

MATERIAL SPECIFICATIONS FOR SANITARY SEWER CONSTRUCTION

Unless superseded or modified by a Special Provision, all materials, apparatus, supplies, methods of manufacture, or construction shall conform to the specification for same contained in this Section. National material standards (ASTM, ANSI, etc.) referred to herein shall be considered to be the latest revisions only.

A. SANITARY SEWER PIPE

1. Vitrified Clay Pipe: Unless amended on the construction drawing or elsewhere in these specifications, all sewer pipe 15-inch in diameter and smaller may be Vitrified Clay Pipe, extra strength only, manufactured in accordance with the standard specification for Extra Strength and Standard Clay Pipe, ASTM C-700. All pipe shall be unglazed.

All joints for Vitrified Clay Pipe shall be factory-fabricated and shall be manufactured in accordance with ASTM C-425 Compression Joints for VCP and fittings.

Vitrified Clay Fittings shall conform to ASTM C-700 extra strength.

2. PVC Pipe:
 - a. Solid Wall PVC: Unless amended on the construction drawings or elsewhere in these specifications, sewer pipe 4-inches through 15-inches in diameter may be Poly Vinyl Chloride (PVC) sewer pipe with a Standard Dimension Ratio (SDR) of 35, and shall meet all requirements of ASTM Specification D-3034. Sewer pipe 18-inches through 27-inches in diameter may be Polyvinyl Chloride Pipe (PVC) large diameter sewer pipe with a minimum pipe stiffness of 46 PSI in accordance with ASTM Specification F-679. Pipe joining shall be push on elastomeric joints only and joints shall be manufactured in accordance with ASTM Specification D-3212. The pipe shall be furnished with integral bells and with gaskets that are permanently installed at the factory. The pipe shall be furnished in nominal lengths of 13 feet. PVC sewer pipe shall be green or white in color.

PVC pipe shall contain the markings required by ASTM D-3034 or F-679 as applicable. The manufacturer shall submit certification that the pipe has been tested in accordance with ASTM D-3034 or F-679 as applicable and has been found to meet all requirements. Test samples shall be as selected by the manufacturer or testing laboratory unless otherwise stipulated in the Special Provision Section of these specifications.

Fittings shall be in accordance with ASTM D-3034, F-679, and/or D-3212 as applicable, with stiffness and wall thickness equal to or greater than the pipe. Adapters shall be provided to join different materials.

- b. PVC Profile Gravity Sewer Pipe: Unless amended on the construction drawings or elsewhere in these specifications, sewer pipe 8-inches through 48-inches may be PVC profile gravity sewer pipe manufactured in accordance with the requirements of ASTM F-794. The minimum pipe stiffness shall be 46 PSI. All seams on the completed pipe shall be thermally fused. Glued seams will not be allowed.

The pipe shall be produced with integral bell and spigot end construction with elastomeric seals and shall conform to all requirements of ASTM D-3212. Joining shall be by rubber gaskets that conform in all respects to the physical requirements specified by ASTM F-477 for low head applications. The lubricant used for assembly shall be as recommended by the manufacturer and shall have no detrimental effect on either the pipe or the rubber gasket.

The average nominal inside diameter and manufacturing tolerance shall be as listed for stiffness Series 46 in Table IA for open profile pipe and Table IB for closed profile pipe of ASTM F-794. The pipe shall be furnished in nominal lengths of 13 feet and shall contain all markings required by ASTM F-794.

One sample of each size pipe specified, from the production runs for this project, shall be tested in accordance with the requirements of ASTM F-794. The manufacturer shall furnish certification that the pipe was manufactured, sampled, tested and inspected in accordance with and has been found to meet the requirements of ASTM F-794 in all respects.

Fittings shall be in accordance with ASTM F-794, D-3212, and/or D-3034 as applicable, with stiffness and wall thickness equal to or greater than the pipe. Adapters shall be provided to join different materials.

- (c) PVC Corrugated Sewer Pipe: Unless amended on the construction drawings or elsewhere in these specifications, sewer pipe 8-inches through 18-inches may be Polyvinyl Chloride Corrugated Sewer Pipe with a smooth interior, manufactured in accordance with ASTM F-949. The pipe shall be produced with integral bell and spigot construction with elastomeric seals and shall conform to all requirements to ASTM D-3212. Joining shall be by rubber gaskets that conform to the requirements of ASTM F-477. The pipe shall be furnished in nominal lengths of 12.5 feet and shall contain all markings required by ASTM F-949. One sample of each pipe size specified, from the production runs of this project, shall be tested in accordance with the requirements of ASTM F-949. The manufacturer shall furnish certification that the pipe was manufactured, sampled, tested, and inspected in accordance with and has been found to meet the requirements of ASTM F-949 in all respects.

Fittings shall be in accordance with ASTM F-949, D-3034, and/or D-3212 as applicable, with stiffness and wall thickness equal to or greater than the pipe. Adapters shall be provided to join different materials.

3. Reinforced Concrete Pipe: Unless amended on the construction drawings or elsewhere in these specifications, all sanitary sewer pipe 18-inch in diameter and larger may be reinforced concrete pipe, Class IV minimum, manufactured with "C" thickness, and conforming to Standard Specification for Reinforced Concrete, Storm Drain, and Sewer Pipe, ASTM C-76 and with the following modifications:

Sacrificial Concrete: This specification is intended to provide sacrificial concrete on the inside of all reinforced concrete sewer pipe. Amendments will be made, as necessary, in the Special Provision Section of this contract to maintain this design and/or specify other acceptable measures when sacrificial concrete is not feasible for large diameter pipe.

In lieu of sacrificial concrete, reinforced concrete pipe may be manufactured with calcareous aggregate. If this option is chosen, all coarse aggregate used in the pipe shall be limestone or dolomite, and the alkalinity of the finished pipe shall be a minimum of 50% when expressed as calcium carbonate equivalent.

Section 9 Design Tables: All Class IV RCP and 48-inch and smaller Class V RCP shall have circular reinforcement (only), equal to the requirements for Wall B reinforcement. The reinforcement shall be placed within C wall (only) the required distance from the outside surface of the pipe for a pipe having Wall B thickness.

All Class V Reinforced Concrete Pipe 54-inch inside diameter and larger shall be furnished with Wall C thickness and Wall C circular reinforcement (only) in accordance with ASTM C-76 Table 5. However 54-inch and larger RCP shall be manufactured with calcareous aggregate as specified above.

Special designs may be submitted by the manufacturer in accordance with Section 7 of ASTM C-76 and will be subject to the review and approval of the Engineer.

Section 5 Cement: The cement shall have a maximum tricalcium aluminate ($3\text{CaOAl}_2\text{O}_3$) content not to exceed eight (8) percent. The Contractor shall submit to the Engineer a certificate from the cement manufacturer stating the guaranteed maximum tricalcium aluminate content.

Pipe Length: The minimum nominal laying length of the pipe shall be not less than 8 feet for 18" and 21" pipe and not less than 12 feet for pipe 24" and larger. Shorter lengths may be provided where required to maintain manhole location and for providing a flexible joint within two (2) feet of the exterior wall of the manhole.

Tests: Acceptability of reinforced concrete pipe in all diameters and classes shall be on the basis of three edge bearing tests for the load required to produce a 0.01 inch crack and ultimate failure of the pipe, absorption tests on selected samples of concrete taken from the pipe wall, by material tests required by Section 6 of ASTM C-76 and by visual inspection of the pipe to determine its conformance to design and its freedom from defects.

All tests shall be performed by an independent testing laboratory and certified test reports submitted to the Engineer. If calcareous aggregate is used, certified test reports shall be submitted stating that the aggregate used is limestone or dolomite and that the alkalinity of the finished pipe is at least 50% when expressed as calcium carbonate equivalent. Test samples shall be selected at random by the testing laboratory except that at least one sample shall be chosen from the production run from which each shipment is made.

Joints for sanitary sewer pipe shall meet the requirements listed in ASTM C-361, Section 8.4 (Subsections 1 through 8, as applicable) and C-443, including Section 10. The manufacturer shall furnish evidence of satisfactory joint design for installation depths greater than 30 feet.

PVC Liners: Where indicated on the plans or elsewhere in these Specifications, RCP shall be provided with a PVC liner as specified below for resistance to corrosive wastewater. PVC Liner shall be designed and installed to protect concrete surfaces from corrosion. All Reinforced Concrete Pipe so specified shall be plastic lined 270-degrees minimum as measured from the pipe crown. Manhole circumferences shall be fully lined from the shelf of the manhole to the top of the cone section. Installation of the plastic liner on all pipes shall be at the point of manufacture, not in the field. The manufacturer of the lining shall furnish an affidavit attesting to the successful use of this material as a lining for concrete structures for a minimum period of ten (10) years in wastewater conditions recognized as corrosive or otherwise detrimental to concrete. The manufacturer shall also document the history and use of its product for such use. The following requirements shall be followed:

a. Composition:

The material used in the liner and in all joint, corner, and welding strips shall be a combination of polyvinyl chloride resin, pigments, and plasticizer, specially compounded to remain flexible. Polyvinyl chloride resin shall constitute not less than ninety-nine percent (99%), by weight, of the formulated compound. Copolymer resins will not be allowed.

b. Physical Properties:

1. Liner plate and weld strip shall have a minimum tensile strength of 2200 PSI.
2. Liner plate placing extensions embedded in concrete shall withstand a test pull of at least 100 pounds per linear inch, applied perpendicularly to the concrete surface for period of one minute, without rupture to the locking extensions or withdrawal from embedment. This test shall be made at a temperature of 70 - 80 degree F inclusive.
3. All plastic liner plate sheets, including lock extensions, all joint, corner, and welding strips shall be free of cracks, cleavages, or other defects adversely affecting the protective characteristics of the material. The Engineer may authorize the repair of such defects by approved methods.

4. The lining shall have good impact resistance, shall be flexible, and shall have an elongation sufficient to bridge up to 1/4-inch settling cracks, which may occur in the pipe or in the joint after installation, without damage to the lining.
5. The lining shall be repairable at any time during the life of the structure.
6. Unless otherwise noted or instructed by the Engineer, the liner shall be white in color.

c. Details and Dimensions:

1. Liner sheets shall be a minimum of 0.065 inches in thickness. Locking extension (T-shaped) of the same material as that of the liner shall be integrally extruded with the sheet. Locking extensions shall be approximately 2.5 inches apart and shall be at least 0.375 inches high.
2. Sheets shall have a nominal width of at least 48-inches and a length of not more than 24 feet, except that longer lengths may be supplied on special order. Lengths specified shall include a tolerance at a ratio of +1/4-inch for each 100 inches.
3. Sheets which will not be used for shop fabrication into larger sheets shall be shop tested for pinholes using an electric spark tester set at 20,000 volts minimum. Any holes shall be repaired and retested.

d. Pipe-Size sheets:

1. Pipe linings shall be supplied as pipe-size sheets, fabricated by shop-welded basic-size sheets together. Shop welds shall be made by lapping sheets a minimum of 1/2-inch and applying heat and pressure to the lap to produce a continuous welded joint. Tensile strength measured across shop-welded joints, measured in accordance with ASTM D-412, shall be at least 2000 PSI.
2. Sheets shall have transverse strap channels cut in the locking extensions so that the strap, used to hold the sheet in the forms during casting of the pipe, can be placed into and perpendicular to the locking extensions.
3. The channels shall not be less than 3/4-inch wide and not more than 1□-inch wide, and shall be cut so that a maximum 3/16-inch of the base of the locking extensions remains in the base of the strap channel. Strap channels shall be provided at intervals of not less than 15-inches nor more than 20-inches center-to-center. The strap channels shall not be cut through the final two locking extensions on each edge of the sheet.

4. Transverse flaps shall be provided at the ends of sheets for pipe. Locking extensions shall be removed from flaps so that 1/32 to 1/64-inch of the base of the locking extension is left on the sheet.
5. Weld strips shall be approximately 1-inch wide with a minimum width of 7/8-inch. The edges of weld strips shall be beveled in the manufacturing process. Thickness of weld strip shall be a nominal 1/8-inch.
6. Joint strips for pipe shall be four (4) inches wide plus or minus 1/4. Thickness of joint strips shall be equivalent to that of the liner.
7. Prior to preparing the sheets for shipment, they shall be tested for pinholes using an electrical spark testing set at 20,000 volts minimum. Any holes shall be repaired and retested.

e. Material:

Liner shall be Ameron T-Lock as manufactured by Ameron Protective Coatings Division of Brea, California, equivalent products by Serrot Corporation of Huntington Beach, California or Poly-Tee, Incorporated of Anaheim, California, or other equal.

f. Installation:

1. Installation of the lining, including preheating of sheets in cold weather and the welding of all joints, shall be done in accordance with the recommendations of the manufacturer.
2. The intent of this specification is to provide for the complete coverage of all interior concrete surfaces of all manholes and structures constructed under this project.
3. The lining shall be installed with the locking extensions running parallel with the longitudinal axis of the pipe.
4. The lining shall be held snugly in place against inner forms by means of steel banding straps or other means recommended by the manufacturer. Banding straps must be located in the precut strap channels to prevent crushing or tilting of the locking extensions.
5. If banding strips are used, a steel channel, angle, or bar may be inserted along the edge locking extensions of each liner sheet for concrete pipe or cast-in-place structures. The steel channel, angle, or bar shall be of sufficient stiffness to hold the longitudinal edges of the concrete as it is vibrated into place, provided the concrete adequately supports the locking extension.
6. Locking extensions shall terminate not more than 1□-inches from the end of the inside surface of the pipe section. Joint flaps shall extend approximately four (4) inches beyond the end of the inside surface.

7. Concrete poured against lining shall be vibrated, spaded, or compacted in a careful manner so as to protect the lining and produce a dense, homogeneous concrete, securely anchoring the locking extensions into the concrete.
 8. In removing forms, care should be taken to protect the lining from damage. Sharp instruments shall not be used to pry forms from lined surfaces. When forms are removed, any nails that remain in the lining shall be pulled, without tearing the lining, and the resulting holes clearly marked. Form tie holes shall be marked before ties are broken off and all areas of serious abrasion or damage shall be marked.
 9. All nail and tie holes and all cut, torn, and seriously abraded areas in the lining shall be patched. Patches made entirely with welding strip shall be fused to the liner over the entire patch area. Larger patches may consist of smooth liner sheet applied over the damaged area with adhesive. All edges must be covered with welding strip fused to the patch and the surrounding lining adjoining the damaged area.
 10. Hot joint compounds, such as coal tar, shall not be poured or applied to the lining.
 11. The Contractor shall take all necessary measures to prevent damage to installed lining from equipment and materials used in or taken through the work.
- g. Application to Concrete Pipe - Special Requirements:
1. The lining shall be set flush with the inner edge of the bell or spigot end of a pipe section and shall extend to the opposite end or to approximately 4-inches beyond the opposite end depending upon the type of lining joint to be made with the adjoining concrete pipe.
 2. Wherever concrete pipe protected with lining, joint structures not so lined, (such as brick structures, concrete pipe, or cast-in-place structures with clay lining or clay pipe), the lining shall be extended over and around the end of the pipe and back into the structure for not less than 4-inches. This protecting cap may be molded or fabricated from the lining material but need not be locked into the pipe.
 3. Lined concrete pipe may be cured by standard curing methods.
 4. Care shall be exercised in handling, transporting, and placing lined pipe to prevent damage to the lining. No interior hooks or slings shall be used in lifting pipe. All handling operations shall be done with an exterior sling or with a suitable fork lift.

5. On pipe having 360 degree liner coverage, the longitudinal edges of the sheet shall be butt welded. When pipe tubes are furnished, these shall be shop-welded joints.
6. No pipe with damaged lining will be accepted until the damage has been repaired to the satisfaction of the engineer.

h. Field Joints in Lining for Concrete Pipe:

1. The joint having sections of lined pipe shall be prepared in the following manner:

The inside joint shall be filled and carefully pointed with cement mortar in such a manner that the mortar shall not, at any point, extend into the pipe beyond a straight line connecting the surfaces of the adjacent pipe sections.

No lining joint shall be made until after the trench has been back-filled and consolidated. Pipe joints must be dry before lining joints are made.

2. All mortar and other foreign material shall be removed from lining surfaces adjacent to the pipe joint, leaving them clean and dry.
3. Field joints in the lining at pipe joints may be either of the following described types:

Type P-1: The joint shall be made with a separate 4-inch joint strip and two welding strips. The 4-inch joint strip shall be centered over the joint, heat-sealed to the lining, then welded along each edge to adjacent liner sheets with a 1-inch weld strip. The 4-inch joint strip shall lap over each sheet a minimum of 1/2-inch.

P-2: The joint shall be made with a joint flap with locking extension removed per Paragraph d.4 and extending approximately 4-inches beyond the pipe end. The joint flap shall overlap the lining in the adjacent pipe section a minimum of 1/2-inch and be heat-sealed in place prior to welding. The field joint shall be completed by welding the flap to the lining of the adjacent pipe using 1-inch weld strip.

Care shall be taken to protect the flap from damage. Excessive tension and distortion in bending back the flap to expose the pipe joint during laying and joint mortaring shall be avoided. At temperatures below 50 degree F, heating of the liner may be required to avoid damage.

4. The joint flap or strip on beveled pipe shall be trimmed to a width (measured from the end of the spigot) of approximately 4-inches for the entire circumferential length of the lining.

5. All welding of joints is to be in strict conformance with the specifications and instructions of the lining manufacturer.

Welding shall fuse both sheets and weld strip together to provide a continuous joint equal in corrosion resistance and impermeability to the liner plate.

Hot-air welding tools shall provide effluent air to the sheets to be joined at a temperature between 500 degrees and 600 degrees F. Welding tools shall be held approximately 0.5" from and moved back and forth over the junction of the two materials to be joined. The welding tool shall be moved slowly enough as the weld progresses to cause a small bead of molten material to be visible along both edges and in front of the weld strip.

6. The following special requirement shall apply when the liner coverage is 360 degrees:

When groundwater is encountered the lining joint shall not be made until pumping of groundwater has been discontinued for at least three days and no visible leakage is evident at the joint.

When welding downstream side of joint strip or flap, do not weld 6 to 8 inches at the pipe invert to provide relief of potential future groundwater buildup.

i. Testing and Repairing Damaged Surfaces:

1. After the lining has been installed and welded, all surfaces covered with lining, including welds, shall be tested with an approved electrical hole detector (Tinker & Razor Model No. AP-W with power pack) with the instrument set at 20,000 volts minimum.
2. All welds shall be physically tested by a nondestructive probing method.
3. Holes in the liner revealed by the electrical hole detector shall be repaired in accordance with Paragraph f.9 of this Section.
4. Holes in welded areas revealed by either test method described above shall be repaired by either rewelding or cutting sections of unacceptable weld with small sections of liner plate and covering the resulting hole as described above as instructed by the Engineer.

4. Ductile Iron Pipe: Ductile iron pipe shall conform to the requirements of AWWA Standard C-151 and shall have a cement-mortar lining of standard thickness in accordance with AWWA C-104. Unless otherwise shown on the construction plans, all ductile iron pipe shall be furnished with push-on joints in accordance with AWWA C-111.

12-inch and smaller diameter pipe shall be pressure class 350. 16-inch and larger diameter pipe shall be minimum pressure class 250. Also, the pipe class selection for 16-inch and larger diameter pipe shall be based on the installation conditions. This pipe class shall be as shown on the plans and/or elsewhere in these specifications.

Fittings shall be in accordance with AWWA C-110 or AWWA C-153 and shall have a cement mortar lining in accordance with AWWA C-104.

5. Steel Pipe - (Aerial Creek Crossings): High Strength Steel Pipe shall be welded or seamless, manufactured in accordance with ASTM A-53 for Welded and Seamless Steel Pipe (1/8-inch to 26-inch inclusive) and/or ASTM A-139 for Welded Straight-Seam Steel Pipe (4-inch to 92-inch inclusive).

All steel shall be Grade "B" only, with minimum yield strength of 35,000 PSI. Thickness shall be 0.250" unless otherwise specified or shown on the plans.

The pipe shall be produced in a single continuous length. Welding of two or more individual pieces together end to end shall not be permitted. Spiral-seam pipe shall not be permitted.

- a. All steel pipe shall receive one (1) of the following shop applied linings on the inside of pipe barrel:
- (1) Coal tar lining 3/32-inch minimum thickness in accordance with AWWA 203.
 - (2) Coal tar epoxy lining 24 mils (dry) minimum dry film thickness and shall be Koppers' No. 300M, Amercoat No. 78, Carboline-Carbomastic No. 14 or approved equal.
- b. The outside of steel pipe and complete couplings shall receive one coat of Koppers 300M coal tar epoxy - 16 mils minimum dry film thickness - or approved equal. The coal tar epoxy coat shall be shop applied to the pipe, and field applied to the couplings. Damage to exterior shop applied coatings shall be repaired with the same coating used by the manufacturer and applied as recommended by the manufacturer.
- c. Pipe ends shall have tolerances within the limits required for approved couplings. Pipe shall also be furnished with plain right-angle ends with all burrs removed from the ends. Steel mechanical transition couplings shall be as follows:

Steel Pipe to Steel Pipe:

- (1) 30-inch and smaller pipe sizes shall have a center ring length of seven (7) inches.
- (2) 36-inch and larger pipe sizes shall have a center ring length of ten (10) inches.

- (3) Couplings shall be as manufactured by Dresser Industries - Style 38 Straight Coupling, or approved equal. Center ring, glands, bolts, and nuts shall receive one shop coat of primer.

Steel Pipe to Ductile Iron Pipe:

- (1) 8-inch and smaller pipe sizes shall have a center ring length of five (5) inches.
- (2) 10-inch through 20-inch pipe sizes shall have a center ring length of seven (7) inches.
- (3) 24-inch and larger pipe sizes shall have a center ring length of ten (10) inches.
- (4) Couplings shall be as manufactured by Dresser Industries - Style 62 Transition Coupling, or approved equal. Center ring, glands, bolts, and nuts shall receive one shop coat of primer.

Couplings shall receive field applied protective coatings as specified for steel pipe.

6. 4-Inch Sanitary Sewer Laterals: All 4-inch laterals shall be SDR 35 PVC, Schedule 40 PVC, Ductile Iron, or Cast Iron Soil Pipe. SDR 35 PVC and ductile iron laterals shall be as hereinbefore specified. 4-inch laterals may connect at manholes or tees.
 - a. Schedule 40 PVC: Schedule 40 PVC laterals shall be in accordance with ASTM D-2665, NSF 14, and D-1785. Fittings shall be socket type in accordance with ASTM D-2466. Joining shall be through solvent cement in accordance with ASTM D-2564.
 - b. Cast Iron Soil Pipe: 4-inch soil pipe shall be in accordance with ASTM A-74 Service Weight, with "Charlotte Seal" gasket.
7. 6-Inch Sanitary Sewer Laterals: All 6-inch laterals shall be Ductile Iron Pipe, SDR 35 Polyvinyl Chloride Pipe, or Schedule 40 PVC Pipe as hereinbefore specified. 6-inch laterals may connect at manholes or tees.
8. Couplings/Saddles: Couplings used to join various types of 12-inch and smaller pipe shall be elastomeric PVC sleeve couplings with stainless steel compression bands and stainless steel shear rings as manufactured by Mission Clay Products, Fernco, Logan Clay Products, or approved equal.

Couplings for 12-inch and smaller pipe may also be elastomeric PVC with internally molded rigid fiberglass insert and stainless steel bands as manufactured by DFW Plastics or approved equal. The coupling shall provide a water and/or gas tight connection.

Couplings for 15-inch and larger pipe shall be submitted to the Engineer for approval.

Saddles for lateral connections shall be ABS Plastic, PVC, Elastomeric PVC, or approved equivalent. Saddles shall be connected to VCP using epoxy sealant. Saddles shall be connected to PVC pipe using a flat or profile gasket, as applicable to the type of pipe, and at least two stainless steel bands around the pipe and saddle. The lateral shall be connected to the saddle with a compression gasket, solvent weld adapter, and /or stainless steel band, as applicable.

B. MANHOLES

All sewer manholes shall be constructed of precast concrete sections only in conformance with the following specifications and Charlotte-Mecklenburg Utility Department Standard Detail Drawings. Special cast in place manhole structures shall be as shown on the plans and shall comply with the various other applicable sections in these specifications.

Manholes will be furnished with the following clear inside diameters according to the sewer main diameter unless amended by the Plans or Special Provisions:

8" to 18" pipe	4' Manhole
21" to 36" pipe	5' Manhole
39" to 54" pipe	6' Manhole
54" and larger	8' Manhole

The manhole diameter for a given pipe size may be increased from that shown above for applications where the angle between the influent and effluent pipes precludes proper installation of the pipe connections in the standard size manhole.

Manholes shall be furnished with pre-cast bottom slabs and flexible watertight boots for 15-inch and smaller pipe. The boots shall be cast in as integral parts of the base or installed in cored openings with stainless steel compression bands, and shall conform to ASTM C-923. Manholes for 18-inch and larger pipe may be furnished with precast bottom slabs and flexible boots, flexible seals, or concrete collars. The flexible seals shall be A-Lok or Contour Seal. Flexible connectors shall conform to ASTM C-923. The concrete collars shall be according to the applicable Standard Detail. Manholes to be placed over existing pipelines shall be furnished with "doghouse" openings cast in the bottom section allowing it to be set over the existing pipe. A concrete base and invert shall be poured around the bottom section and the pipe according to the applicable Standard Detail.

Shop drawings which show dimensions, openings for pipe, reinforcing steel dimensions and layout and other essential details shall be submitted for approval.

1. Precast Reinforced Concrete Manhole Sections: All precast reinforced concrete manholes shall conform to CMUD Standard Detail drawings and to ASTM C-478. The following minimum standards shall also apply:
 - a. Wall thickness shall be 1/12th of the inside diameter with a minimum thickness of five (5") inches.
 - b. Base sections shall be cast monolithically or have a waterstop cast in the cold joint between the walls and the base slab.

- c. Cone sections shall normally be eccentric with the inside face of one side vertical and flush with the inside face of the barrel section. Eccentric cones with bolt down frame and cover shall have a minimum vertical height, as measured from the top of the cone to the bottom of the bell, of 32 inches. Eccentric cones without bolt down frame and cover to be installed flush to finish grade may have a minimum vertical height of 24-inches. Concentric cones with a vertical height of 20-inches may be used on manholes less than five (5') feet deep (4' diameter manhole only). Transition cone sections may be provided for an eccentric transition from a 60-inch riser to a 48-inch cone section to be placed directly beneath the 48-inch cone.
- d. Transition slabs may be placed a minimum of five (5) feet above the invert shelf for six (6) feet and larger diameter manholes where the slab will be buried. Flat top slabs may be used for six (6) feet and larger diameter manholes, unless the manhole is located within pavement or maintained lawns.
- e. Joints between sections shall be manufactured in accordance with ASTM C-443. Joints may be sealed with rubber gaskets in accordance with ASTM C-443 or with butyl rubber sealants conforming to Federal Specification SS-S-210A and AASHTO M-198, Type B.
- f. All markings required by ASTM C-478 shall be clearly stamped on the inside of each section.
- g. Aggregate shall be sound, crushed, angular granitic stone only, substantially in accordance with ASTM C-33, except that the requirement for gradation in that standard shall not apply. Smooth or rounded stone (river rock) shall not be acceptable.
- h. The cement shall be Type II with a maximum tricalcium aluminate ($3\text{CaOAl}_2\text{O}_3$) content 8%.

In lieu of Type II cement and granitic aggregate, precast manhole sections may be furnished of Type III cement with calcareous (limestone) aggregate. The manufacturer will submit lab tests certifying the amount of Alkalinity (minimum 78%) present in the complete mix.

- i. Manhole riser sections, transition slabs, flat top slabs, and cone sections shall be designed for H-20 loadings.
- j. The manufacturer shall furnish the Engineer with test results on compression and absorption for one section in every twenty-five sections poured, and certification from cement manufacturer and aggregate supplier certifying chemical content. The Engineer reserves the right to pick random sections for the required testing.

2. Steps: Manhole steps will be furnished in accordance with Standard Detail Drawings ASTM C-478 and current OSHA regulations. In addition to the testing requirements of ASTM C-478 each step installed in pre-cast manholes will be tested to resist a 1000 lb pullout. The manhole manufacturer will furnish certification of each test with each shipment showing manhole location, date of test, and results.
3. PVC Liner: Where indicated on the plans or elsewhere in these specifications, manholes shall be furnished with a PVC Liner for resistance to corrosive sewers. The liner shall be as hereinbefore specified for RCP.

C. MISCELLANEOUS STEEL

1. Steel Pier Material: Steel piles, cross braces, cradles, etc., shall consist of structural steel shapes of the section required on the Plans and Details. The steel shall conform to Specifications For Steel For Bridges And Buildings, ASTM A-36.

All bolts and nuts will conform to ASTM A-325 for 7/8-inch and to ASTM A-490 for 1-inch and larger.

The Contractor shall handle and store steel members above ground on platforms, skids, or other supports. Members shall be free of dirt, grease, and other foreign material and protected against corrosion.

Coal tar epoxy coating Koppers' No. 300M, Amercoat No. 78, Carboline-Carbomastic No. 14 or approved equal shall be applied to all specified surfaces of the steel pier.

Welding Electrodes shall conform to the following:

Shielded Metal-Arc: AWS A5.1 or AWS 5.5, E70XX

Submerged-Arc: AWS A5.17, F70X-EXXX

Gas Metal-Arc: AWS A5.18, E70S-X or E70U-1

Flux Cored-Arc: AWS A5.20, E70T-X (except 2 and 3)

2. Steel Encasement Pipe: Steel pipe shall be welded or seamless, smooth wall or spiral weld, consisting of Grade "B" steel as specified in ASTM A-139.

Minimum yield strength shall be 35,000 PSI; and pipe thickness shall be as specified for each individual job.

All pipe shall be furnished with beveled ends prepared for field welding of circumferential joints. All burrs at pipe ends shall be removed.

Encasement pipe must be approved by the appropriate controlling agency (D.O.T., R.R., etc.) and the Engineer prior to ordering.

3. Structural Steel Tunnel Liner Plates: The tunnel liner plates shall be either the four (4) flange type (as approved for use within D.O.T. right-of-way) or the lap seam type (as approved for use within railroad right-of-way) fabricated to permit assembly of a continuous steel support system as the tunnel is excavated. Tunnel liner plates shall be fabricated from hot rolled, carbon steel sheets or plates conforming to the specifications of ASTM A-569.

The tunnel liner shall be designed in accordance with the requirements of Section 16-Division I and constructed to conform to Section 25-Division II of the current or interim AASHTO Standard Specifications for Highway Bridges.

Liner plates shall be galvanized in accordance with AASHTO M167 and fully bituminously coated in accordance with AASHTO M190. All hardware necessary to the tunneling operation shall be hot-dip galvanized in accordance with ASTM A-153 prior to bituminous coating application. Hardware shall conform to ASTM Specification A-307, Grade A.

