Minimum Design and Construction Standards

for

Storm Drainage, Sanitary Sewer, Water Distribution, Natural Gas Distribution, and Right-of-Way Corridors

City of Senatobia, Mississippi

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Mayor Alan Callicott

Board of Aldermen
Don Clanton, Alderman At Large
Lana Nail, Ward 1
Penny Hawks Frazier, Ward 2
Michael Cathey, Ward 3
Mike Putt, Ward 4

Karen Vansickle, City Clerk

David Slocum, City Attorney

Prepared by:
ELLIOTT & BRITT ENGINEERING, P.A.
P.O. BOX 308
823 NORTH LAMAR BLVD.
OXFORD, MS 38655
(662) 234-1763

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INTRODUCTION

These are the minimum design standards and construction requirements for public right-of-way corridors, storm drainage systems, sanitary sewer piping systems, water distribution systems, and natural gas distribution systems for construction within the city limits of Senatobia, Mississippi, and for any construction that will connect to the city's facilities.

These minimum design standards and construction requirements apply to any construction for subdivision developments, planned unit developments (PUD), apartment developments, condominium and townhouse developments, shopping centers or malls, commercial developments, and any developments that require a grading permit.

These minimum design standards and construction requirements are to be used in conjunction with the requirements of F.E.M.A., Mississippi Department of Transportation, Mississippi Department of Environmental Quality, the Mississippi Health Department, the City of Senatobia Subdivision Regulations, and the City of Senatobia Building Code.

Where a material supplier, or brand name, is specified in each chapter's "materials" section, it is shown so that all installed products meet the City's current standards and maintenance part availability. The City of Senatobia Public Works Department may allow substitutions, but only after a written request is made from the developer or design engineer to the Director of Public Works and City Engineer. Both the Director of Public Works and the City Engineer shall approve the request before substitute materials may be used.

CHAPTER 1
STORM WATER PLANNING, DESIGN, AND CONSTRUCTION

SECTION 101 – DRAINAGE PLANNING

101.1 – Drainage Systems. The overall drainage network is divided into two components, the minor system and the major system. The minor system, which is sometimes termed the "initial system", consists of a wide variety of drainage appurtenances ranging from inlets, manholes, street gutters, roadside ditches, and swales to small channels or pipes. This system serves to collect the initial storm water runoff and convey it to a proper out-fall within the major system. The major system primarily consists of natural waterways, large storm sewers, and large water impoundments. In addition, the major system includes some less obvious drainage ways such as overland relief swales, and infrequent temporary ponding at storm sewer inlets. The major system includes not only the trunk line drain which receives the water from the minor system, but also the natural backup drain which functions in case of overflow from or failure of the minor system. Proper overland relief will not flood or damage homes, businesses, or other property. It must always be remembered that the major system will function in a drainage basin whether or not it has been planned and designed, and whether or not development is situated wisely in respect to it.

101.2 – Remarks. Designers and reviewers are encouraged to continually seek better solutions to the design of drainage systems. However, in the interest of expediting the processing of plans and construction, certain standard procedures and the use of standards of design are necessary, if there is to be an orderly controlled development. These storm drainage policies, guidelines, criteria, and standards will continually be re-evaluated as additional research and basic information becomes available.

SECTION 102 – DRAINAGE DESIGN CRITERIA AND STANDARDS

102.1 – Limitation on Stormwater Runoff. The minor drainage system and/or the major drainage system shall be designed so that the rate of runoff of surface water from the site, in the condition in which it is proposed to be developed, will not exceed the rate of runoff from the site in its existing condition.

The peak flow shall be calculated for the 2-, 10-, 25-, and 100-year storms. The peak flows shall not be increased at any location for any storm, up to and including the 100-year storm.

102.2 – Detention of Excess Stormwater Runoff. The increased storm water runoff from the developed site shall be detained primarily by structural means. Structural means include retention or detention facilities that are designed to gather runoff in wet ponds, dry ponds, or subsurface multi-chamber systems and slowly releasing it.

Care must be taken to insure that any required detention facilities do not become nuisances or health hazards. The design engineer should strive to design detention facilities which require

minimal maintenance. The maintenance responsibility must be clearly stated on the plans. Where dual purpose facilities are provided, flat grades encountered, or poor draining soils found, provisions for adequate low flow drainage may be required.

All detention facilities located in residential developments, excluding condominium developments, shall be within storm drainage easements, and shall be maintained by the City of Senatobia. Detention facilities located in industrial, commercial, institutional, apartment developments and rental townhouses must be maintained by the property owner, and a maintenance agreement must be executed before the development plan is approved.

The primary concern is maintaining post-development outflow at the level of the pre-development condition, but the requirements of this Section may be applied under certain conditions for the purpose of rendering an existing inadequate out-fall acceptable. When used in that fashion, such a facility may also aid in meeting the requirement for adequate drainage.

102.3 – Storage Capacity. Retention or detention facilities shall be designed with sufficient capacity to accommodate all runoff caused by the development in excess of that runoff which occurs in its existing condition. This storage shall be sufficient to store all excess rates of runoff for the 2-, 10-, 25-, and 100-year storms of 24-hour duration.

102.4 – Channel Stability. The storm water runoff from the proposed development shall not increase channel stability downstream. Velocity dissipaters may be required to achieve this requirement.

102.5 – Retention/Detention Facilities in Floodplains. If detention or retention storage is proposed in a floodplain or floodway, no storage volume for the facility may be provided below established high water elevations.

102.6 – Adequate Drainage. Adequate drainage should be designed to (1) account for both off-site and on-site storm water, (2) honor natural drainage divides, (3) convey said storm water to a stream, channel, and/or natural drainage-way by tying into the drainage-way at natural elevations or by discharging the storm water into an existing facility of sufficient capacity to receive the same.

Determination of the size and capacity of an adequate drainage system shall take into account the future development in the watershed or affected portion thereof. The design must not adversely affect adjacent or neighboring properties.

It is the responsibility of the developer or property owner to pick up or acceptably handle the runoff as it flows onto his property from the watershed above, and conduct it through his property to an adequate outfall at his lower property line or beyond. The outfall must be sufficient to receive the runoff without deterioration of the downstream drainage-way.

102.7 – Minor Drainage System. The design of the minor storm drainage system shall be based on a storm frequency of twenty-five (25) years. This criteria shall be applied to both closed conduit and open channel design. However, if the 25-year design flow for an open channel system is greater than 100 cfs (cubic feet per second), then the channel shall be capable of passing the 100-year design flow within the drainage easement.

In residential subdivision developments, where the average lot size is less than 20,000 sq, ft., the following general guidelines shall be observed in the design of the minor system:

a) No quantity of design surface runoff across lots shall have erosive velocities.
b) Quantities of surface runoff greater than 4 cfs that flow through lots shall be picked up and conveyed in a storm sewer system. This system may be open channel, closed conduit, or a combination of both.
c) Lots should generally be graded in such a manner than surface runoff does not cross more than three lots before it is collected in a storm sewer system. This system may be open channel, closed conduit, or a combination of both.

102.8 – Major Drainage System. Wherever possible, natural waterways serving the major system should remain undisturbed, whereupon the proposed development must be situated wisely in respect to it. However, due to the insufficient capacity of most natural drains, improvements to the channel may be necessary in order to properly utilize the adjacent property.

Improvements to natural open channels which are to primarily function as the major system shall be designed to pass the 100-year design flow without damage to the channel. Man-made channels designed to function as the major system (trunk line system) shall be capable of carrying a 100-year design flow. Where man-made channels are necessary, the channels should be located as far away from buildings or structures as possible and preferably in established greenbelts. Culvert design for the major drainage system is covered thoroughly in Section 107.

The on-site major storm drainage system for most developments is the natural backup system and therefore consists of the less obvious drainage-ways. It is desirable that this major system provide drainage relief such that no building will be flooded with a 100-year design flow even if the minor system should experience total failure. The 100-year frequency storm shall be used to compute runoff for the design of the on-site major drainage system. This system shall be designed to provide relief for flow in excess of the 25-year design flow.

Guidelines for design of the on-site major drainage systems are as follows:

a) Areas should be graded in such a manner and/or buildings located or constructed in such a manner that if complete failure of the storm sewer system occurs, no building will be flooded by the design flow.
b) Key areas to watch are sump areas, relatively flat areas, and areas where buildings are located below streets and/or parking lots.
c) Use the 100-year frequency storm to compute runoff for the major drainage system.

d) For the first trial, use the same time of concentration values that were used in designing the minor drainage system and assume the minor system completely inoperable. If no building will be flooded based on these assumptions, then the analysis can be considered complete.
e) If buildings will be flooded based on the assumptions used in item (d) then the designer should perform more precise hydrologic and hydraulic computations. He should design the minor system, overland relief swales, and/or surface storage in such a way that no building will be damaged by flooding.
f) In general, the designer should try not to oversize the minor storm drainage system as a design for the major system. The major drainage system should be in the form of grading of the area and/or locating and constructing buildings in such a manner that overland relief swales and/or surface storage will accomplish the objective.

Ordinarily, the design guidelines described in the previous paragraph are intended to result in a functional analysis rather than a numerical one. The project drainage plan should denote the major storm drainage system including overland relief swales and areas that may be affected by surface storage for a 100-year design storm. Any calculations that may have been necessary in order to arrive at the major system should be submitted, if requested.

102.9 – Flood Plain Policy. All proposed developments subject to inundation from a major stream channel must have flood plain water surface elevations provided in order that flood plain easements, required fill elevations, and first floor elevations may be established. Flood profiles for some streams in the City have previously been computed during the Federal Insurance Administration study. All developments proposed near streams included in this study must be designed in accordance with the data provided.

Development of property within the flood plain must be designed and constructed carefully. Wise use of the flood plain is encouraged in order to minimize adverse effects on flood heights and velocities. Areas of the flood plain available for development must be protected through the use of compacted fill, elevated structures, dikes, and/or floodwalls. Other flood proofing measures available are subject to the approval of the City of Senatobia.

102.10 – Policy on Drainage Affecting Sinkholes. Due to the many drainage problems commonly associated with sink holes it will be necessary for the developer to provide the following information prior to approval of any alteration of the natural drainage by the City of Senatobia.

a) The developer shall show proposed drainage channels on-site and off-site, to a point of acceptable discharge. The developer shall submit all necessary hydraulic calculations needed to show that off-site flooding will not be increased. Detailed drainage plans and hydraulic calculations are to be prepared by a Mississippi registered professional civil engineer.
b) Detailed contours are to be shown for all sink holes that are to receive storm water run-off from this site. These contours are to have a maximum interval of 2 feet and are to be verified by field surveys.

c) The developer shall provide the City of Senatobia with a geologic investigation of all sink holes receiving storm water run-off from this site. This investigation shall be prepared by a registered engineer experienced in geology and ground water hydrology. The report shall contain the following:
   i. location and nature of underground aquifers.
   ii. estimated safe discharge from sink holes to aquifers.
   iii. potential siltation problems.
   iv. foundation problems that may be expected around sink holes.
   v. details of drainage structures to be built in sink holes.
   vi. any other factors relevant to the design of drainage from sink holes.
d) Any areas within the sink holes that would be flooded by a 100-year flood are to be shown on the plans and no development will be allowed in this area.

SECTION 103 – HYDROLOGIC DESIGN

103.1 – Determination of a Curve Number (CN). A curve number will be required for the development in its pre-developed condition and post-developed condition. The curve number is an empirical parameter used for predicting direct runoff or infiltration from excess rainfall.

The hydrologic soil group(s) of the site must be obtained in order to choose the proper curve number. *The Soil Survey of Tate County (1967)* as published by USDA can be used. If the design engineer does not have access to this publication, the City Engineer can provide this information.

The curve number shall be determined by using the guidelines set forth in *Chapter 6 - Hydrology* of the *Planning and Design Manual for the Control of Erosion, Sediment, and Storm Water* as published by the Mississippi Department of Environmental Quality, Mississippi Soil and Water Conservation Commission, and the USDA Soil Conservation Service, latest edition.

103.2 – Time of Concentration. Time of concentration is the time required for runoff to travel from the hydraulically most distant point in the watershed to the outlet. The hydraulically most distant point is the point with the longest travel time to the outlet, and not necessarily the point with the longest flow distance to the outlet. Time of concentration is generally applied only to surface runoff and will vary depending on slope and character of the watershed and the flow path. Time of concentration shall be determined by the Watershed Lag Method, as found in Chapter 15 of *Part 630 – Hydrology of the National Engineering Handbook* as published by the USDA Natural Resources Conservation Service.

As a general guideline, if the total time of concentration is less than 5 minutes, a minimum value of 5 minutes should be used in estimating the design discharge.

103.3 – Runoff Hydrographs. Using the curve number and time of concentration, runoff hydrographs shall be created for the peak runoff condition and for a 24-hour storm event. The peak rate of runoff from the hydrographs from the pre-developed site and the post-developed site

will be compared to determine whether or not detention is required. If detention is required, the 24-hour storm hydrograph shall be used to estimate storage volume and rate of runoff from at the outlet.

103.4 – Hydrologic Design Calculations. In general, the following items are required to be submitted to the City of Senatobia:

a) Curve number calculations
b) Drainage areas and flow path diagrams
c) Time of concentration calculations
d) Hydrographs for the peak condition for the 2-, 5-, 25-, and 100-year storm event
e) Hydrographs for a 24-hour storm event for the 2-, 5-, 25-, and 100-year storm event
f) Detention design and storage calculations, if applicable

SECTION 104 – CLOSED CONDUIT SYSTEM

104.1 – Size of Storm Sewer Pipe. Size of storm sewer pipe may be determined by the Manning Formula which is expressed as:

$$Q = VA = \frac{1.49 r^{2/3} s^{1/2} A}{n}$$

Where:

Q = Quantity of flow in cubic feet per second
V = Velocity of flow in feet per second
A = Required area in square feet
n = Coefficient of roughness
r = Hydraulic radius in feet = cross sectional area of flow / wetted perimeter
s = Slope of energy gradient in feet per foot

Adjustments of pipe sizes as determined by the Manning Formula may be necessary due to hydraulic gradient considerations.

Other guidelines related to size and configuration of storm sewer pipe are as follows:

a) Minimum size of pipe to be used will be 15 inch (15") diameter where the distance between access openings is 50 feet (50') or less and 18 inch (18”) diameter where access openings exceed 50 feet (50').
b) Pipes will be designed for flows intercepted by the inlets.
c) Except where noted differently under Item a), the maximum length between access openings shall not exceed 400 feet (400') for pipe less than 54 inches (54”) in diameter or 800 feet (800') for pipes 54 inches (54") in diameter or greater. Access opening may be in the form of an inlet or manhole.
d) In general, there may not be a reduction in pipe size along the direction of flow.
e) In general, it is desirable that pipes 36 inches (36”) in diameter and larger not be taken through storm inlets.

f) Minimum cover for storm sewer pipe shall be 2 feet (2') from finish grade to the outside top of pipe, except where approved structural safeguards are provided when cover requirements cannot be met.
g) Minimum drainage easement widths shall be determined as follows:

Pipe Size	Easement Width
15" - 18"	10'
21" - 33"	15'
36" - 48"	20'
54" - 72"	24'

h) Storm sewers shall be designed to provide an average velocity when running full of not less than two and one-half feet per second.

104.2 – Storm Sewer Pipe Material. Pipe material acceptable for storm sewer construction with accompanying roughness coefficients are shown below:

Material	Manning "n"
Corrugated High Density Polyethylene Pipe (HDPE)	0.012
Reinforced Concrete Pipe (RCP)	0.013
Corrugated Metal Pipe (CMP)	0.024

104.3 – Closed Conduit Design Calculations. In general, design calculations are not required for submittal to the City of Senatobia unless requested. If requested, items required shall be as follows:

a) Pipe size determination design calculations
b) A copy of the drainage plan showing flow elevations and percent grades

SECTION 105 – OPEN CHANNEL SYSTEM

105.1 – Channel Size and Shape. Size of a channel shall primarily be established by the Manning Formula which may be expressed as:

$$Q = VA = \frac{1.49\, r^{2/3}\, s^{1/2}\, A}{n}$$

Definitions of the terms are given in Section 104.1.

