of 125 pounds/inch. Spacers and end seals shall be as manufactured by Advance Products, Inc., PSI, or other approved equal.

The void between the carrier pipe and the steel casing pipe shall be grout filled if so directed by the Engineer.

5.11 WARNING TAPE. Warning tape shall meet the standards in Section 2.14. Warning tape shall be installed 18" above all direct buried force mains as the backfill progresses. The tape shall be installed in accordance with manufacturers recommendations. Tape splices shall be knotted in a manner to provide continuous coverage over the sewer pipe. The tape shall be placed in a manner such that trench backfill and settlement will not place significant tensile stress on the material.

5.12 TRACER WIRE AND MARKERS. Tracer wire shall meet the standards in Section 2.15. The Contractor/Developer shall install a trace wire along the entire force main system. The tracer shall be continuous along the main with no gaps, breaks or open circuits. The insulated copper wire shall be installed along the top elevation of the pipe, secured with duct tape, at a maximum spacing of six (6) foot intervals, with the wires strung straight, but not taut. The wire shall be brought to the surface inside a one (1) inch PVC conduit, at each terminus point, any valve structure and any air release valve structure. Said conduit shall be on the outside of the structure and care shall be taken to assure that the conduit is resting against the structure during backfill procedures.

Splices in the tracer wire shall provide a positive, secure connection and shall be protected by wrapping with electrical tape, approved electrical connector or electrical sealing compound. The wire shall be loosely strung and shall not be pulled taut. All tracer wire shall be tested for continuity by the Contractor/Developer in the presence of an RWRA representative, and shall satisfactorily convey electrical signal.

Force Main Markers will be provided by RWRA. They shall be installed by the Contractor/Developer as directed by RWRA.

5.13 MANHOLES. Manholes shall be installed at the end of each line; at all changes in grade, size or alignment; at all intersections; and at distances not greater than 500 feet for collector sewers and 600 feet for interceptors. Sanitary manholes shall be constructed of precast concrete (see Std. Drawing Exhibit 5.2SD) and shall be of the form and dimensions as shown on the approved plans. They shall be constructed of 4000 psi concrete. Cast in place manhole bases shall be a minimum 3500 psi concrete. All precast manhole adjustment rings, cones, flat slabtops, barrel sections and bases shall conform to the requirements of ASTM C 478. All structure shall be designed to handle HS-

20 loading. All cone and transition sections shall be eccentric in shape. Base and riser sections shall be custom-made with openings to meet indicated pipe alignment conditions. The maximum size pipe allowed in a given sized manhole shall be as follows. 24" pipe in four (4) foot diameter structure, 36" pipe in five (5) foot diameter, 48" in six (6) foot diameter. Outside diameter may be considered on a case-by-case basis for other pipe materials. The minimum distance allowed between precast holes for the pipes shall be 12 inches, or $\frac{1}{2}$ the outside diameter, whichever is larger.

Openings in precast structures for pipes shall be the outside diameter of the pipe plus a maximum of six (6) inches. In order to use non-shrink grout, the opening shall be the outside diameter of the pipe plus three (3) inches. (Outside diameter of pipe plus 4 $\frac{1}{2}$ inches is permissible when tapered hole forms are utilized).

Openings around the pipe in precast structures shall either be filled with non-shrink grout for the wall thickness of the structure or the pipe shall be encased with minimum six (6) inch collar of concrete from the inside face of the wall to 1'0" outside the outer face of the wall. The pipe shall be adequately supported to prevent settling while the grout or the concrete encasement is setting up. The inside faces of the structure walls shall be finished with a trowel and wet brush finish.

5.13.1 Standard Manholes. The standard manhole shall be six feet or less in depth, measured from the base of the cover frame to the manhole downstream invert and shall be of cone type, top construction as shown on Std. Drawing Exhibit 5.2SD.

5.13.2 Shallow Manholes. The shallow manholes shall be five feet or less in depth, measured from the base of the cover frame to the manhole downstream invert and shall be of flat top construction as shown on Std. Drawing Exhibit 5.2SD.

5.13.3 Manhole Inverts over existing sewers. Manhole inverts shall be formed from 3500 psi concrete as shown on Exhibit 5.2SD. Inverts for a "straight-through" manhole shall be formed by laying the pipe straight through the manhole, pouring the concrete invert, and then cutting out the top half of the pipe. Curved invert shall be constructed of concrete, as shown, and shall form a smooth, even half-pipe section as shown. The inverts shall be constructed when the manhole is being built using prefabricated forms. The excavation shall be kept free of water while the manhole is being constructed

and the manhole shall not be backfilled until inspected by the Engineer.

5.13.4 Manhole Frames and Lids. Manhole castings shall consist of cast iron frames and 22-3/4 inch diameter covers, weighing not less than 300 pounds per frame and cover, rated for traffic, dimensioned as shown on the plans. Manhole lids must sit neatly in the rings, with contact edges machined for even bearing and tops flush with ring edge. They shall have sufficient corrugations to prevent slipperiness. Lids on sanitary sewer manholes must not be perforated. Lids shall be bolt-down or supplied with an approved diaphragm as may be warranted when surface flooding is a potential. Castings shall meet the requirements for ASTM A 48.

5.13.5 Watertight Sewer Pipe Connections. Watertight sewer pipe connections shall be elastomeric gaskets or couplings, manufactured in accordance with ASTM C 923, Standard Specification for resilient connectors between reinforced concrete manhole structures and pipes, and shall be on RWRA's list of approved materials.

5.13.6 Joint Sealants. Joint seals shall be either Type A Rubber Gaskets or Forsheda Rubber gaskets. They shall meet the requirements of AASHTO M 198. Bituminous mastic joint sealing material is allowed only if it is a one (1) inch molded mastic compound.

5.13.7 Manhole Concrete Sealants. When required by the engineer, manhole sealants shall be used in accordance with the manufacturer's recommendations and by one of the two following methods.

Method #1: The manhole manufacturer shall give written conformation that all reinforced precast concrete manhole sections contain corrosion resistant admixture. Xypex Admix C-1000 (with dye) or approved equal concrete waterproofing admix shall be added to the concrete during the batching operation. Admixture shall be used per manufacturer's specifications and Engineer's approval.

Method #2: Before assembly, the entire outer surface of the manhole, including the underside of the manhole base, shall receive a minimum of two coats of FARBERTITE (IPA Systems, Inc.), or approved equal, in accordance with manufacturer's application instructions. After assembly (sealing all joints between manhole sections and plugging all lift holes as indicated above), Contractor shall apply a minimum of two coats of DRYCON (IPA Systems, Inc.), or approved equal, to

the entire manhole interior in accordance with manufacturer's mixing and application instructions.

5.13.8 Drops into Standard Manholes. Pipe entries into manholes shall be brought in at the invert or top of shelf where feasible. Drop assemblies are required to smoothly transition flows for all drops of two (2) feet or greater. Drops of less than two (2) feet are not allowed unless specifically approved by the Engineer. When internal or external drop assemblies are necessary, precast external drop manholes shall be preferred. Internal drops are not allowed when the size of the pipe to be dropped is greater than 12" diameter. All manhole structures employing inside drop connections for service connections or collector sewers shall utilize the (RELINER) Inside drop bowl (or approved equal). Bowl size shall be determined by incoming pipe size and flow rate. The connection of the stack pipe to the drop bowl shall be by flexible external pipe coupler (FERNCO). The drop pipe shall be securely attached to the manhole using stainless steel fasteners. Bracket spacing shall be 4' max (2 minimum with the first one being directly below bowl or tee fitting). The turn-out at the base shall be with an appropriately angled PVC pipe elbow. All support hardware, including bolts, shall be stainless steel. See Exhibit 5-10.

5.14 BUILDING CONNECTIONS. In both separate and combined sewer systems, building sanitary laterals shall be run to the right-of-way or easement free of any intrusion of storm water flows (i.e. roof drains, foundation drains, yard drains, groundwater, and geothermal systems). The effort shall be made to daylight all storm flows and to allow for surface storage and/or ground absorption of all storm flows whenever possible. In combined sewer systems the effort shall also be made to keep the sanitary and storm systems separate where possible to facilitate the future separation of the systems.

Tee-wye's shall be installed (with the flow) on the collector sewers for all house or building connections at locations established by the developer's Engineer. At least one connection shall be provided for each platted lot. The Contractor shall lay the connection lines from this point to the property line, or easement line.

Each separate dwelling structure, commercial building or industrial building shall be provided with a separate sewer connection. Such connections shall be PVC plastic pipe or Ductile Iron pipe. All connections that service single-family dwellings shall be not less than four (4) inch diameter pipe. All connections that serve multi-family dwellings, commercial buildings and industrial buildings

shall be not less than six (6) inches diameter pipe. Trenching, pipe laying, joints and backfilling shall conform to the requirements set out herein. All open ends shall be sealed with PVC or compression joints compatible with the pipe bell.

For shallow sewers in rock or earth trench, the tee-wyes shall be encased entirely with crushed stone and fully compacted. The pipe shall be laid on a uniform slope from the tee without the use of bends.

For deep sewers in earth, the tee-wyes shall be encased entirely with crushed stone as above. House connection pipe in this case shall be appropriate extra strength sewer pipe from the tee branch to the property line. The pipe shall be laid on a uniform grade from the tee branch to the right-of-way to meet the probable building sewer grade (at a max of 45° incline).

For deep sewers in rock, the tees shall be encased entirely with Class "B" concrete. House connection pipe in this case shall be appropriate extra strength sewer pipe, as shown on the drawings extending from the tee to the property line. The pipe shall be laid on a uniform grade from the tee branch to the right-of-way to meet the probable building sewer grade.

Under normal conditions, where elevations are not critical, house connection pipes shall be laid on a slope of not less than one foot per 100 feet (approximately 1/8-inch per foot).

The tapping of house connections into manholes on the newly constructed sewers will not be permitted, except at the end of the collector lines where necessary or required by the Engineer. Where it is necessary to do so, the invert of the house connection shall not be higher than a point three inches below the top of the bench in the manhole and suitable trough shall be provided in the bench to prevent the accumulation of solids on the bench. If necessary, a standard drop connection shall be provided for a house service that is tapped into a manhole.

The installation of house connections shall follow immediately or be concurrent with the construction of the main sewer. This method of construction will permit more advantageous handling of backfilling and will also avoid possible damage to the main sewer by subsequent exposure for connection of the service lines.

5.15 CONNECTIONS TO EXISTING LINES. Connection to existing gravity sewer lines shall be made where indicated on the plans. The connection shall be made

to the main by installing a proper saddle and tee/wye, or constructing a new manhole at the connection. The proper saddle shall include a gasket and stainless steel clamps. If constructing a new manhole, the invert channel shall be formed around the existing sewer line and the top half of the existing sewer line shall be cut away to form the invert channel of the existing line and to accept the invert channel of the new line.

5.16 REMOVAL AND REPLACEMENT OF EXISTING FACILITIES

5.16.1 Sidewalks. See section 9.1.

5.16.2 Pavement. See section 9.2.

5.16.3 Curb and Gutter. See section 9.3.

5.17 CONCRETE CRADLE, ANCHORS, CAPS OR ENCASEMENT. Concrete cradle, anchors, cap or encasement of sewer lines and/or fittings shall be placed where shown on the plans, required by the specifications, or as directed by the Engineer. Concrete shall be Class "B" and shall be mixed sufficiently wet to permit it to flow under the pipe to form a continuous bed. In tamping concrete, care shall be taken not to disturb the grade or line of the pipe or injure the joints. Measures shall be taken to avoid flotation of PVC pipe.

See Std. Drawing Exhibit 5.1 SD.

5.17.1 CONCRETE CAP. Where shown on the Plans or where a sanitary sewer pipe will have less than two (2) feet of vertical clearance below an existing or proposed storm drain, or utility conduit, a concrete cap shall be installed unless the pipe itself is proven to RWRA to have adequate strength. The length of the concrete cap shall be as shown on the Plans or two (2) feet beyond the outside edge of the storm drain or utility conduit, or two (2) feet beyond the point where the sewer pipe attains 30 inches of cover in an easement or four (4) feet of cover in a right-of-way, or surfaces subject to vehicular traffic, or as directed by RWRA. The sewer pipe shall be laid and supported on uniform crushed stone bedding to the top of the pipe, and concrete shall be placed over the pipe to a thickness of at least six (6) inches for the full trench width.

5.17.2 CONCRETE ENCASEMENT. Where shown on the Plans or where conditions exist requiring additional pipe protection (stream crossings, ditch crossings, shallow trench or poor soil conditions), pipes shall be encased in concrete, as determined by RWRA. The length of the concrete encasement shall be at least two (2) feet beyond the point where additional pipe protection is required, as shown on the Plans, or as directed by RWRA. The sanitary sewer or

storm drainage pipe shall be laid and supported as required for a concrete for a concrete cradle, and concrete shall be placed around the pipe six (6) inches either side of it and up to at least six (6) inches over the top of the pipe. Proper bracing of the pipe shall be provided to prevent movement or flotation of the sewer pipe during placing of concrete. In rock-bottom streams, the encasement shall extend from 6 inches below the pipe up to the original rock level, unless otherwise shown on the Plans. Encasement shall be required when crossing a blue line stream and shall extend to five (5) feet beyond the top of bank on each side of said stream. Concrete encasement is required for plastic pipe with less than 30 inches of cover in easements and less than four (4) feet of cover in street rights-of-way.