The minimum mechanical properties of the flat steel plate before cold forming used for the design of the tunnel liner shall be:

- A. Minimum Tensile Strength of Liner Plates: 42,000 P.S.I.
 - B. Minimum Yield Strength of Liner Plates: 28,000 P.S.I.
 - C. Steel Liner Plates must be approved by the appropriate controlling agency (DOT, Railroad, etc.) and the Engineer prior to ordering. Gauge or thickness of liner plates will be as noted on the plans and elsewhere in these specifications.
 - D. Elongation, 2-inches = 30 percent
 - E. The moment of inertia shall be .042 inches to the 4th power per inch of width for four flange 12 gage liner plate.
4. Steel Vent Pipe: Unless otherwise specified, steel vents shall be Schedule 40 five-inch (5") diameter steel pipe, consisting of Grade "B" steel as specified in ASTM A-139.

All steel shall be Grade "B" only, with a minimum yield strength of 35,000 P.S.I.

The steel pipe shall have an inside coal tar lining 3/32 inch minimum thickness in accordance with AWWA C-203 or a coal tar epoxy lining conforming to that required for steel (aerial creek crossing) pipe.

Outside surface of pipe shall be sand or grit blasted to commercial standard and have one (1) coat of zinc chromate primer applied in accordance with Federal Specification TT-86a.

Pipe shall be furnished with two (2) evenly applied coats of rust inhibiting enamel paint, either Koppers Glamortex No. 501 Enamel (Olive Green), Southern Coatings Rustaloy No. 0537 Enamel (Garden Green), or equal.

5. Steel Straps And Anchors: All pipe and/or pier straps shall conform to the requirements of ASTM A-36 with a minimum yield strength of 36,000 P.S.I.

Finished straps and anchors shall be galvanized in accordance with ASTM A-153. The entire strap and all exposed surfaces of anchors and/or bolts (and nuts) shall be fully bituminously coated in accordance with AASHTO M-190. Anchor bolts (non-head) shall conform to ASTM A-36 with tension test to be made (as required) on the bolt body or on the bar stock used for making the anchor bolts. Unless otherwise specified all other fasteners shall conform to ASTM A-307 for carbon steel externally and internally threaded standard fasteners Grade A or B.

6. Steel Reinforcing For Concrete:
 - A. Bars: All reinforcement bars shall conform to the Standard Specifications for BILLET-STEEL BARS FOR CONCRETE, REINFORCEMENT, ASTM A-615. All bars shall be deformed and of structural Grade 60.
 - B. Wire: All reinforcement wire fabric shall conform to the Standard Specifications for WELDED STEEL WIRE FABRIC FOR CONCRETE REINFORCEMENT, ASTM A-185.

D. CONCRETE

1. Portland Cement: All concrete shall conform to the Standard Specifications for READY MIXED CONCRETE, ASTM C-94. An air-entraining admixture, conforming to ASTM C-260, shall be added to either Type I, Type II, or Type III Portland Cement. Fly Ash conforming to ASTM C-618 for Class C Fly Ash may be added to the concrete mix but shall not be considered as replacement for more than 10% of the cement therein (strengths shall not be less than hereinafter required).

Types I, IA, III and IIIA Portland Cement shall only be used for manhole inverts, concrete encasement, concrete blocking, and/or as directed by the Engineer, and shall conform to ASTM C-150.

Types II and IIA Portland Cement shall be used in precast manholes, cast in place manhole structures, reinforced concrete pipe, reinforced concrete piers and concrete or reinforced concrete rip-rap as directed by the Engineer, and shall conform to ASTM C-150 except that Tricalcium Aluminate ($3\text{CaOAl}_2\text{O}_3$) content shall not exceed 8%.

2. Aggregates: All aggregates used for concreting shall conform to ASTM C-33 and shall be checked daily for any variances in moisture content. Said variances shall be corrected and/or taken into consideration for each batch.
 - a. Coarse Aggregates: Shall be uniformly and evenly graded for each application in accordance with A.C.I. Standard 318. Unless otherwise approved, aggregate shall be sound, crushed, angular granitic stone. Smooth or rounded stone (river rock) shall not be acceptable.

- b. Fine Aggregates: Shall consist of natural sand, manufactured sand or a combination thereof. Fine aggregates shall conform to the sieve analysis as specified in paragraph 4.1 of the standard except that the percent passing a No. 50 sieve shall not exceed 5% and the percent passing a No. 100 sieve shall be 0% as provided for in paragraph 4.2 of the standard.
3. Mix Design: Concrete shall be watertight, resistant to freeze-thaw cycles and moderate sulfate attack, abrasion resistant, workable, and/or finishable. These qualities may be met through the use of admixtures (if and only if approved in the mix design as hereinafter specified) conforming to the appropriate ASTM with the exception of the use of calcium chloride, which shall be limited to no more than 1% by cement weight - thoroughly mixed to insure uniform distribution within the mix. If the concrete is used with reinforcing steel, no calcium chloride will be allowed.

The Contractor shall assume responsibility for concrete mixture. The concrete shall be proportioned to meet the following requirements: (Note: This mix does not apply "in total" to precast manhole or reinforced concrete pipe).

A.	Compressive Strength	Minimum 3600 PSI
B.	Water-Cement Ratio By Weight	Maximum-0.50
C.	Slump	Min. 3" Max. 5"
D.	Air Content (Entrained & Entrapped)	Min. 4% Max. 6%
E.	Coarse Aggregate	3/4"-1 1/2 (as required by the application)

When required by the Engineer, and prior to beginning construction, the Contractor, at his expense, shall obtain from an approved commercial testing laboratory a design for a suitable concrete mix and submit same with his list of materials and material suppliers for approval.

4. Curing Compound: All concrete curing compounds shall conform to the standard specifications for LIQUID MEMBRANE - FORMING COMPOUNDS FOR CURING CONCRETE, ASTM C-309, Type 2.

Curing compounds shall be applied as forms are stripped.

5. Grouts: All grouts shall be of a non-shrink nature (as may be achieved through additives or proportioning) and depending upon application range from plastic to flowable cement water paste. Testing as specified above for concrete may be required for acceptance of grouts to include frequent checks for consistency by a time-of-flow measurement.

Expansion grouts shall be either Gilco pre-mixed or Supreme non-metallic grout as manufactured by Gifford-Hill and Company, Incorporated, or Embecco 636 grout as manufactured by Master Builders or equal.

Acceptable range of testing requirements:

Compressive Strength	10,500 to 12,500 PSI
Bond Strength	1,350 to 1,700 PSI
% Expansion	+0.025% to +0.75%

Expansion grouts shall be used only as directed by the Engineer.

Grouts shall be mixed (if applicable) and placed in accordance with the manufacturer's current recommendations, for each specific application.

6. Mortar: Mortar used in sanitary sewer manholes shall be hydraulic cement mortar in accordance with ASTM C-398. Mortar used in water meter vaults and water valve vaults shall be Type M mortar in accordance with ASTM C-270.

E. STONE AND BRICK

1. Granular Bedding Material: All bedding material shall be angular, clean washed crushed stone graded in accordance with Size #67 in ASTM D-448 for "Standard Sizes of Coarse Aggregate", (NCDOT Standard size #67).

Bedding material will be used only as instructed in the Specifications and/or as specifically directed by the Engineer.

2. Stone Stabilization Material: All stone stabilization material shall be angular, clean washed crushed stone graded in accordance with standard sizes #467 in ASTM D-448, (NCDOT Standard size #467M).

Stabilization material will be used only as instructed in the specifications and/or as specifically directed by the Engineer.

3. Silt Check Dam Material: Shall be coarse angular, clean washed crushed stone, gravel, or rock, well graded, and ranging in size from 2-inches to 6-inches, (NCDOT stone for erosion control-Class A).

4. Rip Rap: All rip rap shall consist of clean field stone or rough unhewn quarry stone, resistant to the action of air and water, varying in weight from 25 to 250 pounds with 60% weighing a minimum of 100 pounds each and no more than 5% weighing less than 50 pounds each, (NCDOT Class 2 Rip Rap). Rip rap will be placed from a minimum of 4.0 feet below the toe of the bank to top of the bank in areas determined by field conditions. Rip rap thickness shall be 1 \square times the diameter of the largest stones used, or 2.0 feet, whichever is greater.

5. Brick: All brick used to construct manhole inverts or adjust frames shall be made from clay or shale, shall be solid only and shall be of standard building size. All brick shall meet or exceed the compressive strength and water absorption properties specified in ASTM C-32 for Grade MS brick or in ASTM C-216 and ASTM C-62 for Grade SW brick.

F. FERROUS CASTINGS

1. Special Castings: All cast iron pipe fittings and special castings shall be furnished in weight, classes, and/or special thickness as specified elsewhere. The castings shall conform to ASTM A-126 and shall be manufactured in domestic foundries. Coatings and linings (if applicable) shall be the same as specified for Ductile Iron Pipe.
2. Frames, Covers And Grates: All manhole frames and covers shall conform to ASTM A-48, Class 30 and shall be manufactured in domestic foundries. Dimensions shall conform to the Standard Details.

Manhole frames and covers shall be furnished with the common contact surfaces between frame and cover machined. Frames and covers shall be Dewey Brothers RCR 2010, Vulcan VM-83, U.S. Foundry or approved equal.

Where watertight frames and covers are specified, the watertight seal between frame and cover shall be accomplished by means of a rubber gasket. Watertight frames and covers shall be Dewey Brothers RCR 2010W, Vulcan VM 1383, U.S. Foundry or approved equal.

G. TRAFFIC CONTROL DEVICES

All traffic control signs, barrels, barricades, pavement markings, etc., shall conform to the "Manual on Uniform Traffic Control Devices" (MUTCD) published by the U.S.D.O.T. and any supplements to the MUTCD adopted by N.C.D.O.T.

H. EROSION CONTROL

1. Seed: All seed shall be labeled to show that it meets the current requirements of the North Carolina Seed Law. Seed shall have been tested within the six (6) months immediately preceding its use. Further specifications for each seed item are given below:
 - a. Kentucky Fescue #31: Minimum 98% pure live seed; maximum 1% weed seed; minimum 90% germination.
 - b. Sericea Lespedeza (Scarified and Unscarified): Minimum 98% pure live seed; maximum .50% weed seed; minimum 85% germination. Scarified may include 20% hard seed.
 - c. Rye Grass (Annual): Minimum 98% pure live seed; maximum .10% weed seed; minimum 85% germination.
 - d. Sudangrass: Minimum 98% pure live seed; maximum .25% weed seed; minimum 85% germination.

- e. Certification/Supplier: The contractor shall furnish the State's Landscape Supervisor in Albemarle, North Carolina (for work in Department of Transportation rights-of-ways) and the City's Construction Engineer (for all work) the name of the supplier of seed, the seed type and the total amount (not seed rate) to be used in restoring disturbed groundcover. This information shall be furnished at least four (4) weeks prior to reseeding operations so that quality tests can be made by the appropriate controlling agency. Seed containing prohibited noxious weed seed shall not be accepted. Seed shall conform to the state law restrictions for restricted noxious weeds.

2. Fertilizer: All fertilizer for undeveloped areas shall have minimum 5-10-10 analysis or a comparable 1-2-2 ratio. All fertilizer for established lawn areas shall have a minimum 10-10-10 analysis or a comparable 1-1-1 ratio. All fertilizer shall be uniform in composition, dry and free flowing and shall be delivered to the job site in the original unopened containers, each bearing the manufacturer's guaranteed analysis. Any fertilizer which becomes caked or otherwise damaged will not be accepted. The quality of all fertilizer and all operations in connection with furnishing same, shall comply with the current requirements of the North Carolina Fertilizer Law and with the current applicable Rules and Regulations adopted by the North Carolina Board of Agriculture.

3. Lime: All lime shall be finely ground limestone (Dolomite) containing not less than 85% total carbonates. Lime shall conform to the specifications of the North Carolina Department of Agriculture for Agricultural Grade.

4. Superphosphate: All superphosphates shall be composed of finely ground phosphate rock, as commonly used for agricultural purposes, containing not less than 20% available phosphoric acid.

5. Mulch: All mulch shall be small grain or tame hay. Small grain or tame hay shall be furnished undamaged, air dried, threshed and free of undesirable weed seed.

6. Erosion Control Fabric: Material shall be as specified in the Environmental Protection Section of these specifications per Erosion Control Standard Detail 6.62.

7. Jute Netting Or Thatching: All jute shall be of a uniform open plain weave of single jute yarn, 18-inches in width (1"). The yarn shall be of loosely twisted construction and shall not vary in thickness by more than one-half (□) its normal diameter.

There shall be 78 warp ends (2), per width of netting; 41 weft ends (1), per linear yard; and the weight shall average 1.22 pounds (5%) per linear yard of netting. Jute shall be anchored into place in accordance with the manufacturer's requirements. Installation shall only be at the direction of the Engineer.

8. Erosion Control Blanket: Erosion control blankets shall be manufactured from wood fiber, straw, coconut fiber or other degradable material woven into a mat and secured with photo degradable plastic mesh or biodegradable thread. Blankets shall be installed according to manufacturers recommendations where directed by the Engineer. The following manufacturers are approved: AMXCO-Curlex Blanket, North American Green-SC 150, and HV Excelsior.

9. Gabions: Gabions shall be manufactured from zinc coated steel wire mesh (minimum H-gauge) to form rectangular units. The front, base, back and lid shall be woven into a single unit and the ends and diaphragms shall be factory connected to the base. The individual units shall be installed per the manufacturers instructions and filled with hard durable, clean stone from 4-8 inches inside or as approved by the Engineer.

DETAILED SPECIFICATIONS FOR SANITARY SEWER CONSTRUCTION

The Contractor shall furnish all materials, equipment and labor required to construct the project as outlined in these specifications and accompanying plans.

A. HANDLING AND STORAGE OF MATERIALS

The Contractor shall be responsible for the safe storage of materials furnished by or to him, and accepted by him and intended for the work, until they have been incorporated in the completed project. The interior of all pipe, manholes and other accessories shall be kept free from dirt and foreign materials at all times.

1. Transportation of Materials and Equipment: The Contractor and his Suppliers are directed to contact the North Carolina Department of Transportation to verify axle load limits on State maintained roads (and bridges) which would be used for hauling of equipment and materials for this project. The Contractor and his Suppliers shall do all that is necessary to satisfy the Department of Transportation requirements and will be responsible for any damage to said roads which may be attributed to this project.

All materials furnished by the contractor shall be delivered and distributed at the site by the Contractor or his material supplier.

2. Loading and Unloading Materials: Ductile iron pipe and cast iron accessories shall be loaded and unloaded by lifting with hoists or skidding so as to avoid shock or damage. Concrete pipe, clay pipe, and precast manholes will be unloaded with hoists and/or as recommended by the respective manufacturers. Under no circumstances shall such materials be dropped. Pipe handled on skidways shall not be skidded or rolled against pipe already on the ground.
3. Responsibility for Materials on Site: In distributing the material at the site of the work, each piece shall be unloaded opposite or near the place where it is to be laid in the trench. Pedestrian or vehicular traffic shall not be unduly inconvenienced in placing of material along the streets or right-of-way, as applicable.

The Contractor will string in advance no more than the amount of pipe and material that can be installed within four (4) weeks or less as approved by the Engineer. All the materials shall be placed in such a manner as not to hinder access, endanger or impede traffic, or create a public nuisance. Materials strung through residential areas (or any area with maintained lawns) shall be placed in such a manner as not to restrict normal maintenance of established lawns, and must either be installed within two (2) weeks or removed to an approved storage yard, as required by the Engineer.

4. Material and Equipment Storage: The Contractor will be responsible for locating and providing storage areas for construction materials and equipment. Unless prior written consent from the owner of the proposed storage area is received by this Department, the Contractor will be required to store all equipment and materials within the limits of the sanitary sewer right-of-way and temporary construction easement provided. The materials and equipment storage shall comply with all local and state ordinances throughout the construction period. Material and equipment may only be stored within road right-of-way if approved by the controlling agency.

The Contractor shall be responsible for the safeguarding of materials and equipment against fire, theft, and vandalism and shall not hold the City responsible in any way for the occurrence of same.

5. Care of Coatings and Linings: Pre-cast manholes, pipe and fittings, including rings and covers, steps, straps, etc., shall be so handled that the coating or lining will not be damaged. If, however, any part of the coating or lining is damaged, the repair shall be made by the Contractor at his expense in a manner satisfactory to the Engineer.

B. CONNECTION TO EXISTING SEWERS

Tie-ins to existing activated sewer lines will be allowed when proper precautions are taken to protect the existing main. Tie-ins to existing unactivated sewer lines not installed under the same contract will not be allowed without written approval from all parties involved (CMUD, contractors, contract holders, etc.). The Contractor will be required to install watertight masonry plugs in the proposed pipeline at the existing manhole and at the first proposed manhole until all construction is completed and testing begun. If the proposed sewer does not begin at an existing manhole, a straddle type manhole as shown on the Standard Details will be constructed over (and around) the undisturbed existing pipeline and the proposed pipeline plugged as specified. The existing pipeline will not be broken-out and the new invert formed until all testing has been successfully completed. Any connection with 18-inch and smaller pipe at an existing precast or cast-in-place manhole will require the Contractor to core the necessary opening through the manhole wall. Connections to existing manholes with 21-inch and larger pipe may be cored or sawed as approved by the Engineer.

1. Temporary Watertight Plugs: The Contractor shall install temporary watertight plugs in the proposed sewer line at any manhole that is incomplete, at the open end of the pipeline prior to leaving the job site daily and elsewhere as dictated by good engineering and construction practices. All installed pipe shall be backfilled or otherwise securely tied down to prevent flotation in the event water enters or rises in the trench.

The plugs as installed shall prevent infiltration or the introduction of any foreign material into either the existing or proposed systems.

The City will not accept any pipeline or manhole which contains any silt, sedimentation or other foreign material, within. The Contractor shall at his own expense flush, or otherwise cause the line (and manholes) to be cleaned out without any discharge into the existing system.

Upon completion of all construction, the Contractor will be responsible for the complete removal of all watertight plugs, in the sequence necessary to allow testing and subsequent activation, all under the direction of the Engineer.

2. Scheduling: When the flow of an existing sewer must be interrupted and/or bypassed, the Contractor shall, before beginning any construction, submit a work schedule which will minimize the interruption and/or bypassing of wastewater flow during construction. This schedule must be approved by the appropriate controlling agencies and Engineer and may require night, holiday, and/or weekend work.
3. Bypass Pumping: If pumping is required, an identical standby pump shall be on site in the event of failure of the primary pump. If, at any time during construction, effluent from the existing sewer is not fully contained by the bypass system, gravity service will be restored by a temporary tie to the new construction and work shall be suspended until the problem is resolved to the satisfaction of the Engineer. The Contractor shall be responsible for any fines levied as a result of effluent reaching the creek. The Contractor will be required to verify his method of handling sewer flows during construction by pumping at peak flows for 1 hour as approved by the Engineer.

C. EXISTING UTILITIES

The Contractor will be required to excavate to determine the precise location of utilities, or other underground obstructions, which are shown on the Construction Plans. Such location and excavation shall be at least 500 feet ahead of construction or as noted in the Special Provision Section of this document.

All utility owners will be notified prior to excavation as required by the 1985 Underground Damage Prevention Act. Owners who are members of ULOCO may be notified in accordance with current ULOCO procedures. The Charlotte-Mecklenburg Utility Department is not a ULOCO member. The Contractor will be fully responsible for damage to any utilities if the owners have not been properly notified as required by the Underground Damage Prevention Act.

Utility owners may, at their option, have representatives present to supervise excavation in the vicinity of their utilities. The cost of such supervision, if any, shall be borne by the Contractor.

Conflicts with underground utilities may necessitate changes in alignment and/or grade of this construction. All such changes will be approved by the Engineer before construction proceeds.

When underground obstructions not shown on the Construction Plans are encountered, the Contractor shall promptly report the conflict to the Engineer and shall not proceed with construction until the conflict is resolved by the Engineer.

Whenever a sewer main crosses under other utility lines (gas, telephone conduit, storm drain, etc.) there shall be 2 feet clearance between the top of the sewer and the bottom of the affected utility. Stone bedding shall be used from 6-inches below the sewer to 12-inches above the sewer from one foot outside the utility trench. If this clearance is not possible, the sewer line shall be Ductile Iron Pipe from one foot outside the utility trench with a minimum length of 10 feet.

Whenever a sewer main crosses over other utility lines (storm drain, gas, encased or capped telephone conduit, etc.) the following will apply:

For VCP sewer lines - The sewer line shall be DIP from one foot outside the utility trench with a minimum length of 10 feet.

For PVC sewer lines - There shall be one foot clearance from the top of the utility to the bottom of the sewer. If this clearance is not possible the sewer line shall be ductile iron pipe from one foot outside the utility trench with a minimum length of 10 feet.

D. SEWER LINE/WATER LINE CLEARANCE

When a sewer main or lateral crosses or is parallel to an existing water main, the Contractor shall install ductile iron pipe (including laterals) for the sewer main and water main as described below.

1. Vertical Separation Of Sewer Lines & Water Lines: Whenever it is necessary for a sewer main to cross under a water main with less than 18-inches of vertical separation, the sewer main and water main shall be constructed of ductile iron pipe, with joints meeting water main standards, for a distance of 10 feet on each side of the point of crossing.

Whenever it is necessary for a sewer main to cross over a water main, the sewer main and water main shall be constructed of ductile iron pipe, with joints meeting water main standards, for a distance of 10 feet on each side of the point of crossing.

2. Horizontal Separation of Sewer Lines and Water Lines: Sewer mains shall be laid at least 10 feet horizontally from existing or proposed water mains unless local conditions or barriers prevent a 10-foot horizontal separation. In that case, the sewer main will be laid in a separate trench, with the elevation of the bottom of the water main at least 18-inches above the top of the sewer. When these conditions are not met, the sewer main and water main shall be constructed of Ductile Iron Pipe with joints meeting water main standards.
3. Horizontal Separation Of Sewer Lines and Water Wells: Sewer lines shall be installed at least 100 feet from water wells. Where this separation is not possible the sewer line shall be ductile iron pipe. Sewer lines shall not be installed within 25 feet of any private well or within 50 feet of any community well.

E. CLEARING

Unless otherwise specified, the entire permanent right-of-way shall be cleared and all stumps, limbs and trash removed and disposed of at an approved location. When the sewer line is installed in undeveloped/non-maintained areas (woods), stumps can be left flush with the ground if they are outside the trench excavation. Stumps must be removed from all maintained areas (yards, lawns, etc.).

Temporary construction easements will be selectively cleared with specimen trees left standing as stipulated in Special Provisions and/or right-of-way agreements. No clearing or grubbing may be performed on rights-of-way except under supervision of the Project Inspector.

Useable timber and/or firewood may be left on adjoining property, off the permanent right-of-way at the request of or with the consent of the property owner. Such requests must be in writing and must release the City from any claims for improper disposal of timber.

The Contractor shall abide by all special conditions contained in the right-of-way agreements for this project. When the right-of-way agreement specifies stacking timber or firewood adjacent to the right-of-way, a written release is not required. The Contractor shall verify cut lengths of timber/firewood for such placement and location with the property owner.

Fences removed during construction shall be replaced of the same material and to the same condition existing prior to the construction. The Contractor may refer to the "Environmental Protection Section" contained herein for further instructions pursuant to right-of-way treatment.

The Contractor shall confine all his operations to the bounds as set forth in all rights-of-way unless prior written approval of the current property owner is obtained and submitted to the Engineer for his approval.

F. EXCAVATION

All excavations for pipe laying, manholes, piers, drainage ditches, grading and any other excavation required for the proper completion of this contract shall be included herein.

Excavation within street rights-of-way shall be backfilled when left unattended for more than 1 hour unless otherwise approved by the controlling agency. Excavations within sewer/water rights-of-way shall be backfilled, fenced or otherwise protected when left unattended for more than 1 hour. Fencing or other protection methods shall be designed to reasonably prevent people and large animals from entering the excavation.

1. Trench Excavation: No more trench (100 LF) shall be opened in advance of the pipe laying than is necessary to expedite the work unless prior approval is given by the Engineer. Ground conditions and/or location requirements shall govern the amount of trench open at any one time as determined by the Engineer.

a. Trench Width: The maximum trench width shall be as indicated for each type of pipe specified. If the actual trench width exceeds the specified width, due to shoring methods, the contractor must obtain approval from the Engineer.

Trench width shall be measured between faces of cut at the top of the pipe bell. If the Contractor varies from this requirement without prior approval of the Engineer, or if specified trench widths cannot be maintained, improved bedding and/or improved pipe material shall be installed as directed by the Engineer.

- b. Trench Bottom Conformation: The excavation shall be made to the elevations, grades, and lines shown on the Construction Plans unless otherwise approved by the Engineer. The trench bottom shall be excavated slightly above grade and cut down to the pipe grade by hand in the fine grading operation. The trench bottom shall be true and even with bell holes at each joint to provide the barrel of the pipe with soil and/or granular bedding (as applicable) support for its full length. This should prevent point loading at the bells. If the trench bottom is inadvertently cut below grade, the Contractor shall fill it to grade with approved material thoroughly tamped.

Pipe depth and/or soil conditions may dictate a granular embedment as specified below. Such bedding shall also be shaped to allow adequate support of the pipe along the full length of the barrel.

If the trench passes either under or over another pipeline or previous excavation, the trench bottom in this area shall be tamped, if necessary, so the disturbed soil has approximately the same supportive strength as the native soil.

2. Excavation for Structures: The excavation shall be made to the lines, grades and elevations shown on the Plans and Standard Details. The area excavated shall be limited to no more than is necessary to allow the proper installation of the structure as determined by the Engineer. The excavation shall remain open no longer than is necessary to allow the proper and complete installation of the structure.
 - a. Structure Pit Bottom Conformation: The pit bottom shall be true and even, and capable of supporting the structure as determined by the Engineer. If the pit bottom is inadvertently cut below grade, the Contractor shall fill it to the proper elevation with approved material capable of continually maintaining adequate supportive strength.
3. Excavation for Bore Pits: The excavation shall be controlled by the limits of the existing rights-of-way and shall not exceed these without prior written approval of the current property owner. The excavation shall be made to the proper elevation, line and grade as required to install the casing pipe as shown on the construction plans.
 - a. Bore Pit Conformation: The pit bottom shall be true and even with adequate stabilization to maintain proper elevation and grade on the boring rig for the duration of the bore.
4. Rock Excavation: Rock excavation shall be defined as solid ledge rock that requires drilling and blasting, sledging, or barring for its removal. Soft, disintegrated rock that can be removed with a pick shall not be classified as solid rock.

Boulders greater than one cubic yard in volume will also be considered rock excavation. Smaller boulders and soft rock which in the opinion of the Engineer can be excavated by the use of a power shovel, without undue delay, shall not be classified as rock.

Rock shall be removed to a depth of six (6) inches below the pipe bell and to the trench widths specified for each size and type of pipe installed. Rock around structures shall be removed to the same twelve (12) inch minimum as measured between vertical planes around the structure, but only to a depth necessary to allow proper installation. Over excavation of rock due to removal methods, or for safety considerations, shall be the Contractor's responsibility.

When rock removal is necessary for pipeline installation either Type II or Type III bedding shall be installed as specified and directed by the Engineer.

All blasting shall be conducted in a manner as specified elsewhere in these Specifications.

5. Piling Excavated Material: All excavated material shall be piled in a manner that will not endanger the work. Excavated material will be piled a safe distance away from the edge of the excavation allowing room for an adequate angle of repose and if shoring, sheeting, and bracing is used to protect the excavation, no material will be piled within three (3) feet of the nearest edge. Sidewalks, driveways, hydrants, valve pit covers, valve boxes, curb stop boxes, existing manholes, fire and police call boxes, or other utility controls shall be unobstructed and accessible until the work is completed. Gutters, catch basins, and natural watercourses shall not be obstructed or silted.

When working in close proximity with a creek channel or natural watercourse the Contractor shall pile all excavated material on the side of his excavation away from the watercourse.

6. De-watering: The Contractor shall at all times provide and maintain ample means and equipment with which to remove and properly dispose of any and all water entering the excavation or other parts of the work and keep all excavations dry until such time as pipe laying and grading is completed and structures to be built therein are completed.

No water shall be allowed to rise around the pipe in unbackfilled trenches nor shall it be allowed to rise over masonry until the concrete or mortar has set (minimum 24 hours). All water pumped or drained from the work shall be disposed of in such a manner as to prevent siltation and erosion to adjacent property or other construction.

7. Shoring And Shielding: The Contractor shall comply with OSHA trenching and excavation regulations as revised in Subpart P of Part 1926 in the Federal Register. Shoring and/or shielding systems shall be used as specified in Subpart P to prevent caving of trench banks and to provide a safe excavation.

The Contractor will be responsible for excavation safety and shall designate his "competent person" (as defined in Subpart P) for the determination of proper shielding/shoring systems.

If, in the opinion of the Engineer, the trench/excavation is not in compliance with OSHA regulations, the Contractor may be directed to stop work. Continued unsafe conditions will be reported to the appropriate regulatory agency. The Contractor will be responsible for paying all fines resulting from safety violations.

G. PIPE LAYING

In all instances pipe shall be laid in a workmanlike manner, true to line and grade, with bell ends facing up-grade in the direction of laying. The various pipes referred to herein shall be handled, belled up and laid in accordance with the manufacturer's requirements and good engineering practices as defined in the various publications referenced in this document. The following requirements and/or standards of the Charlotte-Mecklenburg Utility Department shall govern this construction unless exceeded by other regulatory bodies.

1. Pipe Bedding: Unless otherwise specified or noted on the Plans the following bedding classes are as commonly required by this Department.

When granular material embedment is required, the Contractor will follow the layered procedure specified in Type I for soil placement, above the granular bedding, to an elevation one (1) foot above the top of the pipe bell.

- a. Type I - Shaped Bottom Bedding: The trench bottom shall be shaped so the pipe bears uniformly upon undisturbed native earth. Soil shall then be placed by hand around the pipe and completely under the pipe haunches in uniform layers not exceeding six (6) inches in depth up to an elevation one (1) foot above the top of the pipe bell.

Each layer shall be placed and then carefully and uniformly tamped, so that the pipe is not damaged nor the alignment disturbed.

- b. Type II - Granular Material Embedment: The trench bottom shall be undercut a minimum of six (6) inches below the pipe barrel grade and filled with an approved stone to an elevation such that the pipe will be completely and uniformly bedded to a vertical height of one-third the outside diameter of the pipe bell for the pipe's entire length and for the entire width of the ditch. Depending upon soil and ground water conditions, greater depths (undercut) may be required to create a stable condition. Type II granular material embedment shall be used as directed by the Engineer.
- c. Type III - Granular Material Embedment: The trench bottom shall be undercut a minimum of six (6) inches below the pipe barrel grade and filled with an approved stone to an elevation such that the pipe will be completely and uniformly bedded to vertical height of one-half the outside diameter of the pipe bell for the pipe's entire length and for the entire width of the ditch. Depending upon soil and ground water conditions, greater depths (undercut) may be required to create a stable condition. Type III granular material embedment shall be used as directed by the Engineer.
- d. Stone Stabilization: When the bottom of the trench is not sufficiently stable to prevent vertical or lateral displacement of the pipe after installation with Type II or Type III bedding, stone stabilization will be required to develop a non-yielding foundation for the bedding and pipe. When such conditions are encountered, the trench will be excavated to a depth determined by the Engineer, and #467 crushed stone will be placed to an elevation six-inches

below the bottom of the pipe. The pipe will then be laid with Type II or Type III bedding as directed by the Engineer.