General guidelines related to the size and shape of channels are as follows:

a) Channel bottom of widths greater than 10 feet shall be built with a minimum cross slope of 1 to 12.
b) Low flow sections should be considered in the design of the channels with large cross-sections.
c) Side slopes of channels shall be a function of channel material. Side slopes throughout the entire length of channel shall be stable.

d) Minimum easement widths shall be determined as follows:

Top Width of Channel	Easement Width
Less than 5 feet	10 feet
5 feet - 20 feet	10 feet greater than top width of channel with a minimum of 5 feet on one side
Greater than 20 feet	15 feet greater than top width of channel with a minimum of 5 feet on one side

105.2 – Channel Materials. Channel materials acceptable for open channel design with the accompanying roughness coefficients are shown below:

Material	n
Concrete, broom or float finish	0.015
Rip rap	0.035
Gabion	0.028

105.3 – Grass-Lined Channels. The design of grass lined channels may be performed by use of the Manning equation as described in Section 105.1. However, the value of the roughness coefficient, n, for grass lined channels varies greatly with type of grass, development of grass cover, depth of flow, shape of channel, and slope of channel. The roughness coefficient, n, is proportional to the product of the velocity and the hydraulic radius, (v x r).

Allowable velocities in grass-lined channels are considered to be dependent on the slope, vegetative cover, and the degree of erosion of the soils. Estimated K values for soils shall be obtained from the Soil Conservation Service with the U.S. Department of Agriculture.

The above characteristics shall be taken into consideration when designing grass-lined channels. In general, grass-lined channels shall be designed by the methods described in the U. S. Department of Transportation's latest publication, "Design of Roadside Drainage Canals". The methods basically consist of selecting a trial value of n from the charts and solving the Manning equation. The trial value, n, should be based on classification of vegetative cover to be used. If the resulting product of the velocity and hydraulic radius, v x r, correlate to the trial value of, n, selected from the charts, then the solution is correct. If the product, v x r, does not correlate, then another trial value of, n, is selected and the process is repeated.

General guidelines in the design of grass-lined channels are as follows:

a) Select channel size based on a condition of lower degree retardance. This condition will yield the highest velocity.
b) Check maximum permissible velocity against type of soil. Where grass-lined channels are used, the Engineer shall note on the plans “All grass-lined channels must be in a well-stabilized condition and show no sign of erosion at the time of final acceptance by the maintaining authority.”

105.4 – Channel Design Calculations. In general, design calculations are not required for submittal to the City of Senatobia unless requested. If requested, items required shall be as follows:

a) Channel size determination and capacity design calculations
b) A copy of the drainage plan showing flow elevations and percent grades

SECTION 106 – DRAINAGE APPURTENANCES

106.1 – General. Wherever possible, drainage appurtenances should be standard appurtenances as depicted in current Mississippi Department of Transportation roadway design standards. Any other drainage appurtenances shall be approved by the City of Senatobia.

106.2 – Curb and Gutter Inlets. Curb and gutter inlets shall be located in such a manner that the design curb flow does not exceed 75% of the curb capacity. No flow will be allowed to cross intersecting streets, unless approved by the City of Senatobia. Curb and gutter inlets shall preferably not be built within curb returns.

Preferably, curb and gutter inlets shall be MDOT SS-2 type "open-throat" inlets. Grated gutter inlets are not desirable. SS-2 inlet bottoms may be precast concrete or PVC drain basins, but all SS-2 inlet tops shall be cast-in-place. Curb and gutter inlets shall not be constructed of brick masonry.

106.3 – Yard Inlets/Surface Inlets. Yard and surface inlets should be positioned in such a way that they intercept all the design flow approaching the inlet. This can generally be accomplished by depressing the inlet and/or with use of an earth berm.

Yard and surface inlets shall be grated and may be of concrete and steel construction, precast concrete, or PVC drain basins. Yard and surface inlets shall not be constructed of brick masonry.

106.4 – Open Top Structures. Open top structures shall not be permitted.

106.5 – Energy Dissipation Devices. The terminal ends of all piped and paved channel storm sewer systems should be evaluated to be sure that the receiving surface will experience no erosion due to the design discharge. Where design discharges have velocities greater than the erosive velocity of the receiving surface, and energy dissipation device shall be designed or a standard energy dissipation device shall be specified.

106.6 – Drainage Design Calculations. In general, design calculations are not required for submittal to the City of Senatobia unless requested. If requested, items required shall be as follows:

a) Calculations showing that the gutter flow capacity is within the allowable range.
b) Evaluation of terminal end of piped and paved ditch systems for possible need of energy dissipation device.
c) A copy of the drainage plan showing both on-site and off-site acreage attributing to the runoff to each inlet.

SECTION 107 – CULVERTS

107.1 – Section Scope. This section shall cover the design of all roadway cross drains, pipe or concrete box culverts, designed to carry a flow of 100 cubic feet per second (cfs) or greater; however, it does not apply to streams with a defined floodway boundary.

107.2 – Design Flow. Culverts shall generally be designed for the 100-year rainfall frequency when crossing under primary roads, 25-year rainfall frequency when crossing under secondary roads, and 25-year rainfall frequency at other locations. Culverts should be checked for the effects of the 100-year storm. No flooding of building structures should result from the 100-year design flow.

107.3 – Culvert Size. Culverts experience two major types of flow: that is, flow with inlet control and flow with outlet control. Under outlet control, all of the culvert parameters including the headwater depth, type of inlet, cross sectional area, slope, roughness, length and tail water elevation influence the culvert capacity or size. However, under inlet control, the capacity of the entire culvert is limited by the capacity of the inlet and only the first three of the above parameters are of primary importance. The above items shall be taken into consideration when sizing culverts.

General guidelines in selection of culvert size are as follows:

a) Headwater depth for design discharge shall not exceed a height greater than one and one-half feet below the edge of the shoulder of a road.
b) In general, maximum allowable headwater above the crown of a culvert shall not be greater than five feet.
c) Headwater depth for the design discharge should not cause water to rise above the top of approach channels which are adjacent to improved land or above the established flood plain easements.
d) Headwater depth at design discharge shall cause no flooding of existing or proposed building structures.
e) Outlet velocities shall be calculated. If outlet velocities equal or exceed erosive velocities of channel lining, then rip rap or some other form of energy dissipation device should be placed at culvert outlet.

107.4 – Culvert Design Calculations. In general, design calculations are not required for submittal to the City of Senatobia unless requested. If requested, items required shall be as follows:

a) Calculations of flow for roadway culvert crossings.
b) Drainage area upstream of roadway culvert crossing outlined on a U.S.G.S. Quadrangle Map.
c) Calculations showing headwater depth which won't exceed a height greater than one and a half feet below the edge of the shoulder of the road.

SECTION 108 – BRIDGES

108.1 – Design Flow. All bridges (span of 20 feet or greater) shall be designed for the passage of a 25-year flood. Bridge backwater should be checked to insure that there is no increase in the 25-year flood heights.

108.2 – Hydraulic and Structural Design. Bridges are to be designed in accordance with the latest criteria and bridge design standard drawings of the Mississippi Department of Transportation Office of State Aid Road Construction.

Bridges shall be designed for the seismic category of Tate County, Mississippi.

108.3 – Bridge Design Calculations and Submittals. In general, design calculations required for submittal to the City of Senatobia are as follows:

a) Calculations of flow for the bridge crossing.
b) Drainage area upstream of roadway culvert crossing outlined on a U.S.G.S. Quadrangle Map.
c) Full bridge plans showing span arrangement and pile arrangement, complete with standard drawings. Bridge plans shall be prepared and sealed by a Professional Engineer registered in the State of Mississippi.

SECTION 109 – STORM DRAINAGE CONSTRUCTION

109.1 – General. All plans and specifications for storm drainage design and construction shall be prepared, signed, and sealed by a Professional Engineer registered in the State of Mississippi.

109.2 – Final Approval of Construction. The Engineer who has prepared the plans and specifications for storm drainage construction work in the City of Senatobia must certify that all work has been completed in accordance with the approved plans and specifications and submit a set of "as-built" plans to the City before final acceptance will be made by the City.

109.3.1 – Construction Requirements. Construction of storm drain systems, open channel or closed conduit, and drainage appurtenances shall follow the requirements of the following Sections of the "Mississippi Standard Specifications for State Aid Road and Bridge Construction, latest edition" (the Green Book):

Section S-200 – Earthwork
Section S-601 – Structural Concrete
Section S-602 – Reinforcing Steel
Section S-603 – Culverts and Storm Drains
Section S-604 – Manholes, Inlets and Catch Basins
Section S-800 – Bridges and Structures
Section S-815 – Rip Rap and Slope Paving

CHAPTER 2
SANITARY SEWER PLANNING, DESIGN, AND CONSTRUCTION

SECTION 201 – SANITARY SEWER PLANNING

201.1 – General. The overall planning of sanitary sewer systems should include the following information:

a) Area of service
b) Sanitary sewer flow pattern and quantity of flow
c) Portion of residential, commercial, or industrial flows to comprise projected growth
d) Unusual construction problems
e) Utility interruption problems
f) Erosion control during construction

SECTION 202 – SANITARY SEWER DESIGN CRITERIA AND STANDARDS

202.1 – Approval of Design. In general, the Mississippi Department of Environmental Quality, will approve the design for new systems for residential subdivisions, planned unit development, and other similar developments. New sanitary sewer systems that do not require MDEQ approval are to be submitted to the City of Senatobia for approval. All design documents shall bear the signature and seal of a Professional Engineer registered in the State of Mississippi.

202.2 – Design Capacity. In general, sewer capacities should be designed for the estimated ultimate tributary population, except in considering parts of the systems that can be readily increased in capacity. Similarly, consideration should be given to the maximum anticipated capacity of institutions, industrial parks, etc. Where future relief sewers are programmed, economic analysis of alternatives should accompany initial permit applications.

In determining the required capacities of sanitary sewers the following factors should be considered:

a) Maximum hourly domestic sewage flow
b) Additional maximum sewage or waste flow from industrial plants
c) Inflow and groundwater infiltration
d) Topography of area
e) Location of sewage treatment plant
f) Depth of excavation
g) Pumping requirements

The basis for design for all sewer projects shall accompany the plan documents. More detailed computations may be required by the appropriate reviewing agency for critical projects.

202.3 – Design Flow.

202.3.1 – Per Capita Flow. New sewer systems shall be designed on the basis of an average daily per capita flow of sewage of not less than 100 gallons per day (0.38 m^3/day). This figure is assumed to cover normal infiltration; but an additional allowance should be made where conditions are unfavorable.

For existing sewer systems an additional per capita allowance shall be made where the average annual flow exceeds this value and immediate remedial measures are not proposed.

202.3.2 – Peak Design Flow. Sanitary sewers shall be designed on a peak design flow basis using one of the following methods:

a) The ratio of peak to average daily flow recommended by MDEQ.
b) Values established from an infiltration/inflow study acceptable to the approving agency.

Use of other values for peak design flow will be considered if justified on the basis of extensive documentation.

202.4 – Design Criteria.

202.4.1 – Minimum Pipe Size. No gravity sewer conveying raw sewage shall be less than eight inches (8") (20 cm) in diameter.

202.4.2 – Depth. In general, sewers should be sufficiently deep to receive sewage from basements and to prevent freezing. Insulation shall be provided for sewers that cannot be placed at a depth sufficient to prevent freezing.

202.4.3 – Slope. All sewers shall be designed and constructed to give mean velocities, when flowing full, of not less than two feet per second (2 ft/sec)(0.61 m/s) based on Kutter's formula using an "n" value of 0.013. The following are the minimum slopes which should be provided; however, slopes greater than these are desirable:

Sewer Pipe Size	Minimum Slope in Feet Per 100 Feet (m/100 m)
8 inch (20 cm)	0.40
9 inch (23 cm)	0.33
10 inch (25 cm)	0.28
12 inch (30 cm)	0.22
14 inch (36 cm)	0.17
15 inch (38 cm)	0.15
16 inch (41 cm)	0.14
18 inch (46 cm)	0.12
21 inch (53 cm)	0.10
24 inch (61 cm)	0.08

27 inch (69 cm)	0.067
30 inch (76 cm)	0.058
36 inch (91 cm)	0.046

202.4.4 – Manholes.

202.4.4.1 – Location. Manholes shall be installed at the end of each line, at all changes in grade, pipe size, or alignment, at all intersections, and at distances not greater than four hundred feet (400').

202.4.4.2 – Drop Type. A drop type manhole shall be provided for a sewer pipe entering a manhole at an elevation twenty-four inches (24") or more above the manhole invert. For new construction, an outside drop will be required. For connection to an existing manhole, an inside drop will be required.

202.4.4.3 – Water Tightness. Manholes shall be precast concrete type. Manholes shall be water-proofed on the exterior. Inlet and outlet pipes shall be joined to the manhole with a gasketed flexible water-tight connection that will allow differential settlement of the pipe and manhole wall to take place.

202.4.5 – Sewer Taps and Cleanouts. Sewer service taps must be stubbed out above ground so they can easily be located. There shall be a two-way cleanout located at the property line and every 90 feet thereafter.

202.4.6 – Casings. Steel casings shall be required on sewer lines installed underneath creek and/or ditch flowlines and underneath State or Federal routes and highways. PVC casings shall be required on sewer lines installed underneath local routes.

202.4.7 – Policy on On-Site Wastewater Treatment and Disposal Systems. In order to address the severe grease problem the City of Senatobia has experienced within the sanitary sewer system, all plans for the construction or renovation of any type of establishment that sets forth to prepare and sell food products that produce any amount of grease must be presented to a committee (consisting of the Public Works Superintendent, Wastewater Treatment Operator, Building Inspector, and Mayor) for review and approval prior to commencement of construction or renovation.

Grease traps are generally made of pre-cast concrete, and are purchased completely assembled. However, very large units may be field constructed. Grease traps come in single- and double-compartment versions.

Grease traps are usually buried so as to intercept the building sewer. They must be level, located where they are easily accessible for cleaning, and close to the wastewater source. Where efficient removal of grease is very important, an improved two-chamber trap has been used which has a primary (or grease-separating) chamber and secondary (or grease-separating) chamber. By placing the trap as close as possible to the source of wastewaters, where the wastewaters are still

hot, the separating grease at the surface of the first chamber can be removed by means of an adjustable weir and conveyed to the separate secondary chamber, where it accumulates, cools, and solidifies. This decreases the requirement for cleaning and allows better grease separation in the first chamber.

The inlet, outlet, and baffle fittings are typically of "T" design with a vertical extension twelve (12) inches from the tank floor and reaching well above the water line.

To allow for proper maintenance, manholes to finished grade should be provided. The manhole covers should be of gas-tight construction and should be designed to withstand expected loads.

SECTION 203 – SEWER SYSTEM PLANS

203.1 – General. All plans for sewage works shall bear a suitable title. They shall show the scale in feet, a graphical scale, the north point, date, and the name of the Engineer, with his/her certificate number and imprint of his/her registration seal. A space should be provided for signature and/or approval stamp of the appropriate reviewing agencies.

The plans shall be clear and legible (suitable for scanning). They shall be drawn to a scale which will permit all necessary information to be plainly shown. Generally, the size of the plans should not be larger than 24 inches by 36 inches. Datum used should be indicated. Locations and logs of test borings, when made, shall be shown on the plans. Blueprints shall not be submitted.

Detail plans shall consist of: plan views, elevations, sections and supplementary views which, together with the specifications and general layouts, provide the working information for the contract and construction of the works. They shall also include: dimensions and relative elevations of structures, the location and outline form of equipment, location and size of piping, water levels, and ground elevations. Specifications shall accompany the plans.

Detail plans shall also include the location of all sanitary sewer pipes and structures in relationship to other utilities (including, but not limited to, water distribution, natural gas, fiber optic cable, phone cable, television cable, and storm drainage). A typical section showing the relationship between all planned utilities within the right-of-way corridor shall be required.

203.2 – Plans of Sewers.

203.2.1 – General Plan. A comprehensive plan of existing and proposed sewers shall be submitted for projects involving new sewer systems and substantial additions to existing systems. This plan shall show the following:

203.2.1.1 – Geographical Features.

a) Topography and elevations - Existing or proposed streets and all streams or water surfaces shall be clearly shown. Contour lines at suitable intervals should be included.

b) Streams - The direction of flow in all streams, and high and low water elevations of all water surfaces at sewer outlets and overflows shall be shown.
c) Boundaries – The area to be served by the sewer shall be shown.