5.18 SAFELOADING. Safeloading shall consist of completely filling the designated areas with grout in such a manner to make them safe from collapse or at the Contractor's option, safeloading may be done by filling the designated area with free-flowing low strength mortar. Appreciable deposits of debris shall be removed from other structures prior to safeloading. The ends of existing culverts shall be plugged by use of bulkheads containing small openings at the tops through which the grout may be pumped at a minimum pressure of 15 pounds per square inch. All structures to be safeloaded shall be completely filled with grout or low strength mortar.

5.19 FLOWABLE FILL. Flowable fill is a low strength mixture consisting of Portland cement, sand, class F fly ash, water and other materials as approved by the Engineer. Flowable fill has a density between 115 .b/cf and 130lb/cf and is of a consistency that will flow under and around pipe. Flowablefill does not require compaction, finishing, or curing and will not settle after hardening occurs. It is ideal for use in restricted areas where placing and compacting fill material is difficult and where traffic cannot be delayed for a long period. When used to backfill aluminum pipe, and approved means of separation shall be provided, such as bituminous coating.

To expedite settlement and hardening of the flowable fill, bleed water shall appear on the surface within five (5) to 10 minutes after placement. The release of water by bleeding caused the solid particles to realign into intimate contact and the mixture becomes firm. A delay in bleeding indicates there are too many fines in the mixture or insufficient water. If the maximum water was added, the fly ash quantity shall be reduced in increments of 50 lbs. until the mixture is bleeding feely. Approximately 60 lbs. of sand shall be added to replace each 50 lbs. increment of fly ash to maintain the original yield. If two increment reductions, 100 lbs., do not promote free bleeding of the

mixture, other possible remedies shall be evaluated. The flowable fill is too dry when cracks develop as it flows into place.

A set of test cylinders shall be cast for each 300 cubic yards of flowable fill. Cylinders shall not be rodded, but the sides of the mold shall be tapped lightly. The test cylinders shall be allowed to bleed for about 30 minutes, refilled, and then covered with a sheet of tough durable impervious plastic or cylinder lid. Plastic shall be secured in place around the mold, within one inch of the top, with a rubber band or string prior to covering the lid with wet burlap. The burlap shall be removed after 34 hours and the cylinder cured at 60 degrees Fahrenheit to 90 degrees Fahrenheit, in the shade, until 28 days old. The plastic covering and mold shall then be removed and the compressive strength test shall be performed. The average of the 28 days compressive strength tests shall be 50 psi to 100 psi. This strength range will provide the optimum balance of adequate cohesion while allowing ease of subsequent removal, if necessary.

5.20 LOCATING NEAR WATER MAINS

5.18.1 Horizontal Separation. Whenever possible, sewers should be laid at least 10 feet, horizontally, from any existing or proposed water main (edge to edge). Should local conditions not allow a lateral separation of 10 feet, a sewer may be laid closer than 10 feet to the water main if:

- a. It is laid in a separate trench or the same trench with the water mains located at one side on a bench of undisturbed earth.
- b. The elevation of the crown of the sewer is at least 18 inches below the invert of the water main.

5.20.2 Crossings. Sewers crossing water mains shall be laid to provide a minimum vertical distance of 18 inches between the outside of the water main and the outside of the sewer. The crossing shall be arranged so that the sewer joints will be equidistant and as far as possible from the water main joints. Where a water main crosses under a sewer, adequate structural support shall be provided for the sewer to maintain line and grade.

When it is not possible to obtain proper horizontal and vertical separation as stipulated above, the sewer shall be designed and constructed equal to water pipe and pressure tested at 150 psi to assure water tightness prior to backfilling. The pressure pipe shall extend a minimum of 10 feet in each direction from the crossing and be

properly connected with an approved manufactured fitting or mechanical joint. The sanitary sewer line or the lower of the two utilities shall be encased in concrete or capped as determined appropriate by the Engineer. The encasement or capping shall extend for 10 feet on both sides of the crossing, measured perpendicular to the water main.

5.21 BASEMENTS AND OTHER STRUCTURES BELOW GRADE.

Buildings with any floor level(s) below surrounding ground level, that are connected to the public sewer system are potentially subject to sewer system backup into these floor levels. Therefore, all sanitary sewage lines that will be connected to the sanitary or combined sewer systems must be at an elevation to prohibit sewage backup into the building. This may be accomplished in one of two ways: 1) The building sewer may be installed as a gravity section if the nearest manhole casting downstream is one foot or more lower than the lowest floor level of the building intended to get sewer service, and is certified by a licensed PE/LS to accomplish this; or 2) A sewage ejector pump system may be installed in a manner that allows the discharge line to reach an elevation that assures no backup potential from the sewer system (commonly brought up to just below first floor elevation before dropping back down into the building's sanitary lateral). Sanitary laterals shall not be run at excessive depths that would allow for basement plumbing to gravity to the main.

Only sanitary sewage is allowed to be discharged into the public sewer system. Sanitary sewage does not include any flows from roof drains, foundation drains, yard drains, groundwater sump drains or any other non-wastewater facilities constructed to control the movement of stormwater and/or groundwater. Discharge of any such flows into the building lateral or into any other location that ultimately feeds into the public sewer system is prohibited. See also Section 8.5 for additional information relating to allowed discharge locations for roof drains and foundation drains.

5.22 BUILDING DEMOLITION. During the demolition of any building that has sewer service, the Contractor shall be responsible for locating the tap at the right-of-way or easement line and installing a proper cap on the end of the tap to the public line. Contractor shall comply with permitting and inspection requirements of the Engineer. Expenses incurred by the sanitary sewer service provider shall be assessed to the demolition contractor for failure to properly notify agency for cap inspection.

5.23 GREASE INTERCEPTORS/ GREASE TRAPS / OIL SEPARATORS / MONITORING MANHOLES.

Requirements for these facilities shall be as required in the Wastewater System User Regulations, Kentucky Plumbing code and policies of the Regional Water Resource Agency.

Restaurants/ food service facilities with more than two (2) compartment sink are required to install a minimum 1,000 gallon capacity external grease interceptor. External, 1,000 gallon oil separators are required for all service stations, car washes and commercial garages with floor drains.

Monitoring/sampling manholes are required for industrial/commercial discharges unless the requirement is waived by the Engineer.

5.24 FUTURE SEWER CONNECTIONS. When areas adjacent to a proposed development can best be served by sewers through the proposed development, the engineer may require that the developer extend sewer service to the far property line of a development or may require easement be established that would serve the adjacent area.

5.25 REPLACEMENT OF EXISTING MAILBOXES, CULVERTS AND OTHER SUCH FACILITIES.

Existing mail boxes, drainage culverts and the like shall not be disturbed unless necessary, in which case, they shall be replaced in as good condition as found as quickly as possible. Existing materials shall be re-used in replacing such facilities when materials have not been damaged by the Contractor's operations. Existing facilities damaged by the Contractor's operation shall be replaced with new materials of the same type at the Contractor's expense.

5.26 CLEAN-UP. Upon completion of the installation of the sewer pipes and appurtenances, the Contractor shall remove all debris and surplus construction materials resulting from the work. The Contractor shall grade the ground along each side of the pipe trench in a uniform and neat manner leaving the construction area in a shape as near as possible to the original ground line.

5.27 SEEDING AND SODDING. Requirements shall be accomplished in accordance with the specifications as outlined in Chapter 10 hereinafter.

TOP SLAB REQD. WHEN
MANHOLE IS LESS THAN
4-1/2' TOTAL HEIGHT
(SEE KYP-120)

BUTYL SEALANT
OR GASKETED
PER ASTM C-443

AGGREGATE TO BE PLACED
IN ENTIRE EXCAVATED AREA OF
MANHOLE, AND SHALL BE PLACED UP TO
A POINT 4" ABOVE TOP OF SEWER PIPE.

1" MIN. FALL TO CHANNEL

1/3 PIPE DIA.

2/3 PIPE DIA.

MIN. 8"

12" CENTERS

STEPS

CONICAL SECTIONS
24", 30", 32", 36"

BARREL SECTIONS
12"-72"

4-1/2"

BASE SECTIONS
48" MAX. HT.
(AS REQD.)

4'-10" DIA.

SECTION VIEW

PROVIDE 6" MIN. DGA OR
57's TO VIRGIN DIRT.

NOTES:
CONCRETE TO CONFORM TO ASTM
C-478 STANDARDS
2" MIN. CONCRETE COVER
RESILIENT CONNECTORS MEET ASTM C-923
MEETS OR EXCEEDS ASTM C-478
#5 REBAR @ 12" C.C. EA. WAY IN BASE SLAB
WEIGHT: BASE - 4,350lbs. (30" HT.)
RISER - 850lbs./vert.ft.
CONICAL - VARIES

BOOT KORN SEAL OR EQUAL REQ'D
IN THE EVENT OF UNSTABLE, WET OR PUMPING
SUBGRADE USE DRY MIX CONCRETE BEDDING
OR AS OTHERWISE DIRECTED BY THE ENGINEER.
LEVEL AND TAMP BEDDING MATERIAL PRIOR
TO PLACING MANHOLE BASE SECTION
PROVIDE ELASTOMERIC MANHOLE BOOT/WATERSTOP
AT EACH MANHOLE OPENING. APPROVED WATERSTOPS INCLUDE:
A: PSX, A-LOCK GASKET OR DURA-SEAL CAST IN PLACE
B: KORN-N-SEAL AND FLEX BOOT COMPRESSION GASKET

OWENSBORO METROPOLITAN
PUBLIC IMPROVEMENT SPECIFICATIONS

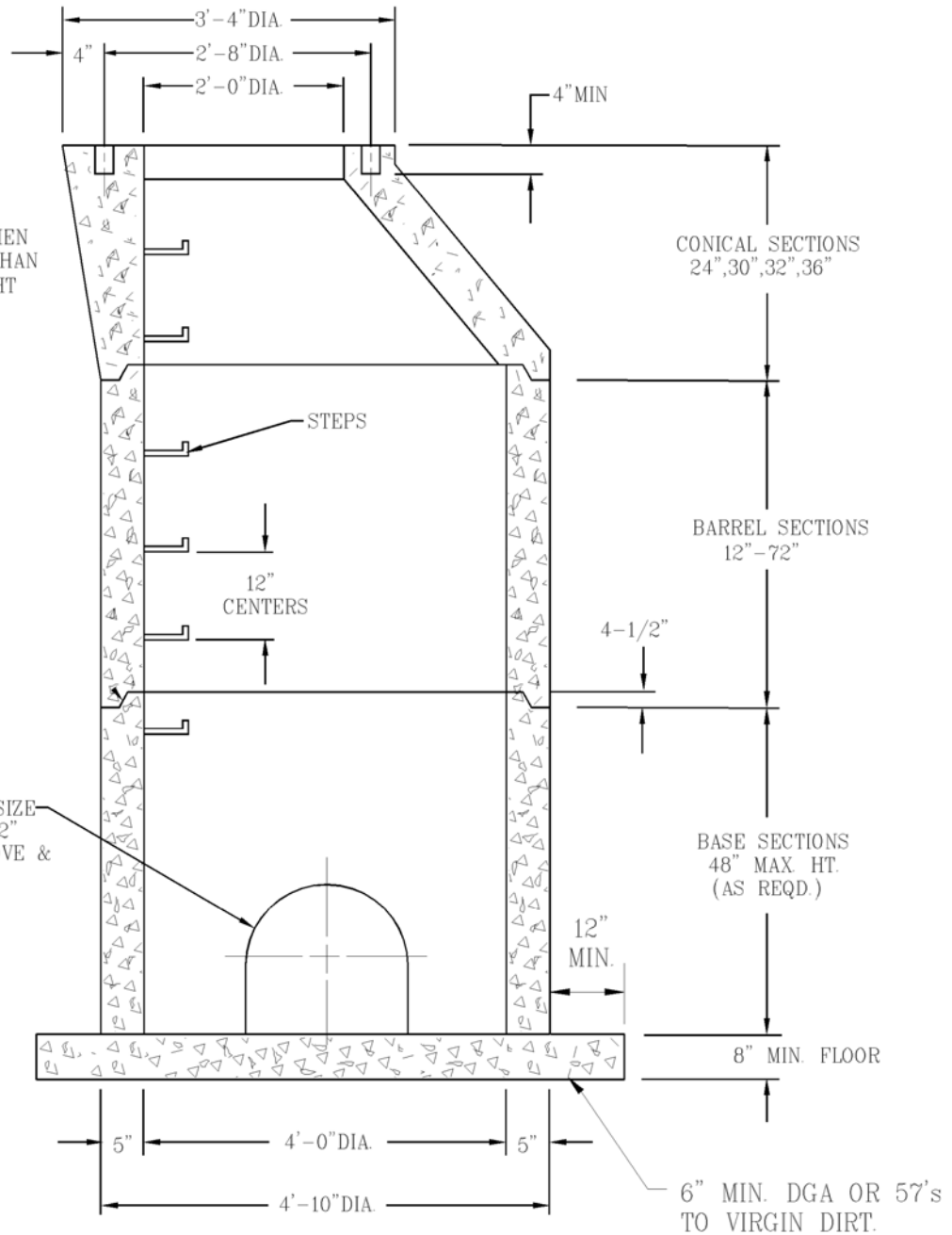
CHAPTER 5
SANITARY SEWERS

4'-0" DIA. MANHOLE W/ DEVELOPED BASE
DETAIL SHEET

EXHIBIT NO. 5-1
NOT TO SCALE

TOP SLAB REQD. WHEN
MANHOLE IS LESS THAN
4-1/2' TOTAL HEIGHT
(SEE KYP-120)

PIPE OPENING SIZE
AS REQ'D. MIN 2"
CLEARANCE ABOVE &
SIDE PIPE.



