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600 Sewer System

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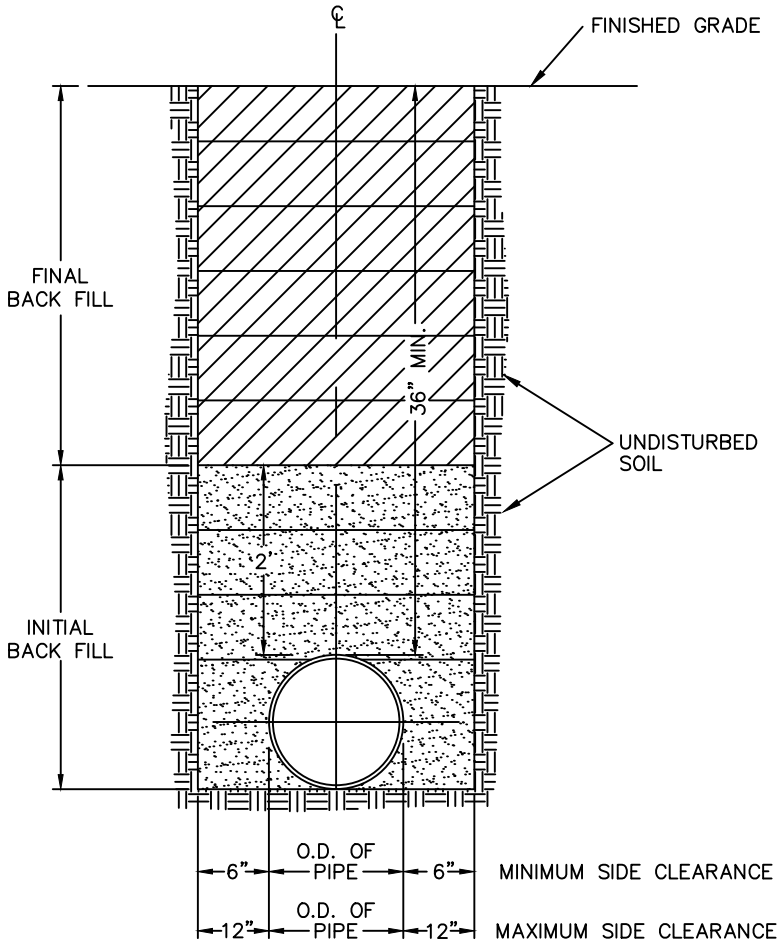
GENERAL NOTES FOR SEWER SYSTEM

SHEET 1 OF 1

DATE: 2-1-07

STD. NO. 601



TYPICAL TRENCH BOTTOM DIMENSIONS FOR:
DUCTILE IRON, PVC, AND CONCRETE PIPE

TRENCH DETAIL
CLASS D FLAT SUBGRADE

DEPTH OF BEDDING
MATERIAL BELOW PIPE

D	d (MIN.)
27" & SMALLER	6"
30" – 60"	12"
66" & LARGER	18"

NOTES:

1. TRENCHES REQUIRING SHORING AND BRACING, DIMENSIONS SHALL BE TAKEN FROM THE INSIDE FACE OF THE SHORING AND BRACING.
2. NO ROCKS OR BOULDERS 2" OR LARGER TO BE USED IN INITIAL BACKFILL.
3. ALL BACKFILL MATERIAL SHALL BE SUITABLE MATERIAL.
4. BACKFILL SHALL BE COMPACTED IN 6" LAYERS IN TRAFFIC AREAS, 12" LAYERS IN NON–TRAFFIC AREAS USING VIBRATORY EQUIPMENT.
5. ALL BACKFILL TO A HEIGHT OF 12" OVER PIPE TO BE COMPACTED BY MANUAL MEASURES.

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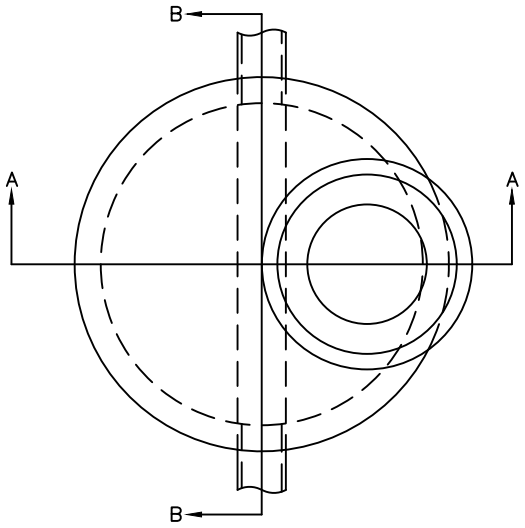
SEWER LINE TRENCH BOTTOM DIMENSIONS AND BACKFILLING REQUIREMENTS

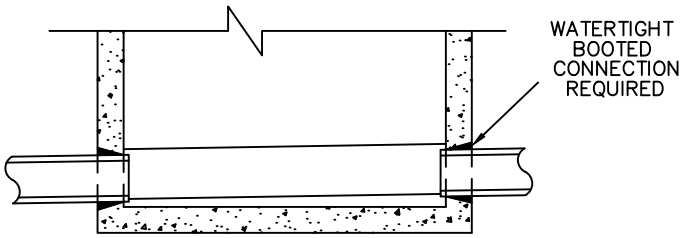
SHEET 1 OF 1

DATE: 2–1–07

STD. NO. 602

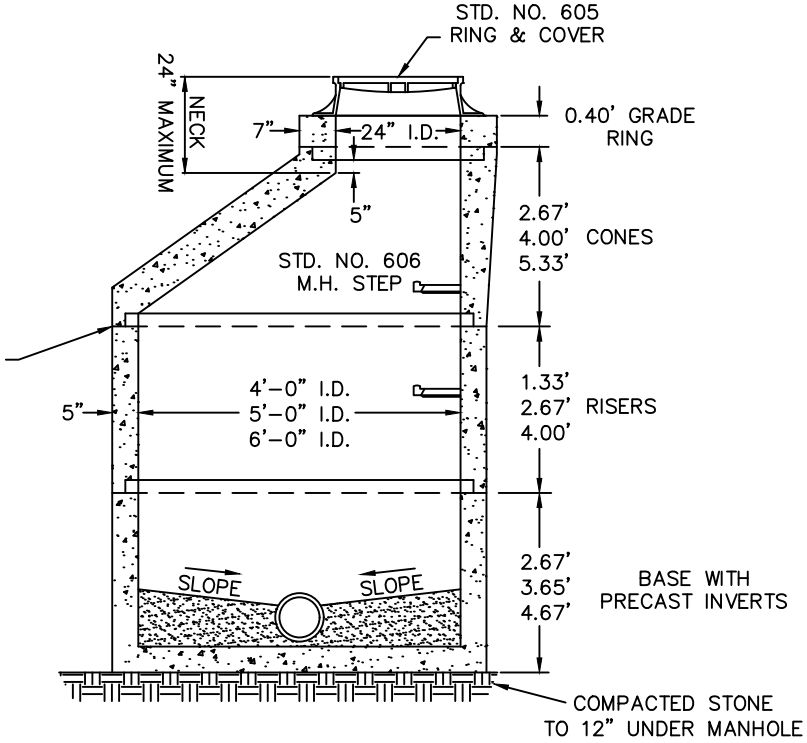


PLAN VIEW



SECTION B–B

NOTES:
1. ON NEW INSTALLATION, A MAXIMUM OF 2 GRADE RINGS SHALL BE USED.
2. CONCRETE SHALL BE 4000 PSI AS PER ASTM C–478.
3. STEEL REINFORCING SHALL MEET ASTM A–305, A–15, A–160 OR LATEST STANDARD
4. MANHOLES OVER 3'–6" IN DEPTH SHALL BE PROVIDED WITH STEPS 1'–3" ON CENTER. STEPS SHALL BE IN ACCORDANCE WITH STANDARD NO. 603.
5. INVERT SHALL HAVE 0.20' OF FALL UNLESS OTHERWISE SPECIFIED.



SECTION A–A

MANHOLE DIAMETER VS. PIPE DIAMETER

4'–0" = 27" PIPE MAXIMUM
5'–0" = 36" PIPE MAXIMUM
6'–0" = ABOVE 36" PIPE

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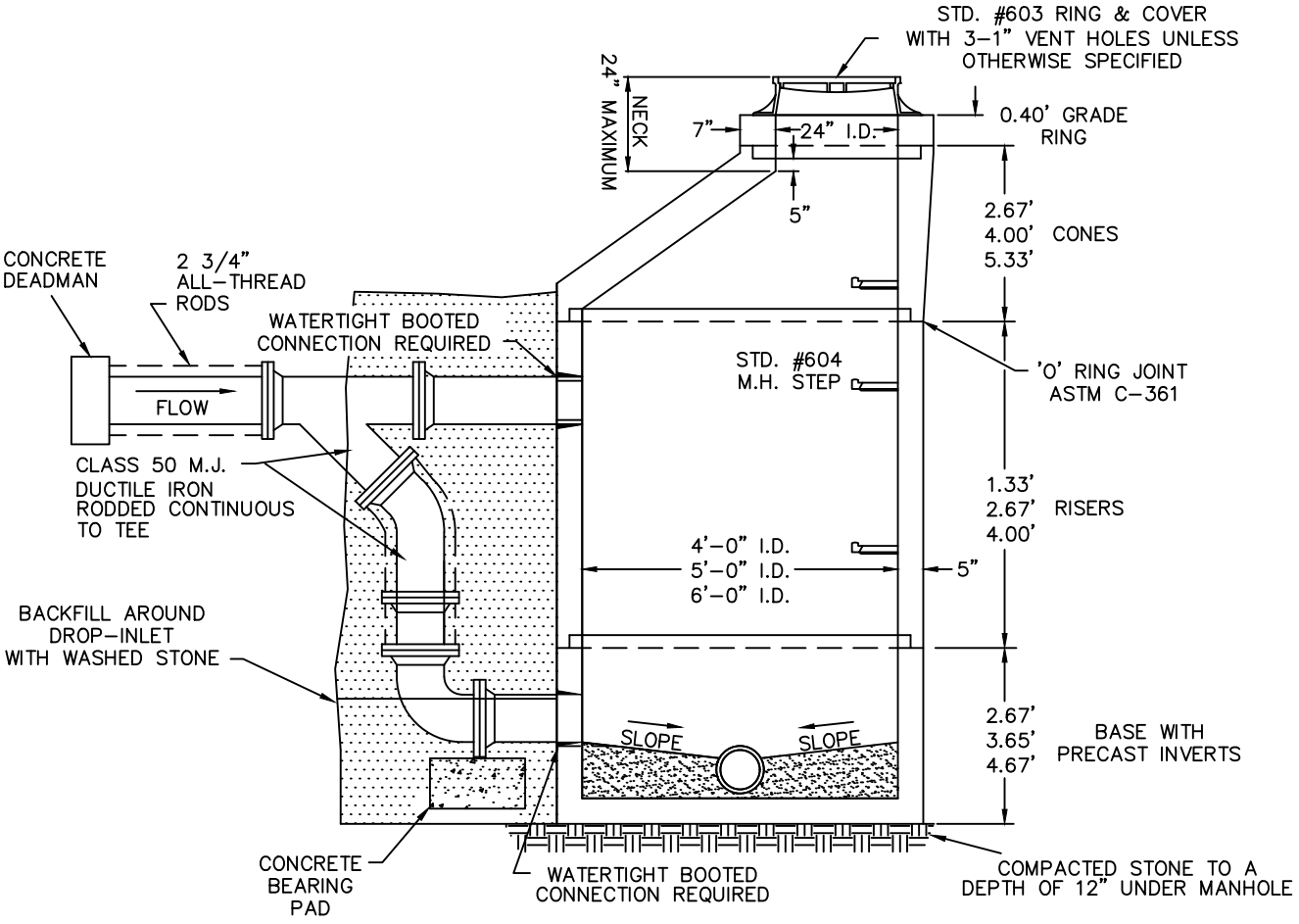
	SANITARY SEWER MANHOLE DETAIL	DATE: 2–1–07	STD. NO. 603



SANITARY SEWER DROP MANHOLE DETAIL

NOTES:
1. ON NEW INSTALLATION, A MAXIMUM OF 2 GRADE RINGS SHALL BE USED.
2. CONCRETE SHALL BE 4000 PSI AS PER ASTM C–478.
3. STEEL REINFORCING SHALL MEET ASTM C–185 FOR 4' DIAMETER, OR ASTM C–478 FOR 5' DIAMETER.
4. MANHOLES OVER 3'–6" IN DEPTH SHALL BE PROVIDED WITH STEPS 1'–3" ON CENTER. STEPS SHALL BE IN ACCORDANCE WITH STANDARD NO. 603.
5. INVERT SHALL HAVE 0.20' OF FALL UNLESS OTHERWISE SPECIFIED.

MANHOLE DIAMETER VS. PIPE DIAMETER

4'–0" = 27" PIPE MAXIMUM
5'–0" = 36" PIPE MAXIMUM
6'–0" = ABOVE 36" PIPE

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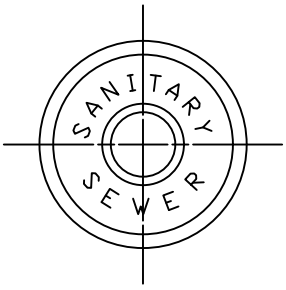
SANITARY SEWER
DROP MANHOLE

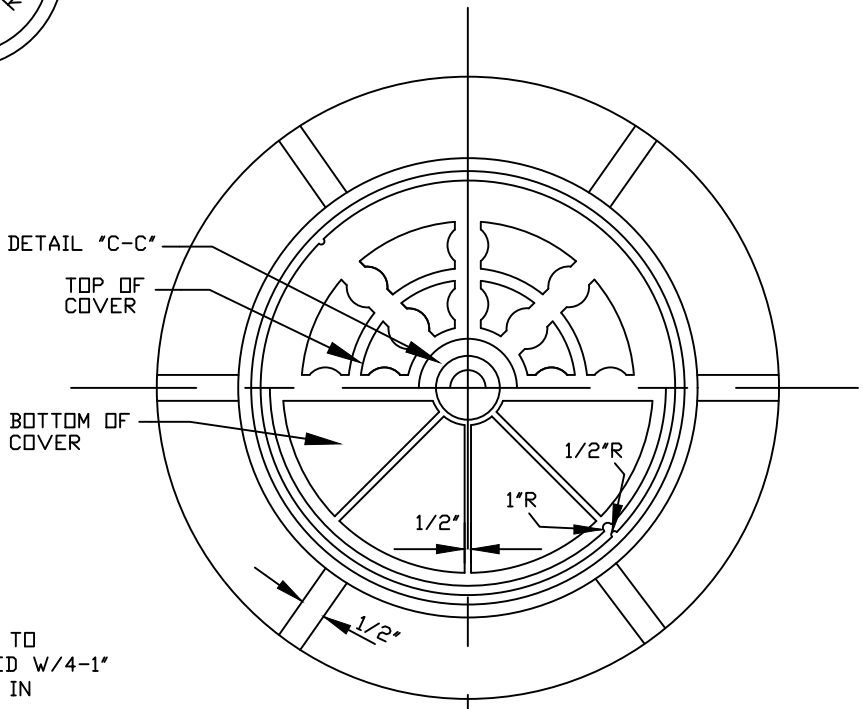
SHEET 1 OF 1

DATE: 2–1–07

STD. NO. 604

*ALL MANHOLE COVERS SHALL MEET
ASTM A48-94 OR LASTEST STANDARD

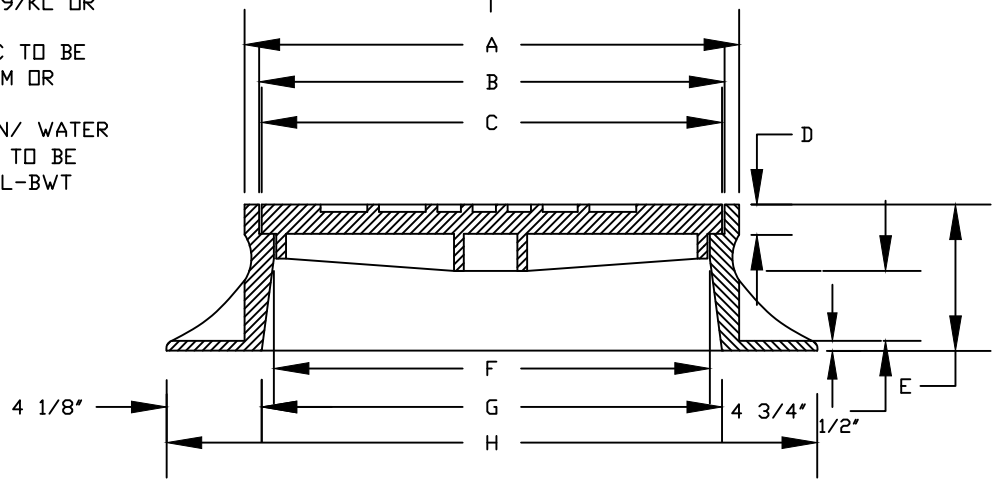




STND MIN. AVE. WTS.	
RING	190
COVER	125
	315

SHORT MIN. AVE. WTS.	
RING	150
COVER	130
	280

NOTES
1. ALL COVERS TO BE SUPPORTED W/4-1" VENT HOLES IN COVER
2. ALL RINGS TO BE SUPPORTED W/4-1" DIA. ANCHOR HOLES.
3. RING & COVER TO BE USF 669/KL OR EQUAL
4. SHORT R&C TO BE USF 686/KM OR EQUAL
5. BOLT DOWN/ WATER TIGHT R&C TO BE USF 668-KL-BWT OR EQUAL



	A	B	C	D	E	F	G	H
STND	25 1/4"	23 3/4	23 1/2"	1"	7 1/2"	22"	25"	33 1/4"
SHORT	25"	23 1/2	23 1/4	1"	4"	22 1/8	23 1/8	33 1/4

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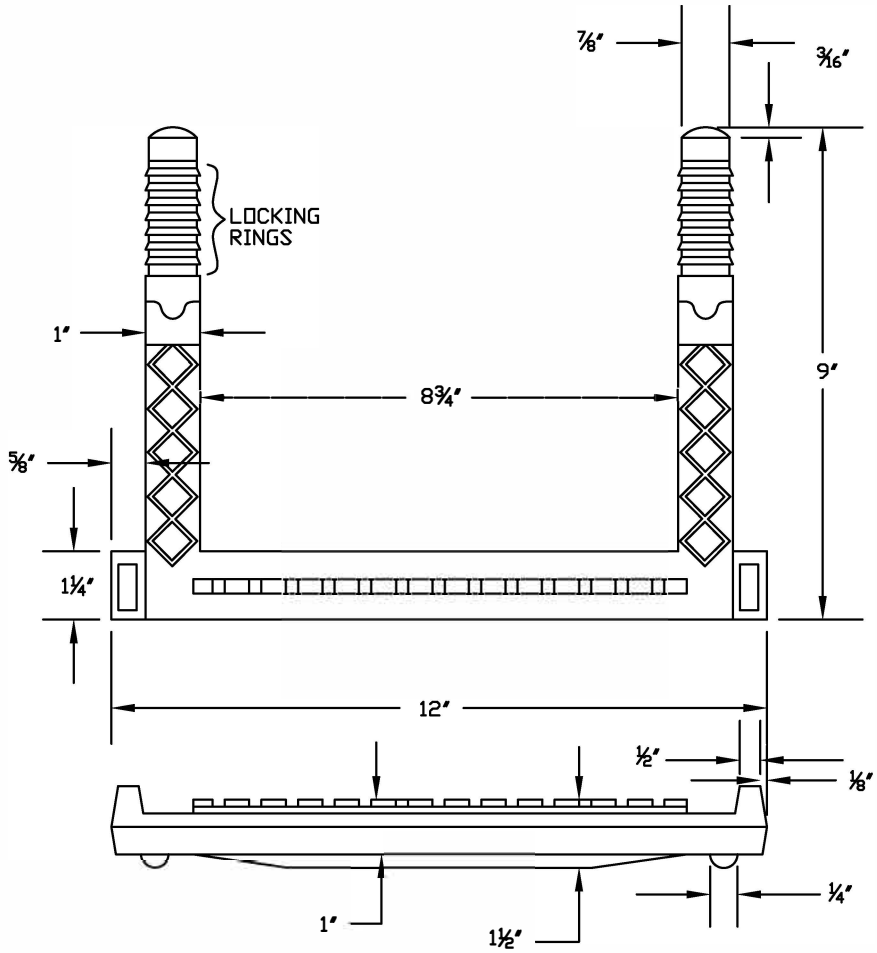
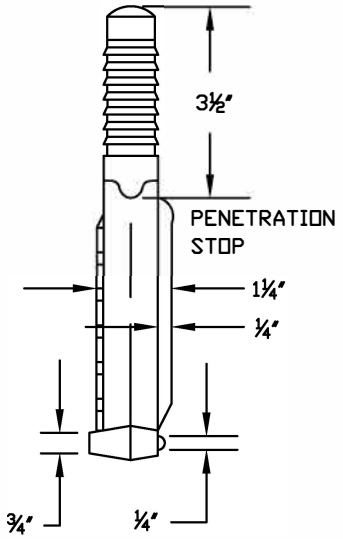
STANDARD & SHORT MANHOLE RING & COVER

SHEET 1 OF 1

DATE: 2-1-07

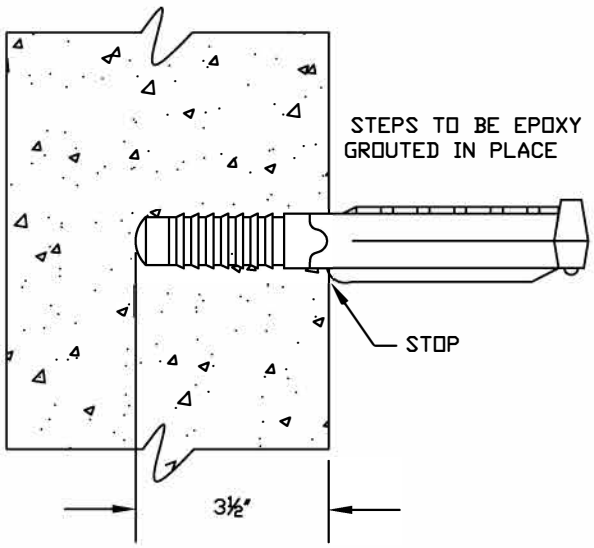
STD. NO. 605



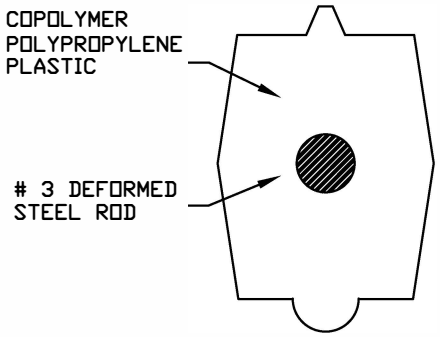


NOTES:

1. STEPS TO BE EPOXY GROUTED IN PLACE.
2. CENTERLINE OF THREAD TO BE LEVEL & PLUMB W/ ALL IN MH SECTION
3. MANHOLES AND OTHER STRORM DRAIN STRUCTURES OVER 3' 6" IN DEPTH SHALL BE PROVIDED WITH STEPS 1' 3" ON CENTER.



