

TN DEPT OF ENVIRONMENT
AND CONSERVATION
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**STANDARD SEWER
SPECIFICATIONS AND DETAILS
FOR
SANITARY SEWER SYSTEM**

**CITY OF GATLINBURG,
TENNESSEE**



WPC14 - 0780

SEWER ONLY

WPC14-0780

**STANDARD SEWER
SPECIFICATIONS AND DETAILS
FOR
SANITARY SEWER SYSTEM

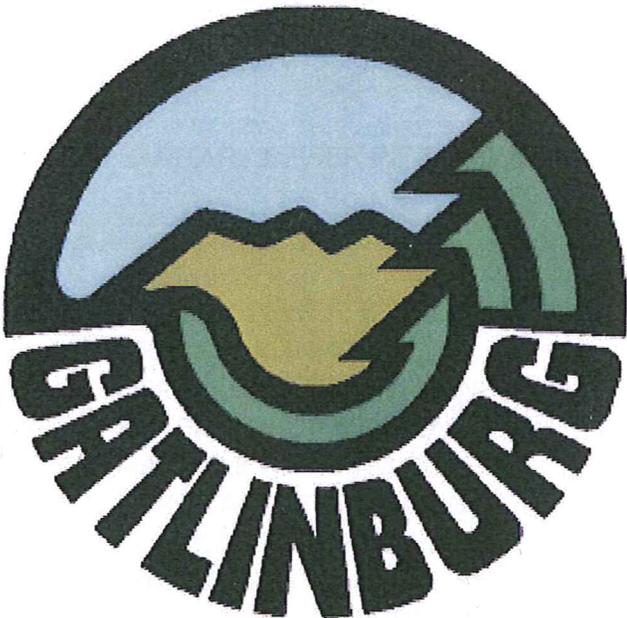
CITY OF GATLINBURG,
TENNESSEE**

APPROVED FOR CONSTRUCTION
THE DOCUMENT BEARING THIS STAMP HAS BEEN RECEIVED AND REVIEWED BY THE
TENNESSEE DEPT. OF ENVIRONMENT & CONSERVATION
DIVISION OF WATER POLLUTION CONTROL
AND IS HEREBY APPROVED FOR CONSTRUCTION BY THE COMMISSIONER

NOV 06 2014

THIS APPROVAL SHALL NOT BE CONSTRUED AS CREATING A PRESUMPTION OF COR-
RECT OPERATION OR AS WARRANTING BY THE COMMISSIONER THAT THE APPROVED
FACILITIES WILL REACH THE DESIGNED GOALS
FOR THE COMMISSIONER

BY *Adna Baha*



**City of Gatlinburg
Gatlinburg Utility Department
405 Reagan Drive Gatlinburg, TN 37738.**

APPROVAL EXPIRES
NOV 06 2017
TN. DEPT. OF ENVIRONMENT & CONSERVATION
DIVISION OF WATER POLLUTION CONTROL



Revised October, 2014

CITY OF GATLINBURG, TENNESSEE
STANDARD SEWER SPECIFICATIONS
AND DETAILS FOR SANITARY SEWER SYSTEM

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SECTION 01200 SPECIAL CONDITIONS FOR DEVELOPMENT

PART 1: GENERAL

1.01 SCOPE OF THESE SPECIFICATIONS

A. INTENT

It is the intent of these Specifications to provide the minimum acceptable standards for materials, equipment, and design parameters for furnishing and installation of various components for the City of Gatlinburg Sewer System. These components include, but are not limited to, gravity sewer lines, manholes, service connections and lines, pumping stations, grinder pumps, force mains, odor control facilities, meters and telemetry, and other special structures, equipment, materials, and appurtenances required for a complete and operable system and restoration of surfaces.

In addition to the Special Conditions for Development of this Section, the Specifications include a section of Detailed Specifications for Sanitary Sewer System Construction with various subsections and component detail sheets.

B. REGULATORY REQUIREMENTS

It is the intent that all sanitary sewerage works to be included in and serviced by the City's Sanitary Sewer System be done in compliance with applicable and current City, State, County, and Federal acts, regulations, and/or guidelines. These acts, regulations, and guidelines include, but are not limited to:

1. City Special Conditions for Development, Standard Specifications, and Details for Sanitary Sewer System Construction; (This document.)
2. City Sewer Use Ordinance;
3. City Sewer Rate Ordinance;
4. City Developer's Agreement;
5. Occupational Safety and Health Act – P.L. 91-596;
6. Contract Work Hours and Safety Standards Act – P.L. 91-54;



7. Tennessee Department of Environment and Conservation, Division of Water Resources, "Tennessee Design Criteria," current edition;
8. Tennessee Department of Environment and Conservation "Guidelines for Erosion and Sediment Control" as promulgated by the current edition of the Tennessee Erosion and Sediment Control Handbook; and
9. City "Permit-Required Confined Spaces Entry Policy."

It is not the intention of these Specifications to conflict with these acts, regulations, or guidelines in any way, and where conflicts may arise, the acts, regulations, or guidelines shall govern. Requirements by the Specifications that are more stringent than those of the acts, regulations, or guidelines shall not be considered conflicts.

The City does not assume responsibility for enforcing County, State, or Federal acts, regulations, or guidelines and will not be considered in charge of or responsible for acts of the Contractor, methods of construction, construction progress, construction forces or equipment, or safety procedures.

1.02 SYSTEM DESIGN AND REVIEW REQUIREMENTS

A. PRELIMINARY ENGINEERING STUDY

1. The City's Sewer System is predominantly composed of standard gravity sewers. Because of the capacity of the System, a Preliminary Engineering Study is required for any significant additions to the System. Any Customer or Developer proposing to connect to the system shall contact the City and perform a study for their proposed project.
2. The Developer shall include the basic information in the study, including, but not limited to:
 - a. project location,
 - b. general layout,
 - c. number of customers,
 - d. required capacity, and
 - e. possible future expansions.



3. The Developer shall submit two (2) copies of the Preliminary Engineering Study and any preliminary drawings to the Utility Manager for review. The study will assist the City in determining if service is feasible, the type of system that will be required, and the size and location of the connection to the City's system.
4. The requirement for the Preliminary Engineering Study may be waived at the City's discretion for short line extensions or service connections to existing lines.

B. DESIGN AND PERMITTING REQUIREMENTS

Following the Engineering Study, the Developer, at his own expense, shall have the system designed by a Tennessee-licensed Professional Engineer qualified to design the type system required.

1. The Plans and Specifications shall be submitted to the City for review and approval.
2. After receiving the City's approval, the Developer shall submit Plans and Specifications to the Tennessee Division of Water Resources for review. Review fees required by the Division of Water Resources will be paid by the customer or Developer. Two (2) copies of the Plans and Specifications stamped "Approved" by the Division of Water Resources shall be provided to the City before construction on the project is begun.
3. In general, proposed sewer collection systems shall be designed in accordance with TDEC Division of Water Resources Guidelines, with specific attention paid to the following:
 - a. Gravity sewer manholes shall be designed and installed no more than three hundred feet (300') apart.
 - b. Force mains shall be designed and installed with a minimum of thirty inches (30") of cover after the area has been brought to final grade.



1.03 **CONSTRUCTION PHASE**

A. PRE-CONSTRUCTION CONFERENCE

1. The Developer shall notify the City at least forty-eight (48) hours in advance to schedule the pre-construction conference.
2. The conference shall include representatives of the Developer, the Contractor, City, and all other utilities having an interest in the project. The conference location will be decided by the City.
3. The roles, responsibilities, and authority of the various parties shall be defined and discussed. Other subjects regarding the project may be covered at the pre-construction conference.
4. At the conclusion of the conference, a "Notice to Proceed" may be issued with the concurrence of the City. No work on the sewer system shall be performed prior to the pre-construction conference.
Note: Submittals shall be submitted a minimum of five (5) days before the pre-construction conference.

B. CONSTRUCTION INSPECTION

1. City will provide an inspector on municipal sewer system construction to determine if the installation complies with the requirements of the approved Plans and Specifications. The Other duties of the inspector may include, but not be limited to, witnessing tests, inspecting material and equipment incorporated into the work, and reporting project progress and status to the Developer and the City. It is the Contractor/Developer's responsibility to maintain project records and prepare field record drawings. The City will not supervise or direct the work of the Contractor/Developer.
2. The City requires third-party inspections and documentation for construction of privately owned sewer systems. The City maintains the option of inspecting installation of privately owned sewer system components to determine regulatory compliance.



C. CONTRACTOR

All sewer system construction activities to be performed for the City Sewer System shall be installed by a fully bonded and insured General Contractor (with Utilities License), properly licensed in the State of Tennessee to perform the type of work required by the project.

D. RECORD DRAWINGS

Upon completion of the project, a set of Record Drawings showing any deviations from the Approved Plans and Specifications, location and depth of all service connections, and other pertinent construction or field data shall be provided to the City in PDF format and any existing CADD and/or GIS files.

E. START-UP OF FACILITIES

1. No sewage shall be discharged into the City Sewer System without prior written authorization by the City. At the City's discrimination, individual line segments or parts of a total project may be allowed to connect to the system, provided the segments or partial sections have been successfully tested, inspected, and approved by the City.
2. Pumping, metering, and other facilities utilizing mechanical equipment shall not be started up until:
 - a. Two (2) bound copies of shop drawings and operation and maintenance manuals have been turned over to the City;
 - b. Electrical and any other required codes inspections have been completed and approved;
 - c. The installation of the facility has been inspected and start-up authorized by the City; and
 - d. Start-up services of a factory-authorized technician have been scheduled.
3. The initial start-up of the facility shall be performed by the factory-authorized technician in the presence of representatives of the Contractor and the City.



- a. As part of the start-up service, the technician shall train and instruct the City's operating and maintenance personnel in the proper operation and maintenance of the facility.
 - b. The Developer or Contractor shall provide sufficient service time to start-up and adjust the facility and to instruct and train the City's personnel.
 - c. The factory-authorized technician shall submit a written start-up report certifying that the equipment has been properly installed, is operating satisfactorily, and that the City personnel have been trained and instructed in the operation and maintenance of the facility.
- 4 For pump stations, vacuum/pump stations, metering facilities and other mechanical facilities, a thirty (30)-day "trial run" period shall be in effect following the initial start-up, during which the Developer/Contractor shall make necessary adjustments, verify that equipment meets performance requirements, and provide additional operation and maintenance instructions to the City's personnel. The City will transfer the necessary utilities for these facilities at the end of the thirty (30)-day trial run.

F. WARRANTY

1. The Developer will provide the City a maintenance bond guaranteeing the work. As a minimum, all sewerage facilities will be guaranteed by the Developer for a period of twelve (12) months against defects in material and workmanship from the written date of acceptance by the City.
2. If certain segments or facilities are accepted and put into service before a total project is completed, the warranty for those segments or facilities will begin upon written acceptance by the City. Providing the equipment meets required performance requirements and the facility is operating properly at the end of the thirty (30)-day "trial run," the City will accept the facility and the twelve (12)-month warranty period will start. This beginning date for



the twelve (12)-month warranty period shall supersede any limitations on the warranty period by the manufacturer or supplier. If the equipment does not meet the performance requirements at the end of the thirty (30)-day "trial run," the beginning of the warranty period will be delayed until the performance requirements are met.

3. In certain instances, extended or graduated warranties may be required for specific pieces of equipment or material. Any such extended or graduated warranties specified or provided by the manufacturer shall accrue to the City upon acceptance of the equipment or material.

G. PROGRESS MEETINGS

1. The Contractor and any subcontractors, material suppliers, or vendors whose presence is necessary or requested shall attend meetings, referred to as Progress Meetings, when requested by the City or his representative for the purpose of discussing the execution of work.
2. Each meeting will be held at the time and place designated by the City or his representative. These meetings shall be binding and conclusive on the Contractor/Developer and such decisions, instructions, and interpretations shall be confirmed in writing by the City or his representative.
3. The proceedings of these meetings will be recorded, and the Contractor/Developer will be furnished with a reasonable number of copies for his use and for his distribution to the subcontractors, material suppliers, and vendors involved.

1.04 SUBMITTALS

A. GENERAL

All transmittals from the Contractor/Developer shall be accompanied by a transmittal cover form that includes pertinent information related to the project and the particular transmittal. The Contractor/Developer shall use the "Transmittal Form"



provided at the end of this section or a similar form that includes the required information.

B. CONSTRUCTION SCHEDULE

The Contractor/Developer shall prepare and submit to the City a practicable construction schedule showing the order in which the Contractor/Developer proposes to carry on the work, the date on which he will start the several salient features, and the contemplated dates for completing such salient features. The schedule may be in any form, at the option of the Contractor, and contain at least the following information:

1. The various classes and areas of work, broken down into times projected for submittals, approvals, and procurement; times for installation and erection; and times for testing and inspection;
2. The work completed and the work remaining to complete the project; and
3. Any items of work that will delay the start or completion of other major items of work so as to delay completion of the whole project.

C. MATERIAL SUPPLIERS AND SUBCONTRACTOR LISTINGS

The Contractor/Developer shall supply the names and addresses of all major material suppliers and subcontractors to the City.

D. SHOP DRAWINGS AND SAMPLES

The Contractual requirements for shop drawings and samples are specified below and in the individual Specification Sections for each item. The Contractor/Developer shall submit shop drawings and samples accompanied by the "Submittal and Routing Form" included at the end of this section a minimum of five (5) days prior to the pre-construction conference. Resubmissions, where required, shall be in accordance with the procedures established for the initial submittal.

Submittals required by the City are identified in the individual Specification Sections for each item.



1. Shop Drawings

The data shown on the shop drawings will be complete with respect to quantities, dimensions, specified performance and design criteria, materials, and similar data to show City the services, materials, and equipment Contractor/Developer proposes to provide and to enable City to review the information for the purposes stated below.

2. Samples

Each sample required shall be identified clearly as to material, Supplier, pertinent data such as catalog numbers, and the use for which the material is intended. City review of submittals is required for the purposes stated below.

3. Where a shop drawing or sample is required by the Specifications, any related work performed prior to the City's review and approval of the pertinent submittal will be at the sole expense and responsibility of the Contractor/Developer.

4. Submittal Procedures

a. Before submitting each shop drawing or sample, Contractor/Developer shall have determined and verified:

i. All field measurements, quantities, dimensions, specified performance criteria, installation requirements, materials, catalog numbers, and similar information with respect thereto;

ii. All materials with respect to intended use, fabrication, shipping, handling, storage, assembly, and installation pertaining to the performance of the Work; and

iii. All information relative to means, methods, techniques, sequences, and procedures of construction and safety precautions and programs incident thereto.



- b. Contractor/Developer shall also have reviewed and coordinated each shop drawing or sample with other shop drawings and samples and with the requirements of the Work and the Specifications.
- c. Each submittal shall bear a stamp or specific written indication that Contractor/Developer has satisfied his obligations under the Specifications with respect to Contractor/Developer's review and approval of that submittal.
- d. At the time of each submittal, Contractor/Developer shall give city specific written notice of such variations, if any, that the shop drawing or sample submitted may have from the requirements of the Specifications, such notice to be in a written communication separate from the submittal; and, in addition, shall cause a specific notation to be made on each shop drawing and sample submitted to City for review and approval of each such variation.

5. City's Review

- a. City will perform review in a timely fashion.
- b. City's review and approval will be only to determine if the items covered by the submittals will, after installation or incorporation in the work, conform to the information found in the Specifications and Drawings and be compatible with the design concept of the completed Project as a functioning whole as indicated by the Specifications and Drawings.
- c. City's review and approval will not extend to means, methods, techniques, procedure of construction, or safety precautions or programs incident thereto except where expressly called for in the Specifications. The review and approval of a separate item as such will not indicate approval of the assembly in which the item functions.



- d. City's review and approval of shop drawings or samples shall not relieve Contractor/Developer from responsibility for any variation from the requirements of the Specifications and Drawings unless Contractor/Developer has in writing called City's attention to each such variation at the time of each submittal, and City has given written approval of each such variation by specific written notation thereof incorporated in or accompanying the shop drawing or sample approval; nor will any approval by City relieve Contractor/Developer from responsibility required within these Specifications.

6. Resubmittal Procedures

Contractor/Developer shall make corrections required by City and shall return the required number of corrected copies of shop drawings and submit as required new samples for review and approval. Contractor/Developer shall direct specific attention in writing to revisions other than the corrections called for by City on previous submittals.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. The Contractor/Developer shall be responsible for delivery, storage, and handling of all materials and equipment, unless otherwise noted. All material and equipment shall be shipped to arrive at the job site on the dates indicated on the purchase order. The following information shall be supplied:
 - 1. The contents, bill of lading, and number of shipments;
 - 2. The method of shipments;
 - 3. The date of shipment; and
 - 4. The name of the construction project.
- B. Prior to shipment, all items shall be properly prepared to protect all critical areas from the effects of weather, normal expected transport, and on-site handling.
- C. Items shall be tagged and marked with equipment and/or motor numbers as per the manner stipulated in the purchase order.



- D. All spare parts and expendable supplies shall be properly crated, marked, and shipped to the job site on the date specified.

PART 2: PRODUCTS

2.01 EQUIPMENT AND MATERIAL STANDARDS

All equipment and materials of construction described in this Specification shall meet the more stringent requirements of the applicable codes listed below:

- A. OSHA - Occupational Safety and Health Administration;
- B. ASTM - American Society for Testing Materials;
- C. ANSI - American National Standards Institute;
- D. AGMA - American Gear Manufacturers Association;
- E. AISC - American Institute of Steel Construction;
- F. AWS - American Welding Society;
- G. NEC - National Electric Code;
- H. NEMA - National Electrical Manufacturers Association; and
- I. API - American Petroleum Institute.

2.02 QUALITY ASSURANCE

- A. All equipment shall, after installation by the Contractor/Developer, be inspected, tested, and started up by a qualified representative of the equipment manufacturer. The Contractor/Developer and the manufacturer's representative shall complete the "Equipment Start-up Form" provided at the end of this section and submit the completed form to the City.
- B. The listing of a manufacturer in the Specifications does not necessarily imply that the manufacturer's standard equipment meets the requirements of the specifications, but that the manufacturer listed has the capability to meet the requirements of the Specifications.



PART 3: EXECUTION

3.01 SPECIAL REQUIREMENTS

A. LIMITS OF CONSTRUCTION

The Contractor/Developer shall confine all operations and personnel to the limits of construction as shown on the plans. There shall be no disturbance whatsoever of any areas outside the limits of construction nor shall the workmen be allowed to travel at will through the surrounding private property.

B. CONSTRUCTION SUPERINTENDENT

The Contractor/Developer shall place in charge of the work a competent and reliable superintendent, who shall have the authority to act for the Contractor/Developer and who shall be accountable to the City. The Contractor/Developer shall, at all times, employ labor and equipment sufficient to accomplish the several classes of work to full completion in the manner and time specified.

C. SITE CONDITIONS

1. The Contractor/Developer shall maintain the work and project grounds free from rubbish, debris, and waste materials during all phases of the work.
2. Immediately upon completion of the work and prior to final acceptance, the Contractor/Developer shall remove all rubbish, debris, temporary structures, equipment, and excess or waste materials and shall leave the work and project grounds in a neat and orderly condition that is satisfactory to the City.

D. RIGHT OF ENTRY

The City and their representative will at all times have access to the work. In addition, authorized representatives and agents of any participating Federal or State agency shall be permitted to inspect all work, materials, payrolls, records of personnel, invoices of materials, and other relevant data and records.



E. TEMPORARY CONSTRUCTION SERVICES AND FACILITIES

The Contractor/Developer shall obtain all necessary permits, licenses, etc., and shall pay all costs incident to the furnishing, installing, and maintenance of temporary utility services and facilities required for the duration of the work.

F. CONTROL OF EROSION, SILTATION, AND POLLUTION

1. The Contractor/Developer shall fully conform to the TDEC Division of Water Pollution Control, Rule 1200-4-10-.05, "General NPDES Permit for Storm Water Discharge Associated with Construction Activity" and Rule 1200-4-7-.08, "General Permit for Utility Line Crossing of Streams."
2. Surface drainage from cuts and fills within the construction limits, whether or not completed, and from borrow and waste disposal areas, shall, if turbidity producing materials are present, be graded to control erosion within acceptable limits. Temporary erosion and sediment control measures such as berms, dikes, or drains, if required to meet the above standards, shall be provided and maintained until permanent drainage and erosion control facilities are completed and operative. The area of bare soil exposed at any one time by construction operations should be held to a minimum. Fills and waste areas shall be constructed by selective placement to eliminate silts or clays on the surface that will erode and contaminate adjacent streams.
3. The Contractor/Developer shall take whatever measures are necessary to minimize soil erosion and siltation, water pollution, and air pollution caused by his operations. The Contractor/Developer shall also comply with the applicable regulations of all legally constituted authorities relating to pollution prevention and control. The Contractor/Developer shall keep himself fully informed of all such regulations that in any way affect the conduct of the work, and shall at all times observe and comply with all such regulations. In the event of conflict between such regulations and the requirements of the specifications, the more restrictive requirements shall apply.



4. The City shall have the authority to limit the area over which clearing and grubbing, excavation, borrow, and embankment operations are performed whenever the Contractor/Developer's operations do not make effective use of construction practices and temporary measures that will minimize erosion, or whenever construction operations have not been coordinated to effectively minimize erosion, or whenever permanent erosion control features are not being completed as soon as permitted by construction operations.
5. The Contractor/Developer shall control dust throughout the life of the project within the project area and at all other areas affected by the construction of the project, including, but not specifically limited to, unpaved secondary roads, haul roads, access roads, disposal sites, borrow and material pits, and production sites. Dust control shall not be considered effective where the amount of dust creates a potential or actual unsafe condition, public nuisance, or condition.

G. DISPOSAL OF MATERIALS

Debris and waste materials, including all combustibles, shall be removed by the Contractor from the construction area unless otherwise approved in writing by the City or their Representative.

I. UTILITY COORDINATION

The Contractor/Developer shall make all necessary arrangements with private and public utility companies to avoid any possible damage to or interruption of utility equipment or service. The Contractor/Developer shall be responsible for all inquiries concerning locations of utility lines. Repair of any damage to public or private utilities resulting from this work shall be the responsibility of the Contractor/Developer.

J. CONSTRUCTION SURVEYING

1. All work shall be constructed in accordance with the lines, grades, and elevations shown on the Plans. The Contractor/Developer shall be fully responsible for maintaining alignment and grade.



2. The Contractor/Developer shall protect and safeguard all points, stakes, grade marks, monuments, and benchmarks at the site of the work and shall re-establish, at his own expense, any marks that are removed or destroyed due to his construction operations.

L. USE OF CHEMICALS

1. All chemicals used during project construction, whether herbicide, pesticide, disinfectant, polymer, reactant, or of other classification, must show approval of either EPA or USDA.
2. Use of all such chemicals and disposal of residues shall be in conformance with instructions provided by the manufacturers of said chemicals.

M. SAFETY AND HEALTH REGULATIONS

1. The Contractor/Developer shall comply with all Federal, State, and Local Safety and Health Regulations, including the Department of Labor Safety and Health Regulations for construction promulgated under the Occupational Safety and Health Act of 1970 (P.L. 91 - 596) and under Section 107 of the Contract Work Hours and Safety Standards Act (P.L. 91-54).
2. The Contractor/Developer shall provide continuous, safe access to all properties, both public and private, along the project in all cases where such access will be provided by the completed facility and shall conduct his operations in such a manner that inconvenience to the property owners will be held to a minimum.
3. The Contractor/Developer shall comply with Tennessee's drug-free workplace law (Tennessee Code Annotated, Section 50-9-101 through 50-9-112).

N. EQUIPMENT AND MATERIAL STORAGE

The Contractor/Developer shall plan his activities so that all materials and equipment can be stored within the project limits. There shall be no disturbance whatsoever of any areas outside the project limits without the prior approval of the City.



O. DISTURBED AREAS

All areas disturbed as a result of the work of the Contractor/Developer shall be restored to the original or better condition. Reasonable care shall be taken during construction to avoid damage to the owner's property or that of any adjacent property owner(s).

P. TEMPORARY SANITARY FACILITIES

1. The Contractor/Developer shall be solely responsible for furnishing and maintaining temporary sanitary facilities during the construction period. Such facilities shall include, but not be limited to, potable water supply and toilet facilities.
2. Such facilities shall be in compliance with all applicable State and Local laws, codes, and ordinances and shall be placed convenient to work stations and secluded from public observation.
3. Once the project is completed, all temporary sanitary facilities shall be removed by the Contractor.

Q. TRAFFIC MAINTENANCE

1. The Contractor/Developer shall provide, erect, and maintain all necessary barricades, suitable and sufficient warning lights, danger signals, and signs; shall provide a sufficient number of flagmen to direct traffic; and shall take all necessary precautions for the protection of the work and the safety of the public.
2. All barricades and obstructions or hazardous conditions shall be illuminated as necessary to provide for safe traffic conditions.
3. Warning and caution signs shall be posted throughout the length of any portion of the project where traffic flow is restricted.

END OF SECTION

(Recommended Standard Forms follow)



ATTENTION: CONSTRUCTION ADMINISTRATION
SUBMITTAL AND ROUTING FORM

(TO BE USED WITH EACH INDIVIDUAL PLAN SUBMITTAL OR SHOP DRAWING)

SUBMITTAL AND APPROVAL (Contractor to complete)	
Project Name: _____	Project #: _____
Contractor: _____	Submittal #: _____
Contract for: _____	Specification Section: _____
Submittal Title: _____	
Sheet/item numbers: _____	
Subcontractor: _____	Supplier: _____
Date Transmitted: _____	Date Needed: _____
Change from Contract Documents? Yes <input type="checkbox"/> No <input type="checkbox"/>	Attached documentation: _____
Complete Submittal? Yes <input type="checkbox"/> No <input type="checkbox"/>	_____
<p>The Contractor must review and approve this submittal for all requirements and conformance to Contract documents prior to submittal to City of Gatlinburg. Submittals forwarded without the Contractor's approval will be returned without review or comment.</p>	
Reviewed by: _____	Date: _____

SUBMITTAL ROUTING (City of Gatlinburg to complete)				
Date Received: _____	Logged _____	To: _____	Return by: _____	
REVIEW CODES: 1 = <u>Approved</u>; 2 = <u>Approved as Noted</u>; 3 = <u>Revise & Resubmit</u>; 4 = <u>Not Approved</u>				
Reviewed by (in order)	Review Code	COMMENTS	Date	Initials
City's approval: _____			Date _____	

PROJECT DATA

NAME: _____	NUMBER: _____
LOCATION: _____	DATE: _____
OWNER: _____	DRAWING NO.: _____
OTHER: _____	SPEC. SECTION: _____

NAME OF EQUIPMENT CHECKED: _____

NAME OF MANUFACTURER OF EQUIPMENT _____

1. The equipment furnished by us has been checked on the job by us. We have reviewed (where applicable) the performance verification information submitted to us by the Contractor.
2. The equipment is properly installed, except for the items noted below.*
3. The equipment is operating satisfactorily, except for the items noted below.*
4. The written operating and maintenance information (where applicable) has been presented to the Owner, and gone over with him in detail. Three (3) copies of all applicable operating and maintenance information and parts lists have been furnished to him.

CHECKED BY:

Name of Manufacturer's Representative

Name of General Contractor

Address & Phone No. of Representative

Authorized Signature/Title/Date

Signature and Title of Person Making Check

Name of Subcontractor

Date Checked

Authorized Signature/Title/Date

MANUFACTURER'S REPRESENTATIVE

Notations: Exceptions noted at the time of check were:

Manufacturer's Representative to note adequacy of related equipment that directly affects operation, performance or function of equipment checked. (No comment presented herein will indicate adequacy of related systems or equipment.)

COPIES TO:

- | | |
|---|--|
| <input type="checkbox"/> OWNER: _____ | <input type="checkbox"/> CONTRACTOR: _____ |
| <input type="checkbox"/> ENGINEER: _____ | <input type="checkbox"/> FIELD: _____ |
| <input type="checkbox"/> ARCHITECT: _____ | <input type="checkbox"/> OTHER: _____ |

PART 1: GENERAL**1.01 SCOPE OF WORK****A. GENERAL**

1. The work covered by this Section shall consist of furnishing all materials, labor, equipment, and services for the excavation and backfill at all areas within the limits of the project. Work is limited to the areas of construction, and includes, but is not limited to, stockpiling of topsoil, site grading, excavation of footings and trenches, filling, backfilling, compaction, finish grading, spreading of topsoil, disposal of waste material, and proof rolling.
2. Perform all excavation, dewatering, sheeting, bracing, and backfilling in such a manner as to eliminate all possibility of undermining or disturbing the foundations of existing structures.
3. Provide all labor, materials, equipment, and services indicated on the Drawings, or specified herein, or reasonably necessary for or incidental to a complete job.
4. Excavations shall provide adequate working space and clearances for the work to be performed therein and for installation and removal of concrete forms. In no case shall excavation faces be undercut for extended footings.
5. Subgrade surfaces shall be clean and free of loose material of any kind when concrete is placed thereon.
6. Backfilling during freezing weather shall not be done except by permission of the City. No backfill, fill, or embankment materials shall be installed on frozen surfaces, nor shall frozen materials, snow, or ice be placed in any backfill, fill, or embankment.

1.02 SYSTEM DESCRIPTION

Excavation consists of the removal and disposal of all materials encountered for footings, foundations, pipework, and other construction as shown on the Drawings. Perform all excavation work in compliance with applicable requirements of governing authorities having jurisdiction.



1.03 QUALITY ASSURANCE

A. REFERENCED STANDARDS

Unless otherwise indicated, all referenced standards shall be the latest edition available at the time of bidding. Any requirements of these Specifications shall in no way invalidate the minimum requirements of the referenced standards. Comply with the provisions of the following codes and standards, except as otherwise shown or specified.

1. ASTM C33: “Standard Specifications for Concrete Aggregate”;
2. ASTM D698: “Standard Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 5.5 lb. Rammer and 12” Drop”;
3. ASTM D3282: “Standard Recommended Practice for Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes”;
4. Standard Specifications for Road and Bridge Construction, Tennessee Department of Transportation, March 1, 1995 edition; and
5. Erosion and Sediment Control Planning and Design Manual.

B. UNAUTHORIZED EXCAVATION

Except where otherwise authorized, indicated, or specified, all materials excavated below the bottom of concrete walls, footings, slabs on grade, and foundations shall be replaced, by and at the expense of the Contractor/Developer, with concrete placed at the same time and monolithic with the concrete above.

C. EXISTING UTILITIES

1. Locate existing underground utilities in the area of work. If utilities are to remain in place, provide adequate means of protection during earthwork operations.
2. Should uncharted or incorrectly charted piping or other utilities be encountered during excavation, consult the City immediately for directions as to procedure. Cooperate with City and utility companies in keeping respective services and facilities in operation. Repair damaged utilities to the satisfaction of utility companies.



1.04 SITE CONDITIONS

No test borings or related subsurface information is available for the project area. Test borings and other exploratory operations may be undertaken by the Contractor/Developer at his own expense provided such operations are acceptable to the City.

PART 2: PRODUCTS

2.01 MATERIALS

A. CLASSIFICATION OF EXCAVATED MATERIALS

All materials excavated for this project, regardless of its nature or composition shall be classified as Unclassified Excavation.

B. CLASSIFICATION OF OTHER MATERIALS

1. Satisfactory Subgrade Soil Materials

Soils shall comply with ASTM D 3282, soil classification Groups A-1, A-2-4, A-2-5, and A-3.

2. Unsatisfactory Subgrade Soil Materials

Soils described in ASTM D 3282, soil classification groups A-2-6, A-2-7, A-4, A-5, A-6, and A-7; also peat and other highly organic soils shall not be used, unless otherwise acceptable to the City.

3. Cohesionless Soil Materials:

Gravels, sand-gravel mixtures, sands, and gravelly-sands are classified as cohesionless soil materials.

4. Cohesive Soil Materials

Clayey and silty gravels, sand-clay mixtures, gravel-silt mixtures, clayey and silty sands, sand-silt mixtures, clays, silts, and very fine sands are classified as cohesive soil materials.



5. Backfill and Fill Materials

Provide satisfactory soil materials for backfill and fill, free of masonry, rock, or gravel larger than four inches (4") in any dimension, and free of metal, gypsum, lime, debris, waste, frozen materials, vegetable, and other deleterious matter. Use only excavated material that has been sampled, tested, and certified as satisfactory soil material.

6. Select Backfill

Select backfill is defined as backfill and fill material that is transported to the site from outside the project limits, and which meets the soil requirements specified above under "Backfill and Fill Materials." Material excavated in conjunction with the construction of this project cannot be considered as "select backfill" for payment purposes.

7. Pipe Bedding

Crushed stone or crushed gravel used in pipe bedding shall meet the requirements of ASTM C 33, Gradation 67.

8. Inundated Sand:

Sand for inundated sand backfill shall be clean with not more than twenty-five percent (25%) retained on a No. 4 sieve and not more than seven percent (7%) passing a No. 200 sieve and shall have an effective size between 0.10 mm and 0.30 mm. Sand shall be deposited in, or placed simultaneously with application of, water so that the sand shall be compacted by a mechanical probe type vibrator. Inundated sand shall be compacted to seventy-percent (70%) relative density as determined by ASTM D4253 and D4254.

9. Graded Gravel

Gravel for compacted backfill shall conform to the following gradation:



Sieve Size	Percent Passing by Weight
1"	100
3/4"	85 - 100
3/8"	50 - 80
No. 4	35 - 60
No. 40	15 - 30
No. 200	05 - 10

The gravel mixture shall contain no clay lumps or organic matters. The fraction passing the No. 4 sieve shall have a liquid limit not greater than 25 and a plasticity index not greater than 5. Gravel backfill shall be deposited in uniform layers not exceeding twelve inches (12") in uncompacted thickness. The backfill shall be compacted by a suitable vibratory roller or platform vibrator to not less than seventy percent (70%) relative density as determined by ASTM D4253 and D4254.