203.2.1.2 – Sewers. The plan shall show the location, size, and direction of flow of all proposed sanitary sewers. The pipe size and direction of flow shall be shown where the proposed lines connect to the existing system.

203.2.2 – Detailed Plans. Detailed plans shall be submitted. Profiles should have a horizontal scale of not more than 100 feet to the inch and a vertical scale of not more than 10 feet to the inch. Plan views should be drawn to a corresponding horizontal scale and preferably be shown on the same sheet. Plans and profiles shall show:

a) Location of streets and sewers;
b) Line of ground surface; size, material and type of pipe; length between manholes; invert and surface elevation at each manhole; and grade of sewer between each two adjacent manholes (All manholes shall be numbered on the profile.);

   Where there is any question of the sewer being sufficiently deep to serve any residence, the elevation and location of the basement floor shall be plotted on the profile of the sewer which is to serve the house in question. The Engineer shall state that all sewers are sufficiently deep to serve adjacent basements except where otherwise noted on the plans.

c) Locations of all special features such as inverted siphons, concrete encasements, elevated sewers, pump stations, etc.;
d) All known existing structures and utilities, both above and below the ground, which might interfere with the proposed construction, particularly water mains, gas mains, storm drains, and telephone and power conduits; and
e) Special detail drawings, made to a scale to clearly show the nature of the design, shall be furnished to show the following particulars:
   i. All stream crossings and sewer outlets, with elevations of the stream bed and of normal and extreme high and low water levels;
   ii. Details of all special sewer joints and cross-sections.

SECTION 204 – SANITARY SEWER CONSTRUCTION

204.1 – Scope. The following construction specifications are set forth by the City of Senatobia for the installation of sanitary sewer mains and manholes and for extensions to the existing sewer collection system. All references to the City in these specifications shall mean the City of Senatobia. All work shall be in full compliance with "Recommended Standards for Wastewater Facilities", (Ten States Standards), 1990 Edition.

204.1.1 – General. The work to be performed shall consist of furnishing all labor, tools, equipment, and materials and performing all work necessary for, or incidental to, the completion of and making ready for operation the sanitary sewer collection facilities as depicted on the Construction Plans and specified herein.

204.1.2 – Standards. Any reference to a specification or designation of the American Society for Testing and Materials (ASTM), American Water Works Association (AWWA), American Standards Association (ASA), Commercial Standards (CS), National Sanitation Foundation (NSF), or other standards, codes, or orders refers to the most recent or latest specification or designation.

204.1.3 – Quality Control. The Contractor shall be responsible for providing quality control for all work and materials under the jurisdiction of the City of Senatobia. The Contractor shall provide a copy of test reports and a certification that all materials incorporated into the work comply with the Specifications set forth herein.

204.1.4 – Project Inspection. The Contractor shall allow access to the project site at all times to the Engineer and officials of the City for inspection of the project. The City's Engineer will inspect and test construction in progress of all public improvement projects.

204.1.5 – Final Approval of Construction. The Engineer who has prepared the Plans and Technical Specifications for sanitary sewer construction work in the City of Senatobia, must certify that all work has been completed in accordance with the approved Plans and Specifications and submit a set of "as-built" plans to the City before final acceptance will be made by the City.

When construction is completed in substantial conformity to the Construction Plans and the City has received the “as-builts” along with the design Engineer’s certification that work has been completed in accordance with the approved Plans, the City Engineer will recommend approval of the work to the City and advise the State regulatory agencies of project completion.

204.1.6 – Location of Sewer Mains. All sewer mains and manholes shall be located within a utility easement, or within the right-of-way of a street. Sewer mains and manholes shall not be installed until final grading of the line location has been completed.

204.1.7 – Maintenance of Traffic. Vehicular traffic shall be maintained on traveled roads and streets during construction of sewer mains, unless temporary closures are authorized by the City. A traffic control plan must be prepared by the Contractor and approved by the City Engineer prior to commencement of construction which will interfere with traffic.

204.1.8 – Protection and Repair of Property. Protection and repair of all property, including all expense, shall be the responsibility of the Contractor. The Contractor shall erect and maintain all necessary fences, barricades, lights and danger signals as necessary for the protection of the public. Buildings, trees, fences and other public properties not schedules for demolition shall be protected during construction.

204.2 – Materials. All materials shall be new. Technical data for all materials shall be submitted to the Director of Public Works and the City Engineer for approval prior to shipment of materials to the project site. All equipment and materials stored outdoors, prior to installation, must be placed on pallets, skids, runners, platforms, or other suitable supports at least six inches above ground. Materials shall conform to the following:

204.2.1 – Polyvinyl Chloride (PVC) Pipe. Polyvinyl Chloride (PVC) gravity sewer pipe and fittings shall be manufactured in accordance with ASTM Standard D-3034 and intended for use for sanitary and industrial wastes. All pipe shall be PVC Sewer Pipe with a wall thickness of SDR 26 and a pipe stiffness of 115 psi. Pipes shall have an integral bell and be joined with an elastomeric gasket in accordance with the manufacturer's recommendations. The pipe joint shall meet ASTM D-3212 for joints for drain and sewer pipes using flexible elastomeric seals, and the seals shall meet ASTM F-477 for elastomeric seals. All gaskets shall be factory installed and have a steel reinforcing ring.

Polyvinyl Chloride (PVC) force main sewer pipe shall meet the latest requirements of ASTM D-2241-80 (AWWA 23), rated at a pressure of 200 psi with a SDR of 21.

All fittings must be of the same material specification as pipe.

204.2.2 – Ductile Iron Pipe. Ductile Iron Pipe (DIP) shall conform to American National Standard ANSI A21.51-1976 (AWWA C151). The ductile iron pipe shall be designed for 350 psi working pressure for Laying Condition Type I and shall be ANSI Thickness Class 50. Rubber gasket joints shall meet all requirements of ANSI A21.11 (AWWA C111). All pipe shall have an inside lining of cement mortar conforming to ANSI A21.4, (AWWA C104). An equivalent enamel lining may be used in place of cement-mortar. All ductile iron pipe shall be of domestic manufacture and if requested, the manufacturer shall furnish the City with certified test certificates stating that all materials furnished are in accordance with the above specifications.

204.2.3 – Precast Reinforced Concrete Manholes. Precast reinforced concrete manhole sections shall be of the size designated on the Construction Plans, 48 inch diameter or 60 inch diameter, and shall conform to the latest edition of ASTM Designation C-478. The exterior of manholes shall be coated with a factory applied waterproof coating. All manhole sections shall have steps which are cast, mortared, or attached by mechanical means into the walls of the riser or conical top sections and which conform to the requirements of the Occupational Safety and Health Standards, U.S. Department of Labor. Design of the steps shall be in accordance with the latest edition of ASTM Designation C-478. Bottom sections of manholes shall be precast reinforced concrete sections or poured-in-place reinforced concrete.

Manhole rings and covers shall be cast iron and shall conform to ASTM Designation A-48, be suitable for heavy duty traffic, and shall be Memphis #7A, or approved equal.

204.2.4 – Casing Pipe. Steel casing pipe for highway and aerial crossings shall have the following minimum wall thicknesses:

Casing Diameter	Minimum Wall Thickness (inches)
2"	0.154
4"	0.156
6"	0.156
8"	0.188
10"	0.188
12" - 18"	0.250
20" - 24"	0.281
30" - 36"	0.375
42" - 48"	0.500

Steel casing pipe shall be new or in good condition and will conform to ASTM Specification A-252, Gr.2 or better. PVC casing pipe shall be Class 160 pressure pipe as a minimum.

204.2.5 – Tracer Wire. Tracer wire shall be AWG No. 12 solid copper wire.

204.2.6 – Pump Stations. Lift stations to be dedicated to the City of Senatobia shall consist of a precast wet well, duplex pumps, and pump enclosure.

204.2.6.1 – Wet Well. Wet wells for pump stations shall be precast concrete.

204.2.6.2 – Pumps. Pumps shall be factory built duplex pumps, as manufactured by the Gorman-Rupp Company, or approved equal.

204.2.6.3 – Pump Enclosure. Station enclosure shall be manufactured of molded reinforced orthophthalic polyester resins with a minimum of 30% fiberglass, and a maximum of 70% resin. Resin fillers or extenders shall not be used.

Chopped glass fibers of 1 1/4 inch average length shall be sprayed and rolled. Major design consideration shall be given to structural stability, corrosion resistance, and watertight integrity. The polyester laminates shall provide a balance of mechanical, chemical, and electrical properties to insure long life. They must be impervious to micro-organisms, mildew, mold, fungus, corrosive liquids, and gases which are expected to be present in the environment surrounding the wet well.

All interior surfaces of the housing shall be coated with a polyester resin-rich finish providing maintenance-free service, abrasion resistance, and protection from sewage, greases, oils, gasoline, and other common chemicals.

Outside surfaces of the enclosure shall be coated with gel-coat pigmented resin to insure long maintenance-free life and UV protection. Color used shall de-emphasize the presence of dirt, grease, etc.

204.3 – Installation.

204.3.1 – Excavation. Trenches shall be excavated in whatever material encountered to the line and grade as shown on the Construction Plans. The width shall be sufficient to properly join the pipe and provide thorough compaction of the bedding and backfill material under and around the pipe. This width should not exceed approximately 12 inches on either side of the pipe. The sides of the trench shall be as nearly vertical as feasible.

The bottom of the completed trench shall be firm for its full length and width and shall be carefully graded, formed and aligned before pipe is laid. The bottom of the trench shall be rounded under each joint of the pipe to conform to the shape of the pipe, and bell holes shall be cut so as to allow the body of the pipe uniform contact and support throughout its entire length.

204.3.2 – Sheeting, Bracing, and Shoring. The Contractor shall do all bracing, sheeting and shoring necessary to perform and protect all excavations as required for safety. Materials used for this purpose shall be carefully withdrawn during backfill operations in such a manner as not to damage the pipe or move it from its correct line and grade.

204.3.3 – Dewatering. The Contractor shall perform all pumping and well pointing necessary to maintain the excavation in a dry state until the backfill operation is complete.

204.3.4 – Bedding. Polyvinyl Chloride (PVC) pipe shall have Class B bedding as described by ASTM Designation C 12-82. Bedding material shall be well-graded clean granular material and shall meet definition of Class II material as defined in ASTM D 2321. The trench shall have bedding material for a depth of six (6) inches below the pipe and shall extend for a distance of 12 inches above the top of the pipe.

204.3.5 – Pipe Laying. The bottom of the trench shall be shaped to give substantially uniform circumferential support to the lower fourth of each pipe. Pipe laying shall proceed up-grade with the spigot ends of bell-and-spigot pipe pointing in the direction of the flow. Each pipe shall be laid true to line and grade and in such manner as to form a close concentric joint with the adjoining pipe and to prevent sudden offsets of the flow line. As the work progresses, the interior of the sewer shall be cleared of all dirt and superfluous materials of every description. Where cleaning after pipe laying is difficult because of small pipe size, a suitable swab or drag shall be kept in the pipe and pulled forward past each joint immediately after the jointing has been completed. If the maximum width of the trench at the top of the pipe, specified above, is exceeded for any reason, the Contractor shall install such concrete cradling, pipe encasement, or other bedding as may be required to satisfactorily support the added load of the backfill.

Trenches shall be kept free of water and pipe shall not be laid when the condition of the trench or the weather is unsuitable for such work. At times when work is not in progress, open ends of

pipe and fittings shall be securely and satisfactorily closed so that no trench water, earth, or other substance will enter the pipe or fittings.

Detectable Marking Tape shall be installed in the trench excavation approximately two (2) feet below the ground line. The tape shall be carefully installed in such a manner as to maintain an approximate constant location below the ground line. Backfill above the marking tape shall be made in such a manner as not to damage or move the tape from its position.

Tracer wire shall be required on all sewer service lines that run from manholes and/or sewer mains to building structures.

204.3.6 – Jointing. Pipe joints shall be made in accordance with the manufacturer's instructions and with special care to avoid breakage. All pipe lengths shall be placed on exact line and grade before pushing home the joint. Pipe shall be pushed home with a constant and even force and shall not be jarred home by the momentum of a moving force that will place a shock load on the pipe already in place. Cement and/or lubricant shall be used as recommended by the manufacturer.

204.3.7 – Manholes. Precast manhole sections without integral base sections shall be installed by supporting the first section of the barrel on brick or concrete block and then pouring the concrete base to assure embedding three (3) inches of the barrel in the concrete base. All precautions shall be taken to insure a watertight joint. Additional sections shall not be set until the base has reached its initial set. A fully watertight joint shall be constructed around the influent and effluent lines. Care shall be taken to insure vertical alignment of the precast barrel sections.

Manhole inverts shall be constructed true to line and grade. Where possible, inverts shall be constructed of half diameter pipe; otherwise, inverts shall be constructed of concrete with a smooth semicircular shape and shall conform to the adjacent sewer pipe. Where the top one-half (1/2) of existing sewer pipes are removed to form the manhole invert, the half diameter invert must extend the total width of the manhole. Changes in direction of flow shall be made with a smooth curve of as large a radius as the manhole size will permit. The floor of the manhole outside the channels shall be smooth and shall slope toward the channels at approximately three (3) inches horizontally to one (1) inch vertically. Manhole rings and covers shall be installed to the grade as shown by the Construction Plans or to that of the surrounding surface and shall be set and anchored in a bed of mortar.

204.3.8 – Backfilling. After the pipe has been laid and jointed as specified herein, Class B bedding as specified above shall be completed in accordance with ASTM Designation C 12-82. The bedding material shall be carefully compacted with hand tamps to a density of 94 percent of standard proctor. After bedding to spring-line of pipe, the remainder of the backfill shall be placed in lifts not to exceed 12 inches and shall consist of dry material, free of debris, organic material and large stones. The remainder of the backfill may be compacted with pneumatic or mechanical tamps in order to obtain a minimum density of 94 percent of standard proctor under areas to be paved, and 90 percent of standard proctor under all other areas.

After the trenches have been properly backfilled, excess dirt shall be windrowed over the trench to refill future settlement.

The material for backfill above the granular bedding, unless otherwise specified, may be excavation taken from trenches and shall be free from stones, broken concrete or asphalt larger than two (2) inches in diameter. It shall be free of all perishable and objectionable materials such as rubbish, forms, blocks, wire or other unsuitable material.

The Contractor shall be totally responsible for the condition of the trenches at all times prior to final acceptance. He shall make frequent inspections of the trenches and repair all settled areas as they occur. All soft or dangerous trenches shall be marked or barricaded and red-lighted at night for protection to the public.

204.3.9 – Street Pavement Repair. Pavement repair for city and country streets shall be performed by using compacted granular material for the full depth of the trench to within eight (8) inches of the top. Six (6) inches of crushed limestone shall be placed above the compacted backfill and then two (2) inches of hot mix asphalt shall be placed to match the existing street surface elevation.

204.3.10 – Driveway Repair. Asphalt driveways shall be repaired using compacted granular material for the full depth of the trench to within six inches of the top. Four (4) inches of crushed limestone shall be placed above the compacted backfill and then two (2) inches of hot mix asphalt shall be placed to match the existing driveway.

Concrete driveways shall be repaired using four (4) inches of concrete above the compacted trench backfill. Concrete shall be a 6 bag mix and shall attain a minimum compressive strength of 4,000 psi after 28 days. Concrete to be removed shall be saw cut or removed at existing slab joints.

204.3.11 – Pump Stations.

204.3.11.1 – Submittals. Prior to fabrication, pump station manufacturer shall submit five (5) copies of submittal data for review and approval.

Submittal shall include shop drawings, electrical ladder logic drawings, and support data as follows: Catalog cuts sheets reflecting characteristics for major items of equipment, materials of construction, major dimensions, motor and v-belt drive data, pump characteristic curves showing the design duty point capacity (GPM), head (FT), net positive suction head required (NPSHr), and hydraulic brake horsepower (BHP). Electrical components used in the motor branch and liquid level control shall be fully described.