- e. Concrete Encasement and Cradles: Shall be as designed for each individual case and will be noted on the Plans and in the Special Provisions when applicable.
2. Installation Depth Limitations: The following are limitations and bedding requirements for supportive strength and shall be adhered to at all times. Granular material embedment may still be required for lesser depths of cover should groundwater and/or soil conditions warrant its use, as determined by the Engineer.
- * The standard trench width for 8"-15" pipe shall be limited to the nominal pipe size plus 30-inches.
 - * The standard trench width for 18"-30" pipe shall be limited to the nominal pipe size plus 36-inches.
 - * The standard trench width for 36" and larger pipe shall be limited to the nominal pipe size plus 42-inches.

Deviations from the standard trench width shall be as approved by the Engineer.

Trench widths must be maintained constant as measured at the top of the pipe. Deviation from the standard trench width will necessitate an increase in the stone bedding around the pipe and/or a change in the type or class of pipe being installed at the Contractor's expense.

All pipes regardless of bedding or pipe type shall require adequate tamping of backfill as specified for Type I, Shaped Bottom Bedding.

- a. Extra Strength Clay Pipe shall be installed with a minimum of 3.0 feet of cover over the top of the pipe and a maximum depth of cover over the top of the pipe subject to the bedding limitations specified below. When the cover is less than 3.0 feet or greater than the depths shown for Type III Bedding, Ductile Iron Pipe must be used.

MAXIMUM DEPTH OF COVER- VCP			
Size	Type I Bedding	Type II Bedding	Type III Bedding
8"-15"	10'	15'	18'

- b. Reinforced Concrete Pipe shall be Class IV or Class V, subject to the maximum depth of cover over the top of the pipe as specified below, based on the bedding type indicated. Greater depths of cover can be attained if the trench width is restricted.

MAXIMUM DEPTH OF COVER - RCP						
SIZE	TYPE I BEDDING		TYPE II BEDDING		TYPE III BEDDING	
	Class IV	Class V	Class IV	Class V	Class IV	Class V
18"-48"	12'	17'	16'	24'	20'	30'

- c. Ductile Iron Pipe: Installation of Ductile Iron Pipe shall be installed subject to the bedding limitations specified below, based on a deflection limit of three (3) percent for cement lining. Greater depths of cover may be achieved by using a higher pressure classification and/or using pipe with a flexible lining.

MAXIMUM DEPTH OF COVER - DIP				
Pipe Size	Pressure Class	BEDDING		
		Type I	Type II	Type III
8"	350	20'	34'	50'
10"	350	15'	28'	45'
12"	350	15'	28'	44'
14"	250	15'	23'	36'
16"	250	15'	24'	34'
18"	250	14'	22'	31'
20"	250	14'	22'	30'
24"	250	15'	20'	29'
30"	250	15'	19'	27'
36"	250	14'	18'	25'
42"	250	14'	17'	25'
48"	250	13'	17'	24'

- d. Poly Vinyl Chloride (PVC) Pipe: PVC pipe shall be installed with a minimum of 3.0 feet of cover and a maximum of 20 feet of cover. When the cover is less than 3.0 feet or more than 20 feet, Ductile Iron Pipe must be used subject to the specified bedding limits. PVC pipe shall be installed in accordance with ASTM D-2321 with the following modifications:

- (1) All PVC pipe shall be installed using Type III Granular Embedment. The bedding shall extend from the pipe to the trench wall or to two and one half pipe diameters (OD) on each side of the pipe, whichever is less.
3. Grade and Line For Pipe: As a minimum, centerline hubs will be set at each manhole and offset stakes set at each manhole, and if required at 100 foot intervals between manholes. Cut sheets will show the vertical distance from the offset stakes to the inlet and outlet pipe invert at each manhole and to the pipe invert at each offset stake. Grade and line may be transferred to "batter boards" set at intervals not to exceed fifty (50) feet. Unless otherwise approved by the Engineer, three (3) batter boards will be in place at all times while pipe laying is in progress. Each joint shall be checked with a grade rod and plumb line with care being taken to keep the string line taut at all times.

Laser beams may be used to set line and grade when the Contractor provides adequate and accurate equipment for the Engineer to check his line and grade at each cut stake (lock levels shall not be considered adequate). If laser equipment is used, the grade shall be checked at each manhole and at benchmarks every 500 feet. The Contractor shall keep close check of his laser for variations in line and grade. No variations between manholes shall be corrected without relaying that portion of line which has deviated from line or grade unless otherwise approved by the Engineer.

H. LATERAL INSTALLATION

1. 4-Inch and 6-Inch Laterals: Four inch and six inch laterals shall be connected to the main with tees as previously specified if the lateral is installed during the construction of the main. Four inch and six inch laterals shall be connected to existing mains with saddles placed in holes cored by an approved coring machine. Saddles and tees shall be as previously specified and as shown on the Standard Details.

Laterals shall be completed to the property line using 22" bends at the tee or saddle and pipe as previously specified and as shown in these Standard Details. The lateral shall be laid with a minimum slope of 1/8-inch per foot (1%). The end of the lateral will be plugged water/air tight. All tees, saddles and bends shall be completely encased in #67 washed stone. An "S" shall be cut in the curb at the location where lateral crosses under curb.

In subdivisions constructed without curb, the Contractor will paint an "S" on the edge of pavement at the location where the lateral crosses under the edge of pavement. Markings will be made using green paint.

All laterals except those serving lots adjacent to in line manholes or upstream from dead-end manholes in cul-de-sacs shall be connected to the sewer main. Laterals connected to manholes shall be laid on a line from the center of the lot to the center of the manhole and shall extend not more than six inches inside the manhole wall. Manholes in cul-de-sacs shall have a maximum of three (3) laterals. Any in line manhole shall have a maximum of two (2) laterals. The lateral elevation entering the manhole shall match crown to crown with the main entering the manhole and a trough shall be formed for the lateral invert. Laterals that are connected to outfall lines shall enter the manhole at the shelf and an invert shall be formed to carry the lateral flow to the main invert.

The laterals shall be installed with a minimum of four (4) feet of cover at the property line, unless otherwise approved by Charlotte-Mecklenburg Utility Department. The depth of the lateral at the property line shall not be greater than five (5) feet unless greater depth is required to serve the building. The Contractor will not backfill any portion of the lateral until the installation is approved by a Charlotte-Mecklenburg Utility Department Inspector.

Measurements: The Inspector, assisted by the Contractor, will measure the distance to the tee or tap from the down-stream manhole to obtain the information required for the "As-Built" records.

2. 8-Inch And Larger Laterals: 8-inch and larger diameter laterals shall connect to manholes with the lateral crown level with the crown of the main line pipe, or with outside drops, in accordance with the specifications and standard details for mainline construction. When the lateral is the same diameter as the main line pipe, a drop of 0.2 feet will be provided in the manhole between the invert of the lateral and the invert of the main line pipe. The lateral shall be laid with a minimum slope of 1/8-inch per foot (1%).

I. BACKFILL

All backfill shall be of a non-plastic nature free from roots, vegetative matter, waste, construction material, rock larger than 3/4 cubic foot, or other objectionable material. Small rock (less than 3/4 cubic foot) shall not exceed 10% of the fill material. Rock shall not be placed within 3-feet of the pipeline or within three feet of the finished grade. Rock larger than 3/4 cubic foot will not be permitted within the trench. No objectionable or unsuitable material will be allowed in the backfill. Backfill material shall be capable of being tamped by mechanical tamps using relatively low velocity and heavy blows. The material shall have no tendency to flow or behave in a plastic manner under the tamping blows. Material deemed by the Engineer as unsuitable for backfill purposes shall be removed from the job site before backfilling operations begin.

When the Engineer determines that the material excavated from the trench is unsuitable for backfill because of the material type or because it contains excessive debris, rock or organics, it shall be removed from the project and replaced with a backfill material approved by the Engineer. When the moisture content of an otherwise suitable material is too high to achieve specified compaction, as determined by a moisture content and density test, the Contractor shall replace the material as necessary to meet backfill requirements. The wet material may be dried to optimum moisture content and used for backfill in subsequent phases of the project. Should an otherwise suitable material be found too dry to achieve compaction requirements, water may be added to the material to raise the moisture content to optimum.

Borrow material placed at the direction of the Engineer shall be clean earth at optimum moisture content, concord (pit) gravel or ABC stone.

Backfill shall be accomplished immediately after the pipe is laid. Backfill around pipe and to an elevation of one (1) foot above the pipe bell shall be done only by hand and in layers not exceeding six (6) inches with each and every layer thoroughly tamped. The first three (3) feet of fill shall be completely free of rocks. Successive layers of backfill shall be compacted in place as specified below.

Under no circumstances shall water be permitted to rise in unbackfilled trenches after the pipe has been placed. Should water rise in an unbackfilled ditch after the pipe has been placed, the Engineer may require the Contractor to remove the pipe, muck the trench and follow the procedure for either Type II or Type III Granular Embedment when relaying the pipe.

1. Backfill of trenches within sewer main rights-of-way: Trenches excavated outside existing roadway and railway right-of-way may be backfilled, above the initial one (1) foot, by mechanical means in layers up to twelve (12) inches thick unless otherwise directed by the Engineer.
2. Backfill of trenches within road and railway rights-of-way: Trenches excavated within existing road and railway rights-of-way shall be backfilled in layers not to exceed six (6) inches and each successive layer shall be thoroughly tamped, as specified.

J. COMPACTION REQUIREMENTS

Compaction shall be attained by the use of mechanical tamps only. Each layer of backfill shall be placed loose and thoroughly compacted in place. Heavy rollers, vehicles or other equipment shall not be used for compacting pipeline and structure backfill nor allowed to cross over completed work except at points adjudged capable of adequately protecting the pipeline. Pneumatic tamps, gasoline ram type tamps or vibrating tamps with sheepsfoot rollers will be required to meet the specifications of "Mechanical Tamp". Variances shall only be with the explicit approval of the Engineer.

1. Compaction Within Sewer Rights-of-way: Trenches excavated outside existing road and railway rights-of-way shall be backfilled as hereinbefore specified and tamped thoroughly:
 - a. All material shall have an in-place density of at least 85% of maximum dry density or as approved by the Engineer.
 - b. Should any public or private roadways, service roads, drives, etc. be encountered during this construction, the Contractor shall at the Engineer's direction comply with those compaction requirements specified below for work within road and railway rights-of-way.
2. Compaction Within Road and Railway Rights-of-Way: Unless otherwise approved by the controlling agencies, trenches excavated within existing road and railway rights-of-way and all structure excavation regardless of location shall be backfilled as hereinbefore specified and thoroughly tamped:

- a. Unless otherwise directed by the Engineer, all material from the bottom of trench to within six (6) inches of the subgrade shall have an in-place density of 95% of the maximum dry density as defined by a standard proctor curve for the material.
 - b. All material within six (6) inches of the subgrade level shall have an in place density of 100% of the maximum dry density.
 - c. On roadway shoulders, all material shall have an in place density of 95% of the maximum dry density. The Contractor shall remove and replace all material failing to meet these requirements with suitable material. The extent of this removal shall be determined by the Engineer.
3. Compaction Testing: Moisture content and density testing of backfill will be performed by CMUD soils technicians. Tests will be performed within all street, highway and railway rights-of-way to insure that the specified compaction requirements are met. The Contractor will cooperate fully with the soils technicians in providing access to backfill at any requested depth for the purpose of performing moisture content/density testing. When requested, the Contractor shall excavate a backfilled ditch to any specified depth for a compaction test and shall insure that the ditch meets all OSHA safety standards before the technician enters to perform the test.

A "standard proctor curve" which establishes the relationship between moisture content and dry density for soil will be determined by the method described in ASTM D-698 or by AASHTO Method T-99. Field density tests will be performed using either the sand cone method or a nuclear moisture/density gauge. Any backfill which does not meet the specified compaction will be re-tamped, or removed and replaced as approved by the Engineer.

K. MANHOLE CONSTRUCTION

All manholes outside street rights-of-way or landscaped areas shall be constructed to a height of two (2) feet above the adjacent ground unless otherwise indicated on the Plans or by the Special Provisions. Manholes within street rights-of-way or landscaped areas shall have finished rim elevations flush with the pavement or adjacent finished grade.

After final inspection is complete and all deficiencies have been corrected, the Contractor shall seal all manholes (rings to covers) with penetration type asphaltic cement No. AC-20 as manufactured by Exxon Oil Company or equal.

1. Precast Reinforced Concrete Structures: All precast manhole sections shall conform to the Material Specifications and Standard Details.

Precast manholes shall be treated similar to reinforced concrete pipe for installation. That is, if ground water and/or soil conditions require stabilization for pipe installation comparable measures will be required for precast manhole installation. Under no circumstances will a precast base section be placed on unstable soil as solely determined by the Engineer.

Jointing of precast sections will be done in accordance with the manufactures recommendation, with special attention called to the amount of force used.

All backfill around structures shall be thoroughly tamped in layers as specified for placing backfill.

Regardless of the type manhole construction used, the Contractor will do that which is necessary to stabilize the soil intended to support the structure. A stable condition shall only be so adjudged by the Construction Engineer or his authorized representative. Any cost incurred by the Contractor in stabilizing the area to support a manhole shall be considered incidental to the manhole construction.

2. Outside Drops: When design considerations dictate a large elevation change across a manhole, an outside drop shall be constructed in accordance with the Charlotte-Mecklenburg Utility Department Standard Details. Depending on the particular fittings used, elevation differences of 2.0 to 2.5 feet are required to accommodate an outside drop. When there is not sufficient elevation difference to permit construction of an outside drop, the grade of the influent pipe shall be lowered such that the vertical separation of the influent and effluent pipes is 0.2 feet, as measured at the center of the manhole when the grades of both pipes are projected to that point. Outside drops shall not enter the cone section of precast manholes.
3. Inside Drops: When connecting a proposed sewer main to an existing manhole at an elevation significantly higher than the existing invert elevation, and where safety considerations or working space limitations preclude building an outside drop, the connection may be made with an inside drop constructed in conformance with the Standard Details. Inside drops will be used only where shown on the plans or specifically approved by the Engineer. They may not be used in lieu of outside drops shown on the plans. Inside drops shall not enter the manhole in the cone section. Inside drops are not allowed on four (4) foot diameter manholes.
4. Installation Of Frames And Covers: The frame shall be installed on the manhole with anchor bolts on all manholes that are not flush with the ground. 8-inch tall or 4-inch tall frames may be used for manholes with bolt down frames. These frames shall have four (4) holes in the support flange to permit installation on the cone with anchor bolts. Holes shall be equally spaced in the flange. Complete anchor bolt assemblies shall be zinc plated steel and shall consist of a drive in type anchor sleeve, a threaded stud and two nuts. Anchors shall be installed in field drilled holes in the cone. Minimum diameter of the threaded stud shall be 1/2 inch. The Contractor shall seal the frame to the manhole by installing a length of butyl rubber joint sealant to form a gasket between frame and manhole. The butyl rubber joint sealant shall have a one inch cross section, and shall make two full circles when placed on the cone section, and shall be compressed by the frame with the anchor bolts. Butyl rubber joint sealant shall be "Rubber Seal" as manufactured by Ru Van, Inc., or approved equal. Cement mortar grouting of the frame shall be required. Brick may not be used to adjust rim elevations of above grade manholes.

Manholes that are installed flush with pavement or grade shall have frames attached to the manhole with a bed of cement mortar grout. 8-inch tall frames are required for all manholes that are flush with pavement or finished grade unless otherwise approved. Standard size brick or reinforced concrete grade rings may be used to adjust the finished rim elevation of such manholes. This adjustment may not exceed 21-inches in height.

5. Manhole Step Testing: The Contractor will furnish a hydraulic driven system consisting of cylinder, connecting hose and above ground pump with gauge to test manhole steps to exceed 1000 lbs. of resistance of pullout. All field installed steps will be tested. In lieu of field testing steps installed at the plant, certified shop reports by the manufacturer showing that each step passed the required 1000 lb. pullout will be accepted. The certificates will be furnished to the Inspector prior to field installation.

Unless the Contractor can furnish the manufacturer's certification on step tests, the Contractor will be required to test 10% of the plant installed steps. An additional 10% will be tested for each failure.

6. False Walls: False walls shall be constructed in manholes when specified on the Plans. Holes of the appropriate size shall be cored or blocked out in the manhole wall at the elevation and alignment shown on the Plans. A four-inch thick masonry wall shall be constructed in the opening. Inverts shall be constructed to match proposed pipe elevations and alignments and permit installation of the future extension without demolition work other than removal of the false wall.
7. Steel Vent Pipes: Steel vent pipes will be installed in accordance with the Standard Details. Shop drawings of strap on vents, mounting straps, and anchor bolts will be subject to approval of the Engineer. Material shall be as specified in the Materials Specification Section.

L. PIERS

Pier locations as shown on the Plans shall be considered a guide only, with final determination made at the time of construction by the Engineer. Pier spacing center to center, will be as shown on the Plans, but all pier locations may be adjusted by the Engineer due to field conditions.

Piers will be placed parallel to the flow of the creek unless otherwise directed by the Engineer.

1. Steel Pile Piers: The work covered by this section consists of furnishing and driving piles, as indicated on the plans, the standard details, and as approved by the Engineer, in conformity with the specifications and to the bearing and penetration required.
 - a. Installation: General - The HP8X36 or W8X35 pilings shall be driven to obtain a bearing capacity of 20 tons based on the following formula (the Engineering News Record Pile Driving Equation) and to a minimum depth of 10 feet in undisturbed earth below the bottom of the creek channel or existing ground when not adjacent to the creek.

ENR Formula: $S = (2E/R) - C$

S = penetration per blow (inches)
R = specified bearing capacity (pounds)
E = energy per blow (ft-lbs)
C = 1.0 for drop hammer; 0.1 for air, steam, or diesel hammer

- b. Piles Lengths: Full length piles shall be used where practicable and not more than 2 pieces (1 splice) of steel pile will be permitted in making up one full length pile unless approved by the Engineer. Splices, where necessary and approved by the Engineer, shall be made as to maintain the true alignment and position of the pile sections. Both pieces of a spliced pile shall be the same shape (HP8x36 or W8x35).

Splices should develop not less than 100 percent of the bending strength of the pile and not less than 100 percent of the axial load strength of the pile. All welded splices will be of butt weld type with back-up plates welded to the flanges and web of the steel piles. All welding of structural steel in the shop or in the field shall meet the requirements of the AWS Code and be done by qualified welders. Certification of welders and welds will be required by the Engineer in accordance with the AWS Code.

- c. Driving: Steel piles shall be driven with a diesel, steam, drop, or air hammer with a rated energy of not less than 15,000 ft. lbs., fixed leads and a ram weight of one (1) to one and a half (1½) times the pile weight. In case the required penetration is not obtained by the use of a hammer complying with the above minimum requirements, the Contractor shall provide a heavier hammer, at his own expense. The piles shall be driven on a batter of 15° to the vertical or as shown on the plans, and shall not be out of position at the top of the pile by more than three inches in any direction after driving.
- d. Cross Bracing: Cross bracing will be required only when the undisturbed ground level is below the intersection of the cross bracing.
- e. Painting Steel Piers: Unless otherwise directed, all steel in the piers shall have a coal tar epoxy coating consisting of two coats of coal tar epoxy as specified. All surfaces of the steel to one foot below the disturbed ground or to one foot below the cross bracing, whichever is greater, shall receive the coating system and shall be thoroughly sand blasted prior to application to remove rust, dirt, grease, and other foreign material and to provide a clean surface to receive the coating. Each coat of paint shall be approved by the Engineer prior to application of the next coat. The total dry film thickness shall be at least 16 mils. Areas with coatings less than 16 mils shall be recoated as required to provide the specified film thickness.
- f. Testing And Inspection: The Charlotte-Mecklenburg Utility Department will provide inspection and will determine bearing capacity of the driven piles. The Contractor will submit certification of rated hammer energy acceptable to the Engineer.

The Inspector will be present during all pile driving operations and the Contractor will provide him evidence that the average penetration for the last 10 blows is less than the S calculated by use of the above formula.

Test piles furnished and driven by the Contractor for his use in determining the lengths of piles to be furnished may be so located that they may be cut off and become a part of the completed structure, provided that such test piles conform to the specifications and are approved by the Engineer.

Test piles shall be driven with equipment of the same type and capacity as that used for driving piles for the structure.

Test piles which are not to be incorporated in the completed structure shall be removed to at least 2 feet below the surface of the ground or the stream bed, and the remaining hole backfilled with earth or other suitable material.

The Contractor shall give written notice before beginning construction on the steel piles in order to coordinate this work with Charlotte-Mecklenburg Utility Department.

2. Concrete Piers: If the required penetration for a pile is not obtained, as determined solely by the Engineer, the Contractor may be directed to construct a reinforced concrete pier. The Contractor will not attempt to drive a second pile at a pier location at which the first pile did not achieve the required penetration unless the Engineer has determined that the first pile will be used.

A pile which will not be incorporated in the completed structure will be removed or cut off so that the top of the pile is below the concrete footing.

M. REMOVAL AND RESTORATION OF PAVEMENT AND ROAD SURFACES

All removal and restoration of pavement and road surfaces will be in accordance with the specifications approved by the Superintendent of Streets of the City of Charlotte or of the North Carolina Department of Transportation and Safety, Division of Highways, whichever applies.

All restored bituminous and concrete pavements shall be placed to existing cross-section and ride quality. Restored pavement will in all instances be flush and level with existing pavement at the sawed edges, and at existing gutter lines where applicable unless otherwise approved by the Engineer. When pavement repairs do not meet the above criteria or are not performed in a workmanship manner as determined by the Engineer, Superintendent of Streets of the City of Charlotte, or North Carolina Department of Transportation, whichever applies, the contractor will remove and re-perform the restoration as specified.

When cuts are to be made in street rights-of-way under maintenance by the City of Charlotte, the Contractor shall contact the Superintendent of Streets or his designated representative before each separate pavement cut is made and secure a permit.

Pavement will be replaced as follows. In all pavement cuts either the permanent pavement or a temporary pavement consisting of 1"-1□" of black asphaltic concrete (later to be replaced permanently) will be placed immediately upon completion of the subgrade unless otherwise approved by the Engineer.

1. Specifications for Cutting Pavement: Unless otherwise approved or required, concrete pavement shall be removed to the nearest expansion or contraction joint. The Contractor will contact the Superintendent of Streets and/or D.O.T.'s District Engineer for a determination of the limits of concrete replacement and location of joints. Where sawed joints are allowed, the depth of the sawed cut shall be at least one (1) inch and shall extend at least 1/5 of the depth of the concrete. More depth may be required if necessary to prevent damage to surrounding pavement.

Bituminous pavement shall be cut in a smooth and straight line. Sawing is required on asphaltic concrete. The width of pavement left between the edge of the ditch and the existing edge of the pavement or the front line of the gutter, shall be at least 2 feet. Residual strips of pavement less than 2 feet in width must be removed and replaced. Existing pavement shall be removed on each side of the trench for at least 12 inches beyond top of trench.

The Contractor shall remove and replace pavement which, in the opinion of the Engineer, has been cracked or displaced by the operation of the Contractor.

2. Specification For Restoring Concrete Pavement: The concrete used to restore pavement shall have a minimum 28 day compressive strength of 3600 P.S.I. The concrete as placed shall conform to the shape, grade, and finish of the existing pavement and will be one (1) inch deeper than the original pavement including base, but in no instance less than six (6) inches.
3. Specification For Restoring Asphalt Pavement: All material above the sub-base level shall be hot-mix bituminous concrete conforming to North Carolina Department of Transportation standard specifications for roads and structures for both mix design and placement. The asphalt pavement as placed shall be one (1) inch deeper than the original pavement including base, but in no instance less than six (6) inches within City maintained roadways or eight (8) inches within state maintained roadways. The asphalt shall be placed in lifts not greater than 4 inches and shall be hot mix bituminous concrete binder Type H. The last two (2) inches in either instance shall be bituminous plant mix (I-2) suitable to the appropriate controlling agency. I-2 asphalt pavement resurfacing will be placed with paving machines and/or rollers of a size and type currently approved by the North Carolina Department of Transportation for use on resurfacing contracts.

If a bituminous surfacing overlays a concrete base, the Contractor, at the option of the Engineer, shall replace the concrete to its original thickness, or to a level 2 inches below the finished surface. The Engineer may direct the Contractor to omit all concrete and to replace the pavement with bituminous materials.

Tack coats shall be employed with each lift. Tack coats shall be placed on both horizontal and vertical surfaces (pavement cuts or face of concrete gutters).

Under normal conditions, asphalt binder will be placed in pavement cuts at the end of each work day. I-2 shall be replaced weekly or within five days following completion of pipeline construction along a continuous section of pavement. During inclement weather, the Engineer may permit the use of temporary asphalt (cold mix) to seal the trench until permanent asphalt can be placed.

N. CONCRETE CONSTRUCTION

1. Acceptance of Concrete: Concrete shall be accepted on the basis of its meeting the requirements listed under the Material Specifications and Detail Specifications Section of this contract. The Inspector will accept no ready mix concrete without the plant dispatch ticket.

The Engineer shall make or require any tests as he deems necessary to insure that the concrete meets specifications. Such tests may be performed by CMUD materials technicians or the Engineer may require the test to be performed by an independent testing laboratory at the Contractor's expense.

2. Placement: Concrete will not be accepted if it cannot be placed within ninety (90) minutes of the dispatch time. Time requirements may fluctuate marginally due to temperature. Concrete shall be deposited in such a manner so as to prevent contamination by foreign material and segregation due to rehandling or flowing. Segregated concrete and/or concrete containing foreign material will not be accepted. Depositing will not be permitted when temperature has not exceeded 35° and rising by 10:00 A.M. Depositing shall cease when the descending air temperature in the shade falls below 40° F. It shall not resume until the ascending air temperature rises to 35° F. All concrete shall be kept from freezing by the Contractor. Frozen concrete shall be replaced at the Contractor's expense. Free fall shall not exceed 3 feet in any case.
3. Forms: Forms may be made of wood, plywood, metal, or any other material approved by the Engineer. Forms shall be mortar tight, of material strong enough to resist noticeable deflection or bulging between supports, and the interior dimensions of the forms shall be such that the finished concrete shall be of the form and dimensions shown on the Plans. The design of the forms shall take into account the effect of vibration of concrete as it is placed and also the rate of speed at which the forms will be filled. Forms shall be coated with a lubricant as approved by the Engineer.

Mechanical vibrators, of an approved type, and continuous spading and/or rodding of concrete shall be used to produce proper contact of concrete with forms and reinforcing steel in piers and with forms and pipe in monolithic inverts insuring a compact, dense and impervious artificial stone of uniform texture.

4. Curing: All concrete will be cured for a seven (7) day period after placement according to the following procedure.

- a. Forms will normally be left in place for the entire seven (7) day period. Exposed surfaces not covered by forms will be kept moist continuously for the entire seven day period or will be cured through use of an approved curing compound which will be applied after all surface water has disappeared.
 - b. At the discretion of the Engineer, forms may be removed after the initial set and before the end of the seven day period. In such cases, the areas previously covered by forms shall be cured as described above.
 - c. The Engineer may permit backfill of certain structures (e.g. concrete piers) before the end of the curing period. In such cases, the forms shall be stripped and the surfaces that remain exposed after backfill shall be cured as described in (a) above. Curing compound shall not be required for backfilled surfaces except where specified by the plans or Special Provisions.
5. Finishing: The structure shall have a uniform and textured surface. All form marks exposed to view shall be rubbed off with a stone.
6. Testing: The following tests will be performed by CMUD technicians to ensure the concrete quality:
- a. Compressive strength in accordance with ASTM C-31 and ASTM C-39. Test cylinders which are formed in the field will be left in the field until compression testing (7 day, 14 day, 28 day) is completed thereby more closely approximately the curing conditions of the field placed concrete.
 - b. Slump Test in accordance with ASTM C-143.
 - c. Air Content Test in accordance with either ASTM C-173 or ASTM C-231.

0. **DRY BORE WITH STEEL ENCASEMENT**

1. Bore Pits (or Tunnel Pits): Bore or tunnel pits shall be safed-up, shored, well marked, lighted, and not left unattended except as approved by the controlling agency. Requirements for stabilization and dewatering of bore pits shall be as hereinbefore specified. The angle of repose method (sloping pit walls) for creating a safe working area shall not be used.
2. Installation: Smooth wall or spiral weld steel pipe may be jacked through dry bores slightly larger than the pipe, bored progressively ahead of the leading edge of the advancing pipe as spoil is mucked by the auger back through the pipe. As the dry boring operation progresses, each new section of encasement pipe shall be butt-welded to the section previously jacked into place. Continuous checks shall be made as to the elevation, grade and alignment of each successive section of encasement as well as the tracks (rails) upon which the boring rig travels.

If voids are encountered or occur outside the encasement pipe, grout holes shall be installed in the top section of the encasement pipe at ten (10) foot centers and the voids filled with 1:3 Portland Cement grout at sufficient pressure to prevent settlement in the roadway/railway.

Boring operations shall be continuous to their completion, and unnecessary or prolonged stoppages shall not be allowed.

In the event an obstruction is encountered during the boring and jacking operations, the auger is to be withdrawn and the excess pipe is to be cut off, capped, and filled with 1:3 Portland Cement Grout at sufficient pressure to fill all voids before reapplying to the Controlling Agency for permission to open cut, bore at an alternate location, or install a tunnel.

Installation shall be to the limits specified by the Controlling Agency and/or as delineated in their encroachment issued to the City. (Copy of the encroachment agreement must be kept at the site throughout boring operations).

The completed casing installation shall be such as to prevent the formation of a waterway under the road or railbed.

The Controlling Agency shall have full authority to require remedial measures and/or to stop all work if, in its opinion, said work will cause any damage to the roadway/railway section or endanger traffic. In all instances the Controlling Agencies reserve the right to sample, test, and approve all materials and methods used.

The Contractor shall notify the Controlling Agency through the Construction Engineer and acknowledgement shall be received a minimum of five (5) working days prior to beginning any work within roadway or railway rights-of-way. If required, 24-hours notice will be given prior to completion.

P. GUARANTEED CASING INSTALLATION

The casing shall be installed by jacking, with simultaneous removal of spoil. The spoil removal shall not proceed more than 18-inches ahead of the casing. The diameter of the excavated hole shall be no larger than necessary to keep the casing moving freely and lubricant may be used to reduce the jacking forces. Casing sections shall be joined by butt weld.

After the casing is jacked in place, 2-inch grout holes shall be used to pump a 1:3 portland cement grout to fill the void outside the casing. Sufficient pressure should be applied to force grout out of the adjacent grout hole. Grout holes shall be a maximum of ten feet apart at the top of the casing.