2.02 EQUIPMENT

A. MECHANICAL EXCAVATION

1. The use of mechanical equipment will not be permitted in locations where its operation would cause damage to trees, buildings, culverts, or other existing property, utilities, or structures above or below ground. In all such locations, hand excavating methods shall be used.
2. Mechanical equipment used for trench excavation shall be of a type, design, and construction and shall be controlled, that uniform trench widths and vertical sidewalls are obtained at least from an elevation one foot (1') above the top of the installed pipe to the bottom of the trench, and that trench alignment is such that pipe when accurately laid to specified alignment will be centered in the trench with adequate clearance between the pipe and sidewalls of the trench. Undercutting the trench sidewall to obtain clearance will not be permitted.



PART 3: EXECUTION

3.01 PREPARATION

A. DEWATERING

1. The Contractor/Developer shall provide and maintain adequate dewatering equipment to remove and dispose of all surface water and groundwater entering excavations, trenches, or other parts of the work. Each excavation shall be kept dry during subgrade preparation and continually thereafter until the structure to be built, or the pipe to be installed therein, is completed to the extent that no damage from hydrostatic pressure, flotation, or other cause will result.
2. All excavations for concrete structures or trenches that extend down to or below groundwater shall be dewatered by lowering and keeping the groundwater level beneath such excavations twelve inches (12") or more below the bottom of the excavation.
3. Surface water shall be diverted or otherwise prevented from entering excavated areas or trenches to the greatest extent practicable without causing damage to adjacent property.
4. The Contractor/Developer shall be responsible for the condition of any pipe or conduit that he may use for drainage purposes, and all such pipes or conduit that he may use for drainage purposes, and all such pipes or conduits shall be left clean and free of sediment.
5. Where trench sheeting is left in place, such sheeting shall not be braced against the pipe, but shall be supported in a manner that will preclude concentrated loads or horizontal thrusts on the pipe. Cross braces installed above the pipe to support sheeting may be removed after pipe embedment has been completed.

B. STABILIZATION

1. Subgrades for concrete structures and trench bottoms shall be firm, dense, and thoroughly compacted and consolidated; free from mud and muck; and sufficiently stable to remain firm and intact under the feet of the workmen.
2. Subgrades for concrete structures or trench bottoms, which are otherwise solid but that become mucky on top due to construction operations, shall be reinforced with one (1) or more



layers of crushed rock or gravel. The stabilizing material shall be spread and compacted to a depth of not more than four inches (4"); if the required depth exceeds four inches (4"), the material shall be furnished and installed as specified for granular fills. Not more than one-half inch (1/2") depth of mud or muck shall be allowed to remain on stabilized trench bottoms when the pipe bedding material is placed thereon. The finished elevation of stabilized subgrades for concrete structures shall not be above subgrade elevations indicated on the drawings.

C. CUTTING CONCRETE OR ASPHALT SURFACE CONSTRUCTION

1. All pavement cutting and repair shall be done in accordance with Local ordinances. Cuts in concrete and asphaltic concrete shall be no larger than necessary to provide adequate working space for proper installation of pipe and appurtenances. Cutting shall be performed with a concrete saw in a manner that will provide a clean groove the complete thickness of the surface material along each side of the trench and along the perimeter of cuts for structures.
2. Concrete and asphaltic concrete over trenches excavated for pipelines shall be removed so that a shoulder not less than twelve inches (12") in width at any point is left between the cut edge of the surface and the top edge of the trench. Trench width at the bottom shall not be greater than at the top, and no undercutting will be permitted. Cuts shall be made to and between straight or accurately marked curved lines that, unless otherwise required, shall be parallel to the center line of the trench.
3. Pavement or other surfaces removed for connections to existing lines or structures shall not be of greater extent than necessary for the installation.
4. Where the trench parallels the length of concrete walks and the trench location is all or partially under the walk, the entire walk shall be removed and replaced. Where the trench crosses drives, walks, curbs, or other surface construction, the surface construction shall be removed and replaced between existing joints or between saw cuts as specified for payment.



D. SITE GRADE

1. General

Uniformly grade areas within limits of grading under this section, including adjacent transition areas. Smooth finish the surface within specified tolerances; compact with uniform levels or slopes between points where elevations are shown, or between such points and existing grades.

2. Ground Surface Preparation

Remove vegetation, debris, unsatisfactory soil materials, obstructions, and deleterious materials from ground surface prior to placement of fills. Plow, strip, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so that fill material will bond with existing surface. Shape the subgrade as indicated on the Drawings by forking, furrowing, or plowing so that the first layer of new material placed thereon will be well bonded to it.

3.02 FIELD MEASUREMENTS

A. ALIGNMENT, GRADE, AND MINIMUM COVER

1. Vertical and horizontal alignment of pipes, and the maximum joint deflection used in connection therewith, shall be in conformity with requirements of the Section covering installation of pipe.
2. Where pipe grades or elevations are not definitely fixed by the Contract Drawings, trenches shall be excavated to a depth sufficient to provide a minimum depth of backfill cover over the top of the pipe cover depths may be necessary on vertical curves or to provide necessary clearance beneath existing pipes, conduits, drains, drainage structures, or other obstructions encountered at normal pipe grades. Measurement of pipe cover depth shall be made vertically from the outside top of pipe to finished ground or pavement surface elevation except where future surface elevations are indicated on the Drawings.



B LIMITING TRENCH WIDTHS

Trenches shall be excavated to a width that will provide adequate working space and sidewall clearances for proper pipe installation, jointing, and embedment. Maximum trench widths shall be no greater than the pipe outside diameter plus twenty-four inches (24") (twelve inches (12") on either side of pipe).

3.03 **PROTECTION**

A. TEMPORARY PROTECTION

Protect structures, utilities, sidewalks, pavements, and other facilities from damages caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.

B. SHEETING AND BRACING

Make all excavations in accordance with the rules and regulations promulgated by the Department of Labor, Occupational Safety and Health Regulations for Construction. Furnish, put in place, and maintain such sheeting, bracing, etc., as may be necessary to support the sides of the excavation and to prevent any movement of earth that could in any way diminish the width of the excavation to less than that necessary for proper construction, or could otherwise injure or delay the work, or endanger adjacent structures, roads, utilities, or other improvements.

C. BLASTING

1. The Contractor/Developer shall be responsible for all damage caused by blasting operations. Suitable methods shall be employed to confine all materials lifted by blasting within the limits of the excavation or trench.
2. All rock that cannot be handled and compacted as earth shall be kept separate from other excavated materials and shall not be mixed with backfill or embankment materials, except as specified or directed.

D. CARE AND RESTORATION OF PROPERTY

1. Enclose the trunks of trees that are to remain adjacent to the work with substantial wooden boxes of such height as may be necessary to protect them from piled material, equipment, or equipment operation. Use excavating machinery and cranes of



suitable type, and operate the equipment with care to prevent injury to remaining tree trunks, roots, branches, and limbs.

2. Do not cut branches, limbs, and roots except with permission of the City. Cut smoothly and neatly without splitting or crushing. In case of cutting or unavoidable injury to branches, limbs, and trunks of trees, neatly trim the cut or injured portions and cover with an application of grafting wax and tree healing paint as directed.
3. Protect by suitable means all cultivated hedges, shrubs, and plants that might be injured by the Contractor/Developer's operations. Promptly heel in any such trees or shrubbery necessary to be removed and replanted. Perform heeling in and replanting under the direction of a licensed and experienced nurseryman. Replant in their original position all removed shrubbery and trees after construction operations have been substantially completed and care for until growth is reestablished.
4. Replace cultivated hedges, shrubs, and plants injured to such a degree as to affect their growth or diminish their beauty or usefulness, by items of kind and quality at least equal to the kind and quality existing at the start of the work.
5. Do not operate tractors, bulldozers, or other power-operated equipment on paved surfaces if the treads or wheels of the equipment are so shaped as to cut or otherwise injure the surfaces.
6. Restore all surfaces, including lawns, grassed, and planted areas that have been injured by the Contractor/Developer's operations, to a condition at least equal to that in which they were found immediately before the work was begun. Use suitable materials and methods for such restoration. Maintain all restored plantings by cutting, trimming, fertilizing, etc., until acceptance. Restore existing property or structures as promptly as practicable and do not leave until the end of construction period.

E. PROTECTION OF STREAMS

Exercise reasonable precaution to prevent the silting of streams. Provide at Contractor/Developer's expense temporary erosion and sediment control measures to prevent the silting of streams and existing drainage facilities.



F. AIR POLLUTION

1. Comply with all pollution control rules, regulations, ordinances, and statutes that apply to any work performed under the Contract, including any air pollution control rules, regulations, ordinances and statutes, or any municipal regulations pertaining to air pollution.
2. During the progress of the work, maintain the area of activity, including sweeping and sprinkling of streets as necessary so as to minimize the creation and dispersion of dust. If the City decides that it is necessary to use calcium chloride or more effective dust control, furnish and spread the material as directed and without additional compensation.

3.04 TRENCH EXCAVATION

A. LENGTH OF TRENCH

1. No more trench shall be opened in advance of pipe laying than is necessary to expedite the work. One (1) block or four hundred (400) feet (whichever is the shorter) shall be the maximum length of open trench on any line under construction.
2. Except where tunneling is indicated on the Drawings, in the Specifications, or is permitted by the City, all trench excavation shall be open cut from the surface.

B. TRENCH EXCAVATION

1. General

Perform all excavation of every description and of whatever substance encountered so that the pipe can be laid to the alignment and depth shown on the Drawings.

2. Brace and shore all trenches, where required, in accordance with the rules and regulations promulgated by the Department of Labor, Occupation Safety and Health Administration, "Safety and Health Regulations for Construction."
3. Make all excavations by open cut unless otherwise indicated in the Specifications or on the Drawings.



4. Width of Trenches

Excavate trenches sufficiently wide to allow proper installation of pipe, fittings, and other materials and not more than twelve inches (12") clear of pipe on either side at any point. Do not widen trenches by scraping or loosening materials from the sides.

5. Trench Excavation in Earth

Earth excavation includes all excavation of whatever substance encountered. In locations where pipe is to be bedded in earth excavated trenches, fine grade the bottoms of such trenches to allow firm bearing for the bottom of the pipe on undisturbed earth. Where any part of the trench has been excavated below the grade of the pipe, fill the part excavated below such grade with pipe bedding material and compact at the Contractor/Developer's expense.

6. Trench Excavation in Fill

If pipe is to be laid in embankments or other recently filled material, first place the fill material to the finish grade or to a height of at least one foot (1') above the top of the pipe, whichever is the lesser. Take particular care to ensure maximum consolidation of material under the pipe location. Excavate the pipe trench as though in undisturbed material.

7. Trench Bottom in Poor Soil

Excavate and remove unstable or unsuitable soil to a width and depth as directed by the City, and refill with a thoroughly compacted gravel bedding.

8. Bell Holes

Provide bell holes at each joint to permit the joint to be made properly and to provide a continuous bearing and support for the pipe.



C. TRENCH BACKFILL

1. General

- a. Unless otherwise indicated in the Specifications or on the Drawings, use suitable material for backfill that was removed in the course of making the construction excavations.
- b. Do not use frozen material for the backfill, and do not place backfill on frozen material. Remove previously frozen material before new backfill is placed.
- c. Start backfilling as soon as practicable after the pipes have been laid or the structures have been built and are structurally adequate to support the loads, including construction loads to which they will be subjected, and proceed until its completion.

2. Material

- a. The nature of the materials will govern both their acceptability for backfill and the methods best suited for their placement and compaction in the backfill. Both are subject to the approval of the City.
- b. Do not place stone or rock fragments larger than four inches (4") in greatest dimension in the backfill.
- c. Do not drop large masses of backfill material into the trench in such a manner as to endanger the pipeline. Use a timber grillage to break the fall of material dropped from a height of more than five feet (5').
- d. Exclude pieces of bituminous pavement from the backfill unless their use is expressly permitted.

3. Zone Around Pipe

- a. Place bedding material to the level shown on the Drawings and work material carefully around the pipe to insure that all voids are filled, particularly in bell holes.
- b. For backfill up to a level of two feet (2') over the top of the pipe, use only selected materials containing no rock, clods, or organic materials.



- c. Place the backfill and compact thoroughly under the pipe haunches and up to the midline of the pipe in layers not exceeding six inches (6") in depth. Place each layer and tamp carefully and uniformly so as to eliminate the possibility of lateral displacement. Place and compact the remainder of the zone around the pipe and to a height of one foot (1') above the pipe in layers not exceeding six inches (6"), and compact to a maximum density of at least one hundred percent (100%) as determined by ASTM D0698.

4. Tamping

- a. Deposit and spread backfill materials in uniform, parallel layers not exceeding twelve inches (12") thick before compaction.
 - b. Tamp each layer before the next layer is placed to obtain a thoroughly compacted mass.
 - c. Furnish and use, if necessary, an adequate number of power driven tampers, each weighing at least twenty (20) pounds for this purpose.
 - d. Take care that the material close to the bank, as well as in all other portions of the trench, is thoroughly compacted.
 - e. When the trench width and the depth to which backfill has been placed are sufficient to make it feasible, and it can be done effectively and without damage to the pipe, backfill may, on approval, be compacted by the use of suitable rollers, tractors, or similarly powered equipment instead of by tamping.
 - f. For compaction by tamping (or rolling), the rate at which backfilling material is deposited in the trench shall not exceed that permitted by the facilities for its spreading, leveling, and compacting as furnished by the Contractor/Developer.
5. Wet the material by sprinkling, if necessary, to insure proper compaction by tamping (or rolling). Perform no compaction by tamping (or rolling) when the material is too wet either from rain or applied water to be compacted properly.



6. Trench Compaction

Compact backfill in pipe trenches to the maximum density as shown on the Drawings, or as listed in Subsection entitled Compaction, with a moisture content within the range of values of maximum density as indicated by the moisture-density relationship curve.

3.05 SITE GRADE

A. PLACEMENT AND COMPACTION

1. Place backfill and fill material in layers not more than eight inches (8") in loose depth. Before compaction, moisten or aerate each layer as necessary to provide the optimum moisture content. Compact each layer to the required percentage of maximum density for each area classification. Do not place backfill or material on surfaces that are muddy, frozen, or contain frost or ice.
2. In areas not accessible to rollers or compactors, compact the fill with mechanical hand tampers. If the mixture is excessively moistened by rain, aerate the material by means of blade graders, harrows, or other approved equipment, until the moisture content of the mixture is satisfactory. Finish the surface of the layer by blading or rolling with a smooth roller, or a combination thereof, and leave the surface smooth and free from waves and inequalities.
3. Place backfill and fill materials evenly adjacent to structures, to the required elevations. Take care to prevent wedging action of backfill against structures. Carry the material uniformly around all parts of the structure to approximately the same elevation in each lift.
4. When existing ground surface has a density less than that specified under the subsection entitled Compaction for the particular area classification, break up the ground surface, pulverize, moisture-condition to the optimum moisture content, and compact to required depth and percentage of maximum density.



B. GRADING OUTSIDE BUILDING LINES

Grade to drain away from structures to prevent ponding of water. Finish surface free from irregular surface changes.

C. PLANTING AREAS

Finish areas to receive topsoil to within not more than one inch (1") above or below the required subgrade elevations, compacted as specified, and free from irregular surface changes.

D. WALKS

Shape the surface of areas under walks to line, grade, and cross-section, with the finish surface not more than zero inches (0") above or one inch (1") below the required subgrade elevation, compacted as specified, and graded to prevent ponding of water after rains.

E. PAVEMENTS

1. Shape the surface of the areas under pavement to line, grade and cross-section, with finish surface not more than one-half inch (1/2") above or below the required subgrade elevation, compacted as specified, and graded to prevent ponding of water after rains. Include such operations as plowing, discing, and any moisture or aerating required to provide the optimum moisture content for compaction.
2. Fill low areas resulting from removal of unsatisfactory soil materials, obstructions, and other deleterious materials, using satisfactory soil material.
3. Shape to line, grade, and cross-section as shown on the Drawings.

F. PROTECTION OF GRADED AREAS

Protect newly graded areas from traffic and erosion, and keep free of trash and debris. Repair and re-establish grades in settled, eroded, and rutted areas to specified tolerances.



G. RECONDITIONING COMPACTED AREAS

Where completed compacted areas are disturbed by subsequent construction operations or adverse weather prior to acceptance of work, scarify surface, reshape, and compact to required density prior to further construction.

H. UNAUTHORIZED EXCAVATION

1. Unauthorized excavation consists of the removal of materials beyond indicated elevations without the specific direction of the City. Under footings, foundations, bases, etc., fill unauthorized excavation by extending the indicated bottom elevation of the concrete to the bottom of the excavation, without altering the required top elevation. Lean concrete fill may be used to bring elevations to proper position only when acceptable to the City.
2. Elsewhere, backfill and compact unauthorized excavations as specified for authorized excavations of the same classification, unless otherwise directed by the City.

3.06 BACKFILL AROUND STRUCTURES

A. GENERAL

1. Unless otherwise indicated in the Specifications or on the Drawings, use suitable material for backfill that was removed in the course of making the backfill, and do not place backfill that was removed in the course of making the construction excavations.
2. Do not use frozen material for the backfill, and do not place backfill upon frozen material. Remove previously frozen material before new backfill is placed.

B. MATERIAL

1. Approved selected materials available from the excavations may be used for backfilling around structures.
2. Obtain material needed in addition to that of construction excavations from approved off-site borrow pits. Furnish all borrow material needed on the work.
3. Place and compact all material, whether from the excavation or borrow, to make a dense, stable fill.



4. Use fill material which contains no vegetation, masses of roots, individual roots over eighteen inches (18") long or more than one-half inch (1/2") in diameter, stones over four inches (4") in diameter, or porous matter. Organic matter must not exceed minor quantities.

C. PLACING BACKFILL

1. Do not place backfill against or on structures until they have attained sufficient strength to support the loads (including construction loads) to which they will be subjected, without distortion, cracking, or other damage.
2. Make special leakage tests, if required, as soon as practicable after the structures are structurally adequate and other necessary work has been done.
3. Use the best of the excavated materials in backfilling within two feet (2') of the structure.
4. Avoid unequal soil pressures by depositing the material evenly around the structure.

3.07 COMPACTION

A. GENERAL

Control soil compaction during construction, providing at least the minimum percentage of density specified for each area classification.

B. PERCENTAGE OF MAXIMUM DENSITY REQUIREMENTS

1. After compaction, all fill will be tested in accordance with Method "C" of ASTM D-698, unless specified otherwise.
3. Except as noted otherwise for the zone around pipe, provide not less than the following percentages of maximum density of soil material compacted at optimum moisture content, for the actual density of each layer of soil material-in-place:



LOCATION OF INSTALLATION	COMPACTION
UNPAVED AREAS	Compact Full Depth to 92%
DRIVES AND PARKING	Top 9" - 100%
TRENCH BACKFILL (PAVED AREAS)	Compact full depth to 95%
TRENCH BACKFILL (UNPAVED AREAS)	Compact full depth to 95%
ALL OTHER BACKFILL	Compact full depth to 95%

C. **MOISTURE CONTROL**

1. Where subgrade or layer of soil material must be moisture conditioned before compaction, uniformly apply water to surface of subgrade, or layer of soil material, to prevent free water appearing on surface during or subsequent to compaction operations.
2. Remove and replace, or scarify and air dry, soil material that is too wet to permit compaction to specified density. Soil material that has been removed because it is too wet to permit compaction may be stockpiled or spread and allowed to dry. Assist drying by discing, harrowing, or pulverizing, until moisture content is reduced to a satisfactory value, as determined by moisture-density relation tests.

3.08 FIELD QUALITY CONTROL

Compaction tests of all fill areas will be made by an independent testing laboratory. Such tests will be provided and paid for by the Developer, except that tests that reveal non-conformance with the Specifications and all succeeding tests for the same area shall be at the expense of the Contractor/Developer until conformance with the Specifications is established. The Developer will be responsible for paying for only the successful tests.

END OF SECTION



PART 1: GENERAL

1.01 SCOPE OF WORK

- A. The work under this section consists of furnishing all materials, labor, equipment, and services 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.
- B. All work in connection with constructing encasement pipes under highways and railroads shall comply with all current requirements of governing highway and railroad agencies. The Contractor/Developer shall be familiar with these requirements.
- C. The Contractor/Developer 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.

PART 2: PRODUCTS

2.01 MATERIALS

- A. Encasement pipe shall be smooth wall welded steel conforming to ASTM Designation A139, Grade B. Minimum pipe diameter and wall thickness for casing installation under roadways shall be as follows:

Pipe - Nominal Diameter Inches	Casing - Nominal Diameter Inches	Wall Thickness - Inches
6	12	0.250
8 -10	16	0.375
12	18	0.375
14	22	0.375
16	24	0.375
18 - 20	30	0.375
24	36	0.375



B. CASING SPACERS

Casing spacers shall meet one (1) of the following requirements and shall be installed no more than seven feet (7') apart:

1. Casing spacers shall be flanged, bolt-on style with a two-section stainless steel shell lined with a PVC liner, minimum 0.09-inch (.09") thick and 85-90 durometer hardness. Runners shall be attached to stainless steel risers, which shall be properly welded to the shell. The height of the runners and risers shall be manufactured such that the pipe does not float within the casing. Casing spacers shall be Cascade Waterworks Manufacturing Company or Advanced Products Systems, Inc.
2. Casing spacers shall be a two-section, flanged, bolt-on style constructed of heat-fused, PVC-coated steel, minimum 14-gauge band and 10-gauge risers, with two inch (2") wide glass reinforced polyester insulating skirts, heavy duty PVC inner liner, minimum 0.09-inch thick and 85-90 durometer hardness, and all stainless steel or cadmium plated hardware shall be Pipeline Seal and Insulator, Inc.

C. GROUT

Grout and brick shall be used for filling the void between the end of the casing pipe and the carrier pipe. Cement shall conform to ASTM C 150, Type I or Type II. Grout shall have a minimum compressive strength of one hundred (100) psi attained within twenty-four (24) hours.

PART 3: EXECUTION

3.01 INSTALLATION

- A. Encasements shall be installed by boring and jacking unless field conditions require otherwise. It shall be the Contractor/Developer's responsibility to notify the City immediately if conditions do not permit a jack and bore installation.
- B. Installation of encasement pipe shall include all related work and services such as mobilization of equipment, constructing and maintaining working pits, right-of-way maintenance and restoration, traffic maintenance, mining, excavations, dewatering, sheeting, shoring and bracing for embankments, and operating pits, and, as elsewhere



required, shall be placed and maintained in order that work may proceed safely and expeditiously.

- C. Installation of the casing pipe shall be carried out without disturbance of the embankment, pavement, tracks, or other railroad or highway facilities and without obstructing the passage of traffic at any time.
- D. The driven portions of the casing shall be advanced from the lower end of the casing unless specific permission to do otherwise is obtained by the Contractor/Developer from the City.
- E. The alignment and grade shall be carefully maintained and the encasement pipe installed in a straight line.
- F. The space outside the encasement and the ground shall be filled with grout, sand or pea gravel, as directed by the City. The City will direct that this space be filled if the space is large enough to cause any earth settling.

END OF SECTION



PART 1: GENERAL**1.01 SCOPE OF WORK**

The work covered by this Section shall consist of furnishing all materials, labor, equipment, and services for the installation of a low pressure sewer system. The Contractor shall be responsible for the satisfactory operation of the entire system.

1.02 SUBMITTALS

The Contractor shall provide a minimum of five (5) sets of shop drawings detailing the equipment to be furnished, including dimensional data and materials of construction. The City shall endeavor to promptly review this data and shall return two (2) copies as accepted or pending requested modifications.

1.03 MANUFACTURER

Grinder pump stations, complete with all appurtenances, form an integral system, and as such, shall be supplied by one (1) grinder pump station Manufacturer.

- A. All Manufacturers proposing equipment for this project shall have at least ten (10) years of experience in the design and manufacture of grinder pumps for specific use in low pressure sewage systems and of identical size(s) and performance to the specified units.
- B. All Manufacturers proposing equipment for this project must have no fewer than five hundred (500) successful installations of low pressure sewer systems utilizing grinder pumps such as those specified herein. An installation is defined as a minimum of twenty-five (25) pumps discharging into a common force main, which forms a low pressure sewer system.



C. The Manufacturer shall:

1. Provide detailed installation and user instructions for its product;
2. Submit evidence of an established service program, including complete parts and service manuals;
3. Maintain a continuing inventory of grinder pump replacement parts; and
4. Provide a reference and contact list of ten (10) of its largest contiguous grinder pump installations of the type specified herein that have been in operation for at least ten (10) years.

1.04 OPERATING CONDITIONS

The pumps shall be capable of delivering fifteen (15) gpm against a rated total dynamic head of zero (0) feet (0 psig) and nine gpm against a rated total dynamic head of one hundred thirty-eight (138) feet (60 psig). The pump(s) must also be capable of operating at negative total dynamic head without overloading the motor(s). Under no conditions shall in-line piping or valving be allowed to create a false apparent head.

1.05. WARRANTY

The grinder pump Manufacturer shall provide a part(s) and labor warranty on the complete station and accessories, including, but not limited to, panel and redundant check valve for a period of sixty (60) months after notice of City acceptance, but no greater than sixty-three (63) months after receipt of shipment. Any manufacturing defects found during the warranty period will be reported to the Manufacturer by the City and shall be corrected by the Manufacturer at no cost to the City.

PART 2: PRODUCTS

2.01 PUMP

- A. The pump shall be a custom-designed, integral, vertical rotor, motor-driven, solids-handling pump of the progressing-cavity type with a single mechanical seal.



- B. The rotor shall be constructed of stainless steel. Plating on the rotor will not be acceptable due to its tendency to delaminate.
- C. The stator shall be of a specifically compounded ethylene-propylene synthetic elastomer. The material shall be suitable for domestic wastewater service. Its physical properties shall include high tear and abrasion resistance, grease resistance, water and detergent resistance, temperature stability, excellent aging properties, and outstanding wear resistance. Buna-N is not acceptable as a stator material because it does not exhibit the properties as outlined above and required for wastewater service.

2.02 GRINDER

- A. The grinder shall be placed immediately below the pumping elements and shall be direct-driven by a single, one-piece motor shaft.
- B. The grinder impeller assembly shall be securely fastened to the pump motor shaft by means of a threaded connection attaching the grinder impeller to the motor shaft. Attachment by means of pins or keys will not be acceptable.
- C. The grinder shall be of the rotating type with a stationary hardened and ground stainless steel shredding ring spaced in close annular alignment with the driven impeller assembly, which shall carry two (2) hardened-type 400 series stainless steel cutter bars. This assembly shall be dynamically balanced and operate without objectionable noise or vibration over the entire range of recommended operating pressures.
- D. The grinder shall be constructed so as to eliminate clogging and jamming under all normal operating conditions, including starting.
- E. Sufficient vortex action shall be created to scour the tank free of deposits or sludge banks that would impair the operation of the pump.
- F. The grinder shall be capable of reducing all components in normal domestic sewage, including a reasonable amount of "foreign objects," such as paper, wood, plastic, glass, rubber, and the like, to finely divided particles that will pass freely through the passages of the pump and the one and one quarter inch (1-1/4") diameter discharge. These requirements shall be accomplished by the following, in conjunction with the pump:



1. The grinder shall be positioned in such a way that solids are fed in an upward flow direction.
2. The maximum flow rate through the cutting mechanism must not exceed four feet (4') per second; this critical design element will prevent jamming.
3. The inlet shroud shall have a diameter of no less than five inches (5"). Inlet shrouds that are less than five inches (5") in diameter will not be accepted due to their inability to maintain the specified four feet (4') per second maximum inlet velocity.
4. The impeller mechanism must rotate at a nominal speed of no greater than 1,800 rpm.

2.03 ELECTRIC MOTOR

- A. As a maximum, the motor shall be a one (1) horsepower (hp), 1,725 rpm, 240 volt (V), 60 hertz (Hz), single-phase, capacitor start, ball bearing, air-cooled induction type with a low starting current not to exceed 30 amperes (A) and a high starting torque of 8.4.
- B. Conditions for the pump motor shall be provided by the use of an automatic-reset, integral thermal overload protector incorporated into the motor. This motor protector combination shall have been specifically investigated and listed by Underwriters Laboratories, Inc., (UL) for the application.
- C. Non-capacitor start motors or permanent split capacitor motors will not be accepted because of their reduced starting torque and consequent diminished grinding capability.
- D. To reduce the potential of environmental concerns, the expense of handling and disposing of oil, and the associated maintenance costs, oil-filled motors will not be accepted.

2.04 MECHANICAL SEAL

The pump core shall be provided with a mechanical shaft seal to prevent leakage between the motor and pump. The seal shall have a stationary ceramic seat and carbon rotating surface with precision-lapped and held in position by a stainless steel spring.



2.05 TANK

- A. The tank shall consist of a single wall of laminated fiberglass construction.
- B. The resin used shall be of a commercial grade suitable for the environment.
- C. The reinforcing material shall be a commercial grade of glass fiber capable of bonding with the selected resin.
- D. The inner surface shall have a smooth finish and be free of cracks and crazing.
- E. The exterior tank surface shall be relatively smooth with no exposed fiber or sharp projections present.
- F. The tank wall and bottom shall be of sufficient thickness and construction to withstand the imposed loading due to saturated soil at the specified burial depth for each available tank height.
- G. All station components must function normally when exposed to the external soil and hydrostatic pressures developed at the specified burial depth.
- H. The tank bottom shall be reinforced with a fiberglass plate extending beyond the tank walls to support concrete anchoring, as required, to prevent flotation.
- I. The tank shall include a solid fiberglass cover, secured with threaded stainless steel fasteners, providing low profile mounting.
- J. The tank shall also be vented to prevent sewage gases from accumulating in the tank.
- K. The tank dimensions shall be twenty-four inches (24") in diameter and sixty inches (60") tall per the City Standard Sewer Details.



2.06 DISCHARGE HOSE AND DISCONNECT/VALVE

- A. All discharge fittings and piping shall be constructed of 304 Series stainless steel, polypropylene, ethylene propylene diene monomer (EPDM), or PVC.
- B. The discharge hose assembly shall include a shut-off valve rated for two hundred (200) psi water, oil, or gas (WOG) and a quick disconnect feature to simplify installation and pump removal.
- C. The bulkhead penetration shall be factory-installed and warranted by the Manufacturer to be watertight.

2.07 ELECTRICAL QUICK DISCONNECT

- A. The grinder pump unit shall include a single NEMA 6P EQD for all power and control functions. J-box type disconnects will not be accepted due to their tendency to leak and inherent issues associated with J-box serviceability.
- B. An integral tube shall allow venting of the control compartment to ensure proper operation of the pressure switch level system.
- C. The grinder pump will be furnished with a length of 6-conductor, 14-gauge, type-SJOW cable, pre-wired and watertight to meet UL requirements.

2.08 ANTI-SIPHON VALVE

The pump discharge shall be equipped with a factory-installed, gravity-operated, flapper-type integral anti-siphon valve built into the discharge assembly.

- A. Moving parts will be made of 300 series stainless steel and fabric-reinforced synthetic elastomer to ensure corrosion resistance, dimensional stability, and fatigue strength.
- B. A nonmetallic hinge shall be an integral part of the flapper assembly, providing a maximum degree of freedom to ensure proper operation even at a very low pressure.
- C. The valve body shall be injection-molded from a glass-filled thermoplastic resin.



- D. Holes or ports in the discharge piping are not acceptable anti-siphon devices, due to their tendency to clog from the solids in the slurry being pumped.

2.09 CHECK VALVE

The pump discharge shall be equipped with a factory installed, gravity operated, flapper-type integral check valve built into the discharge assembly.

- A. The check valve will provide a full-ported passageway when open, and shall introduce a friction loss of less than six inches (6") of water at maximum rated flow.
- B. Moving parts will be made of a 300 series stainless steel and fabric reinforced synthetic elastomer to ensure corrosion resistance, dimensional stability, and fatigue strength.
- C. A nonmetallic hinge shall be an integral part of the flapper assembly, providing a maximum degree of freedom to ensure seating even at a very low back pressure.
- D. The valve body shall be an injection molded part made of glass-filled PVC.
- E. Ball-type check valves are unacceptable due to their limited sealing capacity in slurry applications.
- F. Each grinder pump installation shall also include one (1) separate check valve of the type detailed in this section for installation in the one and one quarter-inch (1¼") service lateral between the grinder pump station and the sewer main, preferably next to the curb stop. The separate check valve shall be provided as a separate line item in the bid schedule.

2.10 CORE UNIT

- A. The grinder pump station shall have an easily removable core assembly containing pump, motor, grinder, all motor controls, check valve, anti-siphon valve, EQD, and wiring.
- B. The pump core shall be suitably mounted on an integral stand of stainless steel.



- C. The watertight integrity of the core unit shall be established by one hundred percent (100%) factory test at a minimum of five (5) pounds per square inch, gauge (psig).