Shop drawings shall provide layout of mechanical equipment and anchor bolt locations for station. Pipe penetrations and station access clearances shall be dimensioned relative to the station centerline. The electrical ladder logic drawings shall illustrate motor branch and liquid

level control circuits to extent necessary to validate function and integration of circuits to form a complete working system.

204.3.11.2 – Operation and Maintenance Manuals. Operation shall be in accordance with written instructions provided by the pump station manufacturer. Comprehensive instructions supplied at time of shipment shall enable personnel to properly operate and maintain all equipment supplied. Content and instructions shall assume operating personnel are familiar with pumps, motors, piping and valves, but lack experience on exact equipment supplied.

Documentation shall be specific to the pump station supplied and collated in functional sections. Each section shall combine to form a complete system manual covering all aspects of equipment supplied by the station manufacturer. Support data for any equipment supplied by others, even if mounted or included in overall station design, shall be provided by those supplying the equipment. Instructions shall include the following as a minimum:

a) Functional description of each major component, complete with operating instructions.
b) Instructions for operating pumps and pump controls in all modes of operation.
c) Calibration and adjustment of equipment for initial start-up, replacement of level control components, or as required for routine maintenance.
d) Support data for commercially available components not produced by the station manufacturer, but supplied in accordance with the specifications, shall be supported by literature from the prime manufacturer and incorporated as appendices.
e) Electrical schematic diagram of the pump station circuits shall be in accordance with NFPA 70. Schematics shall illustrate, to the extent of authorized repair, pump motor branch, control and alarm system circuits including interconnections. Wire numbers and legend symbols shall be shown. Schematic diagrams for individual components, not normally repairable by the station operator, need not be included. Details for such parts shall not be substituted for an overall system schematic. Partial schematics, block diagrams, and simplified schematics shall not be provided in lieu of an overall system diagram.
f) Mechanical layout drawing of the pump station and components, prepared in accordance with good commercial practice, shall provide installation dimensions and location of all pumps, motors, valves and piping.

Operation and maintenance instructions which rely on vendor cut-sheets and literature which include general configurations, or require operating personnel to selectively read portions of the manual shall not be acceptable. Operation and maintenance instructions must be specific to equipment supplied in accordance with these specifications.

204.3.11.3 – Pump Station Installation. Contractor shall off-load equipment at installation site using equipment of sufficient size and design to prevent injury or damage. Station manufacturer shall provide written instruction for proper handling. Immediately after off-loading, contractor shall inspect complete pump station and appurtenances for shipping damage or missing parts. Any damage or discrepancy shall be noted in written claim with shipper prior to accepting

delivery. Validate all station serial numbers and parts lists with shipping documentation. Notify the manufacturer's representative of any unacceptable conditions noted with shipper.

Install, level, align, and lubricate pump station as indicated on project drawings. Installation must be in accordance with written instructions supplied by the manufacturer at time of delivery.

Suction pipe connections are vacuum tight. Fasteners at all pipe connections must be tight. Install pipe with supports and thrust blocks to prevent strain and vibration on pump station piping. Install and secure all service lines (level control, air release valve or pump drain lines) as required in wet well.

Check motor and control data plates for compatibility to site voltage. Install and test the station ground prior to connecting line voltage to station control panel.

Prior to applying electrical power to any motors or control equipment, check all wiring for tight connection. Verify that protective devices (fuses and circuit breakers) conform to project design documents. Manually operate circuit breakers and switches to ensure operation without binding. Open all circuit breakers and disconnects before connecting utility power. Verify line voltage, phase sequence and ground before actual start-up.

After all anchor bolts, piping and control connections are installed, completely fill the grout dam in the pump station base with non-shrink grout.

204.3.11.4 – Pump Station Field Quality Control. Prior to acceptance by the City, an operational test of all pumps, drives, and control systems shall be conducted to determine if the installed equipment meets the purpose and intent of the specifications. Tests shall demonstrate that all equipment is electrically, mechanically, structurally, and otherwise acceptable; it is safe and in optimum working condition; and conforms to the specified operating characteristics.

After construction debris and foreign material haves been removed from the wet well, contractor shall supply clear water volume adequate to operate station through several pumping cycles. Observe and record operation of pumps, suction and discharge gage readings, ampere draw, pump controls, and liquid level controls. Check calibration of all instrumentation equipment, test manual control devices, and automatic control systems. Be alert to any undue noise, vibration or other operational problems.

Coordinate station start-up with manufacturer's technical representative. The representative or factory service technician will inspect the completed installation. He will calibrate and adjust instrumentation, correct or supervise correction of defects or malfunctions, and instruct operating personnel in proper operation and maintenance procedures.

204.4 – Testing. All gravity and force main sewer lines shall be tested with air and with water by the Contractor in the presence of the City Engineer or his representative.

204.4.1 – Horizontal and Vertical Displacement. Gravity sewer lines shall be thoroughly cleaned and checked for obstructions by pulling a mandrel through each line from manhole to manhole. The mandrel shall have a diameter of not less than two (2) inch less than the inside diameter of the pipe. Each line shall also be checked by mirrors and sunlight or by a light flashed between manholes. Any horizontal and/or vertical displacement, or any other defects observed, shall be repaired by the Contractor at his expense.

204.4.2 – Air Testing. Each line tested with air shall be inflated to 4.0 PSIG. The line will then be allowed to stabilize between 4.0 PSIG and 3.5 PSIG for a period of no less than 5 minutes. If necessary, air shall be added to the line to maintain the pressure above 3.5 PSIG. After the stabilization period, the supply valve shall be closed. At that time the line pressure shall be monitored by the "void" pressure gauge and the air supply gauge. When the line pressure drops to 3.5 PSIG, commence timing with a stopwatch. The stopwatch shall be allowed to run until such time as the line pressure drops to 2.5 PSIG. The watch shall then be stopped and the time lapse compared with the allowable time lapse as set forth in the chart below. If the time lapse is greater than that specified, the section undergoing the test will have passed, and the test may be discontinued. If the time is less than that specified, the line has not passed the test and the Contractor shall be required to repair the line at the Contractor's expense until the line passes the test.

The allowable time lapse is as follows:

AIR LEAKAGE CHART (MIN:SEC)

PIPE SIZE	MIN:SEC
4"	2:00
6"	3:00
8"	4:00
10"	5:00
12"	5:30
15"	7:30
16"	10:12
18"	11:34
20"	12:50

In the event that ground water is present, the line shall be pressurized to 4.0 PSIG in excess of the external hydrostatic head. The external head of hydrostatic pressure shall be determined by multiplying the head of water above the pipe by 0.433.

204.4.3 – Hydrostatic Water Test. A hydrostatic test with water shall be performed on each line. The leakage exfiltration or infiltration shall not exceed 200 gallons per inch of pipe diameter per mile per day for any section of the system. An exfiltration or infiltration test shall be performed with a minimum positive head of 2 feet.

204.4.4 – Video Inspection. Prior to final inspection and acceptance of the sanitary sewer system by the City, the Developer, Owner, or Subdivider shall, at his own expense, have a video inspection conducted on the sewer lines and provide a copy of this video inspection to the City Engineer.

204.5 – Connection to Existing Manhole(s). After completion of all testing, the new sanitary mains shall be connected to existing manhole(s) at the location(s) as shown on the Construction Plans. The existing manhole shall be core drilled and fitted with rubber boot connections. These connections shall be made water tight and new inverts shall be constructed to match the new tie-ins.

204.6 – Separation Between Water and Sewer Lines. It is essential to maintain adequate clearance between water supply and sewage lines. A minimum separation of ten (10) feet horizontally and/or eighteen (18) inches vertically below the water line shall be maintained. If such separation is not possible, special precautions, as directed by the City Engineer, shall be taken by the Contractor to prevent possible contamination of waterworks facilities.

Where sewer and water lines leave or enter a building, they must be at least five (5) feet apart.

204.7 – Erosion Control. Contractor shall be responsible for protecting adjacent properties and undisturbed areas from erosion and siltation by placement of temporary silt fence, temporary erosion checks (hay bales), and straw wattles during construction. Installation of these items shall be carried out per Section 200 of the "Mississippi Standard Specifications for State Aid Road and Bridge Construction, latest edition" (The Green Book).

Contractor shall be responsible for reestablishing vegetated cover on all disturbed areas by use of solid sodding and/or seeding and grassing. It shall also be the responsibility of the Contractor to maintain the solid sod and/or seeded areas in order to establish permanent grass growth.

CHAPTER 3
WATER DISTRIBUTION SYSTEM PLANNING, DESIGN, AND CONSTRUCTION

SECTION 301 – WATER DISTRIBUTION SYSTEM PLANNING AND DESIGN

301.1 – General. The planning and design for systems that will become a part of the City of Senatobia's water system shall comply with " Recommended Minimum Design Criteria for Mississippi Public Water Systems" prepared by the Division of Water Supply, Mississippi State Department of Health, Dated: August 2001.

301.2 – Use of Backflow Preventers. In the planning and design of water systems in the City of Senatobia, the use of approved back flow preventers will be addressed to prevent contamination of the City's system. A back flow preventer shall be used at the connection to the City's system for landscaping sprinkler systems, factory potable water systems, factory fire protection sprinkler systems, swimming pools, and connection to other facilities that present a potential contamination to the City's water supply.

SECTION 302 – WATER DISTRIBUTION PLANS

302.1 – General. All plans for water lines shall bear a suitable title. They shall show the scale in feet, a graphical scale, the north point, date, and the name of the Engineer, with his/her certificate number and imprint of his/her registration seal. A space should be provided for signature and/or approval stamp of the appropriate reviewing agencies.

The plans shall be clear and legible (suitable for scanning). They shall be drawn to a scale which will permit all necessary information to be plainly shown. Generally, the size of the plans should not be larger than 24 inches by 36 inches. Datum used should be indicated. Locations and logs of test borings, when made, shall be shown on the plans. Blueprints shall not be submitted.

Detail plans shall consist of: plan views, elevations, sections and supplementary views which, together with the specifications and general layouts, provide the working information for the contract and construction of the works. They shall also include: dimensions and relative elevations of structures, the location and outline form of equipment, location and size of piping, water levels, and ground elevations. Specifications shall accompany the plans.

Detail plans shall also include the location of all water distribution pipes and structures in relationship to other utilities (including, but not limited to, sanitary sewer, natural gas, fiber optic cable, phone cable, television cable, and storm drainage). A typical section showing the relationship between all planned utilities within the right-of-way corridor shall be required.

The water line plans shall be submitted to the Mississippi Department of Health prior to construction.

302.2 – Plans of Water Lines.

302.2.1 – General Plan. A comprehensive plan of existing and proposed water lines shall be submitted for projects involving new water lines and substantial additions to existing systems. This plan shall show the following:

302.2.1.1– Geographical Features.

a) Topography and elevations - Existing or proposed streets and all streams or water surfaces shall be clearly shown. Contour lines at suitable intervals should be included.
b) Streams - The direction of flow in all streams, and high and low water elevations of all water surfaces at sewer outlets and overflows shall be shown.
c) Boundaries – The area to be served by the sewer shall be shown.

302.2.1.2 – Water Lines. The plan shall show the location, size, and direction of flow of all proposed water lines. The line shall be shown where the proposed lines connect to the existing system.

302.2.2 – Detailed Plans. Detailed plans shall be submitted. Profiles should have a horizontal scale of not more than 100 feet to the inch and a vertical scale of not more than 10 feet to the inch. Plan views should be drawn to a corresponding horizontal scale and preferably be shown on the same sheet. Plans and profiles shall show:

a) Location of streets and water lines;
b) Line of ground surface; size, material and type of pipe;
c) All known existing structures and utilities, both above and below the ground, which might interfere with the proposed construction, particularly water mains, gas mains, storm drains, and telephone and power conduits; and

SECTION 303 – WATER LINE CONSTRUCTION

303.1 – Scope. The following construction specifications are set forth by the City of Senatobia for the installation of water lines and water distribution systems and for extensions to the existing water distribution system. All references to the City in these specifications shall mean the City of Senatobia.

303.1.1 – General. The work to be performed shall consist of furnishing all labor, tools, equipment, and materials and performing all work necessary for, or incidental to, the completion of and making ready for operation the water distribution facilities as depicted on the Construction Plans and specified herein.

303.1.2 – Standards. Any reference to a specification or designation of the American Society for Testing and Materials (ASTM), American Water Works Association (AWWA), American Standards Association (ASA), Commercial Standards (CS), National Sanitation Foundation

(NSF), or other standards, codes, or orders refers to the most recent or latest specification or designation.

303.1.3 – Quality Control. The Contractor shall be responsible for providing quality control for all work and materials under the jurisdiction of the City of Senatobia. The Contractor shall provide a copy of test reports and a certification that all materials incorporated into the work comply with the Specifications set forth herein.

303.1.4 – Project Inspection. The Contractor shall allow access to the project site at all times to the Engineer and officials of the City for inspection of the project. The City's Engineer will inspect and test construction in progress of all public improvement projects.

303.1.5 – Final Approval of Construction. The Engineer who has prepared the Plans and Technical Specifications for water distribution construction work in the City of Senatobia, must certify that all work has been completed in accordance with the approved Plans and Specifications and submit a set of "as-built" plans to the City before final acceptance will be made by the City.

When construction is completed in substantial conformity to the Construction Plans and the City has received the “as-builts” along with the design Engineer’s certification that work has been completed in accordance with the approved Plans, the City Engineer will recommend approval of the work to the City and advise the State regulatory agencies of project completion.

303.1.6 – Location of Water Mains. All water mains shall be located within a utility easement, or within the right-of-way of a street. Water mains shall not be installed until final grading of the line location has been completed.

303.1.7 – Location of Water Meters. Water meters shall be set as close to the property line as possible at the front of a residence and/or commercial building. Any other locations shall be approved by the Director of Public Works prior to installation.

303.1.8 – Maintenance of Traffic. Vehicular traffic shall be maintained on traveled roads and streets during construction of water mains, unless temporary closures are authorized by the City. A traffic control plan must be prepared by the Contractor and approved by the City Engineer prior to commencement of construction which will interfere with traffic.

303.1.9 – Protection and Repair of Property. Protection and repair of all property, including all expense, shall be the responsibility of the Contractor. The Contractor shall erect and maintain all necessary fences, barricades, lights and danger signals as necessary for the protection of the public. Buildings, trees, fences and other public properties not schedules for demolition shall be protected during construction.

303.2 – Materials. All materials shall be new. Technical data for all materials shall be submitted to the Director of Public Works and the City Engineer for approval prior to shipment of materials to the project site. All equipment and materials stored outdoors, prior to installation,

must be placed on pallets, skids, runners, platforms, or other suitable supports at least six inches above ground. Materials shall conform to the following:

303.2.1 – Polyvinyl Chloride (PVC) Pipe. All PVC water mains 4 inches and larger shall be C-900. PVC C-900 shall conform to AWWA Specification C-900 and have outside diameter (OD) dimensions of ductile iron pipe. Pipe with a pressure designation of 150 psi shall have DR Series 18 wall thickness and pipe with pressure designation of 200 psi shall have DR Series 14 wall thickness.

All PVC water mains 2 inches and smaller shall be Schedule 40. Schedule 40 PVC pipe shall conform to the United States Department of Commerce Standard No. CS207 Type 1. Class 200 and Class 160 PVC pipe shall have rubber gasket joints and shall conform to Commercial Standard CS256 for Type 1120 material made to SDR 21 dimensions for Class 200 or SDR 26 dimensions for Class 160. All pipe shall be belled end. All PVC pipe and fittings shall be approved by the National Sanitation Foundation and stamped with this approval.

303.2.2 – Ductile Iron Pipe. Ductile Iron Pipe (DIP) shall conform to American National Standard ANSI A21.51-1976 (AWWA C151). The ductile iron pipe shall be designed for 350 psi working pressure for Laying Condition Type I and shall be ANSI Thickness Class 50. Rubber gasket joints shall meet all requirements of ANSI A21.11 (AWWA C111). All pipe shall have an inside lining of cement mortar conforming to ANSI A21.4, (AWWA C104). An equivalent enamel lining may be used in place of cement-mortar. All ductile iron pipe shall be of domestic manufacture and if requested, the manufacturer shall furnish the City with certified test certificates stating that all materials furnished are in accordance with the above specifications.