The casing size and thickness shall be as shown on the Plans or Special Provisions.

Q. TUNNELLING OPERATIONS USING STRUCTURAL STEEL LINER PLATES

All plates shall be formed to provide circumferential flanged joints. Longitudinal joints may be flanged or offset lap seam type. All plates shall be punched for bolting on both longitudinal and circumferential seam or joints. Bolt spacing in circumferential flanges shall be in accordance with the manufacturer's standard spacing and shall be multiples of the plate length so that plates having the same curvature shall be interchangeable to permit staggering of the longitudinal seam. Bolt spacing at flanged longitudinal seams shall be in accordance with the manufacturer's standard spacing. For lapped longitudinal seams, bolt size and spacing shall be in accordance with the manufacturer's standard but not less than that required to meet the longitudinal seam strength requirements of the design specifications. All liner plates for the full length of a specified tunnel shall be either the flanged or the lapped seam type. The two types shall not be mixed in the same tunnel.

Liner plates shall be assembled in accordance with the manufacturer's instructions. Galvanized and coated plates shall be handled in such a manner as to prevent bruising, scaling, or breaking of the coating. Any plates that are damaged during handling or placing shall be replaced, except that small areas with minor damage may be repaired to the satisfaction of the Construction Engineer or his representative.

Galvanized surfaces shall be repaired by thoroughly wire brushing the damaged areas and removing all loose cracked coating, after which the cleaned areas shall be painted with two (2) coats of zinc rich paint as approved, and an acceptable bituminous coating restored.

When tunnelling has proceeded a distance sufficient for placing one section of the tunnel liner, that section of liner will be placed before excavating further. Excavation shall be controlled so that the space outside the liner plate shall be held to a minimum. All voids between the liner plate and the tunnel wall shall be filled with 1:3 portland cement grout, containing no more water than necessary, placed under sufficient pressure to fill all voids. Grout shall be placed through the grout holes provided in the top of the tunnel liner plates. Grout holes 2" in diameter shall be provided at not more than 4.5 foot centers or every third ring of plates to permit grouting as the erection of the tunnel liner progresses. At no time will the grouting operations be further than 10' from the front end or head of the tunnel construction.

At the end of each day's operations, the voids outside installed liner plates shall be grouted whether 10' or less. Grout will be forced into each grout hole. If the grout from one hole should flow along the liner plates so as to plug the next hole, the plug shall be opened by punching through the grout so that each hole may be used for grouting. The grouting operation will be continued at each hole until all spaces outside the liner plates are filled and no grout will flow.

The tunnel shall be constructed to the limits, grade and alignment shown on the Construction Plans. Excavation, without the use of jetting, shall be done in such a manner as to protect public and/or private property from damage. Prior to beginning any construction, the Contractor shall submit pit shoring and tunnel liner details for approval, and no tunneling may begin prior to approval of these details by the appropriate Controlling Agency. After approval of tunnel liner and pit shoring details, a five (5) day notice to the Controlling Agency, through the Construction Engineer, shall be provided as previously specified.

No blasting will be done without prior written approval of the controlling agency and then only in strict accordance with all Federal, State, and Local laws, ordinances, rules, or regulations governing the storage and use of explosives. Where blasting is required, only small controlled charges of 40% dynamite or plastic explosives shall be used. The depths of the holes for these charges shall not exceed the depth necessary to clear an area sufficient to place one section of tunnel liner.

The charges for the initial series of blasts should be placed in the triangle method. The second series should be placed in the radial method a minimum distance from the desired diameter of the tunnel. The triangular charges shall be set to go off first, with the radial charges to go off following a short interval or using the time-lag method.

Where rock is encountered before approaching the shoulder or pavement, the first four series of charges will be used in determining the amount of controlled blasting to be used before beginning any blasting beneath the railway or shoulders or pavement of the highway as applicable. If rock is encountered after tunneling progresses beneath the pavement or railway, the charges will initially be set at very low levels and increased in small increments until the proper amount of charge is determined.

In no case will an overshoot be permitted. If a boulder is encountered and removed by blasting or by other methods, a bulkhead will be formed immediately after removal of the boulder and the area filled with grout before proceeding with the tunneling operations.

If there is any indication of a vertical split in the rock formation, or any indication of settlement of the roadway or railway fill, all operations shall be stopped and the Controlling Agency notified immediately. If the vertical split is not determined to be of too great a magnitude or too close to the rails/pavement, the split shall be filled with grout at a pressure specified by the Controlling Agency, allowed to set and tunneling operations may be continued.

If it is determined that the vertical split is too great of a magnitude or too close to the pavement or railway, the Controlling Agency shall determine the method to be used to correct the split. If settlement of the roadway or railway occurs, the Controlling Agency will advise the Owner and his Contractor of the proper steps to be taken to correct the settlement. If deemed necessary by the Controlling Agency, adequate warning devices (signs, flashers, etc.) accompanied by responsible flagmen shall be placed at a distance allowing any and all traffic time to stop safely before reaching the questionable area. At the option of the Controlling Agency, it may provide the necessary flagmen, warning devices, etc., at the Contractor's expense. Traffic shall be allowed over the questionable area only as directed by the Controlling Agency.

The Controlling Agency shall have full authority to inspect entire tunnel operation, require disposition of remedial measures, and to stop all work if, in its opinion, the work will cause any damage to the roadway/railway section or endanger traffic. In all instances the Controlling Agencies reserve the right to sample, test, and approve all materials used.

The completed liner shall consist of a series of structural steel liner plates assembled with staggered longitudinal joints. Liner plates shall have been fabricated to fit the cross section of the tunnel. All plates shall be connected by bolts on both longitudinal and circumferential seams or joints.

After tunnelling operations have been completed the Contractor will install the carrier pipe in a manner approved by the Engineer. Concrete fill (1:3 portland cement grout) will then be placed after completing installation of the sewer pipe within the tunnel liner as directed by the Engineer and end enclosure walls installed as shown on the Construction Plans or Standard Details. Ends of the tunnel liner will be sealed with an eight-inch (8") masonry wall on the lower end and a twelve-inch (12") masonry wall on the higher end. Weep holes will be provided on the downstream end for drainage - See Standard Detail #16. The Contractor shall then remove the vertical shoring for pits (if ground conditions allow), surplus spoils, and material from the site.

The site shall then be returned to its original condition, seeded, mulched, or restored as specified and left in a neat and satisfactory condition. Shoring material shall be removed in such a manner so as to avoid collapse and to allow proper backfill. The backfill shall be placed in accordance with these Specifications or the requirements of the Controlling Agency.

The Contractor will notify the Utility Department, in writing, upon completion of the tunnel liner installation. Notification of completion of the tunnel operation will then be forwarded to the Division Engineer, in writing, by letter with a copy to the attention of the State Design Services Engineer, North Carolina Department of Transportation, Division of Highways, Raleigh, North Carolina 27611 by the Utility Department.

The Contractor shall reimburse the Utility Department (Owner) and the Utility Department (Owner) shall reimburse the Division of Highways should any settlement or damage result to the roadway within a period of one (1) year after completion of the tunneling operations.

The Contractor and any of his subcontractors performing work on the State's (N.C. DOT) right-of-way in connection with tunneling operations shall furnish for approval, through the Construction Engineer, to the Department of Transportation, attention State Design Services Engineer, North Carolina Department of Transportation, Division of Highways, Raleigh, North Carolina, 27611, a certificate of insurance. An original and one copy of the certificate in the minimum amounts of \$500,000 Bodily Injury and \$250,000/\$500,000 Property Damage shall be submitted for approval as evidence of proper coverage before beginning any work at the site. The Certificate is to show explosion, collapse, and underground insurance coverage is provided. The Certificate will also reference the project, county and the Design Services Units file number.

Insurance requirements for work performed on Railroad (CSX, Norfolk-Southern, etc.) property will be as outlined in the Special Provision Section of this contract. The Contractor shall furnish for approval a certificate of Insurance to this office. All required submittals will be sent to the Utility Department for review and this office will then forward the documentation on to the railroad.

Insurance will remain in full force and effect for one (1) year after acceptance by the owner and the Controlling Agency. The Certificate is to be countersigned by an authorized North Carolina Resident Agent with the name and address of the agent denoted thereon.

R. BLASTING

Prior to commencing any blasting operations the Contractor shall notify either the City Fire Department - Fire Prevention Section or the County Fire Administrator as applicable, and obtain blasting permits as required. The Contractor must furnish certification of Insurance specifically covering any and all obligations assumed pursuant to the use of explosives.

All blasting operations shall be conducted in strict accordance with any and all decrees, rules, regulations, ordinances, and laws as may be imposed by any regulatory body and/or agency having jurisdiction over the work relative to handling, transporting, use and storage of explosives. Blasting shall be done only by competent, sober and experienced personnel whose activities shall be conducted in a workmanlike manner. Satisfactory information must be provided to the Engineer that the blaster meets or exceeds the qualifications enumerated in OSHA Regulations Part 1926, Subpart U, Section 1926.901 -Blaster Qualifications.

All rock, dirt and debris from blasting shall be contained within the excavation by use of weighted mats or undisturbed overburden. The Contractor's blaster shall be fully responsible for determining the method of containment and the weight, size and placement of material required to contain the charge he is using.

Charges shall be sized such that no damage to houses, structures, roadways etc., outside the limits of the excavation will occur. Where there is a possibility of such damage, the charge will initially be set at a very low level and increased in small increments until the proper charge is determined. The Contractor shall be held responsible for any and all injury to persons or damage to public or private property.

1. Permission to Blast: The Contractor shall not be allowed to blast within any rights-of-way maintained by any agency (D.O.T., R.R., Gas, etc.) other than the City without specific approval of the controlling agency and only in accordance with their respective requirements.

S. TESTING AND INTERNAL INSPECTION

The Contractor shall provide proper ventilation of sewer lines and manholes during any test or inspection procedure. The Contractor shall be responsible for providing all equipment and personnel necessary to comply with OSHA confined spaces regulations.

1. Gravity Sewer Pipe Leakage Testing: No sooner than 10 days following completion of backfill, the Contractor along with the project inspector will be required to determine the level of the ground water table. If the level of ground water table is above the top of the pipe, the sewer line shall be tested for infiltration. If there is no ground water above the top of the pipe the sewer line shall be low pressure air tested. Each test shall be performed as follows:
 - a. Infiltration: Weirs are to be furnished by CMUD and installed by the Contractor. The infiltration shall not exceed 100 gallons per day per inch diameter per mile as measured for a reach of pipe the same diameter up to one mile long. However, when excessive infiltration can be isolated to a particular section (manhole-manhole) the limit will be applied to that section. There shall be no visible points of infiltration. Any section (manhole-manhole) must be isolated and tested separately if so directed by the Engineer. The Charlotte-

Mecklenburg Utility Department reserves the right to TV any sewer line to detect sources of infiltration.

- b. Low Pressure Air Test: Tests shall be performed in accordance with ASTM C-828 and C-924 on sewer lines 42-inches in diameter and smaller. Test pressure will be measured by gauges furnished by CMUD and installed by the Contractor above ground at the manhole opposite the air supply. The Contractor shall furnish all other test equipment required including connecting hoses at the CMUD supplied gauge.

Sewer lines larger than 42-inches in diameter shall be tested for infiltration as specified above and each joint shall be visually inspected by a CMUD representative.

2. Manhole Leakage Testing: Manholes shall be tested by plugging the inlet and outlet pipes with airtight plugs and using one of the following procedures:
 - a. Exfiltration: Fill the manhole to the rim with water and allow the level to equalize due to saturation. Refill the manhole and mark the level to begin the test. The test shall last at least 2 hours and allowable leakage shall be 3 gallons per hour. The Engineer will select 25% of the manholes on the project to be tested. If any manhole fails, an additional manhole will be tested. Manholes that fail the test shall be repaired as specified and retested until they pass.
 - b. Vacuum Air: Manhole vacuum air testing shall be performed in accordance with ASTM C-1244. The Engineer will select 25% of the manholes on the project to be tested. Manholes that fail the test shall be repaired as specified and retested until they pass. Manholes that show leaks and are repaired prior to testing shall be tested as specified.
3. Deflection Testing of PVC Pipe: Not less than 30 days following completion of backfill, the pipe shall be tested for deflection with a 5% mandrel sized as defined in ASTM D-3034. Mandrels shall be furnished by the Charlotte-Mecklenburg Utility Department. The mandrel shall be pulled through each section of pipe from manhole to manhole. The mandrel must slide freely through the pipe with only a nominal hand force applied. No mechanical device shall be used in pulling the mandrel. Any pipe which refuses the mandrel shall be removed and replaced or re-rounded and the bedding shall be properly constructed as specified to prevent excessive deflection. Such sections shall be re-tested for deflection after completion of backfill.

T. REPAIRS

All leaks shall be repaired by identifying and exposing the defective section of pipe and completing repairs as follows:

1. PVC, VCP or Ductile Iron Pipe: Defective or damaged pipe including leaking joints shall be removed and replaced with sound new pipe. The pipe shall be re-connected with approved couplings as specified in the MS Section of this document.

2. RCP: Defective or damaged pipe shall be removed and replaced with sound new pipe. Pipe re-connections shall be made, and joint leaks repaired, using concrete collars per Standard Details.

Chemical grouting or internal or external wiping of joints with cement grout are specifically not approved as methods for repairing leaks on new pipelines, regardless of the pipe material.

Repair couplings and/or collars shall be limited to one every one hundred feet not to exceed three pipe repairs between manholes. Deficiencies in excess of these limitations shall be corrected by relaying the section of pipe.

3. Manholes: Any damage to the interior wall of the manhole resulting from penetration of the lift holes shall be repaired with non-shrink cement grout.

Leaks through manhole joints or walls or around pipe collars, may be repaired from inside the manhole with non-shrink cement grout. If the size of the leak, or the external water pressure, prevents such repairs, the manhole shall be excavated and repaired from outside.

Leaks around boots or gaskets used to join pipe to manholes shall be repaired by external concrete collars or as approved by the Engineer.

U. ABANDONMENT

The following requirements shall apply for proposed abandonment of existing facilities unless otherwise shown on the plans or approved by the Engineer. All areas disturbed by abandonment will be restored.

1. Abandonment Of Existing Manholes: Manholes which are to be abandoned will first have both influent and effluent lines plugged inside the manhole with watertight masonry. The manhole will then be filled with non-compressible material (#67 stone or as approved), to a point three feet (3'-0") below the finish grade. The remainder of the manhole shall be broken down and removed. Then the excavation shall be filled to finish grade with suitable soil compacted in place.
2. Abandonment Of Mains At Manholes Which Remain In Service: Abandoned mains at active manholes shall be completely disconnected from the manhole by cutting the pipe outside the manhole and then plugging the abandoned main and the manhole wall with watertight masonry. The invert shall then be rebuilt to conform with the standard details.
3. Abandonment Of Exposed Pipe: Exposed sections of abandoned mains shall be removed to a point not less than 5 feet into the adjacent banks. The remaining ends of the pipe shall be plugged with watertight masonry. Concrete piers or collars in the creek channel shall be removed completely. Concrete piers or collars not located in the creek channel shall be removed to a point three feet (3'-0") below the finish grade. Steel piers shall be cut off three feet (3'-0") below finish grade.

4. Abandonment Of Existing Pump Stations: Pumps, motors, controls, etc., shall be salvaged and transported by the Contractor to the sewer maintenance yard at 3001 Wilmont Road. All influent and effluent pipes shall be plugged with watertight masonry. The pump chamber and wetwell (if abandoned) will be filled with non-compressible material (#67 stone or as approved), to a point three feet (3'-0") below the finish grade. The remainder of the structure shall be broken down and removed. Then the excavation shall be filled to finish grade with suitable soil compacted in place. All above ground structures associated with the pump station, including fencing and the access road shall be removed and the area restored.

V. RESTORATION

All surfaces and structures (both public and private) within and adjacent to the construction operations shall be restored to a condition comparable to that existing prior to construction or as specified in the special provisions.

All surplus materials shall be disposed of in a manner acceptable to the Engineer, and the construction area shall be left in a neat condition, with special attention called to proper drainage, smoothness of surface, and general clean up. No machinery or equipment shall be left or stored on the job site after the project is completed.

Unless otherwise specified, complete restoration to include fertilizing, seeding, and mulching of any and all areas disturbed during construction shall be completed within thirty (30) working days following the initial ground disturbing activity.

1. Water meters, valve boxes, drain pipes, and other structures encountered shall be reset or relaid to match or clear surface grade and/or water main pipe grade as applicable.
2. All shoulder areas shall be restored, stabilized, and maintained to their original condition. Concrete, asphalt, gravel, and dirt walks, drives and roadways are to be replaced to their original shape and serviceability. Unless otherwise approved by the Engineer all areas (shoulders, side streets, drive, parking areas, etc.) which exhibit a gravel surface at the time of construction will be re-graveled with a minimum depth of six (6) inches of C.A.B.C stone compacted-in-place for the width and length of the disturbed area and then feathered gradually into the existing cross section. When a driveway is finished with other than C.A.B.C stone, a one inch finish coating to match existing gravel gradation and appearance shall be placed.

The Contractor should note that all existing side streets and drives which are either dirt or gravel will be restored as specified for graveled areas.

3. Refuse Burial: Timber, rock and other refuse may not be buried within the permanent sewer rights-of-way with the exception of rock smaller than 3/4 cubic foot which is allowed as previously specified.
4. Rip-Rap: The Contractor shall place stone rip-rap as specified in those areas subject to severe water action where directed by the Engineer.

Placement of rip-rap as shown on the Construction Plans shall be considered a guide only, with final determination made at the time of construction by the Engineer. Either the addition or deletion of quantities may be required.

Stone rip-rap will be placed as indicated on the Standard Details immediately following pipe installation and will be installed no steeper than a 2:1 slope except when specifically approved by the Engineer. Grading will be required as necessary to insure continuous even flow.

In locations where a creek bank is eroded near the sewer line the Contractor will be required to place compacted fill material along the creek bank in order to maintain 3' of cover over the sewer line in all directions. This is to be done before the rip-rap is placed.

The rip-rap installation shall include all earthwork necessary to stabilize the creek bank and to provide cover for the sewer line.

5. Jute Netting/Erosion Blanket: The contractor shall install jute netting or Erosion Control Blanket in areas subject to high runoff velocities, areas subject to concentrated runoff and on steep slopes as shown on the plans and/or as directed by the Engineer.
6. Fertilizing, Seeding, and Mulching: Established lawns and landscaped areas damaged by construction shall be restored to their former condition by seeding, unless the type and condition of the existing sod warrants it being cut, removed, preserved, and replaced. All areas, regardless of previous condition, damaged by construction shall be fertilized, seeded, and mulched as outlined below:
 - a. Seed Bed Preparation: The seed bed shall be prepared by pulverizing the soil in an approved manner to a depth of three (3) inches for field conditions or slopes that are 3:1 or flatter and to a depth of one (1) to three (3) inches, as determined on site for slopes steeper than 3:1. The soil shall be tilled until a well pulverized, firm, reasonably uniform seed bed is prepared conforming substantially to ground elevations as shown on the Plans and/or as existed prior to construction. The disturbed area shall blend uniformly into adjacent topography. Good surface drainage must be provided, allowances for settlement made and ground elevations adjusted accordingly. Visible ponding will not be allowed. All stones, roots, sticks, rubbish, and other objectionable material shall be removed.
 - b. Soil Improvements: Soil additives shall be incorporated in an approved manner into the top soil at the following rates:
 - (1) Fertilizer - 20 pounds per 1000 square feet of 5-10-10 fertilizer generally and 30 pounds per 1000 square feet of 10-10-10 fertilizer for established lawn areas.
 - (2) Lime - 100 pounds per 1000 square feet.

(3) Superphosphate (0-20-0) - 12 pounds per 1000 square feet.

c. Seeding: Seeding must be done within thirty (30) calendar days after the initial ground disturbing activity.

(1) The seed bed must be in good, friable condition and not muddy or hard at the time seeding is performed.

(2) Seed shall be applied at the rate specified and raked or tilled into the topsoil with the resulting furrows running across the natural slope of the ground. Under no circumstances will any tilling activity be allowed parallel with said slope.

Slopes steeper than 3:1 shall require the use of hydraulic seeding unless otherwise specifically approved by the Engineer.

d. Mulching: After fertilizing, seeding and raking, dried straw shall be spread uniformly over the area at a rate of 90 pounds per 1000 square feet. Approximately 1/4 of the ground should remain visible to avoid smothering seedlings. The straw shall be sprayed with liquid asphalt to bond it together and anchor it in place within road right-of-way and areas subject to erosion.

(1) Liquid asphalt, thinned with kerosene, shall be used during freezing weather and shall be either rapid or medium curing. It shall be applied at a rate of 200 gallons per ton of straw or approximately 9 gallons per 1000 square feet.

(2) Emulsified asphalt, thinned with water shall be used when temperatures are less severe, shall be rapid curing only, and shall be applied at a rate of 150 gallons per ton of straw or approximately 7 gallons per 1000 square feet.

e. Maintenance: The Contractor shall maintain the seeded areas until there is a uniform growth three (3) inches high. Maintenance shall consist of watering, weed and pest control within established lawns, fertilization, erosion repair, reseeding and all else necessary to establish a vigorous healthy and uniform stand of grass. All areas and spots which do not show a uniform stand of grass, for any reason, shall be treated repeatedly until a uniform stand is attained.

Seasonal seeding mixtures and rates of application shall be as follows. All rates are in pounds per 1000 square feet and any rates listed below may be cut by 1/2 for temporary erosion control measures only.

SEPTEMBER 15 - MARCH 1

Maintained/Established Lawns or road rights-of-way

6# Kentucky Fescue No. 31
2# Rye Grain
30# Fertilizer (10-10-10)
100# Lime
12# Superphosphate

Open-Field (Anything other than an established lawn)

4# Kentucky Fescue No. 31
2# Rye Grain
20# Fertilizer (5-10-10)
100# Lime
12# Superphosphate

Open-Field For Slopes 2:1 or greater or areas subject to erosion

2# Kentucky Fescue No. 31
4# Sericea Lespedeza (Unscarified)
2# Rye Grain
30# Fertilizer (5-10-10)
100# Lime
12# Superphosphate

FEBRUARY 1 - OCTOBER 15

Maintained/Established Lawns or road rights-of-way

8# Kentucky Fescue No. 31
30# Fertilizer (10-10-10)
100# Lime
12# Superphosphate

Open-Field (Anything other than an established lawn)

6# Kentucky Fescue No. 31
2# Sudangrass (May, June, and July only)
20# Fertilizer (5-10-10)
100# Lime
12# Superphosphate

Open-Field For Slopes 2:1 or greater or areas subject to erosion

2# Kentucky Fescue No. 31
4# Sericea Lespedeza (Scarified)
2# Sudangrass (May, June, and July only)
20# Fertilizer (5-10-10)
100# Lime
12# Superphosphate

The Engineer will be consulted prior to seeding for a determination of appropriate seed mixture.

Unless otherwise required by the North Carolina Department of Transportation or the Engineer seeding within road rights-of-way will be as specified for established lawns.

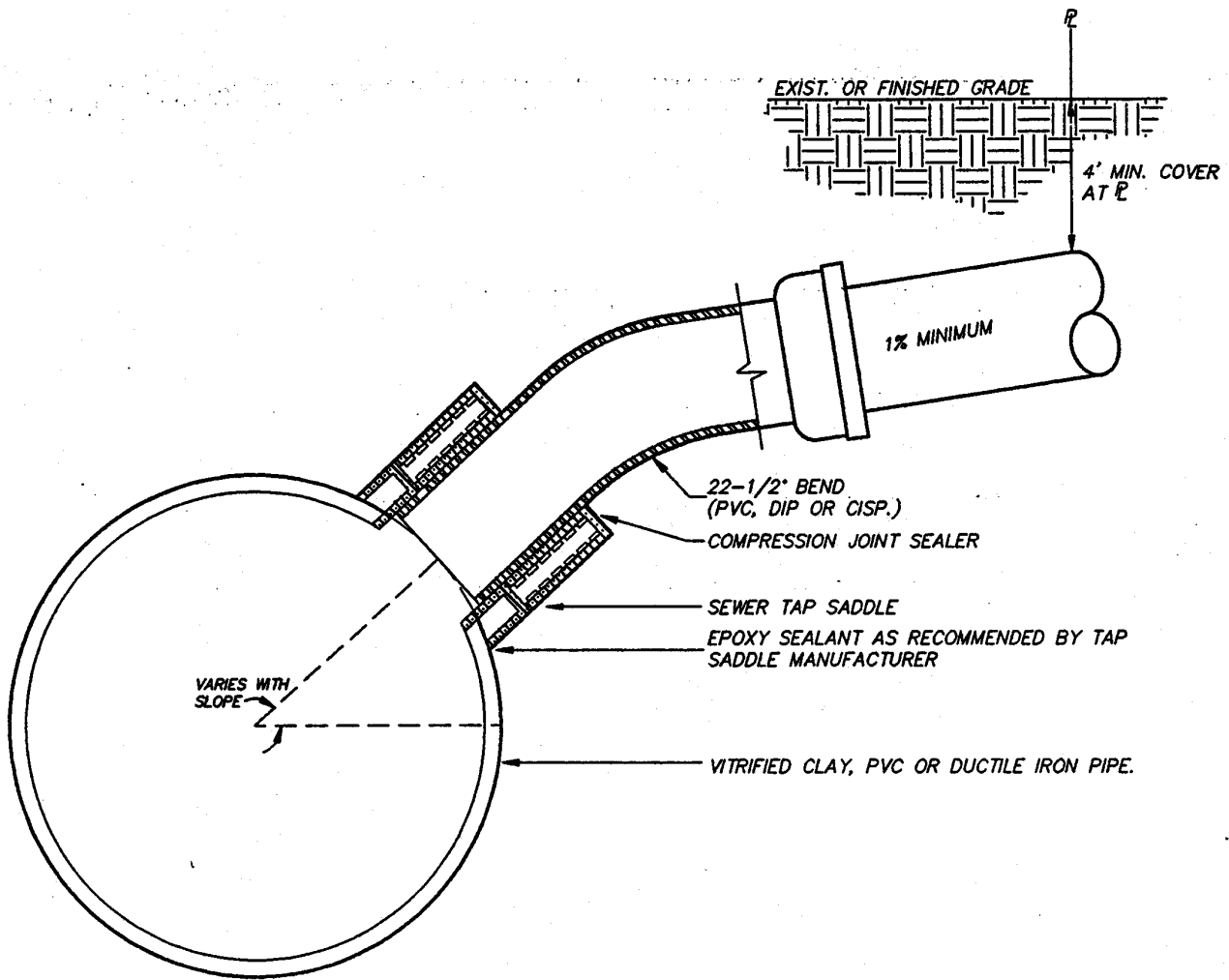
W. WORK WITHIN NORTH CAROLINA DEPARTMENT OF TRANSPORTATION RIGHTS-OF-WAY

Construction is permitted within the rights-of-way of the North Carolina Department of Transportation (DOT), Division of Highways in accordance with their Policies And Procedures For Accommodating Utilities On Highway Rights-Of-Way as amended. The Charlotte-Mecklenburg Utility Department (CMUD) is required to enforce this entire document as it relates to this work. All bidders are required to become familiar with the document and any amendments which are available from the Manager of Right-of-Way, North Carolina Department of Transportation, Division of Highways, Raleigh, North Carolina.

1. Charlotte-Mecklenburg Utility Department has entered into an encroachment agreement with the North Carolina Department of Transportation (DOT) which grants the right for any work within the Department of Transportation's rights-of-way. The encroachment agreement for any work within DOT rights-of-way under this project is included as a special provision in this contract. A copy of the approved encroachment has been attached to this contract or will be supplied to the Contractor prior to construction. A copy of the encroachment agreement must be kept at the construction site at all times.
2. Certain notices are required in writing before any work can proceed within the Department of Transportation's rights-of-way. Upon ample notice by the Contractor, the Engineer will make this notification.
3. Proper signing before, during, and after construction in conformance with the manual on Uniform Traffic Control Devices for Streets and Highways will be required. In addition, warning signs as related to soft and/or low shoulders and broken pavement may be required by the Engineer.

4. Piling and/or storage of excavated material upon the pavement and on some types of shoulders is prohibited unless special permission is granted by the Department of Transportation's Division Engineer. Any material spilled, tracked or placed on the pavement is to be cleaned and damaged pavement repaired subject to stoppage of all work by Charlotte-Mecklenburg Utility Department. Drainage ditches are to be protected from siltation as specified in the EP Section and must be opened at the end of each work day or as weather conditions require.

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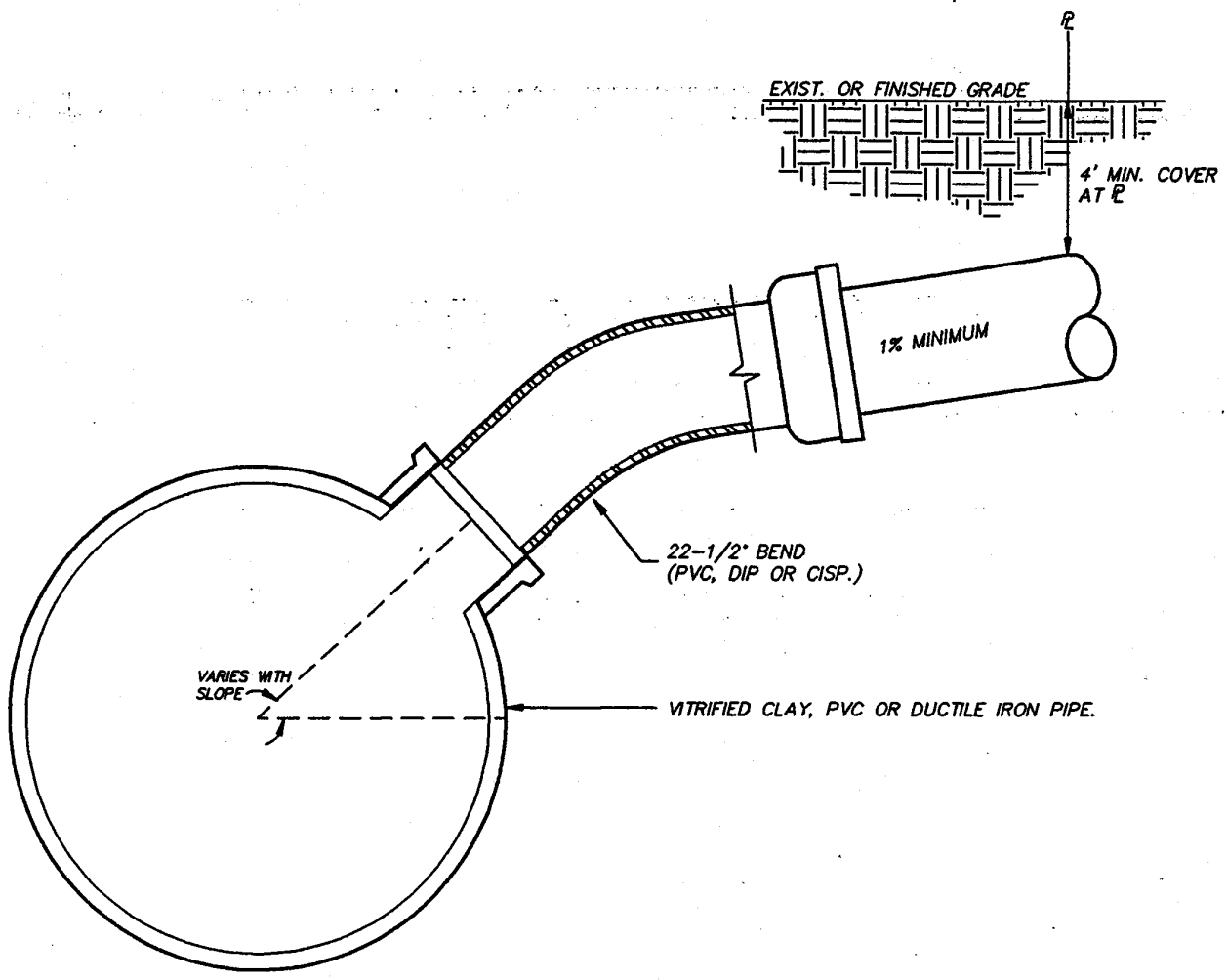


NOTES:

1. THE OPENING IN PIPE SHALL BE CUT WITH A TAP MACHINE ONLY.
2. THE TAP SHALL BE MADE IN THE UPPER HALF OF THE PIPE AT 45° FROM THE HORIZONTAL.
3. MAXIMUM SIZE TAP SHALL BE FOUR INCHES.
4. TEE & BEND TO BE FULLY ENCASED WITH #67 CRUSHED STONE.
5. SDR 35 PVC LATERAL PIPE REQUIRE TYPE III GRANULAR BEDDING.
6. MIN. CLEAR TO PIPE JOINT ON MAIN SHALL BE 1'-0".
7. THE LATERAL MUST BE INSTALLED PERPENDICULAR TO THE MAIN.
8. IF THE LATERAL HAS LESS THAN 3' OF COVER, THE LATERAL MUST BE D.I.P.