2.11 CONTROLS

- A. All necessary controls, including motor and level controls, shall be located in the top housing of the core unit. The top housing will be attached with stainless steel fasteners.
- B. Non-fouling wastewater level controls for controlling pump operation shall be accomplished by monitoring the pressure changes in an integral air column connected to a pressure switch. High-level sensing will be accomplished in the manner detailed above by a separate air-bell sensor and pressure switch of the same type.
- C. The level detection device shall have no moving parts in direct contact with the wastewater.
- D. Closure of the high-level sensing device will energize an alarm circuit as well as a redundant pump-on circuit.
- E. For increased reliability, pump power and high-level alarm functions shall not be controlled by the same switch. Float switches of any kind, including float trees, will not be accepted due to the periodic need to maintain (rinsing, cleaning) such devices.
- F. To ensure reliable operation of the pressure switches, each core shall be equipped with a breather assembly, complete with a suitable means to prevent accidental entry of water into the motor compartment.
- G. The grinder pump will be furnished with a 6-conductor, 14-gauge, type SJOW cable, pre-wired and watertight to meet UL requirements with a factory-installed NEMA 6P EQD half attached to it.

2.12 ALARM PANEL

Each grinder pump station shall include a NEMA 4X, UL-listed alarm panel suitable for wall mounting.

- A. The NEMA 4X enclosure shall be manufactured of thermoplastic to assure corrosion resistance. The enclosure shall include a hinged,



lockable cover, pad lock, and secured dead front. The enclosure shall not exceed 11.38" wide x 13.5" high x 5.63" deep.

- B. For each core, the panel shall contain one (1) 15-A, double-pole circuit breaker for the power circuit and one (1) 15-A, single-pole circuit breaker for the alarm circuit. The panel shall contain terminal blocks, integral power bus, and a complete alarm circuit.
- C. The alarm panel shall include the following features: audio and visual alarm, push-to-run switch, and high level (redundant) pump starting control. The visual alarm lamp shall be inside a red fluted lens at least 2-5/8" in diameter and 1-11/16" in height. Visual alarm shall be mounted to the top of the enclosure in such a manner as to maintain NEMA 4X rating.
- D. The audio alarm shall be a printed circuit board in conjunction with an eighty-six (86) decibel (dB) buzzer with quick mounting terminal strip mounted in the interior of the enclosure. The audio alarm shall be capable of being deactivated by depressing a push-type switch encapsulated in a weatherproof silicone boot and mounted on the bottom of the enclosure.
- E. The entire alarm panel shall be UL-listed.
- F. The alarm sequence is to be as follows:
 - 1. When liquid level in the sewage wetwell rises above the alarm level, visual and audio alarms will be activated. The contacts on the alarm pressure switch will close. The redundant pump starting system will be energized.
 - 2. The audio alarm may be silenced by means of the externally mounted, push-to-silence button.
 - 3. Visual alarm remains illuminated until the sewage level in the wetwell drops below the "off" setting of the alarm pressure switch.

2.13 SERVICEABILITY

- A. The grinder pump core unit shall have two (2) lifting hooks, complete with nylon lift-out harness, to facilitate easy core removal when necessary.



- B. All mechanical and electrical connections must provide easy disconnect capability for core unit removal and installation.
- C. A push-to-run feature will be provided for field trouble shooting.
- D. All motor control components shall be mounted on a readily replaceable bracket for ease of field service.

2.14 OSHA CONFINED SPACE

All maintenance tasks for the grinder pump station must be possible without entry into the grinder pump station as per OSHA 1910.146, "Permit-Required Confined Spaces."

2.15 SAFETY

- A. The grinder pump shall be free from electrical and fire hazards as required in a residential environment. As evidence of compliance with this requirement, the completely assembled and wired grinder pump station in its tank shall be UL-listed to be safe and appropriate for the intended use. UL listing of components of the station or third-party testing to UL standards will not be accepted.
- B. The grinder pump shall meet accepted standards for plumbing equipment for use in or near residences; shall be free from objectionable noise, odor, or health hazards; and shall have been tested by an independent laboratory to certify its capability to perform as specified in either individual or low pressure sewer system applications. As evidence of compliance with this requirement, the grinder pump shall bear the National Sanitation Foundation (NSF) seal. Third-party testing to NSF standards will not be accepted.

PART 3: EXECUTION

3.01 FACTORY TESTING

- A. Each grinder pump shall be submerged and operated for a minimum of five (5) minutes. Included in this procedure will be the testing of all ancillary components such as the anti-siphon valve, check valve, discharge line, and each unit's dedicated level and motor controls. All factory tests shall incorporate each of the above listed items.



- B. Actual appurtenances and controls that will be installed in the field shall be particular to the tested pump only. A common set of appurtenances and controls for all pumps will not be acceptable.
- C. The Manufacturer shall provide the City with certified test results showing the operation of each grinder pump at two (2) different points on its curve, with the maximum pressure no less than sixty (60) psi. The City reserves the right to inspect such testing procedures at the grinder pump Manufacturer's facility.
- D. Completed basins shall be factory leak tested to assure the integrity of all joints, seams, and penetrations.

3.02 DELIVERY

- A. All grinder pump units shall be delivered to the job site one hundred percent (100%) completely assembled, tested, and ready for installation.
- B. Grinder pump stations will be individually mounted on wooden pallets.
- C. Grinder pump cores will be shipped in a separate container and are only required to be installed in the basin.

3.03 INSTALLATION

- A. The Contractor shall be responsible for handling groundwater to provide a firm, dry subgrade for the structure and shall guard against flotation or other damage resulting from general groundwater or flooding.
- B. The grinder pump stations shall not be set into the excavation until the installation procedures and excavation have been approved by the City.
- C. Remove packing material. User's instructions shall be given to the City. Hardware supplied with the unit, if required, shall be used at installation. The basin will be supplied with a standard field-installed four-inch (4") inlet grommet (fiberglass tank) or flange (for high-density polyethylene tank); both will accept a 4.50" outside diameter drain, waste, and vent (DWV) pipe for connecting the incoming sewer line.



Appropriate inlet piping must be used. The basin may not be dropped, rolled, or laid on its side for any reason.

- D. Installation shall be accomplished so that one to four inches (1"-4") of access way, below the bottom of the lid, extends above the finished grade line. The finished grade shall slope away from the unit. The diameter of the hole must be large enough to allow for the concrete anchor.
- E. A six-inch (6") inch (minimum) layer of TDOT #57 stone shall be used as bedding material under each unit.
- F. A concrete anti-flotation collar, as detailed on the drawings, and sized according to the Manufacturer's instructions, shall be required and shall be precast to the grinder pump or poured in place. Each grinder pump station with its precast anti-flotation collar shall have a minimum of three (3) lifting eyes for loading and unloading purposes.
- G. The unit shall be leveled and filled with water to the bottom of the inlet to help prevent the unit from shifting while the concrete is being poured and set. The concrete must be manually vibrated to ensure there are no voids. If it is necessary to pour the concrete to a level higher than the inlet piping, an eight-inch (8") sleeve is required over the inlet prior to pouring the concrete.
- H. The Contractor will provide and install a four-foot (4') piece of four-inch (4") SCH 40 PVC pipe with cap, to stub-out the inlet as depicted on the Contract Drawings.
- I. The electrical enclosure shall be furnished, installed, and wired to the grinder pump station by the Contractor. An alarm device is required on every installation; there shall be no exceptions.
- J. It will be the responsibility of the Contractor and the City to coordinate with the individual property owner(s) to determine the optimum location for the alarm panel. The Contractor shall mount the alarm device in a conspicuous location, as per Federal and Local codes.
- K. The alarm panel will be connected to the grinder pump station by a length of 6-conductor, 12-gauge, TC-type cable as shown on the Contract Drawings. The power and alarm circuits must be on separate power circuits. The grinder pumps station will be provided with a minimum of thirty-two feet (32') total, twenty-five feet (25') of usable



electrical supply cable outside the station, to connect to the alarm panel. This cable shall be provided with a factory-installed EQD half to connect to the mating EQD half on the core.

3.04 BACKFILL REQUIREMENTS

- A. Backfill of clean, native earth, free of rocks, roots, and foreign objects, shall be thoroughly compacted in lifts not exceeding twelve inches (12") to a final Proctor Density of not less than eighty-five percent (85%).
- B. The grinder pump station shall be installed at a minimum depth from grade to the top of the one and one quarter inch 1-1/4" discharge line to ensure maximum frost protection.
- C. The finish grade line shall be one to four inches (1"-4") below the bottom of the lid, and final grade shall slope away from the grinder pump station.

3.05 START-UP AND FIELD TESTING

- A. The Manufacturer shall provide the services of qualified factory trained technician(s) who shall inspect the placement and wiring of each station, perform field tests as specified herein, and instruct the City's personnel in the operation and maintenance of the equipment before the stations are accepted by the City.
- B. All equipment and materials necessary to perform testing shall be the responsibility of the Contractor. This will include, as a minimum, a portable generator (if temporary power is required) and water in each basin.
- C. The services of a trained factory-authorized technician shall be provided at a rate of two (2) days for each two hundred (200) grinder pump stations supplied. Projects with fewer than two hundred (200) units shall provide a trained factory-authorized technician for a minimum of one (1) day. Each day shall be ten (10) person hours in duration.
- D. Upon completion of the installation, the authorized factory technicians will perform the following test on each station:



1. Make certain the discharge shut-off valve is fully open. This valve must not be closed when the pump is operating. In some installations, there may be a valve(s) at the street main that must also be open.
 2. Turn on the alarm power circuit.
 3. Fill the wetwell with water to a depth sufficient to verify the high level alarm is operating. Shut off water.
 4. Turn on pump power circuit. Initiate pump operation to verify automatic power controls are operative. Pump should immediately turn on. Within one (1) minute, alarm light will turn off. Within three (3) minutes, the pump will turn off.
- E. Upon completion of the start-up and testing, the Manufacturer shall submit to the City the start-up authorization form describing the results of the tests performed for each grinder pump station. Final acceptance of the system will not occur until authorization forms have been received for each pump station installed and any installation deficiencies corrected.

PART 4: OPERATION AND MAINTENANCE

4.01 SPARE CORE

The manufacturer will supply one (1) spare grinder pump core for every fifty (50) grinder pump stations installed, complete with all operational controls, level sensors, check valve, anti-siphon valve, pump/motor unit, and grinder.

4.02 MANUALS

The manufacturer shall supply four (4) copies of Operation and Maintenance Manuals to the City.

END OF SECTION

(Recommended form follows.)



WARRANTY CERTIFICATION

I, _____, by and through my duly authorized signature below as its most senior operating executive, certify that _____ will provide a five (5) year warranty on grinder pump equipment manufactured and supplied by _____ for the _____ project. I further certify that, other than failure to install equipment in accordance with manufacturer's instructions, no exclusions and/or cost items to maintain said equipment in warrantable condition, including labor, travel and shipping fees, exist.

Signature

Date

Title



PART 1: GENERAL**1.01 SCOPE OF WORK**

- A. This Section covers the furnishing of all labor, equipment, and materials necessary for the proper restoration of existing surfaces disturbed or damaged as a result of construction operations that are not specifically scheduled or specified for topsoil and seeding, paving, landscaping, or other surfacing.
- B. In general, the types of replacement included in this section are seeding along pipelines, concrete sidewalks, driveways, roadways, ditches, lawns and landscaped areas, and curb and gutter.
- C. Any damage to existing structures shall be repaired using materials and workmanship equal to those of original construction.

PART 2: NOT USED**PART 3: EXECUTION****3.01 RESTORATION OF SURFACES**

- A. SEEDING ALONG PIPELINES
 - 1. All ground surfaces along pipelines that are not classified as lawns, landscaped areas, or pavement areas, but would be classified as open fields, shall be raked smooth and seeded in accordance with the current TDEC Erosion and Sediment Control Handbook. Large rocks, clumps of earth, and excessive spoil material shall be removed from the area prior to seeding.
 - 2. Shoulders of all roads shall be restored as specific for lawns and landscaped areas.
 - 3. Wooded areas not classified as lawns shall be restored to as near the original condition as possible.



B. CONCRETE SIDEWALKS

1. Concrete walks removed in connection with, or damaged as a result of, construction operations under the Contract shall be replaced with new construction. Such walks shall be constructed of Class A concrete on a thoroughly compacted subgrade or mineral aggregate base as shown. Concrete walks shall have a vertical thickness of not less than four inches (4") or not less than the thickness of the replaced walk where greater than four inches (4").
2. Walks shall be float finished, edged with an edging tool, and grooved at intermediate intervals not in excess of the width of the walk, uniform throughout the length of the walk in any one direction.

C. DRIVEWAYS

1. Unpaved driveways shall be surfaced with not less than three inches (3") of mineral aggregate base, topped with three inches (3") of stone, gravel, or other materials equal to that found in the original driveway. Driveways shall be left in a condition better than their original condition.
2. Unless otherwise specified, concrete drives shall be replaced with Class A concrete and shall have equal thickness and reinforcing steel to that of the original drive. Prior to placing the concrete, a six-inch (6") layer of compacted mineral aggregate base shall be placed in the drive area.
3. Bituminous or asphaltic concrete drives shall be restored with a six-inch (6") layer of compacted mineral aggregate base and a two-inch (2") layer of compacted asphaltic concrete surface (hot mix), grading E.

D. ROADWAY REPLACEMENT

1. Bituminous or asphaltic pavements shall include all areas paved with blacktop, built-up pavements of oil and stone or tar and stone, and similar pavements constructed with bituminous or asphaltic and stone materials.
2. Immediately upon completion of installation of underground piping and structures, the trench shall be backfilled and the roadway shall be repaired. Unless otherwise noted, in the



excavated area, the repair shall consist of a six-inch (6") aggregate base course, a four-inch (4") HB Binder Course, and a two-inch (2") surface course. If, in the opinion of the City, the area adjacent to the excavation has not been damaged to the extent that the base course need to be replaced, restoration may consist of a surface course of sufficient thickness to meet the existing pavement.

3. Portland cement concrete roadways shall be replaced with Class A concrete and shall have equal thickness and reinforcing steel as the original roadway. A mineral aggregate base layer of six inches (6") compacted thickness shall be placed prior to the placing of concrete.
4. Differential settlement of restored pavements shall be corrected immediately.
5. The Contractor/Developer shall repair and restripe any traffic markings that were damaged, removed, or covered during construction. All work shall be done in accordance with TDOT requirements and specifications.
6. All existing manhole and valve covers shall be raised as required by the Contractor/Developer prior to paving. The cost of this work shall be included in the unit bid prices for other related work and no additional payment shall be made, unless otherwise noted.

E. DITCHES

Ditches shall be regraded to the original grade and line. The surface of all ditches shall be returned to the same condition as found before commencing work and provide positive drainage.

F. LAWNS AND LANDSCAPED AREAS

1. Lawns and landscaped areas shall be regraded and replaced as follows:
 - a. Grading shall be to the grade existing before construction of the work under this Contract.
 - b. Lawn replacement shall be in accordance with the Section 02931. Topsoiled areas shall be replaced with topsoil of equal quality and quantity.



2. Landscaped areas shall be replaced with shrubs, hedges, ornamental trees, flowers, or other items to original condition.

G. CURB AND GUTTER

Curb and gutter removed with, or damaged as a result of, construction operations or injured or disturbed by the Contractor/Developer, his agents, or employees shall be replaced with new construction to a condition equal to that existing before damage was incurred. Class A Concrete shall be used in curb and gutter replacement.

H. DAMAGE TO STRUCTURES

Any damage to existing structures shall be repaired of materials and workmanship equal to those of original construction. Extensively damaged structures, where the structural stability has been affected or that cannot be repaired in a suitable fashion shall be replaced entirely. Replacement shall not commence until approval of the plan of replacement has been given by the City. Replacement costs shall be responsibility of the Contractor/Developer.

END OF SECTION



PART 1: GENERAL**1.01 SCOPE OF WORK**

- A. This section covers the furnishing of all labor, equipment, and materials necessary for the 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/Developer shall adapt his operations to variations in weather or soil conditions as necessary for the successful establishment and growth of the grasses or legumes.

PART 2: PRODUCTS**2.01 MATERIALS****A. FERTILIZER**

1. The quality of fertilizer and all operations in connection with the furnishing of this material shall comply with regulations adopted by the Tennessee Department of Agriculture.
2. Fertilizer shall be 10-10-10 grade. Upon written approval of the City, a different grade of fertilizer may be used, provided the rate of application is adjusted to provide the same amounts of plant food.
3. During handling and storing, the fertilizer shall be cared for in such a manner that it will be protected against hardening, caking, or loss of plant food values. Any hardened or caked fertilizer shall be pulverized to its original condition before being used.

B. LIME

1. The quality of lime and all operations in connection with the furnishing of this material shall comply with the requirements of the Tennessee Department of Agriculture.



2. During the handling and storing, the lime shall be cared for in such a manner that it will be protected against hardening and caking. Any hardened or caked lime shall be pulverized to its original condition before being used.
3. Lime shall be agriculture grade ground dolomitic limestone. It shall contain not less than eighty-five percent (85%) of the calcium and magnesium carbonates and shall be of such fineness that at least ninety percent (90%) will pass a No. 10 sieve and at least fifty percent (50%) will pass a No. 100 sieve.

C. SEED

1. The quality of seed and all operations in connection with the furnishing of this material shall comply with the regulations adopted by the Tennessee Department of Agriculture.
2. Seed shall have been approved by the Tennessee Department of Agriculture or any agency approved by the City before being sown, and no seed will be accepted with a date of test more than nine (9) months prior to the date of sowing. Such testing however, will not relieve the Contractor/Developer 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 the seed to fall below the minimum pure live seed specified, the Contractor/Developer may elect, subject to the approval of the City, 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.
3. During handling and storing, the seed shall be cared for in such a manner that it will be protected from damage by heat, moisture, rodents, or other causes.
4. Seed shall be entirely free from bulblets 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, Corncockle, 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 twenty-seven



(27) seeds of each per pound. No tolerance on weed seed will be allowed.

D. MULCH

Straw mulch shall be threshed straw of Oats, Rye, or Wheat free from matured seed of obnoxious weeds or other species that would grow and be detrimental to the specified grass.

E. TACKIFIER

Emulsified asphalt or organic tackifier such as Reclamare R2400 shall be sprayed uniformly on mulch as it is ejected from blower or immediately thereafter. Tackifier shall be applied evenly over area creating uniform appearance. Rates of application will vary with conditions. Asphalt shall not be used in freezing weather.

PART 3: EXECUTION

3.01 PREPARATION

A. PROTECTION OF EXISTING TREES AND VEGETATION

1. Protect existing trees and other vegetation indicated to remain in place against unnecessary cutting, breaking, or skinning of roots; skinning and bruising of bark; smothering of trees by stockpiling construction materials or excavated materials within drip line; excess foot or vehicular traffic; or parking of vehicles within drip line. Provide temporary guards to protect trees and vegetation to be left standing.
2. Provide protection for roots over one and a half inch (1-1/2") diameter cut during construction operations. Coat cut faces with an emulsified asphalt, or other acceptable coating, formulated for use on damaged plant tissues. Temporarily cover exposed roots with wet burlap to prevent roots from drying out and cover with earth as soon as possible.
3. The Contractor/Developer shall not remove or damage trees and shrubs that are outside the Clearing Limits established by the City or those within the Clearing Limits designated to remain.



4. Repair trees scheduled to remain and damaged by construction operations in a manner acceptable to the City. Repair damaged trees promptly to prevent progressive deterioration caused by damage.
5. Replace trees scheduled to remain and damaged beyond repair by construction operations, as determined by the City with trees of similar size and species. Repair and replacement of trees scheduled to remain and damaged by construction operations or lack of adequate protection during construction operations shall be at the Contractor/Developer's expense.

B. GRADING

1. Rough grading shall be done as soon as all excavation required in the area has been backfilled. The necessary earthwork shall be accomplished to bring the existing ground to the desired finish elevations as shown on the Contract Drawings or otherwise directed.
2. Fine grading shall consist of shaping the final contours for drainage and removing all large rock, clumps of earth, roots, and waste construction materials. It shall also include thorough loosening of the soil to a depth of six inches (6") by plowing, discing, harrowing, or other approved methods until the area is acceptable as suitable for subsequent landscaping operations. The work of landscaping shall be performed on a section by section basis immediately upon completion of earthwork.
3. Upon failure or neglect on the part of the Contractor/Developer to coordinate his grading with seeding and mulching operations and diligently pursue the control of erosion and siltation, the City may suspend the Contractor/Developer's grading operations until such time as the work is coordinated in a manner acceptable to the City.

C. SEEDBED PREPARATION

1. The Contractor/Developer shall cut and satisfactorily dispose of weeds or other unacceptable growth on the areas to be seeded. Uneven and rough areas outside of the graded section, such as crop rows, farm contours, ditches and ditch spoil banks, fence line and hedgerow soil accumulations, and other minor irregularities that cannot be obliterated by normal seedbed preparation operations, shall be shaped and smoothed as



directed by the City to provide for more effective seeding and for ease of subsequent mowing operations.

2. The soil shall then be scarified or otherwise loosened to a depth of not less than 6" except as otherwise provided below or otherwise directed by the City. Clods shall be broken and the top two to three inches (2"-3") of soil shall be worked into an acceptable seedbed by the use of soil pulverizers, drags, or harrows; or by other methods approved by the City.
3. On 2:1 slopes, a seedbed preparation will be required that is the same depth as that required on flatter areas, although the degree of smoothness may be reduced from that required on the flatter areas if so permitted by the City.
4. On cut slopes that are steeper than 2:1, both the depth of preparation and the degree of smoothness of the seedbed may be reduced as permitted by the City, but in all cases the slope surface shall be scarified, grooved, trenched, or punctured so as to provide pockets, ridges, or trenches in which the seeding materials can lodge.
5. On cut slopes that are either 2:1 or steeper, the City may permit the preparation of a partial or complete seedbed during the grading of the slope. If at the time of seeding and mulching operations such preparation is still in a condition acceptable to the City, additional seedbed preparation may be reduced or eliminated.
6. The preparation of seedbeds shall not be done when the soil is frozen, extremely wet, or when the City determines that it is in an otherwise unfavorable working condition.

D. APPLICATION RATES

Seed shall be applied by means of a hydro-seeder or other approved methods. The rates of application of seed, fertilizer, and limestone shall be as stated below.

1. Lime and Fertilizer

In the absence of a soil test, the following rates of application of limestone and fertilizer shall be:

- a. 4,000 pounds limestone per acre;



- b. 1,000 pounds 10-10-10 (N-P₂O₅-K₂O) fertilizer per acre and the remaining quantity applied when vegetation is three inches (3") in height or forty-five (45) days after seeding, whichever comes first.

2. Mulch

Mulch shall be applied at the following rates per acre:

- a. 3,000-4,000 pounds straw mulch;
- b. 1,500-2,000 pounds wood cellulose fiber;
- c. 35-40 cubic yards of shredded or hammermilled hardwood bark; or
- d. 1,200-1,400 pounds of fiberglass roving.

3. Seed

The kinds of seed and the rates of application shall be as contained in this table. All rates are in pounds per acre. See Notes 1 and 2.

- a. Fall and Winter (Normally September 1 to May 1)
80 pounds of Ky-31 Tall Fescue and 15 pounds of Rye Grain
- b. Summer (Normally May 1 to September 1)
100 pounds of Ky-31 Tall Fescue

NOTE:

1. On cut and fill slopes having 2:1 or steeper slopes, add forty (40) pounds of Sericea lespedeza per acre to the planned seeding (hulled in spring and summer unhulled in fall and winter) plus fifteen (15) pounds of Sudangrass in summer seeding or twenty-five (25) pounds of Rye Cereal per acre in fall and winter seeding, if seeded September to February.
2. These seeding rates are prescribed for all sites with less than fifty percent (50%) ground cover and for sites with more than fifty percent (50%) ground cover where complete seeding is necessary to establish effective erosion control vegetative cover. On sites having fifty to eighty percent (50%-80%) ground cover where complete seeding is not necessary to establish



vegetative cover, reduce the seeding rate at least one-half the normal rate.

E. APPLICATION

1. Equipment to be used for the application, covering, or compaction of limestone, fertilizer, and seed shall have been approved by the City before being used on the project. Approval may be revoked at any time if equipment is not maintained in satisfactory working condition or if the equipment operation damages the seed.
2. Limestone, fertilizer, and seed shall be applied within twenty-four (24) hours after completion of seedbed preparation unless otherwise permitted by the City, but no limestone or fertilizer shall be distributed and no seed shall be sown when the City determines that weather and soil conditions are unfavorable for such operations.
3. Limestone may be applied as a part of the seedbed preparation, provided it is immediately worked into the soil. If not so applied, limestone and fertilizer 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.
4. Seed shall be distributed uniformly over the seedbed at the required rate of application, and immediately harrowed, dragged, raked, or otherwise worked so as to cover the seed with a layer of soil. The depth of covering shall be as directed by the City. If two (2) kinds of seed are to be used that require different depths of covering, they shall be sown separately.
5. When a combination seed and fertilizer drill is used, fertilizer may be drilled in with the seed after limestone has been applied and worked into the soil. If two (2) kinds of seed are being used that require different depths of covering, the seed requiring the lighter covering may be sown broadcast or with a special attachment to the drill, or drilled lightly following the initial drilling operation.
6. When a hydraulic seeder is used for application of seed and fertilizer, the seed shall not remain in water containing fertilizer for more than thirty (30) minutes prior to application unless otherwise permitted by the City.



7. Immediately after seed has been properly covered the seedbed shall be compacted in the manner and degree approved by the City.
8. When adverse seeding conditions are encountered due to steepness of slope, height of slope, or soil conditions, the City may direct or permit that modifications be made in the above requirements that pertain to incorporating limestone into the seedbed; covering limestone, seed, and fertilizer; and compaction of the seedbed.
9. Such modifications may include but not be limited to the following:
 - a. The incorporation of limestone into the seedbed may be omitted on:
 - i. cut slopes steeper than 2:1;
 - ii. 2:1 cut slopes when a seedbed has been prepared during the excavation of the cut and is still in an acceptable condition; or
 - iii. areas of slopes where the surface of the area is too rocky to permit the incorporation of the limestone.
 - b. The rates of application of limestone, fertilizer, and seed on slopes 2:1 or steeper or on rocky surfaces may be reduced or eliminated.
 - c. Compaction after seeding may be reduced or eliminated on slopes 2:1 or steeper, on rocky surfaces, or on other areas where soil conditions would make compaction undesirable.

F. MULCHING

1. All seeded areas shall be mulched unless otherwise indicated in the special provisions or directed by the City.
2. It shall be spread uniformly at a rate of two (2) tons per acre in a continuous blanket over the areas specified.



3. Before mulch is applied on cut or fill slopes that are 3:1 or flatter and ditch slopes, the Contractor/Developer shall remove and dispose of all exposed stones in excess of three inches (3") in diameter and all roots or other debris that will prevent proper contact of the mulch with the soil.
4. Mulch shall be applied within twenty-four (24) hours after the completion of the seeding unless otherwise permitted by the City. Care shall be exercised to prevent displacement of soil or seed or other damage to the seeded area during the mulching operations.
5. Mulch shall be uniformly spread by hand or by approved mechanical spreaders or blowers which will provide an acceptable application. An acceptable application will be that that will allow some sunlight to penetrate and air to circulate but also partially shade the ground, reduce erosion, and conserve soil moisture.
6. Mulch shall be held in place by applying a sufficient amount of asphalt or other approved binding material to assure that the mulch is properly held in place. The rate and method of application of binding material shall meet the approval of the City. Where the binding material is not applied directly with the mulch, it shall be applied immediately following the mulch operation.
7. The Contractor/Developer shall take sufficient precautions to prevent mulch from entering drainage structures through displacement by wind, water, or other causes and shall promptly remove any blockage to drainage facilities that may occur.

G. MAINTENANCE

1. The Contractor/Developer shall keep all seeded areas in good condition, reseeding and mowing if and when necessary as directed by the City, until a good lawn is established over the entire area seeded and shall maintain these areas in an approved condition until final acceptance of the Contract.
2. Grassed areas will be accepted when a ninety-five percent (95%) cover by permanent grasses is obtained and weeds are not dominant. On slopes, the Contractor/Developer shall provide against washouts by an approved method. Any



washouts that occur shall be regraded and reseeded until a good sod is established.

3. Areas of damage or failure due to any cause shall be corrected by being repaired or by being completely redone as may be directed by the City. Areas of damage or failure resulting either from negligence on the part of the Contractor/Developer in performing subsequent construction operations or from not taking adequate precautions to control erosion and siltation as required throughout the various sections of the Specifications, shall be repaired by the Contractor/Developer at his cost and as directed by the City.

END OF SECTION



SECTION 332700 SANITARY SEWER PIPE AND APPURTENANCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including Modified General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Where specific standards are referenced within this document, the most current specification and/or latest revision shall apply.

1.2 SUMMARY

- A. Section Includes:
 - 1. Pipe and fittings.
 - 2. Valves and appurtenances.
 - 3. Transition couplings.
 - 4. Manholes and appurtenances.

1.3 SCOPE OF WORK

- A. Furnish all labor, equipment, materials, incidentals, and temporary facilities necessary to install and complete the sanitary sewer and/or force main installation in accordance with the plans. All pipe and appurtenance material shall be of the type and class specified herein.
- B. All pipeline and appurtenance excavation, bedding, pipe laying, jointing and coupling of pipe joints and backfilling shall be completed as described herein.

1.4 DEFINITIONS

- A. AASHTO – American Association of State Highway and Transportation Officials
- B. ACPA – American Concrete Pavement Association
- C. ANSI – American National Standards Institute
- D. API – American Petroleum Institute
- E. ASTM – American Society for Testing and Materials



- F. AWWA – American Water Works Association
- G. CFM – Cubic Feet per Minute
- H. DIP – Ductile Iron Pipe
- I. HDD – Horizontal Directional Drilling
- J. HDPE – High Density Polyethylene
- K. LB – Pound
- L. Min. - Minute
- M. NFPA – National Fire Protection Association
- N. NSF – National Sanitation Foundation
- O. NSPT – National Standard Pipe Thread
- P. PE – Polyethylene
- Q. PPM – Parts Per Million
- R. PSI – Pounds per Square Inch
- S. PSIG – Pounds per Square Inch (Gauge)
- T. PVC – Polyvinyl Chloride
- U. RCP – Reinforced Concrete Pipe

1.5 SUBMITTALS

- A. All submittals shall be in accordance with the requirements of Division 1 of these specifications.
- B. Shop drawings or submittals shall be required for the following:
 - 1. Drawings and descriptive data on manholes (including wall thicknesses, vertical dimensions, and deflection angles), concrete used in manufacture of manholes and precast inverts, rubber gaskets, joint sealant, flexible manhole sleeves and joints, frames and covers, inverts, and manhole steps shall be submitted to the City for review prior to their manufacture.
 - 2. All sizes and types of pipe.



3. All pipe fittings, valves and appurtenances.
 4. All transition couplings.
- C. Coordination Drawings: For piping and specialties including relation to other services in same area, drawn to scale. Show piping and specialty sizes and valves, meter and specialty locations, and elevations.
- D. Operation and Maintenance Data: For specialties valves and appurtenances to include in emergency, operation, and maintenance manuals.
- E. When utilized on the project, the Contractor/Developer shall submit detailed plans and a description outlining all provisions and precautions to be taken by the Contractor/Developer regarding the handling of existing wastewater flows during the sewer line connections, replacement or startup of the sewage pumps. This plan must be specific and complete, including such items as schedules, locations, elevations, capacities of equipment, materials and all other incidental items necessary and/or required to ensure proper protection of the facilities, including protection of the access and bypass pumping locations from damage due to the discharge flows, and compliance with the requirements and permit conditions. The submitted work schedule shall minimize the interruption and/or bypassing of wastewater flow during construction. The plan shall include the use of a "High Water Alarm" in the manhole or structure used for bypass pumping. The submittals shall include electrical schematics and control panel information for the pumps including start/stop and alarming configurations. No construction shall begin until all provisions and requirements have been reviewed by the City. The Contractor/Developer shall allow 30 days for review of this plan.
1. The plan shall include but not limited to details of the following:
 - a. Staging areas for pumps;
 - b. Plan showing proposed equipment and piping layouts including details of tie-ins to existing sewer lines and/or force mains;
 - c. List of pump sizes, valves, piping, fittings and other appurtenances;
 - d. Method of noise control for each pump and/or generator;
 - e. Method for controlling and monitoring the pumps.
 - f. Contingency plan for a sanitary sewer overflow caused by the diversion of the sewer flow.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. The Contractor/Developer shall coordinate material deliveries with the manufacturer/supplier. All materials shall be handled and stored in accordance with the manufacturer's recommendations using methods that



will prevent damage to the materials. Further, all manhole components shall be handled and stored in accordance with the ASTM C891.

- B. Preparation for Transport: Prepare valves according to the following:
 - 1. Ensure that valves are dry and internally protected against rust and corrosion.
 - 2. Protect valves against damage to threaded ends and flange faces.
 - 3. Set valves in best position for handling. Set valves closed to prevent rattling.
- C. The Contractor/Developer shall unload pipe and appurtenances so as to avoid deformation or other injury thereto. Pipe shall not be placed within pipe of a larger size and shall not be rolled or dragged over gravel or rock during handling. If any defective material is discovered after installation, it shall be removed and replaced with sound pipe or shall be repaired by the Contractor/Developer in an approved manner and at his own expense.
- D. The Contractor/Developer shall store all pipe and appurtenances on sills above storm drainage level and deliver for laying after the trench is excavated. Do not store any plastic materials in direct sunlight. All plastic materials shall be supported to prevent sagging and bending. All plastic materials shall also be covered with tarps if exposed to the elements for extended periods of time.
- E. Protect pipe, pipe fittings, and seals from dirt and damage.
- F. Handle all materials in accordance with the manufacturer's written instructions.
- G. When any material is damaged during transporting, unloading, handling or storing, the undamaged portions may be used as needed, or, if damaged sufficiently, the City will reject the material as being unfit for installation. The City will reject any ductile iron pipe with a damaged cement lining.

1.7 **PROJECT CONDITIONS**

- A. Interruption of Existing Sanitary Sewerage Service: The interruption of sewer flows within the collection system or service to any occupied structure or facility will not be permitted unless specifically approved by the City. The Contractor/Developer shall be responsible for maintaining sewer flows at all times.