NOTES:
CONCRETE TO CONFORM TO ASTM
C-478 STANDARDS
2" MIN. CONCRETE COVER
MEETS OR EXCEEDS ASTM C-478
WEIGHT: BASE - 850lbs./vert.ft.
RISER - 850lbs./vert.ft.
CONICAL - VARIES
FERNCO WATERSTOP OR EQUAL REQ'D

SECTION VIEW

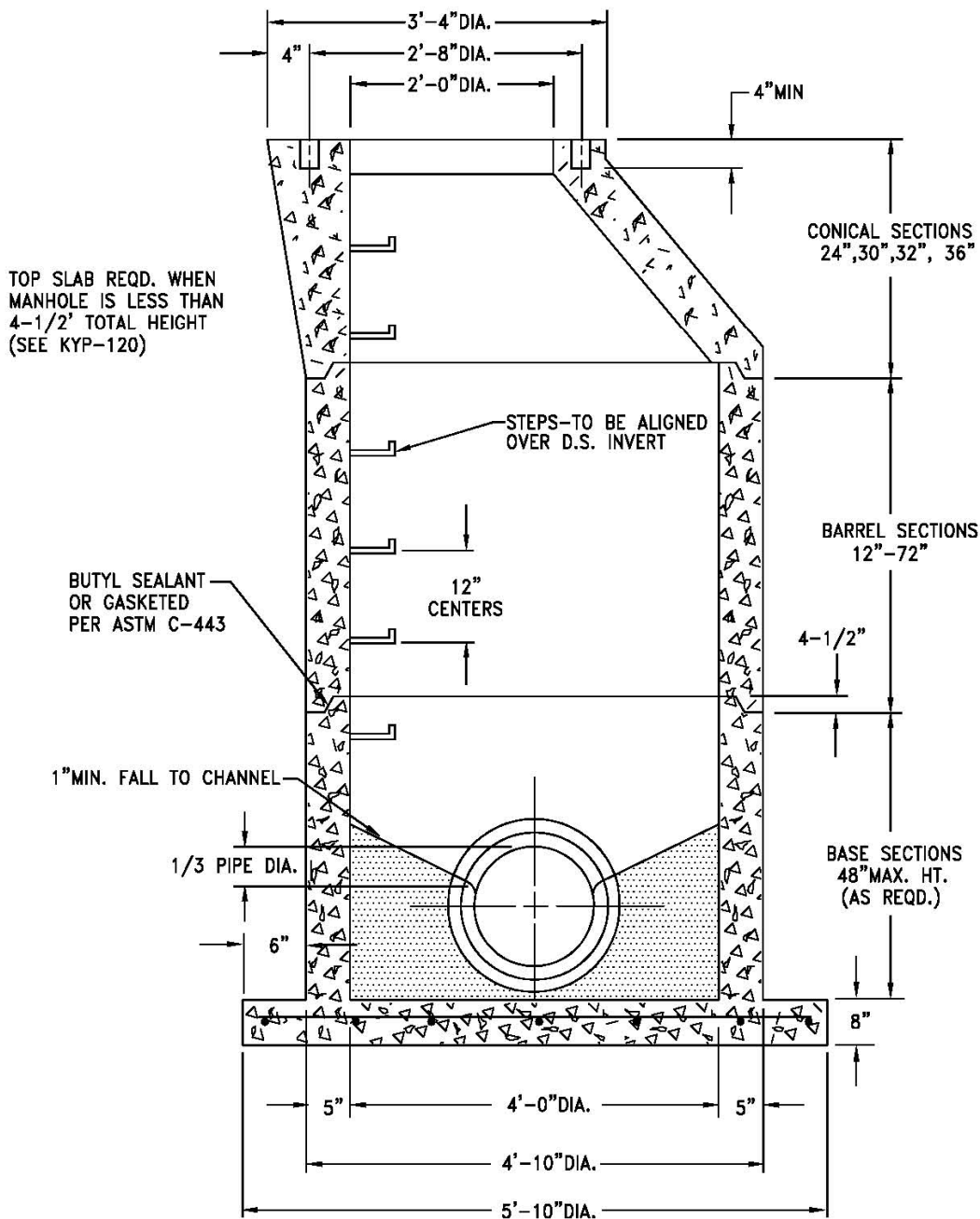
OWENSBORO METROPOLITAN
PUBLIC IMPROVEMENT SPECIFICATIONS

CHAPTER 5
SANITARY SEWERS

4'-0" DIA. OPEN BOTTOM MANHOLE
DETAIL SHEET

EXHIBIT NO. 5-2

NOT TO SCALE



SECTION VIEW

NOTES:
 CONCRETE TO CONFORM TO ASTM C-478 STANDARDS
 2" MIN. CONCRETE COVER
 RESILIENT CONNECTORS MEET ASTM C-923
 #5 REBAR @ 12" C.C. EA. WAY IN BASE SLAB
 WEIGHT: BASE - 5,530 lbs. max
 RISER - 850 lbs./vert.ft.
 CONICAL - VARIES

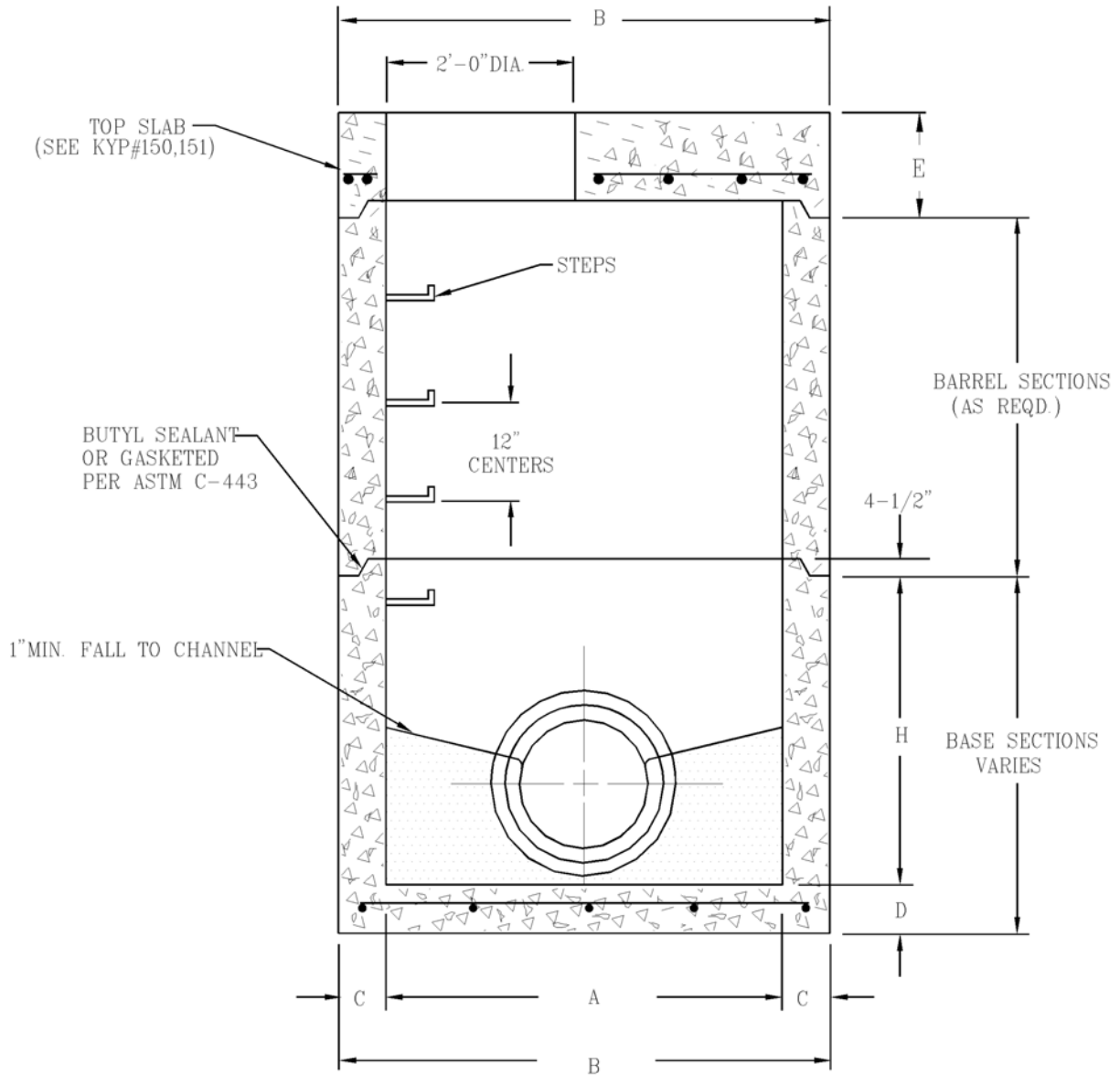
FLANGED BASE MANHOLE TO BE USED ON SEWERS
 12' DEEP OR MORE OR AS DIRECTED BY ENGINEER

OWENSBORO METROPOLITAN
 PUBLIC IMPROVEMENT SPECIFICATIONS

CHAPTER 5
 SANITARY SEWERS

4'-0" DIA. FLANGED BASE MANHOLE W/ INVERT
 DETAIL SHEET

EXHIBIT NO. 5-3
 NOT TO SCALE



SECTION VIEW

DIMENSIONS							WEIGHTS		
DIA.	A	B	C	D	E	H	BASE	RISER/vert.ft	TOP SLAB
4'-0"	4'-0"	5'-0"	5"	8"	12"	30"	4350lbs.		
5'-0"	5'-0"	6'-0"	6"	8"	13"	48"	8,860lbs.	1,300lbs.	2,825lbs.
6'-0"	6'-0"	7'-2"	7"	8"	14"	48"	15,000lbs.	1,800lbs.	4,500lbs.
8'-0"	8'-0"	9'-6"	9"	10"	15"	72"	30,000lbs.	3,100lbs.	8,435lbs.
10'-0"	10'-0"	11'-10"	11"	12"	17"	72"	56,508lbs.	4,368lbs.	15,000lbs.

NOTES:
 CONCRETE TO CONFORM TO ASTM
 C-478 STANDARDS
 2" MIN. CONCRETE COVER
 RESILIENT CONNECTORS MEET ASTM C-923
 MEETS OR EXCEEDS ASTM C-478
 #5 REBAR @ 12" C.C. EA. WAY IN BASE SLAB

OWENSBORO METROPOLITAN
 PUBLIC IMPROVEMENT SPECIFICATIONS

CHAPTER 5
 SANITARY SEWERS

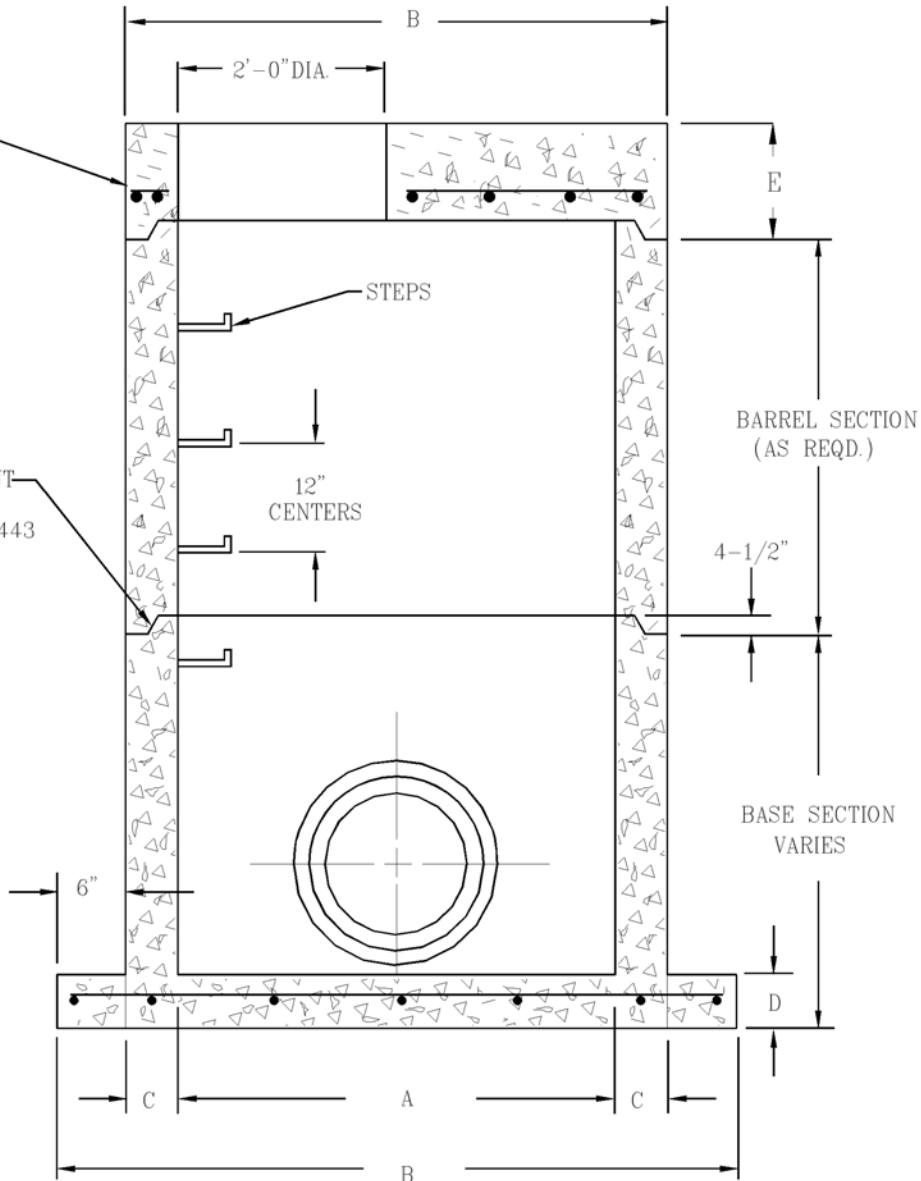
4'-10' DIA. MANHOLES W/ INVERTS
 DETAIL SHEET

EXHIBIT NO. 5-4

NOT TO SCALE

TOP SLAB
(SEE KYP#150,151)

BUTYL SEALANT
OR GASKETED
PER ASTM C-443



SECTION VIEW

DIMENSIONS						WEIGHTS		
DIA	A	B	C	D	E	BASE	RISER/vert. ft	TOP SLAB
5'-0"	5'-0"	7'-0"	6"	8"	13"	7,540lbs.	1,300lbs.	2,825lbs.
6'-0"	6'-0"	8'-2"	7"	8"	14"	14,994lbs.	1,800lbs.	4,500lbs.
8'-0"	8'-0"	10'-6"	9"	10"	15"	27,098lbs.	3,100lbs.	8,435lbs.
10'-0"	10'-0"	11'-10"	11"	12"	17"	41,613lbs.	4,368lbs.	15,000lbs.