PENETRATION



SECTION A-A

NOT TO SCALE

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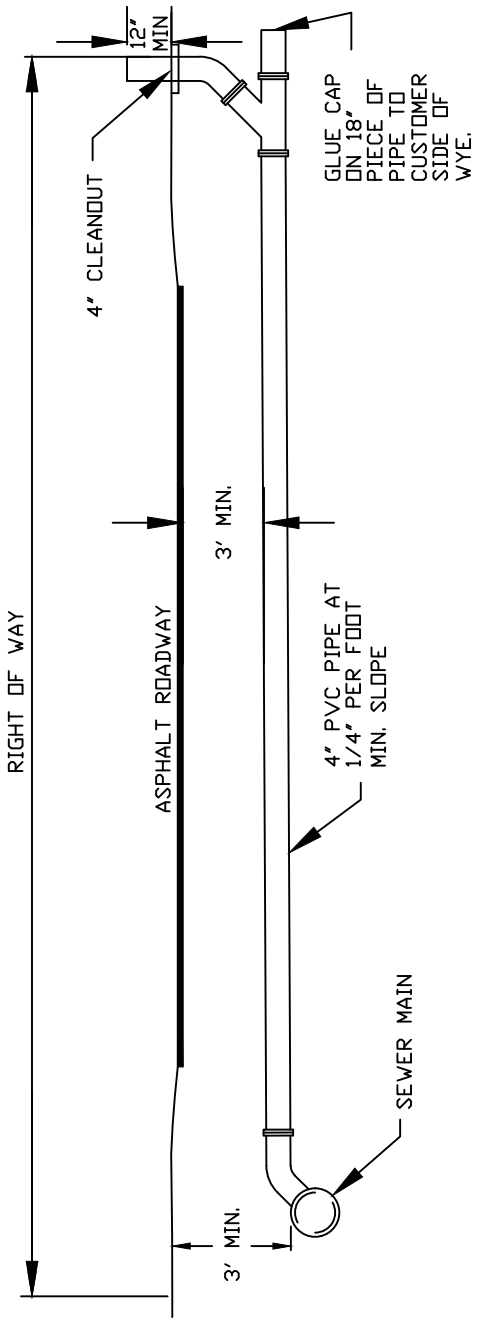
CITY OF HICKORY

MANHOLE STEP FOR PRECAST CONCRETE MANHOLE

	SHEET 1 OF 1
DATE: 2-1-07	STD. NO. 606



NOTE:
1. 4" CLEANOUT TO REMAIN VISIBLE
2. PLUMBER SHALL CONNECT TO 4" LINE BY REMOVING GLUE CAP AND COUPLING PIPE TOGETHER. IN NO CASE SHOULD PLUMBER TIE TO CITY CLEANOUT.

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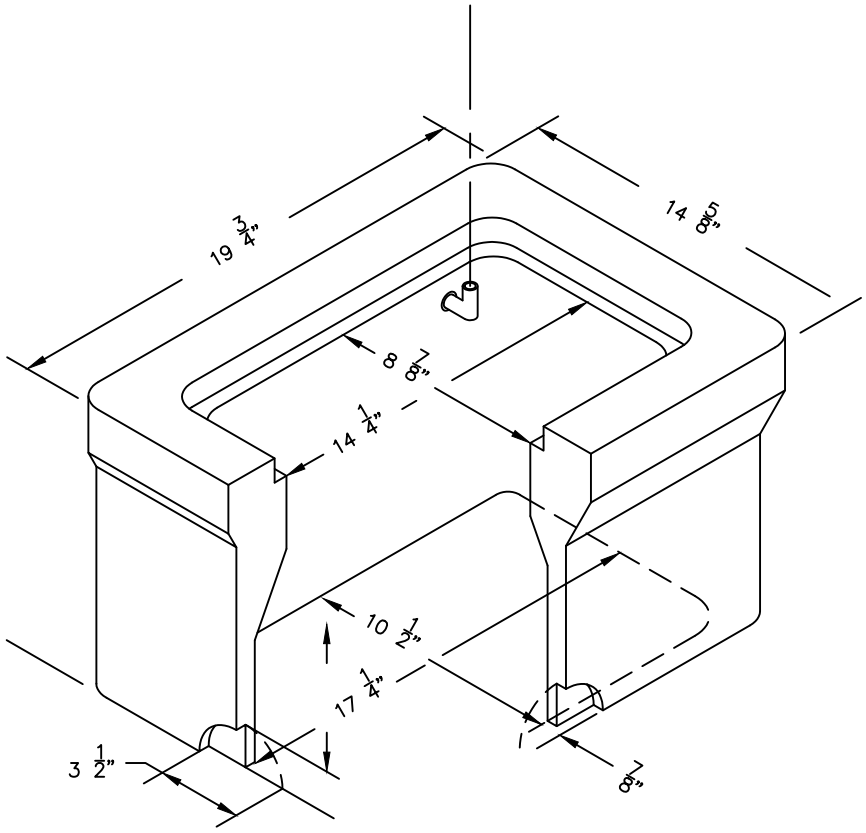
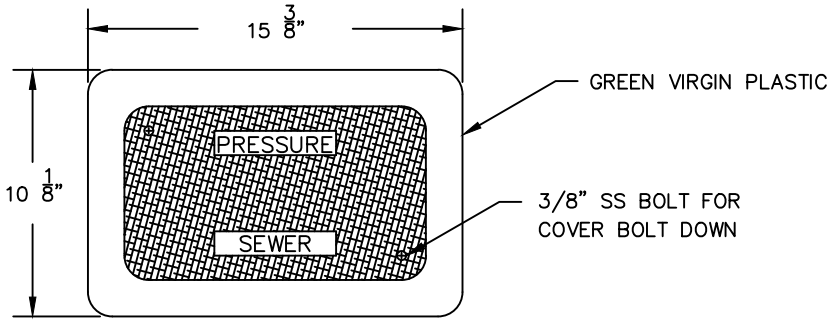
RESIDENTIAL SEWER TAP

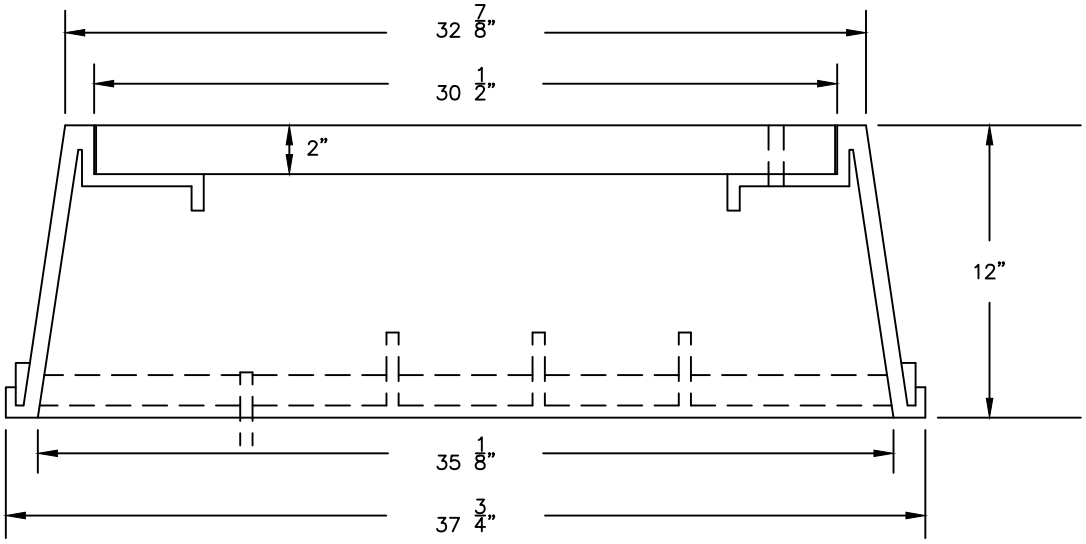
	SHEET 1 OF 1
DATE: 2-1-07	STD. NO. 607

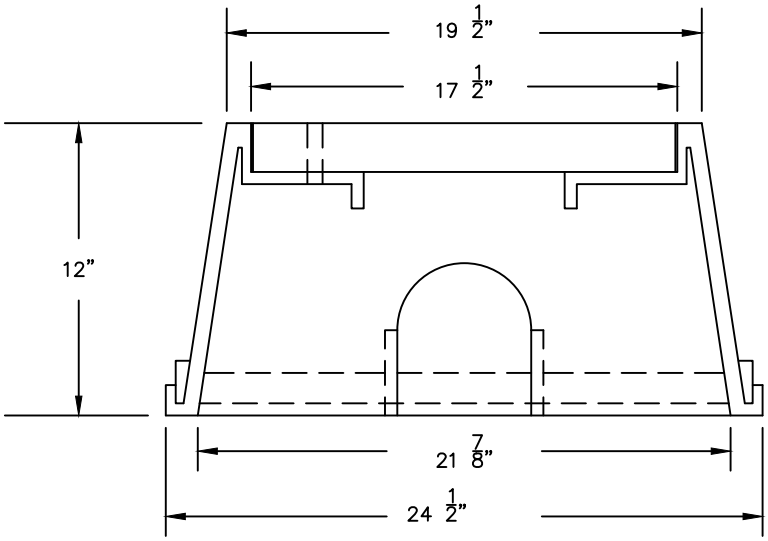


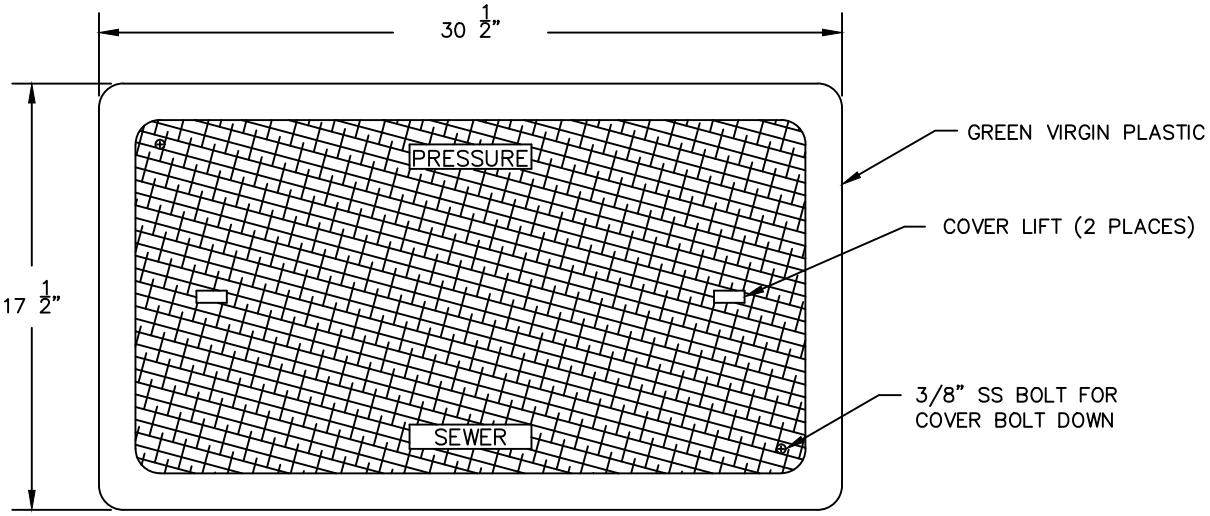


NOT TO SCALE

HICKORY North Carolina Life. Well Crafted.	CITY OF HICKORY		
	LOW PRESSURE SEWER CLEANOUT BOX		SHEET 1 OF 1
		DATE: 2-1-07	STD. NO. 608







NOT TO SCALE

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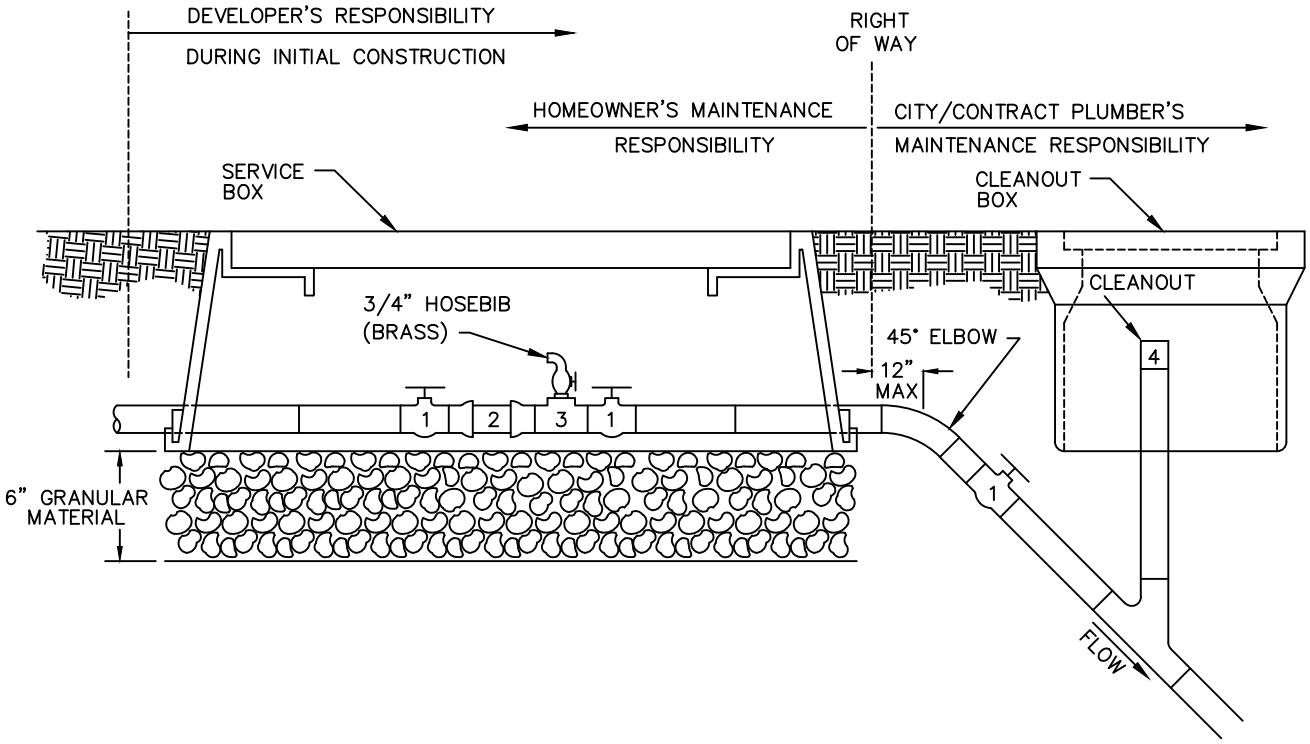
CITY OF HICKORY

LOW PRESSURE SEWER SERVICE BOX

SHEET 1 OF 1

DATE: 2-1-07

STD. NO. 609



LEGEND:

1. 1 1/2" TRUE UNION BALL VALVE
2. 1 1/2" TRUE UNION BALL CHECK VALVE
3. 1 1/2" THREADED "T" WITH 1 1/2"x3/4" THREADED REDUCING BUSHING
4. 3/4" AIR LINE QUICK CONNECT FITTING.

NOTES:

1. BOXES SHALL NOT BE IN SIDEWALKS OR DRIVEWAYS.
2. TOP OF BOXES SHALL BE FLUSH WITH THE FINISH GRADE.

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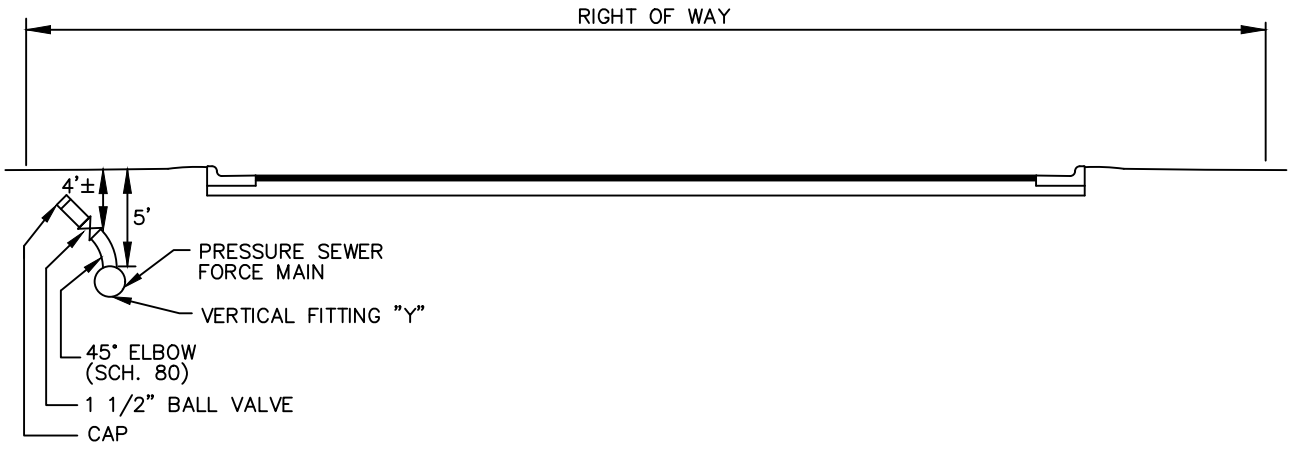
LOW PRESSURE SEWER SERVICE CONNECTION