1. When by-pass pumping of sewer flows is necessary, the Contractor/Developer shall submit a by-pass pumping work plan to the City in conjunction with the submittal of a construction schedule. The plan shall include a primary pump and an identical standby pump.
2. Notify City no fewer than 72 hours in advance of proposed by-pass pumping of sewer flows.
3. Do not proceed with by-pass pumping of sewer flows without City's written permission.

1.8 QUALITY ASSURANCE

- A. Regulatory Requirements:
 1. Comply with all requirements of City providing sanitary sewer service including the connection of new collection system piping.
 2. Comply with all standards of authorities having jurisdiction for sanitary sewer service piping, including materials, installation, and testing.
- B. All piping materials shall bear label, stamp, or other markings of specified testing agency.
- C. Electrical Components, Devices, and Accessories: All associated materials shall be listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- D. The design, installation and operation of any temporary pumping system, when required to maintain sewer flows in the existing system, shall be the Contractor/Developer's responsibility. The Contractor/Developer shall demonstrate experience in the design and operation of temporary bypass pumping systems or employ the services of a vendor who can demonstrate this experience. The Contractor/Developer or vendor shall provide at least five (5) references of projects of a similar size and complexity as this project performed within the past three (3) years. The bypass system shall meet the requirements of all codes and regulatory agencies having jurisdiction.

1.9 COORDINATION

- A. Coordinate any connections to the existing sanitary sewer with the City.



PART 2 - PRODUCTS

2.1 BYPASS PUMPING EQUIPMENT

A. Equipment:

1. All pumps utilized for bypass pumping shall be centrifugal, end suction, fully automatic self-priming units that do not require the use of foot valves in the priming system. The pumps may be electric or diesel powered. All pumps used must be constructed to allow dry running for long periods of time to accommodate the cyclical nature of sewer flows. The pumps shall not be hydraulic submersible type.
2. Pumps shall be equipped with sound attenuation enclosures which reduce operating noise to 66 dB at 30 feet. Pump sizing shall be in accordance with this Specification.
3. The bypass pumping system shall include the necessary stop/start controls for the pumps.
4. The Contractor/Developer shall have adequate standby equipment available and ready for immediate operation and use in the event of an emergency or breakdown. A backup pump of size equal to the largest bypass pump shall be included. The backup pump shall be on-line, isolated from the primary system by a valve.
5. Temporary discharge piping shall be constructed of rigid pipe with positive, restrained joints. Aluminum "irrigation" type piping or glued PVC pipe will not be allowed. Discharge hose will only be allowed in short sections and as accepted by the City.
6. Allowable piping shall be as specified herein or as otherwise approved in writing by the City.

B. System Description:

1. Design Requirements:
 - a. The bypass pumping system shall have sufficient capacity to pump a peak flow equal to or greater than the capacity of the sewer line being bypassed. The Contractor/Developer shall provide, maintain and operate all necessary pipeline plugs, pumps of adequate size to handle the peak flow, and temporary discharge piping to ensure that the total influent flow can be safely diverted around the affected section to be repaired or replaced. Bypass pumping systems will be required to be operated 24 hours



- per day from the time the existing sewer line is removed from service until the new sewer line is put into service and has been determined to be Substantially Complete by the City.
- b. Temporary bypass pumping during construction may be accomplished by utilizing existing sanitary sewer manholes upstream and downstream of the affected section. The Contractor/Developer shall verify location of all utilities, size of fittings, couplings and all other bypass requirements as previously noted. The bypass connection and piping shall be installed and tested prior to bypassing.
 - c. When bypass pumping from an existing valve vault or pump station, the Contractor/Developer shall verify that all necessary components of the existing system are in good working condition. The City shall be responsible for operating these valves during construction/upgrades at existing facilities. The Contractor/Developer shall coordinate with the City's personnel regarding the operation of these facilities and providing a minimum of five (5) days' notice to the City prior to conducting any verification or performing any construction operations.

2.2 PIPE MATERIALS

- A. 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 City at the plant, trench, or other point of delivery, for the purpose of culling and rejecting materials which do not conform to the requirements of these specifications. Such material shall be marked by the City and the Contractor/Developer shall remove it from the project site upon notice being received of its rejection.
- B. 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 which are clearly inapplicable.

2.3 DUCTILE IRON SEWER PIPE (DIP) – GRAVITY SEWER AND FORCE MAINS

- A. Ductile Iron Pipe shall be as manufactured in accordance with AWWA C151, ASTM A-746, ANSI Specification A21.50 and A21.51 and shall be Class 350.
 1. The pipe interior shall be cement mortar lined and seal coated, standard thickness, in accordance with ANSI Specification A21.4.



2. The exterior of all pipe shall be coated with either a coal or asphaltic base bituminous pipe coating in accordance with ANSI Specification A21.8.
 3. Pipe shall be furnished with Slip Joints, Mechanical Joints, or Flanged Joints as indicated on the drawings and in accordance with the specifications described below:
- B. Slip Joints: Slip or "push-on" joints shall be manufactured in accordance with AWWA C111. Pipe thickness shall be Class 350 as determined by AWWA C150.
1. 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 gasket and associated lubricant shall be furnished by the pipe manufacturer and shall be manufactured in accordance with ANSI Specification A21.11.
 2. 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. In force main installations, no joint may exceed a maximum deflection of 11 inches in an 18-foot joint of pipe (3 degrees).
- C. Restrained-Joint Ductile Iron Pipe:
1. All restrained joint pipe shall be ductile iron, manufactured in accordance with the requirements of ANSI/AWWA C151/A21.51. The rated working pressure for pipe sizes 4-inch through 24-inch shall be 350 PSI and 250 PSI for pipe sizes 30-inch through 64-inch as determined by AWWA C150 unless otherwise noted. Push-on joints for such pipe shall be in accordance with ANSI/AWWA C111/A21.11.
 2. Fittings shall use Griffin BOLT-LOK™ or SNAP-LOK™ connections as required for restraint.
 - a. Fittings shall be as specified below.
 3. SNAP-LOK™ pipe shall be capable of being deflected, after assembly, as follows:
 - a. 4° for pipe sizes 6" - 12"
 - b. 3° for pipe sizes 14" - 24"
 - c. 2° for pipe sizes 30" - 36"
 - d. ½° for pipe sizes 42" – 48"



4. BOLT-LOK™ pipe shall be capable of being deflected, after assembly, as follows:
 - a. 4° for pipe sizes 4" – 12"
 - b. 3° for pipe sizes 14" – 24"
 - c. 2-½° for pipe sizes 18" – 20"
 - d. 2° for pipe sizes 24" -36"
 - e. ½° for pipe sizes 42" – 48"
5. External loading conditions shall not deflect the pipe more than 3% in the horizontal direction.

D. Mechanical-Joint Ductile Iron Pipe:

1. All mechanical joint pipe shall be ductile iron manufactured in accordance with AWWA C111. Pipe shall be manufactured in accordance with AWWA C151, and the pipe thickness shall be Class 350 as determined by AWWA C150 unless otherwise noted.
2. All bolts shall be tightened by means of torque wrenches in such a manner that the follower shall be brought up toward the pipe evenly. If effective sealing is not obtained by tightening the bolts to the specified torques, the joint shall be disassembled and reassembled after thorough cleaning.
3. Bolts for mechanical joints shall be high grade steel, low alloy type, with tee or hex head and American Standard threads. Mechanical joint gland shall be gray iron and shall utilize a plain rubber gasket.

E. Flanged-Joint Ductile Iron Pipe:

1. Flanged pipe shall have flanges with long hubs, shop fitted on the threaded end of the pipe.
2. Where required, flanges shall be tapped for stud bolts. Flanges shall be accurately faced at right angles to the pipe axis and shall be drilled smooth and true, and covered with coal tar pipe varnish or otherwise protected against corrosion of flange faces. Flange faces shall be cleaned to bare metal with wire brushed before installation of pipe.
3. Ductile iron flanged joint pipe shall have a thickness of Class 53 minimum and shall conform to AWWA C110 and AWWA C115. Pipe shall be ordered in lengths needed as no pipe shall be cut, threaded or flanged in the field. All pipe shall have Class 125 flanges conforming to AWWA C110 unless otherwise specified.



4. Flanged joints shall be made up with through bolts of the required size. Bolts shall be zinc plated, with good and sound, well fitting threads, so that the nuts may be turned freely by hand.
 5. Flanged joints shall be made up using only full face gaskets with a minimum thickness of 1/8-inch. Ring gaskets are not acceptable. Gasket material shall be rubber or approved equal as recommended by the Manufacturer.
 6. Connecting flanges shall be in proper alignment and no external force shall be used to bring them together.
- F. Long Span Pipe: "Long span" type ductile iron pipe shall be used for unsupported spans greater than 20'-0". "Long span" ductile iron pipe and associated pipe joints shall be designed by the pipe manufacturer specifically for elevated crossings with unsupported spans shown on the drawings. The Contractor/Developer shall submit shop drawings from the pipe manufacturer for the long span pipe. Shop drawings shall include material specifications for the pipe and joints, and shall specify locations of joints with respect to the pier locations shown on the drawings. Long span ductile iron pipe shall be as manufactured by American, U.S. Pipe, or equal.

2.4 POLYVINYL CHLORIDE SEWER PIPE (PVC)

- A. Gravity: Polyvinyl Chloride Pipe shall be as manufactured in accordance with ASTM D-3034, latest edition, and shall be suitable for use as a gravity sanitary sewer pipe. The standard dimension ratio (SDR) shall be 26 unless otherwise specified on the contract drawings.
- B. All polyvinyl chloride pipe joints shall be of an integral bell and spigot of the same material as the pipe. It shall have a solid cross-section with rubber "O" ring securely locked in place at the point of manufacture.
- C. Force Main: Polyvinyl chloride pipe shall be as manufactured in accordance with ASTM D-2241, latest edition, and shall be suitable for use as a sanitary sewer force main pipe. The standard dimension ratio (SDR) shall be 26. PVC force main piping shall have a green exterior color. Under no circumstances shall pipe with a blue exterior color be accepted. No pipe joint may exceed a maximum deflection of 11 inches in an 18-foot joint of pipe (3 degrees).
- D. Where PVC pipe is installed in iron pipe size (IPS), an IPS gasket shall be furnished with each fitting to insure compatibility.



2.5 HIGH DENSITY POLYETHYLENE PIPE (HDPE)

- A. High-density polyethylene pipe may be used in the horizontal directional drilling (HDD) of sewer force mains as indicated on the project drawings. Piping shall be extruded from a polyethylene compound and shall conform to the following requirements:
1. The polyethylene resin shall meet or exceed the requirements of ASTM D3350 for PE 3408 material with a cell classification of 335434C or better.
 2. The polyethylene compound shall be suitably protected against degradation by ultraviolet light by means of carbon black, well dispersed by precompounding in a concentration not less than 2 percent.
 3. The maximum allowable hoop stress shall be 800 psi at 73.4 °F.
 4. The pipe manufacturer shall be listed with the Plastic Pipe Institute as meeting the recipe and mixing requirements of the resin manufacturer for the resin used to manufacture the pipe in this project.
 5. The pipe and bends shall have a minimum standard dimension ratio (SDR) wall thickness as specified by the City.
 6. Joining shall be performed by thermal butt-fusion in accordance with the manufacturer's recommendations.
 7. Sanitary sewer pipe exterior shall be green in color or contain green striping.

2.6 BRASS PIPE AND FITTINGS (For Use In Force Main Appurtenances Only)

- A. Brass goods furnished under this specification shall be new and unused. All brass pipe and fittings utilized in the assembly of force main appurtenances shall be seamless red brass (copper alloy 230) in accordance with ASTM B43. Metal alloy composition shall be as follows:
1. Copper: 84.0% to 86.0%
 2. Lead: 0.05% max.
 3. Iron: 0.05% max.
 4. Zinc: Remainder (approximately 15%)
- B. All brass pipe and fittings shall be regular weight (schedule 40) with threaded ends in accordance with ANSI B1.20.1.



- C. Unless otherwise noted, all pipe and fittings shall have a minimum working water pressure of 150 psi and shall conform to AWWA Standard C800.
- D. All fittings shall either be stamped or embossed with the manufacturer's name.

2.7 FITTINGS – DIP AND PVC FORCE MAINS

- A. Fittings in DIP and PVC force mains shall be required where the sanitary sewer force main has a significant change in alignment or grade. The specifications for the force main fittings are described below:
 - 1. All fittings for any type of sewer force main shall be ductile iron mechanical joint fittings manufactured in accordance with ANSI Specification A-21.1 and AWWA Standard C153 (compact body type) for underground piping for 3 inch through 24 inch diameter fittings and AWWA C110 (full body type) for pipe diameters larger than 24 inches.
Where flanged pipe is used ductile iron fittings shall be flanged in accordance with AWWA C153 or AWWA C110 (based on sizing as stated above) for exposed piping. All flanges shall be Class 125 unless otherwise noted.
 - 2. The interior of all fittings shall be cement mortar lined (not less than 1/16-inch), seal coated in accordance with ANSI Specification A21.4 and AWWA C-104, and suitable for a minimum working pressure of 250 PSI unless otherwise specified.

2.8 GASKETS

- A. All rubber gaskets for DIP and PVC pipe and fittings shall be in accordance with AWWA C111. All gaskets shall be a product of the pipe manufacturer, made specifically for the pipe being installed, and shall match the shape and configuration of the joint.
- B. Gaskets for ductile iron restrained joint shall be push-on pipe shall provide a trouble-free means of joint restraint for the pipe. These restraining systems shall include gaskets provided by the pipe manufacturer that contain high-strength stainless steel elements spaced around the gasket that develop a dependable gripping action. These push-on restrained joint gaskets shall be rated for a working pressure of 350 PSI for pipe sizes 4-inch through 24-inch and 150 psi for 30-inch pipe.

2.9 WYES, SADDLES, AND SERVICES

- A. The materials described within this paragraph shall include all materials to construct a complete sanitary sewer service connection from the gravity sanitary sewer main to the edge of the permanent easement or right-of-way.



- B. Wyes and saddles shall be of the same material and strength as the sewer mains on which they are installed. Saddle type fittings shall not be used on new construction or existing mains for pipes 12 inches in diameter or smaller, unless specifically called for in the Plans and/or Specifications or approved in writing by the City. For ductile iron mains greater than 12 inches in diameter, "CB" Romac tapping saddles as manufactured by Romac Industries, Inc. or an approved equal may be used. Unless otherwise specified in the Plans and/or Specifications, house services from main to cleanout at property line shall be constructed of 6-inch diameter SDR 26 pipe or Class 350 psi ductile iron pipe and from cleanout to home connection shall be 4-inch Schedule 40 PVC or Class 350 psi ductile iron pipe.
- C. For taps and services on an existing PVC or VCP sewer mains that are being repaired by trenchless construction methods, flexible saddles as manufactured by NDS/HPI or an approved equal may be utilized. Flexible saddles shall be affixed to the sewer main by stainless steel bands or straps as provided by the manufacturer and by using a two-part epoxy glue uniformly spread over the contact surface of the saddle.
- D. A compression coupling by Inserta-Tee or approved equal shall be used to re-connect services to existing 8-inch and larger diameter sewer mains that are being rehabilitated by trenchless construction methods.
- E. Wyes shall be placed in sanitary sewers so as to properly serve each existing house and each vacant lot facing or butting on the street or alley in which the sewer is being laid, and at such other locations as may be designated by the City.
- F. The location of all wyes, cleanouts, and service lines installed in the work shall be identified on the plans submitted by the Contractor/Developer at the end of the project.

2.10 TRANSITION COUPLINGS

- A. New Sewer System Construction:
 - 1. In general, transition couplings shall not be permitted in the construction of new sewer systems. For new gravity sewer system construction, the same pipe material shall extend between manholes with no transitions.
 - 2. The pipe material associated with a sewer force main may change, when and where indicated on the Drawings or as approved by the City. When the nominal diameter of the pipe does not change, an approved transition coupling may be used, as necessary, to joint these dissimilar materials. In these cases, a ductile iron, mechanical joint, solid sleeve shall be used to joint these dissimilar materials. The solid sleeve shall



be as specified above for fittings and shall be the long body-type. The appropriate gaskets shall be selected based on the outside diameters of the materials being jointed. All gaskets shall be as specified above. In all cases, the gap between the pipe sections being jointed shall not exceed 0.25 inches.

3. Where the nominal diameter of a sewer force main changes, an appropriate ductile iron, mechanical joint reducer, as specified above for fittings, shall be used to joint these materials. The appropriate gaskets shall be selected based on the outside diameters of the material being jointed. All gaskets shall be as specified above.

B. Rehabilitation of Existing Sewer Systems:

1. In general, during the rehabilitation of existing sewer lines, the use of appropriate transition couplings shall be permitted as approved by the City. All changes in pipe size within the gravity sewer collection system shall require the installation of a manhole as specified elsewhere.
2. Jointing for gravity sewer lines shall require an appropriate shielded rubber sewer coupling. In all cases, the gap between the pipe sections being jointed shall not exceed 0.25 inches. The coupling shall consist of a rubber sleeve conforming to ASTM C425 and ASTM C1173 with a Grade 316 stainless steel shear ring and clamps conforming to ASTM A240. Clamps shall be included with nut and bolt or worm drive take-up fasteners. "O" ring-type seals shall be provided under each sealing clamp to prevent slippage and provide a positive seal.
3. When the rehabilitation of a sanitary sewer force main requires the use of a transition coupling, the use of such couplings shall be as approved by the City. When the nominal diameter of the pipe does not change, an approved transition coupling may be used, as necessary. In these cases, a ductile iron, mechanical joint, solid sleeve shall be used to joint these materials. The solid sleeve shall be as specified above for fittings and shall be the long body-type. The appropriate gaskets shall be selected based on the outside diameter(s) of the material(s) being jointed. All gaskets shall be as specified above. In all cases, the gap between the pipe sections being jointed shall not exceed 0.25 inches.
4. Where the nominal diameter of a sewer force main changes as part of a rehabilitation project, an appropriate ductile iron, mechanical joint reducer, as specified above for fittings, shall be used to joint these materials. The appropriate gaskets shall be selected based on the outside diameters of the material being jointed. All gaskets shall be as specified above.



2.11 MANHOLES

- A. Standard precast concrete manholes sections shall conform to the latest revision of ASTM C 478. All manholes shall be cast with Xypex Admix C-1000 per manufacturer’s specifications. Tapered section and transition sections, where required, shall be of eccentric cone design, having the same wall thickness and reinforcement as the cylindrical ring sections. Flat slab tops shall be required for very shallow manholes where shown or specified. Flat slab tops shall ONLY be utilized when/where approved for use by the City. All manholes shall be constructed to the sizes, shapes and dimensions and at the locations shown on the plans. Unless otherwise shown on the plans, manhole diameters, wall thicknesses and bottom thicknesses shall be as follows:

Pipe Size (inches)	Diameter (feet)	Wall Thickness (inches)	Bottom Thickness (inches)
8 through 18	4	5	6
21 through 36	5	5	8
39 through 54	6	6	8
Larger than 54	8	8	8

- B. The minimum wall thickness of all manhole riser sections shall be as shown in the table above. Cone sections shall have a minimum wall thickness of 8 inches at their top. Suitable openings for inlet and outlet pipes shall be cast into the base section for standard connections and into the riser section for drop connections. These openings shall be circular, accurately located and appropriately sized for each manhole.
- C. The height or depth of each manhole will vary with the location, but unless otherwise indicated, it shall be constructed such that the top of the manhole matches that of the finished grade surrounding the manhole and the invert is constructed at elevation shown on the plans. As directed by the City (or as otherwise indicated on the plans) the top elevations of some manholes maybe elevated above the finished grade of the surrounding area in wooded or other natural (unmaintained) areas. In all cases, the number of manhole sections (joints) necessary to construct the required height shall be minimized.
- D. All manhole and wet well bases shall be monolithically poured complete with a bottom. When indicated on the drawings, precast concrete base sections shall be provided with extended base sections or increased bottom thickness



to provide ballast to prevent flotation. Extended bases, as required by the drawings, may be included in the monolithic pour of the base or integrally cast as approved by the City.

- E. Minimum compressive strength of concrete shall be 4,000 psi at 28 days and shall comply with ACI 318, and ACI 350. The maximum permissible absorption shall be 6.0 percent. All cement used in the mixture shall be in accordance with ASTM C 150, Type II. Fine aggregate shall be sand, while coarse aggregate shall be crushed gravel, both in accordance with ASTM C 33. All water utilized in the concrete mix shall be potable water. Bases and risers shall be reinforced with a single cage of steel placed within the center third of the wall. Welded wire fabric shall be in accordance with ASTM A 185. Steel reinforcing bars shall be grade 60 deformed steel in accordance with ASTM A 615. The tongue or the groove of the joint shall contain one (1) line of circumferential reinforcement equal in area to that in the barrel of the manhole riser. The minimum cross-sectional area of steel per linear foot shall be 0.12 square inches. Precast manhole sections shall fit together readily.
- F. The quality of materials, the process of manufacture, and the finished manhole sections shall be subject to inspection and approval by the City. The manhole sections shall be perpendicular to their longitudinal axis within the limits listed in ASTM C 478.
- G. Joint Sealing Materials: Joints shall be sealed by Tylox SuperSeal Gaskets or two (2) butyl rubber seals.
 - 1. Butyl Seals shall consist of a plastic or paper-backed butyl rubber rope no less than 1 inch cross section. When manholes are larger than 4 feet diameter or have a larger than normal space between the joints, the length and or diameter of the rope shall be increased as required to achieve a seal. Butyl rubber material shall conform to Federal Specification SS-S210A, AASHTO M-198, Type B - Butyl Rubber and as follows: maximum of 1 percent volatile matter and suitable for application temperatures between 10 and 100 degrees F. Butyl rubber shall be applied to clean, dry surfaces only. Use of 2 independent wraps of Butyl Rubber placed side-by-side (not stacked) qualifies for the requirement of two seals.
 - 2. Internal O-Ring Gaskets and Internal Rubber Gaskets shall not be used.
- H. Manhole Sleeves and Entrance Joints: Flexible manhole sleeves or flexible manhole entrance joints shall be installed on all pipes entering and leaving precast manholes. Manhole openings shall be accurately core drilled or cast in place. Sleeve and joint material shall be neoprene which complies with the



requirements of ASTM Specification C 923. Sleeve hardware (clamps, bands, straps, draw bolts, nuts, etc.) shall be stainless steel and make a watertight union. Pipe connections to manholes shall be sealed with non-shrink cementitious grout with smooth troweled finish after boot connection.

I. Flexible manhole entrance joints may be cast into the wall of the manhole base or may be installed by coring the manhole wall and installing the flexible connector to form a tight waterstop. Joints shall be watertight under a 30 foot head of water. Flexible manhole entrance joints shall be A-LOK Joints as manufactured by the A-LOK Products Corp., Press Wedge II as manufactured by the Press Seal Gasket Corp., or equal. Flexible manhole sleeves and flexible manhole entrance joints shall be installed in accordance with instructions of their manufacturer.

J. Manhole Steps:

1. Steps shall be a copolymer polypropylene plastic reinforced with a ½ inch diameter, grade 60 bar and have serrated tread and tall end lugs. Step pull out strength shall be a minimum of 2,000 pounds when tested according to ASTM C-497.
2. Steps shall be required in all structures with a depth greater than four (4) feet. Steps shall be vertically aligned and uniformly spaced for the entire depth of the structure. Steps shall be located in the structures along the vertical face of the eccentric cone and so as to land upon a bench.
3. Steps shall be vertically spaced between 12 and 16 inches on center. Step width shall be a minimum of 12 inches. Steps shall protrude from the wall of the structure a minimum of five (5) inches and a maximum of seven (7) inches.
4. Secure steps to the wall with a compression fit in tapered holes. Steps shall not be vibrated or driven into freshly cast concrete. Steps shall not be grouted in place.

K. Precast Grade Rings and Brick:

Precast reinforced concrete or HDPE grade rings shall be used to adjust ring and covers to finished grade. No more than 12 vertical inches of grade rings will be allowed per manhole. Grade rings shall conform to ASTM C478 and shall be no less than 6 inches and no more than 9 inches in height with a diameter matching that of the frame and cover.



L. Manhole Frames and Covers:

1. Frames and covers shall be ASTM A 48, EJ 104511 frame with 104033 Gatlinburg logo wastewater cover by East Jordan Iron Works. Frame shall be solidly attached with four anchor bolts and appropriate gasket material to manhole.
2. The standard manhole casting shall be designed for heavy duty use with a 190 pound frame and 125 pound cover. All frames and covers shall comply with AASHTO HS20 loading requirements. The minimum opening within the interior of the frame shall be 24-inches. The frame shall have a 4-inch minimum width flange with the cover being 26 inches in diameter.
3. Special waterproof manhole frame and covers shall be installed only at those locations indicated on the contract drawings. Ring shall have a flat type gasket and cover shall be bolted down with a minimum of four (4) bolts.
4. After the manhole has been set in its final position, set the manhole frame to the required elevation using no more than 12 inches of precast concrete grade rings, or Ladtech HDPE adjusting rings set with black gasket material sealing all joints between cone, adjusting rings, and manhole frame. When grade rings are used, grout with non-shrink grout. Where manholes are constructed in paved areas, the top surface of the frame and cover shall be tilted so as to conform to the exact slope, crown and grade of the existing surrounding pavement. Manhole frames which are placed above final grade will have frames attached to manhole cone section by means of 5/8-inch diameter stainless steel anchors and washers. One anchor bolt shall be provided per hole.
5. When flat slab tops are utilized, frames shall be cast into the top for access into manholes. Flat slab tops are to be used only for very shallow manholes.

M. Manhole Inverts and Benches:

1. All sanitary sewer manholes (excluding wet well structures) shall include inverts and benches. Manhole inverts and benches shall be constructed of brick and cement grout or precast concrete in accordance with the standard details shown on the drawings. Inverts shall have a "U" shaped cross section of the same diameter as the invert of the sewers which they connect. "U" shaped inverts shall be constructed to a minimum depth of 6 inches for 8 inch sewers and to full pipe diameter depth of the outlet sewer main for larger mains. The



manhole invert shall be carefully formed to the required size and grade by gradual and even changes in sections. Changes in direction of flow through the manhole, whether horizontal or vertical, shall be made with true tangent curve(s) with as large a radius as the size of the manhole will permit. Provide a ½ inch radius at the intersection of 2 or more channels. The minimum concrete thickness in the invert of the channel shall be 2 inches, not including the manhole base thickness. The fall across the manhole invert shall be as noted on the plans.

2. Manhole benches shall be constructed with a slope of 1 inch per foot (8 percent) sloped toward the invert channel. Finish benches shall provide a uniform slope from the high point at the manhole wall to the low point at invert channel. Provide a radius (1/8 inch to 1 inch range is acceptable) at the edge of the bench and channel.
 3. When the invert and bench are not constructed by the precast manufacturer, the Contractor/Developer shall construct the invert and bench using 3,000 psi concrete or non-shrink grout. Non-shrink grout may be plastered over layered brick and mortar in lieu of solid non-shrink grout invert.
 4. Gradual smooth sided depressions and high spots may be allowed so long as diameter of invert channel ranges from 1/4 inch less than, or 1/2 inch more than the nominal pipe diameter are maintained. Voids, chips, or fractures over 1/8 inch in diameter or depth shall be filled with a non-shrink grout and finished to a texture reasonably consistent with the bench surface. All work from collar down shall have a steel trowel finish.
 5. Pipe Openings: Pipe openings shall provide clearance for pipe projecting a minimum of 2 inches inside the manhole. The crown of smaller diameter pipes shall be no lower than the crown of the outlet pipe. Grout pipe penetrations, including pipe crown, to provide a smooth, uniform finish using non-shrink grout.
- N. Manhole Drops: Standard drop manholes will be constructed only at those locations shown on the drawings or as approved by the City. The design of the drop connection shall be in accordance with the standard detail drawing. The cost of the extra pipe, labor, etc. required to construct a drop manhole will be included in the unit price for the drop manhole at the depths indicated.
- O. Manhole Vents:
1. Where designated on the contract drawings, a 4-inch diameter vent pipe shall be installed as an integral part of the manhole. The vent pipe is to be tapped into the upper most section of the manhole, anchored in



concrete and extended vertically to the elevation shown on the drawings. The pipe shall have a reverse bend and screen to prohibit rain and foreign materials from entering pipe.

2. The pipe material shall be Schedule 40 Steel with a 3/32 inch coal tar interior lining and have an exterior finish consisting of two (2) coats of epoxy paint as approved by the City.

2.12 SWING CHECK VALVES

- A. Swing check valves smaller than 3 inches in diameter shall be single disc with renewable bronze seat rings, bronze discs or disc rings and bronze disc hinges and pins and shall be designed to give a full diameter passage.
- B. Swing check valves 3 inches in diameter and larger shall be constructed with heavy cast-iron or cast-steel body with a bronze or stainless steel seat ring and a non-corrosive shaft for attachment of weight and lever. The valves shall absolutely prevent the return of water back through the valve when the inlet pressure decreases below the outlet pressure. The valve disc shall be of cast-iron or cast-steel and shall be suspended from a non-corrosive shaft.

2.13 PLUG VALVES

- A. Plug valves shall be solid one piece, cast of ASTM A536 ductile iron. The plug shall have a cylindrical seating surface eccentrically offset from the center of the shaft. Plug shall not contact the seat prior to 90 percent closed. Plug facing shall be Chloroprene (CR), or other resilient facing suitable for the application.
- B. Bodies shall be of ASTM A126 Class B cast iron. Port shall be rectangular. Port area shall be 100 percent of Standard class pipe area. Bearings shall be sleeve type and made of sintered, oil-impregnated permanently lubricated type 316 stainless steel per ASTM A743 Grade CF8M.
- C. Seats shall be 1/8-inch thick welded overlay of not less than 95 percent pure nickel. Seat shall be at least 1/2-inch wide and raised. The raised surface shall be completely covered with nickel to insure that the resilient plug face contacts only the nickel seat.
- D. Adjustable Packing shall be of the multiple V-ring type, with a packing gland follower. Shaft seals shall permit inspection, adjustment or complete replacement of packing without disturbing any part of the valve or actuator assembly except the packing gland follower.
- E. Grit Excluders made of PTFE shall be provided to prevent the entry of grit and solids into the bearing areas.



- F. Pressure ratings shall be bi-directional and 175 psi on sizes 3-inch through 12-inch diameters and 150 psi for 14-inch through 36-inch diameters. Every valve shall be given a certified hydrostatic and seat test, with test reports being available upon request.
- G. Worm gear actuators shall be provided on all valves six inches and larger. Actuators shall be enclosed in a cast iron housing, with outboard seals to protect the bearings and other internal components. The actuator shaft and gear quadrant shall be supported on permanently lubricated bronze bearings.
- H. Buried actuators shall be 90 percent grease filled. Input shaft and fasteners shall be stainless steel. Actuator mounting brackets shall be totally enclosed.
- I. Eccentric plug valves and actuators shall meet or exceed the latest revisions of AWWA C517 and other applicable standards. Flanged ends shall be per ANSI B16.1 and mechanical joint ends per AWWA C111.

2.14 BUTTERFLY VALVES (For Use In Reclaimed Water Systems Only)

- A. Valve shall be designed, manufactured, and tested in accordance with AWWA C504, latest revision, and include the following design features. Valve shall be rated and tested for absolute, zero leakage shut-off.
- B. Valve body shall be cast iron per ASTM A 126 Class B or ductile iron per ASTM A536 Grade 65-45-12. Flanged end valves shall be faced and drilled per ANSI B16.1, Class 125, or as specified by purchaser. Mechanical joint ends shall be per ANSI A21.11 and include mechanical joint end accessories. Valve body shall include a stainless steel seat ring that is mechanically retained without use of clamping devices, adjusting segments, or other hardware being in the waterway.
- C. Valve disc shall be solid type ductile iron without any external vanes, ribs, etc., to obstruct flow. Resilient seat shall be located on edge of disc, offset from the shaft, and seal against mating stainless steel body seat with 36 degree uninterrupted contact. The resilient seal shall be locked to the disc by three separate means of retention, and be field-adjustable, if necessary, with no tools other than a standard socket wrench. Replacement of seat in field shall be possible without valve disassembly. The disc shall be connected to the offset stainless steel shaft by locked taper wedge keys and stainless steel retaining nuts on the back side of the disc. Taper keys shall be heat treated 416 Stainless Steel for added strength. Shaft shall be stub type for valves 30inches and larger in diameter; one piece for valves 24 inches in diameter and smaller. The valve shall be equipped with adjustable thruster for centering the disc on valves 30 inches and larger in diameter, if required.
- D. Shaft shall have nylon sleeve or woven Teflon fiberglass-backed sleeve for bearing surfaces. Bearings shall be self lubricating.



- E. Valve body shall be primed with manufacturer's standard primer.

2.15 VALVE BOXES

- A. All valve boxes shall be cast iron and shall conform to ASTM A48 and AWWA M44. Valve boxes shall be of the adjustable screw type (based on depth of burial) with a base to fit the valve yoke with a removable cover with the word "SEWER" cast thereon.