303.2.3 – Pipe Fittings. All ductile iron and C-900 PVC pipe shall have ductile iron fittings. Class 200 and Class 160 PVC pipe four (4) inches in diameter and larger shall have ductile iron fittings. All PVC pipe 3" in diameter or smaller shall have Schedule 40 or Schedule 80 PVC fittings. All fittings, whether PVC or ductile iron shall be installed with “megalugs”.

303.2.3.1 – Ductile Iron Fittings. Ductile iron fittings shall be either push-on or mechanical joint fittings having a working pressure rating of 350 psi. Fittings shall be in accordance with all applicable requirements of ANSI/AWWA C110/A21.10 with the exception of the manufacturer's proprietary design dimensions. Joint components shall be in accordance with the requirements for push-on or mechanical joints in ANSI/AWWA C111/A21.11. Fittings shall be cement lined and seal coated with an asphaltic material in accordance with ANSI/AWWA C104/A21.4.

303.2.3.2 – Ductile Iron Compact Fittings. Ductile iron compact fittings may be mechanical joint or push-on joint. Mechanical joints shall meet the requirements of ANSI/AWWA C153/A21.53. Glands, bolts, nuts, and gaskets shall be in accordance with requirements of ANSI/AWWA C153/ A21.53. Push-on joint shall meet the requirements of ANSI/AWWA C111/A21.11. Fittings shall be cement lined and seal coated with an asphaltic material in accordance with ANSI/AWWA C104/A21.4.

303.2.3.3 – PVC Fittings. PVC fittings shall be Schedule 40 or Schedule 80 pressure fittings. Fittings shall have joints compatible with the type pipe joint required. All threaded fittings shall be Schedule 80. All PVC pipe fittings shall be approved by the National Sanitation Foundation and stamped with this approval.

303.2.4 – Polyethylene Service Tubing. Polyethylene service tubing shall be made of very high molecular weight (VHMW) pipe resin (PE 3408) and shall be copper tube size OD, SDR 9, and conform to ASTM D-2737. All tubing shall have pipe liners for use with compression connections. Polyethylene service tubing shall be Driscopipe 5100 Ultra-Line as manufactured by Phillips 66 Company, or approved equal.

303.2.5 – Casing Pipe. Steel casing pipe for highway and aerial crossings shall have the following minimum wall thicknesses:

Casing Diameter	Minimum Wall Thickness (inches)
2"	0.154
4"	0.156
6"	0.156
8"	0.188
10"	0.188
12" - 18"	0.250
20" - 24"	0.281
30" - 36"	0.375
42" - 48"	0.500

Steel casing pipe shall be new or in good condition and will conform to ASTM Specification A-252, Gr.2 or better. PVC casing pipe shall be Class 160 pressure pipe as a minimum.

303.2.6 – Gate Valves. All gate valves shall have end connections compatible for connection to the type of pipe specified. Valves shall be rated for zero leakage at 200 psi water working pressure and have a 400 psi hydrostatic test for structural soundness. Valves shall be furnished with "O" ring seals using two O-rings. All valves installed underground in standard valve boxes shall have a 2 inch square operating nuts and shall open left.

Gate valves four (4) inches and larger nominal diameter shall be resilient seated wedge type with non-rising stem, epoxy coated to AWWA C550, cast iron body design. These valves shall comply with AWWA Gate Valve Standard C-509 as latest revised, and shall be 3067-NRS as manufactured by the M & H Valve Company, or approved equal.

Gate valves two (2) inches, two and one half (2 1/2) inches and three (3) inches in nominal diameter shall be resilient seated wedge type with non-rising stem, epoxy coated to AWWA C-

550, cast iron body design. These valves shall comply with AWWA Gate Valve Standard C-509 as latest revised, and shall be as manufactured by the M & H Valve Company, or approved equal.

303.2.7 – Valve Boxes. All valve boxes for underground gate valves shall be cast iron, two piece, screw type, 5-1/4 inch shaft, Type 461-S as manufactured by the Tyler Company, or approved equal. The Contractor shall supply boxes with the correct base for all valves and in correct lengths for field conditions.

303.2.8 – Water Service Components.

303.2.8.1 – Corporation Stop. Corporation stops shall be as manufactured by A.Y. McDonald, or approved equal.

303.2.8.2 – Service Saddle. Service saddles shall be double strap bronze with outlet tapped with AWWA taper and designed for use on C-900 PVC pipe, as manufactured by J.C.M. or Smith Blair, or approved equal.

303.2.8.3 – Meter Box. Meter boxes shall be precast concrete body with cast iron lids conforming to AWWA Specifications and shall measure approximately 10 inches x 18 inches x 12 inches deep for 5/8"x3/4" and 1" meters. Box enclosures for 2 inch compound meters shall be precast concrete body with cast iron lid with measurements to adequately accommodate the meter. Meter boxes shall be Goddard #36 H-12", or approved equal.

303.2.8.4 – Water Meter. Water meters shall be positive displacement type with hermetically sealed registers and shall read in gallons. Standard meters shall be 5/8"x3/4", 1" or 1 1/2". All two- inch meters shall be compound meters with no bypass. The six-inch meter shall be manufactured by Master Meter, or approved equal.

City public works personnel, in most cases, will provide and install water meters. The providing and installing of water meters should be verified and confirmed during the planning phase of a project.

303.2.8.5 – Resetters. Resetters for 5/8"x3/4" meters shall be as manufactured by A.Y. McDonald, or approved equal, and shall have 7" riser height.

303.2.8.6 – Curb Stop. Curb stops shall be as manufactured by A.Y. McDonald, or approved equal.

303.2.9 – Fire Hydrant Assembly. Fire hydrants shall comply with AWWA Specification C-502 and shall be of the compression type, closing with the line pressure. The depth of bury shall be such that the "depth of bury" marking shall coincide with the existing ground line. Hydrants shall be furnished with a sealed oil reservoir located in the bonnet so that all threaded and bearing surfaces are lubricated when the hydrant is operated. The hydrant shoe shall have at least two drain outlets. Hydrants shall have a six inch shoe with type connection to be determined by

the type of pipe used. Hydrants shall be furnished with a breakable feature that will break cleanly upon impact and not allow the hydrant to flood when the barrel is broken. This shall consist of a two part breakable safety flange with a breakable stem coupling. Anchor tees will be required to anchor the tee to the fire hydrant valve. An anchor coupling shall be required between the valve and the fire hydrant. Hydrants shall have a 5 1/3" valve opening with two 2 1/2 inch hose nozzles and one 4 1/2 inch pumper nozzle, Clow F-2500, or approved equal. Main valves shall be replaceable without digging. Threading for all nozzles and connections shall be National Fire Underwriters Standard. All hydrants shall have a one inch, five sided bronze operating nut.

303.2.10 – Tapping Sleeve and Valve. Tapping sleeves and valves shall be as manufactured by J.C.M., or approved equal.

303.2.11 – Tracer Wire. Tracer wire shall be AWG No. 12 solid copper wire.

303.2.12 – Detection Tape. Detection tape shall be Allen Detectatape, or approved equal.

303.2.13 – Concrete for Thrust and Anchor Blocks. Concrete shall be 3000 psi mix conforming to ASTM Specification C94 composed of Portland cement, fine and coarse aggregate and water. Thrust blocks shall be constructed between the fitting and undisturbed soil with adequate density to prevent movement of the fitting under test pressure.

303.3 – Excavation. The Contractor shall perform all excavation of every description and of whatever substances encountered to the depth specified in the Construction Plans. The bottom of all trenches shall be carefully shaped, graded and aligned before any pipe is placed. All trenches shall be excavated to a depth to maintain minimum cover over the installed pipe as follows:

a) 36 inches for ordinary pipe laying conditions,
b) 36 inches under existing creeks, ditches, and other waterways with transition depths as required,
c) 18 inches for service lines,
d) Depth as indicated on the Construction Plans for road crossings and/or other locations as required by special conditions.

The width of the trench shall be of adequate size to provide room for making joints and to assure that the barrel of the pipe rests uniformly and in continuous contact with the supporting ground for its entire length.

When rock is encountered, the Contractor shall excavate to a depth at least four (4) inches below the required grade and backfill to grade with four (4) inches of sand cushion.

Pipe shall not be laid when water is in the trench. The Contractor shall not excavate more trench than can be pumped dry with the available pumping facilities.

A tolerance of 6 inches from the established grade may be permitted, when approved by the Engineer, if excessive breaks in alignment at the joints prevent proper installation of the pipe.

If the established grade conflicts with other utilities, the water line grade shall be changed to avoid the conflict.

Project site shall be within 90% of final grade before water lines are installed.

303.4 – Sheeting and Bracing. The Contractor shall furnish and place, to the satisfaction of the Engineer, such sheeting and bracing as may be required to support the sides of the trench and to protect the workmen and pipe or adjacent structures from injury by the sloughing or caving of the trenches. Approval of protective sheeting and bracing by the Engineer will not extend to the Engineer any liability for such protective measures which later prove defective. The sheeting and bracing may be removed as the trench is backfilled, or may be left in place when necessary to prevent damage. In the event the sheeting or bracing is left in place, it shall not extend nearer than 1 foot to the surface of the ground. In no case will extra compensation be allowed for furnishing, placing, or removing any sheeting and bracing. The cost of this work shall be included in the unit price bid for installing the pipe.

303.5 – Pipe Laying. Pipe, appurtenances, and fittings shall be laid to the alignment and at the locations as depicted on the Construction Plans or as directed by the Engineer. All pipe and fittings shall be handled with care in such a way as not to damage the pipe or lining. The inside of the bell and the outside of the spigot shall be cleaned before jointing. Each piece of pipe shall be inspected and swabbed if necessary to remove any foreign matter.

When laying pipe ceases for any period of time, the end of the pipe shall be securely closed to prevent the entrance of water, mud, animals or any other objectionable matter.

Poured-in-place concrete thrust blocks shall be installed at all fittings to prevent movement from hydrostatic pressure.

All pipe and fittings shall be joined in accordance with manufacturer's recommendations. Only those lubricants which are supplied or recommended by the manufacturer shall be used.

As soon as each joint of pipe is laid, it shall be backfilled and compacted to the springline of the pipe to provide stability and prevent further movement.

Tracer wire shall be required on all water service lines that run from water meters to building structures.

303.6 – Backfilling. Backfill of trenches shall be carefully performed to protect pipe, fittings, hydrants and appurtenances and to prevent excessive future settlement. Trenches shall be backfilled with fine, loose earth, free of large clods or stones, to a depth of 12 inches above the pipe and carefully compacted. The remainder of the backfill material shall then be placed and neatly windrowed above the trench. Trenches shall be refilled and dressed after sufficient drying time following each rain. Trenches on slopes which are too steep to hold compacted backfill during heavy rainfall must have additional protection using sandbags stacked in the trench, or other suitable methods.

Backfill in areas to be paved or under dirt or gravel traffic or pedestrian areas shall be compacted in layers not to exceed 8 inches until the trenches have been completely filled. Each layer shall be mechanically tamped to a density of 94 percent of standard proctor. Disposal of excess material shall be the responsibility of the Contractor.

303.7 – Setting Fittings, Valves, and Fire Hydrant Assemblies. All fittings, valves and fire hydrants shall be set at the locations and in the manner as depicted on the Construction Plans. Fittings for water lines four (4) inches in nominal diameter and larger shall be ductile iron fittings as specified herein. Valves and fire hydrants shall be set in a vertical position at 90 degrees to a horizontal plane. Valves shall be set in a poured-in-place concrete cradle; fire hydrants shall be backed with concrete as set forth above for fittings. An adequate amount of clean washed stone shall be set around the base of the fire hydrant to the bottom flange of the barrel to allow the hydrant to bleed through the drain holes without erosion of the soil or stoppage of the drain holes.

Meter boxes shall be set at the property line when the service tap is made.

Omissions or unsatisfactory installation of any of these items shall be corrected by the Contractor at no additional cost to the City.

303.8 – Street and Driveway Repair.

303.8.1 – Street Pavement Repair. Pavement repair for city and country streets shall be performed by using compacted granular material for the full depth of the trench to within eight (8) inches of the top. Six (6) inches of crushed limestone shall be placed above the compacted backfill and then two (2) inches of hot mix asphalt shall be placed to match the existing street surface elevation.

303.8.2 – Paved Driveway Repair. Asphalt driveways shall be repaired using compacted granular material for the full depth of the trench to within six inches of the top. Four (4) inches of crushed limestone shall be placed above the compacted backfill and then two (2) inches of hot mix asphalt shall be placed to match the existing driveway.

303.8.3 – Gravel Driveway Repair. After pipe laying, trench shall be backfilled as specified above to within six (6) inches of the top of the driveway surface. Six (6) inches of granular material shall then be placed above the compacted backfill.

303.9 – Encased Roadway Crossings. Where water mains cross paved roads, they shall be installed inside steel or PVC casing as directed by the City Engineer. The casing shall have an inside diameter large enough to accommodate the water main freely. Installation may be accomplished by wet or dry boring a hole, as approved by the governing agency, to receive the casing pipe and jacking through the road bed. Care shall be used to prevent damage to the road bed or surface and any repairs necessary as a result of the operation shall be the responsibility of the Contractor.

Upon completion of the installation of the casing, the carrier pipe shall be installed in the casing in such a manner as to avoid any undue stress or damage to the pipe or its coating. The carrier pipe shall be free of tension at all points in the casing.

303.10 – Detection Tape. A metallic detection tape shall be buried approximately 24 inches above the installed waterline. The tape shall be at least two (2) inches wide and colored a high visibility safety yellow and imprinted with the legend "Caution Buried Waterline Below" or "Buried Waterline". This tape must not be buried more than eighteen inches (18") below the surface of the ground.

303.11 – Tracer Wire. AWG No. 12 solid copper wire shall be wrapped around pipe in such a manner that allows one complete revolution of wrap, in every ten feet of pipe length. Wire shall be looped around the outside of all valve boxes and other appurtenances in such a manner that there is no interference with the operation of the appurtenances.

303.12 – Separation Between Water, Gas, and Sewer Lines. It is essential to maintain adequate clearance between water supply, gas supply and sewer lines. A minimum separation of five (5) feet horizontally is required between water and gas lines. Water and sewer lines require a minimum separation of ten (10) feet horizontally and eighteen (18) inches vertically with the sewer below the water line. If such separation is not possible, special precautions, as directed by the Engineer, shall be taken by the Contractor to prevent possible contamination of waterworks facilities.

Where sewer and water lines leave or enter a building, they must be at least five (5) feet apart.

303.13 – Hydrostatic Testing. Prior to final acceptance by the City, distribution lines must be tested for pressure and leakage in accordance with the requirements outlined below and on the following pages.

303.13.1 – Pressure Test.

303.13.1.1 – Test Pressure Restrictions.

a) A hydrostatic pressure of at least 1.5 times the working pressure of the section being tested shall be applied, and shall be based upon the elevation of the lowest point in the section.
b) The hydrostatic test pressure shall not be less than 1.25 times the working pressure of the highest point of the section under test.
c) Pressures specified in a) and b) above shall be corrected to the elevation at which the test gauge in installed.
d) The duration of the test shall be not less than two (2) hours.
e) Test pressures shall not vary more than $\pm$ 5 psi.
f) Test pressures shall not exceed pipe or thrust restraint designs.
g) Test pressures shall not exceed twice the rated pressure of valves or hydrants when these are used to isolate the test section.

h) Test pressures shall not exceed the rated pressure of the valves if resilient-seated butterfly valves are used in the section being tested.

303.13.1.2 – Pressurization. Each valved section of line shall be filled with water slowly and the specified test pressure as outlined in 303.13.1.1 above shall be applied by means of a pump connected to the pipe in a manner satisfactory to the City. Where possible, the connection should be made at the lowest point in the section under test.

303.13.1.3 – Air Removal. Before applying the specified test pressure, air shall be completely expelled from the pipe, valves, and hydrants. If permanent air relief valves are not located at the high points, the Contractor shall install corporation stops at such points, so that the air can be expelled as the line fills with water. After the air has been expelled, the corporation stops shall be closed and the pressure applied. At the conclusion of the pressure test, the corporation stops shall be removed and the holes plugged, or, at the discretion of the City they may be left in place.