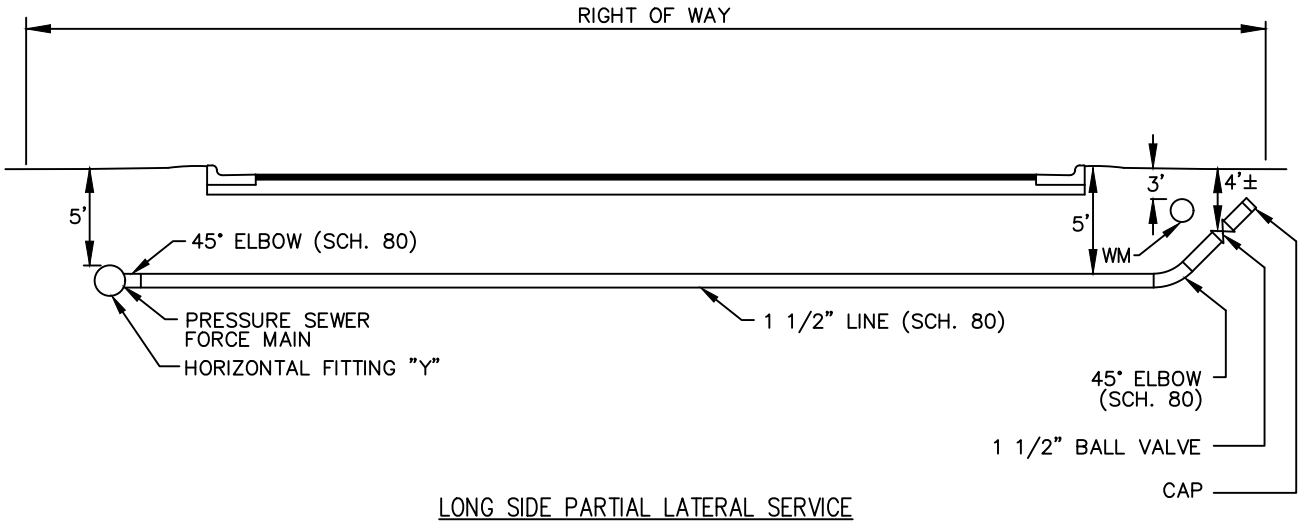
SHEET 1 OF 1

DATE: 2-1-07

STD. NO. 610



SHORT SIDE PARTIAL LATERAL SERVICE

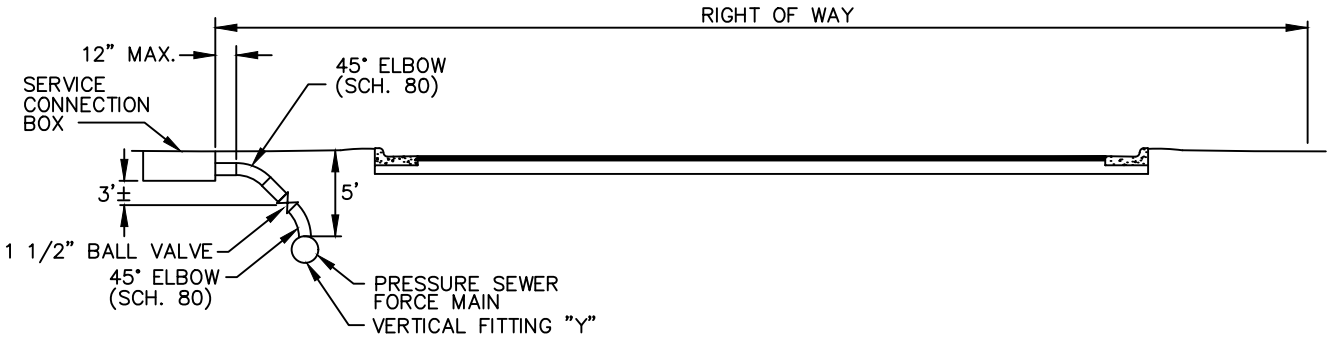


LONG SIDE PARTIAL LATERAL SERVICE

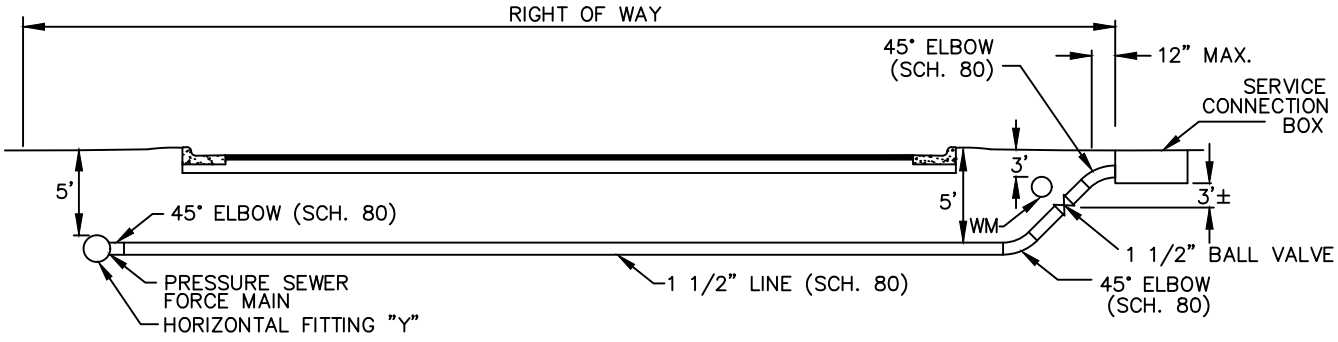
NOTE:
1. A PVC ENCAPSULATED MAGNET SHALL BE ATTACHED TO THE VALVE FOR MAGNETIC LOCATION PURPOSES.

NOT TO SCALE

HICKORY North Carolina Life. Well Crafted.	CITY OF HICKORY		
	LOW PRESSURE SEWER PARTIAL LATERAL SERVICE		SHEET 1 OF 1
		DATE: 2-1-07	STD. NO. 611



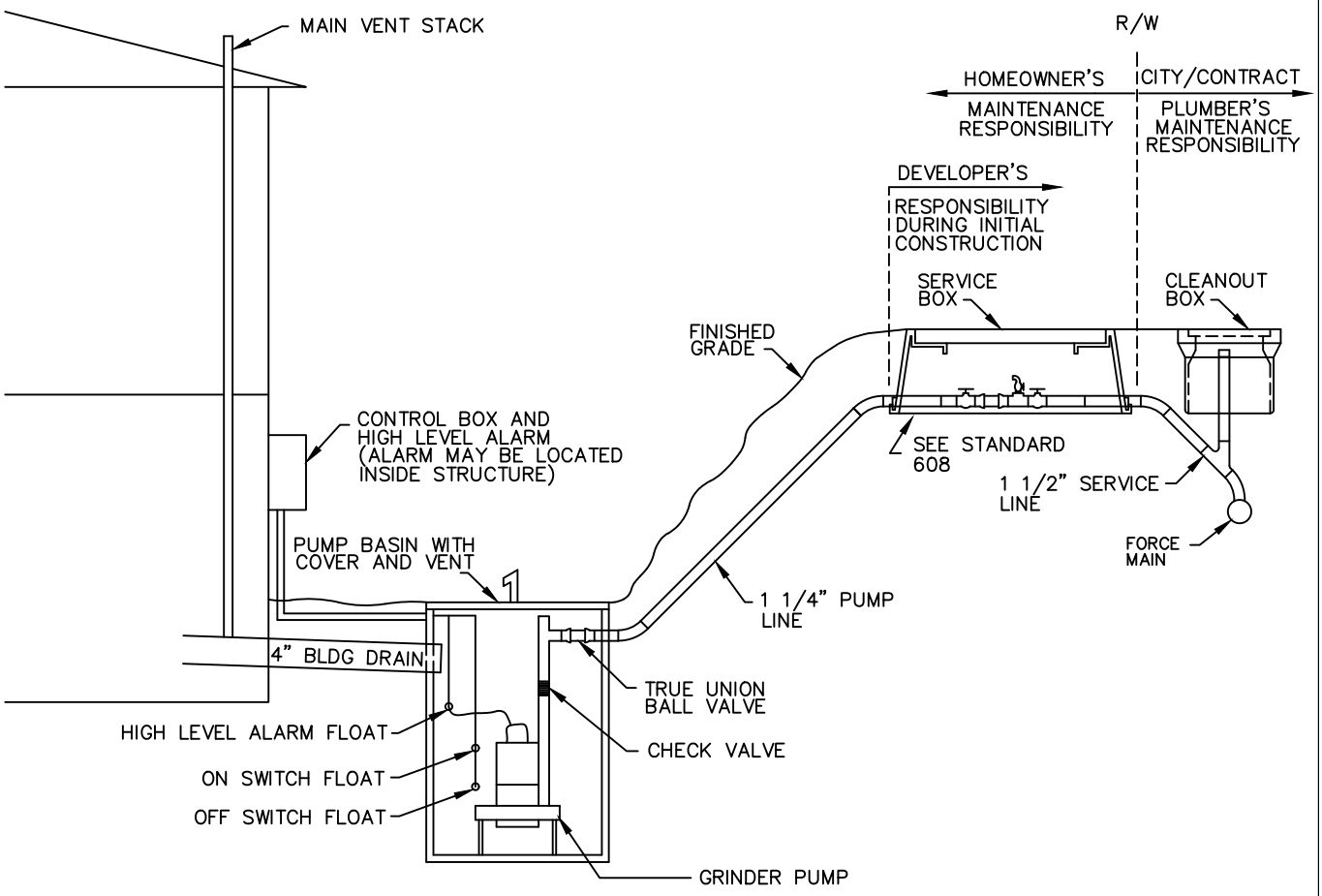
SHORT SIDE LATERAL SERVICE



LONG SIDE LATERAL SERVICE

NOT TO SCALE

HICKORY North Carolina Life. Well Crafted.	CITY OF HICKORY		
	LOW PRESSURE SEWER LATERAL SERVICE		SHEET 1 OF 1
		DATE: 2-1-07	STD. NO. 612



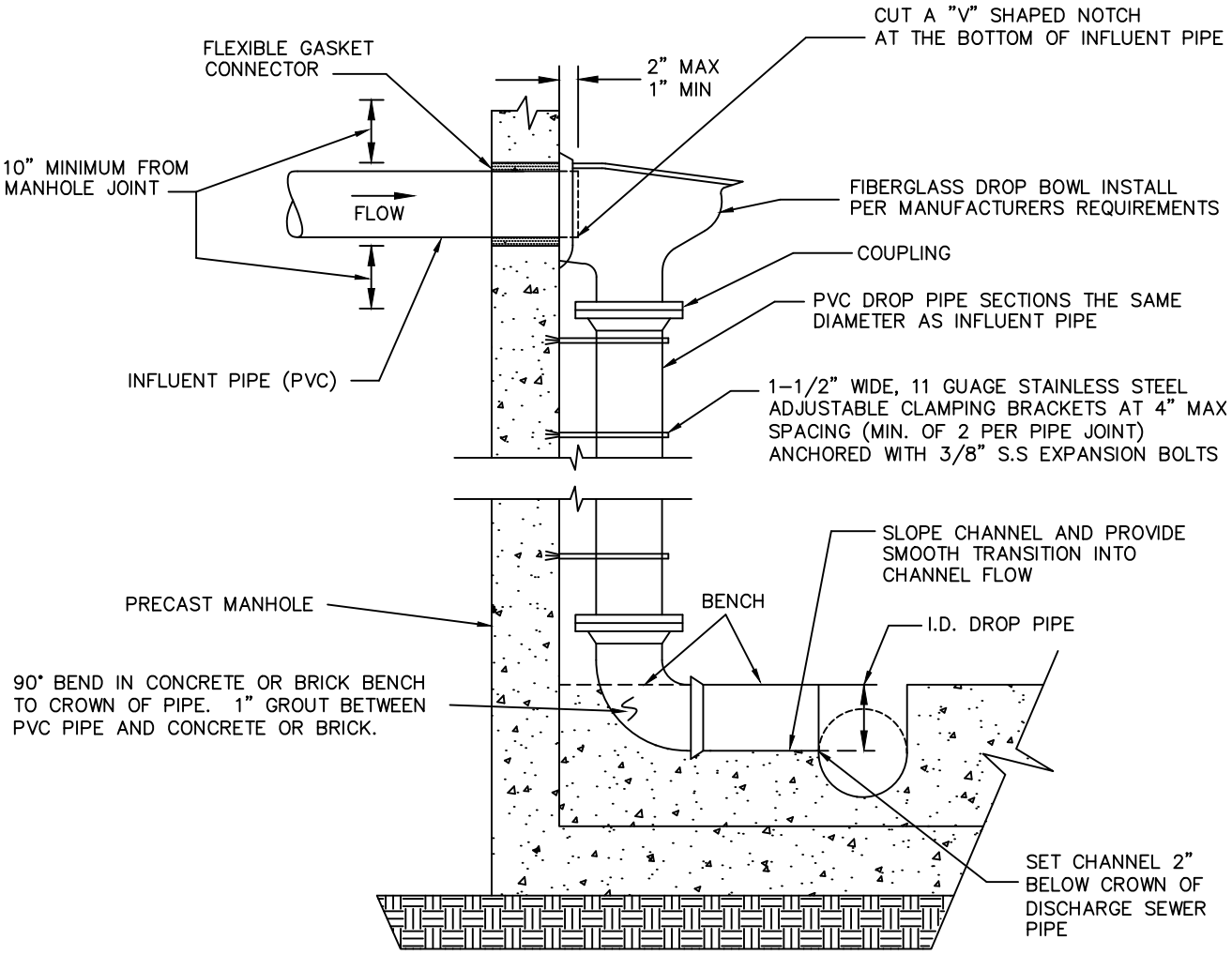
NOTES:
SEE ALSO CITY OF HICKORY STANDARD SANITARY SEWER SPECIFICATIONS. IN THE EVENT OF A CONFLICT BETWEEN THE DRAWINGS AND SPECIFICATIONS, THE MORE STRINGENT SHALL APPLY.

NOT TO SCALE

HICKORY North Carolina Life. Well Crafted.	CITY OF HICKORY		
	LOW PRESSURE SEWER INDIVIDUAL SYSTEM		SHEET 1 OF 1
		DATE: 2-1-07	STD. NO. 613

NOTES

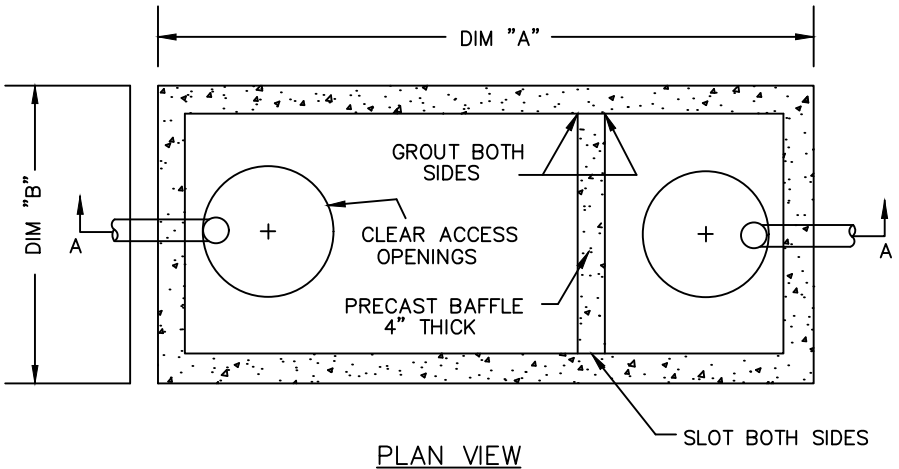
1. ONLY ONE INSIDE DROP CONNECTION PER MANHOLE WILL BE ALLOWED UNLESS OTHERWISE INDICATED ON THE DRAWINGS.
2. THE DROP BOWL SHALL NOT EXTEND INTO THE AREA AS DEFINED BY THE PROJECTION OF THE MANHOLE ENTRANCE VERTICALLY DOWN TO THE MANHOLE BOTTOM. IF NECESSARY, MANHOLE FRAME, COVER CONE SECTION, AND STEPS SHALL BE REMOVED AND PLACED TO ALLOW FOR UNOBSTRUCTED ENTRY AND EXIT.
3. INFLUENT PIPE SLOPE SHALL NOT EXCEED 10%.
4. MAXIMUM SIZE OF INFLUENT PIPE IS 12".



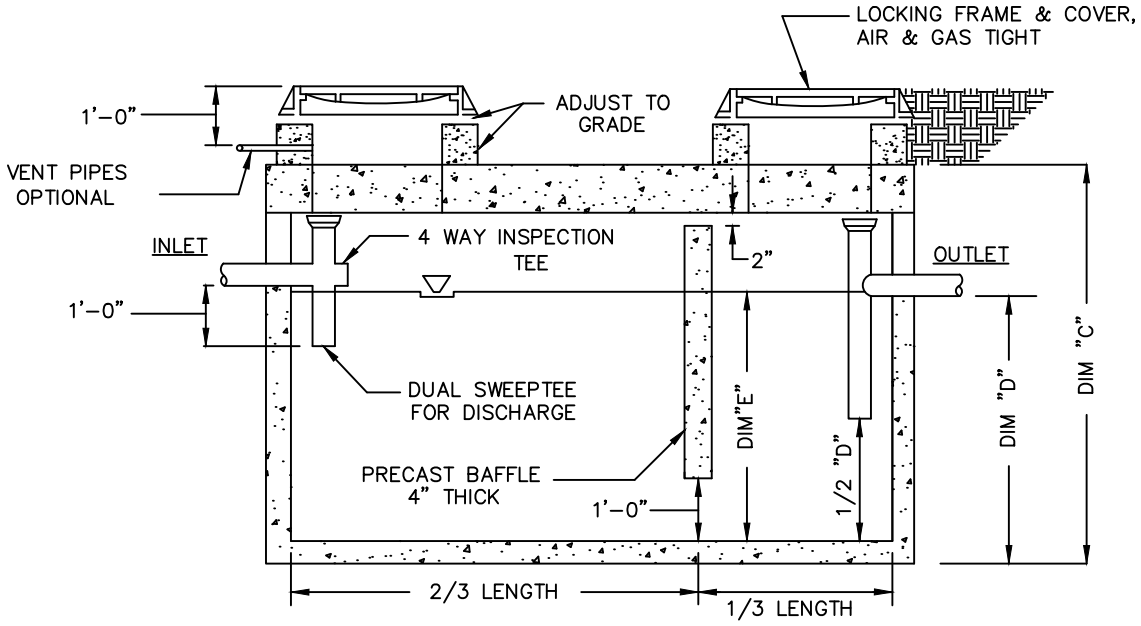
INSIDE DROP CONNECTION FOR
PRECAST CONCRETE MANHOLES
(FIBERGLASS DROP BOWL)

NOT TO SCALE

HICKORY North Carolina Life. Well Crafted.	CITY OF HICKORY		
	INSIDE DROP CONNECTION FOR PRECAST CONCRETE MANHOLE (FIBERGLASS DROP BOWL)		SHEET 1 OF 1
		DATE: 2-1-07	STD. NO. 614



PLAN VIEW



SECTION AA

NOT TO SCALE

HICKORY North Carolina Life. Well Crafted.	CITY OF HICKORY		
	TYPICAL GREASE TRAP DETAIL		SHEET 1 OF 2
		DATE: 2-1-07	STD. NO. 615

SIZING CHART					
GALLON CAPACITY	DIM"A"	DIM"B"	DIM"C"	DIM"D"	DIM"E"
600	7' – 0"	4' – 8"	7' – 0"	3' – 6"	3' – 2"
750	7' – 0"	4' – 8"	7' – 0"	4' – 3"	3' – 11"
1000	7' – 0"	5' – 0"	7' – 2"	4' – 2"	3' – 10"
1250	9' – 0"	5' – 0"	7' – 2"	5' – 2"	4' – 10"
1500	9' – 0"	5' – 8"	7' – 2"	4' – 4"	4' – 0"
1750	11' – 2"	5' – 8"	7' – 2"	4' – 11"	4' – 7"
2000	11' – 2"	6' – 8"	8' – 0"	4' – 7"	3' – 10"
2500	12' – 8"	6' – 8"	8' – 0"	5' – 6"	4' – 9"
2750	12' – 8"	6' – 8"	8' – 0"	6' – 0"	5' – 3"
3000	15' – 7"	9' – 7"	8' – 6.5"	6' – 3"	3' – 9"
4000	15' – 7"	9' – 7"	8' – 6.5"	6' – 3"	5' – 0"
5000	19' – 11"	9' – 11"	8' – 11"	6' – 2"	4' – 9"
6000	19' – 11"	9' – 11"	10' – 5"	7' – 2"	5' – 9"

NOTES

1. CONCRETE: 28 DAYS f c = 4500psi
2. REBAR: ASTM A515 GRADE 60
3. MESH: ASTM A–155 GRADE 65
4. DESIGN: ACI318–83 BUILDING CODE
   ASTM C–857 MINIMUM STRUCTURAL DESIGN
   LOADING FOR UNDERGROUND PRECAST
   CONCRETE UTILITY STRUCTURES
5. LOADS: H–20 TRUCK WHEELS W/30% IMPACT PER AASHTO
6. FILL W/ CLEAN WATER PRIOR TO START UP OF SYSTEM
7. CONTRACTOR TO SUPPLY AND INSTALL ALL PIPING AND SANITATY TEES, 4 CLEAN OUTS, FOR CLEANING TOWARD TRAP AND FOR CLEANING AWAY FROM TRAP ON BOTH THE INLET AND OUTLET/ ALT, DUAL SWEEP CLEANOUTS.
8. GRAY WATER ONLY, BLACK WATER SHALL BE CARRIED BY SEPERATE SEWER.
9. EFFLUENT FILTER REQUIRED: ZABEL A300–12 OR EQUAL