2.16 SEWAGE AIR/VACUUM RELEASE VALVES

- A. Acceptable Products:

1. The air/vacuum release valve shall be designed specifically for use on sanitary sewer pressure (force) mains. It shall exhaust large volumes of air that may be present in a system during filling of the main or on pump start-up. It shall also allow air to re-enter when the system is drained intentionally or due to a break in the main (prevents vacuum from forming).
2. Three inch and smaller combination air valves with operating pressures of 150 psi or less shall be of the integral type with a valve assembly which functions as both an air and vacuum valve and an air release valve. The valves shall be DeZurik Apco/Hilton "Series 400", GA Industries "Figure 942", Crispin "Type SA", Val-Matic "Models 801A/802A/803A" or ARI "D-020".
3. Four inch and larger combination air valves shall consist of an air and vacuum valve with an externally mounted air release valve. The valves shall be DeZurik Apco/Hilton "Series 400C", GA Industries "Figure 950 Kinetic Custom Combination Air Valves", Crispin "Type SL", or Val-Matic "Model No. 48A/49A".

- B. Materials:

1. Except as modified or supplemented herein, materials of construction shall comply with the standards of the authorities having jurisdiction. The use of stressed thermoplastic components will not be acceptable.
 - a. Valve Trim: Bronze or austenitic stainless steel.
 - b. Float: Austenitic stainless steel.
 - c. Seats: Buna-N



C. Shop Coating and Painting:

1. All interior and exterior ferrous metal surfaces, except stainless steel components, shall be shop painted for corrosion protection. The valve manufacturer's standard coating will be acceptable. Field painting is covered in the protective coatings section.

D. Shutoff Valves:

1. A shutoff valve shall be provided in the piping leading to each air release valve and combination air valve. Each 4-inch and larger combination air valve shall be provided with a shutoff valve between the air and vacuum valve and the air release valve.

PART 3 - EXECUTION

3.1 BYPASS PUMPING

- A. Under this item the Contractor/Developer is required to furnish all materials, labor, equipment, power, maintenance, etc. to implement a temporary pumping system for the purpose of diverting the existing flow around the work area for the duration of the project.

B. Field Quality Control and Maintenance:

1. Testing:

- a. The Contractor/Developer shall perform leakage and pressure tests on the new bypass pumping discharge piping using clean water prior to actual operation. The City shall be given 24-hours' notice prior to testing.
- b. The bypass pumping system shall be tested and operated successfully for 24 continuous hours, and the wet well shall be emptied, prior to start of work.

2. Inspection:

- a. The Contractor/Developer shall monitor the bypass pumping operation at all times to ensure that the system is working correctly.



3. Maintenance Service:

- a. The Contractor/Developer shall insure that the temporary pumping system is properly maintained and a responsible operator shall be on-site when pumps are operating.
- b. A factory-trained service technician shall be located within at least 120 miles from the project site with a full complement of in-stock spare parts for pumps and piping.

4. Extra Materials:

- a. Spare parts for pumps and piping shall be kept on site as required.
- b. Adequate hoisting equipment for each pump and accessories shall be maintained on the site.

C. Preparation:

1. Precautions:

- a. The Contractor/Developer shall make all arrangements for bypass pumping during the time when the main is shut down for any reason. System must overcome any existing force main pressure on discharge.
- b. Contractor/Developer is responsible for locating any existing utilities in the area the Contractor/Developer selects to locate the bypass pipelines. The Contractor/Developer shall locate the bypass pipelines to minimize any disturbance to existing utilities and shall obtain approval of the pipeline locations from the City. All costs associated with relocating utilities and obtaining all approvals shall be paid by the Contractor/Developer.
- c. During all bypass pumping operation, the Contractor/Developer shall protect the City's pump station and/or sewer mains and all local sewer lines from damage inflicted by any equipment. The Contractor/Developer shall be responsible for all physical damage to the pumping station and main and all sewer lines caused by human or mechanical failure.

D. Performance Requirements:

- 1. The design, installation and operation of the temporary pumping system shall be the Contractor/Developer's responsibility. The bypass system shall meet the requirements of all codes and regulatory agencies having jurisdiction.



2. The Contractor/Developer shall provide all necessary means to safely convey the incoming sewage past the work area. The Contractor/Developer will not be permitted to stop or impede the flows in existing force mains.
3. The Contractor/Developer shall maintain sewer flow around the work area in a manner that will not cause surcharging of sewers, damage to sewers and that will protect public and private property from damage and flooding. Any sanitary sewer overflow that occurs due to a failure in the bypass system will be the responsibility of the Contractor/Developer. Any penalties issued by authorities having jurisdiction will be reimbursed to the City by the Contractor/Developer.
4. The Contractor/Developer shall protect water resources, wetlands and other natural resources. No sewage or water from the bypass pumping operation shall be spilled on the ground or allowed to drain to storm drains. When disassembling bypass pumping pipe, the Contractor/Developer shall ensure that any sewage remaining in the pipe is drained back to the sewer collection system. All spills shall be reported to the City, contained and cleaned up immediately by the Contractor/Developer.

E. Installation and Removal:

1. The Contractor/Developer shall remove manhole sections or make connections to the existing sewer and construct temporary bypass pumping structures only at the access location indicated on the Drawings and as may be required to provide adequate suction conduit.
2. Plugging or blocking of sewage flows shall incorporate primary and secondary plugging device. When plugging or blocking is no longer needed for performance and acceptance or work, it is to be removed in a manner that permits the sewage flow to slowly return to normal without surge, to prevent surcharging or causing other major disturbances downstream.
3. When working inside manholes or sewer lines, the Contractor/Developer shall comply with OSHA requirements when working in the presence of sewer gases, combustible oxygen-deficient atmospheres, and confined spaces.
4. The installation of the bypass pipelines is prohibited in all saltmarsh/wetland areas. The bypass pipeline must be located off streets and sidewalks and on shoulders of the roads. When the bypass pipeline crosses local streets and private driveways, the Contractor/Developer must place the bypass pipelines in trenches



and cover with temporary pavement. Upon completion of the bypass pumping operations, and after the receipt of written permission from the City, the Contractor/Developer shall remove all the piping, restore all property to pre-construction condition and restore all pavement. The Contractor/Developer is responsible for obtaining any approvals for placement of the temporary pipeline within public ways from authorities having jurisdiction.

5. If, at any time during construction, effluent from the existing sewer is not fully contained by the bypass system, gravity service will be restored by a temporary tie to the new construction and work will be suspended until the problem is resolved to the satisfaction of the City.

3.2 EARTHWORK

- A. Excavating, trenching, backfilling and compaction requirements are specified in Division 31 Section "Earth Moving."

3.3 PIPING AND VALVE APPLICATIONS

- A. General: Use pipe, fittings, and joining methods for piping systems according to the following applications:
 1. Do not use flanged pipe, fittings or valves or unions for underground (buried) piping. Fittings and valves for underground (buried) piping shall be mechanical joint.
 2. Flanged pipe, fittings and valves and unions shall be used on aboveground piping and piping in vaults.
 3. Transition couplings and special fittings with pressure ratings at least equal to piping pressure rating may be used as specified, unless otherwise indicated.

3.4 PIPING INSTALLATION

- A. Existing Utilities and Separation Requirements:
 1. The Contractor/Developer shall be required to excavate to determine the precise location of utilities or other underground obstructions which are shown on the Plans and/or marked by the utilities. Such location and excavation shall be at least 500 feet ahead of construction, unless otherwise noted. This work shall be done at no additional cost to the City.



2. All utility owners shall be notified prior to excavation as required by the 1985 Underground Damage Prevention Act. Utility owners who are members of TN OneCall may be notified by calling 811 (toll free) before any excavation or drilling. The Contractor/Developer will be fully responsible for damage to any utilities if the owners have not been properly notified as required by the Underground Damage Prevention Act. All damage to such structures and pipelines and all damage to property or persons resulting from damage to such structures and pipelines shall be borne by the Contractor/Developer and shall be completely repaired within a reasonable time. No claim shall be made against the City for damage or delay of the work on account of the proximity of, or the leakage from, such structures and pipelines. Where high pressure gas lines are to be crossed, they shall be uncovered by hand excavation methods before other excavation near them is started.
3. No work shall be backfilled or concealed until visually inspected by the City or an agent acting on the City's behalf. The cost, if any, of such supervision shall be borne by the Contractor/Developer.
4. Conflicts with underground utilities may necessitate changes in alignment and/or grade of this construction. All such changes will be approved by the City before construction proceeds.
5. When underground obstructions not shown on the Plans are encountered, the Contractor/Developer shall promptly report the conflict to the City and shall not proceed with construction until the conflict is resolved.
6. When a sewer main or lateral crosses an existing water main or other utility, the Contractor/Developer shall make the installation in accordance with the minimum specifications of the Controlling Agency and in accordance with the following minimum requirements. When a sewer main or lateral crosses or parallels an existing utility, the following clearance requirements are to be met or ferrous sewer pipe with water tight joints shall be used for a distance of 10 feet outside said point of crossing or until horizontal separation requirements are achieved.
 - a. Min. Vertical Separation for Sewer Crossings:
 - 1) Storm Sewers - 24" Vertical
 - 2) Under Water - 18" Vertical
 - 3) Over Water - 18" Vertical * Sewer over water requires that both pipes shall be ferrous pipe with a 20 foot jointless span centered at crossing. *
 - 4) Cable - 24" Vertical
 - 5) Power - 24" Vertical



6) Gas - 24" Vertical

b. Horizontal Separations:

- 1) Storm Sewers - 5'
- 2) Water Mains - 10'
- 3) Water Supply - 100' (WS-I Waters, Class I or Class II impounded reservoirs)
- 4) Water Supply - 50' (WS-II, WS-III, B, SA, ORW, HQW or SB Waters – from Normal High Water)
- 5) Designated Trout Streams - 25'
- 6) Other Stream, Lake or Impoundment - 10'
- 7) Building Foundation - 5'
- 8) Basement - 10'
- 9) Ground Water Lowering and Surface Drainage Ditch 10'
- 10) Swimming Pool - 10'
- 11) Private Wells - 25'
- 12) Public Wells - 50'

B. Conventional Pipe Laying:

1. The layout of gravity sanitary sewer lines and invert elevations at governing points shall be as shown on the drawings.
2. The Contractor/Developer shall do all layout work for lines and grades from that information shown on the drawings or as furnished by the City.
 - a. When a laser beam instrument is used to set line and grade, the unit must be maintained in good working order, and the calibration checked daily for both alignment and percent grade. In the event the required accuracy of alignment and grade is not adhered to, the City will prohibit the use of laser beams.
 - b. All gravity lines to be installed with continuous grade and alignment between manholes. Piping shall be installed beginning at low point, true to the grades and alignment indicated with unbroken continuity. Pipe shall be laid with bell ends facing in the direction of pipe laying, unless directed otherwise by the City. In all cases, pipe is to be installed in strict accordance with the manufacturer's recommendations and the contract material specifications. The City may augment any manufacturer's installation recommendations if, in his opinion, it will best serve the interest of the City.
 - c. Proper tools, implements, and facilities satisfactory to the City shall be provided and used for the safe and convenient prosecution of pipe laying. All pipe and other materials used in the



laying of pipe will be lowered into the trench piece by piece by means of 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, injured or displaced in the process of laying same, or of backfilling the trench.

- d. When cutting short lengths of pipe, a pipe cutter, as approved by the City, will be used and care will be taken to make the cut at right angles to the centerline 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.
- e. Place a plug in the end of incomplete piping at end of day and when work stops. No trench water or other material shall be permitted to enter the pipe. Clear interior of piping and manholes of dirt and superfluous material as work progresses. Maintain swab or drag in piping, and pull past each joint as it is completed.
- f. Where the pipe is laid on a grade of 20 percent or greater, the laying shall start at the bottom of the slope and proceed upward with the bell end of the new pipe upgrade. All pipe laid on a grade of 20 percent or greater shall require thrust blocking or keying as shown on the standard details.
- g. Install ductile iron, gravity sewer piping in accordance with ASTM A 746.
- h. Install PVC gravity sewer piping in accordance with ASTM D 2321 and ASTM F 1668.
- i. Install reinforced-concrete sewer piping in accordance with ASTM C 1479 and ACPA's "Concrete Pipe Installation Manual."
- j. All sanitary sewer force main piping shall be installed with 36-inch minimum cover over the top of the pipe.
- k. Install ductile iron force main piping in accordance with AWWA C600 or AWWA M41.



l. Install PVC force main piping in accordance with AWWA M23 or ASTM D 2774 and ASTM F 1668.

m. Install detectable warning tape over all nonferrous piping.

C. Exposed Piping:

1. All exposed piping to be installed inside wetwells, vaults and buildings shall be installed as shown on the Drawings and field painted as described below. All exposed pipe shall be ductile iron utilizing flanged joints unless otherwise noted.

2. All exposed ductile iron pipe, fittings and valves shall be field painted with two (2) coats of epoxy paint as recommended by the paint manufacturer. Color of paint shall be as selected by the City.

D. Horizontal Directional Drilling of HDPE Force Mains:

1. The Contractor/Developer may install HDPE force mains by means of horizontal directional drilling. The Contractor/Developer shall assemble, support, and pretest the pipeline prior to installation in the directional drill tunnel.

2. Horizontal directional drilling shall consist of the drilling of a small diameter pilot hole from one end of the alignment to the other, followed by enlarging the hole diameter for the pipeline insertion. The exact method and techniques for completing the directionally drilled installation will be determined by the Contractor/Developer, subject to the requirements of these specifications.

3. The Contractor/Developer shall prepare and submit a plan to the City describing the insertion of the HDPE pipe into the opened bore hole. The plan shall include pullback procedure, ballasting, use of rollers, side booms and side rollers, coating protection, internal cleaning, internal gauging, hydrostatic tests, dewatering, and purging.

4. The required piping shall be assembled in a manner that does not obstruct adjacent roadways or public activities. The Contractor/Developer shall erect temporary fencing around the entry and exit pipe staging areas.

5. Each length of pipe shall be inspected and cleaned as necessary to be free of debris immediately prior to joining.



6. Pipes shall be joined to one another by means of thermal butt-fusion. Polyethylene pipe lengths to be joined by thermal butt-fusion shall be of the same type, grade, and class of polyethylene compound and supplied from the same raw material supplier.
7. Mechanical connections of the polyethylene pipe to auxiliary equipment shall be through flanged connections which shall consist of the following:
 - a. A polyethylene “sub end” shall be thermally butt-fused to the ends of the pipe.
 - b. Provide ASTM A240, Type 304 stainless steel backing flange, 125-pound, ANSI B16.1 standard, and gaskets as required by the manufacturer.
 - c. Stainless steel bolts and nuts of sufficient length to show a minimum of three complete threads when the joint is made and tightened to the manufacturer’s standard. Retorque the nuts after 4 hours.
 - d. Butt-fusion of pipes shall be performed in accordance with the manufacturer’s recommendation as to equipment and technique. Butt-fusion jointing shall be 100% efficient offering a joint weld strength equal to or greater than the tensile strength of the pipe.
8. Pipe installed by the directional drilled method must be located in plan as shown on the drawings, and must be no shallower than shown on the drawings unless otherwise approved. The Contractor/Developer shall plot the actual horizontal and vertical alignment of the pilot bore at intervals not exceeding 30 feet. The “as built” plan and profile shall be updated as the pilot bore is advanced. The Contractor/Developer shall at all times provide and maintain instrumentation that will accurately locate the pilot hole and measure drilling fluid flow and pressure. The Contractor/Developer shall grant the City access to all data and readout pertaining to the position of the bore head and the fluid pressure and flows.
9. When requested, the Contractor/Developer shall provide explanations of this position monitoring and steering equipment. The Contractor/Developer shall employ experienced personnel to operate the directional drilling equipment and, in particular, the position monitoring and steering equipment. No information pertaining to the position or inclination of the pilot hole bores shall be withheld from the City.



10. Each exit point shall be located as shown with an over-length tolerance of 10 feet for directional drills of 1,000 linear feet or less and 40 feet for directional drills of greater than 1,000 linear feet and an alignment tolerance of 5 feet left/right with due consideration of the position of the other exit points and the required permanent easement. The alignment of each pilot bore must be approved by the City before pipe can be pulled. If the pilot bore fails to conform to the above tolerances, the City may, at his option, require a new pilot boring to be made.
11. After the pipe is in place, cleaning pigs shall be used to remove residual water and debris. After the cleaning operation, the Contractor/Developer shall provide and run a sizing pig to check for anomalies in the form of buckles, dents, excessive out-of-roundness, and any other deformations. The sizing pig run shall be considered acceptable if the survey results indicate that there are no sharp anomalies (e.g. dents, buckles, gouges, and internal obstructions) greater than 2 percent of the nominal pipe diameter, or excessive ovality greater than 5 percent of the nominal pipe diameter. For gauging purposes, dent locations are those defined above which occur within a span of 5 feet or less. Pipe ovality shall be measured as the percent difference between the maximum and minimum pipe diameters. For gauging purposes, ovality locations are those defined above which exceed a span of 5 feet.
12. Reaming: Reaming operations shall be conducted to enlarge the pilot bore after acceptance of the pilot bore. The number and size of such reaming operations shall be conducted at the discretion of the Contractor/Developer.
13. Pulling Loads: The maximum allowable pull exerted on the HDPE pipelines shall be measured continuously and limited to the maximum allowed by the pipe manufacturer so that the pipe or joints are not overstressed.
14. Torsion and Stresses: A swivel shall be used to connect the pipeline to the drill pipe to prevent torsional stresses from occurring in the pipe.
15. The lead end of the pipe shall be closed during the pullback operation.
16. Pipeline Support: The pipelines shall be adequately supported by rollers and side booms and monitored during installation so as to prevent over stressing or buckling during pullback operation. Such support/rollers shall be spaced at a maximum of 60 feet on centers, and the rollers to be comprised of a non-abrasive material arranged in a manner to provide support to the bottom and bottom quarter points of the pipeline allowing for free movement of the pipeline during pullback.



Surface damage shall be repaired by the Contractor/Developer before pulling operations resume.

17. The Contractor/Developer shall at all times handle the HDPE pipe in a manner that does not over stress the pipe. Vertical and horizontal curves shall be limited so that wall stresses do not exceed 50 percent of yield stress for flexural bending of the HDPE pipe. If the pipe is buckled or otherwise damaged, the damaged section shall be removed and replaced by the Contractor/Developer at his expense. The Contractor/Developer shall take appropriate steps during pullback to ensure that the HDPE pipe will be installed without damage.
18. During drilling, reaming, or pullback operations, the Contractor/Developer shall make adequate provisions for handling the drilling fluids, or cuttings at the entry and exit pits. To the greatest extent practical, these fluids must not be discharged into the waterway. When the Contractor/Developer's provisions for storage of the fluids or cuttings on site are exceeded, these materials shall be hauled away to a suitable legal disposal site. The Contractor/Developer shall conduct his directional drilling operation in such a manner that drilling fluids are not forced through the subbottom into the waterway. After completion of the directional drilling work, the entry and exit pit locations shall be restored to original conditions. The Contractor/Developer shall comply with all permit provisions.
19. Pits constructed at the entry or exit point area shall be so constructed to completely contain the drill fluid and prevent its escape to the beach or waterway.
20. The Contractor/Developer shall utilize drilling tools and procedures which will minimize the discharge of any drill fluids. The Contractor/Developer shall comply with all mitigation measures listed in the required permits and elsewhere in these specifications.
21. To the extent practical, the Contractor/Developer shall maintain a closed loop drilling fluid system.
22. The Contractor/Developer shall minimize drilling fluid disposal quantities by utilizing a drilling fluid cleaning system which allows the returned fluids to be reused.
23. As part of the installation plan specified herein before, the Contractor/Developer shall submit a drilling fluid plan which details types of drilling fluids, cleaning and recycling equipment, estimated flow rates, and procedures for minimizing drilling fluid escape.



24. All drilling operations shall be performed by supervisors and personnel experienced in horizontal directional drilling. All required support, including drilling tool suppliers, survey systems, mud cleaning, mud disposal, and other required support systems used during this operation shall be provided by the Contractor/Developer.
25. A smoothly drilled pilot hole shall follow the design of the pipe profile and alignment described on the construction drawings.
26. The position of the drill string shall be monitored by the Contractor/Developer with the downhole survey instruments. Contractor/Developer shall compute the position in the X, Y, and Z axis relative to ground surface from downhole survey data a minimum of once per length of each drilling pipe (approximately 31 foot interval). Deviations from the acceptable tolerances described in the specifications shall be documented and immediately brought to the attention of the City for discussion and/or approval. The profile and alignment defined on the construction drawings for the bore holes define the minimum depth and radius of curvature. The Contractor/Developer shall maintain and provide to the City, upon request, the data generated by the downhole survey tools in a form suitable for independent calculation of the pilot hole profile.
27. Between the water's edge and the entry or exit point the Contractor/Developer shall provide and use a separate steering system employing a ground survey grid system, such as "TRU-TRACKER" or equal wherever possible. The exit point shall fall within a rectangle 10 wide and 40 feet long centered on the planned exit point.
28. During the entire operation, waste and leftover drilling fluids from the pits and cuttings shall be dewatered and disposed of in accordance with all permits and regulatory agencies requirements. Remaining water shall be cleaned by Contractor/Developer to meet permit requirements.
29. Technical criteria for bentonite shall be as given in API Spec. 13A, Specification for Oil Well Drilling Fluids Material for fresh water drilling fluids. Any modification to the basic drilling fluid involving additives must describe the type of material to be used and be included on Contractor/Developer's drilling plan presented to the City. The City retains the right to sample and monitor the waste drilling mud, cuttings, and water.
30. The horizontal directional drilling operation is to be operated in a manner to eliminate the discharge of water, drilling mud and cuttings to the adjacent creek or land areas involved during the construction process. The Contractor/Developer shall provide equipment and



procedures to maximize the recirculation or reuse of drilling mud to minimize waste. All excavated pits used in the drilling operation shall be lined by Contractor/Developer with heavy-duty plastic sheeting with sealed joints to prevent the migration of drilling fluids and/or ground water.

31. The Contractor/Developer shall visit the site and must be aware of all structures and site limitations at the directional drill crossing and provide the City with a drilling plan outlining procedures to prevent drilling fluid from adversely affecting the surrounding area.
32. The general work areas on the entry and exit sides of the crossing shall be enclosed by a berm to contain unplanned spills or discharge.
33. Waste cuttings and drilling mud shall be processed through a solids control plant comprised as a minimum of sumps, pumps, tanks, desalter/desander, centrifuges, material handlers, and haulers all in a quantity sufficient to perform the cleaning/separating operation without interference with the drilling program. The cuttings and excess drilling fluids shall be dewatered by the Contractor/Developer to the extent necessary for disposal in offsite landfills. Water from the dewatering process shall be treated by the Contractor/Developer to meet permit requirements and disposed of legally. The cuttings and water for disposal are subject to being sampled and tested. The construction site and adjacent areas will be checked frequently for signs of unplanned leaks or seeps.
34. Equipment (graders, shovels, etc.) and materials (such as groundsheets, hay bales, booms, and absorbent pads) for cleanup and contingencies shall be provided in sufficient quantities by the Contractor/Developer and maintained at all sites for use in the event of inadvertent leaks, seeps, or spills.
35. Waste drilling mud and cuttings shall be dewatered, dried, and stock piled such that it can be loaded by a front end loader, transferred to a truck and hauled offsite to a suitable legal disposal site. The maximum allowed water content of these solids is 50 percent of weight.
36. Due to a limited storage space at the worksites, dewatering and disposal work shall be concurrent with drilling operations. Treatment of water shall satisfy regulatory agencies before it is discharged.

3.5 MANHOLE INSTALLATION

- A. Sanitary sewer manholes shall be installed at each change in line or grade in each gravity sanitary sewer line.



- B. The manhole foundation shall be prepared so as to provide a firm, level area on which to place the precast concrete manhole base section. When poor foundation soil is encountered or excess groundwater exists, the foundation shall be excavated 12 inches or greater below the final subgrade elevation, as determined by the City and backfilled with washed stone to provide a proper foundation.
- C. The manhole sections shall be lifted from the side of the excavation to the bottom of the trench with equipment and support slings capable of safely handling the heavy concrete pieces without damaging them. The manhole shall be set plumb and adjusted to the final finished surface grade with brick or grade rings and non-shrink grout.
- D. Thoroughly clean the bells and spigots of each manhole section to remove dirt and other foreign materials that may prevent sealing. Unroll the butyl sealant directly against the base of the spigot. Leave protective wrapper attached until sealant is entirely unrolled against spigot. Do not stretch. Overlap from side to side - not top to bottom.
- E. Pipe openings shall be exactly aligned to that of the pipe entering and leaving the manhole. The gravity sanitary sewer pipe lines shall be placed in the manhole openings, properly aligned, and set to grade. Sanitary sewer shall be connected to the manholes using flexible manhole sleeves as described above.
- F. For large diameter pipe where a flexible rubber sleeve is not available, the pipe line shall be sealed into the manhole using an expanding type or non-shrink type grout.
- G. For manhole steps, refer to the precast manhole section above.
- H. After the manhole has been set in its final position, set the manhole frames to the required elevation using no more than 12 inches of precast concrete grade rings, or bricks sealing all joints between cone, adjusting rings, and manhole frame. When grade rings or bricks are used, grout with non-shrink grout. Where manholes are constructed in paved areas, the top surface of the frame and cover shall be tilted so as to conform to the exact slope, crown and grade of the existing surrounding pavement. Manhole frames which are placed above final grade will have frames attached to manhole cone section by means of 5/8-inch diameter stainless steel anchors and washers. One anchor bolt shall be provided per hole. Seal pipe penetrations, including pipe crown, to provide a smooth, uniform finish using non-shrink grout.



- I. After the placement of manhole frame and vacuum testing, perform the final finishing to the manhole interior by filling all chips or fractures greater than 1/2 inch in length, width or depth (1/8 inch deep in inverts) with non-shrink grout. Grout the interior joints between the precast concrete sections with non-shrink grout. Sharp edges or rough finishes shall be removed providing a smooth surface throughout the manhole. Clean the interior of the manhole, removing all dirt, spills, or other foreign matter.

3.6 CONNECTIONS TO EXISTING SEWER SYSTEMS

- A. Connections to existing collection systems will be allowed when proper precautions are taken to protect the existing collection system.
- B. If the proposed sewer does not begin at an existing manhole, a new manhole will be "cut in" at the required location and the existing pipe(s) repaired as specified. For extensions of the existing system, the new "cut in" manhole or the connection to the existing manhole will not be constructed until all other sewer construction has been completed and tested in compliance with these specifications.
- C. Pipelines or manholes which contain silt, sedimentation, or other foreign material shall not be connected to any portion of the existing collection system. The Contractor/Developer shall, at his own expense, flush, or otherwise cause the line (and manholes) to be cleaned out without any discharge into the existing system.
- D. Any connection with 18-inch and smaller pipe at an existing precast or cast-in place manhole will require the Contractor/Developer to core the necessary opening through the manhole wall and install a flexible manhole sleeve. Sleeve shall be as specified elsewhere. Connections to existing brick manholes do not require coring and an opening may be carefully hammered or sawed. Connections to existing manholes for pipe larger than 18 inches in diameter may be cored or sawed as approved by the City.
- E. The existing manhole bench and invert shall be constructed and/or repaired in compliance with these specifications.

3.7 INSTALLING NEW SEWER SERVICE LINES

- A. For extensions of the existing sewer system, all buildable lots adjacent to the extension shall have a sewer service line provided. Additional service lines may be installed by the Contractor/Developer as directed and authorized by the City.
- B. In general, service lines shall be constructed from the public sewer to a point located at the edge of the public right-of-way or the sewer easement. Service lines shall consist of 6-inch diameter pipe, a cleanout, and a water



tight plug for future customer connection at the end of the service line at the public right-of-way.

- C. Service lines built for vacant lots/future connections shall have a cleanout assembly constructed, which includes a 1 foot capped stub-out on the service line. The vertical cleanout pipe shall also be capped, and shall be a minimum of 3 feet above the finished grade.
- D. The standard sewer service connection shall be 6 inches in diameter unless shown otherwise on the drawings, and shall connect to the main at a wye branch connection installed with the pipe line as it is being laid. Service connections 6 inches or greater shall only be made into an existing or proposed manhole, unless otherwise approved by the City.
- E. The City -maintained portion of each sewer service line shall have a minimum of 3 feet of cover, unless approved by the City.
- F. Sewer service lines and clean-outs shall be ASTM 3034, SDR 26
 - 1. The service line installed will have less than 3 feet of cover; or
 - 2. The service line crosses a creek or drainage ditch (whether aerial or subaqueous).
- G. The minimum slope on any residential sewer service line shall not be less than 2 percent.
- H. At the edge of the public or utility right-of-way, a "cleanout" shall be installed. The cleanout shall consist of a "wye" branch connection, 45-degree bend, riser pipe, and threaded plug installed flush with finished ground elevation. The end of the City's sewer service connection shall terminate at the end of the pipe which will normally extend five feet beyond the "wye" branch for the cleanout. A watertight plug shall be installed at the end of this line until such time as the property owner connects their facilities to the sewer system. In addition, one cleanout shall be constructed for:
 - 1. Every four 45-degree changes located in series (a long sweep is equivalent to two 45-degree bends); and
 - 2. At intervals no greater than 100 feet.
- I. When the depth of cut is over 8 feet and the grade of a sanitary sewer is lower than necessary to serve abutting property, and at such other locations as may be designated by the City, the Contractor/Developer may install the service line with a 22 ½ or 45 degree bend just upstream of the cleanout assembly to bring the service line up to the necessary elevation.



- J. Unless required service depth is noted on construction Plans, the Contractor/Developer shall contact the City and request confirmation of grade prior to constructing any sewer service line at a depth greater than 8 feet.

3.8 REINSTATING EXISTING SEWER SERVICE LINES

- A. Where existing sewer mains are being rehabilitated, sewer service lines shall be constructed for each property that is occupied by a business or dwelling if it is currently served by the system being rehabilitated.
- B. The Contractor/Developer shall be responsible to locate and connect all existing sewer service lines to the new main. In the event a service is missed during construction, the Contractor/Developer shall return to the site and perform all work necessary to reinstate the connection. The Contractor/Developer will be compensated in accordance with the original contract unit pricing; however, re-mobilization to the site will not be paid for. In addition, the Contractor/Developer shall be responsible for any costs associated with a sanitary sewer overflow and associated damage to public or private property through the omission of reinstating an active sewer service.
- C. Service lines 6 inches or greater shall only be made into an existing or proposed manhole, unless otherwise approved by the City.

3.9 ABANDONMENT OF EXISTING SEWERS AND MANHOLES

- A. Manholes which are to be abandoned shall first have both influent and effluent lines plugged inside the manhole with watertight masonry or concrete. The manhole will then be filled with non-compressible material (crushed stone or materials approved by the City), to a point not less than 3 feet below the finish grade. The remainder of the manhole shall be broken down and removed. Then the excavation shall be backfilled to finish grade as specified in Division 31 Section "Earth Moving".
- B. Abandoned mains at active manholes shall be completely disconnected from the manhole by cutting the pipe outside the manhole and then plugging the abandoned main and the manhole wall with watertight masonry. The invert shall then be rebuilt to conform to these specifications.
- C. Exposed sections of abandoned mains shall be removed to a point not less than 5 feet from the adjacent banks or surface waters. The remaining ends of the pipe shall be plugged with watertight masonry. Concrete piers or collars in the creek channel shall be removed completely. Concrete piers or collars not located in the creek channel shall be removed to a point 3 feet below the finish grade. Steel piers shall be cut off 3 feet below finish grade.



- D. The minimum length of watertight masonry plugs will be the diameter of the abandoned pipe plus 1 foot.

3.10 FIELD QUALITY CONTROL

- A. The Contractor/Developer shall maintain the project, insofar as his construction work is concerned, in first class condition for such time as is necessary to satisfy the City that all installations are correct and acceptable.
- B. Line Cleaning: Prior to inspection of any section(s) of gravity sanitary sewer pipe or force main the Contractor/Developer shall completely clean the lines of all debris, silt, etc. The pipe line shall be ready for use by the City and shall be proved to be in first class condition and constructed properly in accordance with the drawings and specifications.
- C. The Contractor/Developer shall notify the City that all or portions of the work are ready for testing. All testing shall be scheduled with the City, who will coordinate with the City, and respond to the Contractor/Developer regarding a mutually available date and time for the necessary testing. All testing shall be done in the presence of the City. All labor, equipment, water and other materials, including meters and gauges, shall be furnished by the Contractor/Developer at his own expense.
- D. Inspection and Testing of Gravity Sewers:
 - 1. Alignment and grade between manholes shall be tested by the City by flashing a light between manholes. A full circle of light shall be seen when reviewed from the adjoining end of the line. All defects disclosed as a result of this test shall be corrected by the Contractor/Developer at his expense.
 - 2. Gravity sewer lines shall pass a go-no go mandrel sized to 95 percent of the pipe diameter (as defined in ASTM D-3034) with the pipe in place and properly backfilled. Mandrel testing shall be performed under the City's supervision. All pipe which will not pass the mandrel shall be relaid or replaced by the Contractor/Developer at no additional cost. The chart that follows indicates the required mandrel diameter for specific sizes of SDR 35 PVC piping. The allowable deflection (less than 5 percent) for other pipe sizes and types shall be calculated using the pipe stiffness formula in ASTM D 2321. The mandrel test shall not take place until the final backfill has been in place for a minimum of 30 days.