CHARLOTTE—MECKLENBURG UTILITY DEPARTMENT ENGINEERING DIVISION CHARLOTTE, NORTH CAROLINA			
Job No. _____ File No. _____		STANDARD DETAIL SEWER	
Scales PLAN _____ NTS _____		4" LATERAL (TAP)	
PROFILE Hor. _____ Vert. _____			
As Built _____ Date _____		MSW	
Surveyed By _____	Designed By _____	Drawn By _____	Project—Engr. _____
		Approved By <i>K. Blain</i>	Sheet 1 of 1

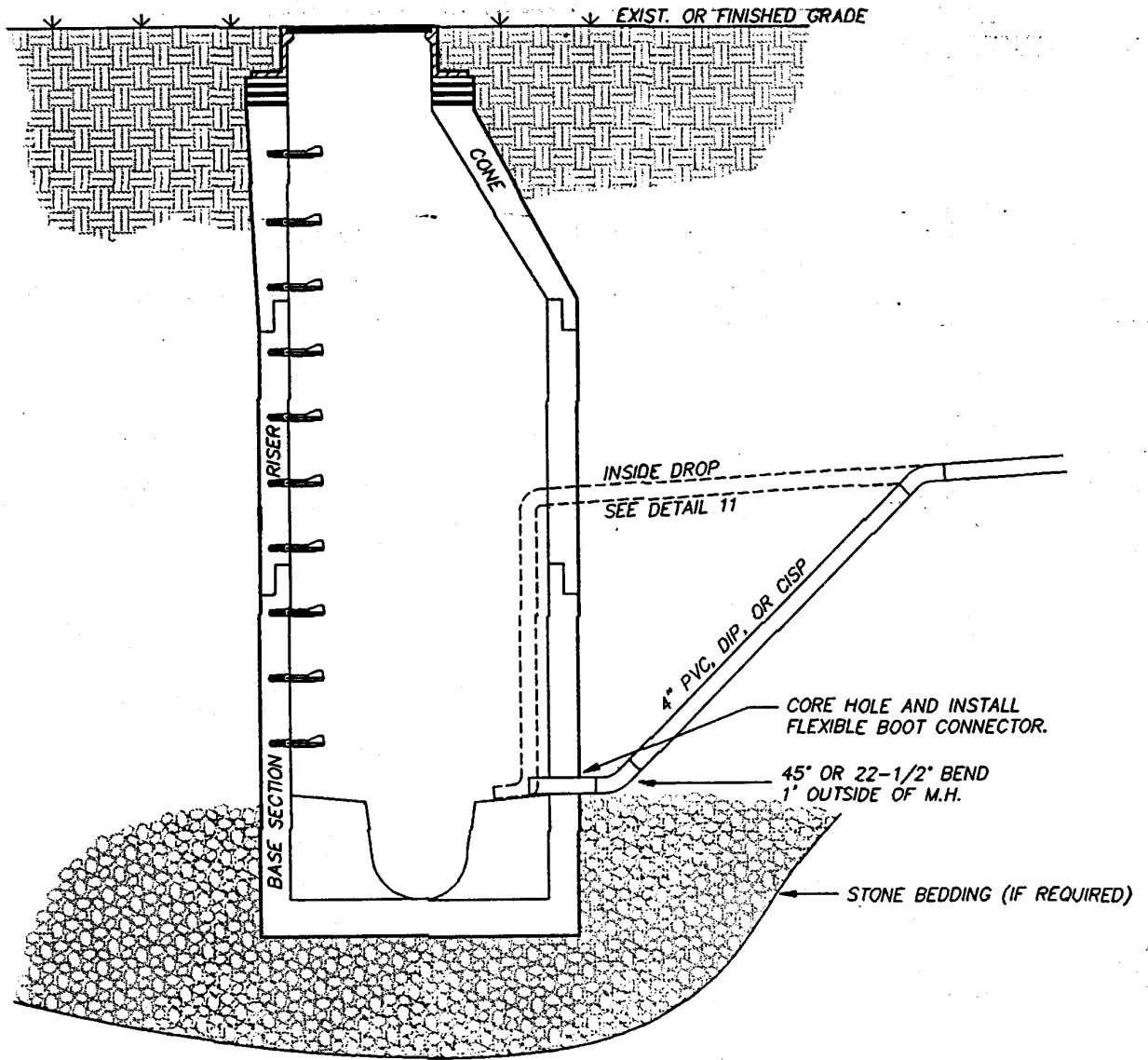
No.	Date	By	Revision



NOTES:

1. CLAY TEES REQUIRE COMPRESSION GASKET TO PROVIDE SEAL FOR PLAIN END OF 22-1/2° BEND.
2. IF THE LATERAL HAS LESS THAN 3' OF COVER, THE LATERAL MUST BE D.I.P.
3. TEE AND BEND TO BE FULLY ENCASED IN #67 CRUSHED STONE.
4. SDR 35 PVC PIPING REQUIRES TYPE III GRANULAR BEDDING.
5. MIN. DISTANCE BETWEEN TEES SHALL BE 7' CENTER TO CENTER.
6. THE LATERAL MUST BE INSTALLED PERPENDICULAR TO THE MAIN.

CHARLOTTE-MECKLENBURG UTILITY DEPARTMENT ENGINEERING DIVISION CHARLOTTE, NORTH CAROLINA			
Job No. _____	File No. _____	STANDARD DETAIL SEWER	
Scales <u>NTS</u>			
PLAN		4" LATERAL (TEE)	
PROFILE			
Hor. _____ Vert. _____			
As Built _____		Date _____	
Surveyed By _____	Designed By _____	Drawn By <u>MSW</u>	Project-Engr <u>K. Blaylock</u>
No. _____	Date _____	By _____	Revision _____
		Approved By _____	Sheet <u>2</u> of _____



**CHARLOTTE-MECKLENBURG
UTILITY DEPARTMENT
ENGINEERING DIVISION
CHARLOTTE, NORTH CAROLINA**

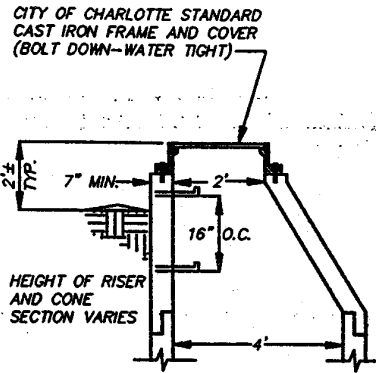
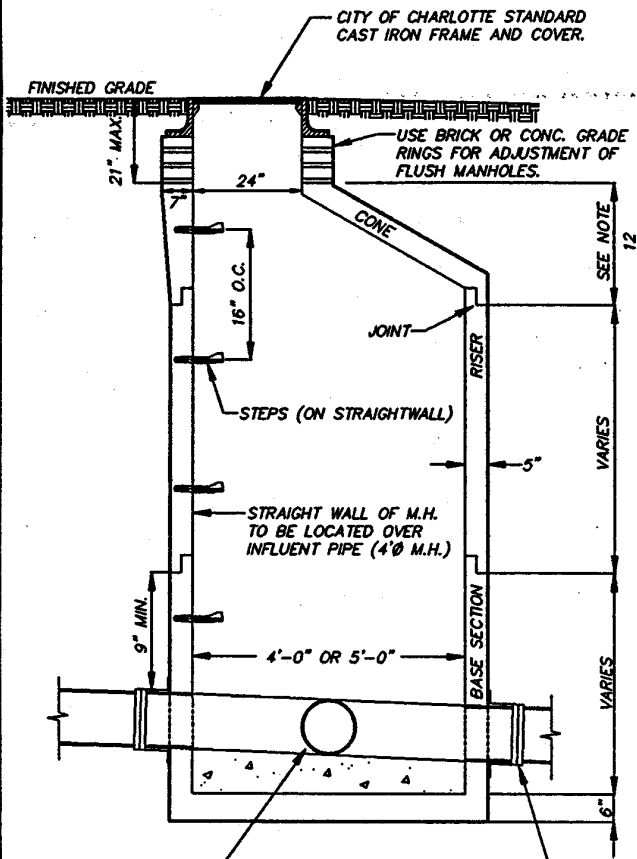
**STANDARD DETAIL
SEWER**

**LATERAL INSTALLATION
AT MANHOLE**

Job No. _____	File No. _____
PLAN Scales _____	NTS
PROFILE Hor. _____	Vert. _____
As Built _____	Date _____
Surveyed By _____	Designed By _____
Drawn By MSW	Project-Engr _____
Approved By K. B. [Signature]	Date 2/14/95
Sheet 3	Of _____

No.	Date	By	Revision

CSL/DWG
01/11/94

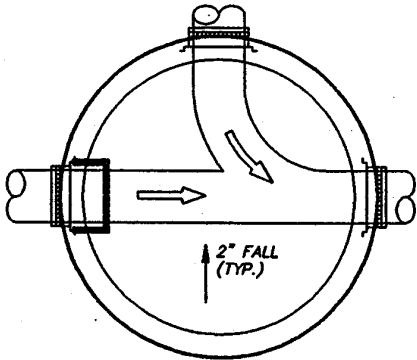


FLEXIBLE COUPLING CAST IN BASE OR INSTALLED IN CORED HOLE WITH STAINLESS STEEL COMPRESSION DEVICE.

FOR 8" AND 10" PIPE, INVERTS ARE TO BE 3/4" PIPE OD AT TROUGH, FOR 12" AND LARGER PIPE, PROVIDE FULL INVERT AS SHOWN. THE SHELF SHALL SLOPE 2" FROM THE MANHOLE WALL TO THE TROUGH.

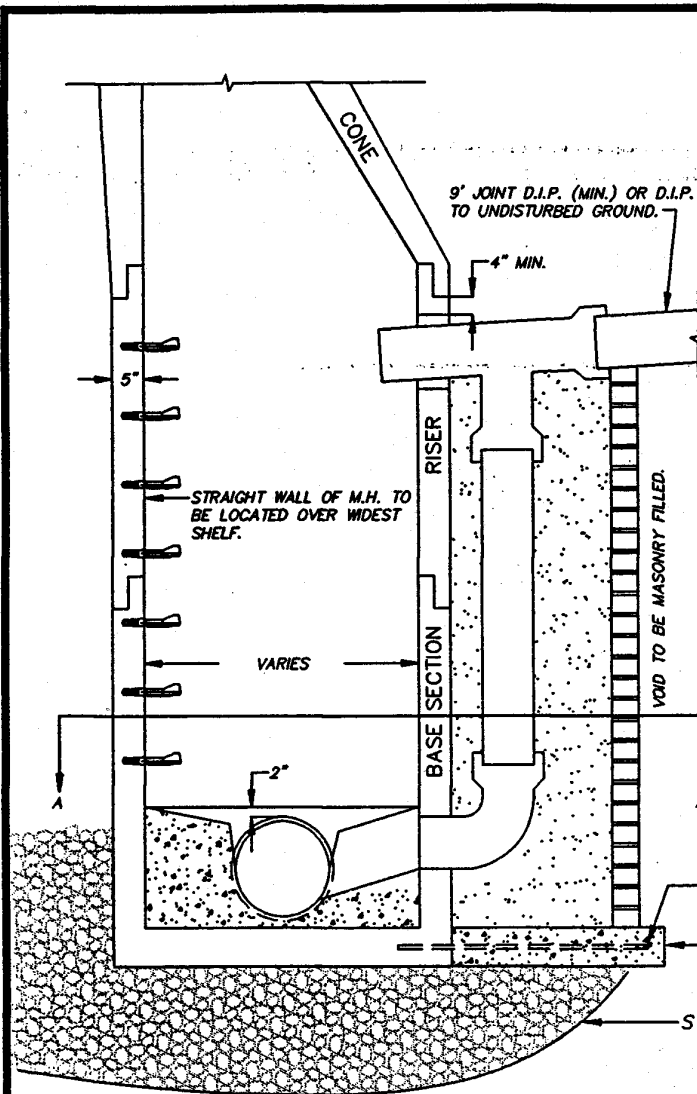
NOTES:

1. MANHOLE TO CONFORM WITH ASTM C478 EXCEPT AS MODIFIED BELOW.
2. MANHOLE BASE TO BE REINFORCED WITH A MINIMUM AREA OF 0.20 SQ. IN. PER LINEAL FOOT EACH WAY. WALL REINFORCING TO BE MINIMUM OF 0.12 SQ. IN. PER LINEAL FOOT. EITHER TONGUE OR GROOVE SHALL HAVE REINFORCING EQUAL IN AREA TO MINIMUM OF WALL SECTION.
3. ALL JOINTS SHALL CONFORM WITH ASTM C443.
4. STEPS TO BE PLASTIC PER CITY STANDARDS.
5. ALL PIPE OPENINGS TO BE NO GREATER THAN 3" LARGER THAN OUTSIDE DIAMETER OF PIPE AND ADDITIONALLY REINFORCED WITH A MINIMUM OF 0.20 SQ. IN. OF STEEL AT 90 DEGREES. (ADDITIONAL REINFORCING NOT REQUIRED FOR CORED OPENINGS)
6. ALL SURFACES SHALL BE SMOOTH EVEN TEXTURED WITH A MINIMUM OF HONEYCOMB, FINS AND OTHER IMPERFECTIONS.
7. PENETRATING LIFTING HOLES SHALL BE PLUGGED WITH EXPANSION GROUT.
8. INVERTS MAY BE 3600 PSI READY MIX CONCRETE IN LIEU OF BRICK. PRECAST INVERTS ARE ACCEPTABLE.
9. STEPS IN 5' DIAMETER MANHOLES TO BE OVER WIDEST SHELF.
10. 4'Ø CONE SECTIONS MAY BE USED WITH 5'Ø MANHOLES WITH A 5'-4" TRANSITION SECTION PLACED DIRECTLY BENEATH THE 4'Ø CONE.
11. ALL MANHOLE SECTIONS SHALL BE DESIGNED FOR H-20 LOADING.
12. MINIMUM HEIGHT FOR CONCENTRIC CONES ON MANHOLES WITH BOLT DOWN F&C IS 32".



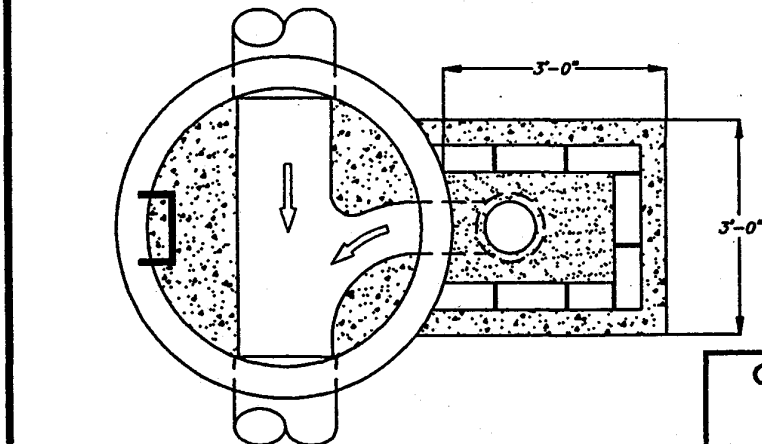
**CHARLOTTE-MECKLENBURG
UTILITY DEPARTMENT
ENGINEERING DIVISION
CHARLOTTE, NORTH CAROLINA**

Job No. _____ File No. _____		STANDARD DETAIL SEWER	
Scales <u>NTS</u>			
PLAN	PRECAST MANHOLES 4' AND 5' DIAMETER		
PROFILE			
As Built _____ Date _____		MSW	K. B. [Signature]
Surveyed By _____	Designed By _____	Drawn By _____	
Project-Engr _____		Approved By _____	Sheet <u>4</u> Of _____



NOTES:

1. ALL MASONRY MORTAR SHALL BE PORTLAND CEMENT 1:3 MIX.
2. CARE MUST BE TAKEN TO FORM A SMOOTH FINISHED TROUGH FROM ENTRANCE PIPES TO EXIT PIPE, AND IN CURVED MANHOLES THE TROUGH MUST BE A SMOOTH CIRCULAR ARC TANGENT TO THE INSIDE WALLS OF THE PIPES AT THEIR ENDS.
3. PROTECTIVE WALL FOR OUTSIDE DROP SHALL BE A MINIMUM OF 4" MASONRY.
4. THE SLOPE OF THE OUTSIDE DROP TROUGH SHALL BE 1/4" PER FOOT.
5. ALL PIPE OPENINGS TO BE NO GREATER THAN 3" LARGER THAN O.D. OF PIPE AND ADDITIONALLY REINFORCED WITH A MINIMUM OF 0.20 SQ. IN. OF STEEL AT 90 DEGREES. PIPE TO BE CENTERED IN OPENINGS. ADDITIONAL REINFORCING NOT REQUIRED FOR CORED OPENINGS.
6. RAMSET MASONRY TIES EVERY 12 INCHES.
7. DROP STRUCTURE MAY BE FORMED AND Poured OF 3600 PSI CONCRETE IN LIEU OF MASONRY.
8. FOOTING FOR DROP MAY BE Poured AS PART OF THE MANHOLE BASE SLAB OR FIELD Poured AND TIED TO MANHOLE BASE WITH THREE EQUALLY SPACED #6 REBARS DOWELED INTO MANHOLE BASE 2" FROM TOP OF SLAB. GROUT INTO 8" DEEP HOLES WITH EXPANSION GROUT.
9. OUTSIDE DROP SHALL NOT ENTER MANHOLE IN CONE SECTION.
10. MATCH DROP INFLUENT CROWN TO CROWN WITH EFFLUENT PIPE.
11. DROP MAY BE PVC, D.I.P. OR V.C.P.



SECTION A-A

**CHARLOTTE-MECKLENBURG
UTILITY DEPARTMENT
ENGINEERING DIVISION
CHARLOTTE, NORTH CAROLINA**

**STANDARD DETAIL
SEWER**

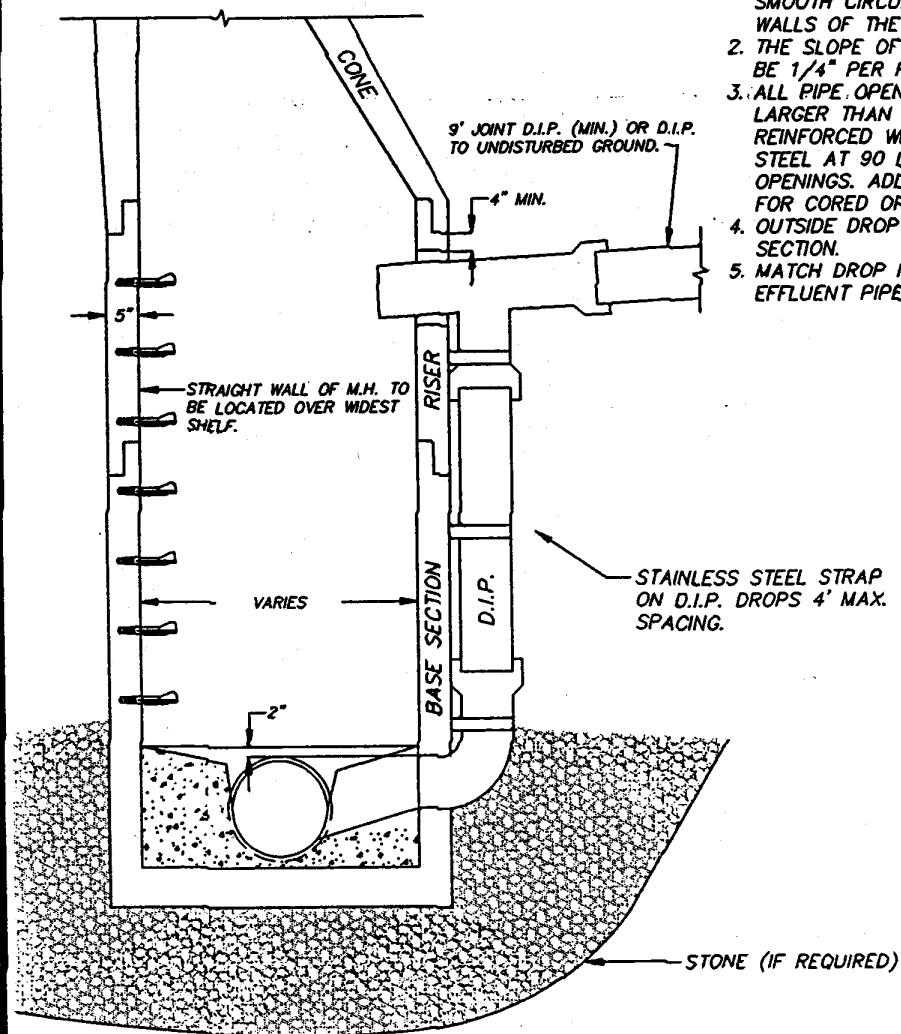
OUTSIDE DROP

Job No. _____	File No. _____	MSW	K. J. [Signature]	2/95	Sheet 5	Of _____
Scales						
PLAN	NTS	Drawn By	Project-Engr	Approved By	Date	
PROFILE	Hor. _____ Vert. _____					
As Built	Date	Surveyed By	Designed By	Drawn By	Project-Engr	Approved By

No.	Date	By	Revision

NOTES:

1. CARE MUST BE TAKEN TO FORM A SMOOTH FINISHED TROUGH FROM ENTRANCE PIPES TO EXIT PIPE, AND IN CURVED MANHOLES THE TROUGH MUST BE A SMOOTH CIRCULAR ARC TANGENT TO THE INSIDE WALLS OF THE PIPES AT THEIR ENDS.
2. THE SLOPE OF THE OUTSIDE DROP TROUGH SHALL BE 1/4" PER FOOT.
3. ALL PIPE OPENINGS TO BE NO GREATER THAN 3" LARGER THAN O.D. OF PIPE AND ADDITIONALLY REINFORCED WITH A MINIMUM OF 0.20 SQ. IN. OF STEEL AT 90 DEGREES. PIPE TO BE CENTERED IN OPENINGS. ADDITIONAL REINFORCING NOT REQUIRED FOR CORED OPENINGS.
4. OUTSIDE DROP SHALL NOT ENTER MANHOLE IN CONE SECTION.
5. MATCH DROP INFLUENT CROWN TO CROWN WITH EFFLUENT PIPE.



**CHARLOTTE-MECKLENBURG
UTILITY DEPARTMENT
ENGINEERING DIVISION
CHARLOTTE, NORTH CAROLINA**

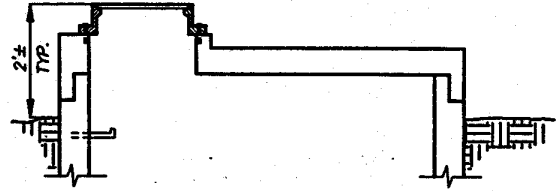
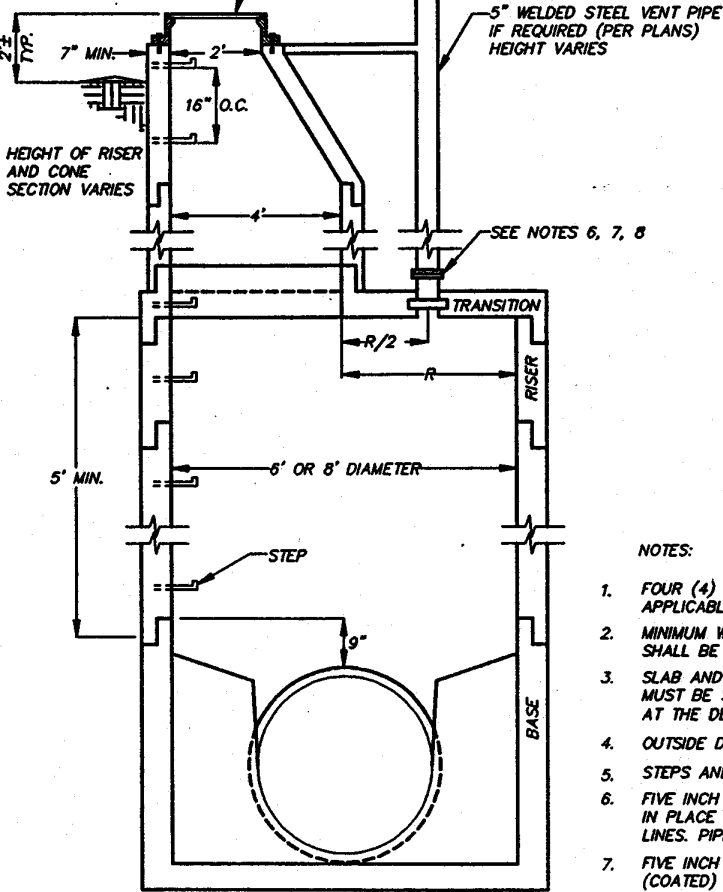
**STANDARD DETAIL
SEWER
OUTSIDE DROP
INSTALLATION (ALTERNATE)**

Job No. _____	File No. _____	MSW	Project-Engr	Approved By	Date	Sheet	Of
PLAN	Scales NTS						
PROFILE	Hor. _____	MSW	Project-Engr	Approved By	Date	Sheet	Of
	Vert. _____						
As Built	Date	MSW	Project-Engr	Approved By	Date	Sheet	Of
Surveyed By	Designed By	MSW	Project-Engr	Approved By	Date	Sheet	Of

No.	Date	By	Revision

12/04/94

CITY OF CHARLOTTE STANDARD
CAST IRON FRAME AND COVER
(BOLT DOWN-WATER TIGHT)

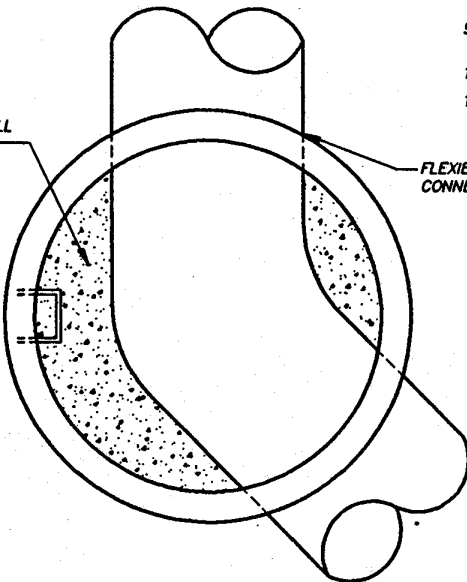


**FLAT TOP WITH FRAME
BOLTED TO MANHOLE**

NOTES:

1. FOUR (4) FOOT DIAMETER MANHOLE SECTIONS TO BE IN ACCORDANCE WITH APPLICABLE STANDARD DETAILS.
2. MINIMUM WALL THICKNESS FOR SIX FOOT DIAMETER AND LARGER MANHOLES SHALL BE 1/12 INSIDE DIAMETER PER ASTM C478.
3. SLAB AND WALL REINFORCING FOR SIX FOOT DIAMETER AND LARGER MANHOLES MUST BE SUBMITTED FOR APPROVAL TO INSURE STRUCTURAL INTEGRITY AT THE DEPTHS INSTALLED.
4. OUTSIDE DROPS SHALL NOT ENTER FOUR FOOT DIAMETER RISER SECTIONS.
5. STEPS AND COMMON STRAIGHT WALL TO BE OVER WIDEST SHOULDER OF INVERT.
6. FIVE INCH DIAMETER FLANGED AND PLAIN END STEEL WALL PIPE SHALL BE CAST IN PLACE (PLUMB) WITH BOLT HOLES IN FLANGE STRADDLING THE CENTER LINES. PIPE TO BE COATED PER VENT PIPE SPECIFICATIONS.
7. FIVE INCH DIAMETER STEEL VENT PIPE TO BE FURNISHED WITH COMPATIBLE (COATED) FLANGE AND ALL NECESSARY HARDWARE FOR BOLTED ATTACHMENT. VENT OUTLET TO POINT DOWNSTREAM.
8. SEE CONSTRUCTION PLANS FOR LOCATION OF TRANSITION SLAB. SOME MANHOLES MAY REQUIRE FLAT TOP SLABS WITH BOLT ON FRAME AND COVER.
9. THIS DETAIL SHALL BE CONSIDERED A RECOMMENDED CONFIGURATION AND COMPARABLE SHOP DRAWINGS MAY BE SUBMITTED FOR APPROVAL.
10. PENETRATING LIFTING HOLES SHALL BE PLUGGED WITH NON-SHRINK GROUT.
11. FOR 6' INSIDE DIAMETER MANHOLES, 6' CONES MAY BE USED IN LIEU OF FLAT TOP SLABS OR TRANSITION SECTIONS TO 4' CONES.