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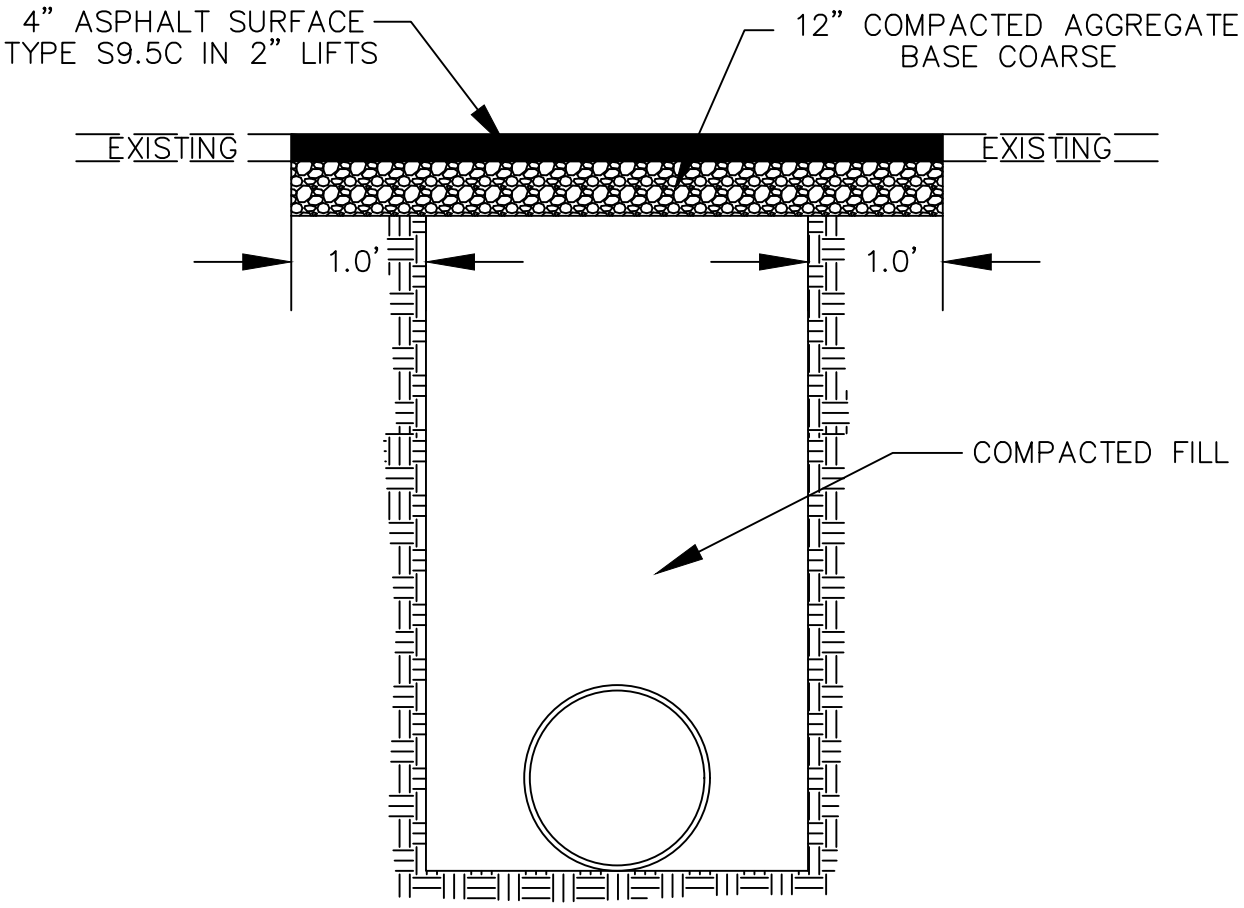
TYPICAL GREASE TRAP DETAIL

SHEET 2 OF 2

DATE: 2–1–07

STD. NO. 615



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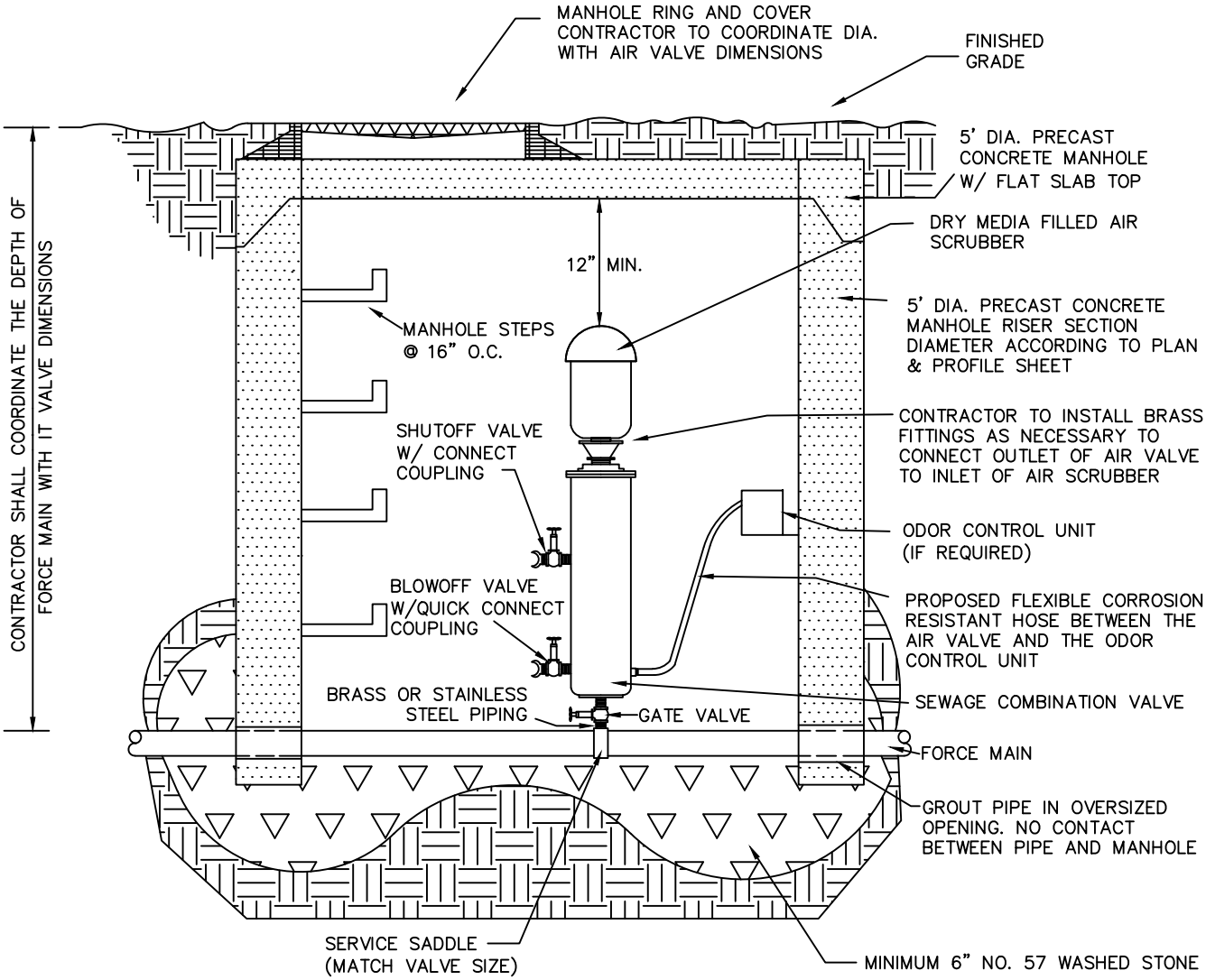
HICKORY North Carolina Life. Well Crafted.	CITY OF HICKORY		
	ROAD PATCH AND REPAIR	DATE: 9-30-22	SHEET 1 OF 1 STD. NO. 616



NOTES:

1. COMBINATION AIR VALVE TO BE INSTALLED AT ACTUAL HIGH POINT OF LINE.
2. COMBINATION AIR VALVE SHALL BE OFFSET IN MANHOLE TO PROVIDE ACCESS.
3. VALVE SIZE AS SHOWN ON DRAWINGS OR DETAILED IN THE SPECIFICATIONS.
4. ALL PIPING AND FITTINGS FOR COMBINATION AIR VALVE SHALL BE BRASS OR STAINLESS STEEL
5. CONTRACTOR SHALL ADJUST THE DEPTH OF THE FORCE MAIN AT ALL HIGH POINTS TO ACCOMMODATE THE INSTALLATION OF THE COMBINATION AIR VALVE.
6. CONTRACTOR SHALL INSTALL ODOR CONTROL UNIT AS DIRECTED BY ENGINEER OR CITY OF HICKORY.

NOT TO SCALE

	CITY OF HICKORY		
	SEWAGE FORCE MAIN COMBINATION AIR VALVE		SHEET 1 OF 1
		DATE: 5-27-21	STD. NO. 617

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Sewer Specifications

SECTION 022000 - EARTHWORK

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Installation, protection and/or modification of utilities during site work construction, including any necessary staging of work.

B. Scarifying, compaction and testing of previously graded sites to ensure proper preparation and acceptability.

C. Excavation and embankment placement to required lines, dimensions, and subgrade elevations.

D. Preparation of existing low areas for placing of fill, including disposal of muck, topsoil, silt and wet or unsuitable materials.

E. SUB-SURFACE DATA:

1. Investigation: Sub-surface investigations tilted Geotechnical Investigation proposed Hickory Center, Hickory, NC Project No. 90G-010100.6, dated September 18, 1990 have been made. A copy of this report can be found at the back of this specification. The report is furnished as a mater of convenience and courtesy and there is no implied or expressed warranty as to the correctness of the report as to the existing condition. However, where a treatment is not covered in the specification, the recommendations made in the report shall be considered binding.

2. Site Visit: Data shown is for general information for bidders. Contractors are expected to examine the site, make investigations and decide for themselves the character of the materials to be encountered.

3. Responsibility: The owner will not assume responsibility for variations of sub-soil quality or condition.

1.02 REFERENCE STANDARDS

The following most current publications form part of this specification to the extent indicated by references thereto and shall be followed for all construction testing.

American Society for Testing and Materials (ASTM):

D 422	Method for Partial Size Analysis of Soils
D 698	Test for Moisture-Density Relations of Soils using 5.5 lb. (2.5 kg) Rammer and 12-inch (304.8mm) Drop (Standard Proctor)
D 1556	Test for Density of Soil in Place by Sand Cone Method
D 1557	Test for Moisture-Density Relations Using 10-lb (4.5 kg) Rammer and 18-inch (457mm) Drop (Modified Proctor)
D 1559	Test Method for Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus
D 2167	Test for Density of Soil in Place by the Rubber Balloon Method
D 2216	Laboratory Determination of Moisture Content of Soil
D 2487	Classification of Soils for Engineering Purposes
D 2922	Tests for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
D 3017	Test for Moisture Content of Soil and Soil-Aggregates by Nuclear Methods (Shallow Depth)
D 4318	Test for Plastic Limit, Liquid Limit & Plasticity Index of Soils
C 25	Chemical Analysis of Limestone, Quicklime and Hydrated Lime
C 110	Physical Testing of Quicklime and Hydrated Lime, Wet Sieve Method
C 618	Specification for Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland cement Concrete
C 977	Quicklime and Hydrated Lime for Soil Stabilization

American Association of State Highway and Transportation Officials (AASHTO)

T 88	Mechanical Analysis of Soils

PART 2 PRODUCTS

2.01 MATERIALS

A. Acceptable Stabilization Fabrics and Geogride:
   1. Mirafi 500X or 600X
   2. Phillips 66 Supac 6WS
   3. Dupont Typar 3401 and 3601
   4. Trevira S1114 and S1120
   5. Tensar SS-1 and SS-2
   6. Exxon GTF-200 or 350

B. Filter/Drainage Fabrics:
   1. Mirafi 140NS
   2. Phillips 66 Supac 4NP
   3. Dupont Typar 3341

C. Silt Fencing Fabrics:
   1. Phillips 66 Supac 5 NP (UV)
   2. Mirafi 100X

D. Material for filling and backfilling shall be clean subsoil free from debris, roots, topsoil, frozen material and rock larger than ½ cu. ft. Fill materials shall be tested and approved by the laboratory for the degree of compaction required by its intended use.

E. Unsuitable fill material shall be defined as that which fails to conform to requirements of paragraph 2.01 above.

PART 3 EXECUTION

3.01 PREPATATION

A. Remove excess or unsuitable materials from the site at no additional cost to Owner. All excess and/or unsuitable material shall be wasted off site at allocation approved by the North Carolina Department of Natural Resources and Community Development (Erosion Control). Backfill areas with layers of material and compact as specified.

B. Prior to placing fill in low areas, such as previously existing creeks, ponds or lakes perform following procedures:

   1. Drain water out by gravity with ditch having flow line lower than lowest elevation in low area. If drainage cannot be performed by gravity ditch, use adequate pump to obtain same results.

   2. After drainage of low area is complete, remove muck, mud, debris, and other unsuitable material by using acceptable equipment and methods that will keep natural underlying low areas dry and undisturbed.

   3. If proposed for fill, all muck, mud and other materials removed from above in low areas shall be dried on-site by spreading in thin layers for observation by Owner's representative. Material shall be inspected and, if found to be suitable for use as fill material shall be incorporated into lowest elevation of site filling operation, but not under or within 10'-0" of perimeter of building pad or paving subgrade. If, after observation by Owner's representative, material if found to be unsuitable material shall be removed from site at no additional cost to Owner.

4. Provide additional materials at no additional cost to Owner where existing materials are insufficient or unsuitable for their intended use. Borrow pits shall be approved by Owner's representative and the North Carolina Department of Natural Resources and Community Development (Erosion Control).

3.02 EXCAVATION FOR FILLING AND GRADING

A. Classification of Excavation: Contractor by submitting bid acknowledges that he has investigated site to determine type, quality, quality and character of excavation work to be performed. All excavation shall be considered unclassified excavation.

B. Perform excavation using capable, well-maintained equipment and methods acceptable to Owner and governing agencies.

C. When performing grading operations during periods of wet weather, provide adequate drainage and ground water management to control moisture of soils. Site dewatering is Earthwork Contractors responsibility at no additional cost to Owner.

D. Shore, base and drain excavations as necessary to maintain safe, secure and free of water at all times.

E. Perform rock excavation in a manner that will produce material of such size as to permit it being placed in embankments. Remove loose or shattered rock, overhanging ledges and boulders, which might dislodge.

F. Use suitable material to replace rock overblast in building area and in expansion area to facilitate placement of utilities and future footings.

G. Break or crush rock obtained from blasting to allow use for fill in parking area as follows:

1. Rock 6" or greater in largest dimension is unacceptable as fill within proposed building and paving area.

2. Rock less than 6" in largest dimension is acceptable as fill to within 24" of surface of proposed subgrade when mixed with suitable material.

3. Rock fragments less than 2" in largest dimension and mixed with suitable material is acceptable as fill within the upper two feet (2') of proposed subgrade.

3.03 USE OF EXPLOSIVES

A. Comply with all laws, rules and regulations of federal, state and local authorities and insure which govern storage, use, manufacture, sale, handling, transportation, licensing, or other disposition of explosives. Take special precautions for proper use of explosives to prevent harm to human life and damage to surface structures, all utility lines or other subsurface structures. Do not conduct blasting operations until persons in vicinity have had ample notice and have reached positions of safety.

B. Contractor shall save harmless Owner, Architect and Owner's representative from any claim growing out of use of such explosives. Removal of materials of any nature by blasting shall be done in such manner and such time as to avoid damage affecting integrity of design and to avoid damage to any new or existing structure included in or adjacent to work. It shall be Contractors' responsibility to determine method of operation to ensure desired results and integrity of completed work.

3.04 FILLING AND SUBGRADE PREPARATION

A. BUILDING SUBGRADE AREAS:

1. Building subgrade pad shall be that portion of site directly beneath and ten feet (10') beyond the building and appurtenance limits.

2. The building subgrade pad shall be prepared in strict accordance with the "foundation subsurface preparation", to be provided by Owner.

3. Unless specifically indicated otherwise on the drawings, areas exposed by excavation or stripping and on which building subgrade preparations are to be performed shall be scarified to a minimum depth of 12" and compacted to a minimum of 98% of the optimum density, in accordance with ASTM D 698, at a moisture content of not less than 1% below and not more than 3% above the optimum moisture content.

These areas shall then be proof rolled to detect any areas of insufficient compaction. Proof rolling shall be accomplished by making a minimum of two (2) complete passes with a fully-loaded tandem-axle dump truck or approved equivalent, in each of the two perpendicular directions under the supervision and direction of a field geotechnical engineer. Areas of failure shall be excavated and replaced with suitable fill material per these specifications.

4. Unless specifically indicated otherwise on the drawing, fill materials used in preparation of building subgrade shall be placed in lifts or layers not to exceed 8" loose measure and compacted to a minimum density of 98% of optimum density, in accordance with ASTM D 698, at a moisture content of not less than 1% below and not more than 3% above the optimum moisture content. Unless specifically stated otherwise in the "foundation subsurface preparation" on the drawing.
5. The top 18" of building and parking subgrade shall be compacted to 100% Standard Proctor.

The following table stipulated maximum allowable values for Plasticity Index (PI) and Liquid Limit (LL) of suitable materials to be used as fill in the specified areas.

Location:	PI	LL
Building area, below upper four feet	20	50
Building area, upper four feet	12	40

B. SETTLEMENT MONITORING OF BUILDING SUBGRADE AREAS:

1. Settlement hubs are to be installed in the building areas in locations shown on the plans by the site grading contractor.

2. Settlement hubs shall be 8" in diameter and embedded a minimum of 30" into the subgrade at the building pad "blue top" elevation as detailed on the plans.

3. Settlement hub monitoring shall begin as soon as the building subgrade is reached. Monitoring shall be performed daily the first week of installation and weekly thereafter. Accuracy of monitoring is to be to 1/100 of a foot.

4. The on-site soils engineer shall monitor the settlement hubs. The site contractor shall insure that a stable bench mark is maintained at all times during monitoring and site work.

5. Reports of settlement monitoring and progress shall be submitted to the architect, and the general contractor.

6. Refer to soils report for further information.

7. After on-site soils engineer has determined when settlement has reached the acceptance limit, the site grading contractor is responsible for providing building pad elevations as shown on the grading plans.

C. AREAS OF CONSTRUCTION EXCLUSIVE OF THE BUILDING SUBGRADE:

1. Unless specifically stated otherwise on the drawing, areas exposed by excavation or stripping and on which subgrade preparations are to be performed shall be scarified to minimum depth of 8" and compacted to minimum of 98% of optimum density, in accordance with ASTM D 698, at a moisture content of not less than 1% below and not more than 3% above the optimum moisture content. These areas shall then be proof rolled to detect any areas of insufficient compaction. Proof rolling shall be accomplished by making a minimum of two (2) complete passes with a fully-loaded tandem-axle dump truck or approved equivalent, in each of the two perpendicular directions under the supervision and direction of a field geotechnical engineer. Areas of failure shall be excavated and replaced with suitable material per these specifications.

2. Unless specifically stated otherwise on the drawings, fill materials used in preparation of subgrade shall be placed in lifts or layers not to exceed 8" loose measure and compacted to a minimum density of 98% of optimum density, in accordance with ASTM D 698, at a moisture content of not less than 1% below and not more than 3% above the optimum moisture content.

3. The following table stipulates maximum allowable values for Plasticity Index (PI) and Liquid Limit (LL) of suitable fill materials to be used in the specified areas, unless specifically stated otherwise on the drawings.

Location*	PI	LL
Area below upper tow feet, exclusive of building area	20	50
Upper two feet, exclusive of building area	15	40

*References to depth are to proposed subgrade elevations.

4. Material imported from off-site shall be CBR (California Bearing Ratio) value equal to or above the pavement design subgrade CBR value indicated on the drawings.

5. The site grading contractor shall provide and install all topsoil as indicated on the drawings and in conformance with landscaping plans and specifications.

3.05 MAINTENANCE OF SUBGRADE

A. Finish subgrades shall be verified to ensure proper elevation and conditions for construction above subgrade.

B. Protect subgrade from excessive wheel loading during construction, including concrete trucks and dump trucks.

C. Remove areas of finished subgrade found to be insufficient for any reason to depth necessary and replace in a manner that will comply with compaction requirements per these specifications. Surface of subgrade after compaction shall be hard, uniform, smooth, stable and true to grade and cross-section.

D. Grading of paving areas shall be within a tolerance of up to 0.10 feet as so long as it does not adversely affect drainage and other conditions. Contractor to provide engineering and field staking necessary for verification of lines, grades and elevations.

E. Maintain subgrade for area to be paved. Make adjustments that may be required in accordance with specifications at no additional expense to Owner.

3.06 RIP-RAP

A. Rip-rap shall be constructed as shown on the drawings.

3.07 FINISH GRADING

A. Grade all areas where finish grade elevations or contours are indicated on drawings, other than paved areas, including excavated areas, filling transition areas and landscaped areas. Grading areas shall be uniform and smooth, free from rock, debris or irregular surface changes. Finished subgrade surface shall not be more than 0.10 feet above or below established finished subgrade elevation and all ground surfaces shall vary uniformly below indicated elevations. Finish ditches shall be graded to allow for proper drainage without ponding and in a manner than will minimize erosion potential. For topsoil application, refer to Section 02900 (LANDSCAPING, SEEDING AND SODDING).

B. Correct all settlement and eroded areas within one year after date of substantial completion of all work at no additional expense to Owner. Bring grades to proper elevation.

3.08 FIELD QUALITY CONTROL

A. Independent Testing Laboratory selected and paid by Owner, shall be retained to perform construction testing and act as the Owner's representative on site based on the following:

1. Building Subgrade Areas, including 10'-0" Outside Exterior Building Lines: In cut areas, not less than one compaction test for every 2,500 square feet. In fill areas, same rate of testing for each lift (measured loose).
2. Areas of construction exclusive of Building Subgrade: In cut areas, not less than one compaction test for every 10,000 square feet. In fill areas, same rate of testing for each lift (measured loose).

B. In compaction requirements are not complied with at any time during construction process, remove and recompact deficient areas until proper compaction is obtained at no additional expense to Owner.

C. In all areas to receive pavement, a CBR (or LBR) test shall be performed for each type of material imported from off-site.

D. The following rest shall be performed on each type of on-site or imported soil materials used as compacted fill as part of construction testing requirements.

1. Moisture and Density Relationship: ASTM D 698 or ASTM D 1557.
2. Mechanical Analysis: AASHTO T-88
3. Plasticity Index: ASTM D 4318

E. Field density tests for in-place materials shall be performed according to one of the following standards as part of construction testing requirements:

1. Sand-Cone Method: ASTM D 1556
2. Balloon Method: ASTM D 2167
3. Nuclear Method: ASTM D 2922
   (Method B-Direct Transmission)

F. Independent Testing Laboratory shall prepare test reports that indicate test location, elevation data and test results. The architect and Contractor shall be provided with copies of reports within 96 hours of time test was performed. In event that any test performed fails to meet these specifications, Independent Testing Laboratory shall notify the General Contractor immediately.