Nominal Pipe Size	Pipe I.D. (SDR 35)	Required Mandrel O.D.
8"	7.665"	7.28"
10"	9.563"	9.08"
12"	11.361"	10.79"
15"	13.898"	13.20"

3. The mandrel shall be pulled through each section of pipe from manhole to manhole. The mandrel must slide freely through the pipe with only a nominal hand force applied. No mechanical device shall be used in pulling the mandrel. Any pipe which refuses the mandrel shall be removed and replaced. Such sections shall be re-tested for deflection 30 days after completion of trench backfill.
4. Mandrel testing may be performed by the City at any time prior to the expiration of the one year warranty. Any pipe which refuses the mandrel shall be replaced by the Contractor/Developer as described above at no cost to the City.
5. When the sewers are completed they shall be inspected by the City for conformance with the provisions of the plans and specifications, particularly line and grade. All visible and audible leaks will be repaired.
6. The infiltration into each section of the sewer shall be measured in wet weather by the temporary installation of suitable V-notch weir. This weir shall be furnished, installed and removed by the Contractor/Developer. Infiltration test limits shall be applied to single reaches of pipe, up to one mile in length, of the same diameter. For pipes 8 inches through 15 inches in diameter, infiltration into the sewer system (including manholes) shall not exceed 50 gallons per mile of sewer per inch of inside diameter of the sewer per 24 hours, and in no case shall it exceed 3,000 gallons per mile per 24 hours. For all pipe sizes larger than 15 inches in diameter, infiltration into the sewer system (including manholes) shall not exceed 100 gallons per mile of sewer per inch of inside diameter of the sewer per 24 hours, and in no case shall it exceed 3,000 gallons per mile per 24 hours.
7. If infiltration into the whole system or any segment thereof exceeds the requirements described above, necessary corrective measures shall be taken by the Contractor/Developer to limit the infiltration to the maximum specified above. The City shall decide the number and length of segments of sewer line on which the testing shall be performed.



8. The Contractor/Developer shall furnish all facilities and personnel and conduct low pressure air tests on all completed sections of gravity sewer. Air tests for PVC and DIP lines shall be performed in accordance with ASTM C828. Air tests for concrete pipe 30 inches in diameter and smaller shall be performed in accordance with ASTM C924. Air tests will not be required on pipe with diameters exceeding 30 inches. Acceptance of pipes exceeding 30 inches will be based on infiltration tests and/or visual inspection of the joints.
9. The acceptance air test shall be made after backfilling has been completed and compacted and in the presence of the City. For ductile iron pipelines, test in accordance with the applicable requirements of ASTM C924. For PVC pipelines test in accordance with ASTM F1417-98.
10. The Contractor/Developer shall furnish an air compressor of the necessary capacity along with all necessary plugs, valves, pressure gages, air hoses, connections, and other equipment necessary to conduct the air tests. Plugs in sewers 18 inches in size and larger shall be connected by steel cable for thrust reaction.
11. Compressor capacity shall be sufficient to pressurize the sewer main to 4 PSIG within a time equal to or less than the required test time. The following equation may be used to insure compliance with this requirement:

$$C = \frac{0.17 \times D^2 \times L}{T} + Q$$

Where: C=Required Compressor Capacity (cfm)

T=Required Test Time (min)

D=Pipe Internal Diameter (feet)

L=Length of Test Section (feet)

Q=Allowable Air Loss Rate (cfm)

The following allowable air loss rates will be used for all pipe tests:

Pipe Size	Q (cfm)	Pipe Size	Q(cfm)
4"	2.0	15"	4.0
6"	2.0	18"	5.0
8"	2.0	21"	5.5
10"	2.5	24"	6.0
12"	3.0		



12. The sewer section shall be plugged at both ends and air pressure shall be applied until the pressure inside the pipe reaches 4 PSIG. When a stable condition has been reached, the pressure shall be bled back to 3.5 PSIG. At 3.5 PSIG, the time and pressure shall be observed and recorded. If groundwater is present at the sewer, the height of the groundwater above the top of the pipe shall be added to the above air pressure readings (height of water in feet X 0.433 = air pressure in psig). A minimum of five (5) readings will be required for each test.
13. If the time for the air pressure to decrease from 3.5 PSIG to 2.5 PSIG is equal to or greater than that shown in the following table, the pipe shall be presumed to be free from defect. When these times are not attained, pipe breakage, joint leakage, or leaking plugs are indicated and the cause must be determined and corrected. After repairs have been made, the sewer sections shall be retested. This process shall be repeated until all sewer sections pass the air tests.

Pipe Diameter (inches)	Specification Time for Length Shown (Minutes : Seconds)							
	100ft	150ft	200ft	250ft	300ft	350ft	400ft	450ft
8	7:34	7:34	7:34	7:34	7:36	8:52	10:08	11:24
10	9:26	9:26	9:26	9:53	11:52	13:51	15:49	17:48
12	11:20	11:20	11:24	14:15	17:05	19:56	22:47	25:38
15	14:10	14:10	17:48	22:15	26:42	31:09	35:35	40:04
18	17:00	19:13	25:38	32:03	38:27	44:52	51:16	57:41
21	19:50	26:10	34:54	43:37	52:21	61:00	69:48	78:31
24	22:47	34:11	45:34	56:58	68:22	79:46	91:10	102:33

14. For testing a sewer system with one or more installed service lateral pipes, an effective pipe length shall be added to the total sewer main pipe length. The equation used to calculate Effective Pipe Length is as follows:

$$L_e = \frac{d^2 \times l}{D^2}$$

Where: L_e =Effective Pipe Length (added to Total Test Length)
 d =Diameter of Service Lateral Pipe
 l =Length of Sewer Lateral
 D =Diameter of Sewer Main Pipe being tested



15. Failure of any section of the pipeline to meet the requirements of this test shall cause the Contractor/Developer to determine, at his own expense, the source(s) of leakage, and repair or replace all defective materials or workmanship. The repaired section(s) of line shall be re-tested to insure conformance with the requirements of these contract specifications.

E. Inspection and Testing of Sewer Force Mains:

1. When the sanitary sewer force main is completed, the City shall inspect the line for conformance with the provisions of the drawings and specifications, particularly with respect to alignment and depth. The minimum depth of all force mains shall be 36 inches unless otherwise specified.
2. All newly constructed sanitary sewer force main and valved sections shall be subjected to a hydrostatic pressure-leakage test. Hydrostatic testing shall be conducted only after thrust blocks, supports, and anchors have fully hardened. Force mains shall be tested in sections not to exceed 4,000 lineal feet per test section. The Contractor/Developer shall install sufficient additional valves if not shown on the drawings to allow for testing.
3. HDPE pipe shall be hydrostatically tested after joining into continuous lengths prior to installation and again after installation. Pressure and temperature shall be monitored with certified instruments during the test. After this test, the water will be removed with pigs. Erosion prevention procedures shall be used during removal and discharge of the water. Hydrostatic testing shall be performed in accordance with these specifications.
4. Each completed section of the pipeline shall be plugged at both ends and slowly filled with water. As the main is being filled with water in preparation of the test, all air shall be expelled from the pipe. The main shall be subjected to a hydrostatic pressure not less than 1-1/2 times the maximum system operating pressure or 100 pounds per square inch, whichever is greater, for a period of two hours unless otherwise specified. Pressure shall be applied to the main by means of a hand pump for small lines or by use of a gasoline pump or fire engine for larger lines.
5. The rate of leakage shall be determined at 15 minute intervals by means of volumetric measure of the water added during the test until the rate has stabilized at the constant value for three consecutive 15 minute periods.



6. Leakage is defined as the quantity of water to be supplied into the newly laid pipe, or any valved section thereof, necessary to maintain the specified leakage test pressure after the pipe has been filled with water and the air expelled. No piping installation will be accepted until the leakage is less than ten (10) gallons per inch of pipe diameter per mile of pipe per 24 hours.
7. Cracked or defective pipe, joints, fittings, or valves discovered in consequence of this test shall be removed and replaced with sound materials, and the test shall be repeated until the test results are satisfactory. Precautions shall be taken to remove or otherwise protect equipment in, or attached to, pipe to prevent damage or injury thereto.
8. Tests of insulated and concealed piping shall be made before the piping is covered or concealed. No leakage will be allowed under the above tests for piping in buildings, structures or on bridges.
9. Ductile iron force main piping shall be tested in accordance with AWWA C600, while all PVC force main piping shall be tested in accordance with AWWA M23. HDPE force main piping shall be tested in accordance with ASTM F2164.

F. Inspection and Testing of Manholes:

1. Manholes shall be constructed to provide a true circular inside diameter with properly corbeled tops, satisfactory inverts and properly placed steps and castings. Any visible leaks in the manholes shall be completely stopped to the satisfaction of the City.
2. All sanitary sewer manholes constructed by the Contractor/Developer shall be vacuum tested for leakage in the presence of the City. Vacuum testing shall be performed in accordance with ASTM C1244. The vacuum test requirement will not apply to any existing manhole, or any existing manhole that has been converted to a drop manhole by the Contractor/Developer.
3. The Contractor/Developer shall furnish all labor, equipment, and any appurtenant items necessary to satisfactorily perform the vacuum test. All testing equipment shall be approved for vacuum testing manholes.
4. Vacuum Testing Procedure:
 - a. Vacuum test the assembled manhole after completing pipe connections, sealing and allowing mortar or cement proper curing time. Plug pipes with suitably sized and rated pneumatic or mechanical pipe line plugs. Place plugs a minimum of 6 inches



beyond the manhole wall and brace to prevent displacement of the plugs or pipes during testing.

- b. All lifting holes shall be plugged with an approved non-shrink grout inside and out. Manhole joints shall be grouted from the outside only. All pipes entering the manhole shall be plugged. The Contractor/Developer shall securely brace the plugs in order to keep them from being drawn into the manhole. The test head shall be placed at the inside of the top of the cone section of the manhole and the seal inflated in accordance with the manufacturer's recommendations.
- c. Position the vacuum tester head assembly according to the manufacturer's recommendations. Draw a vacuum of 10 inches of mercury, close the valve on the vacuum line and shut off the vacuum pump and measure the time for the vacuum to drop to 9 inches of mercury. The manhole shall pass when the time to drop to 9 inches of mercury meets or exceeds the table below:

Manhole Vacuum Testing Time (Seconds)			
Manhole Depth (Feet)	Manhole Diameter (Inches)		
	48	60	72
0-8	20	26	33
10	25	33	41
12	30	39	49
14	35	46	57
16	40	52	67
18	45	59	73
20	50	65	81
22	55	72	89
24	59	78	97
26	64	85	105
28	69	91	113
30	74	98	121

- d. If the manhole fails the test, remove the head assembly and coat the manhole interior with a soap and water solution and repeat the vacuum test for approximately 30 seconds. Leaking areas will have soapy bubbles. Make the necessary repairs and repeat the test until the manhole passes.



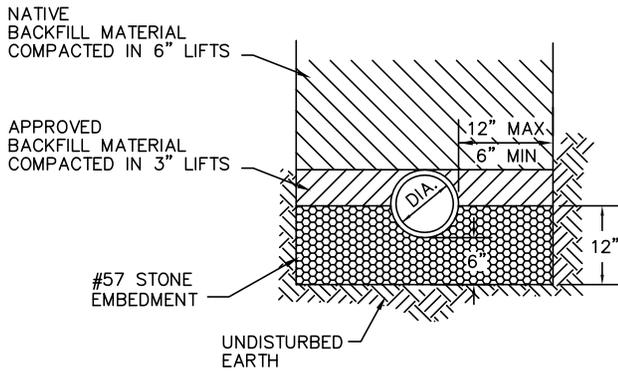
5. Vacuum testing is not required on manholes with pipe connections in excess of 30 inches in diameter.

G. Final Acceptance:

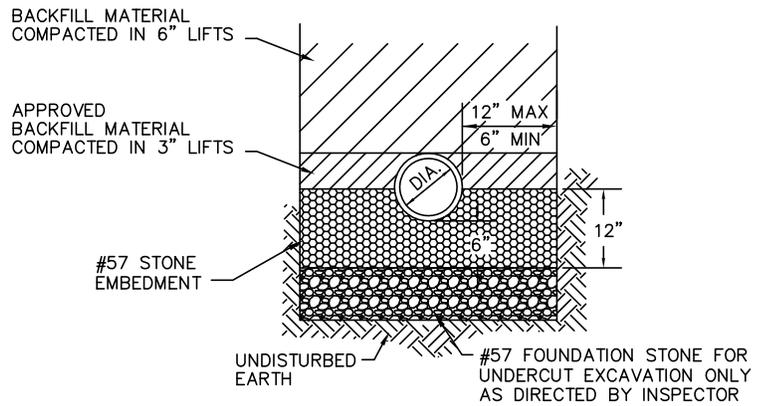
1. The City will notify the Contractor/Developer, in writing, as to the satisfactory completion of the work in any or all sections of gravity sanitary sewer pipe, force main and manholes, included in the project.
2. Upon such notification, the Contractor/Developer shall immediately remove all construction equipment, excess materials, tools, debris, etc. from the site(s) and leave the same in a neat, orderly condition acceptable to the City.
3. Final landscaping requirements and restoration of surfaces shall then be completed by the Contractor/Developer in accordance with their respective specification sections and as shown on the drawings.

END OF SECTION 332700



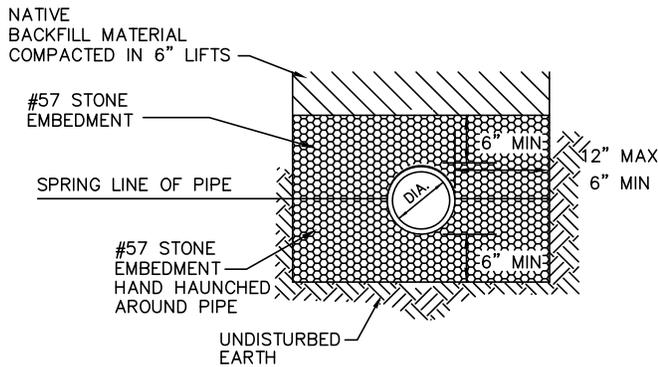


STANDARD EXCAVATION

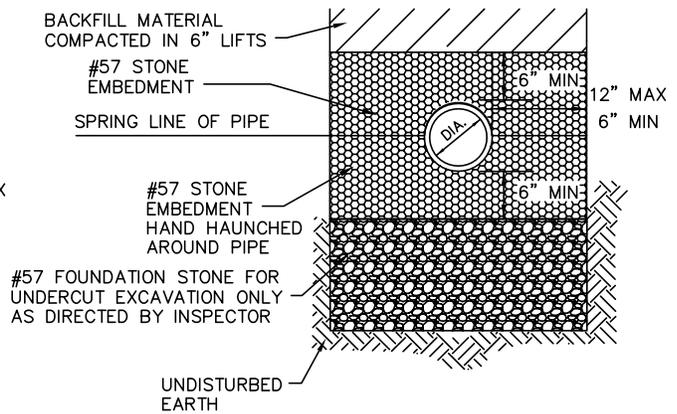


**UNDERCUT EXCAVATION
IN UNSTABLE SOILS TYPES**

DUCTILE IRON GRAVITY SEWER



STANDARD EXCAVATION



**UNDERCUT EXCAVATION
IN UNSTABLE SOILS TYPES**

POLYVINYL CHLORIDE (PVC) SEWER PIPE

**TYPICAL GRAVITY SEWER
TRENCHING DETAILS**

NOT TO SCALE

NOTES:

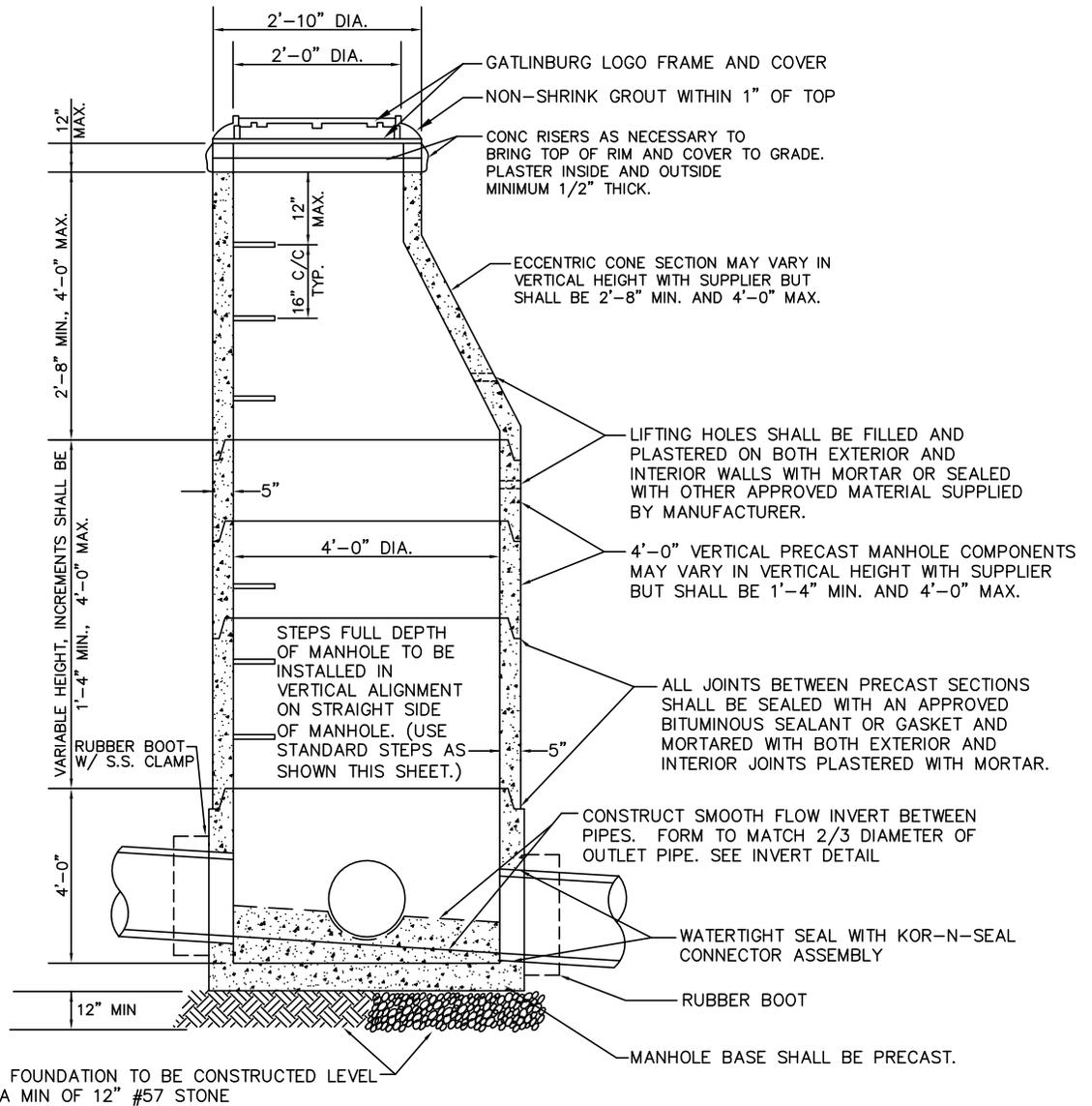
1. CONSTRUCTION OF TRENCHES SHALL COMPLY WITH ALL FEDERAL, STATE AND LOCAL SAFETY AND HEALTH REGULATIONS WHICH HAVE JURISDICTION AT THE PROJECT SITE. IT IS THE CONTRACTOR'S RESPONSIBILITY TO BE FAMILIAR WITH THE APPLICABLE REGULATIONS AND FOLLOW THEM ACCORDINGLY.



CITY OF GATLINBURG
SANITARY SEWER SYSTEM
STANDARD DETAILS

REVISION NO: 1
DATE: MAY 2014

STD-WW-01



ELEVATION VIEW

PRECAST MANHOLE NOTES:

1. ALL PRECAST MANHOLE COMPONENTS SHALL MEET REQUIREMENTS OF ASTM C-478, LATEST REVISION.
2. ALL MANHOLES SHALL BE CONSTRUCTED PLUMB.
3. ALL MANHOLE GRADES SHOWN ON THE PLANS ARE FOR THE INVERT OF THE MANHOLE CENTER.
4. IF MANHOLE IS SET IN LOCATION OF HIGH WATER TABLE OR UNDERGROUND WATER IS ENCOUNTERED, THE CONTRACTOR SHALL INSTALL UNDERDRAINS AND STONE AS DIRECTED IN THE FIELD BY THE INSPECTOR.
5. STEPS SHALL BE INSTALLED ON STRAIGHT SIDE OF MANHOLE.

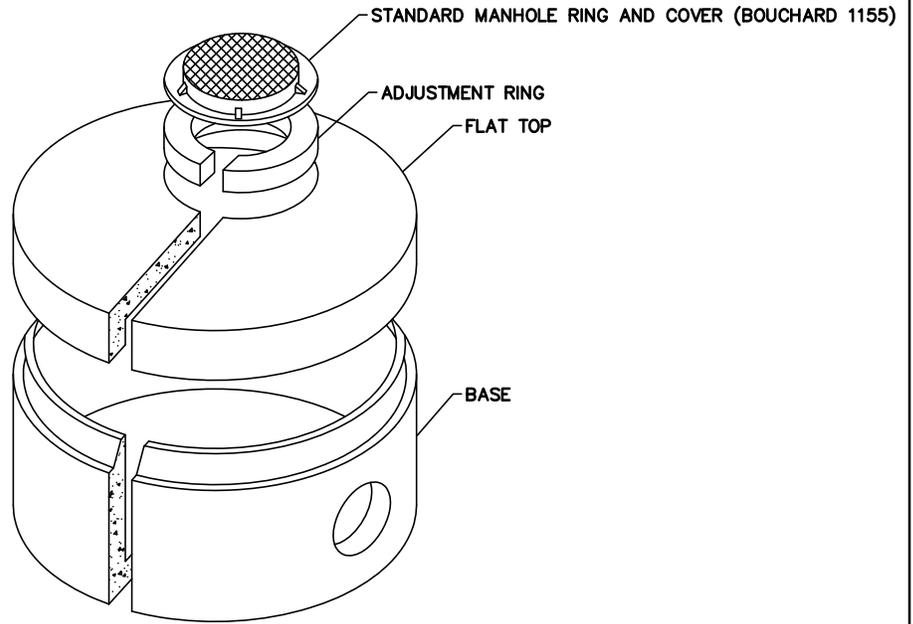
PRECAST CONCRETE MANHOLE NOT TO SCALE



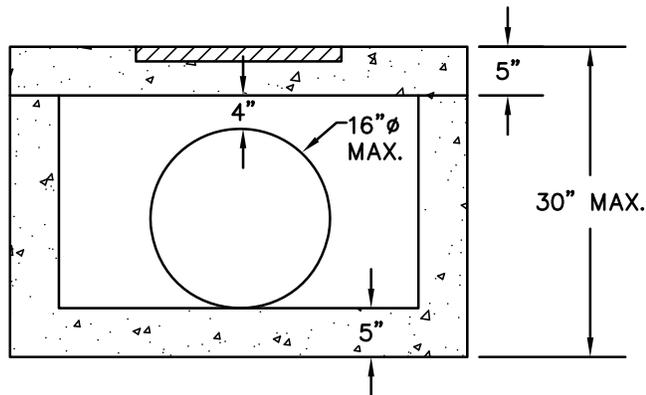
CITY OF GATLINBURG
SANITARY SEWER SYSTEM
STANDARD DETAILS

REVISION NO: 3
DATE: SEPTEMBER, 2014

STD-WW-02



SHALLOW FLAT TOP MANHOLE



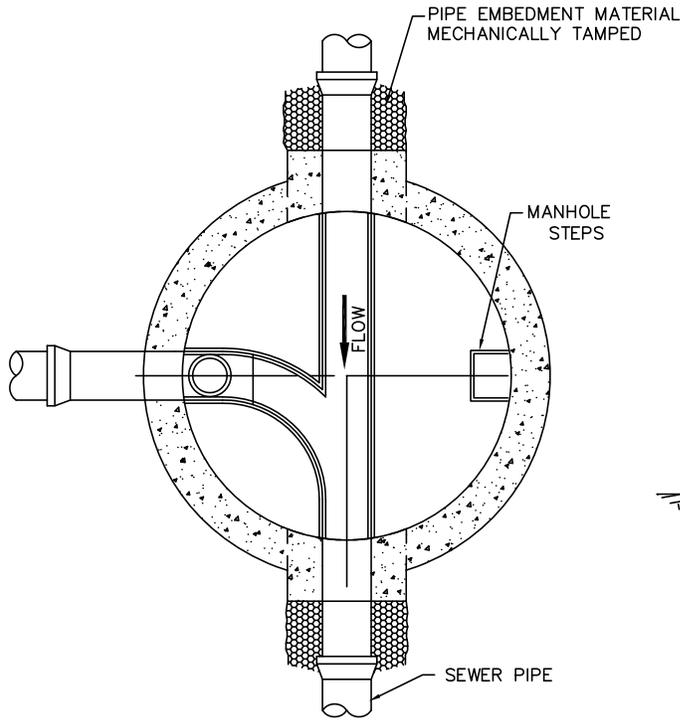
STANDARD SHALLOW MANHOLE
NOT TO SCALE



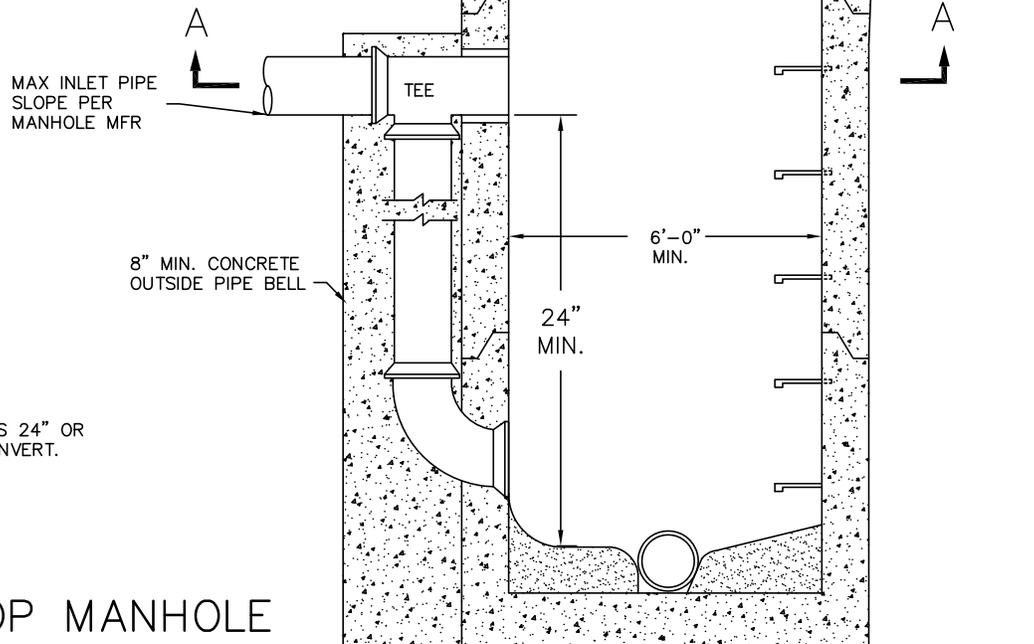
CITY OF GATLINBURG
SANITARY SEWER SYSTEM
STANDARD DETAILS

REVISION NO: 1
DATE: MAY, 2014

STD-WW-03



SECTION A-A



NOTE:
 1. PROVIDE WHEN THE INLET PIPE IS 24" OR GREATER ABOVE THE MANHOLE INVERT.

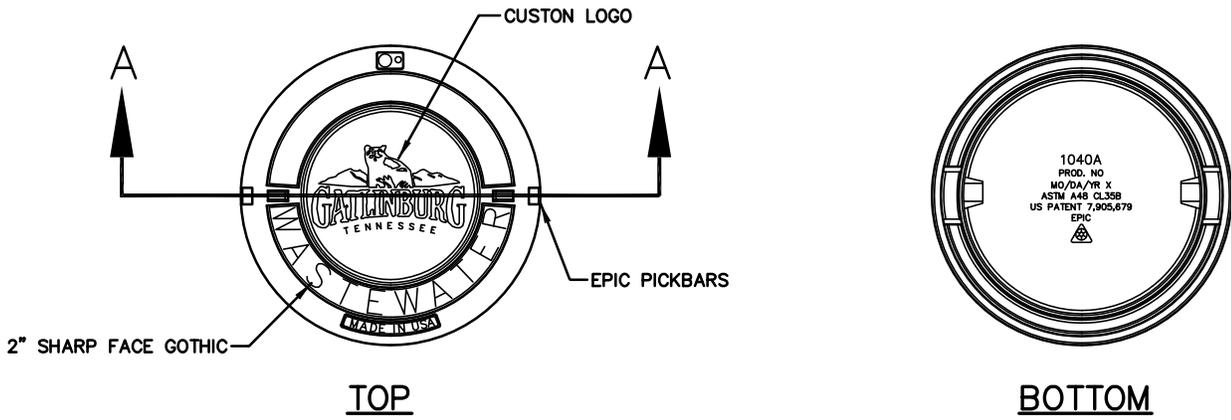
OUTSIDE DROP MANHOLE
 NOT TO SCALE



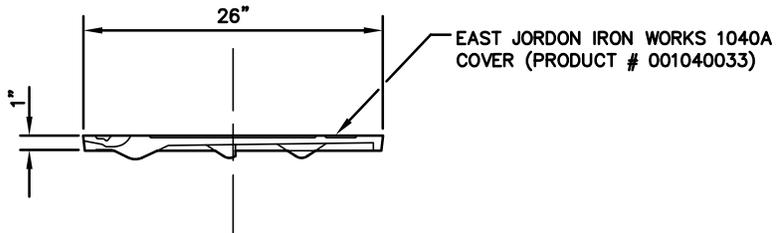
CITY OF GATLINBURG
 SANITARY SEWER SYSTEM
 STANDARD DETAILS

REVISION NO: 1
 DATE: MAY, 2014

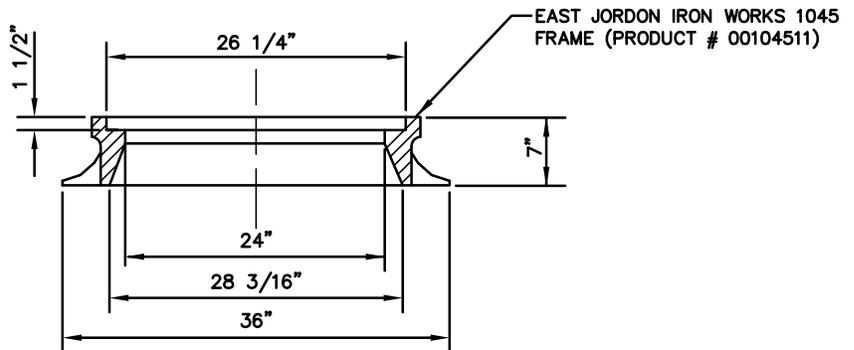
STD-WW-04



PLAN OF MANHOLE COVER



SECTION A-A
MANHOLE COVER



SECTION A-A
MANHOLE RING

MANHOLE RING AND COVER
NOT TO SCALE

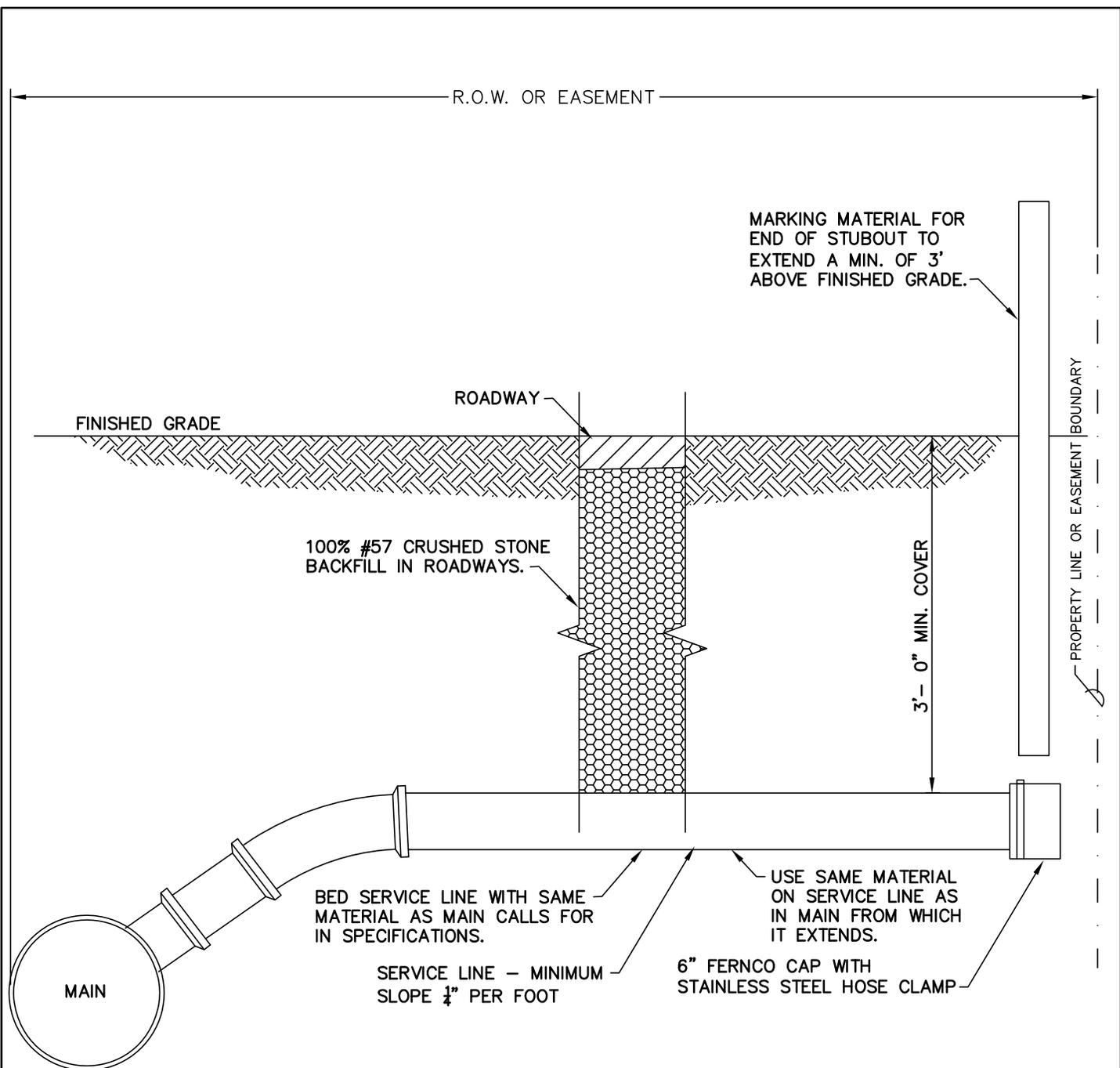
NOTE: TRAFFIC BEARING RING AND COVER.
MINIMUM WEIGHT 315 POUNDS



CITY OF GATLINBURG
SANITARY SEWER SYSTEM
STANDARD DETAILS

REVISION NO: 1
DATE: MAY, 2014

STD-WW-05



LONG AND SHORT TAP GRAVITY
SERVICE LATERAL STUBOUT
NEW CONSTRUCTION

NOT TO SCALE

NOTE:

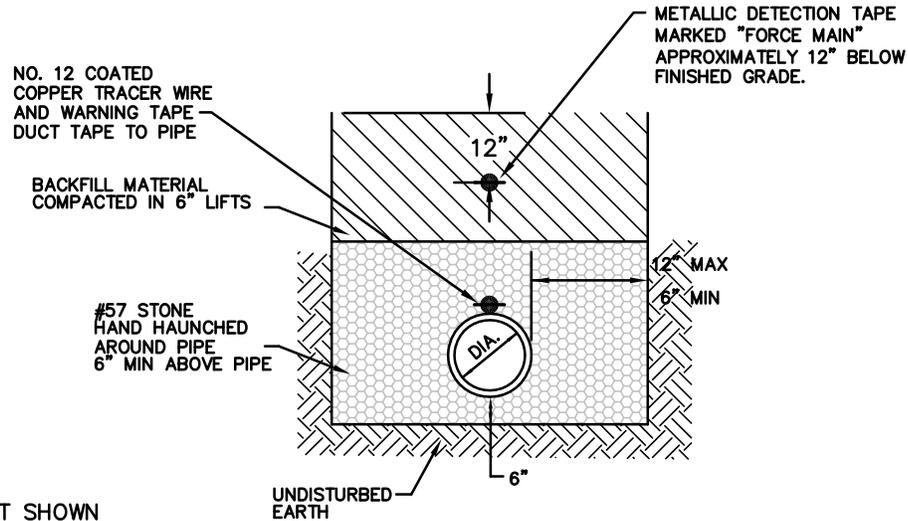
1. DETAIL IS TO BE USED ONLY FOR NEW CONSTRUCTION.
REFER TO STD-WW-12 FOR LATERAL PARTS AND INFORMATION.