SLOPE 1"/FT.
FROM MH WALL
TO TROUGH



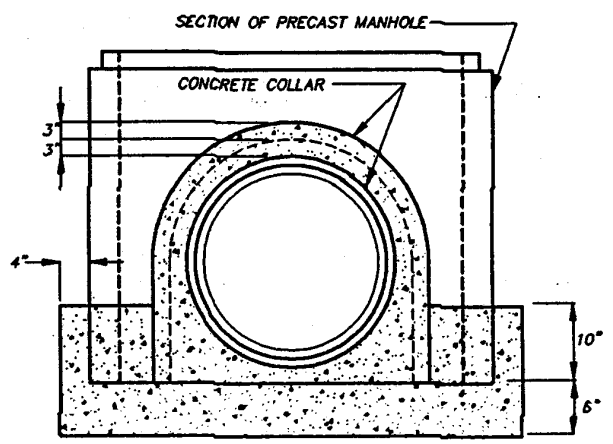
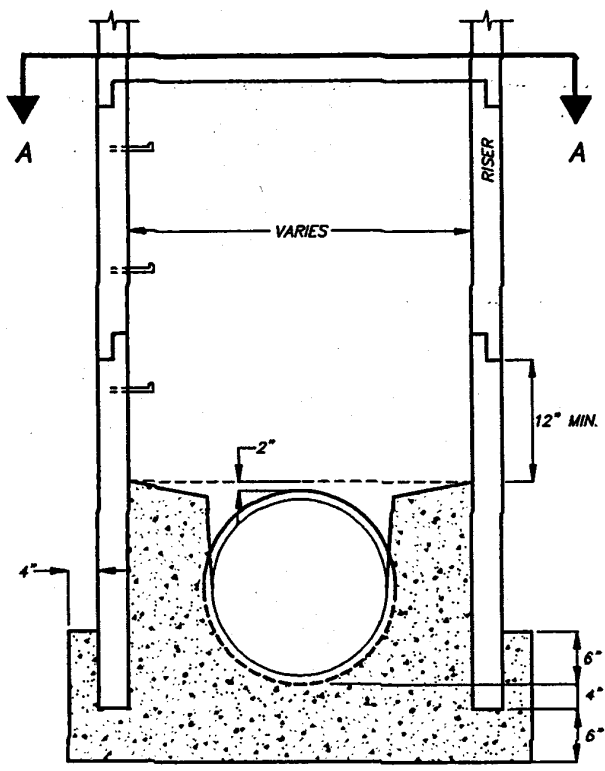
**CHARLOTTE-MECKLENBURG
UTILITY DEPARTMENT
ENGINEERING DIVISION
CHARLOTTE, NORTH CAROLINA**

**STANDARD DETAIL
SEWER**

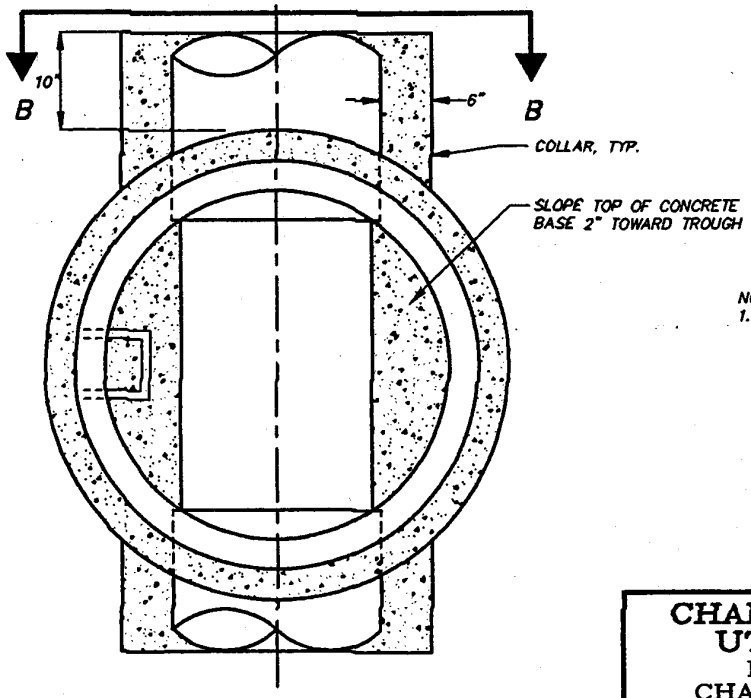
**PRECAST MANHOLE
6' AND 8' DIAMETER**

Job No. _____	File No. _____	Scales PLAN _____ NTS PROFILE _____		As Built _____	Date _____	KHP	KJ	2/11	2/11	Sheet 7	Of _____
Surveyed By _____	Designed By _____										

No.	Date	By	Revision



SECTION B-B



SECTION A-A

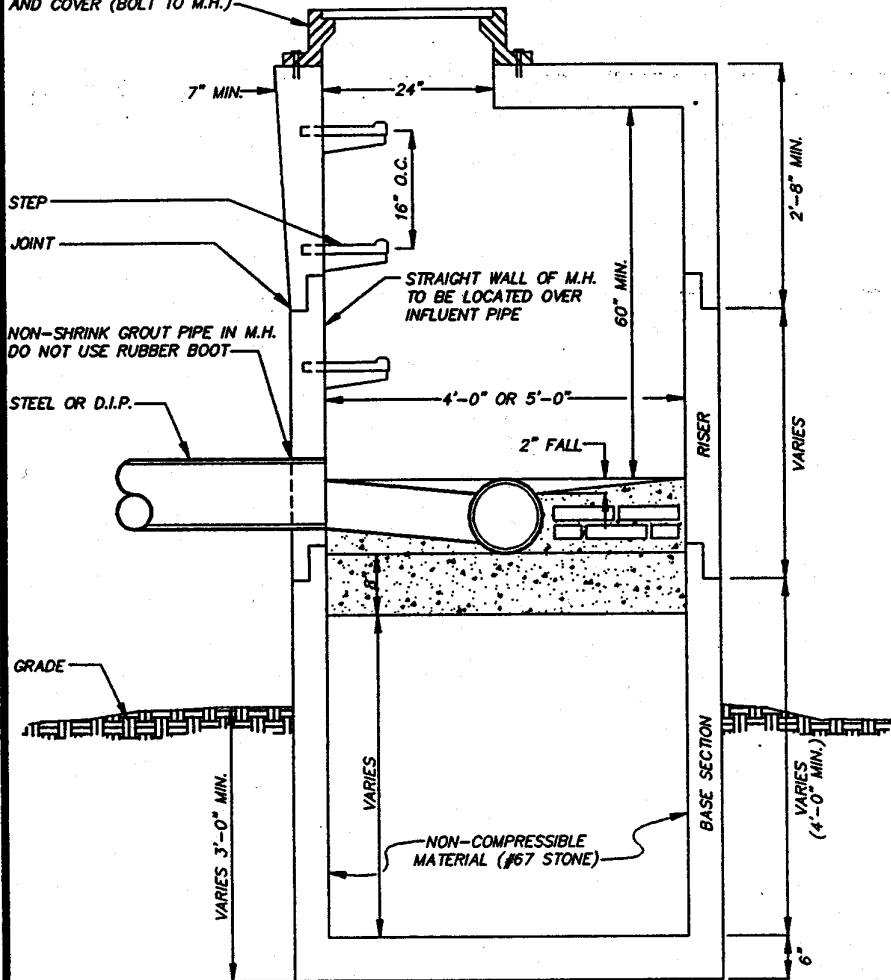
NOTES:
1. MANHOLES SHALL ALSO COMPLY WITH STANDARD DETAILS 4 AND 7 AS APPLICABLE.

CHARLOTTE-MECKLENBURG UTILITY DEPARTMENT ENGINEERING DIVISION CHARLOTTE, NORTH CAROLINA	
STANDARD DETAIL SEWER	
PRECAST MANHOLES INSTALLED OVER EXISTING PIPE	
Job No. _____	File No. _____
PLAN Scales _____	NTS
PROFILE Hor. _____	Vert. _____
As Built _____	Date _____
Surveyed By _____	Designed By _____
Drawn By _____	Project-Engr _____
Approved By _____	Date _____
Sheet _____	Of _____
8	8

No.	Date	By	Revision

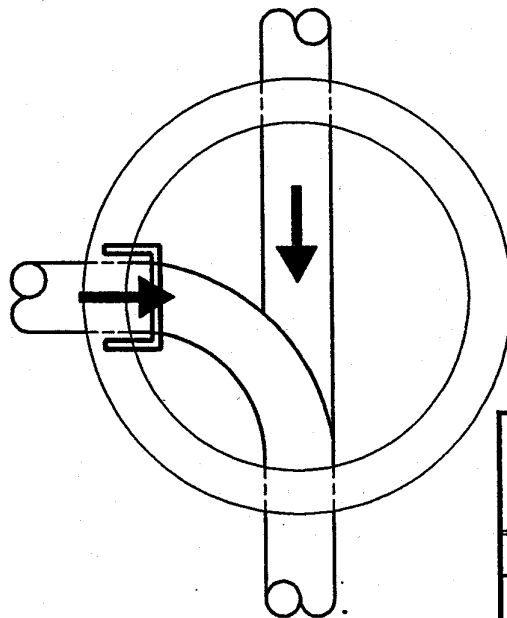
S058.DWG
2/2/94

CITY OF CHARLOTTE
STANDARD C.I. FRAME
AND COVER (BOLT TO M.H.)



NOTES:

1. THIS DETAIL IS TO BE USED WHERE THE INVERT OF THE MANHOLE IS ABOVE THE EXISTING GROUND.
2. FILLING BETWEEN THE BASE AND ELEVATED FLOOR MAY BE CRUSHED STONE, BRICK BATS, OR ANY NON-COMPRESSIBLE MATERIAL. THIS FILLING SHALL BE COVERED WITH IMPERVIOUS MATERIAL BEFORE THE CONCRETE IS PLACED.
3. MANHOLES SHALL ALSO COMPLY WITH STANDARD DETAIL 4 AS APPLICABLE.



CHARLOTTE-MECKLENBURG
UTILITY DEPARTMENT
ENGINEERING DIVISION
CHARLOTTE, NORTH CAROLINA

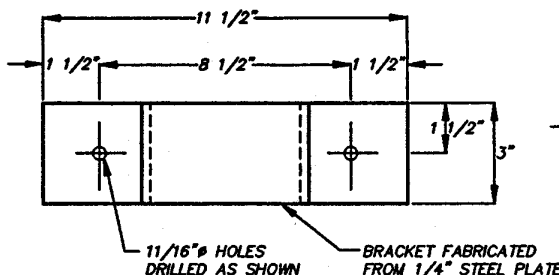
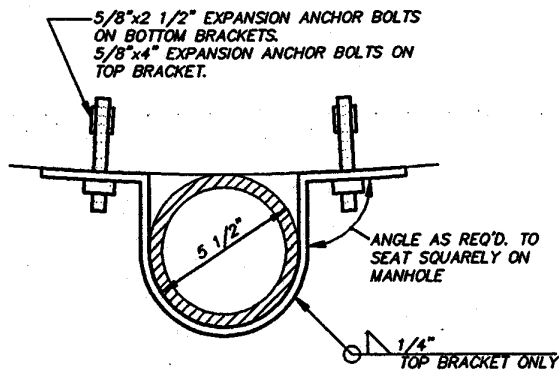
STANDARD DETAIL
SEWER

PRECAST MANHOLE
INVERT ABOVE GROUND

Job No. _____	File No. _____	Scales NTS	
PLAN	Hor. _____		
PROFILE	Vert. _____	As Built _____	
Date _____	Date _____	Date _____	
Surveyed By _____	Designed By _____	Drawn By KHP	Project-Engr _____
Approved By _____	Date _____	Approved By _____	Date _____

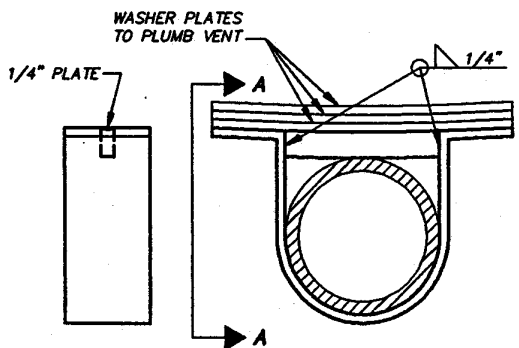
No.	Date	By	Revision

USS:DWG
7/7784



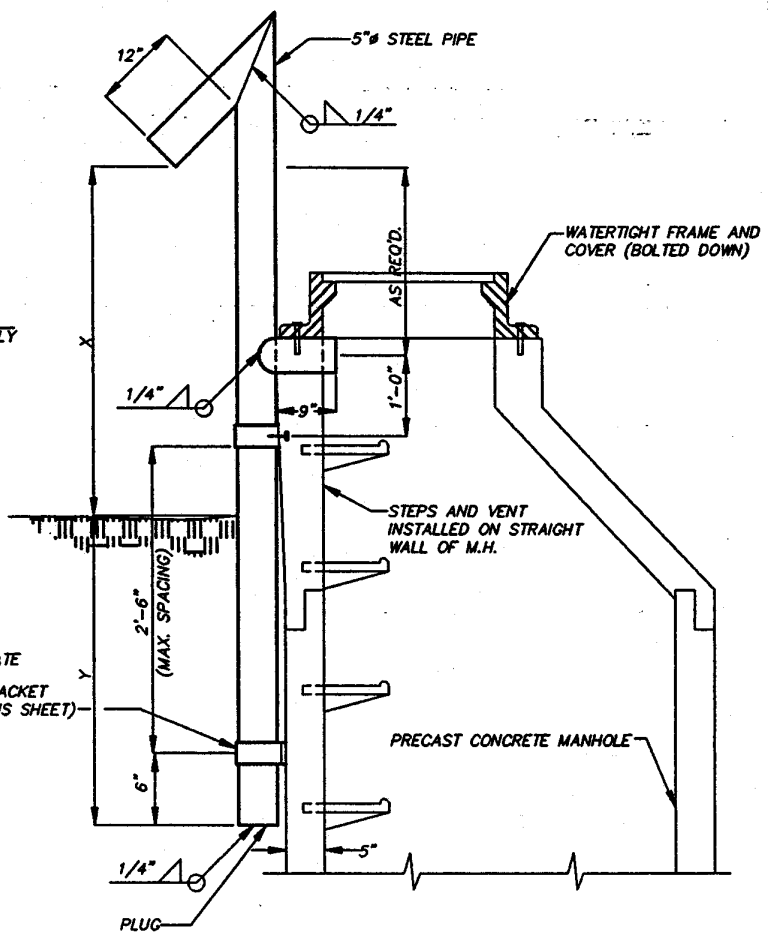
PIPE BRACKET

PIPE BRACKET (SEE THIS SHEET)



SECTION A-A

ACCORDING TO THE TYPE OF PRECAST MANHOLE, WASHER SPACERS MAY BE REQUIRED ON LOWER BRACKETS.



NOTES:

1. VENT SHALL BE ON CREEK SIDE AND POINT DOWNSTREAM.
2. VENT AND BRACKETS SHALL BE PAINTED PER SPECS.
3. AVOID PLACING PIPE BRACKET AT MANHOLE JOINTS OR STEPS.
4. ANCHOR SLEEVE, THREADED STUD AND NUT SHALL BE STAINLESS STEEL OR GALVANIZED STEEL.
5. ROTATE STRAIGHT WALL OF MANHOLE TO CREEKSIDE.

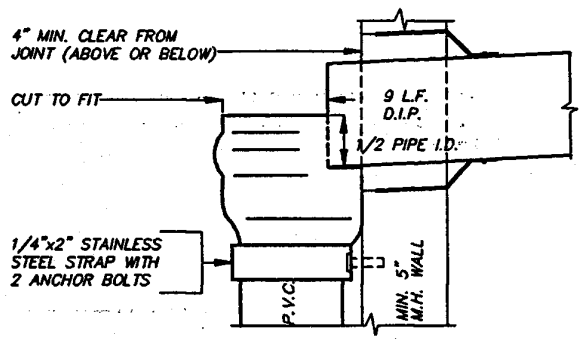
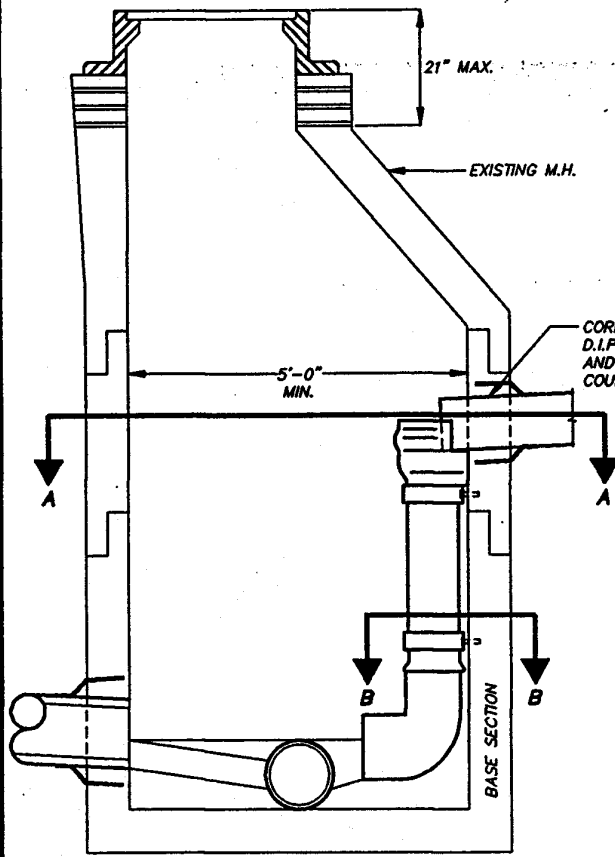
X	Y	MIN. NO. OF PIPE BRACKETS
0"-72"	60"	3
72"-84"	66"	3
OVER 84"	72"	3

**CHARLOTTE--MECKLENBURG
UTILITY DEPARTMENT
ENGINEERING DIVISION
CHARLOTTE, NORTH CAROLINA**

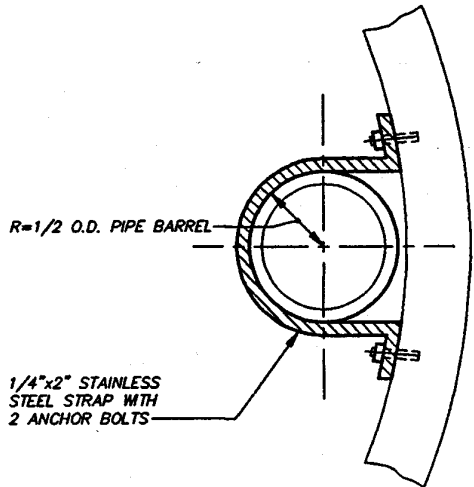
**STANDARD DETAIL
SEWER**

MANHOLE VENT

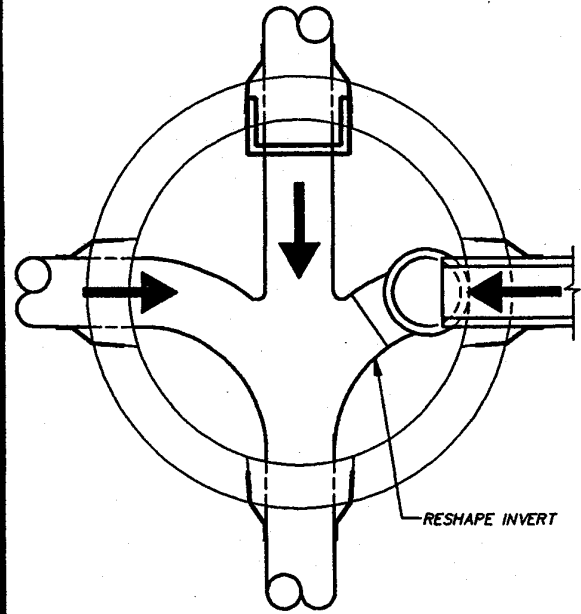
No.	Date	By	Revision	Job No.	File No.	Scale	PLAN	PROFILE	As Built	Date	KHP	Project-Engr	Approved By	Date	Sheet	Of
						NTS									10	



ENLARGED DETAIL



SECTION B-B



SECTION A-A

NOTES:

1. PIPE FOR INSIDE DROP SHALL BE SDR 35 PVC CONFORMING TO ASTM SPECIFICATION D3034.
2. BOTTOM BEND TO BE 90° SHORT BEND, BELL SPIGOT, OF SDR 35 PVC. SPIGOT OF BEND TO REST DIRECTLY ON EXISTING SHELF. CONSTRUCT MASONRY TROUGH FROM DROP EFFLUENT TO MAIN CHANNEL.
3. NOTCH BELL OF PVC DROP TO ACCEPT D.I.P. SPIGOT AS SHOWN.
4. LOCATE STRAPS AT PIPE BELL AND ABOVE BELL OF 90° BEND AS SHOWN. ADD EXTRA STRAPS AS NECESSARY TO MAINTAIN MAXIMUM SPACING OF TEN FEET.
5. HOLE IN MANHOLE WALL TO BE MADE WITH A CORING MACHINE. INSTALL FLEXIBLE RUBBER COUPLING.
6. CORE HOLE SHALL NOT ENTER CONE SECTION.
7. STEPS SHALL BE RELOCATED IF THEY CONFLICT WITH INSIDE DROP.

**CHARLOTTE-MECKLENBURG
UTILITY DEPARTMENT
ENGINEERING DIVISION
CHARLOTTE, NORTH CAROLINA**

**STANDARD DETAIL
SEWER**

INSIDE DROP

Job No. _____	File No. _____
Scales _____	
PLAN _____	NTS
PROFILE _____	
Hor. _____	
Vert. _____	
As Built _____	Date _____
Surveyed By _____	Designed By _____

KHP	_____	_____	_____	_____	_____
Drawn By	Project-Engr	Approved By	Date	Sheet	Of
_____	_____	_____	_____	11	17

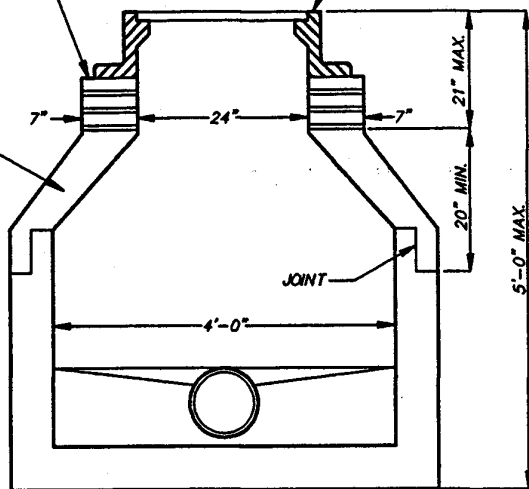
No.	Date	By	Revision

DATE PLOTTED 7/27/95

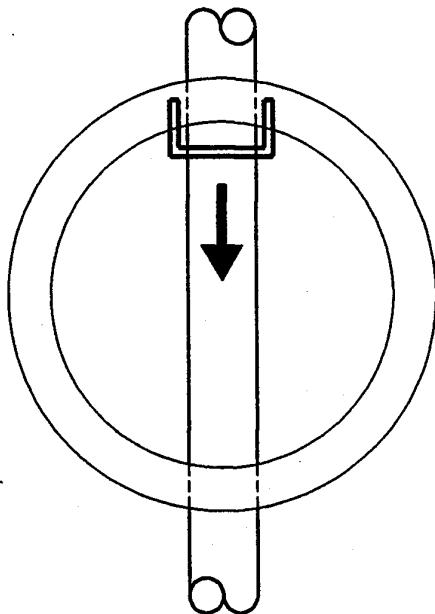
USE BRICK OR CONC. GRADE RINGS FOR ADJUSTMENT

CITY OF CHARLOTTE STANDARD C.I. FRAME AND COVER

CONCENTRIC CONCRETE



SECTION



PLAN

NOTES:

1. MANHOLE TO CONFORM TO ASTM C478 EXCEPT AS MODIFIED BELOW.
2. MANHOLE BASE TO BE REINFORCED WITH A MINIMUM AREA OF 0.20 SQ. IN. PER LINEAL FOOT EACH WAY. WALL REINFORCING TO BE A MINIMUM OF 0.12 SQ. IN. PER LINEAL FOOT. EITHER TONGUE OR GROOVE OF JOINTS SHALL HAVE REINFORCING EQUAL IN AREA TO MINIMUM OF WALL SECTION.
3. ALL JOINTS SHALL CONFORM TO ASTM C443.
4. STEPS TO BE PLASTIC PER CITY STANDARDS.
5. ALL PIPE OPENINGS TO BE NO GREATER THAN 3" LARGER THAN O.D. OF PIPE AND ADDITIONALLY REINFORCED WITH A MINIMUM OF 0.20 SQ. IN. OF STEEL AT 90 DEGREES. ADDITIONAL REINFORCING NOT REQUIRED FOR CORED OPENINGS.
6. ALL SURFACES SHALL BE SMOOTH, EVEN TEXTURED WITH A MINIMUM OF HONEYCOMB, FINS AND IMPERFECTIONS.
7. PENETRATING LIFTING HOLES SHALL BE PLUGGED WITH EXPANSION GROUT.

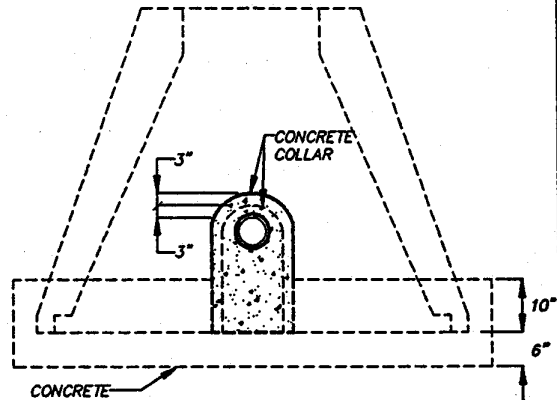
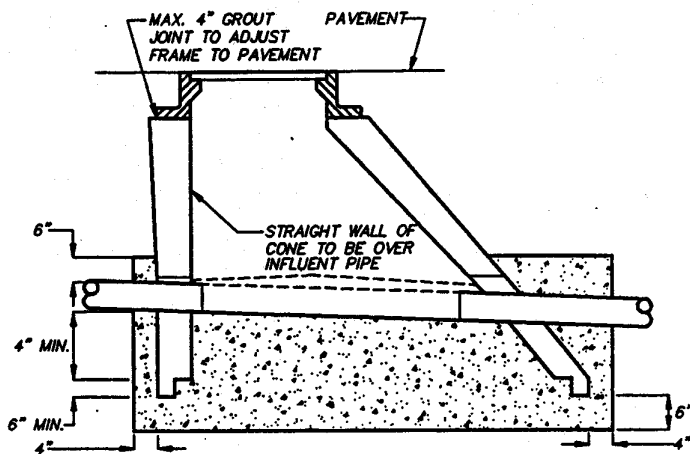
**CHARLOTTE-MECKLENBURG
UTILITY DEPARTMENT
ENGINEERING DIVISION
CHARLOTTE, NORTH CAROLINA**

**STANDARD DETAIL
SEWER**

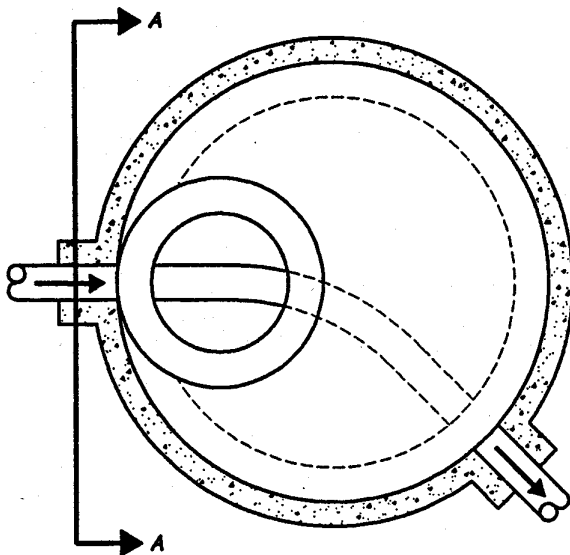
**PRECAST SHORT
MANHOLE-4' DIAMETER**

Job No. _____	File No. _____	STANDARD DETAIL SEWER
Scales <u>NTS</u>		
PLAN _____	PROFILE _____	PRECAST SHORT MANHOLE-4' DIAMETER
Hor. _____	Vert. _____	
As Built _____	Date _____	
Surveyed By _____	Designed By _____	Drawn By <u>KHP</u>
		Project-Engr <u>K. Blaylock</u>
		Approved By <u>[Signature]</u>
		Date <u>2/14/94</u>
		Sheet <u>12</u> OF _____

No.	Date	By	Revision



SECTION A-A



NOTES:

1. MANHOLE TO CONFORM TO ASTM C478 EXCEPT AS MODIFIED BELOW.
2. WALL REINFORCING TO BE A MINIMUM OF 0.12 SQ. IN. PER LINEAL FOOT. EITHER TONGUE OR GROOVE OF JOINTS SHALL HAVE REINFORCING EQUAL IN AREA TO MINIMUM OF WALL SECTION.
3. ALL JOINTS SHALL CONFORM TO ASTM C443.
4. STEP TO BE DELETED FROM CONE.
5. ALL PIPE OPENINGS TO BE NO GREATER THAN 3" LARGER THAN O.D. OF PIPE AND ADDITIONALLY REINFORCED WITH A MINIMUM OF 0.20 SQ. IN. OF STEEL AT 90 DEGREES. PIPE TO BE CENTERED IN OPENINGS.
6. ALL SURFACES SHALL BE SMOOTH, EVEN TEXTURED WITH A MINIMUM OF HONEYCOMB, FINS, AND OTHER IMPERFECTIONS.
7. MANHOLE BASE SHALL BE 3600 P.S.I. CONCRETE PLACED ON UNDISTURBED EARTH AND MAY BE PLACED AGAINST SHAPED BANKS IN LIEU OF FORMS.
8. CARE MUST BE TAKEN TO FORM A SMOOTH FINISHED TROUGH FROM ENTRANCE PIPES TO EXIT PIPE, AND IN CURVED MANHOLES THE TROUGH MUST BE A SMOOTH CIRCULAR ARC TANGENT TO THE INSIDE WALLS OF THE PIPES AT THEIR ENDS.

