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THE CITY OF TROY
TROY UTILITIES

STANDARD SPECIFICATIONS

APRIL 2018

SANITARY SEWER
SYSTEM

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**Specifications contained herein supersede all
previously published versions.**

CITY OF TROY
STANDARD SPECIFICATIONS
SANITARY SEWER SYSTEM

TABLE OF CONTENTS

Preface.....	1
Section 1 General and Administrative	
1.1 Scope.....	2
1.2 Work Included	2
1.3 Inspection of The Work	2
1.4 Contractor Credentials	2
1.5 Engineers Certificate of Engineering Design and Construction	2
1.6 Regulatory Requirements.....	3
1.7 As-Built Drawings	3
1.8 Burden of Testing	4
1.9 Traffic Control	4
1.10 Amendments	4
1.11 Abbreviations.....	4
Section 2 Design and Construction of Linear Sanitary Sewer Attributes	
2.1 Location	4
2.2 Easements	5
2.3 Depth of Cover.....	6
2.4 Size.....	7
2.5 Slope	7
2.6 Pipe Grade	8
2.7 Hydraulic Grade Line	8
2.8 Trenching	8
2.9 Excavation Stability	9
2.10 Pipe Bedding.....	9
2.11 Backfill and Fill	10
2.12 Manholes.....	12
2.13 Service Laterals.....	13
2.14 Connections to Existing Sewers.....	13
2.15 Air and Vacuum Valves for Force mains	13
2.16 Aerial Sewer Crossings.....	13
Section 3 Sanitary Sewer Pipe Materials	
3.1 General.....	14
3.2 Ductile Iron Sewer Pipe	14
3.3 PVC Sewer Pipe-SDR (Standard Dimension Ratio) 26	14
3.4 Steel Pipe	15
3.5 Unloading and Storing of Pipe Materials.....	15

Section 4 Pipe Bedding Classifications

4.1	Pipe Bedding Classes.....	16
-----	---------------------------	----

Section 5 Service Laterals

5.1	General.....	16
5.2	Service Lateral Diameters.....	16
5.3	Pipe Materials and Ratings.....	16
5.4	Installation.....	16
5.5	Sewer Service Requirements (Residential and Commercial).....	17
5.6	Residential Sewer.....	17
5.7	Commercial Sewer.....	18

Section 6 Precast Concrete Sanitary Sewer Manholes

6.1	General Requirements.....	18
6.2	Precast Manholes.....	18
6.3	Manhole Ring and Cover.....	19
6.4	Mortar.....	19
6.5	Flexible Sealing System for Joining Pipes to Precast Manholes.....	19
6.6	Stone for Stabilization of Trench Foundation.....	19

Section 7 Concrete

7.1	Concrete.....	19
-----	---------------	----

Section 8 Plugs

8.1	Plugs.....	20
-----	------------	----

Section 9 Corrosion Resistant Manhole Lining

9.1	Description.....	20
9.2	Submittals.....	20
9.3	Quality Assurance.....	20
9.4	Materials and Equipment.....	21
9.5	General Requirements.....	22
9.6	Pre-Coat Inspection.....	22
9.7	Surface Preparation.....	22
9.8	Material Installation.....	23
9.9	Testing and Inspection.....	23
9.10	Concrete Repair.....	23
9.11	Chemical Grout.....	24
9.12	Warranty.....	24

Section 10 Pipe Rehabilitation – Cured in Place

10.1	Design Requirements.....	24
10.2	Performance Requirements.....	24
10.3	Submittals.....	24
10.4	Qualifications.....	25

10.5	Coordination	25
10.6	Cured-In-Place (CIPP) Liner	26
10.7	Source Quality Control	27
10.8	Cleaning and Flushing	27
10.9	Initial Video Inspection and Repair	28
10.10	Installation Cured-in-Place Pipe (CIPP) Liner for Mainline	28
10.11	Field Quality Control	28
10.12	Cleaning	29

Section 11 Small Capacity Submersible Lift Stations

11.1	General Design Criteria	29
------	-------------------------------	----

Section 12 Removal and Replacement of Pavement

12.1	Cutting & Replacement of Existing Pavements	30
------	---	----

Section 13 Clearing and Grubbing

13.1	Submittals	30
13.2	Quality Assurance	30
13.3	Preparation	30
13.4	Protection	30
13.5	Clearing	30
13.6	Removal	31
13.7	Topsoil Excavation	31
13.8	Site Restoration	31

Section 14 Grassing

14.1	Definitions	31
14.2	Submittals	32
14.3	Delivery, Storage, and Handling	32
14.4	Maintenance Service	32
14.5	Seed Mixture	32
14.6	Soil Materials	32
14.7	Accessories	32
14.8	Preparation of Subsoil	33
14.9	Placing Topsoil	33
14.10	Seeding	33
14.11	Hydroseeding	33

Section 15 Trench Excavation and Preparation

15.1	General Requirements	34
15.2	Dewatering	34
15.3	Rock Excavation	34
15.4	Blasting Procedures	34

Section 16 Maintaining Wastewater Flow

16.1	Submittals	35
16.2	Pumps.....	36
16.3	Plugs.....	36
16.4	Hoses.....	36
16.5	Depth of Flow	36
16.6	Bypass Pumping	37

Section 17 Inspection and Testing of Gravity Sewers

17.1	Visual Inspection of Pipeline Interior	38
17.2	Low Pressure Air Tests.....	38
17.3	Infiltration Tests.....	39
17.4	Deflection Testing of PVC Sewer Pipe (SDR-26).....	39

Section 18 Vacuum Testing of Manholes

18.1	Vacuum Testing of Manholes.....	40
------	---------------------------------	----

Section 19 Fats, Oils and Grease Management

19.1	Definitions.....	41
19.2	Requirements	43
19.3	Prohibitions.....	45
19.4	Certified Hauler/Plumber Program.....	45
19.5	Grease Interceptor (GI) Cleaning/Maintenance Requirements.....	47
19.6	Grease Trap (GT) Cleaning/Maintenance Requirements	47
19.7	Additives.....	48
19.8	Right of Entry for Inspection and Monitoring	48
19.9	Enforcement Action	49

Section 20 Sewer Infrastructure Ownership

20.1	Applicability	49
20.2	Private and Public Sewer Laterals	49
20.3	Addressing Sewer Service Disruptions.....	50

Standard Sewer System Details	50
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STANDARD SPECIFICATIONS SANITARY SEWER SYSTEM

SANITARY SEWER SYSTEM FOR THE CITY OF TROY, ALABAMA

PREFACE

Presented herein are Standard Specifications for the Sanitary Sewer System for the City of Troy, Alabama, hereinafter known as the “City”. These specifications are to ensure the quality of material, workmanship, and compatibility of products with the existing materials installed in the City.

Sanitary sewer infrastructure installed in conjunction with private development, extension of existing service, private upgrading of existing service, or for any other purpose to be tied to sanitary sewer infrastructure being operated and maintained by the “City” shall conform to these specifications. It shall be the responsibility of the Owner/Developer/Contractor to ensure that all materials and methods of installation of all sanitary sewer infrastructures shall strictly conform to these specifications. Any deviations not approved by the City, in writing, shall be grounds for rejection of any part or all sanitary sewer infrastructures installed. Rejection, at the City’s discretion, shall result in the sanitary sewer infrastructure in question not being connected to sanitary sewer infrastructure owned and/or operated by the City.

Prior to any laying operation, the Owner/Developer shall submit to the City for approval a set of plans showing size and location of all proposed material and equipment and submittal data showing manufacture and model number of all material and equipment to be used. The submittal of material and plans, and the approval thereof, in no way relieves the Owner/Developer/Contractor of his responsibility to adhere to these specifications. Upon delivery of material/equipment, the Owner/Developer/Contractor shall notify the City and make this material/equipment available to its representative for inspection.

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Section 1 General and Administrative

1.1 Scope

- A. These specifications shall govern the handling, installation, distribution and testing of sanitary sewer infrastructure including gravity sewer, force mains, manholes, valves, lift stations, and accessories described herein, and as shown on the accompanying plans and details.
- B. This work shall consist of installing linear sanitary sewer infrastructure (i.e., gravity sewer and force mains) as well as the construction of lift stations, valves, and related accessories for completing necessary service connections.

1.2 Work Included

- A. All labor, equipment and material necessary to complete the work stipulated herein. The Contractor shall remove so much of the pavement as may be necessary; excavate the trenches and pits to the required dimensions; excavate the bell holes; construct and maintain all bridges required for traffic control; sheet, brace and support the adjoining ground or structures where necessary; handle all drainage or ground water; guard the site; unload, haul, distribute, lay and test the pipe, fittings, valves, hydrants, lift stations, and accessories; rearrange the branch connections to main sewers, or rearrange other conduits, ducts or pipes where necessary; replace all damaged drains, sewers, or other structures; backfill and compact the trench pits; restore the roadway surface; remove surplus excavated material, and clean the site of the work.

1.3 Inspection of The Work

- A. The Owner/Developer/Contractor shall make available to the City reasonable inspection opportunities. The City also requires all work to be inspected by a qualified representative of the Design Engineer to ensure that the work complies with the City's specifications and the plans as submitted to the City.

1.4 Contractor Credentials

- A. The Directors of the City have directed the General Manager to examine the credentials of the potential contractor, selected by the developer to perform the construction and installation of water/sewer piping, to determine the experience and competency of such contractor. Contractors seeking to install utilities connected to the Board's systems shall provide written proof of satisfactory installations of an equivalent scope of work, as defined in the project proposal, along with names, addresses, and telephone numbers of associated references.

1.5 Engineers Certificate of Engineering Design and Construction

- A. The Design Engineer shall be required to certify that the work complies with plans and specifications by providing the following statement:

ENGINEER'S CERTIFICATE OF
ENGINEERING DESIGN AND CONSTRUCTION

I, _____, a professional engineer licensed in the State of Alabama, License Number _____, do hereby certify that to the best of my knowledge, the Sanitary Sewer System Improvements have been constructed in accordance with these Standard Specifications as submitted to the City.

Failure to provide the above certificate shall result in rejection by the City. Rejection, at the City's discretion, shall result in the sanitary sewer infrastructure in question not being connected to any sanitary sewer infrastructure owned and operated by the City.

The Contractor shall notify the City 24 hours prior to beginning any work.

The City shall not be held responsible for damage caused by the Contractor to private or public property and shall be held harmless therefrom by the Contractor. The Contractor shall carry insurance with suitable coverage for the value of work to be done.

1.6 Regulatory Requirements

- A. In addition to the specifications, all current requirements of the applicable regulatory agencies shall be satisfied. This shall include, but is not limited to the Environmental Protection Agency (EPA) and Alabama Department of Environmental Management (ADEM).

1.7 As-Built Drawings

- A. A complete set of As-built drawings is required for all projects. A complete set shall consist of all sanitary sewer infrastructure as constructed, all engineering design specifications (i.e., plans, details, profiles showing hydraulic grade line, operations and maintenance manuals, etc.) and the engineer's signature and seal. All As-Built must be approved by the City prior to any service connection to any City-owned infrastructure.
- B. Construction drawings for sanitary sewer collection systems shall be prepared by or under the direct supervision of a professional engineer licensed to practice in the state of Alabama. Drawings shall conform to the applicable requirements, specifications and standards established by the City.
- C. Plans shall indicate the deflection angles at all manholes. Profile elevations shall be on NCGS datum and benchmarks shall be shown and described on the Drawings. Hydraulic grade lines should be indicated on all gravity sewer profiles. Lift station plans must show operating levels.
- D. A hardcopy (standard 22" x 34" D-size) and an Auto Cad or ArcGIS file of the As-Built must be provided to the City upon request.

1.8 Burden of Testing

- A. All testing requirements shall be arranged and paid by the contractor. The testing laboratory shall be approved by the City. Results from all required testing shall be provided to the City for review.

1.9 Traffic Control

- A. Prior to any work requiring traffic control, a traffic control plan prepared in accordance with the latest revision of the MUTCD shall be submitted to the City for approval. The Contractor shall coordinate any road closures with first responders. It shall be the Contractor's sole responsibility to maintain adequate traffic control, to provide detours around construction activities, and to hold the City harmless from claims arising therefrom. Unless approved by the City in writing, no street shall remain closed to traffic over night. In addition, the Contractor shall cooperate with local residents in gaining access to their homes during working hours and shall assist at all times when vehicles experience trouble due to construction activities.

1.10 Amendments

- A. These specifications may be amended from time to time by the City when necessary. It shall be the contractor's responsibility to obtain the latest amendments and/or updates from the City

1.11 Abbreviations

- A. Found below, for the readers' convenience, are the abbreviations used within these specifications:

AASHTO American Association of State Highway and Transportation Officials

ADEM Alabama Department of Environmental Management

AWWA American Water Works Association

AWS American Welding Society

ANSI American National Standards Institute

ASTM American Society for Testing and Materials

NFPA National Fire Protection Association

NSF National Sanitation Foundation

USEPA United States Environmental Protection Agency

Section 2 Design and Construction of Linear Sanitary Sewer Attributes

2.1 Location

- A. All public sanitary sewer mains shall be within dedicated street rights-of-way or dedicated sanitary sewer easements. Sewer mains on State roads shall be installed inside an easement located outside and adjacent to the right of way. When sanitary

sewer mains are installed in street rights-of-way, they shall be located in the center of the pavement or right-of-way, where practical, or the south or west side of the pavement. When sanitary sewer mains are installed outside street rights-of-way, they shall be located in the center of an easement.