303.13.1.4 – Examination. All exposed pipe, fittings, valves, hydrants, and joints shall be examined carefully during the test. Any damaged or defective pipe, fittings, valves, or hydrants that are discovered following the pressure test shall be repaired or replaced with sound material and the test repeated until it is satisfactory to the City.

U.S. GALLONS REQUIRED TO FILL PIPE IN LENGTHS SHOWN BELOW

NOMINAL DIAMETER	100 FOOT SECTION	1000 FOOT SECTION	NOMINAL DIAMETER	100 FOOT SECTION	1000 FOOT SECTION
2	16	160	16	1044	10,440
2 1/2	26	260	18	1322	13,220
3	37	370	20	1632	16,320
4	65	650	21	1799	17,990
6	147	1470	24	2350	32,500
8	261	2610	27	2974	29,740
10	408	4080	30	3672	36,720
12	588	5880	33	4443	44,430
14	800	8000	36	5288	52,880

*Quantities are based upon the nominal diameter of the pipe and will vary somewhat from actual quantities.

303.13.2 – Leakage Test. A leakage test should, and normally, will be conducted concurrently with the pressure test. Leakage is defined as the quantity of "make-up" water that must be injected in the newly laid pipe, or any valved section thereof, to maintain pressure within 5 psi of the specified test pressure after air in the pipeline has been expelled, and the pipe filled with water.

303.13.2.1 – Allowable Leakage. No pipe installation should be accepted if the leakage is greater than that determined by the following equation:

$$L = \frac{ND\%P}{7400}$$

Where:

L = Allowable leakage in gallons per hour
N = Number of joints in the length tested
D = Nominal diameter of the pipe in inches
P = Average test pressure during the test in pounds per square inch gage (psig.). This normally is 150 psig since most systems in Mississippi are designed for 80 psig working pressure. However, the test pressure may be more or less, depending upon the design pressure for the section being tested.

The length of the test should be sufficient to disclose any weak points in the line, but in no case should the length of the test be less than two (2) hours after the line has been brought to full test pressure. The following table provides information concerning allowable leakage for various types of pipe. This information is for pipe tested at 150 psig based upon the above formula.

ALLOWABLE LEAKAGE IN GALLONS PER HOUR AT 150 PSIG PRESSURE

DIAMETER (Inches)	PVC PIPE (1000 ft.)		DUCTILE IRON PIPE (1000 ft.)	
	20 Foot Joints	40 Foot Joints	18 Foot Joints	20 Foot Joints
2	.17	.08	.19	.17
2 1/2	.21	.10		
3	.25	.12	.28	.25
4	.33	.16	.37	.33
6	.50	.25	.55	.50
8	.66	.33	.74	.66
10	.83	.41	.92	.83
12	1.00	.49	1.10	1.00
14			1.29	1.13
16			1.47	1.16
18			1.66	1.50
20			1.84	1.60
21				
24			2.21	2.00
27				
30			2.76	2.50
33				
36			2.31	3.00

*Represents a leakage of 30 gpd per mile of pipe per inch of pipe diameter for pipe in 13 foot length.

When testing against closed, metal seated valves, an additional leakage per closed valve of 0.078 gallons per hour per inch of nominal diameter may be added to the above figures. When hydrants are in the test section, the test shall be made against the closed hydrant.

303.13.2.2 – Measurement of Water Used. Water which is introduced into the line to determine leakage shall be measured by use of a calibrated water meter. The meter must have the capability of accurately measuring the low flows which may be required to maintain the test pressure on the line. A displacement type meter with sweep hand should be used with the sweep hand representing not more than ten gallons.

303.13.2.3 – Acceptance. Acceptance shall be determined on the basis of allowable leakage. If any test of pipe laid discloses leakage greater than that shown in 303.13.2.1, the Contractor shall, at his own expense, locate and repair the defective material until the leakage is within the specified allowance. All visible leaks are to be repaired regardless of the amount of leakage.

303.13.3 – Record of Testing. The City Engineer or his authorized representative shall maintain a written record showing the results of testing for each section of line. The following information will be included as a minimum:

a) Name of owner, engineer, and contractor performing work.
b) Identification of the section being tested.
c) Date of the test.
d) Length of the section being tested and the nominal diameter of the pipe.
e) Test pressure in psig.
f) Duration of the test in hours.
g) Amount of water added during the leakage test in gallons.
h) Total number of leaks on the section being tested.
i) Date leaks were repaired.
j) Brand name of pipe used.
k) Pressure rating (SDR and psi).
l) A similar set of data for any section of line which is retested.

303.14 – Disinfection. After completion of installation and testing, the water lines shall be thoroughly flushed to remove dirt and foreign matter and be disinfected in accordance with AWWA C651-92, Continuous Feed Method.

When the pipes are disinfected, at least one sample of water shall be extracted from every dead-end line and every major looped line for examination by the Mississippi State Department of Health to determine whether the system is free of organisms of the Coli-Aerogenes group. Water samples will be collected by a representative of the Health Department, the Certified Operator for the Utility, or the Professional Engineer for the project. The results of these samples should indicate no coliform bacteria and should not show confluent growth. If the samples submitted contain such organisms, the piping shall be disinfected again and redisinfected, if necessary, until the system is free of organisms of the Coli-Aerogenes group.

All arrangements, materials and labor required for complete disinfection and testing of the system shall be furnished by the Contractor at no expense to the City.

CHAPTER 4
NATURAL GAS DISTRIBUTION SYSTEM PLANNING, DESIGN, AND CONSTRUCTION

SECTION 401 – NATURAL GAS SYSTEM PLANNING AND DESIGN

401.1 – General. The planning and design for systems that will become a part of the City of Senatobia's natural gas system shall comply with the latest edition of the Code of Federal Regulations 49 Department of Transportation 192 and the Mississippi Public Service Commission Regulations.

401.2 – Planning Requirements for Buildings. In order to keep a safe natural gas system, rules and regulations under pipeline safety, Southern Building Code and City Code must be abided by. The following are a few things that need to be pointed out:

a) All electric and natural gas lines shall be kept three (3) feet apart.
b) A natural gas riser must be kept three (3) feet from electrical service entrance.
c) A natural gas meter setup must be kept three (3) feet from air condition unit.
d) In crossing natural gas lines with electric lines, electric lines must be deepest with a minimum of twelve (12) inches between them.
e) When natural gas piping is stubbed out of a brick or block wall, it must have a PVC sleeve and the sleeve must be sealed.
f) When natural gas is stubbed from a building, pipe must be no less than one (1) inch.
g) Consumer's gas piping in building shall be black steel, schedule 40. If threaded joints are used, fitting must be of like material.
h) There shall be no bushings used in consumer's piping.
i) Every building piped for natural gas has to be pressure tested at 30 pounds for 10 minutes before any valves are installed or appliances hooked up. This test must be checked by the City Inspector who will issue a signed inspection ticket. If this inspection ticket is not completed, a meter will not be installed.
j) In the installation of a natural gas meter, the City is not responsible for piping from meter to building. The meter will have a connection joint on the outlet side for customer connection.

SECTION 402 – NATURAL GAS SYSTEM PLANS

402.1 – General. All plans for gas lines shall bear a suitable title that reflects the area of the project. They shall show the scale in feet, a graphical scale, the north point, date, and the name of the Engineer, with his/her certificate number and imprint of his/her seal. A space should be provided for the signature and/or approval stamp of the appropriate reviewing agencies.

The plans shall be clear and legible (suitable for scanning and copying). They shall be drawn to a scale (engineering scale) which will permit all necessary information to be plainly shown. The size of the plans shall be no larger than 24 inches by 36 inches. Datum used should be indicated.

Location and logs of soil test borings, when made, shall be shown on the plans. Location and logs of soil resistivity tests, when made, shall be shown on the plans.

Detail plans shall consist of: plan views, elevations, sections and supplementary views which, together with the specifications and general layouts, provide the working information for the contract and construction of the works. They shall also include: dimensions and relative elevations of structures, the location and outline form of equipment, location and size of existing and proposed piping, water levels and ground elevations. Specifications shall accompany the plans.

Detail plans shall also include the location of all natural gas lines and structures in relationship to other utilities (including, but not limited to, sanitary sewer, water distribution, fiber optic cable, phone cable, television cable, and storm drainage). A typical section showing the relationship between all planned utilities within the right-of-way corridor shall be required.

402.2 – Plans of Gas Distribution Lines.

402.2.1 – General Plan. A comprehensive plan of existing and proposed gas distribution lines shall be submitted for projects involving new gas distribution lines and substantial additions to existing systems. This plan shall show the following:

402.2.1.1 – Geographical Features.

a) Topography and elevations – Existing and or proposed streets, existing and or proposed gas easements, and all streams or water surfaces shall be clearly shown. Contour lines at suitable intervals should be included.
b) Streams – The direction of flow in all streams, and high water elevations of all water surfaces at points of proposed gas distribution line crossings shall be shown.
c) Boundaries – The area to be served by the gas distribution line shall be shown.

402.2.1.2 – Gas Distribution Lines. The plan shall show the location, size, type of material, pressure rating of valves and fittings, length and direction of flow of all proposed gas distribution lines. The plan shall exhibit the gas system Maximum Allowable Operating Pressure. The gas distribution line shall be shown where the proposed gas line(s) connect to the existing system along with materials that will be utilized to make connections and taps.

402.2.2 – Detailed Plans. Detailed plans shall be submitted. Profiles should have a horizontal scale of not more than 100 feet to the inch and vertical scale of not more than 10 feet to the inch. Plan views should be drawn to a corresponding horizontal scale and preferably be shown on the same sheet. Plans and profiles shall show:

a) Location of streets and gas distribution lines;
b) Line of ground surface; size, material and type pipe, fittings and valves;
c) All known existing structures and utilities, both above and below the ground, which might interfere with the proposed construction, particularly water mains, gas mains, storm drains, and telephone and power conduits;
d) Mississippi Department of Transportation right of way boundaries, center line of road way, edge of pavement and proposed gas distribution line crossing depth;
e) Railroad right of way boundaries, center line of railroad and proposed gas distribution line crossing depth.

SECTION 403 – NATURAL GAS SYSTEM CONSTRUCTION

403.1 – Scope. The following construction specifications are set forth by the City of Senatobia for the installation of gas distribution lines and gas distribution systems and for extensions to the existing gas distribution system. All references to the City in these specifications shall mean the City of Senatobia.

403.1.1 – General. The work to be performed shall consist of furnishing all labor, tools, equipment, and materials and performing all work necessary for, or incidental to, the completion of and making ready for operation the gas distribution facilities as depicted on the Construction Plans and specified herein.

403.1.2 – Gas Operator Qualification Training and Evaluating Program. Any Contractor installing natural gas systems within the City of Senatobia shall submit their Gas Operator Qualification Training and Evaluating Program to the Director of Public Works. Thereafter the program shall be reviewed by the gas operator or committee(s) representing the gas operator. This process shall be implemented to address critical issues or deficiencies in the contracting company(s) qualification process or the qualification of each covered task and the establishment of frequencies for re-qualification. The contracting company(s) shall provide an Operator Qualification Program that either equals or exceeds the gas operator's Operator Qualification Program. The Contractor's Operator Qualification Program must be accepted by the gas operator prior to the beginning of any work. The Operator Qualification Program shall communicate the following:

a) Written Statement/Communication of Statement
b) Covered Task List
c) Covered Task Performance Evaluation List
d) Operator Qualification Assessment List
e) Employee Matrix
f) Covered Task Employee Information Records
g) Covered Task Evaluation Methods Identification List

The submitted Operator Qualification Program shall communicate the following:

a) Duties described to perform - detailed description of how a specific covered task is performed through policy and procedure.
b) Abnormal operating conditions – detailed description of hazardous or unsafe conditions that may occur during the performance of the covered task.
c) Re-qualifications – through established re-qualification frequencies, post incident and accident re-qualification, and observed poor performance.
d) Communication of changes – changes to the program involving technology, duties, equipment, procedures, and policies that would affect the training and qualification of personnel performing a specific task.

The Contractor shall supply the Director of Public Works with his/her drug testing program for all workers who will be working on the project site. This will be kept by the Director of Public Works in the event that inspectors from the Public Service Commission visit the project site and request to view the program.

403.1.3 – Standards. Any reference to a specification or designation of the American Society for Testing and Materials (ASTM), American National Standards Institute (ANSI), Mississippi Department of Transportation (MDOT), Mississippi Public Service Commission (MPSC), or other standards, codes, or orders refers to the most recent or latest specification or designation.

403.1.4 – Permits. Before construction begins, approved permits shall be included with the construction plans. Permit types that may be needed are:

a) MDOT Highway Crossing Permit
b) MPSC Construction Notification Permit
c) Railroad Crossing Permit
d) Mississippi Department of Environmental Quality (MDEQ) Permit.

403.1.5 – Quality Control. The Contractor shall be responsible for providing quality control for all work and materials under the jurisdiction of the City of Senatobia. The Contractor shall provide a copy of test reports and a certification that all materials incorporated into the work comply with the Specifications set forth herein.

403.1.6 – Project Inspection. The Contractor shall allow access to the project site at all times to the Engineer and officials of the City for inspection of the project. The City's Engineer will inspect and test construction in progress of all public improvement projects.

403.1.7 – Final Approval of Construction. The Engineer who has prepared the Plans and Technical Specifications for gas distribution construction work in the City of Senatobia must provide as-built plans that reflect location of new facilities. The locations that are provided shall utilize street center lines for physical descriptions to give an x and y coordinate location, along with new construction depth of cover. All valves and fittings shall be reflected on the as-built plans, along with location information. The as-built plans shall be provided to the City of

Senatobia so that a final approval review can be performed. If necessary, a field review will be made with the Contractor to inspect the final installation of work.

403.1.8 – Location of Natural Gas Lines. All gas lines shall be located within a utility easement, or within the right-of-way of a street. Gas lines shall not be installed until final grading of the line location has been completed.

403.1.9 – Maintenance of Traffic. Vehicular traffic shall be maintained on traveled roads and streets during installation of gas lines, unless temporary closures are authorized by the City. A traffic control plan must be prepared by the Contractor and approved by the City Engineer prior to commencement of construction which will interfere with traffic.

403.1.10 – Protection and Repair of Property. Protection and repair of all property, including all expense, shall be the responsibility of the Contractor. The Contractor shall erect and maintain all necessary fences, barricades, lights and danger signals as necessary for the protection of the public. Buildings, trees, fences and other public properties not schedules for demolition shall be protected during construction.

403.2 – Materials. All materials used in the work shall be new, firstline products of domestic manufacturers experienced in the natural gas industry. Material suppliers shall submit a written certification to the Director of Public Works and the City Engineer that all materials meet the specifications set forth herein below. In addition, all materials shall meet the requirements of "Parts 191 and 192, Transportation of Natural Gas By Pipeline, Minimum Federal Safety Standards, Title 49 of the Code of Federal Regulations" and the following specifications:

403.2.1 – Steel Pipe. All steel pipe 2 inch through 4 inch diameter shall be Schedule 80 manufactured in accordance with API 5L, Grade A, B or A25 standard, continuous weld, electric resistance or seamless with a minimum yield strength of at least 28,000 psi. Pipe shall be furnished in double random lengths, plain ends, and beveled 30 degrees for welding. Unless otherwise shown on plans, minimum wall thickness for distribution pressures shall be as specified.

Manufacture by the continuous-butt welded process is acceptable on pipe sizes through 4 inch. Previously used steel pipe shall not be installed in any capacity of new construction and is not permitted. Steel pipe shall be of domestic origin. Each joint shall have been hydrostatically tested and shall bear the stamp of the manufacturer.

403.2.1.1 – Pipe Coating. All steel pipe shall have a factory applied, fusion bonded epoxy coating with a minimum thickness of 7 mills. An epoxy coating equivalent to the specifications of Trenton Wax – Innercoat for Girth Welds shall be hand-applied and encircle all welded joints and fittings in order to protect the pipe, fittings and joints from corrosion.