The Contractor at no additional expense shall pay for all costs related to retesting due to failures to Owner. We reserve the right to employ an Independent Testing Laboratory and to direct any testing that is deemed necessary. Contractor shall provide free access to site for testing activities.

END OF SECTION

SECTION 02222 - EXCAVATION, BACKFILLING AND COMPACTING FOR UTILITIES

PART 1 – GENERAL

1.01 SUMMARY

This section includes the excavation, bedding and backfilling of utilities necessary to perform work indicated on drawings and contract documents.

1.02 RELATED REQUIREMENTS

Construction drawings
Specs. Section 02110 SITE PREPARATION
Specs. Section 02200 EARTHWORK

1.03 SUBMITTALS

A. Shop drawings or details pertaining to site utilities are not required unless use of materials, methods, equipment or procedures contrary to drawings or these specifications are proposed. Do not perform work until required shop drawings have been accepted by Owner.

B. The Contractor shall contact all utility companies and determine if additional easements will be required to complete the project. Contractor shall provide written confirmation of the status of ALL easements to the owner's Construction Manager at the time of the preconstruction conference or no later than 90 days prior to the project possession date.

PART 2 – PRODUCTS

A. Bedding Material: Processed sand and gravel free from clay lumps, organic or other deleterious material and complying with following gradation requirements:

U.S. Sieve Size	Percent Passing (by weight)
1 inch	100
¾ inch	90-100
3/8 inch	20-55
No. 4	0-10
No.8	0-5

B. Steel Casing Pipe: Comply with AWWA C-201 or C-202, minimum grade B, size and wall thickness as indicated on drawings.

PART 3 – EXECUTION

3.01 SUMMARY

A. Set all lines, elevations and grades for utility and drainage system work and control system for duration of work, including careful maintenance of bench marks, property corners, monuments or other reference points.

B. Maintain in operating condition existing utilities, active utilities and drainage systems encountered in utility installation. Repair any surface or subsurface improvement shown on drawings.

C. Verify location, size, elevation and other pertinent data required to make connections to existing utilities and drainage systems as indicated on drawings. Contractor shall comply with local codes and regulations.

3.02 EXCAVATION, TRENCHING AND BACKFILLING

A. Perform excavation as indicated for specified depths. During excavation, stockpile materials suitable for backfilling in orderly manner far enough from bank of trench to avoid overloading, slides or cave-ins.

B. Remove excavated materials not required or not suitable for backfilling or embankments and waste off-site. Any structures discovered during excavation(s) shall be disposed of as specified.

C. Prevent surface water from flowing into trenches or other excavations by temporary grading or other methods, as required. Remove accumulated water in trenches or other excavations by pumping or other acceptable methods.

D. Open cut excavation with trenching machine or backhoe. Where machines other than ladder or wheel-type trenching machines are used, do not use clods for backfill. Dispose of unsuitable material and provide other suitable material at no additional cost to owner.

E. All excavation shall be unclassified.

3.03 TRENCH EXCAVATION

A. The local utility companies shall be contacted before excavation shall begin. Dig trench at proper width and depth for laying pipe, conduit or cable. Cut trench banks as nearly vertical as practical and remove stones as necessary to avoid point-bearing. Overexcavate rock, wet or unstable soil, if encountered, from trench bottom as necessary to provide suitable base for continuous and uniform bedding as directed by soils engineer.

B. All trench excavation side walls greater than 5 feet in depth shall be sloped, shoring, sheeted, braced or other wise supported by means of the sufficient strength to protect the workmen within them in accordance with the applicable rules and regulations established for construction by the Department of Labor, Occupational Safety and Health Administration (OSHA), and by local ordinances. Lateral travel distance to an exit ladder or steps shall not be greater than 25 feet in trenches 4 feet or deeper.

C. Accurately grade trench bottom to provide uniform bearing and support for each section of pipe on bedding material at every point along entire length, except where necessary to excavate for bell holes, proper sealing of pipe joint, or other required connections. Dig bell holes and depressions for joints after trench bottom has been graded. Dig no deeper, longer or wider than needed to make joint connection properly.

D. Trench width requirements below the top of the pipe shall not be less than 12” not more than 18” wider than outside surface of any pipe or conduit that is to be installed to designated elevations and grades. All other trench width requirements for pipe, conduit or cable shall be at least practical width that will allow for proper compaction of trench backfill.

E. Trench depth requirements measured from finished grade or paved surface shall meet the following requirements or applicable codes and ordinances.

1. WATER MAINS: 36” to top of pipe barrel
2. SANITARY SEWER: Elevations and grades as indicated on drawings.
3. STORM SEWER: Depths, elevations and grades as shown on drawings.
4. ELECTRICAL CONDUITS: 24” minimum to top of conduit or as required by NEC 300-5, NEC 710-36 codes or the local utility company requirements, whichever is deeper.
5. TV CONDUITS: 18” minimum to top of conduit or as required by the local utility company, whichever is deeper.
6. TELEPHONE CONDUITS: 18” minimum to top of conduit, or as required by the local utility company, whichever is deeper.
7. GAS MAINS AND SERVICE: 30” minimum to top of pipe, or as required by the local utility company, whichever is deeper.

3.04 SHEETING AND BRACING

Provide sheeting and bracing, when necessary, in trenches and other excavations where protection of workmen required. Sheeting may be removed after sufficient backfilling to protect against damaging or injurious caving.

3.05 PIPE BEDDING

Accurately cut trenches for pipe or conduit that is installed to designed elevations and grades to line and grade from 4" below bottom of pipe and to width as specified. Place 4" of bedding material, compact in bottom of trench, and accurately shape to confirm to lower portion of pipe barrel. After pipe installation, place select backfill as determined in Section 02200, and compact in maximum 8" layers measured loose to the top of the trench.

3.06 TRENCH BACKFILLING

A. Criteria: Trenches shall not be backfilled until required test are performed and the utility systems comply with and are accepted by applicable governing authorities. Backfilling trenches as specified. If improperly backfilled, reopen to depth required to obtain proper compaction. Backfill and compact, as specified, to properly correct condition in an acceptable manner.

B. Backfilling: After pipe or conduit has been installed, bedded and tested as specified, backfill trench or structure excavation with specified material placed in 8" maximum loose lifts. Compact to minimum density of 98% of optimum density in accordance with ASTM D 698.

C. Compaction: Exercise proper caution when compacting immediately over top of pipes or conduits. Water jetting or flooding is not permitted as method of compaction.

D. Compaction Testing: If determined by the owner and at the owner's expense an independent testing laboratory shall perform test at intervals not exceeding 200'-0" or trench for the first and every other eight-inch (8") lift of compacted trench backfill and furnish copies of test results as specified.

END OF SECTION

SECTION 02227 - BORING AND ENCASEMENT

PART 1 – GENERAL

1.1 GENERAL DESCRIPTION: This section covers the furnishing of all supervision, labor, equipment and materials required for the complete installation of encasement pipe and carrier pipes under highways and railroads by boring and jacking as shown on the drawings and specified herein.

1.2 GENERAL INTENTION: This section shall include construction methods for pipe lines installed by boring and jacking in the locations as shown on the contract drawings. The contractor shall inspect the locations at the proposed crossings and shall familiarize himself with the conditions under which the work will be performed, and with all necessary details and the suitability of his equipment and methods for the work required. All work in railroads shall comply with all current requirements of governing highways and railroad agencies. The Contractor shall be familiar with these requirements.

PART 2 – MATERIALS

2.1 The encasement pipe shall be of the size as shown on the contract drawings. All encasement pipe shall be smooth wall welded steel conforming to ASTM Designation A139, Grade B. The outside of the pipe shall be coated in accordance with AWWA Standard C203. Minimum pipe wall thickness shall be as follows:

Pipe-Nominal Diameter Inches	Wall Thickness Inches
16	.250
20	.250
24	.250
30	.312
36	.500

2.2 Steel spiders shall be galvanized.

PART 3 – EXECUTION

3.1 Encasements shall be installed by boring and jacking unless field conditions require otherwise. It shall be the Contractor's responsibility to notify the Engineer immediately if conditions do not permit a jack and bore installation.

3.2 Installation of encasement pipe shall include all related work and services such as mobilization of equipment, construction and maintaining working pits, right-of-way maintenance and restoration, traffic maintenance, mining, excavations, dewatering, sheeting, shoring and bracing for embankments, operating pits, and as elsewhere required shall be placed and maintained in order that work may proceed safely and expeditiously.

3.3 The encasement pipe shall be of the diameter indicated for the carrier pipe as shown on the drawings.

3.4 Boring Machine Alignment: The boring machine shall be accurately aligned before the boring is commenced and the Contractor shall take such necessary steps as are required to accurately place the encasement with respect to line and grade. Payment will not be made for a bore and encasement that is not accurate as to line and grade as determined by the Engineer.

3.5 Extension of Encasement Pipe: As the boring operation progresses, each new section of the encasement pipe shall be butt welded to the section previously jacked into place. The boring auger shall not be of a greater diameter than the outside diameter of encasement. The leading edge of the steel casing shall be kept as close to the auger head as possible and shall be advanced at the same rate of speed as the earth auger in order to minimize any unsupported holes in the earth. Any voids that occur are to be filled with 3:1 ratio sand to cement grout at 50 psi pressure, sand or pea gravel, as directed by the Engineer to insure that there will be no settlement. The Engineer will direct that this space be filled if the space is large enough to cause any earth settling. There will be no payment for grout work.

3.6 Before the pipe is installed in the casing, bolt-on meter skids painted with bitumastic paint shall be rigidly fastened to the barrel of the pipe. After completion of the casing, the Contractor shall insert the pipeline in the pre-jointed segments. No contact will be permitted between the casing and the carrier pipeline.

3.7 Obstructions: In the event that an obstruction is encountered during the boring operation which cannot be penetrated as determined by the Engineer, the auger is to be withdrawn and the steel pipe encasement is to be cut off, capped and completely filled with 3:1 ratio sand to cement grout at 50 psi pressure before moving to a new site. Payment will be made by the Owner on completed before the boring operation was stopped plus the additional linear footage at the new site. There will be no payment for the grout work.

3.8 Pipeline Installation: After completion of the boring and encasement, the Contractor shall insert the pipeline in pre-jointed segments. A galvanized steel spider shall be installed behind each carrier pipe bell in the encasement pipe, as shown on the Contract Drawings. After placing and jointed the pipeline, the ends of casing pipes and tunnels shall be closed with brick masonry bulkheads.

3.9 Method of Measurement: Measurement will be in feet along the flow line of the encasement pipe which is installed.

3.10 Basis of Payment: The quantity of encasement pipe measured as provided in paragraph entitled "Method of Measurement" will be paid for at the contract unit price per linear feet.

3.11 Payment shall be for the total number of lineal feet of encasement pipe installed at the respective unit price bid for the item.

3.12 Price and payment shall constitute full compensation for furnishing all equipment, labor, tools, and materials to complete all of the work required under this section including excavation of working pits, encasement pipe, carrier pipe, dewatering, shoring, etc.

End Section

SECTION 2570 – BITUMINOUS PAVEMENT REPAIR

1.1 INTRODUCTION

The scope of this section is to furnish all labor, equipment, materials and any other items necessary to replace or repair all asphalt surfaces. All work shall be performed in conformance with the applicable sections of the North Carolina Department of Transportation, Division of Highways, "Standard Specification for Roads and Structures"(Latest Edition).

1.2 PERFORMANCE

Asphalt mixtures shall not be prepared or placed when the average ambient temperature is less than 40 degrees farenheight, during rainy weather, when sub grade or base course is frozen, when sub grade or base course is showing evidence of excess moisture or when the surface to be adjoined to is excessively moist and would prevent proper bonding with the new surface.

Preparation and construction of sub grade, base course and surface course shall be completed immediately after completion of all underground piping or structures, installation of curb and gutters, all yard piping, conduits and other facilities passing under paved areas and all structural slabs and foundations required within or adjacent to the paved areas.

1.3 INSTALLATION

A. Sub grade Preparation:
Sub grade preparation activities shall be in strict conformance with Section 500 or Section 505, where applicable, of the "Standard Specifications for Road and Structures" (Latest Edition) issued by NCDOT- Div. of Highways.

B. Aggregate base Course Installation:
Application of aggregate base course shall be in strict conformance with Section 520 of the "Standard Specification for Roads and Structures" (Latest Edition) issued by NCDOT- Div. of Highways.

C. Bituminous Plant Mix – General:
The work covered under this section of this specification shall be performed in strict conformance with Section 610 and Section 620 of the "Standard Specifications for Road and Structures" (Latest Edition) issued by NCDOT- Div. of Highways.

D. Prime Coat:
The work covered under this section of this specification shall be performed in strict conformance with Section 600 of the "Standard Specifications for Road and Structures" (Latest Edition) issued by NCDOT- Div. of Highways.

E. Tack Coat:
The work covered under this section of this specification shall be performed in strict conformance with Section 605 of the "Standard Specifications for Road and Structures" (Latest Edition) issued by NCDOT- Div. of Highways.

F. Bituminous Surface Course (S 9.5B):
The work covered under this section of this specification shall be performed in strict conformance with NCDOT Superpave specifications (Latest Edition) issued by NCDOT- Div. of Highways.

G. Traffic Markings:
The Contractor shall repair and restore any traffic markings that were damaged, destroyed or covered during the construction operation. All work shall be done in accordance with the requirements and specifications of NCDOT and in conformance with the MUTCD Manual (Latest Edition). The payment for work under this section shall be included in the unit bid price for bituminous surface coat and no additional payment will be made.

H. Existing Structures:
All existing structures which fall under or near repaired or restored bituminous areas shall be adjusted to final grade prior to application. All work under this section shall be included in the unit bid price for bituminous surface coat and no additional payment will be made if depicted on the plans. All encountered structures, which were not depicted on the plans or visible, will be paid at agreed upon price by Contractor and Engineer/Owner.

I. Testing and Acceptance:
All work in this section shall be subject to thickness and compaction tests as deemed necessary by the Engineer/Owner. All tests shall be included in the unit bid price for bituminous paving and paid by the Contractor. All tests found to be in nonconformance require the removal, replacement and restoration of areas in question. For additional tests requested by the Engineer/Owner, the Owner will pay for all successful tests and the Contractor shall pay for tests resulting in nonconformance and repair area as previously discussed. Compaction test shall be required as follows:

1. One test per intersection.
2. One test per road crossing less than 100 feet.
3. One test per 500 feet for excavations in a bituminous area.

Upon submittal of successful test reports and aesthetic acceptance, the Contractor shall be given an acceptance of the work in writing. The Contractor shall remain responsible for all improvements until final acceptance of the project.

END OF SECTION

SECTION 02601 - MANHOLES, DROP MANHOLES AND CONFLICT MANHOLES

1. DESCRIPTION: The Contractor shall furnish all labor, materials, equipment and supplies and shall perform all work necessary for the construction of all manhole drop connections and conflict manholes complete and ready for use. The manhole drop connections and conflict manholes shall be constructed at the locations and grades shown or established by the Engineer and shall conform to the details shown on the Plans.

1.1 Any reference to NCDOT standard specifications was obtained from "Standard Specification for Roads and Surfaces" published by the North Carolina Department of Transportation. Unless otherwise noted, the most current date published applies.

2. MATERIALS:

Materials for manholes shall be new and shall be furnished by the Contractor in accordance with the following requirements:

2.1 Manholes: Manholes shall be precast reinforced concrete sections conforming to ASTM C-478 and to the following.

2.1.1 Tops shall be eccentric cone where cover permits unless shown otherwise on the drawings and flat slab tops otherwise. Bottoms shall be integrally cast unless the Contactor proposes to use specialty bases ("Dog-House") at points of connection to existing sewer mains. Any special bases or riser used must be detailed in shop drawings and submitted for approval. Manhole wall and base dimensions shall conform to C-478 or to the minimum dimensions shown on the drawings.

2.1.2 Manhole supplier shall design manhole sections to resist earth loads and to resist uplift resulting from buoyant forces calculated with ground water table at the ground surface. Wall and base dimensions shall be increased accordingly.

2.1.3 Pipe connection shall consist of an approved continuous boot of 3/8 inch minimum thickness neoprene as shown on the drawings conforming to ASTM C-923. Boots shall be either cast into the manhole wall or installed into a cored opening using internal compression rings. Installed boot shall result in a water-tight connection meeting the performance requirements of ASTM C-443.

2.2 Frames and Covers: Frames and covers shall be of domestic manufacture good quality cast iron of uniform grain, conforming to ASTM A48, Class 30 or better, constructed in accordance with details shown on the plans.

2.3 Manhole Steps: Manhole steps shall be of aluminum or composite plastic-steel construction. Aluminum steps shall be aluminum alloy 606IT6. Composite plastic-steel steps shall consist of a ½ inch deformed steel reinforcing rod encapsulated in a co-polymer polypropylene plastic; reinforcing rods shall conform to ASTM A615, Grade 60; and polypropylene plastic shall conform to ASTM D2146, Type II, Grade 16906. Minimum design live load of steps shall be a single concentrated load of 300 pounds. Steps shall be nine inches in depth and at least twelve inches in width. Steps shall have non-skid top surfaces. All parts of aluminum steps to be embedded in concrete or masonry shall be coated with bituminous paint or zinc chromate primer.

2.3.1 Steps shall be uniformly spaced not more than sixteen inches (16") on center, including the spacing between the top step and the manhole cover. Steps shall be embedded in the wall a minimum distance of 4 inches in either cast or drilled holes. Steps shall not be driven or vibrated into fresh concrete and shall withstand a pullout resistance of 2000 lbs when tested in accordance with ASTM C-497. Each step shall project a minimum of 5 inches from the wall measured from the point of embedment.

2.4 Concrete (poured in place): Air entrained Portland Cement Concrete having minimum twenty-eight (28) day compressive strength of 3000 psi.

2.5 Joint Sealant: Butyl Rubber based conforming to AASHTO M-198, type B – Butyl rubber, suitable for application temperatures between 10 and 100 degrees F.

2.6 O-Ring or Gasket (Contractor's option): ASTM C-443

2.7 Sand Cement:

2.7.1 Portland Cement: ASTM C50, Type I.

2.7.2 Sand: Clear, sharp, graded from fine to coarse, ASTM C-144.

2.7.3 Water: Clean and potable.

2.7.4 Mixture: One (1) part cement, two (2) parts sand.

2.8 Pipe and Fittings: Same as sewer pipe.

2.9 Precast Grade Rings: Shall be no less than 4" in height and conform to ASTM C 478.

2.10 Washed Stone: Stone material, crushed stone or gravel shall be strong, durable and conform to standard size No. 57 per NCDOT Section 1000.

3. CONSTRUCTION:

3.1 Excavation for all sanitary manholes shall be carried to a depth such as to provide a minimum of 6 inches of washed stone bedding material below the bottom of structures and extend to a minimum width of 8 inches beyond each side of structures.

3.2 Should unstable soil, organic soil, or soil types classified as fine-grained soils (silts and clays) by ASTM D-2487 be encountered at the bottom of excavations, such soils shall be removed to a depth and width determined by the Engineer and properly disposed of. The resulting undercut shall be backfilled with washed stone. Placement and compaction shall conform to applicable earthwork specifications.

3.3 Manholes shall be constructed of precast reinforced concrete with cast iron frames and covers in accordance with details shown on the Plans.

3.4 Invert channels shall be smooth and accurately shaped to semi-circular bottom conforming to the inside of the adjacent sewer sections. Inverts shall be formed of concrete, and no laying pipe through manholes will be permitted. Changes in size and grade shall be made gradually and evenly. The minimum bending radius of the trough centerline shall be 1.5 times the pipe I.D. A minimum ½" radius shall be provided at the intersection of 2 or more channels.

3.5 Precast concrete bottom sections, risers, and top sections shall be fabricated such that when assembled, they provide a manhole conforming to the depth required. The Contractor shall be responsible for the furnishing and constructing manholes such that the completed assembly is flush (0.1 foot above) finished grade or at other elevations as may be shown on the drawings. No manhole assembly will be accepted or paid for that will allow surface water inflow to occur through the cover due to poor attention to construction grades.

3.6 Sections are to be assembled so as to provide a plum structure with uniform bearing at all joints and at the base slab. Joints shall be thoroughly cleaned to remove dirt and foreign material. The butyl rope sealant shall be unrolled directly against the base of the spigot. Leave the protective paper in place until the sealant is fully in place. Overlap rope from side to side, not top to bottom. Joints to be plastered smooth inside and outside of manhole with a cement grout. <u>JOINTS SHALL BE WATER TIGHT.</u>

3.7 Pipes shall project into the manhole 2 inches and shall be mechanically sealed with a MOLDED NEOPRENE boot.

3.8 Manhole frames and covers shall be set flush (0.1 foot above) with the finished grade or as otherwise shown on the drawings. Precast adjustment (grade) rings shall be used as required. No more than 8 vertical inches of grade ring will be allowed per manhole. Seal frame to adjustment ring, or cone section with butyl sealing rope and completely grout the ring to the top manhole section.