- B. In natural drainage ways, sewers shall be extended to the property lines to readily enable future connection to adjoining property. Sewer design shall account for future upstream development based on the current land use plan, and shall include evaluation of existing downstream sewer capacity. Sanitary sewers shall not be installed under any part of an existing impoundment or beneath any area to be impounded. Sanitary sewers shall not be installed through, above, or below any retained earth structure. Sewer profile shall follow natural topography and road grade.
- C. A 100' minimum separation must be maintained from any private or public water supply source, including any wells or impounded reservoirs used as a source of drinking water. A twenty (20)' minimum separation must be maintained from any other stream, lake, or impoundment. If a deviation from these separations is proposed and approved by the City, DIP sewer main with joints equivalent to water main standards must be used.
- D. Sanitary sewers shall be designed at least 10' laterally from the existing or proposed water mains unless the elevation of the top of the sewer is at least 18" below the bottom of the water main.
- E. Where public sanitary sewer mains are installed within easements crossing private property, the City shall have the right to enter upon the easement for purposes of inspecting, repairing, or replacing the sewer main and appurtenances. Where paved private streets, driveways, parking lots, etc. have been installed over public sewer mains, the City shall not be responsible for the repair or replacement of pavement, curbing, landscaping, etc., which must be removed to facilitate repairs.

The Public Works Department shall excavate as necessary to make the repair, and shall backfill the disturbed area to approximately the original grade. Replacement of privately owned pavement, curbing, walkways, etc. shall be the responsibility of the property owner.

2.2 Easements

- A. Minimum width of permanent sanitary sewer easements for public sewer mains shall be 20'. Where sewer mains are installed at a depth in excess of 8' nominal, the easement widths shall be increased in accordance with the following table:

Sewer Main Depth (D)	Easement Width Increase
8' < D ≤ 12'	10' or Determined by the City
12' < D ≤ 14'	20' or Determined by the City
>14'	Determined by City

- B. Sewer mains shall be centered in the easement. Under special conditions, temporary construction easements may be required upon approval of the City.
- C. The minimum permanent combination easement width for sanitary sewer and storm sewer is 30'. There must be a separation of 10' between outside diameters of pipes and 10' from the centerline of the sanitary sewer to the easement line.
- D. All sanitary sewer lines shall have an easement width during construction of not less than 40'.
- E. All off-site easements shall be acquired by the Developer. These off-site easements shall be recorded by deed of easement prior to construction approval. These easements shall be dedicated to the City and labeled "The City of Troy Sanitary Sewer Easement".
- F. No person shall place any part of a structure, any permanent equipment, or impoundment on sanitary sewer easements or mains. Prohibited structures include, but are not limited to buildings, houses, air conditioning units, heat pump units, decks, garages, storage/tool sheds, swimming pools, walls, retaining wall mechanisms/appurtenances, and fences. Upon prior written approval by the City, fences may be permitted across easements, provided that an access gate is installed with a minimum width of 14' for residential and the full width of the easement for commercial.
- G. No plantings or structures allowed within sewer easements.

2.3 Depth of Cover

- A. All sanitary sewer mains in non-traffic areas shall be installed with a minimum cover of 3' measured from the finish grade to the top of the pipe. In traffic areas, the minimum depth of cover shall be 4' measured from finish subgrade to the top of the pipe. Ductile iron pipe shall be used when the minimum 3' of cover in a non-traffic area or the minimum 4' of cover in a traffic area cannot be maintained.
- B. The depth of sewer mains shall be great enough to serve adjoining property, allowing for sufficient grade on the service line. Lateral connections are to be into manholes or into the top quarter of sewer mains, avoiding angles that go against the flow of the main.
- C. Proposed sewers paralleling a creek shall be designed to a proper depth to allow lateral connections, such that all creek crossings will be below the stream bottom elevation. The top of the sewer pipe should be at least 3' below the streambed elevation.
- D. No bells or connections shall be within the waterway crossing area. Where a sanitary sewer and a water main cross, and the vertical separation is less than 18 inches or the water line passes under the sewer, the sewer shall be ductile iron pipe equivalent to water main standards.
- E. Sanitary sewers shall have the top of pipe at least 24" below the bottom of storm sewer pipe when the horizontal separation is 3' or less from existing or proposed storm sewer. Where a sanitary sewer and a storm sewer cross, and the vertical

separation is less than 24", the sanitary sewer shall be ductile iron pipe equivalent to water main standards.

2.4 Size

- A. Gravity sewer mains shall be designed to serve the total natural drainage basin unless dictated and approved otherwise. Total offsite drainage area in acres must be shown on the plans. An 8" main shall be the minimum size permitted.
- B. Sewers shall be designed as to carry the total peak tributary flow at one-half of full depth (50% capacity) for sewers 15" and smaller, and two-thirds of full depth (approximately 66% of full capacity) for sewers 18" and larger.
- C. The minimum velocity for gravity sanitary sewer mains is 3 fps. Minimum velocities less than 3 fps must receive approval from the City.
- D. Sewer size shall be based on an average daily flow based on the current capacity fee schedule and a peak/average ratio of 2.5, which includes an allowance for infiltration. Where average daily flows are less than 10,000 gpd, the peak/average ratio shall be increased to 3.0.
- E. Pipe diameter changes shall occur in a manhole with the pipe crowns matched as long as a minimum drop of approximately 0.20' is maintained between inverts.

2.5 Slope

- A. The minimum gradient for sanitary sewer shall not be less than the following:

Sewer Size (in)	Minimum Slope (ft./100ft)
8	0.52
10	0.39
12	0.30
14	0.25
15	0.23
16	0.21
18	0.18
24	0.12
30	0.09
36	0.07
42	0.06
48	0.05

- B. The maximum gradient for sanitary sewers shall be 10%, or such lesser gradient as may result in a maximum velocity of 15 fps.

2.6 Pipe Grade

- A. All grades and inverts shown on submitted plans shall be maintained throughout construction. Any variation from the grade will be deemed sufficient reason to cause the work to be rejected and rebuilt at the Contractor's expense. The City reserves the right to make adjustments to the grades and slopes to fit actual field conditions. All adjustments shall be submitted to the City for approval prior to completing the construction of the invert and/or line segment in question.

2.7 Hydraulic Grade Line

- A. The hydraulic grade line or energy grade line of flow in a manhole shall always be designed to stay within the crown of the pipe. When the pipe size does not change, or increases by only one pipe size, a minimum elevation drop of 0.2' shall be applied to the invert of the outgoing pipe. Calculations shall be performed to insure that the hydraulic grade line stays within the crown of the pipe when there is reason for concern. These calculation checks may be performed by hand calculations or with the aid of computer software.

2.8 Trenching

- A. Erect erosion control devices prior to excavation.
- B. Remove lumped subsoil, boulders, and rock up of 1/6 cubic yard, measured by volume.
- C. Perform excavation within 24" of existing utility in accordance with utility's requirements.
- D. Do not advance open trench more than 50' ahead of installed pipe.
- E. Excavate trenches to uniform width, sufficiently wide to provide ample working room and a minimum of 12" of clearance on both sides of pipe or conduit.
- F. Remove water or materials that interfere with Work.
- G. Excavate trenches and conduit to depth indicated or required to establish indicated slope and invert elevations and to support bottom of pipe or conduit on undisturbed soil and bedding material.
- H. Do not interfere with 45° bearing splay of building foundations or roadbeds.
- I. When subsurface materials at bottom of trench are loose or soft, notify Engineer, and request instructions.
- J. Cut out soft areas of subgrade not capable of compaction in place. Backfill with Fill Type A1 and compact to density equal to or greater than requirements for subsequent backfill material.
- K. Correct over excavated areas with compacted backfill as specified for authorized excavation or replace with concrete as directed by Engineer.
- L. Remove excess subsoil not intended for reuse, from site.

2.9 Excavation Stability

- A. General: Comply with local codes, ordinances, OSHA Standards and Requirements, and the requirement of other agencies having jurisdiction. Design of retaining structures must be performed, signed and sealed by a registered engineer licensed in the state in which the project is located.
- B. Slope sides of excavations to comply with local codes, ordinances, OSHA and requirements of agencies having jurisdiction. Shore and brace where sloping is not possible because of space restrictions or stability of material excavated. Maintain sides and slopes of excavations in safe condition until completion of backfilling
- C. Shoring and Bracing: Provide materials for shoring and bracing, such as sheet piling, uprights, stringers, and cross braces, in good serviceable condition. Maintain shoring and bracing in excavations regardless of time period excavations will be open. Extend shoring and bracing as excavation progresses.
 - 1. Provide permanent steel sheet piling or reinforced concrete drilled shaft walls wherever subsequent removal of retaining structure might permit lateral movement of soil under adjacent structures. Cut off tops a minimum of 2'-6" below final grade and leave permanently in place.
- D. Repair damage caused by failure of the sheeting, shoring, or bracing and for settlement of filled excavations or adjacent soil.
- E. Repair damage to new and existing Work from settlement, water or earth pressure or other causes resulting from inadequate sheeting, shoring, or bracing.

2.10 Pipe Bedding

- A. Coarse Aggregate Type A1 (ALDOT Aggregate size No.4) shall be graded in accordance with the following limits:

<u>Sieve Size</u>	<u>Percent Passing</u>
2"	100%
1½"	90 to 100%
1"	20 to 55%
¾"	0 to 15%
½"	-----
⅜"	0 to 5%
No. 4	-----
No. 8	-----
No. 16	-----
No. 50	-----
No. 200	-----

- B. Coarse Aggregate Type A2 (ALDOT Aggregate size No.57) shall be graded in accordance with the following limits:

<u>Sieve Size</u>	<u>Percent Passing</u>
2"	-----
1½"	100%
1"	95 to 100%
¾"	-----
½"	25 to 60%
⅜"	-----
No. 4	0 to 10%
No. 8	0 to 5%
No. 16	-----
No. 50	-----
No. 200	-----

- C. Pipe Bedding in Unpaved Areas
1. Bedding: Fill Type A2
 2. Cover and Backfill: As shown in the details
- D. Pipe Bedding in Paved Areas
1. Bedding: Fill Type A2
 2. Cover and Backfill: As shown in the details

2.11 Backfill and Fill

- A. General: Place soil material in maximum 8-inch loose layers to required final subgrade elevations.
1. Under grassed areas, use satisfactory excavated or borrow material, or a combination. The final soil lift should be the required thickness of topsoil.
 2. Under walks and pavements, use base material, satisfactory excavated or borrow material, or a combination. The final fill lift should be the required thickness of base.
 3. Under piping and conduit and equipment, use base materials where required over rock bearing surface and for correction of unauthorized excavation. Shape excavation bottom to fit bottom 90° of cylinder.
 4. Backfill trenches with concrete where trench excavations pass within 18" of column or wall footings and that are carried below bottom of such

footings or that pass under wall footings. Place concrete to level of bottom of adjacent footing.

- a. Do not backfill trenches until tests and inspections have been made and backfilling is authorized by Engineer. Use care in backfilling to avoid damage or displacement of pipe systems.
5. Provide 4" thick concrete base slab support for piping or conduit less than 2'-6" below surface of roadways. After installation and testing of piping or conduit, provide minimum 4-" thick encasement (sides and top) of concrete prior to backfilling or placement of roadway base.
- B. Backfill excavations as promptly as work permits, but not until completion of the following:
1. Acceptance of construction below finish grade including, where applicable, damp proofing, waterproofing, and perimeter insulation.
 2. Inspection, testing, approval, and recording locations of underground utilities have been performed and recorded.
 3. Removal of concrete formwork.
 4. Removal of shoring and bracing, and backfilling of voids with satisfactory materials. Cut off temporary sheet piling driven below bottom of structures and remove in manner to prevent settlement of the structure or utilities, or leave in place if required.
 5. Removal of trash and debris from excavation.
 6. Permanent or temporary horizontal bracing is in place on horizontally supported walls.
- C. Ground Surface Preparation: Remove vegetation, debris, unsatisfactory soil materials, obstructions, underground structures (foundations, slabs, walls and utilities), and deleterious materials from area prior to placement of fills. Backfill disturbed areas with compacted and tested fill. Contractor shall notify City to evaluate the natural ground prior to fill placement. Contractor shall provide pneumatic-tired equipment capable of producing the pressure equal to that produced by a fully loaded, tri-axle dump truck for use in evaluation.
1. When existing ground exhibits instability, scarify ground surface, moisture-condition to within 2% of the optimum moisture content, and compact to the project requirements or remove and replace unstable soils with suitable, compacted soils.
 2. Bench sloped surfaces steeper than 1 vertical to 4 horizontal so that fill material will bond with existing surface. Benches shall consist of alternating horizontal and vertical soil surfaces in the original ground at least 4' in width and height, respectively.
 3. Overbuild slopes and cut back to the desired configuration to ensure the soils at the slope face are properly compacted and tested.