CITY OF GATLINBURG
SANITARY SEWER SYSTEM
STANDARD DETAILS

REVISION NO: 2
DATE: JUNE, 2014

STD-WW-06



NOTE:
BELL HOLES NOT SHOWN

STANDARD EXCAVATION

NOTE: 1. CONSTRUCTION OF TRENCHES SHALL COMPLY WITH ALL FEDERAL, STATE AND LOCAL SAFETY AND HEALTH REGULATIONS WHICH HAVE JURISDICTION AT THE PROJECT SITE. IT IS THE CONTRACTOR'S RESPONSIBILITY TO BE FAMILIAR WITH THE APPLICABLE REGULATIONS AND FOLLOW THEM ACCORDINGLY.

TYPICAL SEWER FORCE MAIN TRENCHING DETAILS

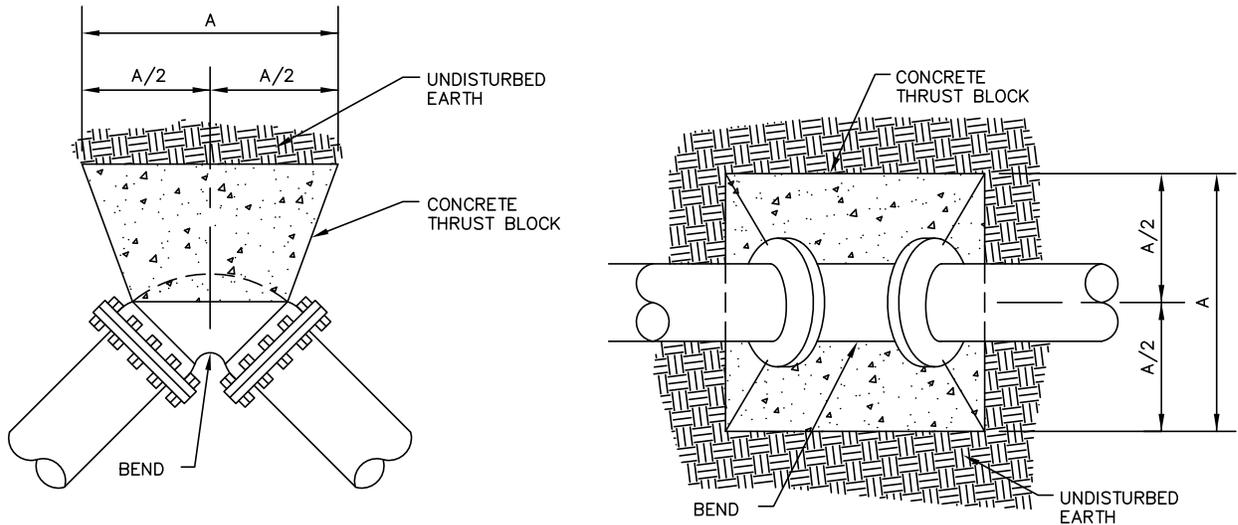
NOT TO SCALE



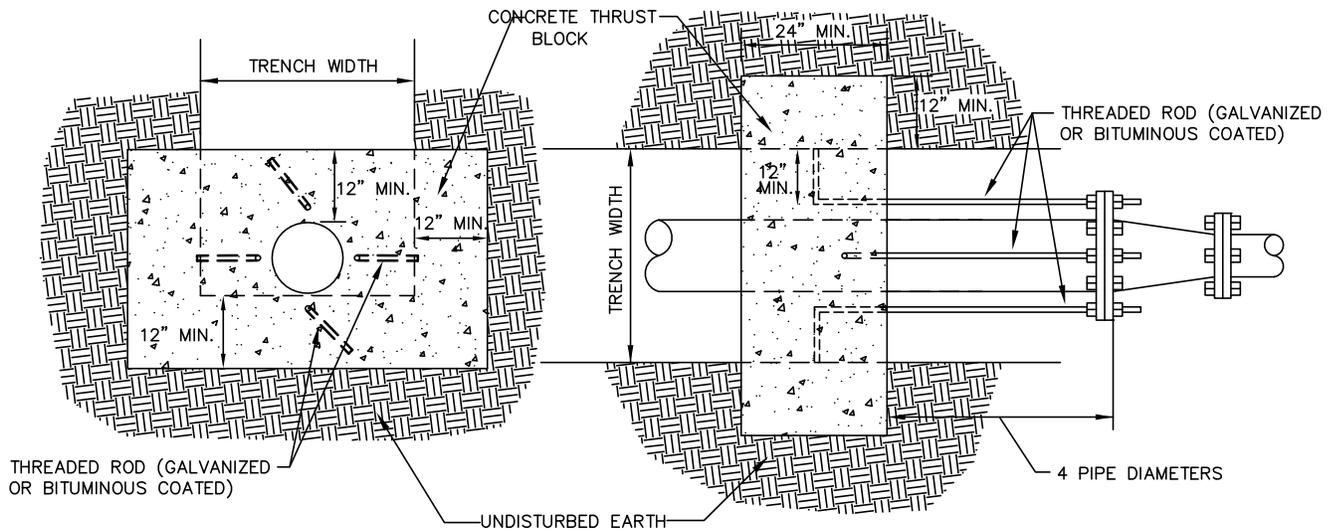
CITY OF GATLINBURG
SANITARY SEWER SYSTEM
STANDARD DETAILS

REVISION NO: 1
DATE: MAY, 2014

STD-WW-07



TYPICAL THRUST BLOCK FOR BENDS



TYPICAL THRUST BLOCK FOR REDUCERS

NOTES:

1. FITTING JOINTS SHALL NOT BE POURED IN CONCRETE OR HAVE CONCRETE SPILLED ON THE BOLTS OR NUTS. THE FITTING SHALL BE WRAPPED IN A LAYER OF POLYETHYLENE PLASTIC PRIOR TO POURING THE THRUST BLOCK.
2. ROD AND EYE BOLT DIAMETER SHALL BE A MINIMUM OF 3/4" AND SHALL MATCH THE SIZE OF THE BOLT PROVIDED WITH THE FITTING.
3. CONTRACTOR SHALL REPLACE FITTING BOLTS WITH THREADED ROD FOR 1/2 OF THE BOLTS SUPPLIED WITH EACH FITTING. RODS SHALL BE EQUALLY SPACED.

SIZE	TYPE			
	11-1/4' BEND	22-1/2' BEND	45° BEND	90° BEND
2-6	12	12	12	16
8	12	12	16	22
10	12	14	20	28
12	12	18	24	32
14	14	20	28	38
16	16	22	32	42
18	18	26	36	48
20	20	28	40	52
24	24	34	46	64
30	30	42	58	78
36	36	50	70	94
42	40	58	80	108
48	46	66	90	124

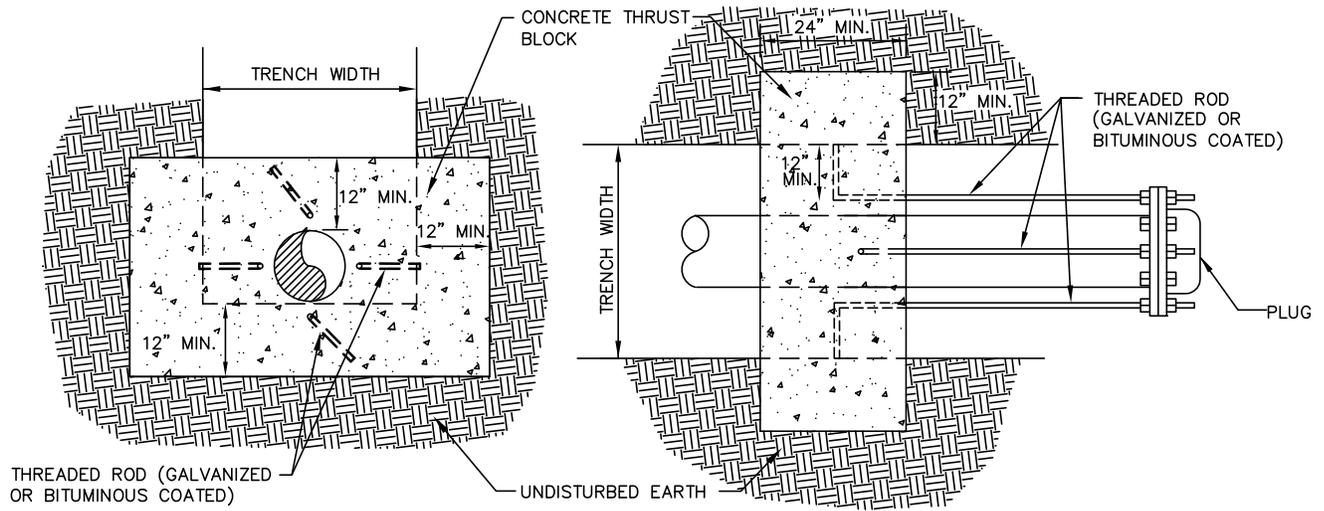
THRUST BLOCK DIMENSION "A" NOT TO SCALE



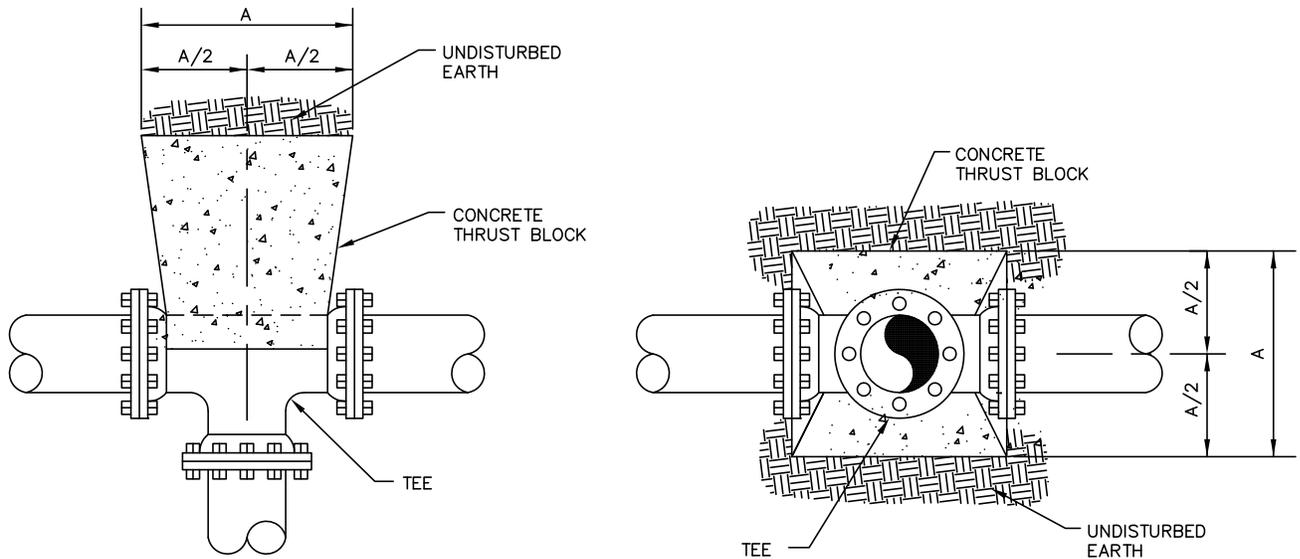
CITY OF GATLINBURG
SANITARY SEWER SYSTEM
STANDARD DETAILS

REVISION NO: 1
DATE: MAY, 2014

STD-WW-08



TYPICAL THRUST BLOCKS FOR PLUGS



TYPICAL THRUST BLOCKS FOR TEES

NOTES:

1. FITTING JOINTS SHALL NOT BE POURED IN CONCRETE OR HAVE CONCRETE SPILLED ON THE BOLTS OR NUTS. THE FITTING SHALL BE WRAPPED IN A LAYER OF POLYETHYLENE PLASTIC PRIOR TO POURING THE THRUST BLOCK.
2. ROD AND EYE BOLT DIAMETER SHALL BE A MINIMUM OF 3/4" AND SHALL MATCH THE SIZE OF THE BOLT PROVIDED WITH THE FITTING.
3. CONTRACTOR SHALL REPLACE FITTING BOLTS WITH THREADED ROD FOR 1/2 OF THE BOLTS SUPPLIED WITH EACH FITTING. RODS SHALL BE EQUALLY SPACED.

SIZE	TEE	PLUG
2-6	16	14
8	22	18
10	28	22
12	32	28
14	38	32
16	42	36
18	48	40
20	52	44
24	64	54
30	78	66
36	94	80
42	108	92
48	124	104

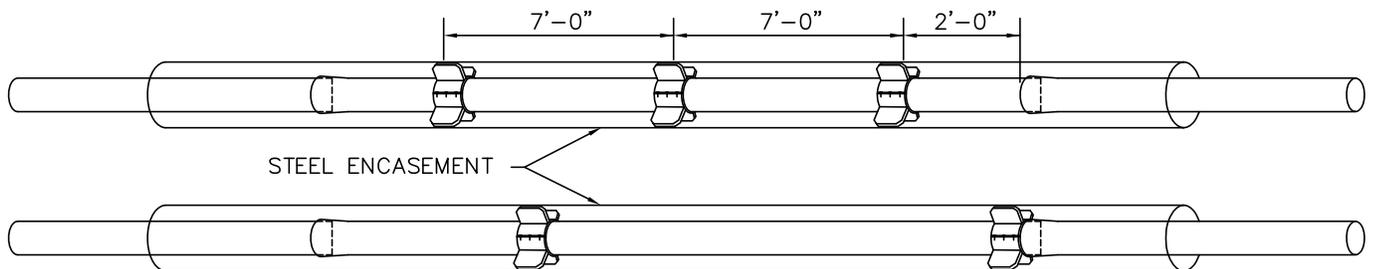
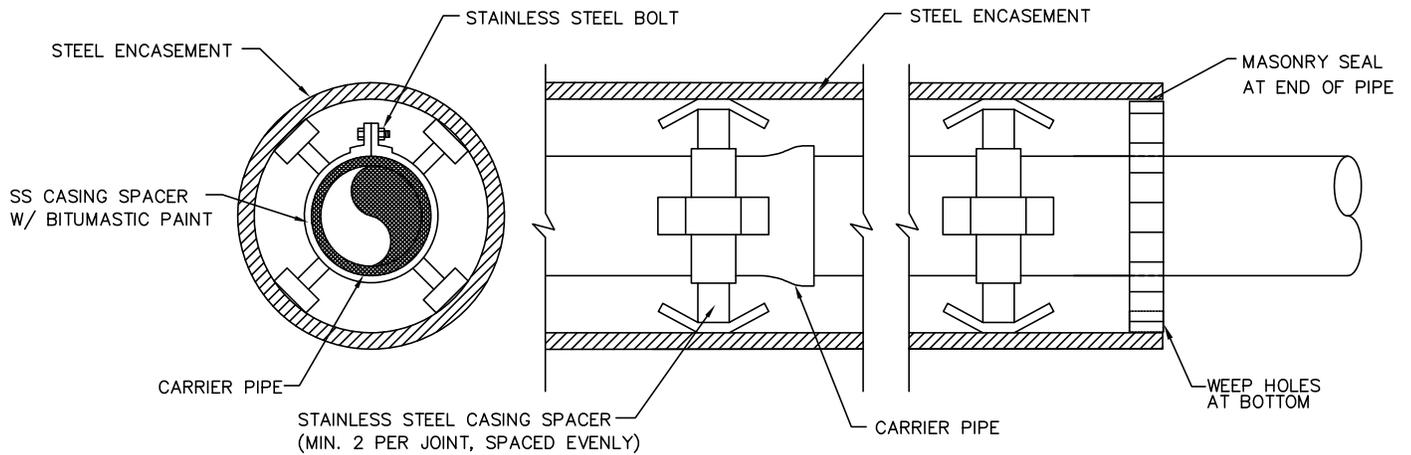
THRUST BLOCK DIMENSION "A" NOT TO SCALE



CITY OF GATLINBURG
SANITARY SEWER SYSTEM
STANDARD DETAILS

REVISION NO: 1
DATE: MAY, 2014

STD-WW-09



NOTE: STANDARD POSITIONING TO BE USED UNLESS OTHERWISE NOTED
 ALL BELLS INSIDE CASING SHALL BE INSTALLED WITH A LOCKING GASKET
 CASING SPACERS FOR GRAVITY SEWERS SHALL MAINTAIN SEWER LINE GRADE

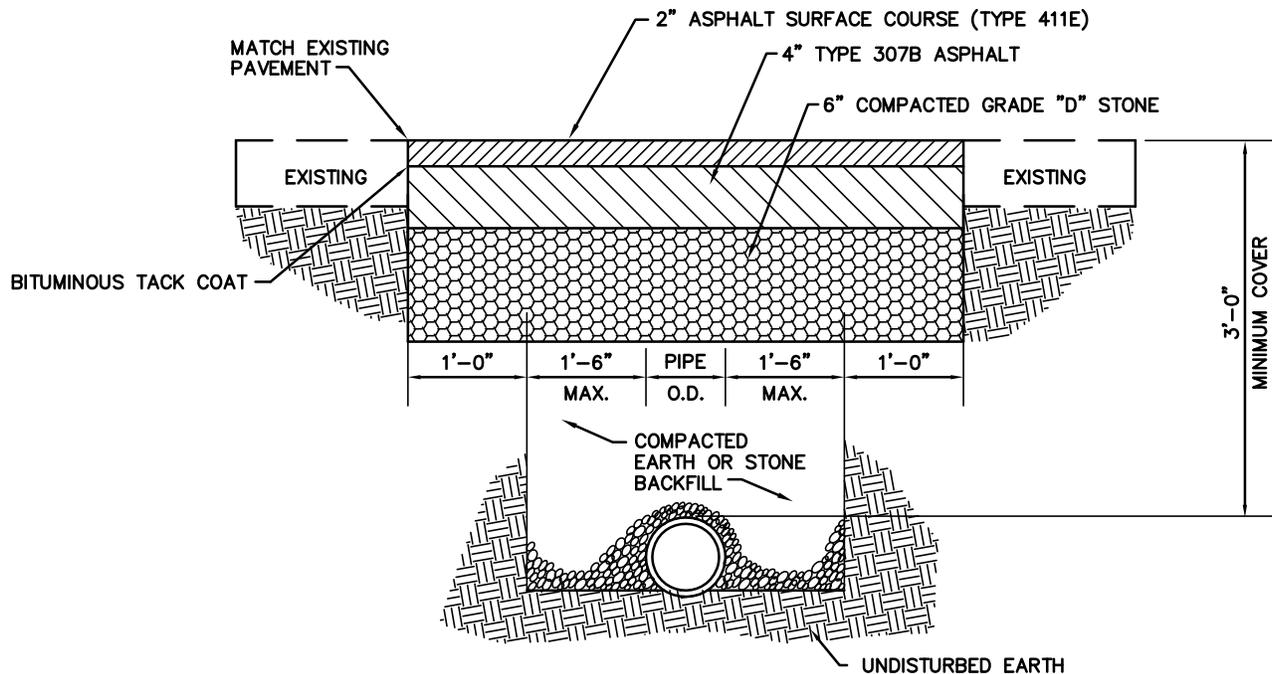
CARRIER PIPE IN STEEL ENCASEMENT DETAIL
 NOT TO SCALE



CITY OF GATLINBURG
 SANITARY SEWER SYSTEM
 STANDARD DETAILS

REVISION NO: 1
 DATE: MAY, 2014

STD-WW-10



NOTES:

1. EDGE TO BE SAWED WITH A CONCRETE SAW TO A NEAT SQUARED EDGE. BROOMED CLEAN OF DUST BEFORE TACK COAT IS APPLIED.
2. EDGES TO BE TACKED WITH CRS-I OR CRS-II.
3. CONTRACTOR RESPONSIBLE FOR REPLACEMENT OF ANY PAVEMENT MARKINGS DISTURBED OR COVERED BY OVERLAY.

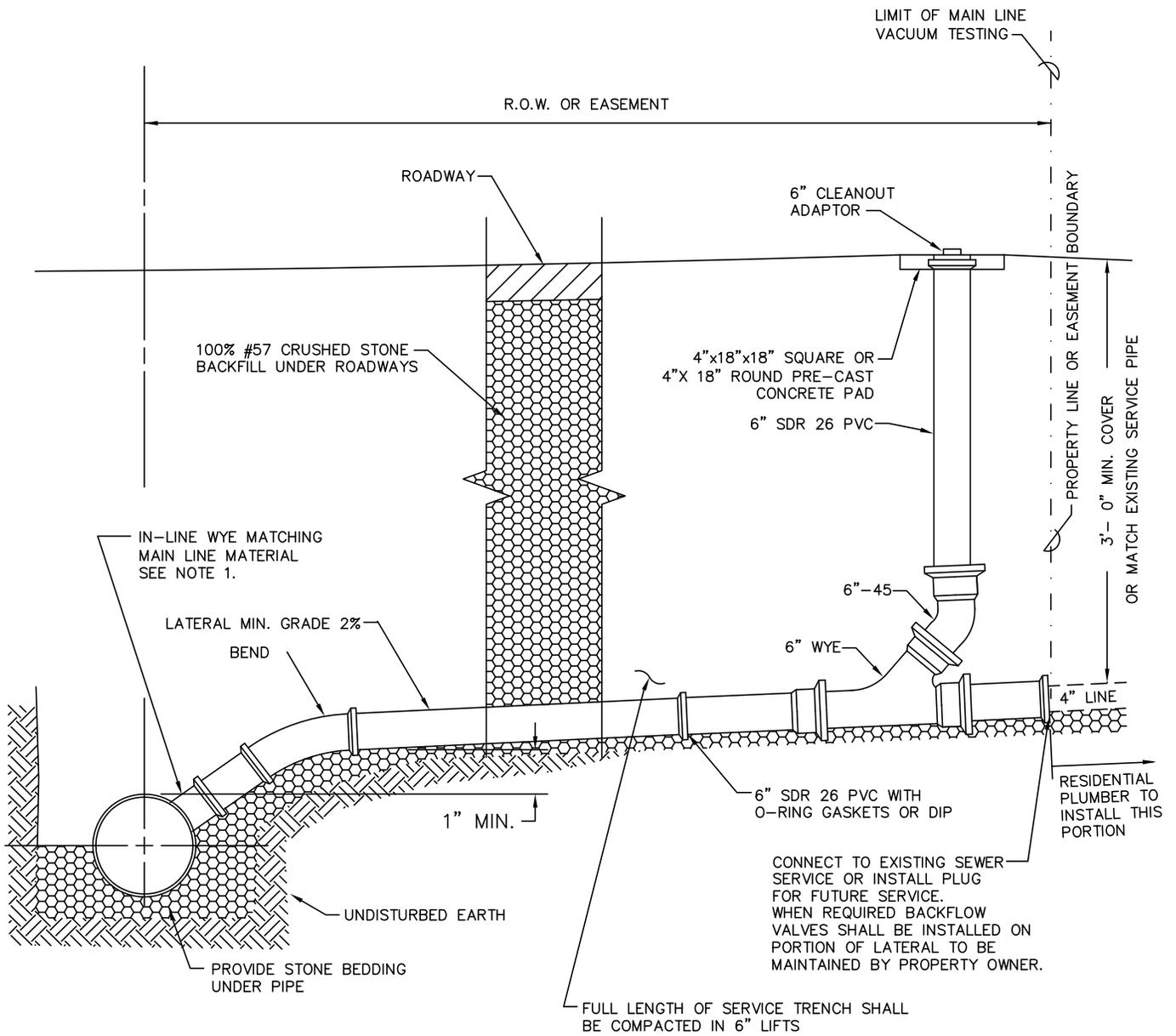
TYPICAL PAVEMENT REPAIRS
NOT TO SCALE



CITY OF GATLINBURG
SANITARY SEWER SYSTEM
STANDARD DETAILS

REVISION NO: 1
DATE: MAY, 2014

STD-WW-11



LONG AND SHORT TAP SANITARY SEWER SERVICE

NOT TO SCALE

NOTE:

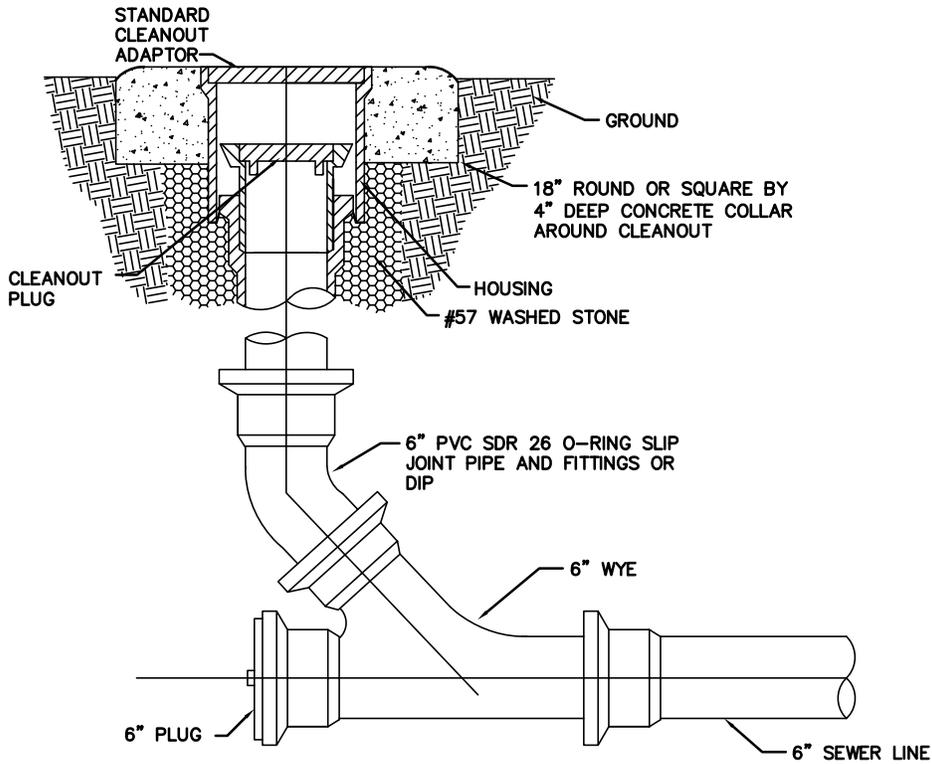
1. TAPPING SADDLES ARE APPROVED FOR CONNECTIONS TO EXISTING SEWER LINES ONLY
2. INTERMEDIATE CLEANOUTS SHALL BE INSTALLED EVERY 75 LINEAR FEET OF CUSTOMER'S SEWER SERVICE LATERAL AND AT ALL CHANGES IN DIRECTION.
3. REFER TO STD-WW-06 FOR NEW CONSTRUCTION LATER STUBOUT.



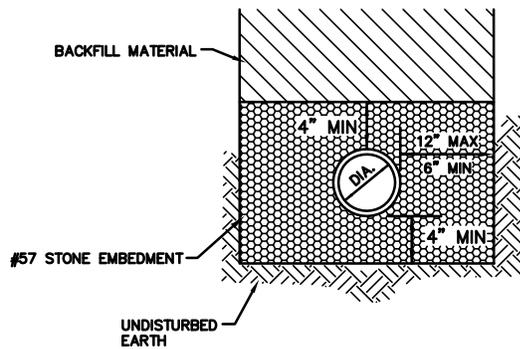
CITY OF GATLINBURG
SANITARY SEWER SYSTEM
STANDARD DETAILS

REVISION NO: 3
DATE: SEPTEMBER, 2014

STD-WW-12



CLEANOUT DETAIL
NOT TO SCALE



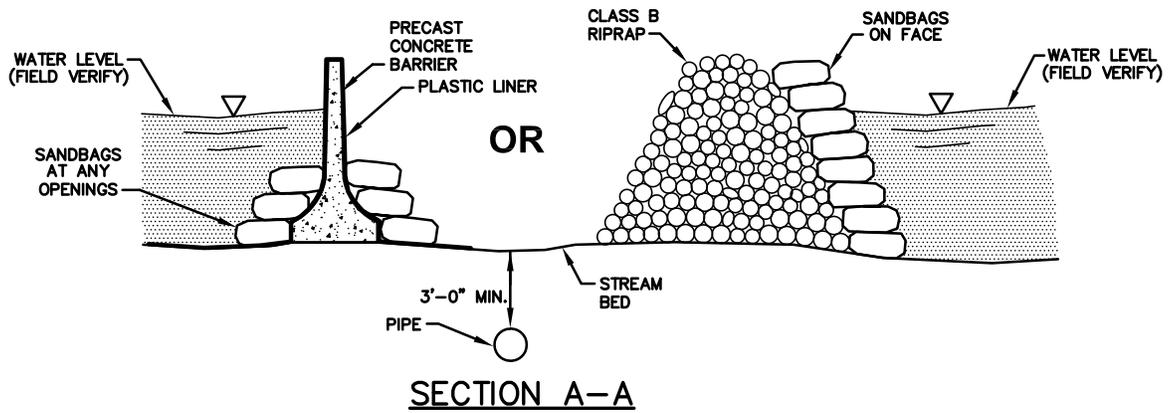
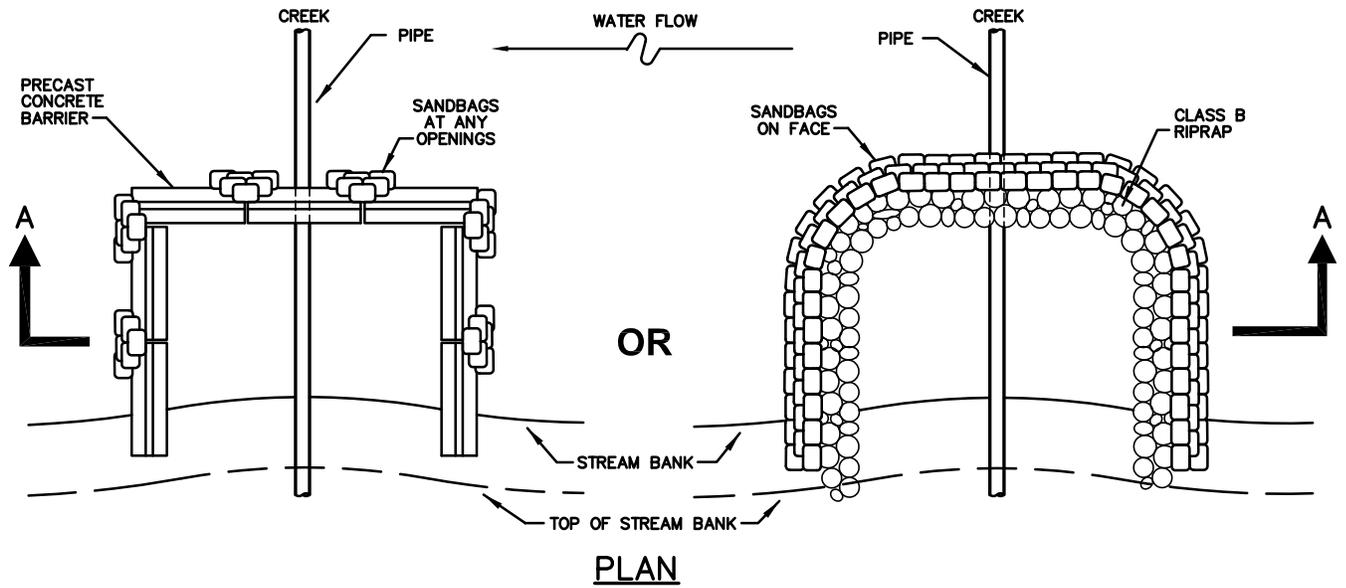
TYPICAL SEWER SERVICE LINE TRENCHING DETAIL
NOT TO SCALE



CITY OF GATLINBURG
SANITARY SEWER SYSTEM
STANDARD DETAILS

REVISION NO: 2
DATE: OCTOBER, 2014

STD-WW-13



NOTES:

1. COFFER DAM WILL BE BUILT SO THAT APPROXIMATELY ONE-HALF (1/2) OF THE STREAM CHANNEL IS OPEN AT ALL TIMES.
2. MATERIAL FROM THE STREAM BED SHALL NOT BE USED FOR COFFER DAM.
3. NO EARTHEN MATERIAL SHALL BE USED FOR COFFER DAM OR PLACED IN STREAM FOR ANY REASON.
4. STREAM BED SHALL BE DISTURBED THE MINIMUM REQUIRED FOR CONSTRUCTION OF PIPE LINE AND WILL BE RESTORED TO ORIGINAL CONTOURS WHEN WORK IS COMPLETE.
5. ALTERNATIVE COFFER DAM MATERIAL IS ACCEPTABLE BUT SHALL BE APPROVED BY THE ENGINEER.