NOTES:
CONCRETE TO CONFORM TO ASTM
C-478 STANDARDS
2" MIN. CONCRETE COVER
RESILIENT CONNECTORS MEET ASTM C-923
MEETS OR EXCEEDS ASTM C-478
#5 REBAR @ 12" C.C. EA. WAY IN BASE SLAB

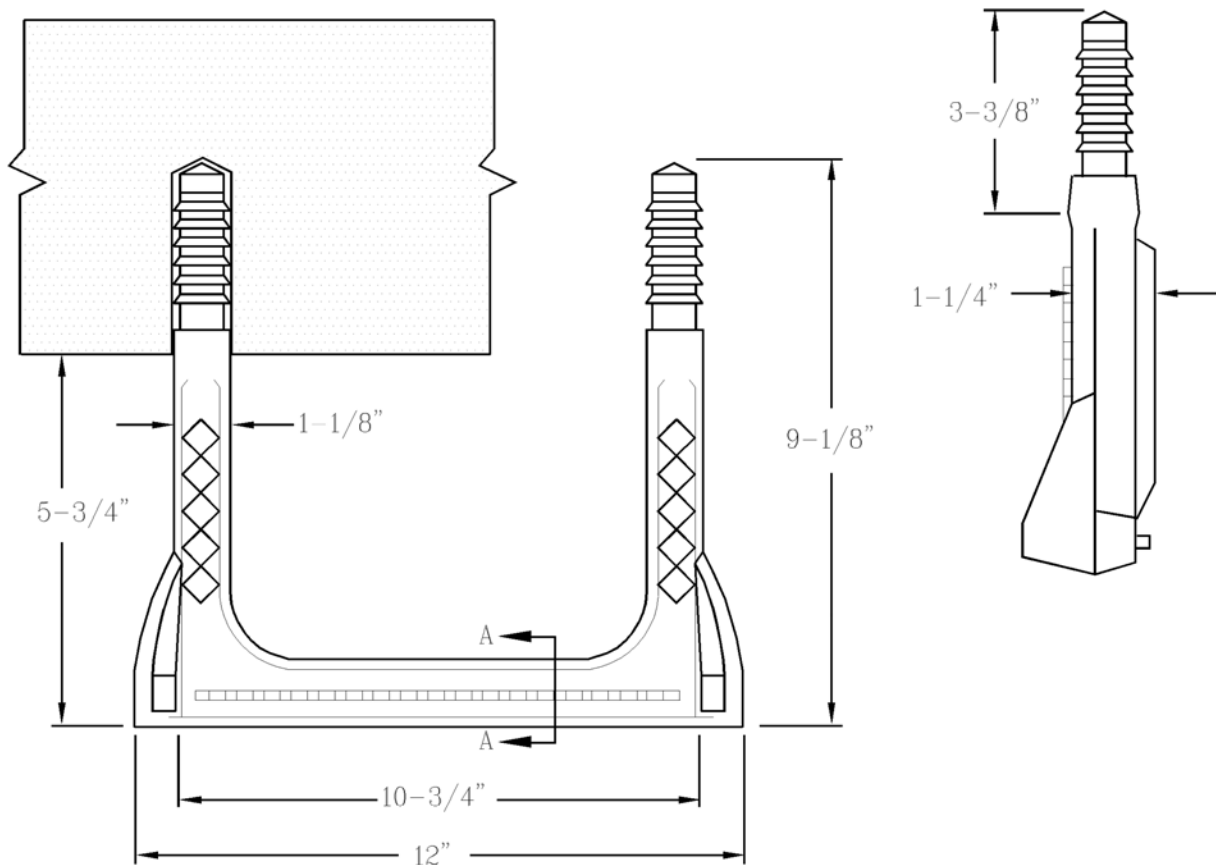
OWENSBORO METROPOLITAN
PUBLIC IMPROVEMENT SPECIFICATIONS

CHAPTER 5
SANITARY SEWERS

5'-10' DIA. FLANGED BASE MANHOLES
DETAIL SHEET

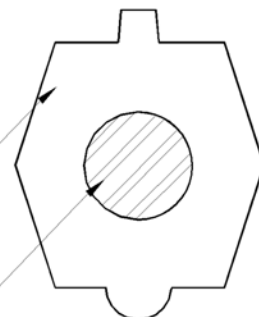
EXHIBIT NO. 5-5

NOT TO SCALE



COPOLYMER POLYPROPYLENE
PLASTIC

#4 REBAR (GRADE 60)



SECTION A-A

NOTES:

STEPS TO BE INSTALLED IN TAPERED
HOLE FORMED OR DRILLED IN CONCRETE
STEP IS MANUFACTURED BY M.A. INDUSTRIES, INC.

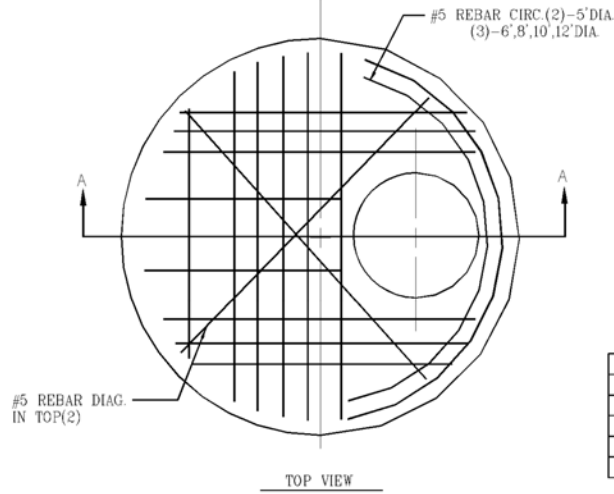
OWENSBORO METROPOLITAN
PUBLIC IMPROVEMENT SPECIFICATIONS

CHAPTER 5
SANITARY SEWERS

PLASTIC MANHOLE STEPS
DETAIL SHEET

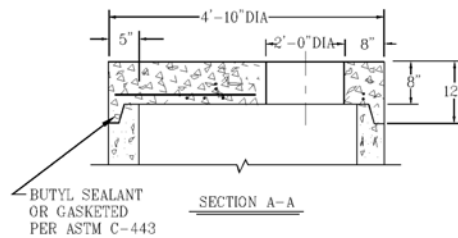
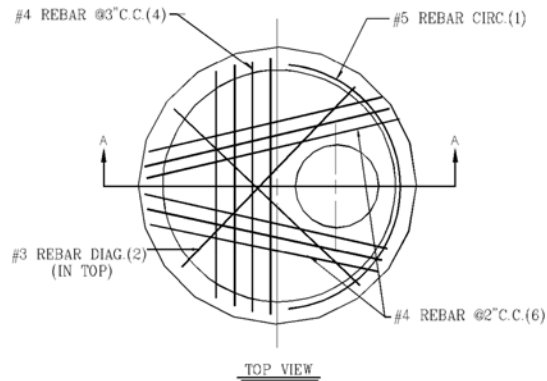
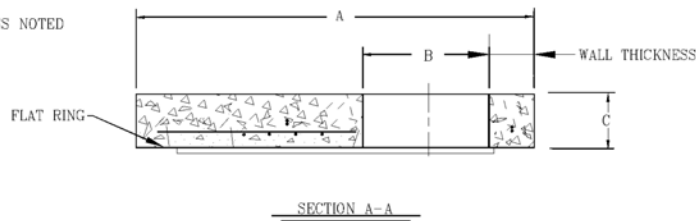
EXHIBIT NO. 5-6

NOT TO SCALE



DIA.	A	B	C	WEIGHT
5'-0"	6'-0"	2'-0"	9"	2,825 lbs.
6'-0"	7'-2"	2'-0"	10"	4,500 lbs.
8'-0"	9'-6"	2'-0"	10"	8,435 lbs.
10'-0"	11'-10"	2'-0"	12"	15,000 lbs.
12'-0"	14'-0"	2'-0"	12"	18,600 lbs.

NOTES:
CONCRETE TO CONFORM TO ASTM
C-478 STANDARDS
2" MIN. CONCRETE COVER
MEETS OR EXCEEDS ASTM C-478
#5 REBAR 12" C.C. EA. WAY UNLESS NOTED



12" THK. TOP SLAB
STANDARD 4'

NOTES:
CONCRETE TO CONFORM TO ASTM
C-478 STANDARDS
2" MIN. CONCRETE COVER
MEETS OR EXCEEDS ASTM C-478
WEIGHT: 7'-1,500 lbs.
8'-1,500 lbs.
12'-1,660 lbs.

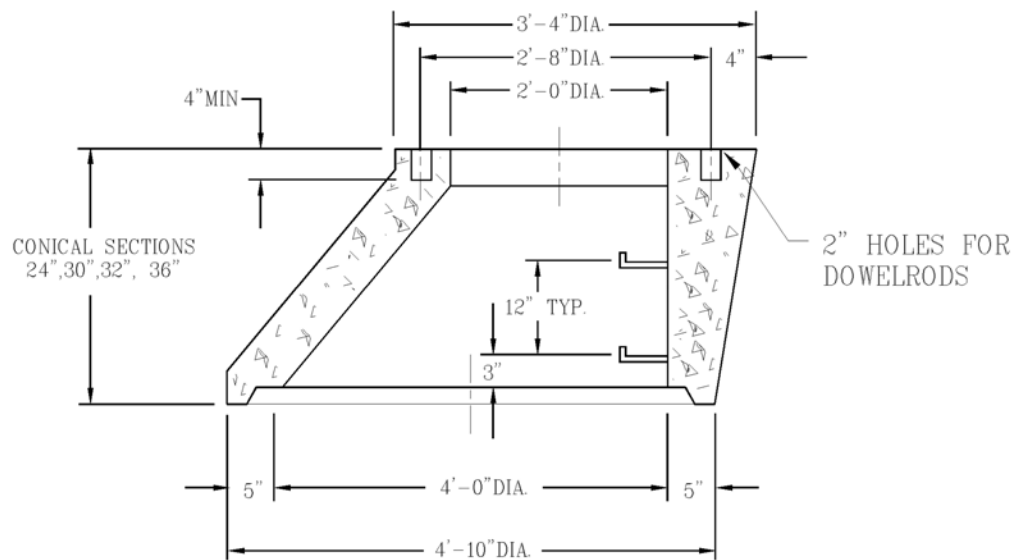
OWENSBORO METROPOLITAN
PUBLIC IMPROVEMENT SPECIFICATIONS

CHAPTER 5
SANITARY SEWERS

4'-12' DIAMETER FLAT TOP SLABS
DETAIL SHEET

EXHIBIT NO. 5-7

NOT TO SCALE



SIDE VIEW SECTION

WEIGHT: 24" - 1,525lbs.
 30" - 1,860lbs.
 32" - 1,985lbs.
 36" - 2,440lbs.