- D. Place backfill and fill materials in layers not more than 8" in loose depth for material compacted by heavy compaction equipment, and not more than 4" in loose depth for material compacted by hand-operated tampers.
- E. Before compaction, moisten or aerate each layer of fill as necessary to provide moisture content within the fill at $\pm 2\%$ of the optimum moisture content. Compact each layer to required percentage of maximum dry density or relative dry density for each area classification. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.
- F. Place backfill and fill materials evenly adjacent to structures, piping, or conduit to required elevations. Prevent wedging action of backfill against structures or displacement of piping or conduit by carrying material uniformly around structure, piping, or conduit to approximately same elevation in each lift.
- G. Control soil and fill compaction, providing minimum percentage of density specified for each area classification indicated below. Correct improperly compacted areas or lifts as directed by Engineer if soil density tests indicate inadequate compaction.
 - 1. Percentage of Maximum Standard Proctor density Requirements: Compact soil to not less than 98% of the maximum Standard Proctor density, in accordance with ASTM D 698.
 - 2. Moisture Control: 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. Apply water in minimum quantity as necessary to prevent free water from appearing on surface during or subsequent to compaction operations.
 - a. Remove and replace, or scarify and air dry, soil material that is too wet to permit compaction to specified density
 - b. Stockpile or spread soil material that has been removed because it is too wet to permit compaction. Assist drying by disking, harrowing, or pulverizing until moisture content is reduced to a satisfactory value.

2.12 Manholes

- A. Manholes shall be spaced a maximum distance of 400' apart. Manholes shall be installed at each deflection of line and/or grade with a minimum drop in the invert of 0.2'. Drop manholes shall be required where the difference in pipe inverts exceeds 24" in elevation. All manholes shall have a maximum chimney height of 8", including mortar joints. The total thickness of grade rings shall not exceed 6". All frames shall be sealed and bolted to the manhole.
- B. Flat top manholes shall be used in outfalls and other non-traffic bearing areas. Concentric manholes shall be used in road rights-of-way. Manholes located in cul-de-sacs shall be 5' diameter.

2.13 Service Laterals

- A. Service laterals may be tapped directly into the top quarter of mains or manholes. Connections 6" and larger shall be made into manholes. All dwellings and businesses shall require at least one sewer tap. Clean-outs for sewer services shall be located at intervals no greater than 50' for 4" pipe and 100' apart for 6" pipe.
- B. All single-family residences and businesses shall have individual connections to public sewer main.
- C. Multiple service connections are for private use only will not be maintained by the City. A sewer permit from the appropriate regulatory agencies, be it USEPA, ADEM, The City of Troy, etc., will be required on all private collection systems before construction plan approval. A clean-out and/or a manhole shall be installed within each serviced lot's right-of-way or easement for the City's use, and shall extend a minimum of 6" above the finish grade. Minimum grade for service laterals shall be 1/8" per foot for 4" and 0.6% for 6".
- D. All 4" service laterals shall connect directly into an 8" (minimum) sewer main in the fronting street or into an easement which is contiguous to the lot, or which traverses through the lot. All 6" service laterals shall connect directly into a manhole. No service lateral may cross another adjacent lot to gain access to a sewer main. Private service easements will not be permitted.
- E. All service laterals installed at a depth greater than or equal to 12' shall be DIP and use Class A bedding. Furthermore, any sewer service lateral deeper than 20' shall be pre-approved by the City.
- F. Service laterals to be maintained by the City shall not be located beneath a driveway or curb, nor shall a clean out be located in a sidewalk area without prior written permission of the City.

2.14 Connections to Existing Sewers

- A. When connecting a new sewer line to an existing manhole, the existing manhole shall be core drilled and flexible connectors, such as Kor-N-Seal or approved equal, installed to connect the pipe.
- B. Clean outs are required to be installed at the back of the right of way.

2.15 Air and Vacuum Valves for Force mains

- A. All force main air relief valves must be combination valves as manufactured by Val-Matic or approved equal. Valve placement and sizing calculations shall be stamped by a registered professional engineer and submitted to the City for review and approval.

2.16 Aerial Sewer Crossings

- A. All design efforts shall be made to limit the need for aerial crossings of any sewer infrastructure.
- B. When a gravity sewer must include an aerial section, the aerial segment must be designed by a licensed, professional engineer. Design calculations must be submitted

along with plans and specifications to outline, at a minimum, the pipe pressure class, joint spacing and type, pier design, and method by which piping is to be secured to the pier structure.

Section 3 Sanitary Sewer Pipe Materials

3.1 General

- A. Sanitary sewer collection lines, trunk sewers, and interceptors shall conform to the following depth criteria:

Diameter (inches)	Depth (feet)	Material
8 -15	< 12	polyvinyl chloride pipe (PVC)
> 15	any	ductile iron pipe (DIP)
any	> 12	ductile iron pipe (DIP)

- B. Transition of sewer main materials shall only occur at manholes.

3.2 Ductile Iron Sewer Pipe

- A. Ductile iron pipe shall be designed in accordance with ANSI Standard A21.50, latest revision. Unless noted otherwise on the drawings, the pipe thickness class may be Class 50 and shall be designed for an 8' minimum cover and a "Type1" laying condition as denoted in Figure 1 of ANSI A21 .50.
- B. The ductile iron pipe shall be manufactured in accordance with ANSI A21.51, latest revision. Pipe shall have cement mortar lining and seal coat in accordance with ANSI A21.4. The seal coat shall be the coat tar epoxy lining and shall be Indurall coating, Inc. "Ruff-Stuff", Kopper's Company, Inc. "Bitumastic No. 300-M", or equal. Joints for ductile iron pipe shall be mechanical or of the "push on" type conforming to the requirements of ANSI A21.11.
- C. Ductile iron pipe used in bored encasements shall be "restrained joint" type.
- D. Gravity sewer which runs from a connection point with force main shall be lined with 401-type ceramic epoxy for no less than 1,200'.

3.3 PVC Sewer Pipe-SDR (Standard Dimension Ratio) 26

- A. PVC sewer pipe for gravity flow installations shall be manufactured in accordance with all requirements of ASTM Standard D-3034 for SDR 26, "Type PSM Polyvinyl Chloride Sewer Pipe and Fittings". PVC gravity sewer pipe shall be furnished in nominal laying lengths of 12.5 feet.
- B. PVC sewer pipe (SDR-26) and fittings shall be of cell classification of 12454, as defined in ASTM D-1784. PVC of other cell classifications will not be accepted. This pipe shall be appropriately marked.
- C. Pipe Joints - Pipe joints for PVC Sewer Pipe shall be of the bell and spigot type with rubber gasket conforming to ASTM F-477.

- D. Manufacturer's Certification - The manufacturer of non-pressure PVC Sewer Pipe shall furnish a notarized affidavit certifying as to compliance with the foregoing ASTM Specifications and with the PVC cell classification as specified.
- E. All PVC pipe shall be marked using a metalized tape buried between 3" and 6" above the top of the pipe. Sewer force mains shall be marked with red tape and water mains shall be marked with blue tape. Tape shall be Terra Tape, 3" wide minimum, as manufactured by Griffolyn Company, Inc. or an approved equal. The pipe trench shall be backfilled to approximately 3" over the top of the pipe then the metalized tape shall be placed flat over top of pipe. Backfill shall be carefully placed to a depth of 3" by hand to assure that the tape is secured in place over the pipe. It is the intent of this paragraph to provide a means to locate PVC pipe using standard pipe location equipment. The tape shall be carried up through valve boxes and terminated at least 2' above the ground line to permit connecting of location equipment.
- F. Install trace wire continuous 18" to 24" inches above pipeline.

3.4 Steel Pipe

- A. For Aerial Crossings & Miscellaneous Special Uses Where Approved by the City – Steel pipe shall be high strength steel, welded or seamless manufactured in accordance with ASTM A139 and consisting of grade “B” steel with a minimum yield strength of 35,000 psi.
- B. The outside of the pipe shall have 1 shop coat of epoxy primer. The pipe shall receive a field touch up primer and 2 field coats of black coal tar epoxy.
- C. Pipe ends shall be square to receive a Dresser style “62” - Type I or approved equal mechanical transition coupling.
- D. For Bored Casings - Steel encasement pipe shall be welded or seamless, consisting of grade, “B” steel with a minimum yield strength of 35,000 psi and manufactured in accordance with ASTM A139.
- E. The pipe thickness shall be as specified on the encroachment agreement or approved plans, and the ends shall be beveled and prepared for field welding of the circumferential joints.
- F. Metal fabricated “spiders” with poly feet shall be used for support of the carrier pipe within the bored casing. Spiders with poly feet shall be placed at 8' O.C. maximum for the entire length of the casing.

3.5 Unloading and Storing of Pipe Materials

- A. The unloading and loading of all pipe, fittings, and other accessories shall be in accordance with the manufacturer's recommended practices and shall at all times be performed with care to avoid any damage to the material.
- B. Once on the job site, all materials shall be stored in accordance with the manufacturer's recommended practices, and within the limits of the project site.

Section 4 Pipe Bedding Classifications

4.1 Pipe Bedding Classes

- A. Pipe-bedding classes shall be those classes as defined below:
 - 1. Class "A" Bedding -Depth \leq 20': is that condition existing when the trench bottom is undercut a minimum of 6" below the pipe and filled to pipe spring line with No. 57 or No. 67 stone.
 - 2. Class "B" Bedding -Depth $>$ 20 feet: is that condition existing when the trench bottom is undercut a minimum of 6" below the pipe and filled to 6" above the pipe with No. 57 or No. 67 stone.

Section 5 Service Laterals

5.1 General

- A. All service connections shall be noted by permanently placing an "S" in the curb at the location of the service connection to the sanitary sewer system.
- B. Service lateral connections shall be with factory-made fittings. Saddle type fittings will not be allowed on new construction. The connection between the service lateral and the sewer main shall be watertight. The service lateral shall not protrude into the sewer main.

5.2 Service Lateral Diameters

- A. Residential service laterals shall not be less than 4" in diameter. Industrial service laterals shall be sized according to the quantity of flow produced by the connecting entity with no service laterals less than 4" in diameter being allowed.

5.3 Pipe Materials and Ratings

- A. Service lateral pipe materials shall be the same as the mainline unless nearby utilities pose problems. Ductile iron pipe service laterals shall be minimum Pressure Class 350. Poly Vinyl Chloride service laterals shall be minimum SDR-26. Drain pipe, such as, Foam Core, Cell Core or 40 DWV PVC Pipe is not acceptable.
- B. SDR-26 PVC pipe for sanitary sewer service lines is acceptable for depths up to 12 feet. At depths greater than 12', ductile iron pipe is required. For installations in traffic areas with less than 3' of cover, ductile iron pipe is required.

5.4 Installation

- A. Service laterals shall be installed for each lot or property to the property or easement line. (A copy of the recorded sanitary sewer easement must be provided to the City for its records prior to the sewer inspection.)
- B. For existing structures, should the location of the existing sewer service meet grade and other specifications, the new service lateral shall be provided in line with that service.
- C. For vacant or abandoned property, service laterals shall be installed at the low point of the lot or property. A standard detail for service laterals is included in the appendix.

- D. An exterior service cleanout shall be installed at the end of the service connection at the edge of the easement, right-of-way, or property line. This cleanout will serve as a location marker as well as a maintenance device. A clean out box shall be installed at the cleanout location. A manhole shall be installed in lieu of a clean out on all industrial/commercial service lines greater than or equal to 8 inches in diameter.
1. Threaded clean-out caps shall be available at the end of each clean out.
 2. Clean-outs located in paved areas, any parking or traffic areas shall have;
 - a. A pre-constructed concrete collar and brass threaded plug at finished level.
 - b. A clean out may be recessed below finished level with a brass-threaded plug and a traffic rated sewer box installed at finished level.
 3. Clean-outs located in a sanitary sewer easement shall be recessed below finished level with a threaded plug and a traffic rated sewer box installed at finished level on each clean out. (see Detail of Clean-out, diagram SD-12)
 4. Service shall be re-connected with Mission Rubber Co. adjustable repair coupling or approved equal.

5.5 Sewer Service Requirements (Residential and Commercial)

- A. Clean-outs shall be at every turn.
- B. Turns must be of sufficient radius to accommodate rodding equipment.
- C. Clean-outs shall be accessible and capped.
- D. Clean out boxes must be installed to finished grade before final inspection and acceptance.
- E. The minimum slope on the sewer service shall be 14" per 100' of pipe (Lesser slope must be approved by City).
- F. In Paved and Traffic areas, D.I. Pipe is required where there are 3' or less of cover.
- G. Each structure must have an unshared connection to the Wastewater Collection System main.
- H. Service Tee's must be SDR 26.
- I. All connections to Wastewater Collection System shall be made by a certified, licensed plumber by the City.
- J. All piping and connections must be left uncovered to accommodate inspection by the City. Pipe manufacturer's markings must be turned as to be clearly visible to accommodate inspection.