**CHARLOTTE-MECKLENBURG
UTILITY DEPARTMENT
ENGINEERING DIVISION
CHARLOTTE, NORTH CAROLINA**

**STANDARD DETAIL
SEWER**

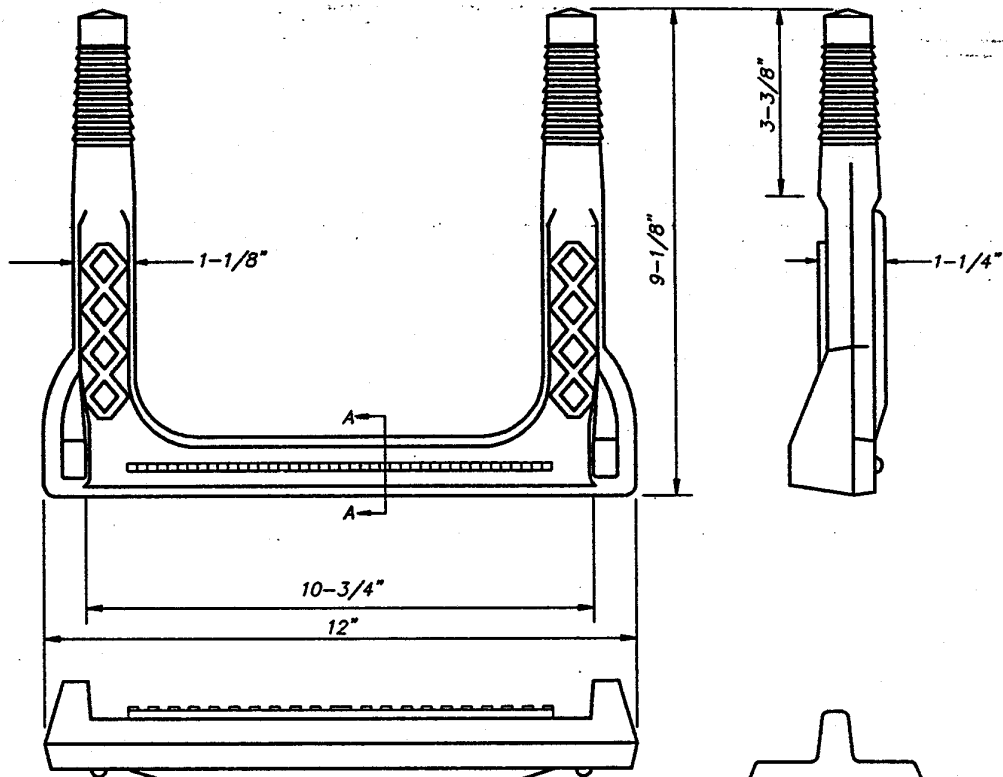
**ECCENTRIC CONE SHORT
MANHOLE-4' DIAMETER**

Job No. _____	File No. _____
Scales _____	
PLAN _____	NTS _____
PROFILE _____	Hor. _____
	Vert. _____
As Built _____	Date _____
Surveyed By _____	Designed By _____
Drawn By _____	Project-Engr _____

KHP	KD	2/4	Sheet	Of
Drawn By	Approved By	Date	13	

No.	Date	By	Revision

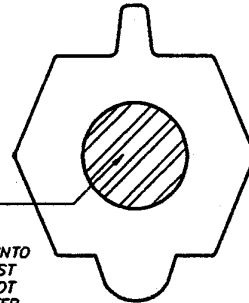
KDP/2/2



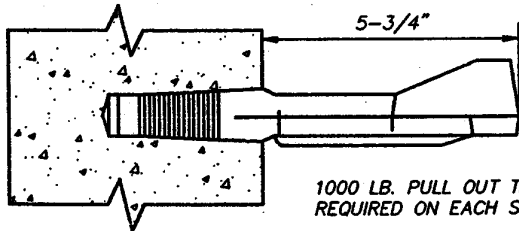
COPOLYMER POLYPROPYLENE PLASTIC

1/2" GRADE 60 STEEL REINFORCEMENT

NOTE:
THIS STEP TO BE DRIVEN INTO
TAPERED HOLES IN PRECAST
MANHOLE SECTIONS. DO NOT
USE AS A GROUTED-IN STEP.



SECTION A-A



1000 LB. PULL OUT TEST REPORT
REQUIRED ON EACH STEP.

**CHARLOTTE-MECKLENBURG
UTILITY DEPARTMENT
ENGINEERING DIVISION
CHARLOTTE, NORTH CAROLINA**

**STANDARD DETAIL
SEWER**

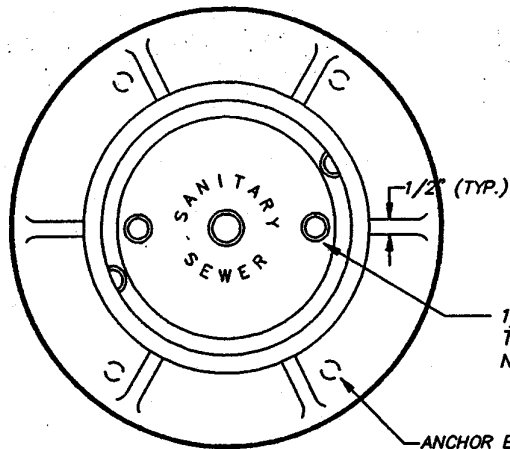
**PLASTIC STEP CORED HOLE
DRIVEN IN PLACE**

Job No.	File No.
Scales	
PLAN	NTS
PROFILE	
Hor.	
Vert.	
As Built	Date
Surveyed By	Designed By

MSW	Project-Engr	Approved By	Date	Sheet	Of
				14	

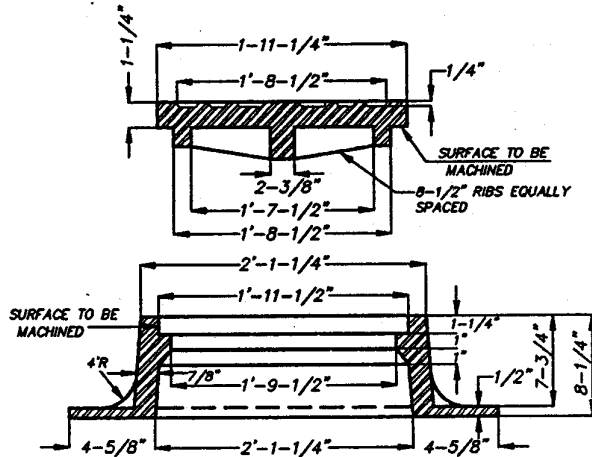
No.	Date	By	Revision

02/08/94

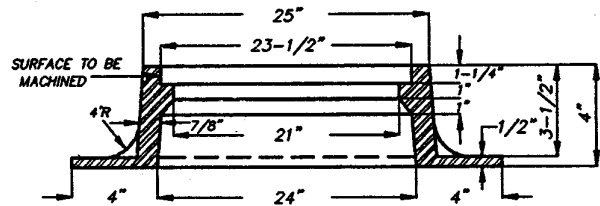


1/4" RIM RAISED 1/4" 1" HOLE AT TOP, TAPER TO 1-1/8" AT BOTTOM. NO HOLE FOR WATERTIGHT F & C.

ANCHOR BOLT HOLE



STANDARD HEIGHT



SHORT - 4 INCH HEIGHT

NOTES:

1. ALL CASTING TO BE FREE FROM SAND HOLES AND NO PLUGGING WILL BE ALLOWED.
2. CAST WITH THE USE OF ALUMINUM PATTERNS.
3. SLIGHT DRAFT ALLOWED ON STRAIGHT FACES.
4. APPROXIMATE WEIGHT OF FRAME 230 LBS.
APPROXIMATE WEIGHT OF FRAME 143 LBS.
APPROXIMATE WEIGHT OF FRAME 373 LBS.
5. WHEN THE MANHOLE RIM IS ABOVE FINISH GRADE, THE FRAME WILL BE BOLTED TO THE MANHOLE CONE AS SPECIFIED.
6. WATERTIGHT COVERS WITH GASKETS SHALL BE USED WHERE SHOWN ON CONSTRUCTION PLANS.
7. BOLT HOLE SHALL NOT BE GREATER THAN BOLT DIA. PLUS 1/8".
8. SLIGHT VARIATION IN DIMENSIONS NOT CRITICAL TO INTER-CHANGEABILITY ARE PERMITTED. ENGINEER'S APPROVAL REQUIRED FOR EACH FRAME AND COVER.
9. 4 INCH TALL FRAME WILL ONLY BE ALLOWED WHERE FRAME IS BOLTED TO MANHOLE.

**CHARLOTTE-MECKLENBURG
UTILITY DEPARTMENT
ENGINEERING DIVISION
CHARLOTTE, NORTH CAROLINA**

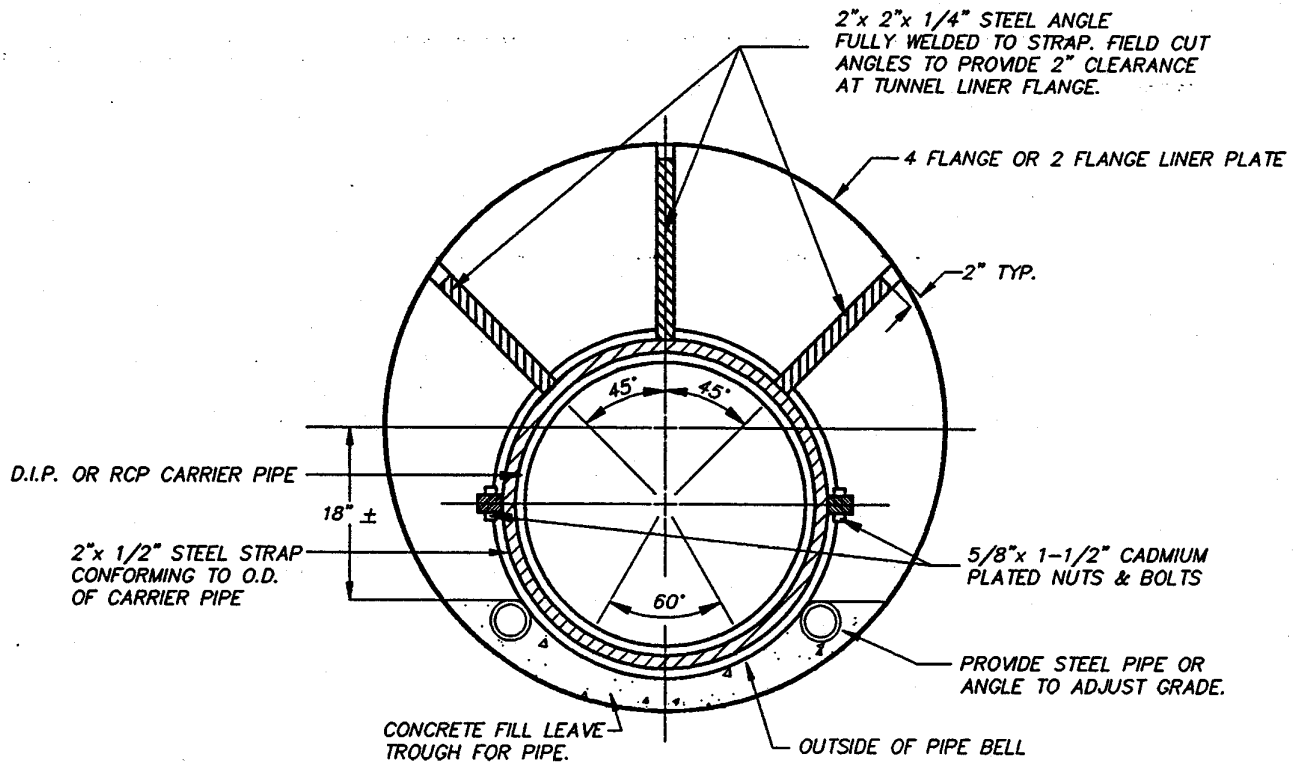
**STANDARD DETAIL
SEWER**

**CAST IRON FRAME AND COVER
SANITARY SEWER MANHOLES**

Job No.	File No.
Scales	
PLAN	NTS
PROFILE	
Hor.	
Vert.	
As Built	Date
Surveyed By	Designed By
Drawn By	Project-Engr

MSW	2. Blaylock	2/24	Sheet 15 of
Drawn By	Project-Engr	Approved By	Date

No.	Date	By	Revision



NOTES:

1. COAT ENTIRE SPIDER WITH COAL TAR BEFORE ASSEMBLY ON CARRIER PIPE. TOUCH UP BEFORE JACKING PIPE.
2. ONE SPIDER REQUIRED FOR EACH JOINT OF CARRIER PIPE.
3. SEAL TUNNEL ENDS PER SPECIFICATIONS.
4. PLACE CONCRETE FILL PRIOR TO PIPE INSTALLATION.
5. SPIDER DETAILS OR ALTERNATIVE SHALL BE SUBMITTED FOR APPROVAL.

**CHARLOTTE-MECKLENBURG
UTILITY DEPARTMENT
ENGINEERING DIVISION
CHARLOTTE, NORTH CAROLINA**

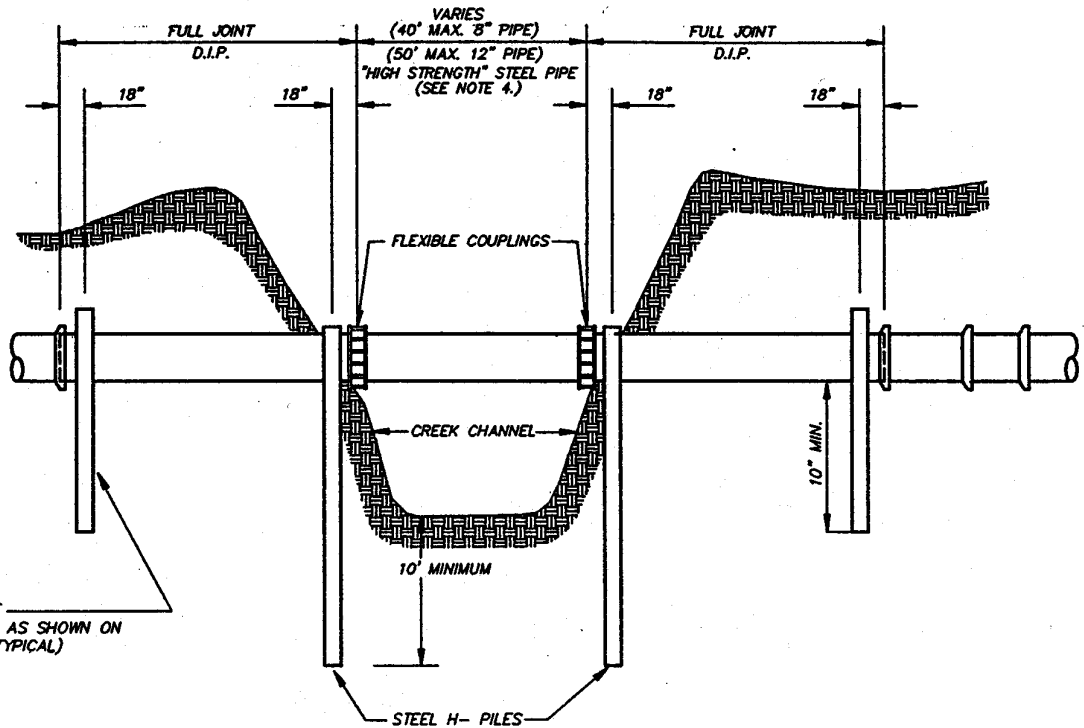
**STANDARD DETAIL
SEWER**

TUNNEL LINER SECTION

Job No.	File No.
Scales	
PLAN	NTS
PROFILE	
Hor.	
Vert.	
As Built	Date
Surveyed By	Designed By

MSW		K. Blayton	2/16	Sheet	Of
Drawn By	Project-Engr	Approved By	Date		

No.	Date	By	Revision



H-PILE IF
REQUIRED AS SHOWN ON
PLANS. (TYPICAL)

NOTES:

1. FLEXIBLE COUPLING SHALL BE LONG BODY TYPE.
2. MINIMUM DEPTHS SHALL BE IN UNDISTURBED SOIL.
3. MAXIMUM HEIGHT FROM PIPE TO BE UNDISTURBED SOIL IS 20 FEET.
4. STEEL PIPE MUST BE SEAMLESS OR STRAIGHTSEAM. SPIRAL WELD NOT PERMITTED.

**CHARLOTTE-MECKLENBURG
UTILITY DEPARTMENT
ENGINEERING DIVISION
CHARLOTTE, NORTH CAROLINA**

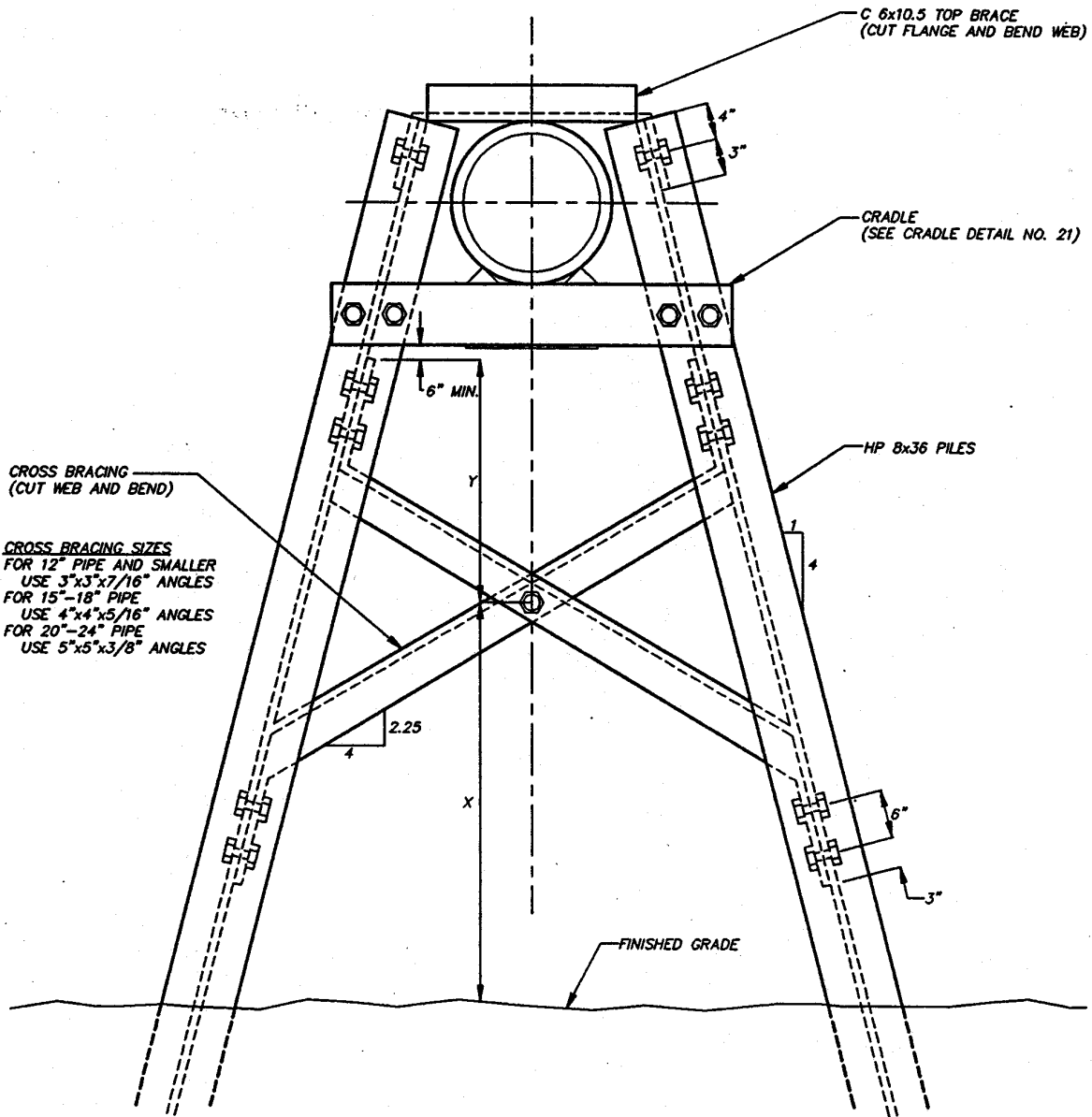
**STANDARD DETAIL
SEWER**

**CREEK CROSSING
STEEL H-PILES**

Job No.	File No.
Scales	
PLAN	NTS
PROFILE	
Hor.	
Vert.	
As Built	Date
Surveyed By	Designed By

MSW	Project-Engr	Approved By	Date	Sheet 17	Of
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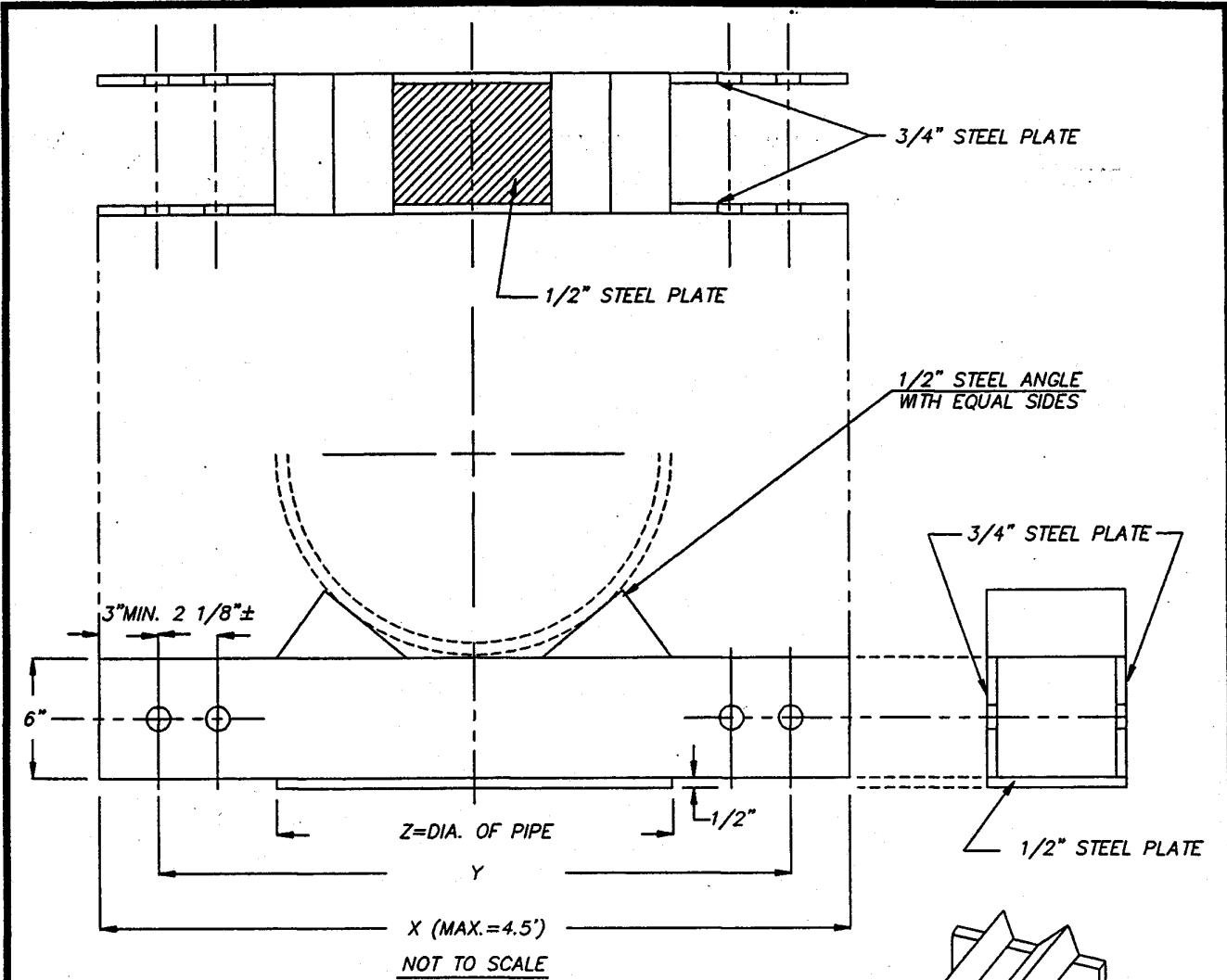
No.	Date	By	Revision



NOTES:

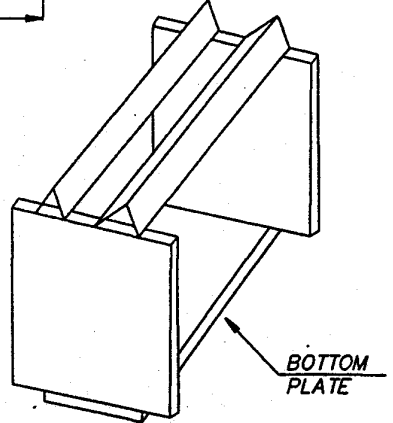
1. MAXIMUM HEIGHT FROM PIPE TO UNDISTURBED SOIL IS 20 FEET.
2. PIPE SHALL FIT SNUGLY.
3. X SHALL EQUAL Y OR AS APPROVED.
4. FOR 8 INCH TO 18 INCH PIPE ALL BOLTS SHALL BE 7/8" IN DIAMETER AND MEET ASTM A325. FOR 24" PIPE, BOLTS ON THE CRADLE SHALL BE 1" IN DIAMETER AND MEET ASTM A490. BOLTS SHALL BE AT LEAST 2 1/2" LONG. PLAIN ROUND WASHERS WILL BE REQUIRED.
5. BOLT HOLES SHALL BE 1/16" LARGER THAN THE DIAMETER OF THE BOLT AND SHALL BE DRILLED.
6. ALL STEEL SHALL BE A36 STEEL.
7. SEE STEEL H-PILE SPECIFICATIONS.
8. PILES SHALL BE DRIVEN TO A MINIMUM DEPTH OF TEN (10) FEET BELOW GROUND OR AS DIRECTED BY THE ENGINEER.
9. PILES SHALL BE DRIVEN TO A DEPTH AT WHICH PILE BEARING CAPACITY IS TWENTY (20) TONS OR AS APPROVED BY THE ENGINEER.
10. THESE PIERS SHALL BE USED FOR DUCTILE IRON PIPE OR HIGH STRENGTH STEEL PIPE ONLY.
11. CONTRACTOR MAY SUBSTITUTE WBx35 FOR HP8x36 FOR THE PILES.

CHARLOTTE-MECKLENBURG UTILITY DEPARTMENT ENGINEERING DIVISION CHARLOTTE, NORTH CAROLINA																	
Job No. _____ File No. _____ Scales _____ PLAN _____ NTS _____ PROFILE _____ Hor. _____ Vert. _____ As Built _____ Date _____ Surveyed By _____ Designed By _____	STANDARD DETAIL SEWER STEEL H-PILES PIERS FOR 24" PIPE AND SMALLER																
<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 25%;">No.</td> <td style="width: 25%;">Date</td> <td style="width: 25%;">By</td> <td style="width: 25%;">Revision</td> </tr> <tr> <td> </td> <td> </td> <td> </td> <td> </td> </tr> </table>	No.	Date	By	Revision					<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 25%;">KHP</td> <td style="width: 25%;">C. Bayly</td> <td style="width: 25%;">2/14</td> <td style="width: 25%;">18</td> </tr> <tr> <td>Drawn By</td> <td>Project-Engr</td> <td>Approved By</td> <td>Date</td> </tr> </table>	KHP	C. Bayly	2/14	18	Drawn By	Project-Engr	Approved By	Date
No.	Date	By	Revision														
KHP	C. Bayly	2/14	18														
Drawn By	Project-Engr	Approved By	Date														



NOTES:

1. DIMENSIONS X AND Y VARY ACCORDING TO PIPE SIZE ELEVATION OF PIPE. THE MAXIMUM LENGTH OF X IS 4.5'.
2. DIMENSION Z IS EQUAL TO THE DIAMETER OF THE PIPE.
3. ALL STEEL PLATES SHALL MEET ASTM A36.
4. FOR 8 INCH - 18 INCH PIPE ALL BOLTS SHALL BE 7/8" IN DIAMETER AND MEET ASTM A325. FOR 24 INCH PIPE, BOLTS ON THE CRADLE SHALL BE 1" DIAMETER AND MEET ASTM A490. BOLTS SHALL BE AT LEAST 2 1/2" LONG. PLAIN ROUND WASHERS WILL BE REQUIRED.
5. BOLT HOLES SHALL BE 1/16" LARGER THAN THE DIAMETER OF THE BOLT AND SHALL BE DRILLED.
6. THIS CRADLE SHALL NOT BE USED FOR PIPE LARGER THAN 24" IN DIAMETER.
7. ATTACH THE CRADLE TO THE PILES WITH FOUR(4) BOLTS ON EACH SIDE [TOTAL OF EIGHT (8) BOLTS].
8. ATTACH BOTTOM PLATE TO CRADLE SIDES WITH A CONTINUOUS 3/8" FILLET WELD.
9. THE 1/2" STEEL ANGLES SHALL BE SPOT WELDED TO THE SIDES OF THE CRADLE.