3.9 Drop connections shall be constructed with ductile iron outside the manhole unless approved otherwise by the Director.

4. TESTING: All manholes shall be tested in accordance with the Infiltration/Ex-filtration Test in Section 02730, unless otherwise directed by the Director.

5. METHOD OF MEASUREMENT AND BASIS OF PAYMENT: Manholes, Drop Connections, Manhole Vent Pipes, existing manhole removal and existing manhole abandonment shall be paid for at the unit prices specified in the Bid. All prices shall be for full payment for all labor, materials, tools, equipment, backfilling, sheeting, shoring, dewatering, and other costs necessary to complete the work as shown, directed and specified.

5.1 Manholes are to be measured and the depth determined as the vertical distance between top of the cast iron frame and the lowest pipe invert and rounded to the nearest foot.

5.2 Drop Connections will be measured and paid for at the price per vertical foot, rounded to the nearest foot.

5.3 Payment for manholes constructed over existing sewers shall be lump sum for each specialty manhole identified, including all appurtenances for a complete installation at each location identified.

END OF SECTION

SECTION 02722 - EXTERIOR SANITARY SEWERS AND APPUTENANCES

PART 1 – GENERAL

1.1 General Description: This section covers the furnishing of supervision, materials, labor, equipment and miscellaneous items necessary to construct sewers and appurtenances as shown on the plans and as specified herein, complete, tested, and ready for service. All pipe and appurtenances shall be of the class and type as indicated on the plans and designated herein.

1.2 General Intention: The work covered by this section consists of all supervision, excavation, bedding, laying pipe, jointing and coupling pipe sections, and backfilling necessary to install the various types of pipe required to complete the project.

PART 2 – MATERIALS

2.1 Materials: All materials shall be first quality with smooth interior and exterior surfaces, free from cracks, blisters, honeycombs and other imperfections, and true to theoretical shapes and forms throughout. All materials shall be subject to the inspection of the Engineer at the plant, trench, or other point of delivery, for the purpose of culling and rejecting material that does not conform to the requirements of these specifications. Such material shall be marked by the Engineer and the Contractor shall remove it from the project site upon notice being received of its rejection. As particular specifications are cited, the designation shall be construed to refer to the latest revision under the same specification number, or to superseding specifications under a new number except provisions in revised specifications that are clearly inapplicable.

2.1.1 Handling and Storing Materials: The Contractor shall unload pipe so as to avoid deformation or other injury thereto. Pipe shall not be rolled or dragged over gravel or rock during handling. When any joint or section of pipe is damaged during transporting, unloading, handling, or storing, the undamaged portions of the joint or section may be used where partial lengths are needed, or, if damaged sufficiently, the Engineer will reject the joint or section as being unfit for installation. If any defective pipe is discovered after installation, it shall be removed and replaced with sound pipe or shall be repaired by the Contractor in an approved manner and at their own expense.

2.2 PIPE AND FITTINGS:

2.2.1 Polyvinyl Chloride Pipe (PVC): Polyvinyl Chloride Pipe (PVC) pipe shall meet the requirements of ASTM D3034, latest editions, and be suitable for use as a gravity sewer conduit. The pipe shall be SDR 35 unless otherwise specified. The pipe shall be supplied in standard laying lengths of 20 feet and 12.5 feet.

2.2.1.1 PVC Pipe Joints: All PVC pipe joints shall be of an integral bell and spigot of the same material as the pipe with a solid cross-section rubber O-ring securely locked in place at the point of manufacture. Service saddles and other fittings shall be supplied by the pipe manufacturer and shall be of the same material and type of construction as the pipe material.

2.2.3 Ductile Iron Pipe (DIP): Ductile Iron Pipe shall be manufactured in accordance with ANSI Specification A21.51. All ductile iron pipe shall be Class 50 unless other wise specified and shall be lined with cement mortar not less than 1/16"-inch thick conforming to ANSI Specification A21.4.

2.2.3.1 DIP Joints: Slip or "push-on" joints shall be manufactured in accordance with ANSI Specification A21.11. Bells of "slip" joint pipe shall be contoured to receive a bulbshaped, circular rubber gasket, and plain ends shall have a slight taper to facilitate installation. The pipe manufacturer shall furnish the lubricant used in making up the joints. The jointing shall be done by guiding the plain end into the bell until contact is made with the gasket and by exerting a sufficient compressive force to drive the joint home until plain end makes full contact with the base of the bell.

2.2.4 Reinforced Concrete Pipe: Reinforced concrete pipe shall be furnished in sizes and classes shown and specified on the Contract Drawings and the Bid Schedule. All pipes under this Section shall conform to the latest revisions of ASTM CC-76 – Reinforced Concrete Culvert, Storm and Sewer Pipe. The provisions of ASTM C-655 may also be utilized. Reinforced concrete pipe shall be manufactured by centrifugal or vertical casting methods. For vertical casting methods, mechanical vibration shall be provided to insure proper consolidation of concrete. Density of cured concrete shall be 150 lbs/ft. or greater.

2.2.4.1 Concrete Pipe Test: All shipments of pipe shall be tested at the Contractor's expense in accordance with ASTM C-76 Section 11 (2) except as modified. Preliminary testing for extended deliveries shall include 3-edge bearing tests to the .01-inch crack on three (3) sections of each size pipe. Testing shall be by an approved testing laboratory. Specimens up to 0.5 percent of the number of each size of pipe furnished shall be tested, except that in no case shall less than two specimens be tested. The laboratory making the tests shall furnish the Engineer with three (3) certified copies of these tests. No pipe shall be laid before the Engineer approves test reports.

2.2.4.2 Concrete pipe shall be manufactured in joint lengths of 8 feet or greater.

2.2.4.3 Results of absorption tests performed on the pipe shall not exceed 6.5 percent.

2.2.4.4 The alkalinity of the concrete cover over the inner reinforcing steel on the inside pipe wall at the crown shall be no less than 0.50 (50%) expressed as calcium carbonate equivalent. The manufacturer shall determine the alkalinity of the concrete cover at intervals determined by the Engineer. Samples for alkalinity determination shall be obtained by drilling one-inch diameter holes in the pipe interior to the reinforcing steel. The ground concrete from this drilling shall be the sample material used for the alkalinity determination. Core holed in test pipe may be suitably repaired by a method approved by the Engineer and used on the project. The laboratory making the test shall furnish the Engineer with three (3) certified copies of these tests. No pipe shall be laid before the Engineer approves these reports.

2.2.4.5 Bell and spigot reinforced concrete sewer pipe shall be joined with an O-ring rubber gasket type joint conforming to the applicable provisions of ASTM C-361, latest revisions. A groove shall be provided in the spigot end to receive the rubber gasket and it shall be so formed that when the joint is complete, the gasket will be deformed to a near rectangular shape and confined on all four sides. All inside surfaces of the bell and outside closure of the joint, and at any degree or partial closure shall be parallel within one degree and have an angle of not more than two degrees with the longitudinal axis of the pipe. The gasket shall be the sole element utilized in sealing the joint from either internal or external hydrostatic pressure. Gaskets shall be the product of a manufacturer having at least five years' experience in the manufacturer of rubber gaskets for pipe joints. The gaskets shall have smooth surfaces free from blisters, porosity, and other imperfections. The joint shall be assembled in accordance with the standard directions of the gasket manufacturer.

2.2.4.6 The pipe manufacturer shall design walls to meet the following requirements.

2.2.4.6.1 Pipe wall sections shall meet the structural requirements for pipe classes stated in the Bid Schedule for each size pipe.

2.2.4.6.2 Concrete cover over the inner reinforcing cage shall be a minimum of 1" greater than that required to meet structural properties. This may be accomplished by moving the inner reinforcing cage towards the outside of the pipe, by adding concrete on the inside of the pipe, by adding concrete on the outside of the pipe, or both. Inside pipe diameter shall not be decreased.

2.2.4.6.3 Reinforcing shall be sufficiently strong so that the pipe, without the additional interior cover, will meet the 3-edge bearing test requirements of ASTM C-76 for the .01-inch crack.

2.2.5 Steel Sanitary Sewer Pipe: Steel sanitary sewer pipe shall conform to ASTM A-53 Grade B or ASTM A-139 Grade B standard specifications. Steel sewer pipe shall have minimum yield strength of 35,000 psi and a minimum tensile strength of 60,000 psi with a wall thickness of .375 inches. External and internal surfaces shall have protective coatings. Coating shall consist of a coal-tar primer followed by hot coal-tar enamel at least 1/16-inch thick, or approved equal.

2.2.6 Steel Casing Pipe: Steel casing shall conform to ASTM A-53 Grade B or ASTM A-139 Grade B Standard specifications. Casing pipe shall have a wall thickness as follows:

30”	0.312 inches wall thickness
26”	0.312 inches wall thickness
16”	0.250 inches wall thickness

External surfaces of steel casing pipe to have a protective coating. This coating shall consist of a coal-tar primer followed by hot coal-tar enamel at least 1/16-inch thick, or approved equal.

2.3 Manholes: See Section 02601 Manholes, Drop Manholes and Conflict Manholes

PART 3 – EXECUTION

3.1 Preparation of Pipe Foundation: The pipe foundation shall be prepared to be uniformly firm and shape be true to the lines and grades as shown on the Contract Drawings. Any deviation or field adjustment will require the approval of the Engineer. The Contractor shall be responsible for the finished work conforming to proper line and grade.

3.1.1 Bedding: Whenever the nature of the ground will permit, the excavations at the bottom of the trench shall have the shape and dimensions of the outside lower third of the circumference of the pipe, care being taken to secure a firm bearing support uniformly throughout the length of the pipe. A space shall be excavated under and around each bell to sufficient depth to relieve it of any load and to allow ample space for filling and finishing the joint. The pipe, when thus bedded firmly, shall be on the exact grade. In case the bed shape in the bottom of the trench is too low, the pipe shall be completely removed from position, and earth of suitable quality shall be placed and thoroughly tamped to prepare a new foundation for the pipe. In no case shall the pipe be brought to grade by blocking up under the barrel or bell of the same, but a new and uniform support must be provided for the full length of the pipe. Where rock or boulders are encountered in the bottom of the trench, the same shall be removed to such depth that no part of the pipe, when laid to grade, will be closer to the rock or boulders than 6 inches. A suitable tamped and shaped foundation of approved material shall be placed to bring the bottom of the trench to proper subgrade over rock or boulders.

The preparation of the pipe bedding shall be in accordance with the typical trench cross sections as shown on the Contract Drawings for the type of pipe being installed. Crushed stone use for pipe bedding shall be shovel sliced so that the materiel fills and supports the haunch area and encases the pipe to the limits shown on the trench cross sections.

3.1.2 Bedding at Creek Crossing: Where it is necessary to cross a creek, the following requirements pertain.

1a) One foot of cover where the sewer is located in rock.

2a) Three feet of cover in other material unless ferrous pipe is specified. More cover in major streams.

3a) In paved stream channels, the top of the sewer line shall be placed below the bottom of the channel pavement.

3.1.3 Proper backfilling shall take place to prevent erosion or siltation.

1a) If crossing above water, Ductile Iron Pipe shall be used and the bottom of the pipe shall be above the 25-year flood elevation and special care taken to ensure minimal erosion on the creek banks.

3.1.4 Poor Foundation Material: Where the foundation material is found to be of poor supporting value, the Engineer may make minor adjustment in the location of the pipe to provide a more suitable foundation. Where this is not practical, the foundation shall be conditioned by removing the existing foundation material by undercutting to the depth as directed by the Engineer and backfilling with foundation conditioning material consisting of crushed stone.

3.1.5 Crushed Stone for Pipe Bedding: Crushed stone for pipe bedding and for foundation conditioning is to be size #67 in ASTM designation D 488, "Standard Sizes of Coarse Aggregate for Highway Construction: (AASHTO M-43, size #67)

The sieve analysis of #67 stone is as follows:

passing 1"	100%
passing ¾"	90% - 100%
passing 3/8"	20% - 55%
passing #4	0% - 10%
passing #8	0% - 5%

3.2 Water in Pipe Trench: The Contractor shall remove all water which may encountered or which may accumulate in the trenches by pumping or bailing and no pipes shall be laid until the water has been removed from the trench. Water so removed from the trench must be disposed of in such a manner as not to cause damage to work completed or in progress.

3.3 LAYING PIPE:

3.3.1 Manufacturer's Recommendations: All piping is to be installed in strict accordance with the manufacturer's recommendations and the contract material specifications.

3.3.2 Proper Tools and Equipment: Proper tools, implements, and facilities satisfactory to the Engineer shall be provided and used for the safe and convenient protection of pipe laying. All pipe and other materials used in the laying of pipe will be lowered into the trench piece be piece by means of a suitable equipment in such a manner to prevent damage to the pipe, materials, to the protective coating on the pipe, materials, and to provide a safe working condition to all personnel in the trench. Each piece of pipe being lowered into the trench shall be clean, sound and free from defects. It shall be laid on the prepared foundation, as specified elsewhere to produce a straight line on a uniform grade, each pipe being laid so as to form a smooth and straight inside flow line. Pipe shall be removed at any time if broken, damaged or displaced in the process of laying same, or of backfilling the trench.

3.3.3 Cutting Pipe: When cutting short lengths of pipe, a pipe cutter as approved by the Engineer will be used and care will be taken to make the cut at right angles to the center line of the pipe or on the exact skew as shown on the plans. In the case of push-on pipe, the cut ends shall be tapered with a portable grinder or coarse file to match the manufactured taper.

3.3.4 Location of Groove or Bell: All pipe shall be laid with the groove or bell end upgrade, and the spigot or tongue fully inserted. All pipe joints will be constructed in strict accordance with the pipe manufactures specifications and materials and any deviation must have prior approval of the Engineer.

3.3.5 Pipe Deflection: All pipe installations shall be tested for deflection. No pipe shall exceed deflection of 5 percent. The maximum deflection per joint of flexible joint pipe shall be that deflection recommended by the manufacturer. A stopper or plug shall be installed in the pipe mouth when pipe laying is not in progress.

3.4 MINIMUM SEPARATION:

3.4.1 The following minimum separations must be maintained:

a) Any private or public water supply source consisting of wells, WS-I waters, Class I, Class II, or Class III reservoirs used a source of drinking water — 100ft.

b) Waters classified WS-II, WS-III, WS-IV, B, SA, ORW, HQW, or SB from normal high water or tide elevation, wetlands that are directly abutting these waters, and wetlands classified as UWL or SWL — 50ft.

c) Any other stream, lake, impoundment, wetlands classified as WL, waters classified as C, SC, or WS-V, or ground water lowering and surface drainage ditches 10ft.

d) Any building foundation 5ft.

e) Any basement 10ft.

f) Top slope of embankment or cuts of 2 feet or more of vertical height 10ft.

g) Interceptor drains & drain lines 5ft.

h) Any swimming pool 10ft.

i) Storm sewers (vert.) 18in.
(horiz.) 12ft.

j) Water mains (vert.) 18in.
(horiz.) 10ft.

k) Benched trenches (horiz.) 18in.

3.4.2 Where the required minimum separations cannot be maintained, ferrous sanitary sewer pipe with joints equivalent to water main standards must be used. However, the minimum separations shall not be less than 25 feet from a private well or 50 feet from a public water supply source.

3.5 SIZE:

3.5.1 The minimum size of public gravity sewer mains shall be 8".

3.5.2 New sewer systems shall be designed based on the proposed land use of the contributory area. The following flow factors shall be used:

PROPOSED LAND USE	FLOW FACTOR
Residential	120 gal/bedroom/unit
Office and Institutional	.09 gad/ sq. ft.
Commercial	.12 gad/ sq. ft.
Industrial	.20 gad/ sq. ft.

3.5.3 Flow factors not described shall be in conformance recommendations of NCDEQ.

3.5.4 Sanitary sewers shall be designed to carry the projected peak flow at no more than 2/3 full and at a minimum velocity of 3 fps. The ratio of peak flow to average daily flow shall be 3.

3.5.5 Sewer extensions are to be designed to meet proposed flow requirements even if larger than existing. If proposed is larger than existing then a manhole is to be set and the larger line is to be placed so that the energy gradient of the two lines are similar.

3.6 INSTALLATION:

3.6.1 Minimum slopes for pipe shall adhere to the following table.

Diameter of Pipe (inches)	Minimum slope (feet per 100 feet)
6	0.60
8	0.40
10	0.28
12	0.22
14	0.17
15	0.15
16	0.14
18	0.12
21	0.10
24	0.08
27	0.07
30	0.06
36	0.05

3.6.2 Sanitary sewer lines shall be deep enough to serve all adjoining property and allow for sufficient slope in lateral lines. All sanitary sewer mains shall have the following minimum covers:

a) 4 ft. from top of pipe to finish subgrade when under a roadway.

b) 3 ft. from top of pipe to finished subgrade when outside a roadway.

3.6.3 The above requirements may be waved by authority of Director, in which case ductile iron pipe shall be used.

3.6.4 Sewer mains deeper than 12 feet require stone bedding.

3.6.5 Transitions between pipe materials shall occur at manholes.

3.6.6 Where sanitary sewer lines and water lines must cross, ductile iron pipe shall be used and pipes shall cross at near 90 degree angles with 18" minimum separation, as stated in the separation table.

3.6.7 Sewer mains shall be installed in dedicated public right of ways or in dedicated utility easements.

3.6.8 Sewer line easements shall be graded smooth, free from rocks, boulders, roots, stumps, and all other obstructions and seeded and mulched upon completion of construction.

3.6.9 Downstream manholes on sanitary sewer lines under construction shall be plugged and secured to prevent any seepage of water into or out of the line while under construction.

3.7 BACKFILL:

3.7.1 Initial Backfill: The initial backfill for pipe shall be carefully placed to a level of 12 inches over the top of the pipe. This backfill shall be excavated soil free from debris, organic material and large rock and stones. Initial backfill shall be shovel sliced so that the material fills and supports the haunch area and encases the pipe to the limits shown on the trench cross sections on the Contract Drawings.

3.7.2 Final Backfill: Final backfill for pipelines shall be defined as that portion of the trench from an imaginary line drawn 12 inches above the top of the pipe to the original ground surface. Final backfill will be done with suitable excavated material and tamped in 12 inch lifts. Debris, material not given to adequate compaction, and stone over one cubic foot will not be allowed within the trench limits. If material excavated is not suitable for backfilling, the Contractor shall, at no increased cost to the Owner, remove and dispose of such unsatisfactory material and shall backfill the trench with suitable material obtained elsewhere.

3.7.3 Steep Slope Protection: Sewers on 20 percent slopes or greater shall be anchored securely with concrete, or equal, with the anchors spaced as follows:

a) Not greater than 36 feet center to center on grades 21% to 35%

b) Not greater than 24 feet center to center on grades 35% to 50%

c) Not greater than 16 feet center to center on grades 50% and over

3.8 COMPACTION:

3.8.1 Within Traffic Areas: When pipelines installed within the ditch to ditch limits of any roadway, driveway or parking area etc., backfill shall be compacted to a minimum dry density of 95 percent of the maximum dry density in pounds per cubic foot as determined by the Standard Proctor Compaction Test. Backfill material shall be placed in 6 inch layers and thoroughly tamped or rolled to the required degree of compaction by sheepsfoot or pneumatic rollers, mechanical tampers, vibrators, etc. Successive layers shall not be placed until the layer under construction has been thoroughly compacted.

3.8.2 Outside Traffic Areas: In areas outside the ditch to ditch limits of a roadway, driveway, parking areas, etc., backfill shall be compacted to a minimum dry density of 90% of the maximum dry density in pounds per cubic foot as determined by the Standard Proctor Compaction Test. Any settlement shall be immediately corrected.

3.8.3 Equipment Traffic: Heavy equipment shall not be operated over any pipe until it has been properly backfilled and has a minimum cover of 24 inches. Where any part of the required cover is above the proposed finish grade, the Contractor shall place, maintain, and finally remove such material at no cost to the Owner. Pipe which becomes misaligned, shows excessive settlement, or has been otherwise damaged by the Contractor's operations shall be removed and replaced by the Contractor at no cost to the Owner.

3.8.4 Pipe Maintenance: The Contractor shall maintain all pipes installed in a condition that they will function continuously from the time the pipe is installed until the project is accepted.

3.9 MANHOLE INSTALLATION:

3.9.1 Precast Concrete Manhole: A precast concrete manhole shall be installed at each break in line or grade in each sanitary sewer as shown in detail on the Contract Drawings. Manhole sections shall be set plumb and on a firm foundations. Each joint between sections and all wall openings shall be sealed with 2:1 sand-cement mortar mix and made watertight. An eccentric cone section and standard frame and cover is to be installed on each new manhole. Final adjustment to grade of all manholes shall be done with brick and mortar and each frame and cover shall be grouted firmly into place.

3.9.2 Manholes shall be spaced at a maximum distance of 425 feet apart for lines 12 inches in diameter or smaller and at a maximum of 500 feet apart for lines greater than 12 inches in diameter.

3.9.3 Manholes for sewers under 21 inches in diameter shall be a minimum of 4 feet in diameter. Manholes for sewer 21 inches in diameter or greater shall be 5 feet in diameter. All manholes requiring inside drops shall be a minimum of 5 feet in diameter. When two or more inside drops occur at one manhole, a minimum of 6 feet in diameter manhole shall be used. All manholes shall have a minimum access of 22 inches in diameter.