5.6 Residential Sewer

- A. Distance between clean-outs shall be no greater than 50'.
- B. Multiple households will not be allowed.

5.7 Commercial Sewer

- A. Distance between clean-outs shall be no greater than 100'.
- B. Two-Way clean-outs are required.

Section 6 Precast Concrete Sanitary Sewer Manholes

6.1 General Requirements

- A. All new manholes shall be of precast concrete construction, flat bottom type. Doghouse manholes shall be used where required for tie-ins to existing sewers. The following minimum diameter manholes shall be utilized dependent upon the size of the mains and depth of installation.

Manhole Diameter	Pipe Size (single)	Pipe Size (multiple)	Depth
4'-0"	8" – 12"		0' to 12'
5'-0"	16" – 24"	8" – 12"	>12' – 18'
6'-0"	30" – 36"	16" – 24"	>18' – 24'
8'-0"	≥42"	30" – 36"	>24'
10'-0"		≥42"	

- B. Variance from this specification must be approved by the City prior to construction. Each manhole shall be of consistent diameter throughout its entire height.
- C. Inside drop manholes shall be a minimum 5' diameter. If more than one inside drop occurs within the same manhole, a 6' diameter manhole is required.

6.2 Precast Manholes

- A. Design -Precast concrete manholes shall be designed and manufactured in accordance with ASTM C478. The manhole walls shall be a minimum of 5" thick and the base slab shall have a minimum thickness of 6". The minimum compressive strength of the concrete shall be 4,000 psi. The manhole sections shall have reinforcement as required to provide resistance to the hydrostatic and passive earth pressures to which they will be subjected, and to provide adequate resistance to temperature and shrinkage cracking.
- B. All manholes shall be equipped with a flexible watertight connection and sealing system for all pipe penetration 6" and larger.
- C. Joints -Manhole sections shall have a standard tongue and groove joint with an "O" -ring, conforming to ASTM Standard C-443 or butyl rope sealant such as Ram-Nek.
- D. Cone Sections -The upper precast cone sections shall be of the concentric type with a minimum height of 24". Flat top slabs shall be used in all non-traffic areas.

- E. Sulfate Attack Protection – All manholes shall be coated with a multi-part polymer field-applied protective interior coating. Coating shall be applied to all interior surfaces. Coating shall be as detailed within these Specifications.

6.3 Manhole Ring and Cover

- A. Manhole ring and cover shall meet the requirements of Section 500 of these Specifications for Gray Iron Castings. The cover shall be perforated with two 1" diameter holes unless otherwise noted on plans. Manholes shall have rings and covers made by East Jordan Iron Works, Neenah Foundry Company, or equal and should facilitate raising of manhole for future paving. Where deemed necessary in low areas of streets, solid manhole covers may be required by the City to prevent surface water inflow into the sewer.
- B. Manholes located along outfalls within the 100-year flood plain shall utilize a watertight cover and vent as necessary.

6.4 Mortar

- A. Calcium Aluminate (mortar) shall be used in manhole invert construction. Mortar shall be mixed in a clean, tight mortar box or in an approved mechanical mixer and shall be used within 45 minutes after mixing.

6.5 Flexible Sealing System for Joining Pipes to Precast Manholes

- A. Each connection to a manhole shall be sealed watertight by means of a flexible sleeve or gasket type sealing system. The flexible sleeve type system, if used, shall be equal to Flexible Manhole Sleeve as manufactured by the Interpace Corporation. The gasket type system, if used, shall be equal to the PSX system as manufactured by the Press Seal Gasket Corporation. The sealing system shall be furnished by the manhole manufacturer.

6.6 Stone for Stabilization of Trench Foundation

- A. Stone used for pipe bedding and trench stabilization shall meet the gradation requirements for standard aggregate size No. 57 or 67 as contained in the Standard Specifications for Roads and Structures as published by the ALDOT.

Section 7 Concrete

7.1 Concrete

- A. The minimum compressive strength required at twenty-eight days is 3,000 pounds per square inch. Field specimens and laboratory tests shall be made in accordance with the standards of the American Society of Testing Materials. The minimum amount of water shall be used to produce a workable mix and shall not exceed six (6) U.S. Gallons per sack of cement. Slump shall range between 2"-5".

Section 8 Plugs

8.1 Plugs

- A. The downstream side of the last manhole of a sanitary sewer line extension under construction shall be plugged with a non-pneumatic wing nut plug and secured with a stainless steel cable or wire rope to prevent the passage of ground water, runoff, and sediment into the sanitary sewer system. Each plug shall have a steel tag engraved with Contractor's name and phone number. The plug installation shall be witnessed, secured to the satisfaction of the INSPECTOR, and documented for location on a Sewer Plug Permit Form. The Contractor shall have a representative present to sign and attest that no additional plugs will be installed throughout the system without prior written approval of the INSPECTOR. All water upstream of the plug shall be pumped out at the discretion of the INSPECTOR or any official from the Utility Department, and all sediment and solids shall be removed and disposed of by the CONTRACTOR. This maintenance of water removal is required on a 30-day cycle from installation until total acceptance by the City the sanitary sewer system. The plug shall not be permanently removed, displaced, or relocated without the written approval. The City shall reserve the right to assess the Contractor or Developer a fine to cover any remediation costs borne by the City due to the Contractor's failure to adhere with the requirements of this paragraph.

Section 9 Corrosion Resistant Manhole Lining

9.1 Description

- A. The work described within details a complete program for the installation of a corrosion resistant liner for the existing and proposed wet wells. This section details the methods, procedures, materials and equipment as required to produce complete and in place structure liner. The completed system will provide a corrosion resistant liner to rehabilitate deteriorated structures and prevent further deterioration from hydrogen sulfide and other corrosive gases/acids.

9.2 Submittals

- A. All materials and procedures required to establish compliance with the specifications shall be submitted to the City for review. Submittals shall include the following:
1. Descriptive literature, bulletins and or catalogs of materials.
 2. Work procedures including flow diversion plan, method of repair, etc.
 3. Material and method for repair of leaks or cracks in concrete structures.
 4. Final installation report on completed structures.

9.3 Quality Assurance

- A. The manufacturer and/or installer of the total liner system shall be a company that specializes in the design, manufacture or installation of corrosion protection systems for concrete structures including wet wells, junction chambers, etc. Installer shall be completely trained in leak repair, surface preparation and

corrosion materials application on concrete structures. Corrosion materials/products shall be suitable for installation in a severe hydrogen sulfide environment without any deterioration to the liner and shall completely prevent the breakdown of concrete surfaces.

- B. To ensure total unit responsibility, all materials and installation thereof shall be furnished and coordinated with/by one supplier/installer who turnkeys the work and assumes full responsibility for the entire operation.

9.4 Materials and Equipment

- A. The materials to be utilized in the lining of concrete structures shall be designed and manufactured to withstand the effects of hydrogen sulfide in a wastewater environment. Manufacturer of corrosion protection products shall have long proven experience in the production of the coating products utilized and shall have satisfactory installation record.
- B. Abrasive blasting equipment or high pressure (>3,500psi) hydro blasting shall be suited to completely remove deteriorated concrete and hard contaminants from the existing concrete surfaces. Containment unit to capture spent abrasive material shall be provided unless otherwise approved by the City.
- C. The lining system to be utilized for concrete structures shall be spray-applied 100% Solids Epoxy of 100% polyurethane monolithic surfacing system for use in sewer manholes. Coating systems which include cementitious material will not be considered.

The 100% Solids epoxy lining system shall be one of the following products:

- Warren Environmental System 100% Solids Epoxy
- Raven Lining Systems 100% Solids Epoxy
- Or approved equal

The 100% polyurethane lining system shall be:

- Spectrashield
- Spraywall
- Or approved Equal

- D. In order to be considered as an equal a product will have the following minimum characteristics as measured by the applicable ASTM standards referenced herein:

Minimum Compressive Strength:	12,000 psi
Minimum Tensile Strength:	7,400 psi
Minimum Flexural Strength:	12,000 psi
Minimum Tensile Elongation:	4%
Minimum Bond Strength:	900 psi
Minimum Corrosion Resistance:	suitable for environments PH of 0.5

- E. The interior surfacing system shall be continuously bonded to all brick, mortar, concrete, chemical sealant, grout, pipe and other surfaces inside the manhole

according to ASTM C882 testing and therefore shall be designed for hydrostatic loading.

- F. The finished system shall provide an average total thickness of 250 mils.

9.5 General Requirements

- A. Details of the structure size, condition (including a picture), location and a recommendation of new thickness shall be submitted to the City. The cured surfacing shall be monolithic with proper sealing connections to all unsurfaced areas and shall be placed and cured in conformance with the recommendations of the monolithic surfacing system manufacturer. When cured, the system shall form a continuous, tight fitting, hard, impermeable surfacing that is suitable for sewer system service and chemically resistant to any chemicals, bacteria or vapors normally found in domestic sewage. The system shall effectively seal the interior surfaces of the manhole and prevent any penetration or leakage of groundwater infiltration. The system shall be compatible with the thermal conditions of the existing sewer manhole surfaces.

9.6 Pre-Coat Inspection

- A. Applicator shall inspect all surfaces specified to receive the monolithic surfacing system prior to surface preparation. Applicator shall notify the City in writing of any defects in the surfaces that may interfere with the proper preparation or application of the monolithic surfacing system.

9.7 Surface Preparation

- A. All contaminants including: all oils, grease, incompatible existing coatings, waxes, efflorescence, sealers, salts, or other contaminants shall be removed. All concrete that is not sound or has been damaged by chemical exposure shall be restored to a sound concrete surface using cementitious material specified under the heading "CONCRETE REPAIR" (Section 3.6A).
- B. Surface preparation method(s) shall be based upon the conditions of the substrate and the requirements of the monolithic surfacing system to be applied. Surfaces to receive protective coating shall be cleaned and abraded to produce a sound concrete surface with adequate profile and porosity to provide a strong bond between the monolithic surfacing system and the substrate. The first procedure upon entering each structure will be to blast all specified surfaces by low-pressure water cleaning as defined by NACE Standard 5. When all loose or contaminated debris has been removed, the surface will be acid etched with a 20% muriatic acid solution to clean and open the pores of the substrate. Then the surface shall be water blasted by the use of a hand held wand again. The wash water shall include a dilute solution of chlorine to diminish microbiological bacteria growth and to kill any bacteria residing on or in the surface. The surface will be tested at this point to ensure that the pH is within acceptable limits (not to exceed 8.5). These tests will be performed in the presence of the City with litmus paper on various areas within the structure. All test results will be retained by the Contractor.

- C. Surfaces that require additional cleaning or profiling will be prepared by abrasive blast to rough the surface sufficient to obtain and ensure adequate bonding of the system. A minimum surface profile of 8-10 mils or 10% of the total recommended coating system thickness must be achieved to assure proper adhesion. Detergent water cleaning and hot water blasting may be necessary to remove oils and grease from the concrete. Whichever methods are used, they shall be performed in a manner that provides a uniform, sound clean surface that is not excessively damaged.
- D. Active water infiltration shall be stopped by using a hydroactive grout material specified under the heading "CHEMICAL GROUT".

9.8 Material Installation

- A. The limits of the corrosion protection system shall be all exposed concrete surfaces including walls, tap sections, risers, benches, etc.
- B. Application procedures shall conform to the recommendations of the interior surfacing system manufacturer, including material handling, mixing, and environmental controls during application, safety, and equipment.
- C. The equipment shall be specially designated to accurately ratio and apply the specified materials and shall be regularly maintained and in proper working order.
- D. All manhole surfaces shall be lined with the monolithic surfacing system to provide an average total thickness of 250 mils. The cured surfacing shall be monolithic with proper sealing connections to all unsurfaced areas and shall be placed and cured in accordance with the recommendations of the monolithic surfacing system manufacturer. Specially designed spray application equipment shall be used to apply each coat of the system.

9.9 Testing and Inspection

- A. A spark test shall be performed to identify any small holes in the coating. Any areas where the spark test indicates a hole, the coating shall be re-coated and re-tested.
- B. A final visual inspection of the lining system shall be made by the City and Applicator. Any deficiencies in the finished system shall be marked and repaired according to the procedures set forth by Applicator.

9.10 Concrete Repair

- A. Materials: A quick setting cementitious material shall be used as a patching mix. It shall be mixed and applied according to the manufacturer's recommendations and shall meet the following minimum requirements.
 - Compressive Strength ASTM C 579 B 1400 psi @ 6 hr.
 - Shrinkage ASTM C 596 0% @ 90% relative humidity
 - Bond ASTM C 321 140 psi @ 28 days
 - Density (when applied) 105 ± pcf

- B. Application: The patching mix shall be applied according to the manufacturer's recommendation.

9.11 Chemical Grout

- A. Used for stopping active infiltration in concrete and masonry manholes and filling exterior soil voids:
 - 1. A pre-mixed quick set chemical grout shall be injected through the manhole wall to form a watertight seal on the exterior of the manhole and fill voids in soils immediately adjacent to the manhole wall. Grout mixing, additive/accelerators, preparation, and application shall be in accordance with manufacturer's requirements. Grout pumping equipment shall have metering device to document gallons of grout pumped.
 - 2. Grout shall be Avanti AV-100, Scotch-Seal 5610, Prime Resins Prime-Flex920, or equivalent.