403.2.1.2 – Fittings. Steel pipe field bends are not permitted. Extra-strong (schedule 80), long radius, seamless welded fittings such as, but not limited to, elbows, 45 degree bends, tees, reducers and flanges are to be used for all directional changes.

403.2.1.3 – Welding Electrodes. Electrodes shall be stored in a dry heated area and shall be kept free of moisture or dampness. Electrodes that have lost part of their coating shall be discarded. Contractor shall submit mill reports and certifications with applicable specifications with each segment of pipe to the City Engineer. Contractor shall submit a list of all welders who work on this project with the identifying code for each welder and a copy of the welder's current certification of qualification to meet the requirements of this Section as certified by a testing laboratory acceptable to the City Engineer. All work performed by the Contractor shall meet the applicable published standards including, but not limited to (1) DOT Title 49, CFR Part 192, Transportation of Natural and Other Gas by Pipeline: Minimum Federal Safety Standards (2) ASME B31.8, Gas Transmission and Distribution Piping Systems, and (3) API Std. 1104, Standard for Welding Pipelines and Related Facilities.

403.2.2 – Polyethylene Plastic Pipe, Tubing, and Fittings. All plastic pipe and fittings shall be PE3408., SDR11 High Density Polyethylene Tubing which meets ASTM Specification D 1248. All components of the plastic piping system shall meet the requirements of ASTM Specification D 2513.

Socket-type polyethylene fittings shall meet ASTM D 2683. Butt heat fusion polyethylene fittings shall meet ASTM D 3261. All plastic pipe and fittings shall have a wall thickness equal to or greater than Standard Dimension Ratio (SDR) 11.

All polyethylene plastic gas pipe shall be as manufactured by Plexco, Phillips 66, or approved equal, and shall be a member of Plastic Pipe Institute of America.

All pipe shall be manufactured of virgin material, with the exception of the clean rework material that is generated from the manufacture's own production, as long as the pipe and/or fittings meet the required specifications. All pipe formulation must have suitable outdoor weather resistance. The color of all polyethylene pipe shall be either yellow or black.

All pipe shall be designed for direct burial as specified in D.O.T. Title 49, Part 192, "Transportation of Natural and Other Gas By Pipeline: Minimum Federal Safety Standards," through current Amendment, for natural gas mains and services operated at 60 p.s.i.g. or less. The pipe must be homogeneous and be free of holes, cracks, foreign material, blisters or other deleterious faults. The minimum design stress must comply with the requirements of ASTM D-2513.

403.2.2.1 – Pipe Size. The pipe shall be designated and pressure rated to conform to the requirements in ASTM D-2513. The minimum wall thickness for distribution pressures shall be as follows:

Size	O.D.	S.D.R.	Minimum Wall Thickness
½"	0.840	9.3	0.090
¾"	1.050	11.0	0.095
1"	1.315	11.0	0.119
1-1/4"	1.660	11.0	0.151
1-1/2"	1.900	11.0	0.173
2"	2.375	11.0	0.216
3"	3.500	11.5	0.307
4"	4.500	11.5	0.395
6"	6.625	11.5	0.581

Any pipe that has defects such as a groove, notch, or gouge shall not be used.

403.2.3 – Connection to Existing Gas Line(s). The connection assembly shall consist of a Shortstop 3-way, full encirclement tee "300D", temporary valve, TOR Fitting, and plugging apparatus, as manufactured by T.D. Williamson, or approved equal.

403.2.4 – Control Valves for Steel Pipe. Control valves shall be ball valves, full-port weld end, permanently lubricated with stainless steel ball and stem. Valves shall be carbon steel and meet API-6D specifications with a built-in locking device. They shall be Broen "Ballomax" (for underground installation) or approved equal, equipped with a 2 inch square head adapter and for use with natural gas, 0.6 specific gravity. Valves shall be ANSI Class 300 and installed as depicted on the Contract Drawings.

403.2.5 – Shut-off Valve for Plastic Pipe. Shut-off valves used in the plastic piping system shall comply with ANSI B16.40 and be manufactured of the same material as the pipe used to ensure fusion compatibility. Valves shall be installed as depicted on the Contract Drawings.

403.2.6 – Excess Flow Valve. Excess flow valves are to be installed in-line on all service lines 3/4" and larger and shall comply with USDOT regulation 49CFR Part 192.383 and shall be equivalent as manufactured by Powell Flow Limiters by Perfection Corporation and molded from ASTM D-2513 listed, gas grade, medium density PE 2406 and high density PE 3408 polyethylene materials or equal. All valves shall be installed in permasert couplings with a pull-out strength greater than the connected polyethylene tubing as per manufacturer's specifications for size of line, pressure, flow, trip and reset.

403.2.7 – Valve Boxes. Valve boxes shall be placed over all underground valves. Boxes shall be constructed of cast iron and shall be Mueller H-10360, Clow F2450, or approved equal, and shall be equipped with covers marked "GAS". Box extension lengths shall be fitted to trench depths. Box shall be self-adjusting, and have a 6" shaft with an arch base.

403.2.8 – Valve Markers. Valve markers in paved areas shall be two-way yellow high performance raised pavement markers meeting the Office of State Aid Road Construction S-627 specification.

Valve markers in unpaved areas shall be yellow flexible, fiberglass reinforced composite which are ultraviolet and temperature stable, as manufactured by ACP, Carsonite, or approved equal. Markers shall be 72 inch in length and shall be labeled "GAS VALVE".

403.2.9 – Pipeline Markers. Markers shall be installed to mark the gas pipeline at locations as shown on the contract drawings including anode test stations or wherever it is necessary to identify the location of the pipeline to reduce the possibility of damage or interference.

Markers shall be 72 inches long composite pipeline markers, ACP flexible, Carsonite CUM-375, Sentry Posts, or pre-approved equal shall be used. Each sign must have the following printed legibly on a background of sharply contrasting color:

a) The word "WARNING:" followed by the words "Natural Gas Pipeline" with a letter height of at least 1-inch and a ¼-inch wide stroke.
b) The name "Senatobia Gas System" followed by "Call 662-562-8288 or 8956, 662-562-5643 or 4434, or 911". The Contractor shall verify the telephone number before manufacturing signs.

Pipeline markers shall be submitted to the Senatobia Gas Department for approval before ordering for the project.

After the pipeline installation has been completed, the Contractor shall install markers at the locations designated by the Director of Public Works. Bury the anchor end of all markers approximately two (2) feet deep.

403.2.10 – Tracer Wire for PE Pipe. A tracer wire shall be placed in the ditch with the gas pipe. Tracer wire shall be a minimum of 14 gauge copper with insulation suitable for direct burial. Proposed procedures for tying wire together at each end shall be submitted by the Contractor to the Public Works Director for approval.

Tracer wire shall be required on all gas service lines that run from gas mains to building structures.

403.2.11 – Tracer Tape. A metallic tracer tape shall be buried above all underground steel and plastic gas pipe. The tape shall be at least two (2) inches wide and colored a high visibility safety yellow and imprinted with the legend "Caution Buried Gas Line Below" or "Buried Gas Line." This tape must not be buried more than eighteen (18") inches below the surface of the ground. The tape shall be Allen Detectatape or approved equal.

403.2.12 – Service Taps. Service taps shall be as manufactured by Invensys, or approved equal, and made by a self-tapping tee that also acts as a positive shut-off at the main. The base of the tapping tee shall be designed for heat fusion to polyethylene pipe and a socket end branch

connection for heat fusion to the service line pipe. The heat fusion base and socket must be manufactured from the same material as the pipe. Service taps shall be submitted to the Director of Public Works for approval prior to installation.

403.2.13 – Service Riser. Service riser shall be one (1) inch IPS prefabricated, anodeless, epoxy coated Schedule 40 steel with one (1) inch IPS polyethylene transition. Riser shall be 24-inch vertical by 36-inch.

403.2.14 – Pipe Bedding Material. Pipe bedding material used by the Contractor in areas where natural materials are unsatisfactory shall be Standard Size No. 8 granular material meeting the requirements of ASTM D 448 (AASHTO M-43) specification. This specification requires that 85%-100% of the material pass the 3/8-inch sieve and not more than 5% of the material pass the No. 16 sieve.

403.2.15 – Select Backfill Material. Select backfill material used by the Contractor in areas where natural material is unsatisfactory shall be sand clay topping (Class 7, 8, 9, or 10) meeting the requirements of Sections 304 and 703 of the latest edition of the Mississippi Standard Specifications for State Aid Road and Bridge Construction.

403.2.16 – Pavement Repair Materials. All pavement repair materials including granular base, bituminous base, and asphaltic or portland cement concrete paving materials shall meet the requirements of the latest edition of the Mississippi Standard Specifications for State Aid Road and Bridge Construction. Unless otherwise approved by the City Engineer, all pavement repair materials shall be secured from pretested stockpiles approved by the MDOT.

403.3 – Gas System Installation. All gas system facilities shall be installed by skilled workmen experienced in the type of work required by these specifications and the Contract Drawings. All work shall meet the requirements of the Minimum Federal Safety Standards, OSHA and the gas pipeline industry.

403.3.1 – Excavation. The contractor shall perform all excavation of every description and of whatever substances encountered to the depth specified in the Contract Drawings. The bottom of all trenches shall be carefully shaped, graded, and aligned before any pipe is placed. Care shall be taken not to excavate below the depth specified. However, in the event excessive excavation shall occur, the bottom of the trench shall be filled back to grade with approved material and thoroughly compacted. All trenches shall be excavated to a minimum depth of 36 inches for ordinary conditions.

Holes of ample size shall be cut under and around all joints and fittings to provide adequate room for making joints and to assure that the barrel of the pipe rests uniformly and in continuous contract with the supporting ground for its entire length.

When rock is encountered, the Contractor shall excavate to a depth at least four (4) inches below the required grade and backfill to grade with four (4) inches of sand cushion.

Pipe shall not be laid when water is in the trench. The Contractor shall not excavate more trench than can be pumped dry with available pumping facilities.

A tolerance of six (6) inches from the established grade may be permitted if excessive breaks in alignment at the joints prevent proper installation of the pipe. If the established grade conflicts with other utilities the gas line grade shall be changed to avoid the conflict as directed by the Director of Public Works.

403.3.2 – Sheeting and Bracing. The Contractor shall furnish and place such sheeting and bracing as may be required to support the sides of the trench and to protect the workmen and pipe or adjacent structures from injury by the sloughing or caving of the trenches. This sheeting and bracing may be removed as the trench is backfilled, or may be left in place when necessary to prevent to prevent damage. In the event the sheeting or bracing is left in place, it shall not extend nearer than one (1) foot to the surface of the ground.

403.3.3 – Pipe Laying and Handling. The Contractor shall employ only workmen who are skilled in the handling, jointing and installation of the materials required by these specifications and the Contract Drawings. Qualifications of welders shall be in accordance with the requirements of the "Minimum Federal Safety Standards" and the following sections of these specifications.

The Contractor shall inspect each length of pipe, each fitting and all other components of the gas system at the site of installation (and prior to installation) to ensure that it has not sustained visually determinable damage that could impair its serviceability. Any damaged gas system components shall be rejected and immediately removed from the job site.
Pipe, fittings, and appurtenances shall be laid to the line and grade established on the Contract Drawings. As stated earlier in these specifications, there shall be a minimum cover of thirty-six (36) inches over all subsurface piping. The bed for the piping shall be shaped by either trimming the bottom of the trench or by placing selected excavated earth (free of clods, rock, or other deleterious material) in the bottom of the trench and tamping so that each piece of pipe has a uniform firm support.

The inside of all pipe and fittings shall be thoroughly swabbed to ensure that they are clean and free of obstructions and foreign matter until the work is completed. When pipe laying ceases at the end of the day or for any cause, the end of the pipe shall be securely closed to prevent the entrance of water, mud, or other objectionable matter. Plastic pipe shall be snaked in the trench in accordance with the manufacturers' instructions.

When pipe must be cut to install valves, fittings or other appurtenances, such work shall be performed by the Contractor. When pipe is cut, the ends shall be thoroughly reamed to remove all burrs.

All underground gas system piping shall be installed with at least twelve (12) inches of clearance from any other subsurface utilities or underground obstructions. If this clearance cannot be attained the Contractor shall take special precautions, as directed by the Director of Public

Works, to protect the gas piping. All plastic gas piping shall be thoroughly insulated from any source of heat that could impair service ability of the pipe.

Prior to joining, all individual gas main lengths shall be swabbed. All gas mains shall be pigged prior to initiation of gas service, but after joining has been complete. The pigs used shall be suitable for different size pipes and be designed for the type pipe being pigged. Any pig which could damage the pipe, such as wire brush type pigs, shall not be acceptable for use. Only use of compressed air to drive the pig through the pipe shall be permitted.

403.3.4 – Preparation and Installation of Steel Pipe. Prior to any welding, the Contractor shall inspect the pipe for gouges, grooves, dents, excessive scale, split ends, inherent manufacturing defects, transportation damage, bevel or end damage or any other damage to the pipe. Contractor shall inform the Director of Public Works of any damage noticed. The Public Works Director shall review for approval any acceptable repair procedure of any damage to the pipe. The surfaces to be welded shall be smooth, uniform and free of any material that may be detrimental to the weld. The cleaning of the surfaces shall produce a bright metal.

The pipe ends shall be properly aligned using a lineup clamp which does not damage the pipe or coating. Misalignments shall be corrected by first rotating the pipe to obtain a satisfactory fit and then by a minimum amount of hammering. In no circumstances shall a pipe be sprung or jacked into position to correct the misalignment. Misalignments shall not exceed 1/16 of an inch.

Beveling of the pipe ends in the field shall be done by machine tool and machine oxygen cutting. The beveled ends shall be smooth and uniform and shall meet the dimension requirements of API 5LX. If it is required to cut the pipe prior to forming beveled ends, care shall be taken to ensure the cut is at a right angle to the longitudinal axis.

403.3.4.1 – Welding. Contractor shall present the Director of Public Works with his/her welding qualifications and procedures according to API 1104 prior to beginning welding operations.

The lineup clamp may be released prior to completing the root bead if movement of the pipe and undue stress is avoided upon release of the clamp and at least fifty percent (50%) of the circumference of the pipe has been welded with beads of approximately equal length and spacing around the pipe. All scale, slag or other welding imperfections shall be removed from each weld with power tools prior to commencing the next layer of welding. The finished weld shall be at least flush with, but not more than 1/16 of an inch above the parent metal surface. The width of the finished weld shall be approximately 1/8 of an inch wider than the width of the original groove. Each welder shall identify his work by marking the pipe adjacent to the weld with a nondestructive, easily identifiable marking. No welding shall be done if weather conditions are unsatisfactory and would impair the quality of welds. Use of wind and rain guards or shelters may be allowed with approval of the Director of Public Works. A suitable cover shall be provided for the open end of welded pipeline segments at the end of each day's work.

403.3.4.2 – Defective Welds. All welded joints shall be tested for 100% penetration and defects via x-ray. All welds around fittings shall be tested by magnaflux blacklights. Welds not meeting the quality requirements of API 1104 must be repaired or removed. The welding defect shall be completely removed down to clean metal and all slag or scale removed. The segment to be repaired shall be properly preheated prior to the repair. If the repair is not acceptable to the Director of Public Works, the weld must be removed. A weld that has a crack longer than eight percent (8%) of the weld length or that penetrates the root bead must be removed.

403.3.4.3 – Coating Inspection. Prior to lowering the pipe in the ditch, Contractor shall inspect the pipe coating and make any repairs which are required. Contractor shall provide adequate labor and holiday detection equipment to check the coating immediately prior to lowering the pipe in the ditch. Holiday detection shall be performed according to the applicable NACE Standard with the appropriate amount of impressed voltage. Any defects in the coating shall be immediately repaired.

403.3.4.4 – Lowering Pipe in Ditch. The Director of Public Works shall be informed reasonably in advance of the commencement of the lowering of any pipe in the ditch. No pipe shall be lowered in the ditch until the Director of Public Works has had an opportunity to make an inspection of the external coating of the pipe and the condition of the ditch bottom. The pipe shall be lowered by such means that do not damage the pipe or external coating and provides for an adequate amount of slack in the pipeline as a whole. The lowered pipe shall fit and conform to the contour of the ditch. All side bends shall press firmly against the outer wall of the ditch. Contractor shall use sackcrete or other suitable material to provide adequate support for the pipe at severe turns and at tie-ins of fabricated assemblies. Crossties shall not be used for the required permanent support or be left in the ditch upon backfill. The pipe shall not be forced into place and any excess slack in the pipeline shall be removed by cutting out the required amount of pipe and rewelding the resulting two ends together.