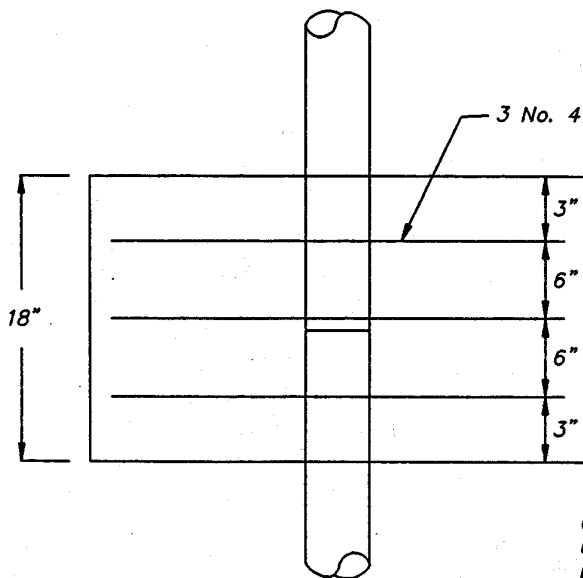
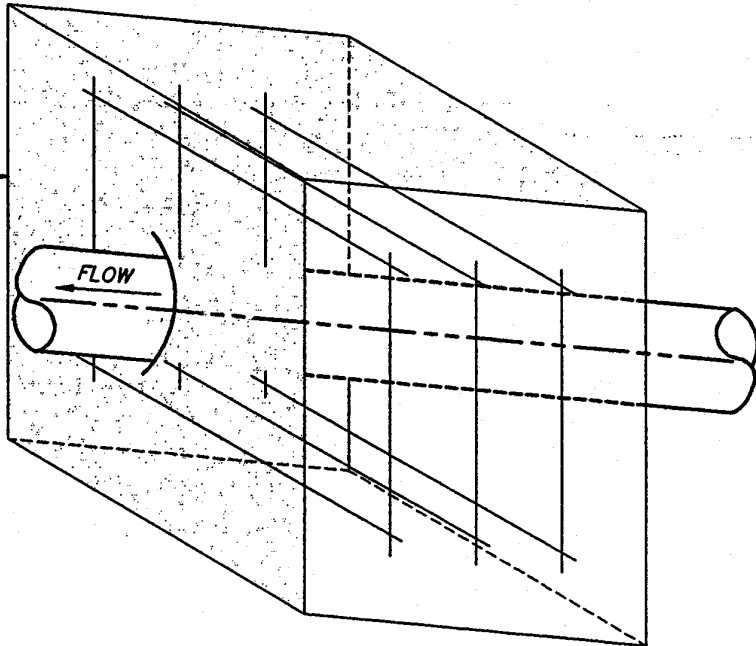


**CHARLOTTE-MECKLENBURG
UTILITY DEPARTMENT
ENGINEERING DIVISION
CHARLOTTE, NORTH CAROLINA**

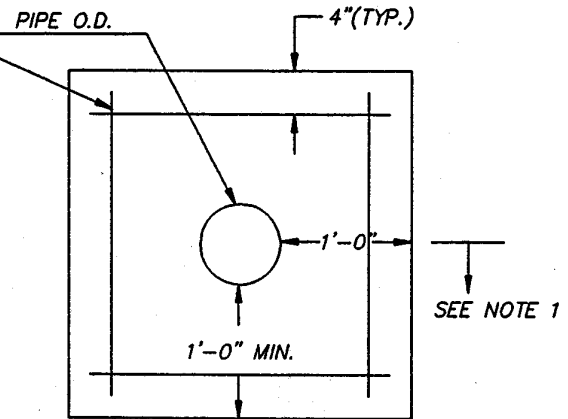
Job No. _____ File No. _____		STANDARD DETAIL SEWER	
Scales _____		PIER CRADLE 24" PIPE & SMALLER	
PLAN _____	PROFILE _____		
Hor. _____		As Built _____	
Vert. _____		Date _____	
Surveyed By _____	Designed By _____	Drawn By <i>JRW</i>	Project-Engr _____
No. _____ Date _____ By _____		Approved By <i>K. Blalock</i>	Sheet <i>19</i> Of _____
Revision _____		Date _____	Date _____

POURED IN PLACE

CONCRETE



PLAN VIEW



VERTICAL VIEW

NOTES:

1. FORMS NOT REQUIRED BELOW SPRING LINE, CONCRETE MAY BE PLACED AGAINST SHAPED BANKS IN LIEU OF FORMS.

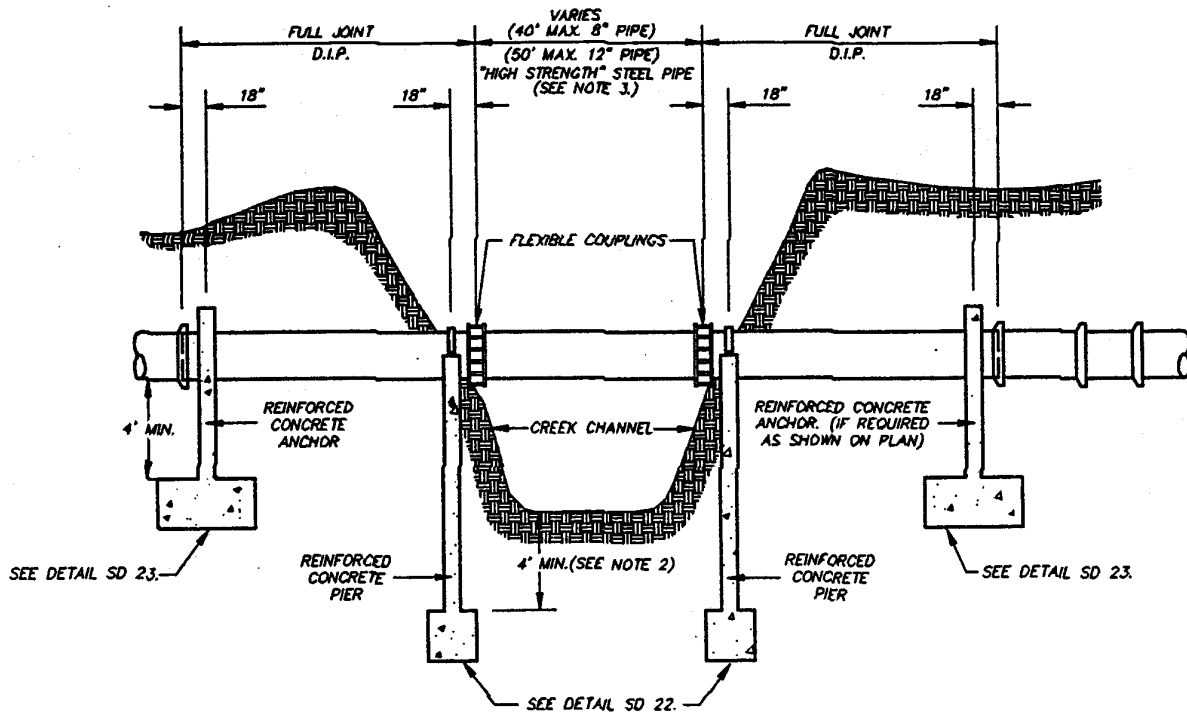
**CHARLOTTE—MECKLENBURG
UTILITY DEPARTMENT
ENGINEERING DIVISION
CHARLOTTE, NORTH CAROLINA**

**STANDARD DETAIL
SEWER**

CONCRETE COLLAR

Job No. _____	File No. _____
Scales _____	
PLAN _____	Scale <u>NONE</u>
PROFILE _____	Hor. _____
	Vert. _____
As Built _____	Date _____
Surveyed By _____	Designed By _____
Drawn By <u>JRW</u>	Project-Engr _____
Approved By <u>E. B. [Signature]</u>	Date <u>20</u>

No.	Date	By	Revision



NOTES:

1. FLEXIBLE COUPLING SHALL BE LONG BODY TYPE, AND COMPLETELY EXPOSED.
2. FOOTING DEPTH SHALL BE TO SUITABLE GRADE AS DETERMINED BY THE ENGINEER, SHALL NOT BE LESS THAN AS SHOWN. (EXCEPT WHEN PIER IS ANCHORED TO SOLID ROCK.)
3. STEEL PIPE MUST BE SEAMLESS OR STRAIGHTSEAM. SPIRAL WELD IS NOT ALLOWED.

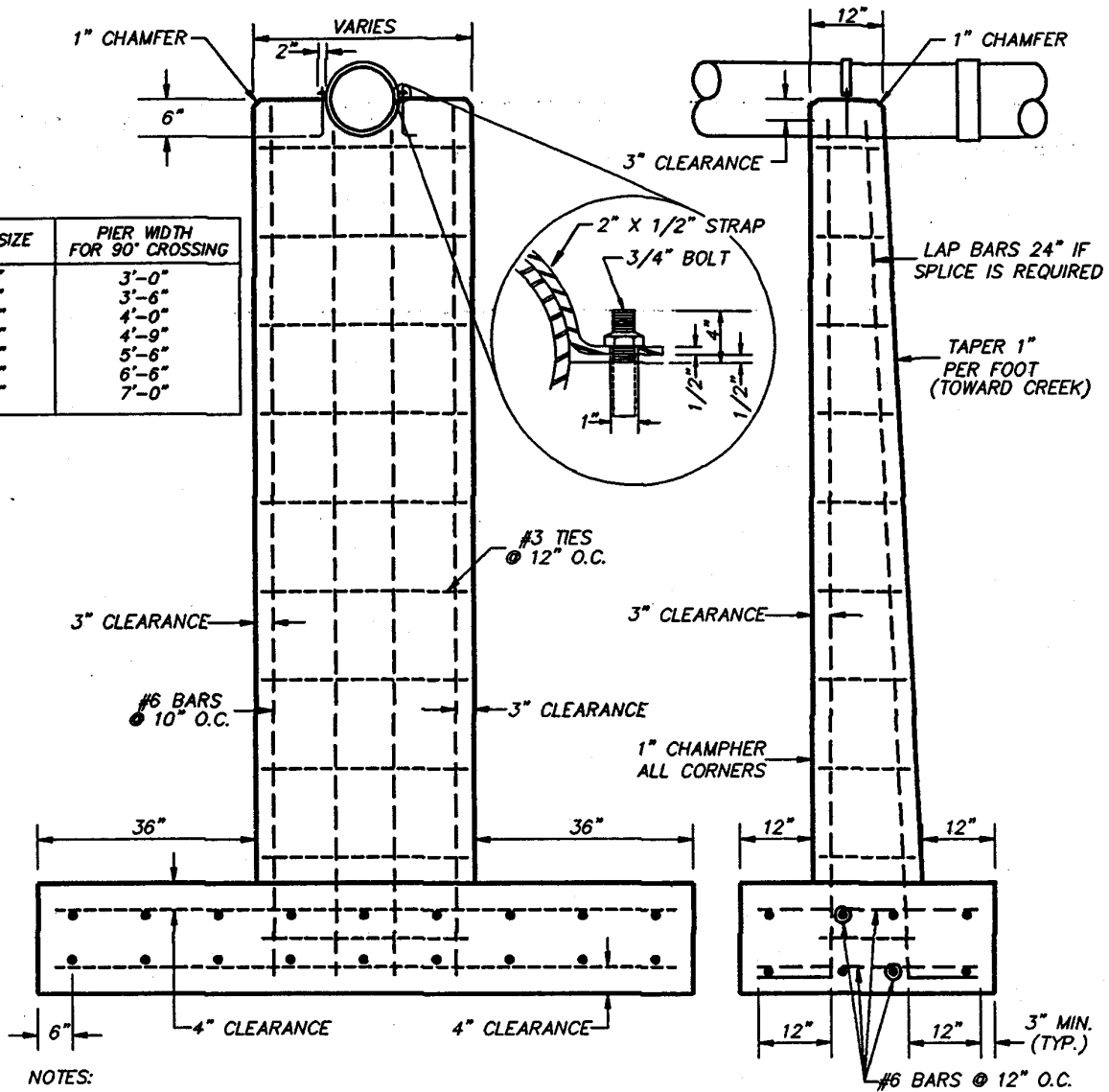
**CHARLOTTE-MECKLENBURG
UTILITY DEPARTMENT
ENGINEERING DIVISION
CHARLOTTE, NORTH CAROLINA**

**STANDARD DETAIL
SEWER**

**ELEVATED CREEK CROSSING
WITH CONCRETE PIERS**

Job No. _____		File No. _____		MSW		Project-Engr	Approved By	Date	Sheet 21 of _____		
Scales										PLAN	PROFILE
NTS											
Hor. _____		Vert. _____		As Built		Date					
No.	Date	By	Revision			Surveyed By	Designed By				

PIPE SIZE	PIER WIDTH FOR 90° CROSSING
15"	3'-0"
18"	3'-6"
24"	4'-0"
30"	4'-9"
36"	5'-6"
42"	6'-6"
48"	7'-0"



NOTES:

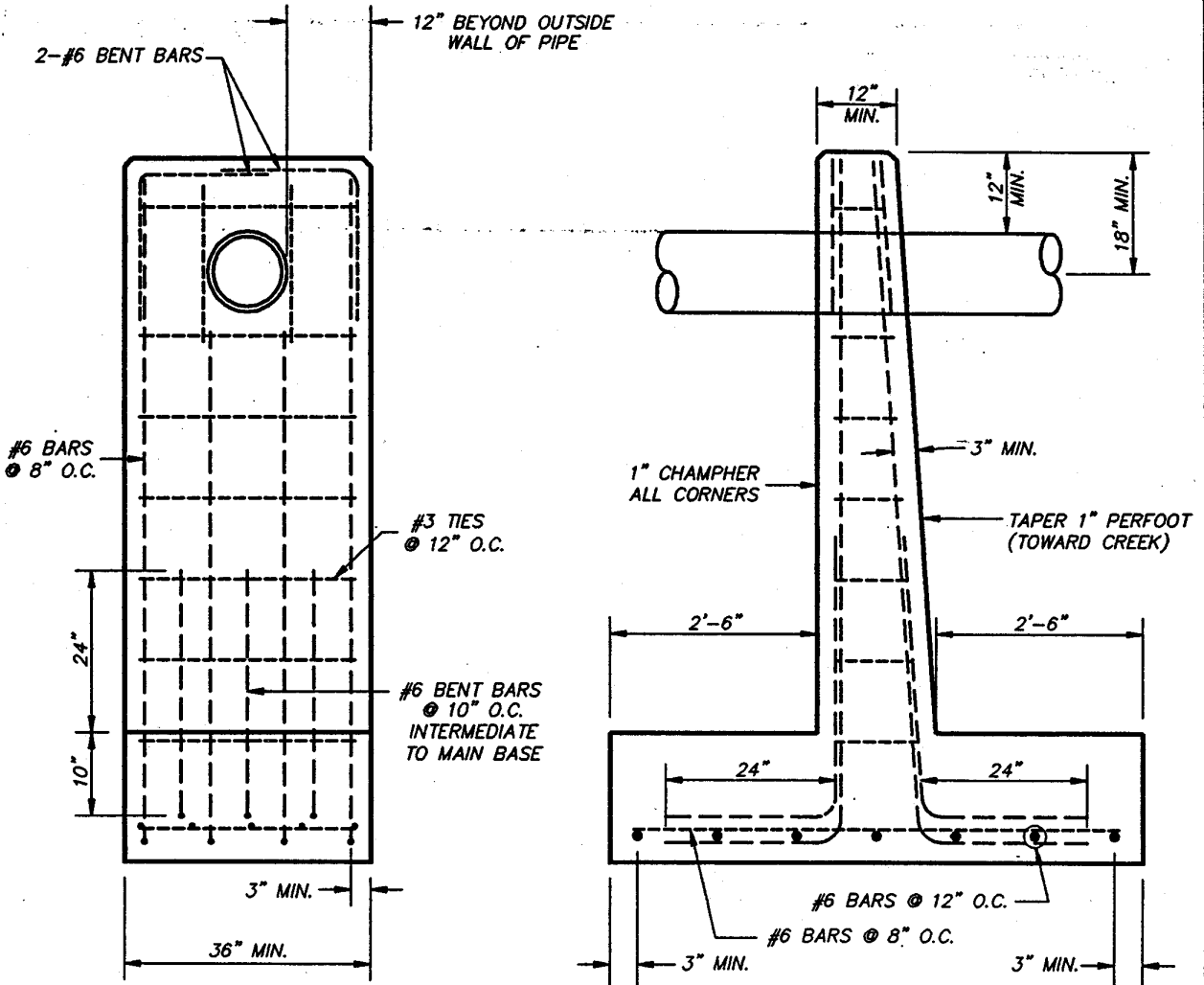
1. ALL CONCRETE TO BE 3600 P.S.I.
2. MAXIMUM HEIGHT REINFORCED CONCRETE PIERS TO BE 20'-0"
3. FOOTING THICKNESS SAME AS BASE THICKNESS OF PIER, BUT NOT TO EXCEED 2'-0"
4. PIERS TO BE BUILT WITH LONG SIDE PARALLEL TO CREEK FLOW.
5. PIER TO BE CENTERED ON FOOTING WHEN PIPE IS PARALLEL TO CREEK.
6. PIPE TO BE SET 1/2" IN PIER AND 1/2" PROTRUDING ABOVE PIER. WHEN PIERS ARE PLACED PARALLEL TO THE FLOW OF THE CREEK AND THE PIPE IS ON A SKEW WITH THE PIER, HOLDING STRAPS MAY STILL BE PLACED AT RIGHT ANGLES TO THE PIPE, PROVIDING THE ANCHOR BOLTS ARE NOT SET WITH A CLEARANCE OF LESS THAN 2" TO THE SURFACE OF THE PIER.
7. NO REINFORCING STEEL TO BE PLACED WITH A CLEARANCE OF LESS THAN 3" TO THE SURFACE OF THE PIER.

**CHARLOTTE-MECKLENBURG
UTILITY DEPARTMENT
ENGINEERING DIVISION
CHARLOTTE, NORTH CAROLINA**

**STANDARD DETAIL
SEWER
REINFORCED CONCRETE
PIER**

Job No. _____	File No. _____	MSW	K. B. [Signature]	Sheet 22 Of
PLAN Scales <u>NTS</u>	PROFILE Hor. _____ Vert. _____			
As Built _____	Date _____	Drawn By _____	Project-Engr _____	Approved By _____
Surveyed By _____	Designed By _____	Drawn By _____	Project-Engr _____	Date 7/22

No.	Date	By	Revision

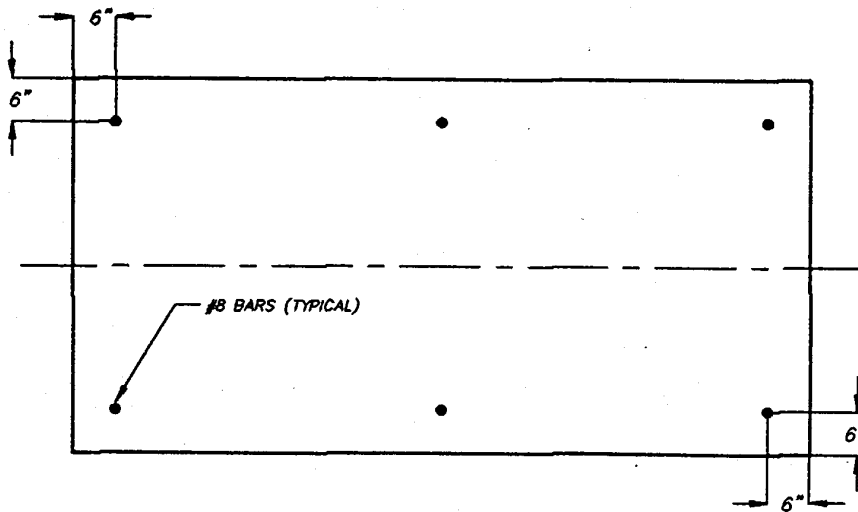
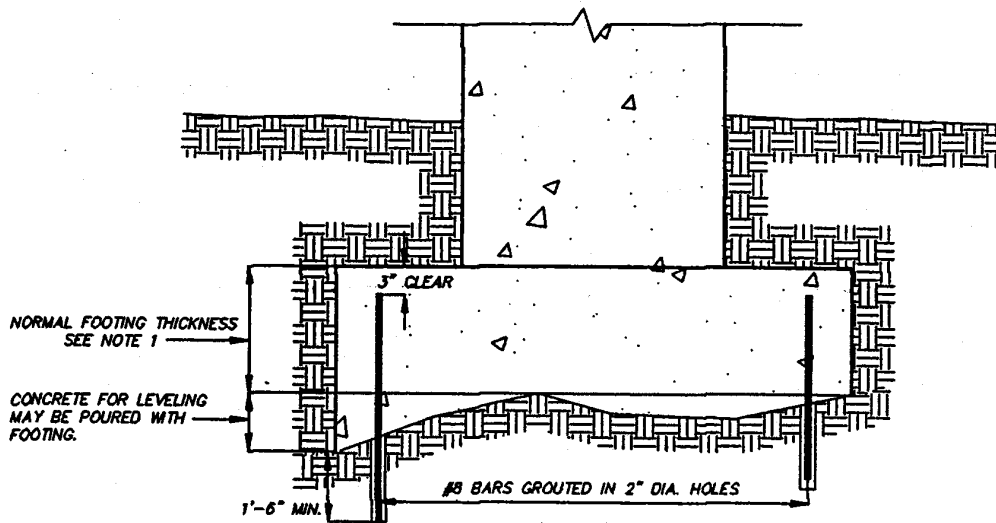


NOTES:

1. ALL CONCRETE TO BE 3600 PSI.
2. DEPTH OF PIERS TO BE DETERMINED BY THE ENGINEER.
3. FOOTING THICKNESS SAME AS BASE THICKNESS OF PIER, BUT NOT TO EXCEED 2'-0".
4. PIERS TO BE BUILT WITH LONG SIDE OF FOOTING PERPENDICULAR TO CREEK FLOW.
5. REINFORCING STEEL TO BE PLACED WITH A MINIMUM CLEARANCE OF 3" WITH THE SURFACE OF THE CONCRETE.

CHARLOTTE-MECKLENBURG UTILITY DEPARTMENT ENGINEERING DIVISION CHARLOTTE, NORTH CAROLINA			
STANDARD DETAIL SEWER			
REINFORCED CONCRETE ANCHOR PIER			
Job No. _____	File No. _____		
Scales			
PLAN _____	NTS		
PROFILE _____	Hor. _____		
	Vert. _____		
As Built _____	Date _____		
Surveyed By _____	Designed By _____	MSW	Project-Engr
		Drawn By _____	Approved By _____
			Date 23

No.	Date	By	Revision



NOTES:

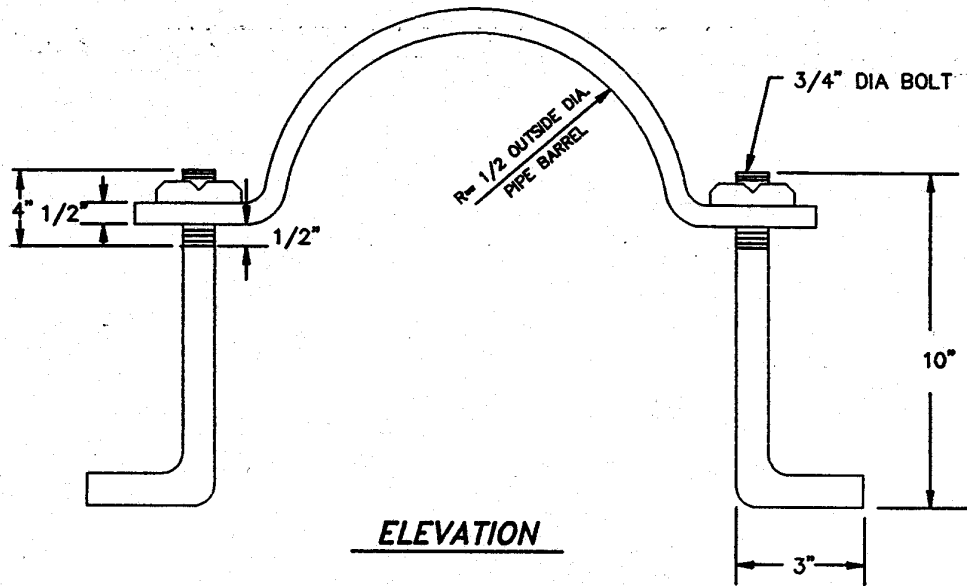
1. MINIMUM THICKNESS OF FOOTING ABOVE ROCK TO BE SAME AS BASE THICKNESS OF PIER.
2. MAT STEEL FOR FOOTING SHALL BE TIED TO DOWELS.
3. CONCRETE SHALL BE 3600 PSI.

**CHARLOTTE-MECKLENBURG
UTILITY DEPARTMENT
ENGINEERING DIVISION
CHARLOTTE, NORTH CAROLINA**

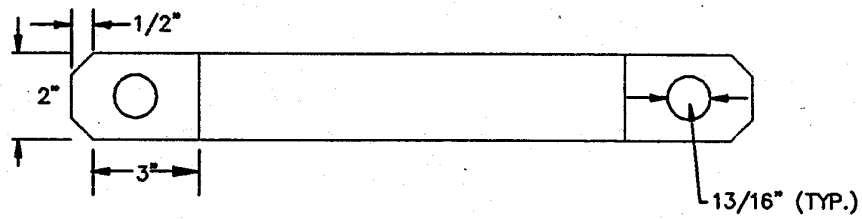
**STANDARD DETAIL
SEWER**

PIER FOOTING ON ROCK

Job No. _____	File No. _____	STANDARD DETAIL SEWER	
PLAN	Scale <u>NTS</u>		
PROFILE	Hor. _____ Vert. _____		
As Built _____		Date _____	
Surveyed By _____	Designed By _____	MSW Drawn By _____	Project-Engr _____
No. _____		Approved By <u>K. D. [Signature]</u>	Date <u>24</u>
Date _____	By _____	Revision _____	Sheet <u>24</u> Of _____



ELEVATION



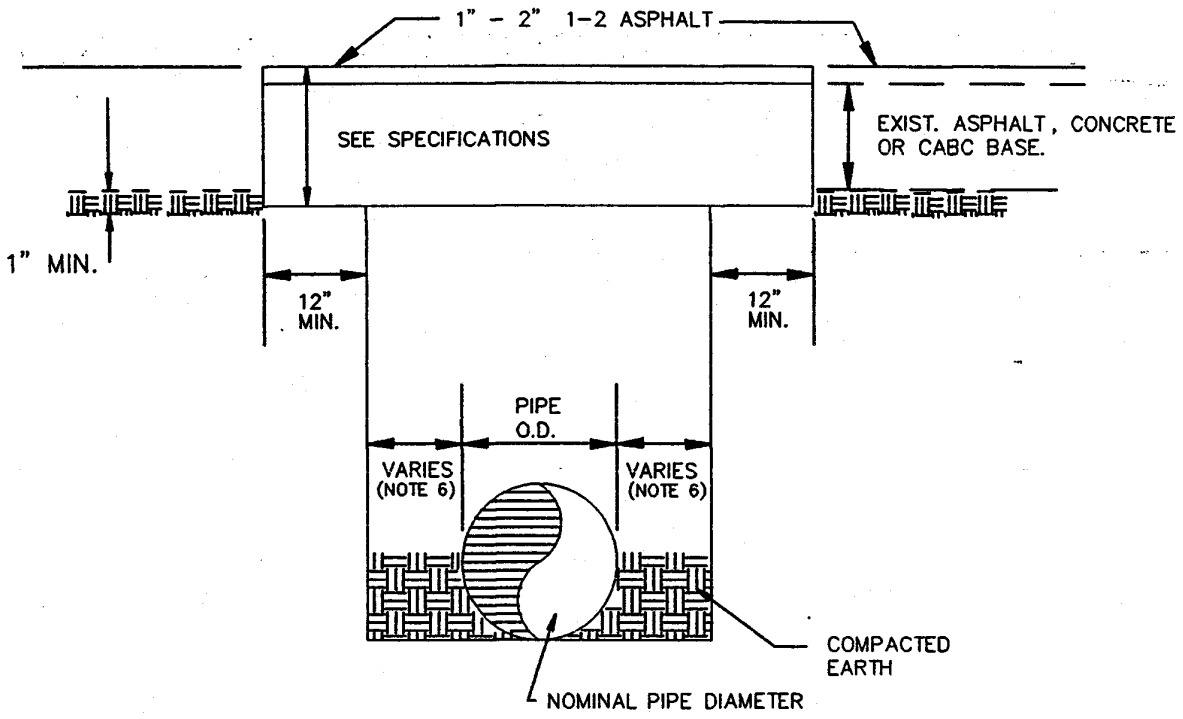
PLAN

NOTES:

1. ANCHOR BOLTS AND STRAPS SHALL BE GALVANIZED AND HOT ASPHALT DIPPED.
2. GALVANIZED STEEL OR IRON CAN BE USED.
3. FOR PIPES 24" AND LARGER USE 1" DIA. BOLTS. AND 1 1/16" ϕ HOLE IN STRAP
4. HOLES TO BE DRILLED IN STRAP.
5. PROVIDE WASHERS UNDER STRAP SUCH THAT STRAP IS PULLED DOWN TIGHT.

CHARLOTTE-MECKLENBURG UTILITY DEPARTMENT ENGINEERING DIVISION CHARLOTTE, NORTH CAROLINA			
Job No. _____ File No. _____ Scales PLAN <u>NTS</u>		STANDARD DETAIL SEWER	
PROFILE Hor. _____ Vert. _____		PIPE STRAPS FOR PIERS	
As Built _____ Date _____		S.C. _____ Project-Engr _____ Approved By _____ Date _____	
No. _____ Date _____ By _____	Revision _____	Surveyed By _____ Designed By _____ Drawn By _____	Sheet <u>25</u> Of _____

07/23/94



ELEVATION SECTION

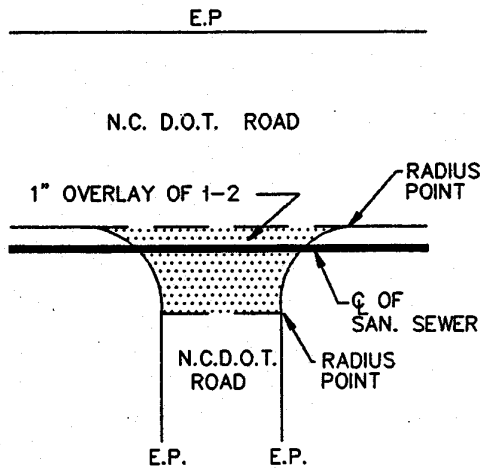
NOTES:

1. ALL CONCRETE AND ASPHALT PAVEMENT, INCLUDING DRIVEWAYS, TO BE CUT WITH A SAW.
2. WHERE CONCRETE PAVEMENT IS OVERLAID WITH ASPHALT H-BINDER MAY BE SUBSTITUTED FOR CONCRETE, AS A BASE MATERIAL, WITH THE APPROVAL OF THE CONTROLLING AGENCY.
3. ALL PAVEMENT REPAIRS ARE SUBJECT TO APPROVAL BY CITY OF CHARLOTTE D.O.T. AS APPLICABLE.
4. 12-INCH MIN. MINIMUM CUT OUTSIDE TRENCH IS ALSO REQUIRED FOR SLOPED TRENCH WALLS.
5. SHORING REQUIRED IN ACCORDANCE WITH OSHA STANDARDS, PART 1926, SUBPART P.
6. SEE DETAILED SPECIFICATIONS FOR TRENCH WIDTH.

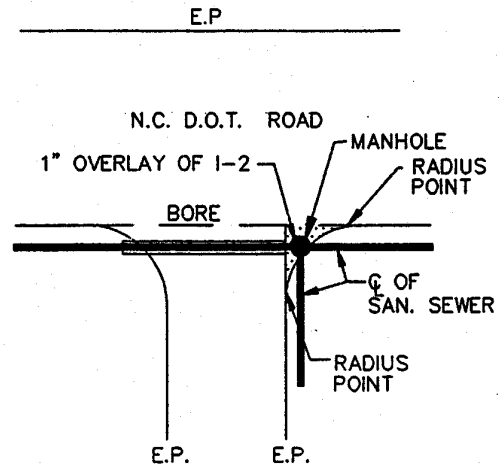
CHARLOTTE-MECKLENBURG UTILITY DEPARTMENT ENGINEERING DIVISION CHARLOTTE, NORTH CAROLINA			
STANDARD DETAIL SEWER		PAVEMENT REPAIR DETAIL	
Job No. _____	File No. _____	SCALE NTS	
PLAN			
PROFILE	Hor. _____	DATE 4/99	
	Vert. _____		
As Built _____	Date _____	APPROVED BY K. Blaylock	
Surveyed By _____	Designed By _____		
Drawn By _____	Project-Engr _____	Approved By _____	Date 26

No.	Date	By	Revision

01/23/04



PLAN VIEW



PLAN VIEW

NOTES:

1. ALL SHORING WILL BE ACCORDING TO OSHA TRENCHING STANDARDS PART 1926 SUBPART P.
2. PAVEMENT OVERLAY IS IN ADDITION TO PAVEMENT REPAIR PER STANDARD DETAIL 27.
3. FEATHER OVERLAY SMOOTHLY INTO EXISTING PAVEMENT.
4. THIS DETAIL APPLIES TO N.C. DEPARTMENT OF TRANSPORTATION ROADS ONLY, UNLESS OTHERWISE DIRECTED BY THE ENGINEER.

CHARLOTTE-MECKLENBURG
UTILITY DEPARTMENT
ENGINEERING DIVISION
CHARLOTTE, NORTH CAROLINA

Job No. _____ File No. _____		STANDARD DETAIL SEWER	
Scales _____			
PLAN _____	NTS	1-2. SURFACE COURSE OVERLAY	
PROFILE _____	Hor. _____ Vert. _____		
As Built _____	Date _____		
Surveyed By _____	Designed By _____	S.C. _____	Approved By <i>K. Black</i>
Drawn By _____		Project-Engr _____	Date <i>7/27</i>

No.	Date	By	Revision