NOTES:
 CONCRETE TO CONFORM TO ASTM
 C-478 STANDARDS

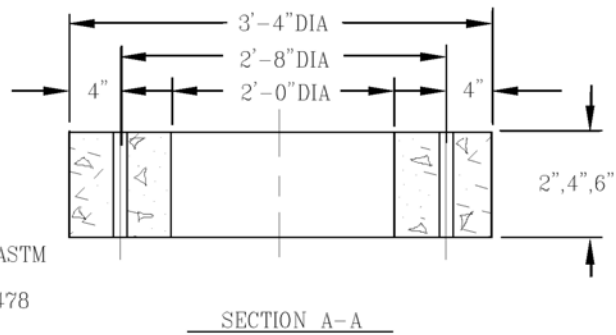
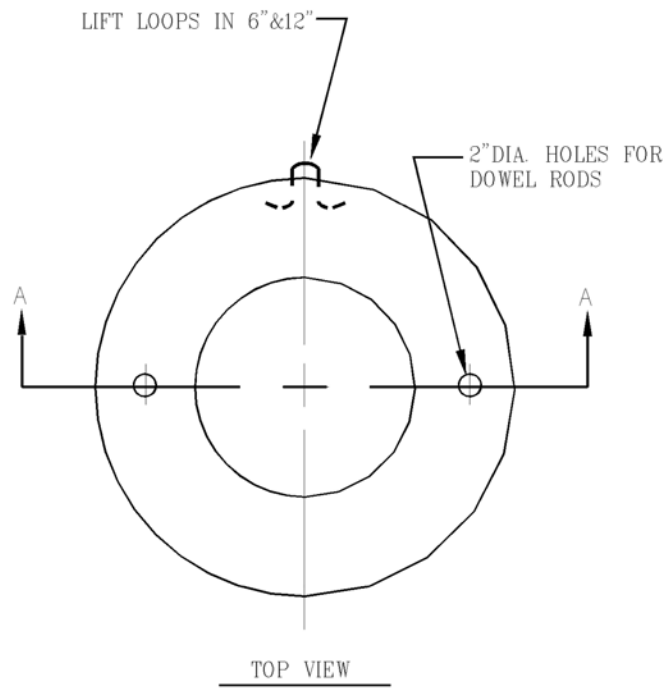
OWENSBORO METROPOLITAN
 PUBLIC IMPROVEMENT SPECIFICATIONS

CHAPTER 5
 SANITARY SEWERS

4'-0" DIA. ECCENTRIC CONICALS
 DETAIL SHEET

EXHIBIT NO. 5-8

NOT TO SCALE



NOTES:
 CONCRETE TO CONFORM TO ASTM
 C-478 STANDARDS
 MEETS OR EXCEEDS ASTM-C478
 STEP NOT REQD. FOR 3"-6"
 GRADE RINGS
 WEIGHT: 3"-210lbs.
 6"-420lbs.
 12"-840lbs.

OWENSBORO METROPOLITAN
 PUBLIC IMPROVEMENT SPECIFICATIONS

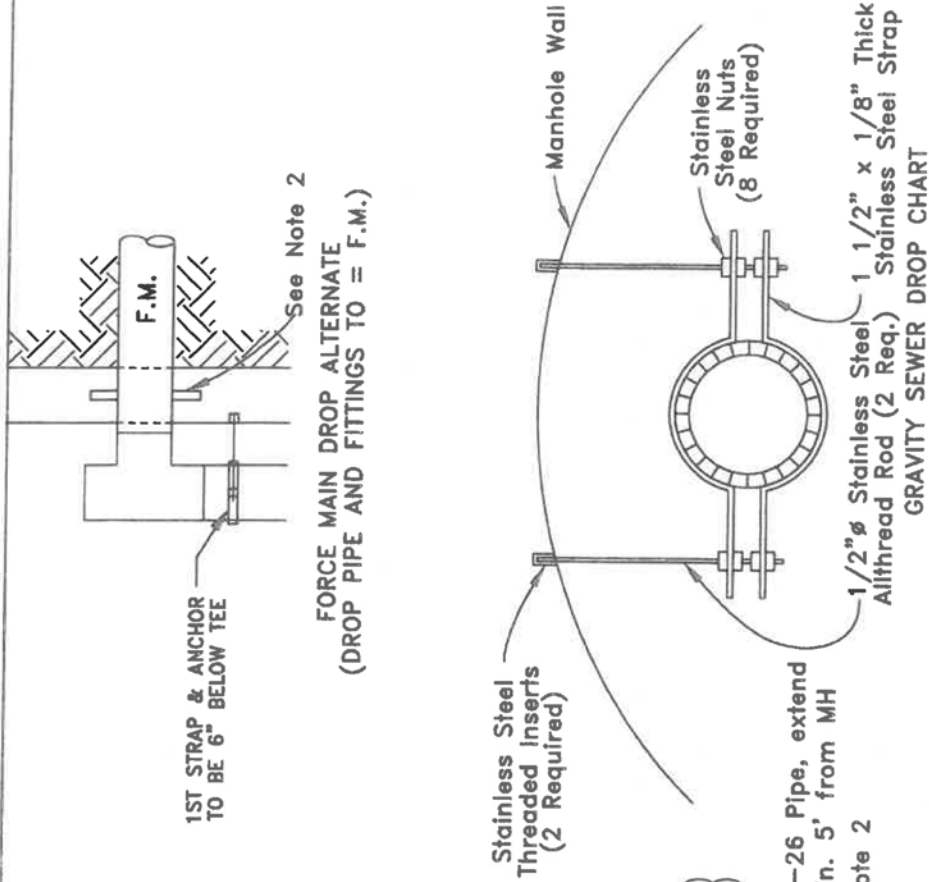
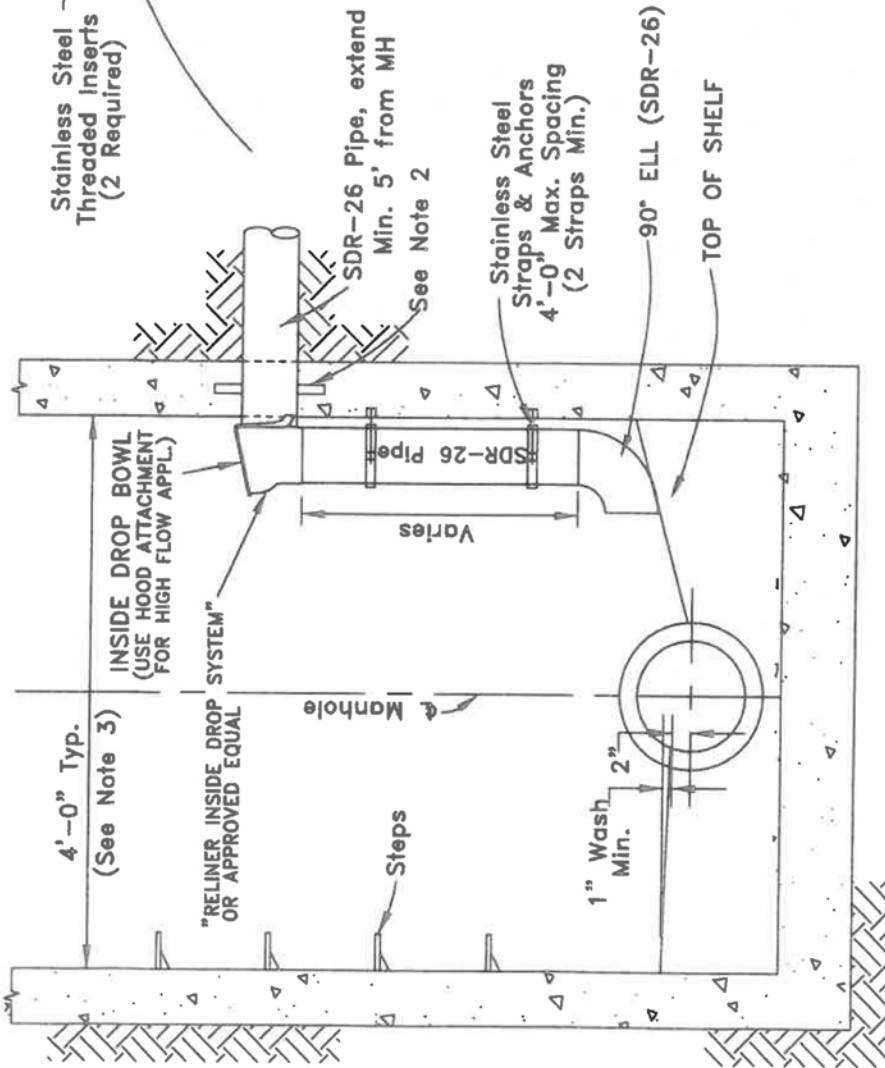
CHAPTER 5
 SANITARY SEWERS

GRADE RING
 DETAIL SHEET

EXHIBIT NO. 5-9
 NOT TO SCALE

NOTES:

1. Sewer pipe connection to existing precast manhole shall be designed to enter at the top of the shelf, unless otherwise approved by R.W.R.A.
2. Sewer pipe connection to precast manhole with Positive Seal Gasketing System (A.S.T.M. C-923). Gasket shall be as manufactured by A-lok or Kor-N-Seal Manhole gasket pipe connectors or approved equal for sanitary sewers.
3. The minimum diameter will be 4'-0" for an 8-inch sewer. For pipe sizes greater than 8-inches, the manhole diameter shall be approved by RWRA.
4. For drops less than 24", the shelf shall be modified to form a taper to the influent flowline with a non-shrink grout.



SEWER SIZE	DROP SIZE	MIN MH DIA.
UP TO 6"	4"	4'
8" TO 10"	8"	4'
12" TO 18"	10"	4'
18" TO 30"	18"	5'

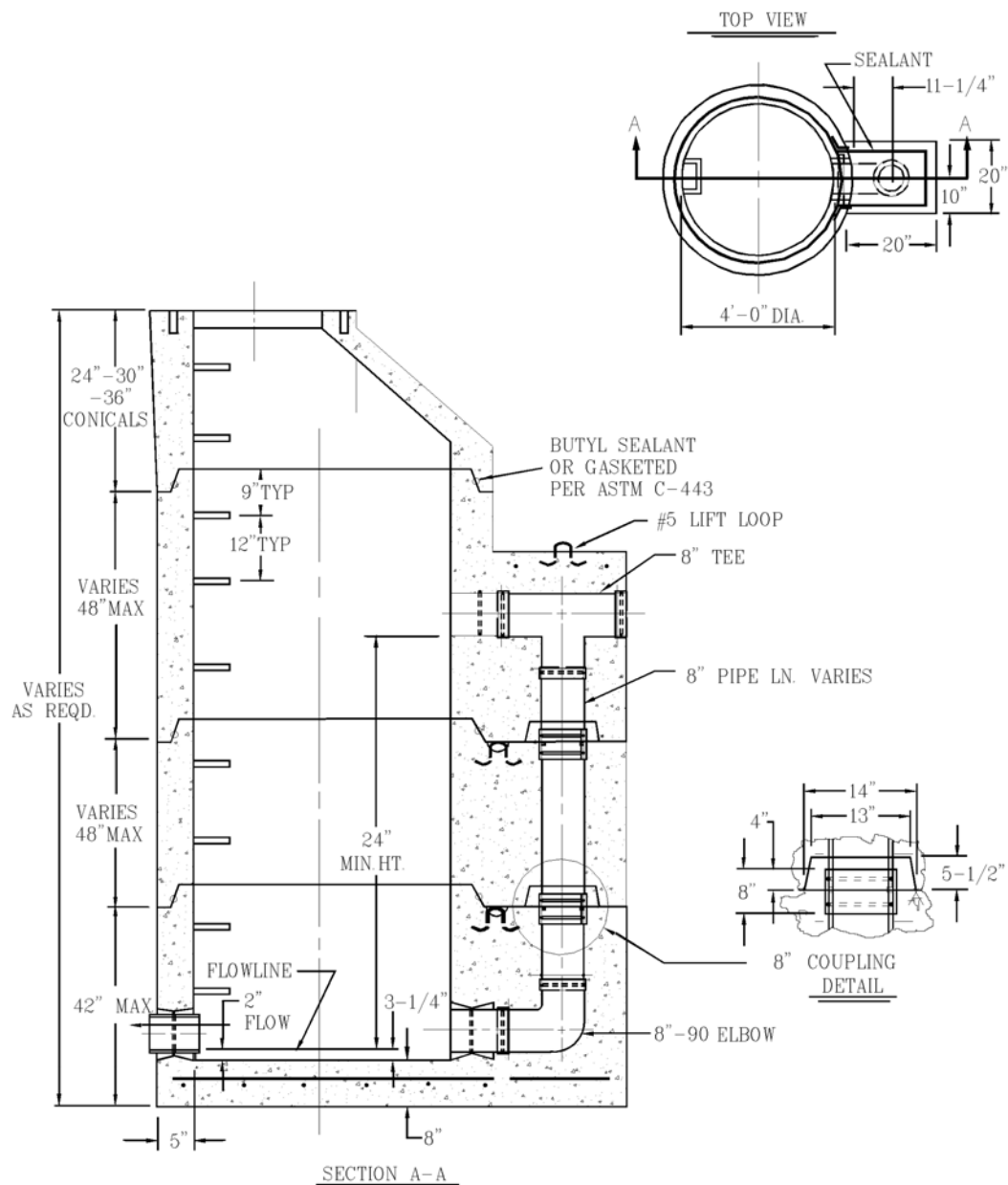
OWENSBORO METROPOLITAN
PUBLIC IMPROVEMENT SPECIFICATIONS

CHAPTER 5
SANITARY SEWERS

INTERNAL DROP
MANHOLE DETAIL

EXHIBIT NO. 5-10
NOT TO SCALE

LOW FLOW DROP DETAIL



NOTES:
 CONCRETE TO CONFORM TO ASTM
 C-478 STANDARDS
 2" MIN. CONCRETE COVER
 RESILIENT CONNECTORS MEET ASTM C-923
 MEETS OR EXCEEDS ASTM C-478
 GASKET, ANGLE & FALL PER PLAN
 1" DIA. CONEAL TO BE ADDED BETWEEN JOINTS
 OF PRECAST DROP & TIE INTO BARREL SEALANT
 WEIGHT: BASE-VARIES
 BARREL-3,599lbs.