9.12 Warranty

- A. The supplied lining system shall include a 10-year limited warranty covering both materials AND installation beginning on the date of final acceptance. Both the Manufacturer and the Applicator shall stand behind this warranty for 10 years. An affidavit executed under seal by an officer of the Manufacturer stating that the Manufacturer will warrant the finished, in-place, lining system against infiltration and corrosion for a minimum of 10 years from the installation date will be required to accompany the installers written warranty.

Section 10 Pipe Rehabilitation – Cured in Place

10.1 Design Requirements

- A. Design lining material to have sufficient structural strength to support loads, live loads and groundwater load imposed assuming existing pipe cannot share loading or contribute to structural integrity of liner.
- B. Design liner to least possible thickness (10 mm minimum) to minimize decreasing of inside pipe diameter.
- C. Design liner material to provide jointless and continuous structurally sound construction able to withstand imposed static, dynamic and hydrostatic loads on long-term basis.
- D. Identify design provisions for shrinkage control to prevent future misalignment of service reconnections.

10.2 Performance Requirements

- A. Perform relining and internally reestablish service connections without need for excavation while minimizing disruptions to adjacent occupied buildings and traffic.

10.3 Submittals

- A. Shop Drawings: Indicate liner dimensional information for each pipe size to be relined.

- B. Product Data: Submit manufacturer's information on liner material, curing chemicals, and lubricants.
- C. Samples: Submit sample of liner material in uncured and cured state.
- D. Design Data: Submit two copies of liner thickness and design calculations, signed and sealed by Professional Engineer.
- E. Test Reports: Submit reports certifying liner material meets ASTM testing standards listed in this section.
- F. Manufacturer's Installation Instructions:
- G. Submit detailed description of liner placement and curing procedures for piping.
- H. Include description of procedures for internally reestablishing service connections.
- I. Submit manufacturer's requirements for receiving, handling, and storage of materials.
- J. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

10.4 Qualifications

- A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum five years documented experience. Manufacturer shall have a minimum of 500,000 linear feet of documented successful installations in sanitary sewer systems and a minimum of 2,000 documented, successful manhole-to-manhole line sections in sanitary sewer systems. Of this experience, qualifications must indicate the successful completion of a minimum of 100,000 linear feet of documented successful installations in sanitary sewer systems with pipe diameters 12" and larger.
- B. Installer: Company specializing in performing work of this section with minimum five years documented experience in installation of liner materials and licensed or certified by manufacturer. Installer shall have a minimum of 50,000 linear feet of documented successful installation of the product.
- C. Design liner under direct supervision of Professional Engineer experienced in design of this Work and licensed in State of Alabama.

10.5 Coordination

- A. Coordinate work with users connected to system.
- B. Notify homeowners and businesses at least twenty-four hours in advance of expected disruption of sanitary service.
- C. Limit disruption of service to individual properties to no later than same day on which product is installed.
- D. Provide and maintain temporary facilities including piping and pumps to meet requirements.

- E. The Contractor must supply all water required. Contractor must provide transmission to site. Coordinate the use of the nearest feasible fire hydrant with the City.

10.6 Cured-In-Place (CIPP) Liner

A. Manufacturers:

- 1. Insituform Technologies
- 2. Suncoast Infrastructure, Inc.
- 3. Or Equal

B. Materials:

- 1. Tube consisting of one or more layers of absorbent non-woven felt fabric or glass reinforced plastic. It shall not be possible to separate the tube layers. The application of the resin to the felt tubing or fiberglass layers shall be conducted under factory conditions and the materials shall be fully protected against UV
- 2. Light degradation, excessive heat and contamination at all times.
- 3. Furnish product material in accordance with ASTM F1216, ASTM F1743 and ASTM F2019.
- 4. Liner effective length to match length of piping to be lined as determined by the Contractor to effectively carry out the rehabilitation and extend into the adjoining manhole structures. The Contractor shall be responsible for field verifying all liner lengths prior to liner fabrication. Each liner shall contain an end section, which shall be bonded to each end of the host pipe to prevent leakage from the liner and host pipe.
- 5. Furnish wet-out tube with uniform thickness that when compressed at installation pressures will meet or exceed design thickness.
- 6. Furnish tube of sufficient size to provide tight fit to existing pipe. Allowances shall be made for longitudinal and circumferential expansion. All dimensions shall be verified by the Contractor prior to fabrication.
- 7. Furnish resin system consisting of corrosion resistant polyester, vinyl ester, or epoxy. Recycled resins will not be allowed.
- 8. Chemical and Physical Testing: Test samples in accordance with ASTM D790. Comply with minimum property values shown below with applicable ASTM requirements.

<u>Property</u>	<u>ASTM Method</u>	<u>Test Value</u>
Flexural Modulus	D790	250,000 psi
Flexural Strength	D790	4,500 psi

Longitudinal Flexural Modulus D2990 150,000 psi

9. Liner Thickness: All liner thickness calculations shall be submitted in accordance with provisions made in this Specification. The thickness design shall be in accordance with ASTM D2412 and F1216. Calculations shall be based on fully deteriorated gravity pipe values. Liner thickness calculations shall comply with, at a minimum, the following design constraints and the following considerations shall be made:
 - a. Minimum Factor of Safety = 2.0
 - b. Service Temperature = 33 to 150° Fahrenheit
 - c. Groundwater Elevation = At Surface
 - d. Minimum Liner Thickness = 10 mm
 - e. Maximum Long Term Deflection = 5%
 - f. Long-term flexural modulus shall be estimated as one-half of the lowest short-term flexural modulus dictated by ASTM.
 - g. Liner thickness shall be the maximum of that dictated by bending, deflection, buckling, and stiffness calculations.
 - h. Soil Characteristics
 - 1) Unit Weight = 120 pcf
 - 2) Modulus of Elasticity = 1,000 psi
 - 3) Coefficient of Friction = 0.130r

10.7 Source Quality Control

- A. Inspect each lot of liner for defects. Verify liner is homogeneous throughout, uniform in color, free of cracks, holes, foreign materials, blisters or deleterious faults.
- B. Marking:
 1. For testing purposes, mark each production lot with identical marking number.
 2. Mark liner at 5' intervals or less with coded number identifying manufacturer, size, material, date and shift when liner was manufactured.
 3. At end of production shift, change marking code to indicate where new production shift started.

10.8 Cleaning and Flushing

- A. Clean existing sewer pipes of debris, sedimentation and mineral deposits with high velocity cleaner, bucket and scraper, root saws, rolling or balling units. All cleaning and flushing must be in accordance with liner manufacturer's requirements. Any protruding taps not removed during the pre-installation television inspection shall

be removed and surfaces cleaned as required by the lining manufacturer to avoid liner puncture.

10.9 Initial Video Inspection and Repair

- A. Determine condition of existing piping, degree of offset of joints, crushed walls, and obstructions.
- B. Determine and document in writing sizes and locations of service entrances and service connections.
- C. Clear obstructions, service-piping protrusions and other materials from existing pipe to ensure inserted pipe liner contacts only existing pipe wall.
- D. City shall be provided with video.

10.10 Installation Cured-in-Place Pipe (CIPP) Liner for Mainline

- A. Install liner in accordance with ASTM F1216, ASTM F1743, ASTM 2019 and manufacturer's instructions.
- B. Pull or invert liner through existing pipe through access points or using existing manholes. Take care not to damage deformed pipe during installation. Use appropriate sleeves and rollers to protect liner.
- C. Liner Curing:
 - 1. Use steam or circulated hot water to cure liner. Ensure temperatures inside liner pipe are sufficient to effect resin curing and are within manufacturer's instructions. Monitor temperature for entire curing period.
- D. Cool-down:
 - 1. Cool cured pipe in accordance with manufacturer's recommendations.
- E. Finish:
 - 1. Install finished lining continuous over entire length of piping free of visual defects including foreign inclusions, pinholes and delamination. Confirm lining is impervious and free of leakage from pipe to surrounding ground or from ground to inside lined pipe.
 - 2. Repair defects affecting integrity or strength of lining.
 - 3. Seal annular space between finished liner and existing sewer main at manholes, with polyurethane, chemical grout.

10.11 Field Quality Control

- A. When liner fails to meet installation requirements, remove failed liner and install new liner.
- B. Conduct closed-circuit video inspection of completed rehabilitation work.
- C. No infiltration of groundwater is permitted. No visual defects including foreign inclusions, dry spots, pinholes, cracks or delamination are allowed.
- D. Confirm service connections are complete and are unobstructed.

- E. Submit summary report of final inspection with copy of video documentation.

10.12 Cleaning

- A. Remove debris resulting from work and unused materials from site and legally dispose.

Section 11 Small Capacity Submersible Lift Stations

11.1 General Design Criteria

All small capacity, residential-type submersible lift stations shall meet certain minimal requirements. Provided herein are general guidelines. Pump selection and station design must be by a registered professional engineer licensed in the state of Alabama. All stations must receive written approval prior to construction.

- A. Minimum site dimension 30' x 30'
- B. Fenced site with gate, graveled lot, vehicle access
- C. Security light
- D. $\frac{3}{4}$ " Water Meter
- E. Influent manhole with one inlet to pump basin
- F. SEL 2411P controller with PEPWAVE Max BRI Sim card for communication with SCADA
- G. Three phase power supply (Adequately sized for future upgrade)
- H. Two (2) Fairbanks Morse 3 HP (minimum) 3 phase-230 volt - 4" non-clog pumps (or approved equal)
- I. Power cords must be one-piece construction with sufficient length to extend from the pump to the control panel. Splices will not be permitted.
- J. Duplex Control Panel with high water alarm and time meters (Uni-strut support bracket within 2' of basin), No visual lights or audible alarms shall be used.
- K. Terminal Strip for telemetry connections
- L. Minimum 60" diameter concrete basin with a minimum 5' holding capacity below influent pipe
- M. All interior hardware, fasteners, and supports shall be stainless steel
- N. Stainless steel guide rails (Adequately sized guide rails for future upgrade)
- O. Stainless steel guide brackets
- P. Stainless steel lifting chain
- Q. Stainless steel float bracket
- R. Stainless steel float bracket
- S. 4" (minimum) Schedule 80 PVC discharge piping
- T. Fairbanks Morse pump control floats with ample cord lengths (or approved equal)

- U. Flanged Cast Iron Internal Weighted Discharge Check Valve
- V. Concrete vault with aluminum, locking hatch with safety insert (to house check and gate valves, pressure gauges)
- W. Aluminum Basin Cover with stainless steel hardware
- X. Stainless Steel Basin vent with screen

Section 12 Removal and Replacement of Pavement

12.1 Cutting & Replacement of Existing Pavements

- A. The open cutting of existing pavements may be permitted for sewer line installations across designated streets. Any open cutting of City or State maintained roadways shall require prior written approval from the proper agency. The cutting and replacement of such pavements, when approved, shall conform to the Alabama Department of Transportation details as well as the details of the City.

Section 13 Clearing and Grubbing

13.1 Submittals

- A. Product Data: Submit data for herbicide. Indicate compliance with applicable codes for environmental protection.

13.2 Quality Assurance

- A. Conform to applicable codes for environmental requirements, disposal of debris, burning debris on site, use of herbicides, and disposal of sludge.

13.3 Preparation

- A. Verify existing plant life designated to remain is tagged or identified.
- B. Call Alabama One Call service at 1-800-292-8525 not less than three working days before performing Work.
- C. Request underground utilities to be located and marked within and surrounding construction areas.

13.4 Protection

- A. Locate, identify, and protect utilities indicated to remain, from damage.
- B. Protect trees, plant growth, and features designated to remain.
- C. Protect benchmarks, survey control points, and existing structures from damage or displacement.

13.5 Clearing

- A. Clear areas required for access to site and execution of Work to minimum depth of 12".
- B. Remove trees and shrubs within indicated areas. Remove stumps, surface rock, and fences.

- C. Clear undergrowth and deadwood, without disturbing subsoil.
- D. Apply herbicide to remaining stumps to inhibit growth.

13.6 Removal

- A. Remove debris, rock, and extracted plant life from site.
- B. Partially remove paving, curbs, and gutters. Neatly saw cut edges at right angle to surface.
- C. Remove abandoned utilities. Indicated removal termination point for underground utilities on Record Documents.
- D. Continuously clean-up and remove waste materials from site. Do not allow materials to accumulate on site.
- E. Do not burn or bury materials on site. Leave site in clean condition.

13.7 Topsoil Excavation

- A. Excavate topsoil from areas to be further excavated, re-landscaped, or regraded, without mixing with foreign materials for use in finish grading.
- B. Do not excavate wet topsoil.
- C. Stockpile in area designated on site to depth not exceeding 8' and protect from erosion. Stockpile material on impervious material until disposal.
- D. Remove excess topsoil not intended for reuse, from site.