3.9.4 Manholes Inverts: Manhole inverts shall be constructed of concrete or concrete and brick of semicircular section conforming to the inside diameter of the outlet sewer. Changes in size of pipe or grade shall be made gradually and changes in direction constructed by using true curves. Each manhole shall be provided with such channels for all connecting sewer pipes. Drop manholes shall be provided where invert separations exceed 2.5 feet.

3.9.5 Manholes located within the 100 year flood plain or in areas of high ground water shall abide by the following when applicable:

3.9.5.1 WATERTIGHTNESS:

3.9.5.1.1 Manholes shall be pre-cast concrete or poured-in-place concrete. Manhole lift holes and grade adjustment rings shall be sealed with non-shrinking mortar or other material approved by the Division.

3.9.5.1.2 Inlet and outlet pipes shall be joined to the manhole with a gasketed flexible watertight connection or any watertight connection arrangement that allows differential settlement of the pipe and manhole wall to take place.

3.9.5.1.3 Watertight manhole covers are to be used wherever the manhole tops may be flooded by street runoff or high water. Locked manhole covers may be desirable in isolated easement locations or where vandalism may be a problem.

3.9.5.2 Manholes shall be designed for protection from the 100-year flood by either:

3.9.5.2.1 Manhole rims shall be 12 inches (1 foot) above the 100-year flood elevation or,

3.9.5.2.2 Manholes shall be watertight and vented 12 inches (1 foot) above the 100-year flood elevation. Manholes shall be vented every 1,000 feet or every other manhole, whichever is greater.

3.9.6 CORROSION PROTECTION FOR MANHOLES:

3.9.6.1 Where corrosive conditions due to septicity or other causes are anticipated, consideration shall be given to providing corrosion protection on the interior of the manholes.

3.9.6.2 Where high flow velocities are anticipated, the manholes shall be protected against displacement by erosion and impact. High velocity is defined as 15 fps or greater.

3.10 Testing: All pipe installations shall be tested as specified herein. Tests shall be performed by Contractor at his expense in the presence of the Engineer or his representative. Testing shall not be performed until such time that all work which may affect the results of the testing has been completed. Where a test section fails to meet test requirements, Contractor shall make corrections as specified herein and retest the section. The correct/retest procedure shall continue until such time as test requirements are met.

3.10.1 Air Test: All gravity sewer pipe.

3.10.1.1 Air test shall be conducted in strict accordance with the testing equipment manufacturer's instructions, including all recommended safety precautions. No one will be allowed in the manholes during testing. Equipment used for air testing shall be equipment specifically designed for this type of test, and is subject to approval of the Inspector

3.10.1.2 The test shall be performed only on clean sewer mains after services are installed and the pipe is completely backfilled. Clean sewer mains by propelling snug fitting inflated rubber ball through the pipe with water. After completely cleaned, plug all pipe outlets with suitable test plugs. Brace each plug securely.

3.10.1.3 For pipe within test sections above the ground water table, add air slowly to the portion of the pipe installation under test until the internal air pressures is raised to the starting pressure of 4 psig. After the starting pressure is obtained, allow at least two minutes for air temperature to stabilize, adding only the amount of air required to maintain pressure. When pressure decreases to 3.5 psig. Start stopwatch. Determine the time that is required for the internal air pressure to reach 2.5 psig.

3.10.1.4 For pipe with test sections below the ground water table, determine the starting pressure for the test section, in psig, as follows:

1. Determine the maximum depth of pipe within the test section in feet.

2. Multiply this depth by 0.67 feet and add 9.3 feet.

3. Multiply the result in part 2 by 0.43 and round to the nearest 0.5 psig. After this starting pressure is obtained, continue the test in accordance with the procedure in the paragraph above.

3.10.1.5 Requirement: The test section shall be acceptable if the elapsed time for pressure drop of 1.0 psig is greater than the sum of the times shown below for all pipe sizes within the test section.

PIPE DIAMETER (INCHES)									
LENGTH	**4**	**6**	**8**	**10**	**12**	**15**	**18**	**21**	**24**
25	0:04	0:10	0:18	0:28	0:40	1:02	1:29	2:01	2:38
50	0:09	0:20	0:35	0:55	1:19	2:04	2:58	4:03	5:17
75	0:13	0:30	0:53	1:23	1:59	3:06	4:27	6:04	7:55
100	0:18	0:40	1:10	1:50	2:38	4:08	5:56	8:05	10:34
125	0:22	0:50	1:28	2:18	3:18	5:09	7:26	9:55	11:20
150	0:26	0:59	1:46	2:45	3:58	6:11	8:30	"	"
175	0:31	1:09	2:03	3:13	4:37	7:05	"	"	"
200	0:35	1:19	2:21	3:40	5:17	"	"	"	12:06
225	0:40	1:29	2:38	4:08	5:40	"	"	10:25	13:36
250	0:44	1:39	2:56	4:35	"	"	8:31	11:35	15:07
275	0:48	1:49	3:14	4:43	"	"	9:21	12:44	16:38
300	0:53	1:59	3:31	"	"	"	10:12	13:53	18:09
350	1:02	2:19	3:47	"	"	8:16	11:54	16:12	21:10
400	1:10	2:38	"	"	6:03	9:27	13:36	18:31	24:12
450	1:19	2:50	"	"	6:48	10:38	15:19	20:50	27:13
500	1:28	"	"	5:14	7:34	11:49	17:01	23:09	30:14

3.10.2 Corrective Measures: If elapsed time is less than the specified amount, Contractor shall locate and repair leaks and repeat the test until elapsed time exceeds the specified amount.

3.10.3 INFILTRATION/EX-FILTRATION TEST (Use All Manholes):

3.10.3.1 The use of this method for sewer pipe, in lieu of air tests may be used as an alternate test method.

3.10.4 Procedure:

1. Infiltration: Immediately following a period of heavy rain a test of work constructed up until the time shall be made. Three measurements shall be made at one (1) hour intervals to compute the amount of the infiltration. Test for manholes only shall be conducted on individual manholes. Tests for pipe and manholes shall be performed on test sections not exceeding 600 linear feet of collector sewer and shall include both pipe and manholes.

The Engineer reserves the right to use his judgment as to whether the ground is sufficiently saturated and/or whether the fall of rain is adequate to permit making infiltration tests. In the event that sufficient rain does not occur before the date of completion, the Contractor shall be required to conduct the tests at any time during a 30-day period following this date. Should the Engineer determine that certain pipe of manholes couldn't be tested by infiltration methods, the Engineer may direct the filling of lines and the measurement of ex-filtration. The allowable rate of ex-filtration shall be the same as for infiltration.

2. Ex-filtration: Determine test sections as outlined for infiltrations tests. Install a temporary water plug at the inlet and outlet of the test section. Fill test section with clean water up to the bottom of the lowest manhole frame within the test section. Allow time for saturation of pipe and manholes refilling test section as required. Beginning with a full test section, allow at least eight (8) hours to elapse without adding water. Measure the water level at the beginning and end of the elapsed time above. Compute the volume of water lost in gallons per hour.

3.10.5 Test Requirements: The rate of water loss/gain shall be less than the rate, in gallons per hour, calculated for the test section using the following allowances:

1. Sewer main and manholes with or without service laterals; 100 gallons per 24 hours per inch of sewer main diameter per mile of sewer main (gpd/in-mil).

2. Manholes only; 1 gallon per 24 hours per vertical foot of manhole.

3.10.6 Corrective Measures: If actual leakage rate is greater than required leakage rate, Contractor shall locate and repair leaks and repeat the test until actual leakage is less than the required rate.

3.11 MEASUREMENT – PAYMENT:

3.11.1 Measurement and payment of pipelines: Measurement of pipelines shall be the actual number of lineal feet of pipe installed, complete in place and accepted. No deductions in length will be made for manholes. Pipelines shall be paid for at the unit contract price for each pipe size and depth of cut below the original ground over the pipe invert as shown on the plans and itemized in the Bid Schedule. The unit contract price for pipelines is to include stone bedding for the type of pipe material being bid. The unit price for pipelines also includes clearing and grubbing, pavement removal, shaping and seeding, traffic control and other related work.

3.11.2 Measurement and payment of precast manholes: The unit prices shall include furnishing and installing manhole steps, rings and covers and the construction of inverts.

Each manhole 0' – 6'0", measured vertically from the invert of the outlet pipe to the top of the manhole ring and cover casting will be paid for at the contract unit price for additional manhole depth. Payment will be made for the additional vertical feet of manhole installed above 6'0", measured to the nearest tenth of a foot.

PART 4 – FORCE MAIN SEWER

4.0 MATERIALS:

4.1 Ductile Iron Pipe: Shall be designed and manufactured in accordance with ASTM A-746 ANSI specifications A21.50, A21.51, and AWWA Standard C150 and C151 for laying conditions and shall be Class 250 unless otherwise specified on contract drawings.

4.1.1 Pipe joints shall be of the push-on type as per AWWA C111. Pipe lining shall be cement mortar with a seal coat of bituminous material, all in accordance with AWWA C104.

4.1.2 Exterior of all pipes shall be coated with either a coal or asphalted base bituminous pipe coating in accordance with ANSI specifications A21.8.

4.2 PVC Pipe: Shall meet the requirements of AWWA C900 and shall be manufactured in accordance with ASTM D-2241, latest edition, and shall be suitable for use as a sanitary sewer force main pipe. Pipe shall be Class 235, DR 18, integral bell with strength equal to the pipe wall, 18-foot length, with rubber "O" ring securely locked in place at point of manufacture.

4.2.1 PVC Pipe: Force mains with a diameter of three (3) inches or less shall be SDR 21 or SCH 40 in accordance with ASTM D1785.

4.2.2 PVC Pipe: Shall require the installation of a detector tape placed a maximum of 2 feet below the covering surface. Detector tape shall be 3 inches wide.

4.3 Pipe fittings shall be cast or ductile iron designed and manufactured as per AWWA C110. Sizes of fittings up to and including 12 inches shall be designed for a working pressure of 200 psi; larger size fittings shall be designed for a working pressure of 150 psi. Joints for fittings shall be mechanical joints and lined with cement mortar with a seal coat of bituminous material, all in accordance with AWWA C104.

4.4 Gate Valves: Shall be designed for a working pressure of 200 psi, unless otherwise specified, and shall have a clear waterway equal to the full nominal diameter of the pipe and shall be opened by turning clockwise. Each valve shall have the initials of the maker, pressure rating and year of manufacture cast on the body. Prior to delivery, each valve must be tested at twice the hydraulic working pressure. Gate valves larger than two (2) inch shall meet the requirements as set forth in AWWA C500.

5.0 INSTALLATION:

5.1 All components which are subject to hydrostatic thrust shall be reaction blocked by securely anchoring the items with concrete thrust blocks poured in place. No concrete shall interfere with the removal of fittings. Material for reaction blocking shall be 3000 psi concrete.

5.2 Sewage Combination Air Valves: Shall be installed at all high points along force mains. Manholes containing valves shall receive a bituminous or coal tar epoxy coating on the interior. The engineer shall determine size and valves shall be located at every high point.

5.3 Force Sewer Mains: Shall be installed in dedicated public right of ways or in dedicated utility easements.

5.4 Force Main Valve: Shall be spaced at appropriate intervals as determine by the City Engineer, and shall have valve box lids marked “Sewer.” Force main valves shall be resilient wedge gate type.

5.5 Force Mains: Shall discharge in the invert of the receiving manhole and shall be 180 degrees from the outlet pipe.

5.6 Force Mains: Shall be appropriately identified upon installation to negate confusion with potable water lines. Pipe material shall be designated continuously along the length with the word “Sewer.”

6.0 TESTING:

6.1 Force main material shall be placed and tested in accordance with water main standards.

6.2 All materials used must have a preliminary inspection by the Construction Inspector before materials are used for construction purposes. Rejections of material not meeting these specifications will be ordered and such materials shall be immediately removed from the job.

6.3 Sanitary sewer lines shall be free and clean from obstructions and shall be visually inspected from every manhole to ensure all lines exhibit a fully circular pattern. Lines that do not exhibit a true line and grade or have structural defects shall be corrected. Sanitary sewer service connections shall be visually inspected prior to back filling.

6.4 The Contractor shall furnish all materials, labor, and equipment to perform all testing to the satisfaction of the Construction Inspector. Water for testing purposes will be provided by the owner.

6.5 The low-pressure air testing shall be performed before all laterals or stubs are installed on the line and after the main has been backfilled to finish grade. Plugs shall be installed at each manhole to seal off the test section.

The line will be pressurized with a single hose and monitored by a separate hose connection from the plug. Air then shall be slowly introduced into the sealed line until the internal air pressure reaches 4.0 psi. The air pressure shall then be allowed to stabilize for a minimum of 2 minutes at no less than 3.5 (plus groundwater pressure, if any).

6.6 If the section fails to meet these requirements, the source of leakage shall be determined and repaired. The pipe section shall then retested and meet the specified requirements.

6.7 The Construction Inspector may require that an infiltration test be performed that shall not exceed 100 GPD/inch/mile.

END OF SECTION

SECTION 02723 – LOW PRESSURE SEWERS

1. LOW PRESSURE SEWERS

Pressure sewer systems are permitted in the Hickory Service Area on a case by case basis and approved by the Public Utilities Administration Department. These areas will be situated on severe rolling terrain where gravity service would require lift stations. Material and construction specifications and standard details for pressure sewer connections are included in this section.

2. MATERIAL SPECIFICATIONS

Unless superseded or modified by an amendment or special provision, all materials and their method of manufacture shall conform to these specifications. Reference to any National Material Standard shall be latest revision.

The City of Hickory or Engineer may waive certain material requirements on case specific requests. The contractor may request to substitute material that has been specified. The Engineer, in writing, may accept or reject requests.

3. PUMPS AND WETWELLS

All low pressure sewer systems shall be uniform throughout the development. No variation in pump head curves will be allowed. Pumps shall be grinder type or positive displacement pumps supplied per manufacturers recommendations. Wetwells will be supplied with a minimum of 120 gallon storage capacity above the operating level. A complete package shall be one containing a siphon valve (for down hill pumps), installed outlet plumbing, control panel with alarm in a NEMA 4 watertight enclosure and pre-wired wetwell enclosed in a NEMA 4 watertight enclosure. Pumps and wetwells shall be as manufactured by Environment One Corporation and Myers.

4. PIPING

All pressure sewer piping shall be DIP or PVC as specified below. All pressure sewer shall be marked with detectable tape to the edge of the road right-of-way, including forcemain service connections. Detectable tape shall be green or brown tape printed with sanitary sewer as produced by Lineguard Maintenance System. In lieu of detectable tape, non-metallic piping shall be traced with a copper wire along the length and detector tape placed above along the length.

4.1 DIP

All DIP furnished shall be CL 350, conforming to ANSI/AWWA C-151/A21.51 and shall have a cement mortar lining as specified in AWWAC-104. DIP shall have push-on joints in accordance with AWWA C-111.

4.2 PVC

All four, six and eight inch pressure sewer may be PVC 1120, furnished in accordance with AWWA C-900, and shall be CL150 with a SDR of 18 or less, unless specified different on the construction drawings. All three inch and smaller sewer mains may be PVC 1120 furnished in accordance with ASTM D-2241, shall be CL160 with a SDR of 26 or less. PVC pipe shall be made from materials whose cell classifications are CL1245A or CL1245B. Pipe shall be supplied in 20 foot lengths. Shorter lengths are acceptable in cases to meet proper placement of fittings, valves, etc. All PVC pipe shall be delivered and stored so as that ultraviolet radiation exposure is no more than four (4) weeks.

Pipe joining shall be "elastomeric gasket joints" conforming to ASTM D-3139. Pipe three inch and larger shall have integral bells. No sleeve couplings will be allowed.

PVC pipe shall be replaced by DIP whenever it crosses or is within 18" of a water main. The DIP shall extend not less than ten (10) feet on each side of the water main.

5. FITTINGS

All fittings for pipe four inch or larger shall be ductile or cast iron. All fittings three inch or smaller shall be solvent weld PVC.

5.1 DUCTILE OR CAST IRON FITTINGS

All iron fittings shall be CL 250, mechanical joint, in accordance with AWWA C-110 or CL 350 compact fittings in accordance with AWWA C-153. All fittings shall be furnished bell and bell unless specified different by engineer. Fittings shall be cement mortar lined in accordance with AWWA C-104.

5.2 PVC FITTINGS

All PVC fittings shall be Schedule 80 in accordance with ASTM D-2467 and solvent weld joints installed with ASTM D-2855.

6. VALVES

All valves shall be plug or ball valves as specified. Valve operation shall be open left.

6.1 PLUG VALVES

All valves shall be eccentric plug valves as follows:

6.2.1 Plug valves shall be non-lubricated, with a plug facing as specified by the manufacturer for the application and shall have stainless steel permanently lubricated upper and lower plug stem bearings. Valves shall be designed with adjustable seals which are replaceable without removing the bonnet. Bearing and seal areas shall be protected with grit seals. Port opening for all valves shall be no less than 81% of full pipe area. Twelve inch and smaller valves shall be pressure rated to 175 psi. Fourteen inch and larger valves shall be pressure rated to 150 psi. Shut offs shall be bi-directional.

Plug valves shall be as manufactured by Dezurik Corporation, Milliken Valve Company, Keystone Valve, or approved equal.

6.2.2 Four inches and larger or as specified shall have mechanical joint ends as per ANSI A21.11 for buried valves.

6.2.3 Three inches and smaller buried valves shall have Schedule 80 threaded ends and shall be connected to the main by Schedule 80 PVC threaded by socket adapters.

6.3 Buried plug valves shall have two inch operating nuts within 10 to 15 inches below finish grade.

6.3.1 All accessories shall be supplied as specified by manufacturer.

6.3.2 Buried plug valves shall be provided with adjustable valve boxes. Valve boxes shall be cast iron conforming to ASTM A-48, CL30. Valve boxes shall be Tyler 462A or approved equal.

6.4 THERMOPLASTIC BALL VALVES

Thermoplastic ball valves shall be used at each service connection and shall be made of PVC thermoplastic. Valves shall be furnished with Teflon seats and true union threaded ends. Thermoplastic ball valves shall be as manufactured by Heyward, Incorporated or approved equal.

6.4.1 THERMOPLASTIC BALL CHECK VALVES

Check valves shall be located and specified as above. The valves shall be furnished with elastomeric seats and true union threaded ends.

7. SERVICE BOXES AND LIDS

All service connections and cleanouts shall be placed in an appropriately sized box, as depicted in the standard details, and shall be as manufactured by Brooks Products Company (36 series) or approved equal.

7.1 Concrete boxes shall be made from a concrete of 1:2:1, cement to granite screening to 3/8" granite stone. Meter boxes shall be machine made and tamped with pneumatic tamps. Concrete shall be steam cured for 24 hours and yard cured for two (2) weeks.

All service connection boxes shall be made of green plastic and sized as in the standard details for thermoplastic material using structural foam as manufactured by Brooks Products Company (Series 1730). The plastic shall be uniform and suitable for outdoor, buried application. Plastic lids shall be furnished with "snap-lock" tabs and be imprinted with the words "pressure sewer" on the lid.

CONSTRUCTION SPECIFICATIONS

8. INSTALLATION OF PVC LOW PRESSURE PIPE

PVC pressure sewer main shall be installed substantially in accordance w/ the standard recommended practices for Underground Installation Of Flexible Thermoplastic sewer pipe ASTM D-2321.

8.1 INSTALLING VALVES AND FITTINGS

Valves and fittings shall be installed in the manner specified for cleaning, laying and jointing pipe. Valves shall be installed at locations shown on the plans and/or as directed by the Engineer.

9. VALVE BOXES

A valve box shall be installed at every buried plug valve. The valve box shall not transmit shock or stress to the valve and shall be centered and plumb over the operating nut with the box cover flush with the pavement or other existing surface. The valve box shall be bedded in stone and flush with the existing terrain. The location at the valve will be identified by the letters "P.S.V." imprinted onto the curb adjacent to the valve.

10. ALIGNMENT AND GRADE

Unless specifically approved by the Engineer, the curb be in place and backfilled, and the area between curb and street right of way line graded smooth and to finish grade before the pressure sewer mains are installed. Pressure sewer shall be placed on the opposite side of the road from H_2O and 3-5 feet behind curb where specified different by the Engineer in approved plans. Pressure sewer may be installed before curbing if a written request is made and approved by the Engineer and Public Utilities Administration and all comments are abided by. Installation before curbing will be field verified and deficiencies rectified at the contractor expense.

11. DEPTH OF PIPE INSTALLATION

Tap or pipe shall be 5.0 (min.) below the edge of adjacent roadways or 4.5' (min) below finish ground unless specified different by the Engineer or approved plans.

The Contractor may be required to vary the depth of pipe to achieve minimum clearances from existing utilities and maintain the above minimum cover requirements. Existing utilities spotting is responsibility of Contractor. PVC pressure sewer shall be installed with 18" clearance above or below existing utilities.

The test pressure will be 100 psi at the low point at the section under test.

Allowable leakage will be determined by Table 6, AWWA C-600 or by the formula:

L=.000083(S)D,

where S is the length of pipe under test and D is the pipe diameter. Add .0050 gal/1hr for each 1-1/2" lateral.

Finally, without reduction in pressure progressing from the end opposite the test pump, each mainline valve will be closed and pressure released to determine if the valve is holding pressure.