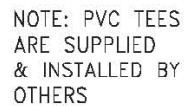
OWENSBORO METROPOLITAN
 PUBLIC IMPROVEMENT SPECIFICATIONS

CHAPTER 5
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4'-0" DIA. W/ PRECAST DROP
 DETAIL SHEET

EXHIBIT NO. 5-11

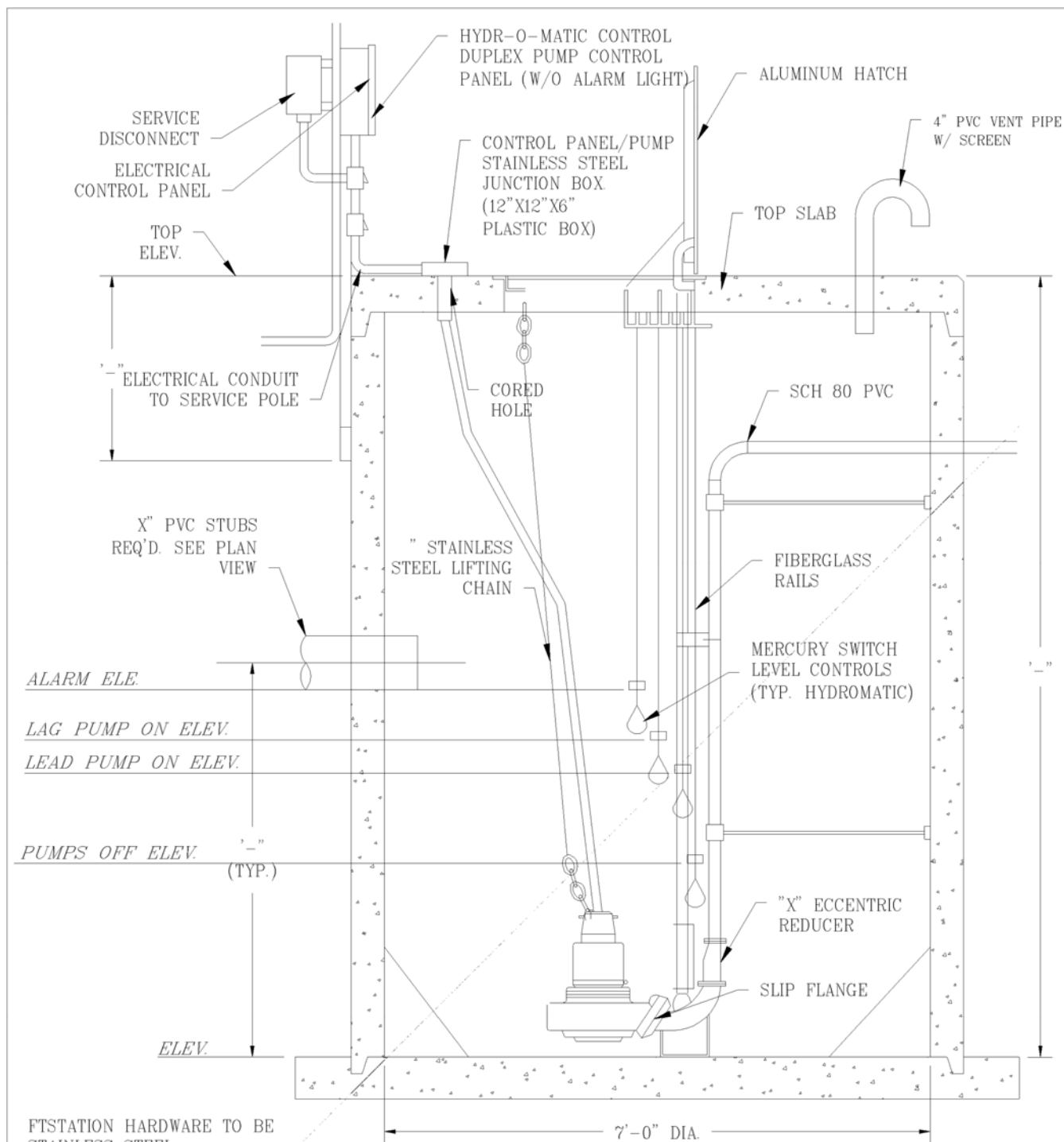
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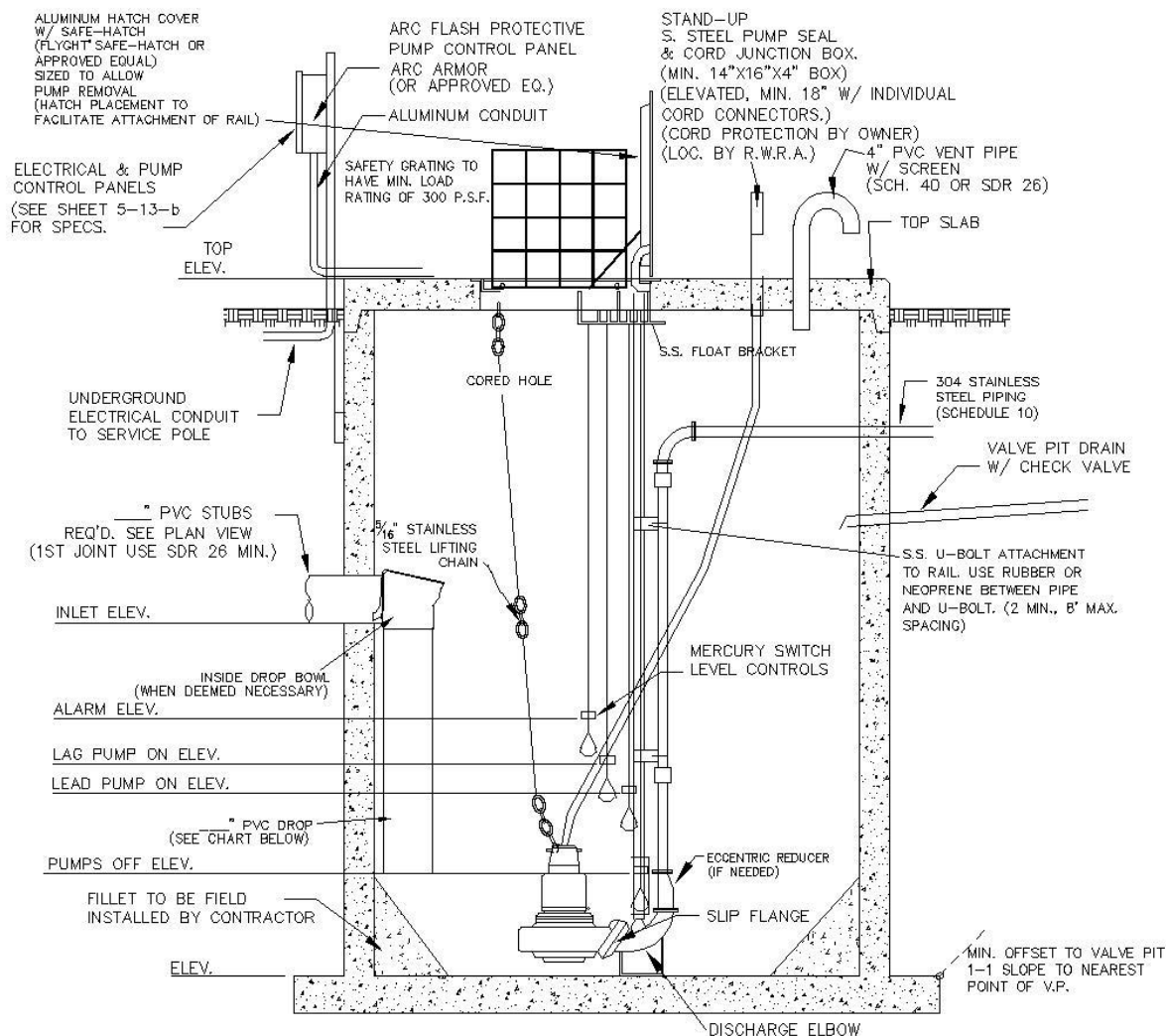


PIPE SEAL CAST IN
AT INLET & OUTLET

CONCRETE TO CONFORM TO ASTM C-478 STANDARDS
REINFORCEMENT - ASTM A-615 & ASTM A-615M (LATEST REVISION). GRADE 60
DESIGN LOAD - AASHTO HS25 & AASHTO HS25M (LATEST REVISION)
APPROX. WEIGHT - BASE 11,200#; LID 4,100#
HOLE SIZE - LENGTH 10'-10", WIDTH 6'-10", DEPTH 6'-0"
PIPE CONNECT. OPT. - GROUT HOLES. OTHER GASKETS
OTHER OPTIONS - RISERS TO GRADE. CAST IRON. PETROLEUM RESISTANT MASTIC

OWENSBORO METROPOLITAN PUBLIC IMPROVEMENT SPECIFICATIONS
CHAPTER 5 SANITARY SEWERS
GREASE INTERCEPTOR/ OIL SEPARATOR DETAIL
EXHIBIT NO. 5-12 NOT TO SCALE





PUMP STATION DETAIL

NOT TO SCALE (RWRA STAND.)

PUMP SPECIFICATIONS

PUMPS	ABS, KSB, FLYGT, OR APPROVED EQUAL
PUMP MANUF.	
PUMP MODEL	
PUMP SIZE	
DESIGN GPM	
DESIGN TDH IN FEET	
MOTORS	
HORSEPOWER	
RPM	
VOLTAGE	
PHASE	
HERTZ	
FORCE MAIN	
SIZE	
TYPE	
SUCTION EL. =	
DISCHARGE EL. =	

SEWER SIZE	DROP SIZE
UP TO 10"	8"
12" TO 18"	10"
18" TO 30"	18"

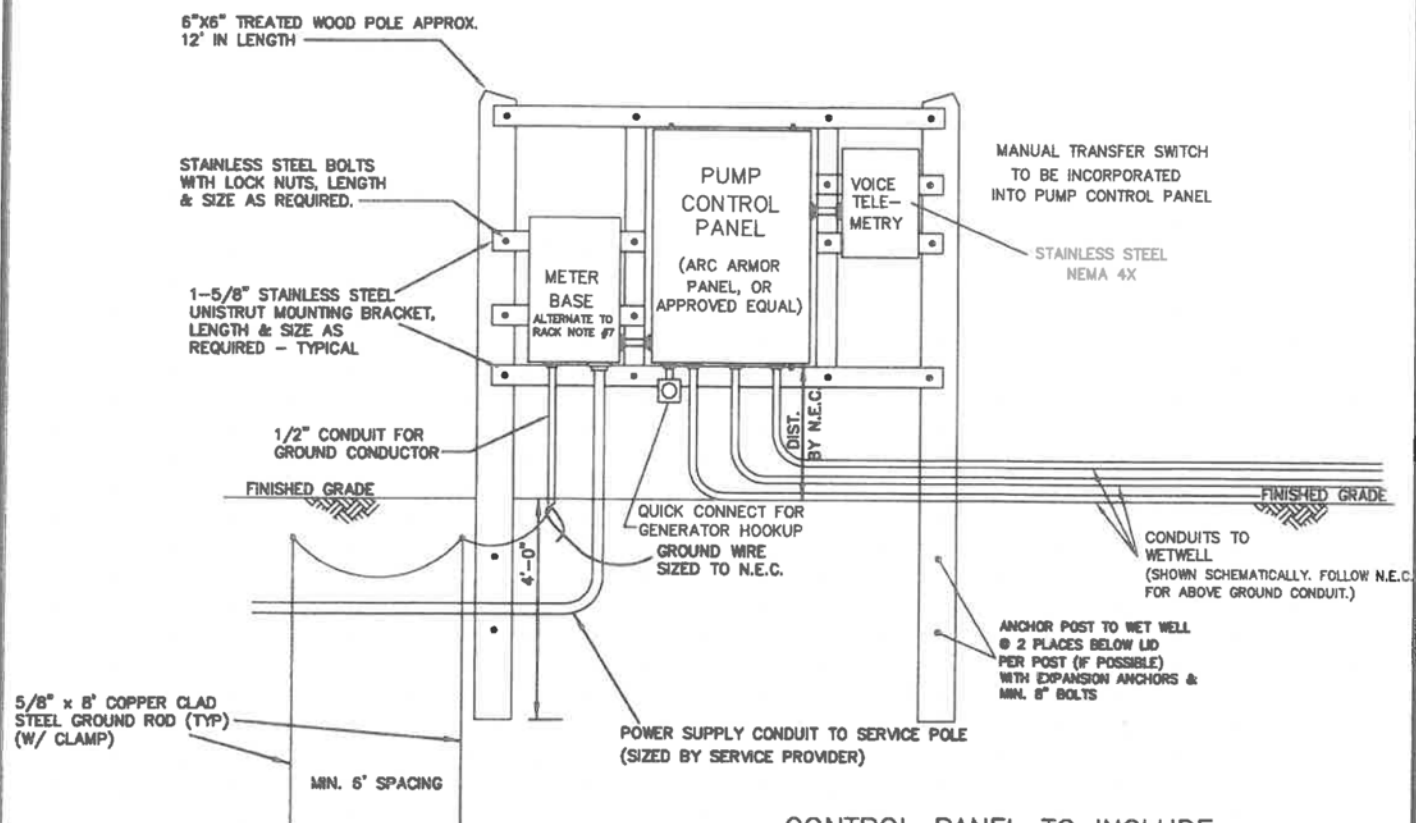
NOTES:

1. L.S. AREA TO BE ENCLOSED BY FENCE. (SIZE, TYPE, HEIGHT SPEC BY RWRA)
2. ALL PRECAST LIFT STATIONS TO HAVE INORGANIC COPOLYMER WATERPROOFING ADMIXTURE "IPANEX" OR "XYPEX" AS PER OWENSBORO PUBLIC IMPROVEMENT SPECS SECTION 5.13.7 METHOD #1
3. ALL LIFTSTATION HARDWARE TO BE 304 STAINLESS STEEL (UNLESS NOTED OTHERWISE)
4. RAIL SYSTEM TO BE STAINLESS STEEL, SIZED ACCORDING TO PUMP SIZE (6" OR LESS) ANY VARIANCE TO BE APPROVED BY R.W.R.A.
5. CONTRACTOR SHALL PROVIDE ONE CELLULAR VOICE TERMINAL UNIT INTO VOICE TELEMTRY CONTROL PANEL. CELLULAR COMMUNICATION VIA CDMA FIXED WIRELESS VOICE TERMINAL COMPATIBLE W/ "VERIZON" NETWORK AXESSTEL TX2416 OR APPROVED EQUAL.
6. CONTRACTOR TO PROVIDE SYNTHESIZED VOICE TELEPHONE TELEMTRY ALARM SYSTEM (SENSAPHONE 1400 OR EQUAL). ALARM ENCLOSURE TO BE IN A SEPARATE LOCKABLE, WEATHERPROOF NON-METALLIC ENCLOSURE. BOX SHALL BE 18" X 18", 6" FIBERGLASS W/ HINGED DOOR.)
7. DEVELOPER/ENGINEER MUST CONTACT R.W.R.A. TO RECEIVE "CAD" DRAWNGS

OWENSBORO METROPOLITAN
PUBLIC IMPROVEMENT SPECIFICATIONSCHAPTER 5
SANITARY SEWERSPUMP STATION
DETAIL SHEET 1EXHIBIT NO. 5-13-a
NOT TO SCALE

SERVICE SWITCH RACK NOTES:

1. MAINTAIN CODE-REQUIRED SPACING (MINIMUM OR GREATER) FOR ALL RACK MOUNTED COMPONENTS.
2. GRIND SMOOTH THE CUT EDGES OF ALL STRUCTURAL MEMBERS.
3. ALL MOUNTING HARDWARE SHALL BE STAINLESS STEEL.
4. ALL EQUIPMENT TO BE BOLTED TO RACK WITH 1/4" DIA. STAINLESS STEEL BOLTS WITH STAINLESS STEEL LOCK WASHERS. DAMAGE ALL THREADS SO NUTS CANNOT BE REMOVED.
5. ALL BOXES AND PANELS NOT MOUNTED TO WETWELL, SHALL BE MOUNTED TO A STAINLESS STEEL STRUCTURAL SUPPORT MEMBER.
6. ALL RIGID CONDUIT SHALL BE ALUMINUM, NO PVC ACCEPTED
7. SERVICE POLE AND METER BASE SHALL BE LOCATED OUTSIDE FENCED AREA UNLESS DIRECTED BY R.W.R.A. AND ELECTRIC PROVIDER.



GENERAL NOTES:

1. PRIMARY ELECTRIC SERVICE PREFERENCE IS TO BE A.) 460 VOLT, 3 PHASE, B.) 230 VOLT, 3 PHASE; OR C.) 230 VOLT, 1 PHASE, IF APPROVED BY R.W.R.A. TO BE PROVIDED BY DEVELOPER.
(PHASE CONVERTERS OR VFD'S TO ACHIEVE 3 PHASE IF APPROVED BY R.W.R.A.)
2. MOUNT PUMP STATION CONTROL PANEL AND ELECTRICAL EQUIPMENT ON TWO PRESSURE TREATED 6"x6" WOODEN POSTS WITH STAINLESS STEEL UNISTRUT.
3. CONTRACTOR SHALL PROVIDE CDMA FIXED WIRELESS VOICE TERMINAL COMPATIBLE W/ "VERIZON"
4. CONTRACTOR TO INSTALL GENERATOR RECEPTACLE (HUBBELL OR PS 4100-R9W- RECEPTACLE W/ BACK BOX BB-001 (OR EQUAL) FOR 208 OR 240 VOLT INSTALLATIONS. (R4100-R7W FOR 480 VOLT)
5. ALL CONTROL PANELS SHALL HAVE 3' CLEARANCE ANY OBSTRUCTION, INCLUDING FENCING. ALL CONTROL PANELS EXCEPT VOICE TELEMETRY, SHALL BE LOCKABLE, WEATHERPROOF, STAINLESS STEEL ENCLOSURES. (PADLOCK PROVIDED BY R.W.R.A.) CONTROL PANEL BOX TO HAVE SIDE WITH MAIN BREAKER/STARTERS FACING OUTWARD. ARC FLASH PROTECTIVE PANEL BOX TO MEET MANUF. SPECS, APPROVED BY R.W.R.A.
6. WET WELL ELECTRIC JUNCTION BOX MOUNTED VERTICALLY APPROX. 18" ABOVE WELL SLAB OPENING ON TWO STAINLESS STEEL STRUT BRACKETS; PUMP AND FLOAT CORDS TO ENTER APPROPRIATELY SIZED WEATHERPROOF CORD CONNECTORS WITH STRAIN RELIEFS.
7. ALL DRAWINGS AND SPECIFICATIONS ARE TO BE REVIEWED BY RWRA AND ARE SUBJECT TO CHANGE BASED ON CHANGES TO REGULATORY CODE OR TECHNOLOGY.

CONTROL PANEL TO INCLUDE:

- NEMA TYPE 4X STAINLESS STEEL ENCLOSURE
- BACK PANEL AND INNER DOOR
- INCOMING POWER BLOCK
- MOTOR AND CONTROL CIRCUIT BREAKERS
- NEMA RATED MOTOR STARTERS W/OVERLOAD HEATERS
- CONTROL VOLTAGE TRANSFORMER
- CONTROL CIRCUIT FUSE
- DUPLEX ALTERNATING RELAY W/LEAD SELECT SWITCH
- LAG/OVERLOAD/OVERTEMPERATURE PUMP CIRCUITRY
- HAND-OFF-AUTO SWITCHES
- PUMP RUN LIGHTS
- SEAL FAIL LIGHTS
- CONTROL AND FAULT RELAYS AND ASSOCIATED PUMP MANUFACTURER RELAY MODULES AS REQUIRED
- GENERATOR TRANSFER SWITCH
- TERMINAL BLOCKS AND GROUND LUGS AS REQUIRED
- AUX. DRY HIGH LEVEL AND SEAL FAIL TELEMETRY CONTACTS
- ALL OPERATING CONTROLS MUST BE MOUNTED ON AND BE OPERABLE FROM METAL INNER DOOR
- AUXILIARY CONTACTS TO TELEMETRY FOR PUMP BREAKER TRIP AND OVERLOAD TRIP

SERVICE SWITCH RACK ARRANGEMENT

ALL MAIN POWER SUPPLY SHALL BE UNDERGROUND
WITHIN PROPOSED LIFT STATION FENCE AREA

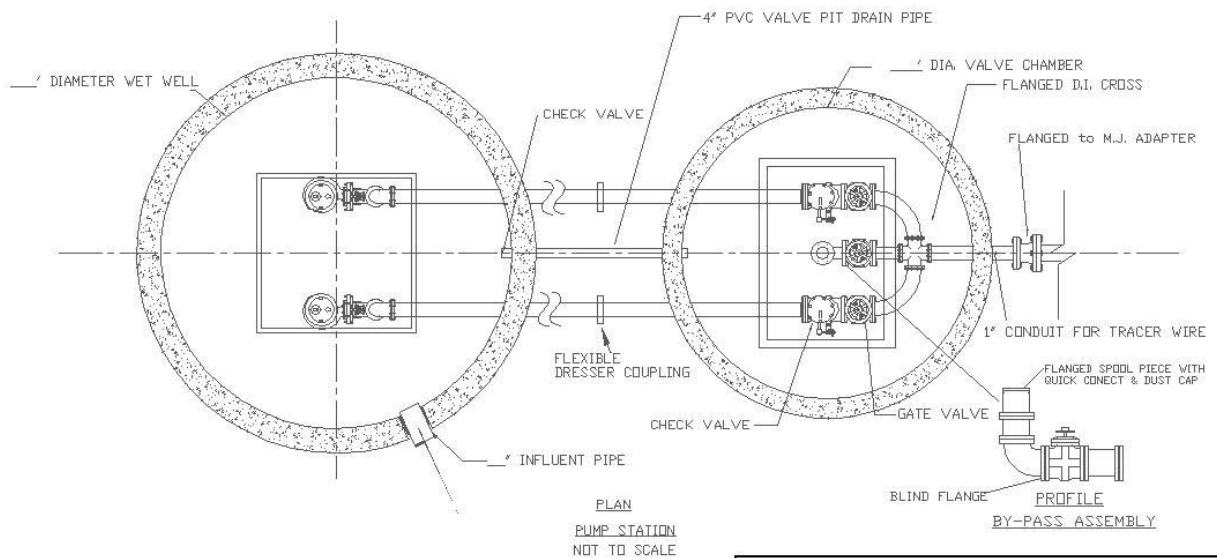
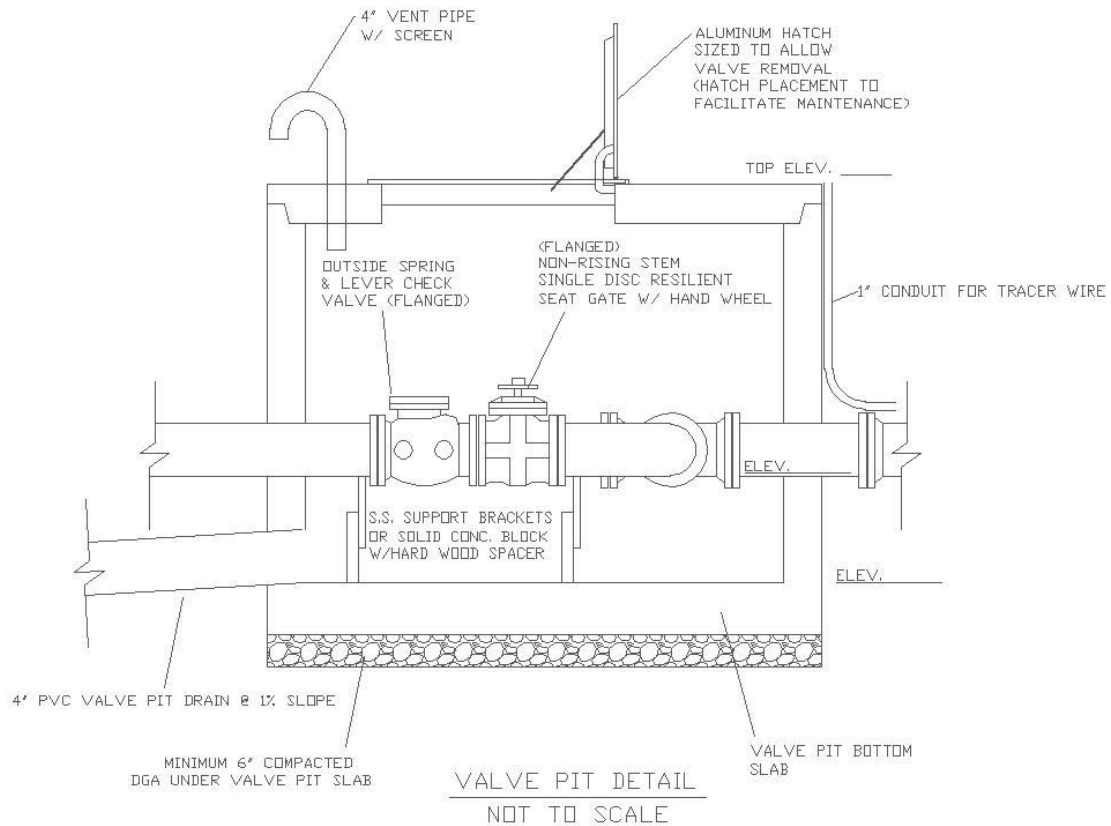
OWENSBORO METROPOLITAN
PUBLIC IMPROVEMENT SPECIFICATIONS