13.8 Site Restoration

- A. Restore all areas disturbed by the construction activities to pre-construction conditions or better.
- B. Restore areas to satisfaction of the City and Land Owner if work has occurred on private property.
- C. If preconstruction documentation of existing conditions has not been performed, restore areas to complete satisfaction of the City and Land Owner at no additional cost to the City.
- D. Restore paved or unpaved streets, roads, sidewalks, curbs, etc. disturbed by the construction activities to preconstruction conditions or better using materials and workmanship conforming to requirements of Land Owner, the City, or Alabama Department of Transportation, whichever applies.
- E. Maintain seeded areas and re-seed as needed until a stand of grass satisfactory to the City is established.

Section 14 Grassing

14.1 Definitions

- A. Weeds: Include Dandelion, Jimsonweed, Quackgrass, Horsetail, Morning Glory, Rush Grass, Mustard, Lambsquarter, Chickweed, Cress, Crabgrass, Canadian

Thistle, Nutgrass, Poison Oak, Blackberry, Tansy Ragwort, Johnson Grass, Poison Ivy, Nut Sedge, Nimble Will, Bindweed, Bent Grass, Wild Garlic, Perennial Sorrel, and Brome Grass.

14.2 Submittals

- A. Product Data: Submit data for seed mix, fertilizer, mulch, and other accessories.

14.3 Delivery, Storage, and Handling

- A. Deliver grass seed mixture in sealed containers. Seed in damaged packaging is not acceptable.
- B. Deliver fertilizer in waterproof bags showing weight, chemical analysis, and name of manufacturer.

14.4 Maintenance Service

- A. Maintain seeded areas immediately after placement until grass is well established and exhibits vigorous growing condition.

14.5 Seed Mixture

- A. Seed Mixture for Rights-of-Way and Unimproved Property:
 - 1. Hulled Bermuda grass 12%.
 - 2. Unulled Bermuda grass 18%.
 - 3. Annual Lespedeza 46%.
 - 4. Pensacola Bahia grass 24%.
- B. Seed Mixture for Lawns and Improved Property:
 - 1. Annual Rye: 40%.
 - 2. Unhulled Bermuda grass: 60%.

14.6 Soil Materials

- A. Topsoil fertile, agricultural soil, typical for locality, capable of sustaining vigorous plant growth, taken from drained site; free of subsoil, clay or impurities, plants, weeds and roots; pH value of minimum 5.4 and maximum 7.0.
- B. Topsoil: Excavated from site and free of weeds where approved by City.

14.7 Accessories

- A. Mulching Material: Oat or wheat straw, free from weeds, foreign matter detrimental to plant life, and dry. Hay or chopped cornstalks are not acceptable.
- B. Water: Clean, fresh and free of substances or matter capable of inhibiting vigorous growth of grass.
- C. Erosion Fabric: Jute matting, open weave.

- D. Stakes: Softwood lumber, chisel pointed.
- E. String: Inorganic fiber.

14.8 Preparation of Subsoil

- A. Prepare sub-soil to eliminate uneven areas and low spots. Maintain lines, levels, profiles and contours. Make changes in grade gradual. Blend slopes into level areas.
- B. Remove foreign materials, weeds, undesirable plants, and their roots. Remove contaminated sub-soil.
- C. Scarify subsoil to depth of 3" where topsoil is to be placed. Repeat cultivation in areas where equipment, used for hauling and spreading topsoil, has compacted sub-soil.

14.9 Placing Topsoil

- A. Spread topsoil to minimum depth of 4" over area to be seeded. Rake until smooth.
- B. Place topsoil during dry weather and on dry unfrozen subgrade.
- C. Remove vegetable matter and foreign non-organic material from topsoil while spreading.
- D. Grade topsoil to eliminate rough, low or soft areas, and to ensure positive drainage.

14.10 Seeding

- A. Apply seed at rate of 5.5 lbs. per 1000 sq. ft. evenly in two intersecting directions. Rake in lightly.
- B. Do not seed areas in excess of that which can be mulched on same day.
- C. Do not sow immediately following rain, when ground is too dry, or when winds are over 12 mph.
- D. Immediately following seeding, apply mulch to thickness of 1/4 inches. Maintain clear of shrubs and trees.
- E. Apply water with fine spray immediately after each area has been mulched. Saturate top 4" of soil.

14.11 Hydroseeding

- A. Apply mulch and seeded slurry with hydraulic seeder at rate established by manufacturer.
- B. After application, apply water with fine spray immediately after each area has been hydroseeded. Saturate to 4" of soil and maintain moisture levels two to four inches.

Section 15 Trench Excavation and Preparation

15.1 General Requirements

- A. The pipeline trench shall be excavated to the line and gradient shown on the approved drawings. Trench width shall be a minimum of 16" plus the outside diameter of the pipe and a maximum of 24" plus the outside diameter of the pipe.
- B. The length of trench which may be open ahead of pipe laying operations shall be no more than 100' and no less than 20' unless warranted by special circumstances, and then only upon approval of the City.
- C. The trench bank shall be vertical from the bottom to a point not less than 1' above the top of the pipe. The CONTRACTOR shall do all bracing, sheeting, sloping of bank, shoring, pumping, etc., as required to prevent caving of the banks, all in strict accordance with applicable OSHA regulations. Trench sheeting shall be cut off and left in place where its removal might adversely affect the sewer pipe installation.
- D. During trench excavation operations, the CONTRACTOR shall endeavor to separate the excavated materials by soil types, so that the better materials (if any) may be used in the bedding, haunching, and initial backfill zones.

15.2 Dewatering

- A. The ground adjacent to the excavation shall be graded to prevent surface water from entering the trench. The CONTRACTOR will, at his expense, remove by pumping or other means approved by the City any water accumulated in the trench and shall keep the trench dewatered until bedding and pipe laying are complete. When water is pumped from the trench, the discharge shall follow natural drainage channels. Proper erosion control measures shall be employed. Direct discharge into stream is not permissible.
- B. In trenches where water is present or where dewatering is required, the trench bottom shall be undercut and stabilized with No. 57 or No. 67 stone, having a minimum depth of 8".

15.3 Rock Excavation

- A. Where rock is encountered, the trench shall be excavated to a depth of not less than 6 inches beneath the bottom of the pipe and then refilled with No. 57 or No. 67 stone. For ductile iron sewer pipe, the bedding may be other native granular soil as may be approved by the City. The trench width in rock excavation shall be as previously specified.

15.4 Blasting Procedures

- A. Blasting for trench rock may be initiated only after the permitting requirements prescribed in Section 200 of these Specifications have been met. The CONTRACTOR is also reminded of the work hour limitations for blasting.
- B. Blasting procedures shall conform to all applicable local, state, and Federal laws and ordinances. The CONTRACTOR shall take all necessary precautions to protect life and property, including the use of an approved blasting mat where there exists

the danger of throwing rock or overburden. The CONTRACTOR shall keep explosive materials that are needed on the job site in specially constructed boxes provided with locks. These boxes shall be painted red and plainly identified as to their contents. After working hours, the boxes containing explosive materials shall be removed from the job site.

- C. Failure to comply with this specification shall be grounds for suspension of blasting operations until full compliance is made. No blasting shall be allowed unless a galvanometer is employed to check cap circuits. Where blasting takes place within 500-feet of a utility, structure, or property which could be damaged by vibration, concussion, or falling rock, the CONTRACTOR shall be required to keep a blasting log containing the following information for each and every shot:
 - 1. Date of shot
 - 2. Time of shot
 - 3. Foreman's name
 - 4. Number and depth of holes
 - 5. Approximate depth of overburden
 - 6. Amount and type of explosive used in each hole
 - 7. Type of caps used (instant or delay)
 - 8. The weather
- D. This blasting log shall be made available to the City upon request and shall be kept in an orderly manner. Compliance by the CONTRACTOR with these specifications does in no way relieve him/her of legal liabilities relative to blasting operations.
- E. The City reserves the right to require removal of rock by means other than blasting where any utility, residence, structure, etc. is either too close to, or so situated with respect to the blasting as to make blasting hazardous.

Section 16 Maintaining Wastewater Flow

16.1 Submittals

- A. Submit equipment proposed for bypass pumping to City for approval. Submit written plan outlining provisions and precautions to be taken to adequately route wastewater flow around the work area and prevent overflow or other spillage of wastewater.
- B. Submit data on equipment showing flow capacities and heads for pumps; capacities and number of tanker trucks; lengths, sizes and materials of hoses and sizes and materials of plugs; plans and schedules for bypass operations. List all equipment available for bypass pumping.
- C. Submit written back-up plan for maintaining wastewater flow should primary equipment fail.

16.2 Pumps

- A. Fully automatic self-priming units, which do not require the use of foot-valves or vacuum pumps in the priming system.
- B. Provide pumps with automatic start/stop controls and discharge piping adequate to prevent spillage of wastewater.
- C. Provide sufficient engine silencers to limit noise where diesel units are utilized.
- D. Provide pumping system with on-line back-up pump isolated from primary system by valve. Backup pumping systems shall represent a redundant system and be capable of meeting the same design requirements associated with the primary pumping system.
- E. Pumping System capable of operating 24 hours per day and capable of running dry for long periods.
- F. Pump noise attenuation shall be provided such that the noise level from the entire pumping system does not exceed 72 dBA measured at a distance of 30 feet.
- G. Primary pumping systems shall be designed to convey peak and wet-weather flows without the need for utilization on an available on-line backup pump. Flow quantification and pump sizing shall be the responsibility of the Contractor.
- H. Provide filter bags and other necessary erosion control devices associated with the bypass pumping system equipment.

16.3 Plugs

- A. Inflatable type pneumatic plugs capable of releasing wastewater back-up slowly without surges. Plugs may be required in downstream manholes to prevent backflow.
- B. Plugs shall be tethered to prevent loss in the sewer.

16.4 Hoses

- A. Hoses of suitable material for laying on the ground and capable of being run over by vehicular traffic without breaking. Provide hoses free from pinholes or other means of leakage.

16.5 Depth of Flow

- A. Control depth of flow in upstream sewer using by-pass pumping to the following depths whenever the following work is occurring.

Maximum Depth of Flow as Percentage of Pipe Diameter					
Television Inspection		Joint Testing and Sealing		Pipe Lining	
Pipe Diameter	Max. % Depth of Flow	Pipe Diameter	Max. % Depth of Flow	Pipe Diameter	Max. % Depth of Flow

6-10"	20%	6-12"	25%	6-10"	20%
12-24"	25%	15-24"	30%	12-24"	25%
Larger than 27"	30%	Larger than 27"	35%	Larger than 27"	30%

16.6 Bypass Pumping

- A. Implement by-pass pumping where, in the opinion of the City, pumping is required to assure completion of downstream inspection, lining or replacement work.
- B. Plug outgoing side of manhole upstream from work area and bypass pump wastewater from plugged manhole to manhole downstream of work area. Do not allow wastewater to surcharge in plugged manhole or back-up into upstream sewer.
- C. If no adequate downstream sewer is available, provide tanker trucks of sufficient number and capacity to haul wastewater to location approved by the City.
- D. Place equipment in location suitable to permit traffic flow and access to homes and business.
- E. Route hose through trenches backfilled with crushed aggregate base materials where hoses must cross local streets. Do not route hoses through storm drainage pipes or drainage ditches unless specifically directed by the City.
- F. Protect public and private property water resources, wetlands and other natural resources from damage from spills or back-ups.
- G. Pay all clean-up costs and/or fines incurred by the City because of wastewater overflows or back-ups caused by operation of the bypass pumping system.
- H. Notify the City immediately of leaks or spills and implement emergency containment procedures.
- I. It is the Contractor's responsibility to divert incoming flow from all service connections and laterals. Provide all the necessary materials and equipment to tie this flow in to the main diversion system.
- J. The Contractor is responsible for keeping pumping engine noise complaints from the citizens to a minimum. The City will terminate all pumping activities if noise control is not adequately addressed.
- K. Conduct all construction activities such that connections are restored and standard non-bypassed flow may continue during non-working hours. If bypass operations are to continue after standard working hours, the CONTRACTOR must provide staff to monitor the operations on site at no additional cost to the City.
- L. All measures to provide adequate erosion control relating to any pumping operations shall be provided by the Contractor in accordance with all applicable regulations and permit requirements.

Section 17 Inspection and Testing of Gravity Sewers

17.1 Visual Inspection of Pipeline Interior

- A. Upon completion of any designated portion of the sewer lines, the City in the presence of the CONTRACTOR shall conduct a visual inspection of the pipeline interior. The test shall be conducted by flashing a light between manholes, by use of mirrors, or by such other devices as will allow an adequate inspection of the line to detect misalignment or structural defects. Any portion of the line which does not exhibit a true alignment and uniform grade, or which shows any defect shall be corrected to the complete satisfaction of the City.
- B. The City may re-inspect the line at any time prior to final acceptance if any damage or displacement is suspected to have occurred subsequent to the initial inspection.

17.2 Low Pressure Air Tests

- A. The low pressure air testing shall be conducted in accordance with ASTM C-828. Prior to testing, the sewer line shall be clear of debris and flushed with water as necessary. The line shall be plugged and the plugs shall be securely braced to prevent slippage. The line shall be pressurized with air to 5 psi and allowed to stabilize for a period of 2 minutes. To simplify the ASTM procedure, the following table shall be used to determine the test time. If there are multiple sizes, add the various times together.