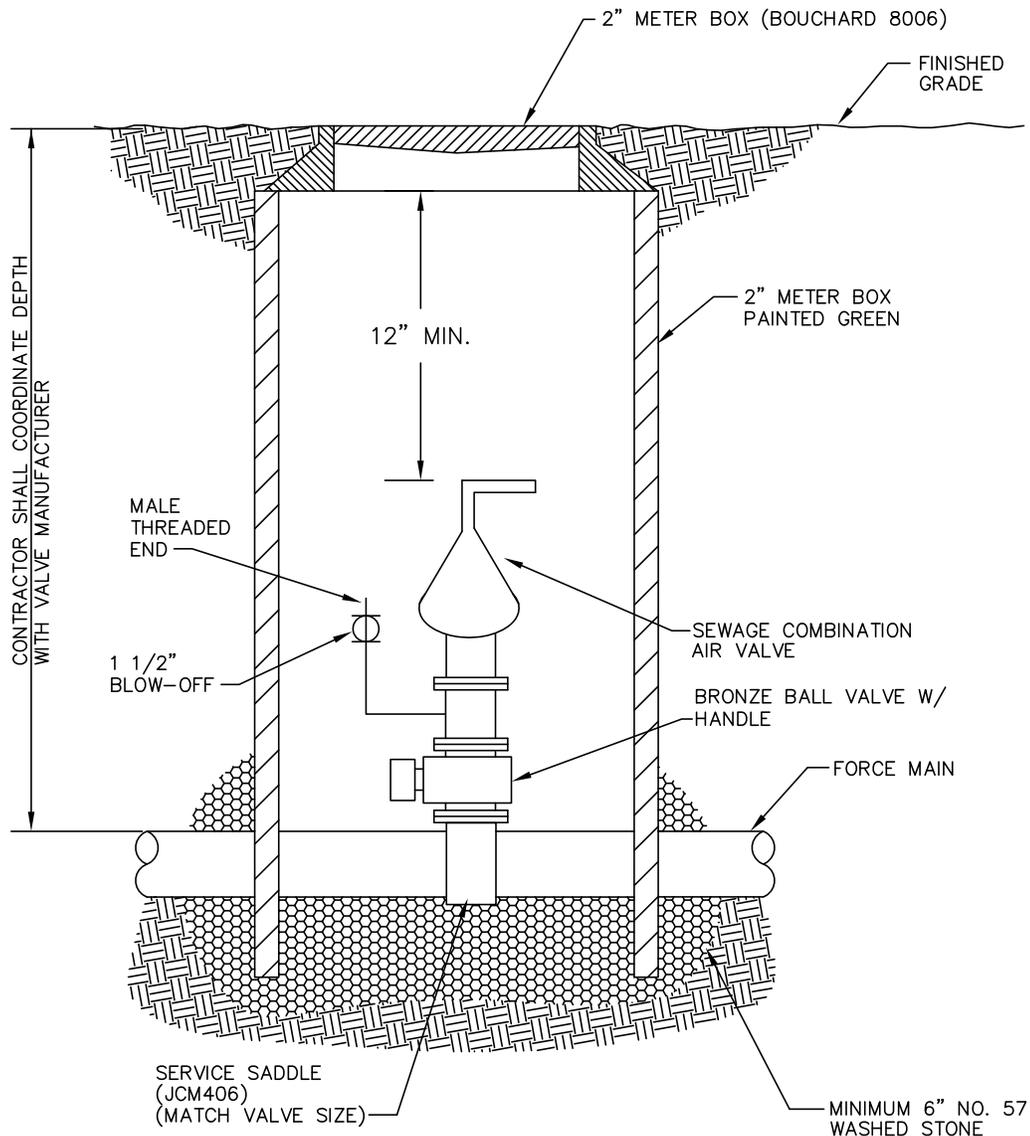
**CREEK OR RIVER CROSSING
(LARGE CREEKS AND RIVERS)
NOT TO SCALE**



CITY OF GATLINBURG
SANITARY SEWER SYSTEM
STANDARD DETAILS

REVISION NO: 1
DATE: MAY, 2014

STD-WW-14



NOTES:

1. COMBINATION AIR VALVE TO BE INSTALLED AT ACTUAL HIGH POINT OF LINE. CONTRACTOR SHALL COORDINATE LOCATION WITH INSPECTOR.
2. VALVE SIZE AS SHOWN ON DRAWINGS OR DETAILED IN THE SPECIFICATIONS.
3. ALL PIPING FOR COMBINATION AIR VALVE SHALL BE BRASS OR STAINLESS STEEL.
4. CONTRACTOR SHALL ADJUST THE DEPTH OF THE FORCE MAIN AT ALL HIGH POINTS TO ACCOMODATE THE INSTALLATION OF THE COMBINATION AIR VALVE.

SEWAGE FORCE MAIN COMBINATION AIR VALVE

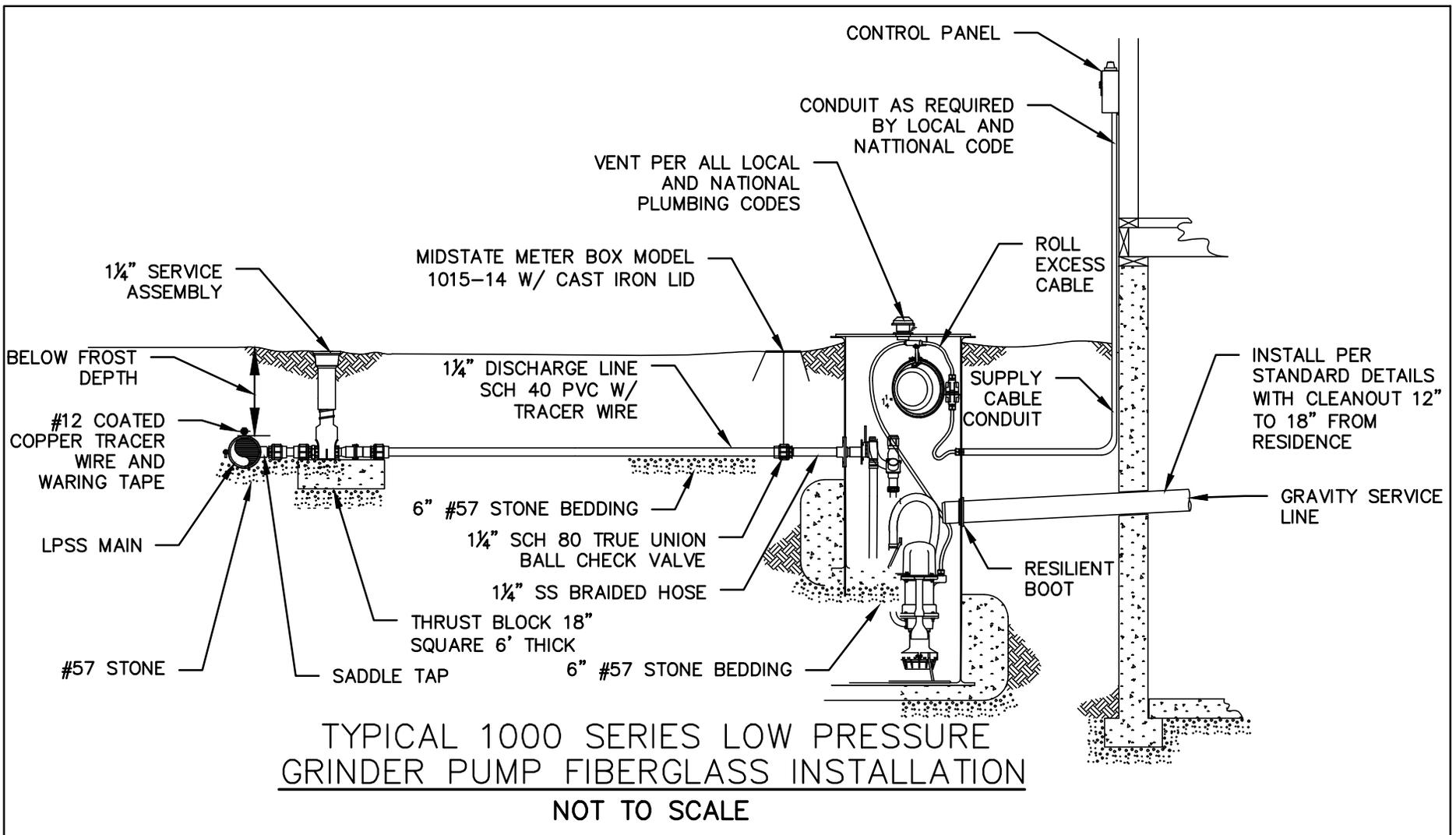
NOT TO SCALE



CITY OF GATLINBURG
 SANITARY SEWER SYSTEM
 STANDARD DETAILS

REVISION NO: 1
 DATE: MAY, 2014

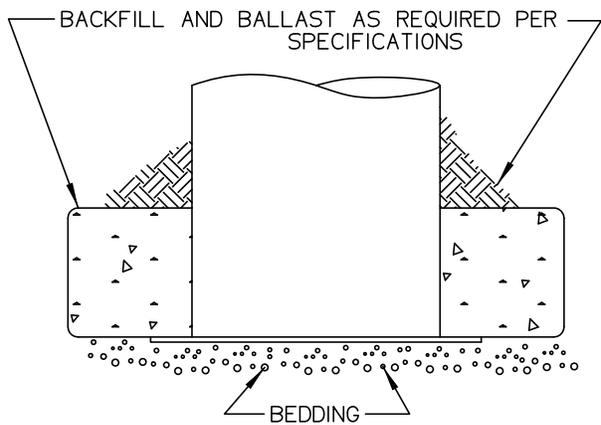
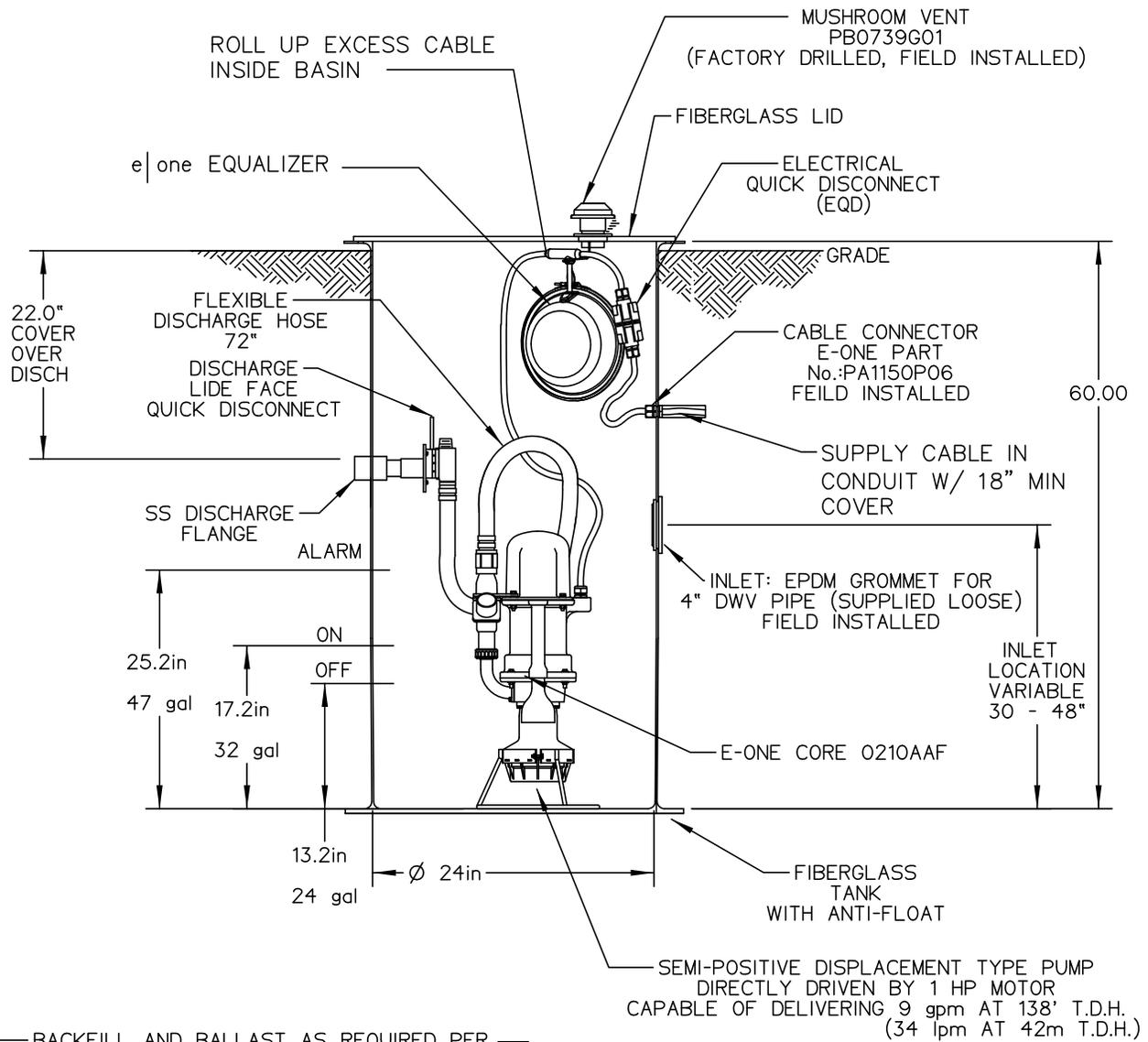
STD-WW-15



CITY OF GATLINBURG
 WASTEWATER
 STANDARD SEWER DETAILS

REVISION NO: 2
 DATE: OCTOBER, 2014

STD-LP-01



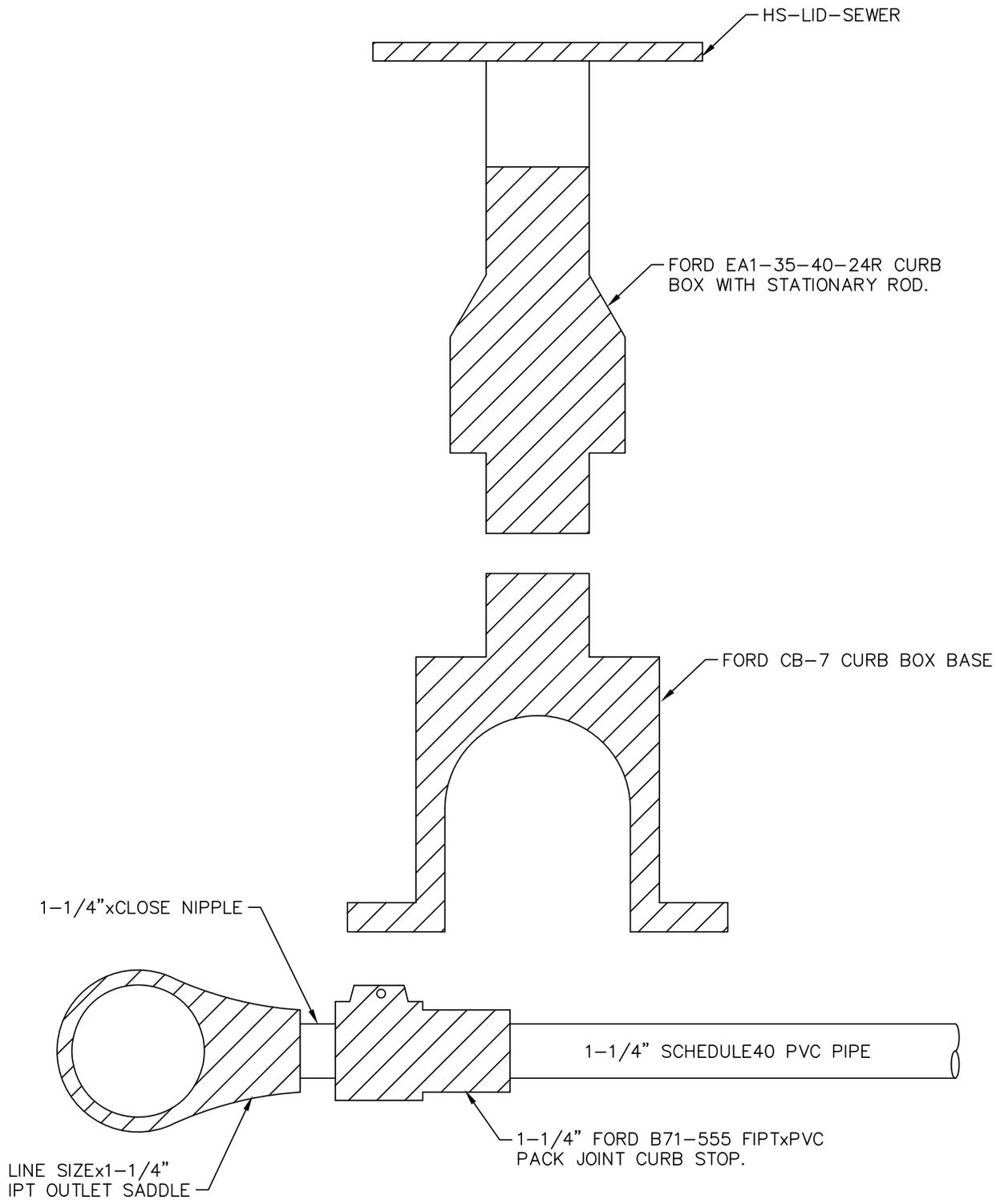
**AMGP SIMPLEX GRINDER
PUMP, W/ 24 X 60
FIBERGLASS STATION**
NOT TO SCALE



CITY OF GATLINBURG
WASTEWATER
STANDARD SEWER DETAILS

REVISION NO: 1
DATE: MAY, 2014

STD-LP-02



1 1/4" SERVICE ASSEMBLY
NOT TO SCALE



CITY OF GATLINBURG
 WASTEWATER
 STANDARD SEWER DETAILS

REVISION NO: 1
 DATE: MAY, 2014

STD-LP-03

MID-STATE MSCBC-1015-"SEWER" LID
 MID-STATE MSBC+015-18 METER BOX

2" STAINLESS STEEL DUST CAP: GOODYEAR #DC200SS
 2" STAINLESS STEEL FIPTxCAMLOCK: #A2200SS
 STAINLESS STEEL CHAIN
 2" STAINLESS STEEL FIPTxMALE CAMLOCK WITH DUST CAP

JBS #8006 "SEWER"
 FRAME AND COVER

HULA 18" CONCRETE
 VALVE BOX WITH
 FOOTER BLOCKS

2"x6" BRASS
 NIPPLE

2" ASAHI
 #1210-020 TRUE
 UNION BALL
 CHECK VALVE

2"x18" BRASS NIPPLE

2" SDR21

2" FORD C87-77
 MIPTxPVC PACK JT
 COUPLING

2" THIRD
 GATE VALVE

2"x12" BRASS NIPPLE

2" BRASS 90° ELBOW

2" PVC LINES

FLUSHING STATION
 NOT TO SCALE



CITY OF GATLINBURG
 WASTEWATER
 STANDARD SEWER DETAILS

REVISION NO: 1
 DATE: MAY, 2014

STD-LP-04

MID-STATE MSCBC-1015-"SEWER" LID
MID-STATE MSBC+015-18 METER BOX

2" STAINLESS STEEL DUST CAP: GOODYEAR #DC200SS
2" STAINLESS STEEL FIPTxCAMLOCK: #A2200SS
STAINLESS STEEL CHAIN
2" STAINLESS STEEL FIPTxMALE CAMLOCK WITH DUST CAP

JBS #8006 "SEWER"
FRAME AND COVER

HULA 18" CONCRETE
VALVE BOX WITH
FOOTER BLOCKS

2"x6" BRASS
NIPPLE

2" ASAHI
#1210-020 TRUE
UNION BALL
CHECK VALVE

2"x18" BRASS NIPPLE

3"x2" M.J. TAP &
PLUG "EPOXY"

3" SDR21

2" BRASS 90° ELBOW

2"x12" BRASS NIPPLE

3" M.J.
GATE
VALVE

3"+ PVC LINES

FLUSHING STATION

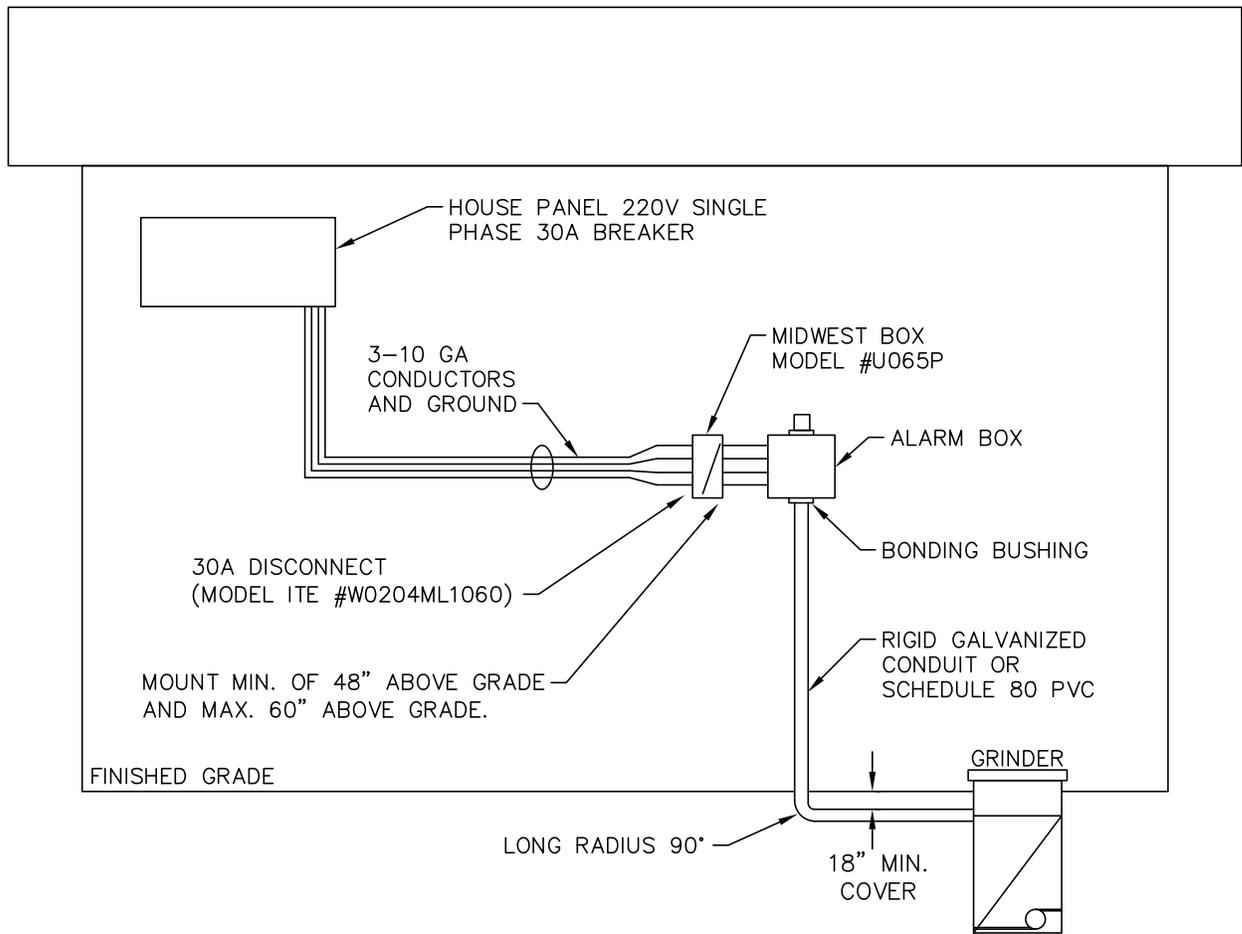
NOT TO SCALE



CITY OF GATLINBURG
WASTEWATER
STANDARD SEWER DETAILS

REVISION NO: 1
DATE: MAY, 2014

STD-LP-05



FINISHED GRADE

MOUNT MIN. OF 48" ABOVE GRADE AND MAX. 60" ABOVE GRADE.

NOTE: VERIFY MOTOR AMPERAGE AND ALL NAMEPLATE REQUIREMENTS PRIOR TO INSTALLATION. ALL CONNECTIONS SHALL BE IN ACCORDANCE WITH LOCAL CODES AND NEC.

NOTE: ROLL UP EXCESS ELECTRICAL CABLE AND STORE IN BASIN LID.

ELECTRICAL INSTALLATION FOR SIMPLEX GRINDER PUMPS

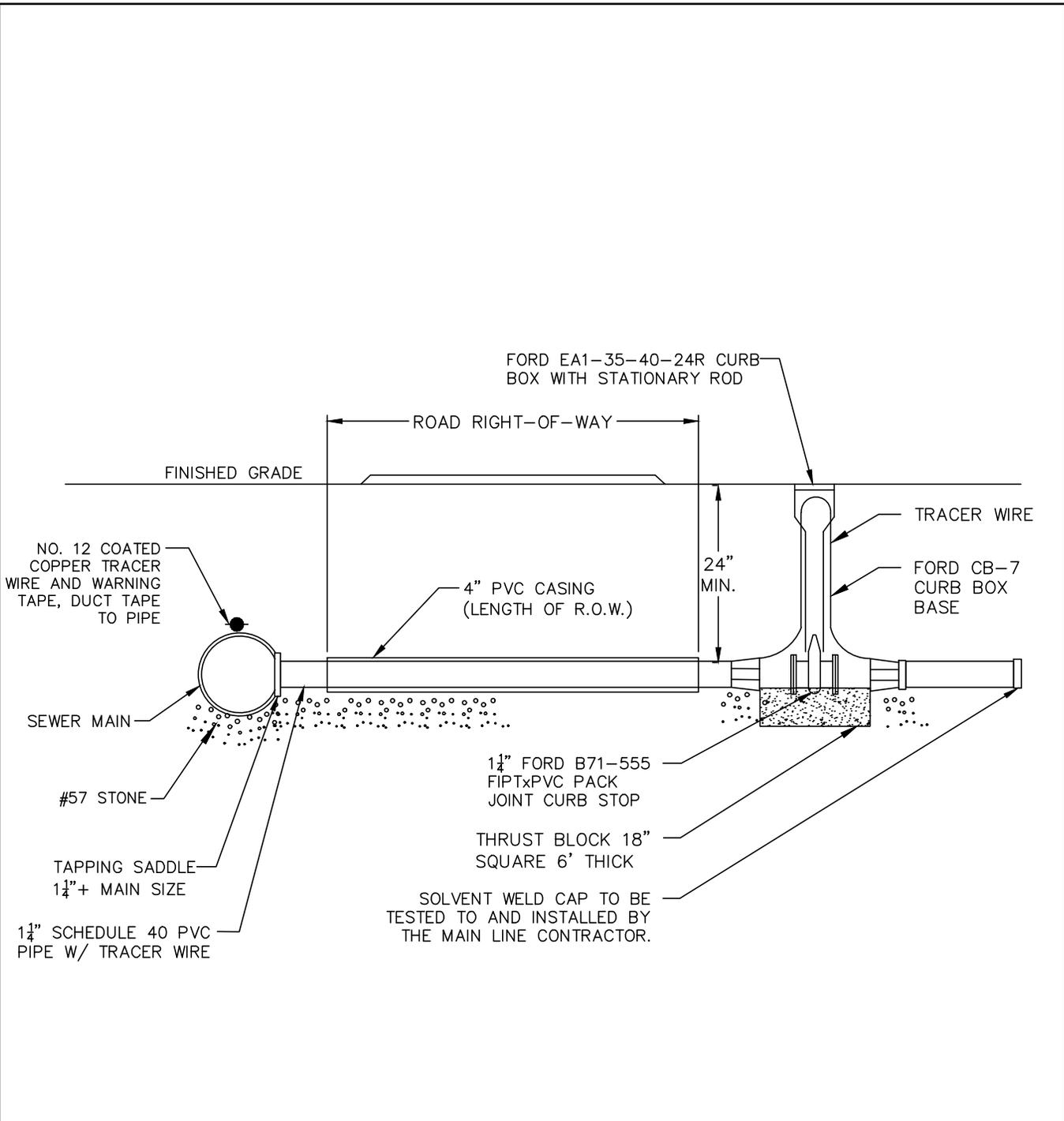
NOT TO SCALE



CITY OF GATLINBURG
WASTEWATER
STANDARD SEWER DETAILS

REVISION NO: 1
DATE: MAY, 2014

STD-LP-06



**LONG SIDE INSTALLATION OF
SIMPLEX GRINDER PUMP CROSSING**

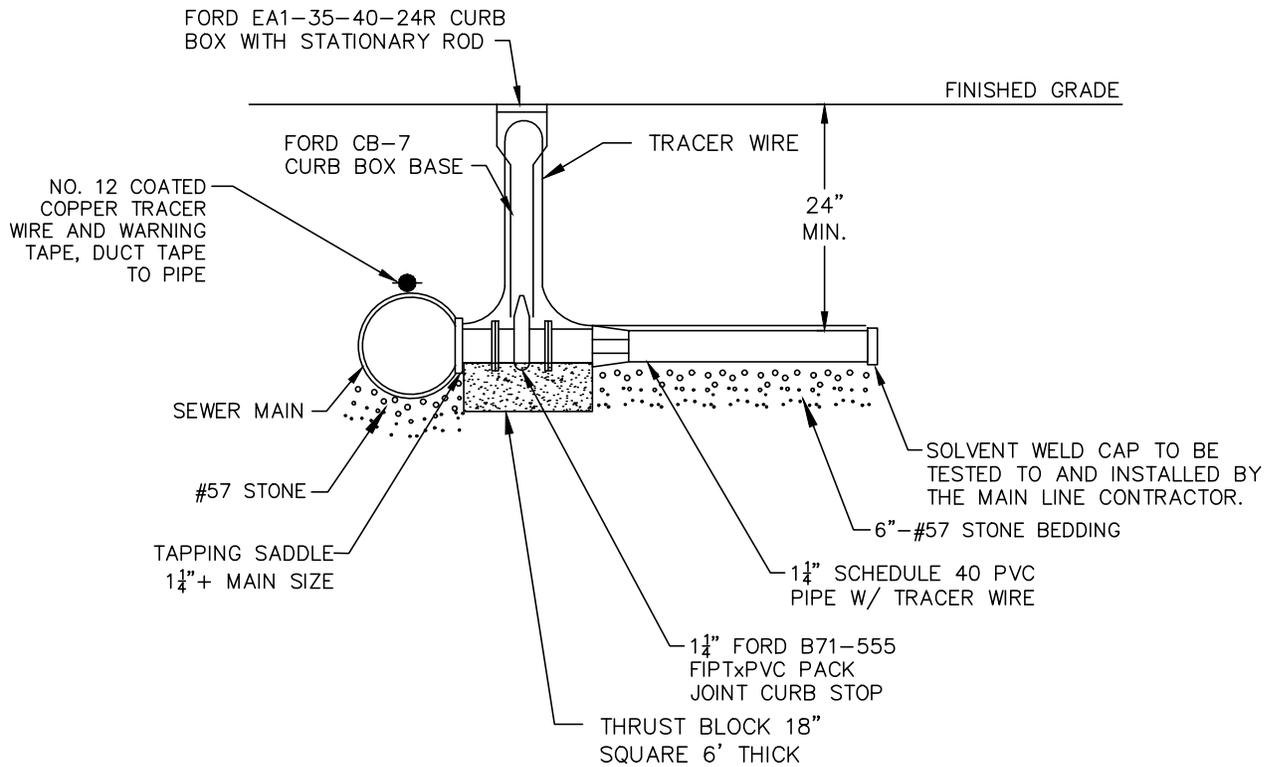
NOT TO SCALE



CITY OF GATLINBURG
WASTEWATER
STANDARD SEWER DETAILS

REVISION NO: 2
DATE: OCTOBER, 2014

STD-LP-07



SHORT SIDE INSTALLATION OF SIMPLEX GRINDER PUMP

NOT TO SCALE



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WASTEWATER
STANDARD SEWER DETAILS

REVISION NO: 2
DATE: OCTOBER, 2014

STD-LP-08