11.1 1.5" SERVICE CONNECTIONS

On 3- inch and smaller mains, the 1.5" laterals shall be connected to the street main with schedule 80 PVC solvent weld wyes. On 4-inch and larger mains, the 1.5 inch laterals shall be connected to the street main with a MJ tee plugged and tapped for a threaded by solvent weld schedule 80 PVC Adaptor. The 1.5" service lateral shall be completed to the property line where a service connection meter box shall be installed. The service connection shall contain the following fittings in accordance with the Standard Details, 45 degree solvent weld elbow, solvent weld nipple, solvent weld by threaded adapter, two true union threaded ball values, threaded 1.5" x 1.5" x 1.5" tee, threaded adapter, threaded nipple, true union ball check valve, threaded x solvent weld nipple. 1.5" x 1.25" solvent weld reducing bushing and a brass .75" hose bib placed on top of the 1.5" tee.

11.2 PARTIAL SERVICE CONNECTIONS

Partial service connections shall be installed according to the Standard Details at the locations indicated on the Plans. The location for this future service connection stub-out shall be marked by cutting an "S" on the curb above the service. Also, a PVC encapsulated magnet shall be attached near the valve and cap for magnetic locating purposes.

12. DESIGN OF PRESSURE SEWER SYSTEMS

The developer shall have all pressure sewers designed by a professional engineer licensed in North Carolina. The Engineer shall submit preliminary design and calculations to Public Utilities Administration for review before initiating final design. All head and pressure calculations shall be submitted in tabular form for each branch. In addition to drawings and specifications, the developer shall include a design memorandum detailing the design procedures used for the pressure sewer system. The design memorandum shall include:

12.1 Hydraulic calculations demonstrating that the total dynamic head (TDH) does not exceed 100 feet at any existing or potential grinder pump location.

12.2 Profiles of all pressure sewer lines demonstrating that the system will be under positive pressure sewer lines demonstrating that the system will be under positive pressure at all time. Specifically, the discharge elevation shall be above all intervening high points.

12.3 Calculations indicating determination of pressure main sizing. Initial pipeline sizing shall be based on providing a minimum of 3.0 foot per second (fps) velocity at a discharge calculated according to the following equation:

$$Q \text{ (in gpm)} = 15 + 0.5D$$

where: D = The number of dwelling units upstream of the reach under investigation.

12.4 Calculation of final pipe size may be adjusted based on evidence from hydraulic calculations, provided that such calculations indicate that a minimum of 2.0 fps can be achieved in all lines with no more than 5% (or minimum of 2) pumps operating simultaneously through the line under determination.

12.5 Determination of Hazen-Williams coefficient. A Hazen-Williams coefficient, C, of 140 to 150 may be used, provided that if C=150, the nominal pipe size only may be used, and an allowance for minor losses associated with fittings should be included in the hydraulic calculations.

12.6 Calculation of Impeller Diameters for each pump. The impeller diameter of individual pumps in a system with varying pump elevations shall be sized such that full size impellers are used at pumps at the lowest elevations, and reduced size impellers are used at higher pumps such that the total TDH of any one pump is within 20% of all other pumps.

12.7 Calculations of the maximum flow discharged from the pressure sewer system with all pumps operating. This condition will be experienced upon restoration of power following a system wide power outage. If the maximum flow calculated, including other pressure sewers, exceeds the rated maximum pumping capacity of any downstream pump stations, the discharge shall be into a gravity sewer of sufficient diameter and length to provide 150 gallons of storage capacity per grinder pump within the gravity pipeline. All gravity sanitary sewers shall be constructed in accordance with the Requirements and Specifications for Sanitary Sewer Construction.

12.8 Private pressure sewers shall connect to the City of Hickory maintained system at a stub from the property line side of the dual ball valve/check valve assembly according to the service connection Standard Details (See Pressure Sewer Material Specifications).

12.9 Engineers must submit a copy of all preliminary design calculations to the City of Hickory Public Utilities Administration before plans and specifications are submitted.

12.10 Owners/Developers shall include a list of possible licensed plumber's who may be contracted to maintain the internal network, pump assemblies, and appurtenances. A contracted licensed plumber will be required for service.

END OF SECTION

SECTION 2900 – RESTORATION OF SURFACES

1.1 INTRODUCTION

The scope of this section is to furnish all labor, equipment and materials necessary for the proper restoration of existing surfaces disturbed or damaged as a result of any construction activity not specifically detailed for other landscaping or restoration in any other part of this specification. Any damage to existing surfaces or structures shall be restored to original condition or better using like materials and workmanship to the original.

1.2 INSTALLATION

All pervious surfaces shall be dressed smooth and seeded in strict accordance with the section of these specifications entitled Seeding and Landscaping. Shoulders of all roads shall be restored as specified for lawns. Wooded areas or fields shall be restored raked smooth and seeded as specified in the section entitled Seeding and Landscaping.

A. Ditches:

Ditches shall be regarded to the original grade or such grade that flow is maintained to prevent ponding or standing water. If the grade must be altered, the Engineer shall approve the final grade and all adjacent slope grades with the Contractor performing the work as directed by the Engineer. The surface of all ditches shall be returned to the same condition as found before commencing work. The unit price for this work shall be encumbered in pipeline installation prices.

B. Concrete Walks:

Concrete walks removed or damaged as a part of the construction operation shall be replaced with new Class B concrete formed and poured in place and installed to match the original line, grade and general appearance of the existing walk. Concrete shall be poured to match the original walk thickness, but not less than 4” thick, over a thoroughly compacted and leveled sub grade. Walks shall be float finished, edged with an edging tool and grooved at intervals to match the existing walk, or at intervals not exceeding the width, uniform throughout the length of the replacement measured in one direction. This work shall be paid at unit price.

C. Driveways

Concrete drives removed or damaged as a part of the construction operation shall be replaced with new Class B concrete formed and poured in place and installed to match the original line, grade and general appearance of the existing drive. Concrete drives shall be poured the same thickness of the original drive, but not less than 4” thick, and shall contain reinforcing steel, mating, etc. to match the original drive. Prior to placing the concrete a 4” aggregate base course shall be placed in the drive area and leveled. The Contractor shall be responsible for coordinating restoration with property owner and allowing for curing time.

Bitumous or Asphaltic concrete drives shall be restored to the original base and asphalt thickness. As a minimum, all bitumous or asphaltic concrete drives shall consist of 6" base course and 2" surface material. Base material shall be thoroughly compacted and leveled to provide the appropriate depth of support and surface material shall be compacted in 2" lifts and topped with the appropriate depth to match the existing surface grade. All work done under this provision shall be performed in accordance with the section entitled Bituminous pavement Repairs. The Contractor shall be responsible for coordinating restoration activities with the property owners.

All unpaved drives shall be surfaced with not less than 4" of Crusher-run gravel and topped with similar surface material as the existing drive. The final drive shall consist of the 4" base and not less than 3" of surface material to match the existing drive. All unpaved drives shall be restored to a condition better than the original when encountered.

All drives shall be temporarily replaced with 4" of Crusher-run installed level with the existing drive surface and maintained until such time as the permanent drive can be restored. Restoration should not take more than three weeks without approval from the Engineer/Owner.

D. Roadway Replacement

Bituminous or Asphaltic pavements shall include all areas paved with blacktop; built-up pavements, oil and stone, tar and stone or any similar pavements constructed with a bituminous or asphalt and stone material.

Immediately upon completion of installation of underground piping and structures, the trench shall be backfilled and compacted to specification and roadway shall be repaired. The excavated area shall be restored to match the original material. In the case of tar and stone, oil and stone or other unprocurable material the repair shall consist of asphalt repair. The repair shall consist of a 12" aggregate base course, and a 4" surface course as defined in the specification entitled Bituminous Pavement Repairs. If Engineer deems appropriate then the Contractor may be allowed to surface treat damaged pavements outside of the excavation without removal of existing surface and base courses by overlaying the area in question and matching back to the existing surface.

Portland cement concrete road surfaces shall be replaced with Class B concrete and shall have equal thickness and reinforcing steel as the original roadway. Prior to placing concrete an aggregate base course of 6" thickness shall be placed and compacted.

The Contractor shall repair or replace any and all traffic markings damaged, removed or covered during construction. All existing manholes or valve covers shall be raised to finished grade prior to paving to prevent covering of existing infrastructure. The Contractor shall include this work as a part of the project and shall not seek additional compensation outside of the original unit prices. All such inquiries shall be requested and approved by the Engineer.

All differential settlement shall be corrected immediately as directed by the Engineer and the Engineer shall approve corrections.

All work under this category shall be performed in accordance with NCDOT Standards and shall be subject to inspection by the local representative for conformance with the requirements and specifications.

E. Lawns and Landscaped Areas

All lawns and disturbed area shall be regarded to match the existing grade prior to construction. Lawns, as previously defined, shall be graded, seeded and fertilized in strict conformance with the section of this specification entitled Seeding and Landscaping. Top soiled areas shall be replaced with topsoil of equal or better quality and quantity.

All shrubs, hedges, ornamental trees, flower or other items constituting landscaping shall be replaced to the original condition with the same items as removed or similar materials at property owner's approval.

F. Curb and Gutter

Curb and gutter sections removed, damaged, destroyed or otherwise impacted by the construction operation, Contractor or his agents shall be replaced with new Class B concrete to a condition matching or similar to that existing before construction activities. If curb and gutter cannot be matched exactly to the original condition, the Engineer shall approve alteration.

G. Damage to any Structure

All damage to existing structures shall be repaired by materials and workmanship equal to the original construction. At the direction of the Engineer, sufficiently damaged structures may require total replacement to the extent deemed appropriate by the Engineer. The Engineer shall approve all such replacements and unless otherwise noted separate payment for the repair or replacement will not be allowed.

END SECTION

SECTION 2930 – SEEDING AND LANDSCAPING

1.1 INTRODUCTION

This section covers the furnishing of all labor, equipment, material and any other items necessary for landscaping of all areas of the site disturbed by construction operations and all earth surfaces of embankments including rough and fine grading, topsoil if required, fertilizer, lime, seeding and mulching. The Contractor shall adapt his operations to variations in weather or soil conditions as necessary for successful establishment and growth of grasses or legumes.

1.2 CATALOG CUT SUBMITTALS

Contractor shall submit 4 copies of catalog cuts to Engineer for review for all materials that are required to complete the work as described in the associated plans. Engineer will retain tow sets of original submittals and return two sets to the Contractor with the appropriate response annotated.

1.3 STORAGE AND HANDLING

Contractor shall take all prudent and customary measures to ensure that all materials stay moisture free and are not degradated by storage or handling. All lime and fertilizer shall be kept free from hardening or caking and if this occurs they shall be pulverized to their original state. All seed shall be further protected such that it is not subjected to heat or rodents. If degradation occurs and the materials no longer hold the mineral values advertised then they shall be removed from the site and new materials applied.

1.4 MATERIALS

A. Lime

The quality of lime and all operations in connection with the furnishing of this material shall comply with the requirements of the North Carolina Lime Law and regulations adopted by the NC- Board of Agriculture.

Lime shall be agriculture grade ground dolomite limestone. It shall contain not less than 85% of the calcium and magnesium carbonates and shall be of such fineness that at least 90% will pass a No. 10 sieve and at least 50% will pass a No. 100 sieve.

B. Fertilizer

The quality of fertilizer and all operations in connection with the furnishing of this material shall comply with the requirements of the North Carolina Fertilizer Law and regulations adopted by the NC- Board of Agriculture.

Fertilizer shall be 10-10-10 grades. Upon written approval of the Engineer a different grade of fertilizer may be used, provided the rate of application is adjusted to provide the same amounts of plant food.

C. Seed

The quality of seed and all operations in connection with the furnishing of this material shall comply with the requirements of the North Carolina Seed Law and regulations adopted by the NC- Board of Agriculture.

The NC-Dept. of Agriculture shall have approved seed or any agency approved by the Engineer before being sown, and no seed will be accepted with the date of test more than 9 months prior to the date of sowing. Such testing does not relieve the Contractor from responsibility for furnishing and sowing seed that meets these specifications at the time of sowing. When a low percentage of germination causes the quality of seed to fall below the minimum pure live seed specified, the Contractor may elect, subject to approval of the Engineer, to increase the rate of seeding sufficiently to obtain the minimum pure live seed contents specified, provided that such an increase in seeding does not cause the quantity of noxious weed seed per square yard to exceed the quantity that would be allowable at the regular rate of seed.

Seed shall be entirely free from bulbets or seed of Johnson Grass, Nutgrass, Sandbur, Wild Onion, Wild Garlic and Bermuda Grass. The specifications for restricted noxious weed seed refers to the number per pound, singly or collectively, of Blessed Thistle, Wild Radish, Canada Thistle, Corncockel, Field Bindweed, Quackgrass, Dodders, Dock, Horsenettle, Bracted Plantain, Buckhorn or Wild Mustard; but in no case shall the number of Blessed Thistle or Wild Radish exceed 27 seeds of each per pound.

D. Mulch

Straw shall be free of weed seed or any other species, which would be detrimental or deterring to specified grass maturation. Straw shall be from oat, rye or wheat species and threshed to limit seed content.

E. Tack

Emulsified asphalt or organic tack shall be applied uniformly over straw so as to ensure proper hold and give uniform appearance over the entire area. Tack shall be applied by spraying onto surface immediately after applying straw. Application rates will vary dependent upon conditions. Organic tack shall be used when the ambient temperature is below freezing

1.5 PREPERATION

A. Protection of Existing Vegetation

The Contractor shall not remove or damage vegetation, which is outside the Clearing Limits established by the Owner/Engineer or as displayed on the plans. All trees that are damaged and scheduled to remain shall be repaired in an acceptable manner promptly to prevent progressive deteriation. Vegetation which is scheduled to be replaced or is damaged beyond repair during construction operations shall be replaced with a similar size and species. Where this is not feasible the property owner shall be compensated for the vegetation damaged. Damage incurred during construction operations and due to insufficient protection shall be paid at the Contractors expense.

Existing vegetation not indicated for removal shall be protected against unnecessary cutting, breaking or skinning of roots, skinning or bruising of bark or smothering of vegetation by placing stockpiles of excavated material against the trunk or excessively over roots within the drip line. Vegetation shall also be protected against excessive vehicle or foot traffic within the drip line.

Roots cut during excavation shall be properly protected by either asphalt sealing or in some cases wrapping exposed roots in wet burlap to prevent drying.

B. Grading

Rough grading of the area shall be achieved as soon as the excavated area is backfilled and compacted. Rough grading shall be defined as all material restored which is required to bring the area to finish grade and acceptable surface drainage for storm water which provides for water to flow from the site in such a manner as that it does not place unusual risk to unsuspecting users of adjacent areas or inhabitants.

Fine grading of the area shall be achieved in a timely manner after completion of rough grading of the area. Fine grading shall consist of shaping final contours to ensure proper drainage and removing all debris or construction waste materials to provide an acceptable appearance. Construction area subject to finish grading shall have soil loosened to a depth of not less than 6 inches in a manner approved by the Engineer to promote seed growth. All finish landscaping shall be completed on a section-by-section basis where it is reasonable to expect completion of landscaping.

All grading, landscaping, and erosion control measures shall be properly pursued and maintained in order to maintain and acceptable appearance of the project. If such time occurs as this perception is degraded then the Engineer may suspend progress on the project until the issues are appropriately addressed.

C. Surface and Bed Preparation

The Contractor shall smooth or shape surface contours outside the project site when such contours are detrimental to the seedbed preparation or will pose foreseeable problems with future maintenance of the area. The Engineer shall direct the Contractor to what extent outside areas shall be affected or the Contractor may elect to work with individual property owners with written verification delivered to the Engineer/Owner of the agreement with the property owner's signature.

1.c Level Areas and Slopes Less than 2:1

The construction area shall have soil loosened to a depth not less than 6 inches and shall be free from all debris, clods and all other irregularities which would prohibit a smooth, shaped finish grade. Top 3 inches of soil shall be worked to a clod free finish suitable for planting seed.

2.c Slopes Greater Than 2:1

The construction area shall have soil loosened and acceptable for vegetation growth but the surface shall be free from all debris, clods and other irregularities. The surface may be track finished, scarified, grooved or punctured so as to provide a place for seed and other planting material to lodge. In the case of such slopes the Engineer may allow partial completion of the slope sections at different times to promote stabilization. If the vegetation growth is acceptable the Engineer may allow this to remain as the permanent ground cover.

The Contractor shall not pursue the finished preparation of surface areas to be landscaped if the soil is frozen, marginally wet or when the Engineer deems it unsuitable for working conditions.

D. Rate of Application

Seed shall be applied by means of Broadcast Spreader, Hydro-Seeder or other previously approved method. In no case shall seed, lime, or fertilizer be spread by hand. The rates of application for seed, lime and fertilizer shall be as follows, unless a variance is permitted by the Engineer in writing prior to performing work.

1.d Limestone

In the absence of a soil test performed at the Contractors expense and given to the Engineer on letterhead from the testing laboratory, Limestone shall be applied at the rate of 2000 lb/ acre.

2.d Fertilizer

In the absence of a soil test performed at the Contractors expense and given to the Engineer on letterhead from the testing laboratory, Fertilizer shall be applied at the rate of 1000 lb/ acre. Fertilizer shall be 10-10-10 grade, unless a variance is permitted by the Engineer in writing prior to performing work. A second application at 500-lb/ acre shall be applied to the area when the grass has reached a blade height of 3 inches or 45 days which ever comes first.

3.d Seed

The type and rate of application shall vary at different times of the year and shall be applied at the rate and type appropriate for the time of year. All rates of application are measured in pounds per acre.

a. Fall and Winter (Sept. 1 to May 1)
85 pounds of Ky-31 tall fescue mixed with 15 pounds of rye grain.

b. Spring and Summer (May 1 to September 1)
100 pounds of Ky-31 tall fescue mixed with 10 pounds of rye grain.

c. Cut of Fill slopes greater than 2:1
The application rate on cut or fill slopes greater than 2:1 shall include the appropriate mix above for the time of year along with; 40 lb/acre of sericea lespedeza (hulled in spring or summer and unhulled in fall and winter) and either15 pounds of Sudan grass in spring and summer or 25 pounds of rye cereal per acre in fall and winter.

4.d Mulch

Mulch shall be straw mulch applied at a rate of approximately 3000 pounds per acre. Straw shall be applied at such rate necessary to thoroughly cover and protect all finish grading, seed, lime and fertilizer but not smoother the maturation of seed.

E. Application

Application of all limestone, fertilizer, seed and mulch shall be completed immediately following final preparation of the seed bed and shall not be pursued during a time when the Engineer deems weather to be non-conducive for seed growth, i.e. ground wet, frozen, etc. Lime, fertilizer and seed shall be distributed uniformly over the prepared seedbed at the specific rate of application and then harrowed, raked, or otherwise thoroughly worked or mixed into the seedbed. Immediately following the covering operation, the seedbed shall be properly compacted as directed in the manner and degree approved by the Engineer.

When a hydraulic seeder is used for application of seed and fertilizer, the seed shall not remain in water containing fertilizer for more than 1 hour prior to application unless otherwise permitted by the Engineer.

The Engineer may permit modifications to the requirements for covering or compacting lime, fertilizer and seed in the prepared seedbed if the Contractor requests modification due to height, steepness of slope or non-conducive soil conditions. Modifications may be considered if the case of: Slopes greater than 2:1 and Slopes where surface is to rocky to successfully permit compaction or covering of the seedbed. Modifications may be permitted to include reduction of application rates and reduction or elimination of compaction requirements.

All equipment normal and prudent for the preparation of seedbed and uniform distribution of lime, fertilizer and seed shall be approved by the Engineer prior to use on the project. In the event of malfunctioning or improperly maintained equipment, the Engineer reserves the right to suspend work on the project until such time as the equipment is restored to good repair and properly operational.

F. Mulching

Mulch shall be spread uniformly over all seeded areas at a rate of 1 ½ to 2 tons per acre in a continuous, uniform blanket. Mulch shall be spread by hand or by approved mechanical shredder or blower which will provide a uniform blanket. An acceptable application shall be one that completely covers the ground but still allows some sunlight to penetrate and air to circulate while providing effective soil moisture conservation and reduced erosion. Mulching operation shall be pursued immediately following final seedbed preparation.

Tack or other approved binding material shall be applied over top of mulch in all necessary areas to ensure mulch will be held in place during adverse conditions. The rate and method of application shall be completed as directed by the Engineer.

The Contractor shall implement sufficient precautions to prevent mulch from entering drainage structures through displacement by wind, water or other causes. The Contractor shall remove completely any blockage to drainage structures, which may occur.

G. Maintenance

Grassed areas shall be accepted when a 95% cover of permanent grasses is achieved and weeds are not the dominant foliage. The Contractor shall keep all grassed areas in good condition, reseeding and mowing if and when necessary as directed by the Engineer. A good lawn shall be established over the entire project area and shall be maintained by the Contractor in an approved manner and kept in an approved condition until final acceptance.

The Contractor shall protect against washouts on slopes and ditch sections by a manner approved by the Engineer. Any damage or failure due to any cause shall be corrected by being either repaired or completely redone as may be directed by the Engineer. Areas of damage or failure resulting either from negligence on the part of the Contractor in performing construction operations or from not taking sufficient precautions to control erosion and silt as required throughout the various sections of the specifications, shall be repaired by the Contractor as directed by the Engineer at no cost to the Owner.

End of Section