Normal Pipe Size (inches)	Time (t) (Minutes/100 ft.)
4	0.3
6	0.7
8	1.2
10	1.5
12	1.8
15	2.1
18	2.4
21	3.0
24	3.6
27	4.2
30	4.8
33	5.4
36	6.0
42	7.3

- B. If the pressure stays at 5 psi for the required test time length as noted above, the pipe is acceptable. Should the section of pipe being tested fail to meet these requirements, the source of leakage shall be determined and repaired to the

satisfaction of the City the section shall then be retested until it is deemed to be acceptable by the City.

- C. The CONTRACTOR shall furnish all plugs, compressors, hose, gauges, etc., as required to conduct the low-pressure air test.

17.3 Infiltration Tests

- A. Portions of the sewer lines, which exhibit a higher ground water table during construction, shall be tested for infiltration. The portions of the line to be infiltration tested shall be determined by the City.
- B. The portion of the sewer line designated by the City shall be tested for infiltration by installing a V-notch measuring weir or other suitable measuring device in the downstream end of the pipe to be tested. When a steady flow occurs over the weir, the rate of flow (infiltration) shall be measured. The rate thus measured shall not exceed 100 gallons per 24 hours per inch of sewer pipe diameter per mile of pipe. The CONTRACTOR shall furnish weirs, other equipment required for infiltration tests, and the tests shall be performed in the presence of the City.
- C. Should the infiltration tests reveal leakage in excess of the allowable, the leaking joints shall be re-laid if necessary or other remedial construction shall be performed by and at the expense of the CONTRACTOR. The section of sewer thus repaired shall then be retested to determine compliance with the Specifications.

17.4 Deflection Testing of PVC Sewer Pipe (SDR-26)

- A. If PVC Sewer Pipe (SDR-26) is used for gravity sewer, a deflection test shall be conducted on all such pipe installed. These pipes shall be mandrelled with a rigid device sized to ensure that the final long-term deflection or deformation of the pipe barrel has not exceeded 5 percent for PVC sewer pipes.
- B. The mandrel (Go/No-Go) device shall be cylindrical in shape and constructed with 9 or 10 evenly spaced arms or prongs. Mandrels with fewer arms (in odd or even numbers) will be rejected as not sufficiently accurate.
- C. The outside diameter of the 9-arm mandrel shall be as shown below for 8-inch PVC Pipe. The mandrel diameter shall have a tolerance of +/-0.01 inch. Contact length shall not be less than 2 inches.

Mandrel Dimensions	
Main Size	PVC Sewer
8"	7.28
10"	9.08
12"	10.79
15"	13.20

- D. Any lines not meeting this test shall be corrected by the CONTRACTOR and the test repeated. Allowances for pipe wall thickness tolerances or ovality shall not be deducted from the “D” dimension but shall be counted in as a part of the deflection allowance.
- E. The mandrel shall be hand pulled by the CONTRACTOR through all PVC sewer lines. Any sections of sewer not passing the mandrel shall be uncovered and the CONTRACTOR shall re-round or replace the sewer to the satisfaction of the City. These repaired sections shall be retested.
- F. The initial inspection shall be conducted no earlier than thirty (30) days after reaching final trench backfill grade. Deflection testing shall be accomplished at such times as may be directed by the City. Upon completion of all work, the City may require such final deflection testing as may be deemed necessary to ensure that the long-term deflection has not exceeded the maximum allowed deflection.
- G. The City shall approve the mandrel. The CONTRACTOR shall furnish drawings of the mandrel with complete dimensions to the City upon request.

Section 18 Vacuum Testing of Manholes

18.1 Vacuum Testing of Manholes

- A. Prior to making sewer systems active, all manholes shall pass a vacuum test in accordance with ASTM C 1244-93. The Contractor shall supply all equipment and materials necessary to vacuum test the manholes. Vacuum Testing shall not be initiated until the manholes and all specified coatings and lining materials have been cured in accordance with manufacturer recommendations. The Inspector shall be present and witness all vacuum testing. The following vacuum testing criteria shall apply for compliance with the testing procedure.
 - 1. A vacuum of 10" of mercury shall be drawn with an approved vacuum testing unit.
 - 2. The testing time shall not be measured until after the vacuum pump has been shut off.
 - 3. The time required for the vacuum to drop from 10" to 9" of mercury shall meet or exceed the values listed in the following table.

Manhole Vacuum Testing Time (seconds)			
Depth (feet)	Manhole Diameter (inches)		
	48	60	72
8	20	26	33
10	25	33	41
12	30	39	49
14	35	48	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

Section 19 Fats, Oils and Grease Management

19.1 Definitions

- A. Additives: Include but are not limited to products that contain solvents, emulsifiers, surfactants, caustics, acids, enzymes and bacteria.
- B. Exemption: A release from the requirement to install grease control equipment (GCE).
- C. Extensive Remodeling: Modifications made to an existing FSE sufficient to require issuance of a building permit, or the temporary closure of the FSE for building renovation.
- D. Fats, Oils, & Grease (FOG): Organic polar compounds derived from animal and/or plant sources. FOG may be referred to as grease or greases in this section.
- E. Food Service Establishment (FSE): Any establishment, business, facility or user engaged in preparing, serving or making food available for consumption. Single-family residences are not to be classified as an FSE.
FSE's will be classified as follows:
1. Class 1: Day Care Facilities, Deli, Ice Cream shops, Coffee Shops, Beverage Bars, Mobile Food Vendors engaged in the sale of cold-cut and microwaved sandwiches/subs with no frying or grilling on site, as defined by North American Industry Classification System (NAICS) 722213.
 2. Class 2: Limited-Service Restaurants - (i.e. Fast Food Facilities) as defined by NAICS 722211 and Caterers as defined by NAICS 722320.
 3. Class 3: Full Service Restaurants - as defined by NAICS 722110.
 4. Class 4: Buffet and Cafeteria Facilities - as defined by NAICS 722212.
 5. Class 5: Institutions (i.e. Schools, Hospitals, Prisons, etc.) - as defined by NAICS 722310.
- F. Garbage Disposal: A kitchen appliance designed to grind food particles to a small enough size to dispose to a sink drain.
- G. Grease (Brown): Fats, oils and grease that are discharged to the grease control equipment, or are from kitchen or food prep wastewater.
- H. Grease (Yellow): Fats, oils and grease that has not been in contact or contaminated from other sources (water, wastewater, solid waste, etc.) and can be recycled.

- I. Grease Control Equipment (GCE): Devices for separating and retaining FSE wastewater FOG prior to entering the sewer system. The GCE is constructed to separate and trap or hold fats, oils and grease substances from entering the sewer system. GCE should only receive kitchen wastewater. Devices include grease interceptors (normally located outdoors), grease traps (normally located indoors), or other devices approved by the City.
- J. Grease Interceptor (GI): GCE identified as a large multi-compartment tank, usually 1,000 gallon to 2,000-gallon capacity with proper inlet and outlet structures, and other necessary components, that provides FOG control for a FSE. No sanitary wastewater (black water) line should be connected to the grease interceptor. Grease interceptors will be located outside the FSE.
- K. Grease Trap (GT): GCE identified as an under-the-sink trap, small container with baffles, or a floor trap. The minimum size requirement shall be the equivalent of a 25-gallon per minute/50 pound capacity trap. Grease traps shall have air relief bypass, flow control restrictor, and a vent pipe. No dishwasher or sanitary wastewater (black water) line shall be allowed to be connected to an under-the-sink or floor grease trap.
- L. Grease Recycle Container: A container used for the storage of yellow grease.
- M. Licensed Waste Hauler/Plumber: Individuals or entities that are licensed by the Alabama On-site Wastewater Board and hold all current permits and/or certifications necessary to conduct business.
- N. Multi-Unit Facility: A single building or facility with multiple separate but adjoining units, each with separate plumbing and possibly other utilities.
- O. NAICS: North American Industry Classification System. The website is found at <http://www.census.gov/epcd/www/naics.html>
- P. Series: (Grease Interceptors Installed in Series): Grease interceptor tanks that are installed one after another in a row and are connected by plumbing pipe.
- Q. Single Service Kitchen: A FSE that does not prepare food onsite (heat and serve only) and which uses only disposable service ware (utensils and dishes).
- R. Tee or T (Influent & Effluent): A T-shaped pipe extending from the ground surface below grade into the grease interceptor to a depth allowing recovery (discharge) of the water layer located under the layer of FOG. Influent & effluent T's are to be made of PVC schedule 40 or equivalent approved material. Influent T's should extend 2/3 of the grease interceptor water depth, and effluent T's should extend to within 12" to 15" of the bottom of the interceptor tank to prevent short-circuiting.
- S. User: Any person that contributes, causes, or permits the contribution or introduction of wastewater or pollutants into the sanitary sewer system, whether intentional or unintentional, and whether direct or indirect.
- T. Water (Black): Wastewater containing human waste, from sanitary fixtures such as toilets and urinals.
- U. Water (Gray): Wastewater other than black water as defined in this section.

19.2 Requirements

- A. Grease Control Equipment (GCE) shall be designed and constructed in accordance with the provisions of this FOG Management Policy and/or The City of Troy Utilities' Standards and Specifications.

Minimum acceptable size of GCE for each FSE Classification will be as follows:

1. Class 1: Deli, Ice Cream shops, Beverage Bars, Coffee Shops, Mobile Food Vendors minimum requirement - 25 gallons per minute/50 pound Grease Trap (GT).
 2. Class 2: Limited-Service Restaurants / Caterers 1,000 gallon Grease Interceptor
 3. Class 3: Full Service Restaurants- 1,000 gallon Grease Interceptor
 4. Class 4: Buffet and Cafeteria Facilities- 1,500 gallon Grease Interceptor
 5. Class 5: Institutions (Schools, Hospitals, Prisons, etc.) - 2,000 gallon Grease Interceptor or two 1000-gallon Grease Interceptors installed in series.
- B. The City will review GCE sizing information received from the FSE's engineer, architect or contractor. The City will make a decision to approve, or require additional GCE volume, based on the type of FSE, the number of fixture units, and additional calculations. Grease interceptor capacity should not exceed 2,000 gallons for each interceptor tank. In the event that the grease interceptor calculated capacity needs to exceed 2,000 gallons, the FSE shall install an additional interceptor of the appropriate size. If additional interceptors are required, they shall be installed in series.
- C. Grease interceptors that are installed in series shall be installed in such a manner to ensure positive flow between the tanks at all times. Tanks shall be installed so that the inlet invert of each successive tank shall be a minimum of 2-inches below the outlet invert of the preceding tank.
- D. Grease Control Equipment (GCE) shall not be located in food preparation areas.
- E. Grease interceptors that are installed in series shall include adaptors, gaskets or flexible transition couplings of minimum of schedule 40 PVC pipe.
- F. Property service connections shall be sized based on fixture units with a minimum size of a 4" connection.
- G. All new FSE construction and upgrades having a GCE requirement shall be constructed to include a sample monitoring station approved by the City.
- H. If an existing undersized GCE is structurally sound and installed properly, then, in lieu of replacing it with a larger unit, the FSE may choose to install an additional unit in series with the existing unit to satisfy the total size capacity required.
- I. New FSE's, as well as existing facilities that are undergoing extensive remodeling shall install and maintain at a minimum, an approved 1,000-gallon grease interceptor located outside the FSE building.

- J. New construction of FSE's shall have separate sanitary (restroom) and kitchen process lines. The kitchen process lines shall be plumbed to the appropriately sized GCE. Kitchen process lines and sanitary lines may combine prior to entering the public sewer; however, the lines cannot be combined until after the GCE. Sanitary wastewater, or black water, cannot be connected to GCE.
- K. When an existing building and/or building's plumbing is being renovated and the facility is a FSE, internal plumbing shall be reconstructed to separate sanitary (restroom) flow from kitchen process flow. Sanitary flow and kitchen process discharges shall be approved separately by the City and shall discharge from the building separately. The kitchen process line(s) shall be plumbed to appropriately sized GCE. Kitchen process lines and sanitary lines may combine prior to entering the public sewer; however the lines cannot be combined until after the GCE.
- L. New multi-unit facility, or new strip mall facility, owners shall contact the City prior to conducting private plumbing work at the multi-unit facility site. Multi-unit facility owners, or their designated contractor, shall have plans for separate private wastewater lines for kitchen and sanitary wastewater for each individual unit. In addition, the plans shall identify stub-out locations to accommodate a minimum 1,000-gallon grease interceptor for each unit of the multi-unit facility. New multi-unit facility, or new strip mall facility owners shall consider suitable physical property space and sewer gradient that will be conducive to the installation of an exterior, in-ground GI when determining the building location.
- M. The City's Utilities will review plans for FSE in classes 1 through 5 as part of the building permit acquisition process.
- N. FSE owners or their designee shall submit three (3) sets of FSE facility plans to the City for review and approval.
- O. Facility plans shall include the following sheets:
 - 1. floor plan detailing
 - 2. kitchen prep equipment and showing how grease waste lines discharge to GCE
 - 3. plumbing sheets, and a
 - 4. GCE specification sheets.
- P. All surface water must drain away from the GCE to exclude rainfall from the sewer system.
- Q. Traffic locations installations require the top of the interceptor to be below the pavement. Inspection, maintenance, and cleaning manholes must be brought to grade with frames and covers suitable for traffic loads.
- R. Plumbing sheets shall include identification of all cooking and food preparation equipment (i.e. fryers, grills, woks, etc.); the number and size of dishwashers, sinks, floor drains, and other plumbing fixtures; greasy waste bearing plumbing lines, the location of GCE, and specifications for GCE. The discharge from the following fixtures shall be plumbed to the GCE: all sinks (3-compartment, vegetable prep,

mop, etc.), dishwashers, floor drains in food preparation and storage areas, garbage disposals, and other fixtures through which grease may be discharged such as woks and soup ladles.