CHAPTER 5

SANITARY SEWERS

PUMP STATION
DETAIL SHEET 2

EXHIBIT NO. 5-13-b



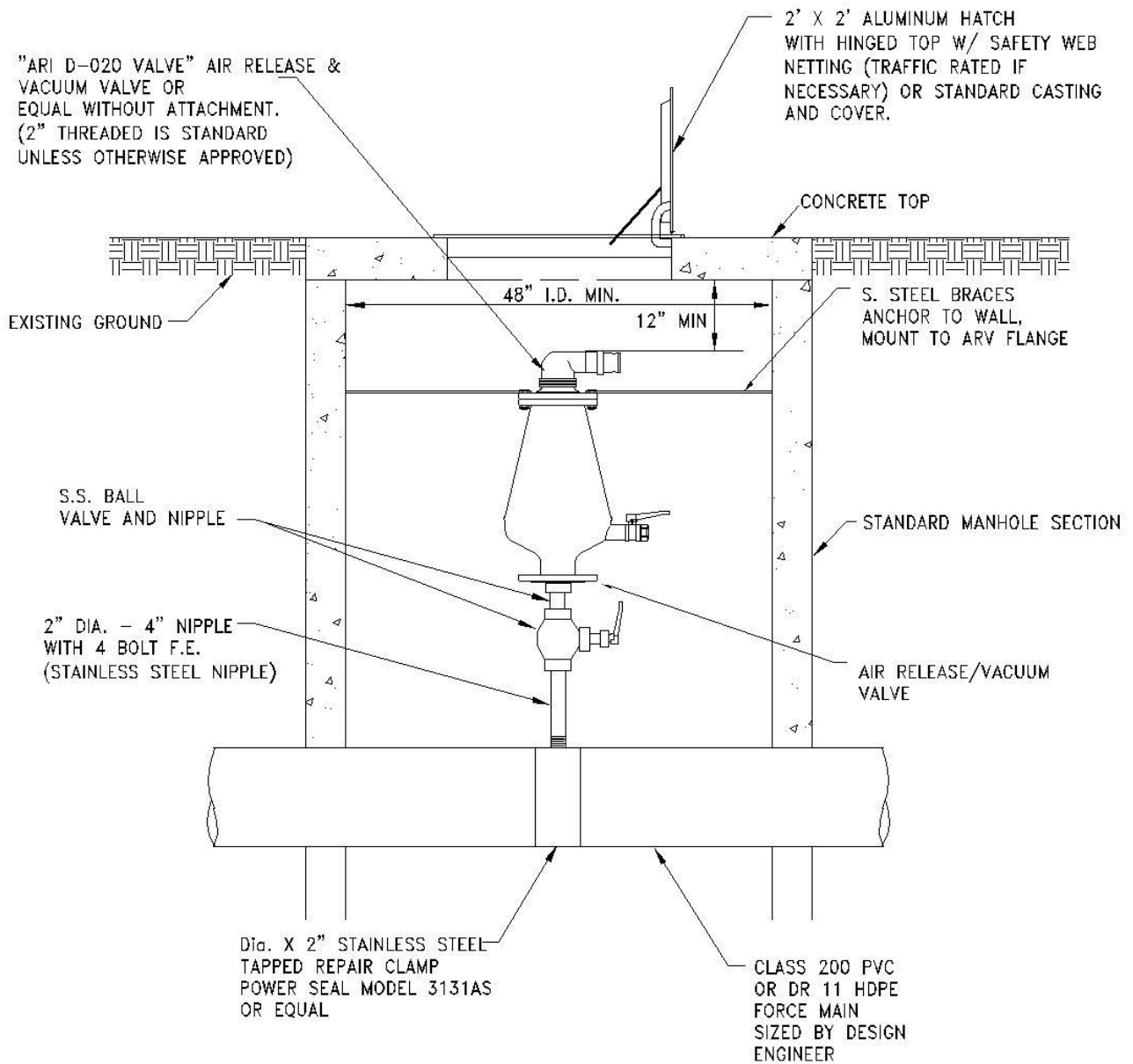
ALL PIPING TO BE S. STEEL OR FLANGED D.I.

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CHAPTER 5
SANITARY SEWERS

PUMP STATION
DETAIL SHEET 2

EXHIBIT NO. 5-14
NOT TO SCALE



AIR RELEASE PIT DETAIL

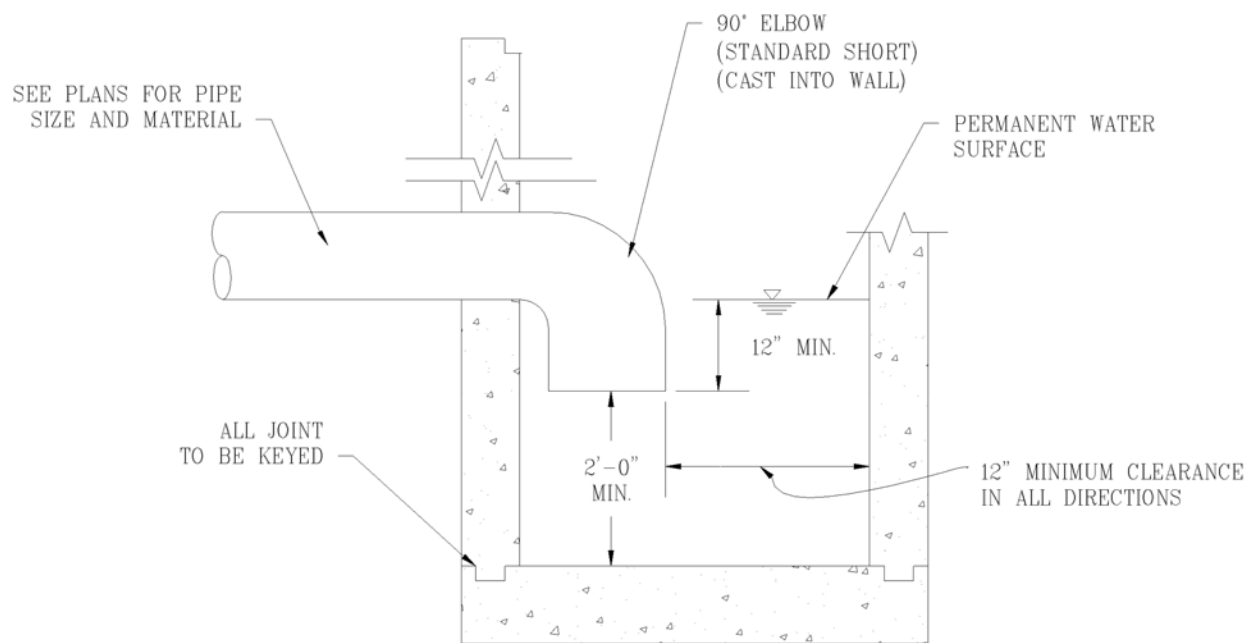
NOTE:
ALL FITTINGS AND HARDWARE TO BE 304 STAINLESS STEEL
(S.S.)

OWENSBORO METROPOLITAN
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AIR RELEASE
PIT DETAIL

EXHIBIT NO. 5-15
NOT TO SCALE



SECTION VIEW

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TRAPPED INLET/MANHOLE
DETAIL SHEET

EXHIBIT NO. 5-16

NOT TO SCALE

Exhibit 5-17 Gravity sewer air test standard

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

1 Pipe Diameter (in)	2 Minimum Time (min:sec)	3 Length of Min. time (ft)	4 Time for Longer Length (sec)	Specified Minimum for Length (L) Shown (min:sec)							
				100ft	150ft	200ft	250ft	300ft	350ft	400ft	450ft
4	1:53	597	.190L	1:53	1:53	1:53	1:53	1:53	1:53	1:53	1:53
6	2:50	398	.427L	2:50	2:50	2:50	2:50	2:50	2:50	2:51	3:12
8	3:47	298	.760L	3:47	3:47	3:47	3:47	3:48	4:26	5:04	5:42
10	4:43	239	1.187L	4:43	4:43	4:43	4:57	5:56	6:55	7:54	8:54
12	5:40	199	1.709L	5:40	5:40	5:42	7:08	8:33	9:58	11:24	12:50
14	7:05	159	2.671L	7:05	7:05	8:54	11:08	13:21	15:35	17:48	20:02
18	8:30	133	3.846L	8:30	9:37	12:49	16:01	19:14	22:26	25:38	28:51
21	9:55	114	5.235L	9:55	13:05	17:27	21:49	26:11	30:32	34:54	39:16
24	11:20	99	6.837L	11:24	17:57	22:48	28:30	34:11	39:53	45:35	51:17
27	12:45	88	8.653L	14:25	21:38	28:51	36:04	43:16	50:30	57:42	64:54
30	14:10	80	10.683L	17:48	26:43	35:37	44:31	53:25	62:19	71:13	80:07
33	15:35	72	12.926L	21:33	32:19	43:56	53:52	64:38	75:24	86:10	96:57
36	17:00	66	15.384L	25:39	38:28	51:17	64:06	76:55	89:44	102:34	115:23
42	20:14	57	20.942L	34:54	52:21	69:49	87:15	104:42	122:10	139:37	157:04
48	23:07	50	27.352L	45:35	68:23	91:11	113:58	136:46	159:33	182:21	205:09

* Q is the allowable leakage rate in cu ft/min/ft sq of inside surface area of pipe.

Table is generated from Uni-Bell PVC Pipe Association Handbook of PVC PIPE

OWENSBORO METROPOLITAN
PUBLIC IMPROVEMENT SPECIFICATIONS

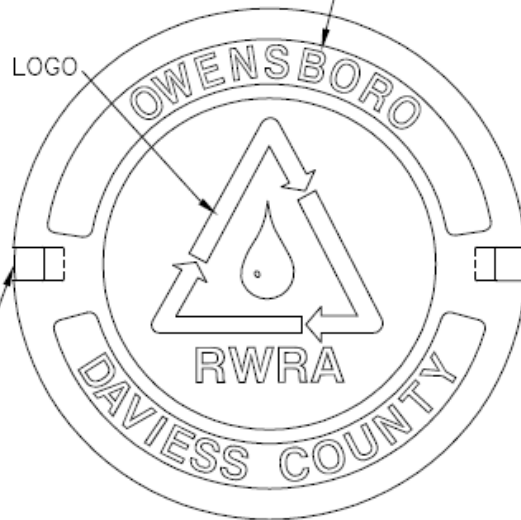
CHAPTER 5
SANITARY SEWERS

GRAVITY SEWER
AIR TEST STANDARD

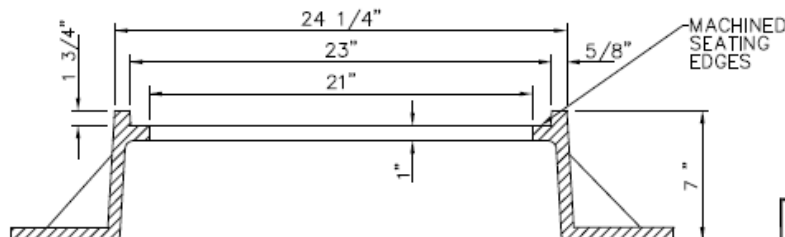
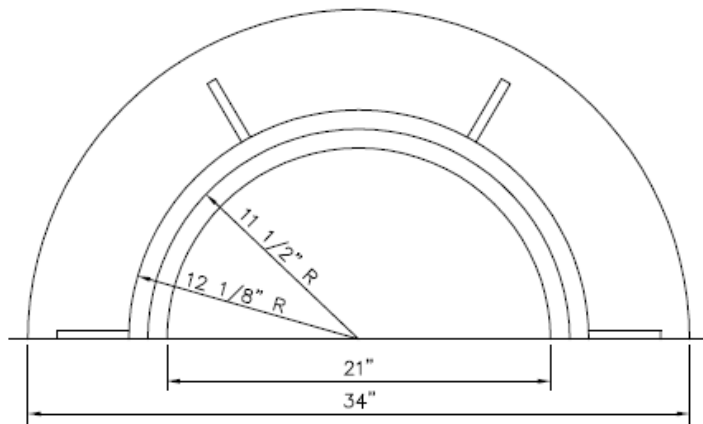
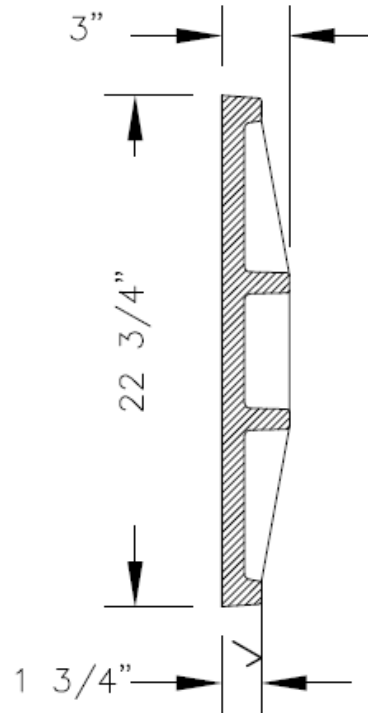
EXHIBIT NO. 5-17
NOT TO SCALE

ALL LETTERING IS 1 1/2" HIGH
RAISED FLUSH w/ TOP SURFACE

CUSTOM LOGO



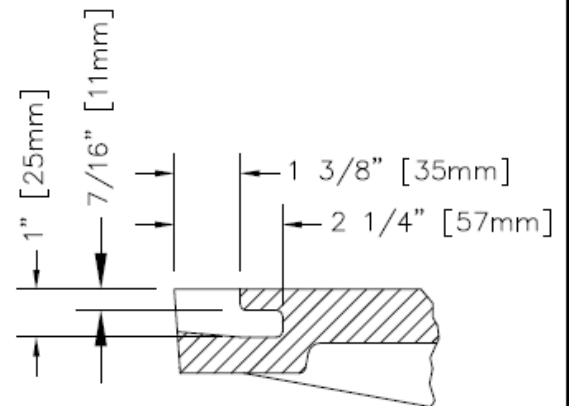
(2) SPECIAL CONCEALED
PICKHOLES (CORE #1015CF3)



STANDARD CIRCULAR MANHOLE FRAME

NOT TO SCALE

ALL NEW



CONCEALED PICKHOLE DETAIL
NOT TO SCALE

MATERIAL: CAST GRAY IRON ASTM A-48, CLASS 35B
FINISH: NO PAINT
WEIGHT: 149# WAS NF-1772T73

NEENAH R-1772 (OR EQUAL) LID w/LOGO
LTRD. "OWENSBORO - DAVIESS COUNTY"

OWENSBORO METROPOLITAN
PUBLIC IMPROVEMENT SPECIFICATIONS

CHAPTER 5
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MANHOLE CASTING LID & FRAME
DETAIL SHEET

EXHIBIT NO. 5-18
NOT TO SCALE