- S. The City will review the plumbing plans and GCE sizing; and approve, or make changes as necessary to aid in the protection of a FOG discharge from the FSE.
- T. If the plans are approved by the City, a Preliminary Release will be issued to the FSE.
- U. Personnel from the City will inspect the GCE. Contact Troy Utilities at least forty-eight (48) hours prior to installation to schedule the inspection. All components of the GCE must be visually inspected before any component is covered. The City will not accept GCE that has not been inspected and approved by the City per these guidelines.
- V. If the installed GCE is approved by the City, a Final Release will be issued to the FSE.
- W. Coffee shops that brew coffee on the premises for consumption and bakeries will not be granted exemptions due to the pH of the wastewater discharged.
- X. Substandard GCE - In the event an existing FSE's GCE is deemed by the City to be either undersized or substandard in design, the FSE owner(s) will be notified in writing by the City of the deficiencies and required improvements, and given a compliance deadline not to exceed six (6) months to comply.

19.3 Prohibitions

- A. FSE's shall not contribute or cause to be contributed into the City's collection system the following:
 - 1. Hot water running continuously through GCE;
 - 2. Discharge of concentrated alkaline or acidic solutions into GCE; and
 - 3. Discharge of concentrated detergents into GCE.

19.4 Certified Hauler/Plumber Program

- A. Participating haulers/plumbers shall:
 - 1. Be permitted by the Alabama On-site Wastewater Board to haul waste in the State of Alabama.
 - 2. Agree to provide information on GCE to the City in a timely manner.
 - 3. Agree to completely evacuate FOG from GCE when servicing such GCE at FSE's. If the volume of the GCE is greater than the tanker capacity, the hauler/plumber agrees to provide additional tankers so that the GCE is fully evacuated within a 24-hour period from the initial instigation of the evacuation.
 - 4. Agree to never return gray water removed from GCE to the GCE under any circumstances

5. Agree to provide information relative to FOG removed at FSE's in format required by the City
 6. Dispose of FOG waste at a facility permitted and authorized to receive such waste in accordance with applicable federal, state and local laws and regulations.
 7. Perform GCE maintenance in accordance with these guidelines.
- B. The City will provide a listing of all approved haulers/plumbers to FSE's at the request of the FSE.
 - C. FSE's under the City's jurisdiction must have their grease interceptor or grease trap inspected annually to ensure the GCE is in proper working condition. If a grease interceptor or grease trap fails the certification requirement, then a corrective action response is required from the FSE owner or authorized representative by a date specified in the corrective action response.
 - D. Failure of a Grease Interceptor Certification, or Grease Trap Certification - The FSE owner, or authorized representative, is responsible for including detailed corrective action response information on the grease interceptor inspection. At a minimum, the corrective action response information must include the reason for the failed certification, what corrective action will be taken to correct the problem, and the date the corrective action will be completed.
 - E. FSE's with GCE shall maintain a log of the pumping/cleaning maintenance activities performed for each GCE on the premises. GCE maintenance records shall include, at a minimum, the date of cleaning/maintenance, company or person conducting the cleaning/maintenance, invoice number of company or person conducting the cleaning/maintenance, FSE name and address, and specific volume of grease wastewater removed from the GCE. Manifests/trip tickets shall be maintained for a period of three (3) years to substantiate the maintenance log. However, manifests alone will not meet the requirement. FSE's shall provide compliance reports as requested by the City.
 - F. GCE maintenance records shall be available at the FSE premises so they can be provided to City personnel or their representative. The FSE shall maintain GCE maintenance records onsite for three (3) years.
 - G. An owner, manager or designated employee of the FSE shall supervise the GCE cleaning/maintenance activities and shall be physically present and observe the entire operation each time cleaning/maintenance is conducted.
 - H. Each GCE shall be fully evacuated (complete pump out of GI contents) unless the volume is greater than the tank capacity of the pumper vehicle in which case the hauler shall arrange for additional transportation capacity so that the GCE is fully evacuated within a 24-hour period.
 - I. The return of gray water back into the GCE from which the waste was removed is prohibited.

- J. Waste removed from GCE shall be disposed of at a facility permitted and authorized to receive such waste in accordance with applicable federal, state and local laws and regulations. Pumped waste shall not be discharged to a private or public sewer.
- K. FSE's shall observe Best Management Practices (BMP's) for controlling the discharge of FOG from their facility.

19.5 Grease Interceptor (GI) Cleaning/Maintenance Requirements

- A. Grease interceptors must be pumped-in-full when the total accumulations of surface FOG (including floating solids) and settled solids reaches twenty-five percent (25%) of the grease interceptor's overall liquid depth. This criterion is referred to as the 25% Rule. At no time, shall the cleaning frequency of the grease interceptor exceed 90 days, unless approved by the City. Some existing FSE's in Class 2 through 5 will need to consider a 30-day pumping frequency or a 60-day pumping frequency to meet the 25% Rule requirement.
- B. Partial pump of interceptor contents or on-site pump & treatment of GI contents will not be allowed due to reintroduction of fats, oils and grease to the interceptor and pursuant to the Code Federal Regulation 40 CFR403.5 (b)(8), which states specific prohibitions.
- C. Special pumping frequency approval may be granted by the City, on a case-by-case basis, for unusual circumstances.
- D. All FSE's in the City Utilities' jurisdiction must have a certified grease waste hauler or plumber completes a grease interceptor certification annually. The grease interceptor certification must be signed by the FSE owner or authorized representative. If a grease interceptor certification fails, then the FSE owner or authorized representative must provide a corrective action response to the City. The corrective action response will identify the reason for the failure, what corrective action will be taken to correct the problem, and the date the corrective action will be completed.
- E. Grease interceptor effluent-T shall be inspected during cleaning and maintenance and the condition noted by the grease waste hauler's company or individual conducting the maintenance. Effluent-T's that are loose, defective, or not attached must be repaired or replaced immediately.

19.6 Grease Trap (GT) Cleaning/Maintenance Requirements

- A. GT's shall be cleaned of complete fats, oils, and grease and food solids at a minimum of every two (2) weeks, unless more or less cleaning frequency is authorized by the City. If the FOG and food solids content of the grease trap are greater than 25% of the water depth capacity of the grease trap, then the grease trap shall be cleaned every week, or as frequently as needed to prevent 25% of capacity being occupied with FOG and food solids.
- B. FSE's in the City's Utilities jurisdiction shall have a City's Utilities certified grease waste hauler or plumber completes a grease trap certification annually. The grease trap certification shall be signed by the FSE owner or authorized representative. If a grease trap certification fails, then the FSE owner or authorized representative shall

provide a corrective action response to the City. The corrective action response shall identify the reason for the failure, what corrective action will be taken to correct the problem, and the date the corrective action will be completed.

- C. During cleaning of the grease trap, the flow restrictor shall be checked to ensure it is attached and operational.
- D. Grease Trap waste shall be sealed or placed in a container to prevent leachate from leaking, and then disposed of properly. Disposal of grease trap waste into a sanitary sewer service line or manhole is prohibited.
- E. Grease Trap waste shall not be mixed with yellow grease in the grease recycle container.

19.7 Additives

- A. Additives are prohibited for use as grease management and control. Additives include but are not limited to products that contain solvents, emulsifiers, surfactants, caustics, acids, enzymes and bacteria.
- B. If the City identifies an FSE that is using additives and is contributing FOG to the City's sewer system, or has caused any interference to the sewer system, the FSE shall immediately stop use of the additive and shall be subject to enforcement action as described in this policy.
- C. At no time shall additives be used just prior to under-the-sink or floor grease traps. The use of additives is prohibited with the following exceptions:
 - 1. Additives may be used to clean the FSE drain lines but only in such quantities that it will not cause fats, oils and grease to be discharged from the GCE to the sewer system, or cause temporary breakdown of FOG that will later re-congeal in the downstream sewer system, if the product used can be proven to contain 100% bacteria, with no other additives.
 - 2. Approval of the use of the product must come from the City, and the FSE must submit a full disclosure Material Safety Data Sheet and certified sample results from the manufacturer of the product.
 - 3. The use of approved additives shall in no way be considered as a substitution to the maintenance procedures required per this policy.

19.8 Right of Entry for Inspection and Monitoring

- A. The City's Utilities shall have the right to enter the premises of FSE's to determine whether the FSE is complying with the requirements of this policy and/or wastewater discharge regulations. FSE's shall allow City personnel full access to all parts of the premises for the purpose of inspection, monitoring, and/or records examination. Unreasonable delays in allowing City personnel access to the FSE premises shall be a violation of this policy and the wastewater discharge regulations.

- B. The City may require that the FSE install monitoring or additional pretreatment equipment deemed necessary for compliance with this policy and/or all applicable wastewater discharge regulations.

19.9 Enforcement Action

- A. Enforcement action may result against a FSE for instances that include, but is not limited to the following:
 - 1. Failure to clean or pump grease control equipment,
 - 2. Failure to maintain grease control equipment including inspection and installation of properly functioning effluent-T and baffles,
 - 3. Failure to install grease control equipment,
 - 4. Failure to control FOG discharge from the FSE,
 - 5. Contributing to a sewer line blockage or obstruction,
 - 6. Contributing to a sanitary sewer overflow, and
 - 7. Use of additives in such quantities so that FOG is pushed downstream of the FSE.
- B. Enforcement actions may include the following:
 - 1. Requirement of the Food Service Establishment (FSE) to pay all expenses associated with corrective action taken by the City to clear blockages caused by the failure of the grease control equipment or the failure of the FSE to properly maintain the grease control equipment; and/or
 - 2. Termination of all utility services provided by Troy Utilities.

Section 20 Sewer Infrastructure Ownership

20.1 Applicability

- A. Sanitary sewer service is provided to each end user through a network of collection and conveyance piping. The City's and end users each hold ownership of portions of this infrastructure and are responsible for its maintenance to ensure proper sewer flows. The discussion of ownership and responsibility presented herein is applicable to circumstances in which a gravity lateral is connected to either a gravity trunk line or a City-owned lift station. Additional items for consideration may be applied in circumstances where sanitary sewer service connects by means of a privately owned lift station and/or service is to a pressurized sewer main.

20.2 Private and Public Sewer Laterals

- A. Sewer service extends to an end user through a sewer lateral. For the purposes of these Specifications, the lateral is described in two segments, each with unique responsibility assignments. The first segment extends from the trunk line to the edge of the right-of-way and is referred to herein as the public sewer lateral. The City is responsible for maintaining the public sewer lateral. The portion of the sewer lateral that extends from the edge of the City's right-of-way towards the

property of the end user is referred to herein as the private sewer lateral. The end user is responsible for maintaining the private sewer lateral.

20.3 Addressing Sewer Service Disruptions

- A. In the event of a disruption in sewer service, it shall be the responsibility of the end user to determine the cause and location of the disturbance (i.e., blockage, etc.). This shall be completed by the utilization of a licensed plumber.
- B. If a licensed plumber locates the cause of the disruption and it is found to lie within the limits of the private sewer lateral, the end user shall bear the costs associated with locating and correcting the issue. In any instance in which the licensed plumber finds a defect within the public sewer lateral to be the cause of a service disruption, the end user shall immediately contact the City of Troy Utilities. The City will make a site visit while the licensed plumber is still on-site and mobilized to show the disruption. Following confirmation that the disruption is within the public sewer lateral, the City will bear the burden of correcting the issue identified.

Standard Sanitary Sewer Details

Detail ID	Detail
200-01	Sanitary Sewer Pipe Bedding & Backfilling
200-02	Sanitary Sewer Tap & Service
200-03	Sanitary Sewer Service Connections
200-04	Precast Manhole
200-05	Precast Manhole
200-06	Precast Manhole (Outfalls)
200-07	Drop Manhole
200-08	Drop Manhole for Sewer Service
200-09	Air and Vacuum Release Valve Station
200-10	4" Sanitary Sewer Tap & Service for Sewer Mains Over 13' Deep
200-11	High Velocity Manhole Invert
200-12	Doghouse Manhole Installation Over Existing Sewer Main
200-13	Manhole Vent
200-14	Cleanout Cover for Vehicle Traffic Areas
200-15	Concrete Encasement for Stream Crossing
200-16	Sanitary Sewer Plug Installation
200-17	Sanitary Sewer Easement
200-18	Manhole Frame & Cover