403.3.4.5 – Backfilling. Backfilling shall be performed in such a manner to prevent damage to the external coating of the pipe from the impact of the backfill material. The pipe shall be surrounded and the ditch filled to a depth of six inches (6) above the top of the pipe with well consolidated fine material free from stones, rocks, hard clods or other hard objects. No scrap metal, welding rods or other foreign debris shall be backfilled into the pipe ditch.

403.3.4.6 – Swabbing and Pigging. All mains will be swabbed in individual length prior to welding. After welding and prior to initiation of gas service, all gas mains shall be pigged using pigs suitable for the different pipe sizes. Compressed air only shall be used to drive the pig through the pipe.

403.3.4.7 – Gouges, Grooves, Dents, and Arc Burn. Gouges and grooves shall be removed by cutting out the damaged portion of the pipe as a cylinder or by grinding, provided the grinding does not reduce the nominal wall thickness of the pipe by more than ten percent (10%). Arc burns shall be repaired under the same criteria as gouges and grooves except that in repairing by grinding, the entire arc burn shall be removed and after removal, swabbed with a solution of

ammonium persulfate to indicate complete removal of the metallurgical notch created from the arc burn.

Dents shall be removed from the pipeline by cutting out the damaged portion of the pipe as a cylinder if the dent contains scratch, gouge, groove or arc burn, affects any longitudinal or circumferential welds or is of a greater depth than ¼ of an inch.

403.3.5 – Heat Fusion Welding of Plastic Pipe and Fittings. All polyethylene plastic pipe and fittings shall be joined by heat fusion welding. Heat fusion welding of polyethylene plastic pipe and fittings shall be performed in strict conformity with the requirements of Subpart F, Part 192, Title 49 of the Code of Federal Regulations. All fusion welding shall be performed in accordance with written procedures that have been proven by test or experience to produce strong gas tight joints. The Contractor shall furnish the Public Works Director with copies of the written procedures for approval.

All workmen who perform fusion welding shall be experienced in the work and shall be qualified by training and testing in accordance with the requirements of said Subpart F. The Contractor shall furnish the Public Works Director with a certificate from a major manufacturer of polyethylene gas pipe (or an approved testing firm) certifying that each workman performing heat fusion welding has been qualified for the work in accordance with the requirements of Subpart F within the past six (6) months.

Only persons qualified under 49 CFR 192.285 shall be allowed to join plastic pipe. Persons installing or repairing the natural gas distribution system shall undergo drug testing in accordance with DOT and HSUD requirements.

The Contractor shall inspect such fusion weld to ensure compliance with the requirements of Subpart F.

403.3.6 – Directional Bores. Directional bores shall be installed at the locations and to the depths and clearances as shown on the Contract Drawings. This work shall be performed by workmen who are experienced in this type of construction.

403.3.7 – Control Valves and Fittings. Control valves, valve boxes, and other fittings shall be installed as shown on the Contract Drawings. Valves shall be set plumb on concrete pads, and valve boxes shall be carefully centered over the valves. Tops of valve boxes shall be set flush with the finished grade and the cover shall be leveled with concrete pads. Backfill shall be carefully compacted around all valve boxes and concrete pads.

The Contractor shall take particular care in installing valves on plastic pipelines. These valves shall be installed in such a manner as to protect the plastic material against excessive torsional or shearing loads when the valve is opened and from any other secondary stresses that might be exerted through the valve or the valve box.

403.3.8 – Backfilling Trenches. Backfilling shall be carefully performed and the original surface restored to equal or better than existed before excavation. The trenches shall be backfilled with select natural material from the excavation consisting of fine, loose earth, free from large clods or stones, carefully compacted until enough has been placed to provide a cover of not less than one (1) foot above the pipe.

The remainder of the backfill material in open, unpaved areas shall be placed in successive loose layers not to exceed twelve (12) inches and tamped to a density at least 85% of Standard Proctor density at optimum moisture content as measured by AASHO T-99. The backfill shall be wetted or dried as necessary to maintain optimum moisture content. Whenever the trenches have not been properly filled, or if settlement occurs, they shall be refilled, smoothed off, and made to conform to the surface of the ground.

Backfill in areas to be paved shall be made, as above specified, except that fill above pipes shall be deposited in layers not to exceed six (6) inches. Such fill shall be compacted with mechanical tampers so that, when completed, the compacted soil shall have a density of at least 95% of maximum density at optimum moisture content as measured by AASHO T-99. Each six (6) inch layer of backfill material shall be wetted or dried to bring it to optimum moisture contents.

When the backfill material is restored to a level one (1) foot below the finished grade over plastic gas pipe, it shall be leveled off and the metallic tracer tape shall be installed. The tracer tape shall be at least one (1) foot above the plastic gas pipe at all times.

403.3.9 – Pavement Repairs. After the trench or structures excavation has been backfilled and thoroughly compacted to within eight (8) inches of finished street grade, the Contractor shall place eight (8) inches of limestone rock and sand base course material in the excavation in two (2) four (4) inch layers and compact the material in accordance with Section 309 of the latest edition of the Mississippi Standard Specifications for State Aid Road and Bridge Construction.

The Contractor shall maintain the base course at finished street grade for thirty (30) days (or until such shorter time as the City Engineer may specify) by adding limestone as necessary to maintain the street in a smooth condition. At the end of the thirty (30) day period, the required depth of the base course material shall be cut out and replaced with Portland Cement concrete pavement or hot bituminous pavement installed and compacted in accordance with the requirements of Section 403 of the latest edition of the Mississippi Standard Specifications for State Aid Road and Bridge Construction.

All concrete pavement repair, including sidewalks, curbs, gutters, and related structures, shall be performed in accordance with the latest edition of the Mississippi Standard Specifications for State Aid Road and Bridge Construction.

403.4 – Cathodic Protection. This section covers the installation of packaged magnesium anodes for cathodic protection of underground steel pipe installations to obtain a minimum pipe to soil potential at all sections of the line of -0.85 volts.

403.4.1 – Submittals. Submit three (3) copies of complete descriptive data for anodes to the Director of Public Works.

403.4.2 – Materials. Anodes shall weigh 17 pounds and be packaged in a chemical backfill consisting of 75% gypsum, 20% bentonite, and 5% sodium sulfate. The metal in the anode shall have a maximum copper content of 0.05%. Extra lead wire required shall be similar to the wire attached to the anode and shall in no event be less than No. 12 type TW wire. A flush mounted "Fink" test station shall be installed to house the leads.

403.4.3 – Installation. Anodes shall be installed in holes at a depth to insure permanent moisture and in all cases shall be a minimum of six feet. The test lead shall be attached to the main by the alumino-thermite welding process using aluminum powder and copper oxide provided the charge is limited to #15 (15 gram) cartridges. Remove weld slag and verify that connection is sound. Other methods of brazing are prohibited. The test station shall be placed in a protected location away from vehicular traffic and shall rest on a solid foundation with the top extending approximately three (3) inches above ground level.

Should it become necessary to use additional lead wire, No. 12 type TW wire shall be used. The splice shall be made with a 3M direct bury splice kit. Anodes should never be handled by the lead wire. A fiberglass insulating spacer shall be used when crossing foreign utility lines.

403.4.4 – Field Quality Control. All nodes shall be tested with a criteria of acceptability based on achieving a potential difference of -0.85 volts (pipe to soil). The Contractor shall perform the testing of all anodes to be witnessed by the Public Works Director. Shop drawings showing anode location and initial pipe to soil voltage shall be furnished by the Contractor.

All underground piping shall be electrically inspected for coating voids prior to lowering into trench. Wrapping defects shall be repaired immediately and retested. The Contractor shall furnish the labor and equipment required to conduct this test. Spot checking will be periodically conducted by the Public Works Director with the cooperation of the Contractor.

403.5 – Delivery, Storage, and Handling.

403.5.1 – Steel Pipe. Particular care shall be taken during pipe stringing operation, throwing lengths of coated and wrapped pipe off the truck will not be permitted. Protect pipe ends from damage and prevent foreign matter from entering pipe. Any pipe or coating damage beyond repair in the Public Works Director's opinion shall be rejected and removed from the project site immediately.

403.5.2 – Polyethylene Pipe. In shipping, delivering, and installing, pipe and accessories shall be handled in such a manner as to insure a sound undamaged condition. Care shall be exercised in order to avoid rough handling. The pipe and accessories shall not be dropped or have any objects dropped upon them, nor shall they be pushed or pulled over sharp projections. Caution shall be taken to prevent kinking and buckling. Any damage, including kinks and buckles which occur shall be removed by cutting out as a cylinder and replacing at the cost of the Contractor.

403.6 – Testing. All gas system facilities installed under this contract shall be pressure tested in the presence of the City Engineer or his designated representative. The purpose of pressure testing is to locate and repair all leaks. To the extent possible, all facilities installed shall be tested as a complete system (including line valves, fittings, and appurtenances) prior to connecting the new facilities to the existing system. In the event of leakage, the Contractor may, at his expense, subdivide the new system into small segments for testing and locating leaks, subject to approval by the City Engineer.

The Contractor shall test all gas mains at 1.5 times maximum allowable operating pressure or 450 p.s.i.g. air and show that the lines are leak free, prior to the initiation of gas service. The gas main shall be subject to the required pressure for a period of 24 hours. A pressure chart shall be completed of the test. The location of the project along with the temperature at the time the test pressure is placed upon the pipe shall be recorded on the chart. The pressure chart shall report the time of day a gauge reading was taken, along with the gauge reading itself. Each day's work shall be tied into the preceding day's work and tested overnight. A pressure-time gauge in good working order shall be furnished by the Contractor. All testing shall comply with D.O.T. Title 49, Part 192, Transportation of Natural and Other Gas By Pipeline: Minimum Federal Safety Standards.

The pressure charts shall be given to the City Engineer on a daily basis. In order to facilitate daily testing, appropriate testing apparatus shall be used. Leaks shall be repaired in a manner approved by the City Engineer, before additional lengths of pipe that need to be tested are added to the main.

The Contractor shall locate and repair all leaks discovered during the pressure testing process. The system shall be tested and retested as necessary to deliver to the City a leak free system.

403.7 – Purging of Gas Line. All new gas system facilities installed under this contract shall be purged of air before they are put into service. Purging operations shall be in accordance with Part 192 of the Minimum Federal Safety Standards.

The air may be safety displaced by introducing a moderately rapid and continuous flow of natural gas through one end of the piping system and venting through the other end. The flow of natural gas should be continued without interruption until the vented gas, as tested with a combustible gas indicator, is completely free of air. The vent shall then be closed.

Whenever possible, a "squeegee" type pig or a slug of inert gas should be used to separate the natural gas and air and thus to minimize the possibility of an explosive mixture. If the natural gas cannot be supplied in a moderately rapid and continuous flow sufficient to prevent formation of a hazardous mixture of gas and air, physical separation of the natural gas and air shall be required.

403.8 – Erosion Control. Contractor shall be responsible for protecting adjacent properties and undisturbed areas from erosion and siltation by placement of temporary silt fence, temporary erosion checks (hay bales), and straw wattles during construction. Installation of these items

shall be carried out per Section 200 of the "Mississippi Standard Specifications for State Aid Road and Bridge Construction, latest edition" (The Green Book).

Contractor shall be responsible for reestablishing vegetated cover on all disturbed areas by use of solid sodding and/or seeding and grassing. It shall also be the responsibility of the Contractor to maintain the solid sod and/or seeded areas in order to establish permanent grass growth.

CHAPTER 5
RIGHT-OF-WAY CORRIDOR PLANNING, DESIGN, AND CONSTRUCTION

SECTION 501 – RIGHT-OF-WAY CORRIDOR ELEMENTS

501.1 – Description. As it pertains to this manual, a right-of-way corridor is made up of the following elements:

a) Street or roadway surface
b) Curb and gutter
c) Driveway aprons
d) Green space behind the curb
e) Sidewalk
f) Traffic signs
g) Traffic stripe

In any development, where any one of the above elements will be constructed by a land owner and/or developer, and the right-of-way dedicated to the City of Senatobia for public use and maintenance, the planning and construction of said elements will be required to be in compliance with this Chapter.

These technical specifications are to be used as a guide for street and sidewalk construction in the City of Senatobia. All plans and specifications must be prepared, signed, and sealed by a Professional Engineer registered in the State of Mississippi.

501.2 – Final Approval of Construction. The Engineer who has prepared the plans and specifications for street and sidewalk construction work in the City of Senatobia must certify that all work has been completed in accordance with the approved plans and specifications and submit a set of "as-built" plans to the City before final acceptance will be made by the City.

SECTION 502 – RIGHT-OF-WAY CORRIDOR ELEMENTS PLANNING AND DESIGN

502.1 – General. Design and planning of right-of-way corridor elements within the limits of the City of Senatobia shall be in compliance with applicable sections of the following publications:

a) Mississippi Standard Specifications for State Aid Road and Bridge Construction, latest edition ("the Green Book")
b) Mississippi Department of Transportation Roadway Design Manual, latest edition
c) Mississippi Department of Transportation Access Management Manual, latest edition
d) Public Right-of-Way Accessibility Guidelines (PROWAG), latest edition
e) City of Senatobia Subdivision Ordinance

502.2 – Street Plan. The location and width of all highways, thoroughfares, streets, and roads shall conform to the comprehensive plan, zoning ordinance and descriptions herein.

The proposed street system shall be laid out according to good land planning principles and practices for the type of development proposed and shall be coordinated with the street systems of the surrounding areas. All streets must provide for the continuation or appropriate projection of principal streets in the surrounding area and provide a reasonable means of ingress and egress for surrounding acreage tracts. The proposed street system shall also be laid out according to existing topography to reduce the amount of site grading and removing of existing vegetation.

All developments that border on any arterial street or major highway shall provide a design so that the minimum number of ingress/egress points are required to access it.

502.2.1 – Street and Right-of-Way Widths. Proposed street and right-of-way widths shall be as follows:

Street Classification	R.O.W. Width	Street Width (face-of-curb to face-of-curb)
Arterial	80-foot min.	48-feet
Collector	60-foot min.	40-feet
Minor	50-foot min.	30-feet
Cul-de-sac	50-foot min.	30-feet
Cul-de-sac turnaround	50-foot radius min.	40-foot radius
Alley	20-foot min.	16-feet

502.2.2 – Street Alignment. Street alignment shall be designed to eliminate sharp curves and street jogs.

Tangents of at least 100 feet will be required between reverse curves.

Street intersections with centerline offsets of less than 125 feet will not be permitted.

Street intersections will be as nearly at right angles as possible, with no intersection at an angle of less than 60 degrees.

Curb line radii at street intersections shall be at least 20 feet. Curb radii of streets or driveways feeding into highways and arterial streets shall have a radius of not less than 25 feet.

502.2.3 – Dead End Streets. Cul-de-sac streets or courts designed to have one end permanently closed shall be no more than 400 feet long.

For other dead end streets, or streets that will be extended in the future, a paved temporary turnaround with no curb and gutter will be required.

Streets should be connected where possible, and dead end streets should be avoided where possible.

502.2.4 – Street Grades. Street grades of minor streets shall comply with good engineering practice and shall not exceed ten (10) percent or be less than one-half of one (0.5) percent. Street

grades for arterial streets shall not exceed five (5) percent. Street profile shall not change more than three (3) percent per 100 feet.

Grades approaching intersections shall not exceed five (5) percent for a distance of not less than 100 feet from the centerline of said intersecting roads.

502.2.5 – Street Base Material. Base material for streets and roadways shall be one of the following:

a) Clay gravel, Class 4 Group B: twelve (12) inches compacted thickness
b) Crushed limestone: eight (8) inches compacted thickness
c) Cement-treated granular material, Class 9 Group D: eight (8) inches with the top six (6) inches cement-treated

502.2.6 – Street Pavement. Wearing surface for streets and roadways shall be composed of three (3) inches of hot mix asphalt, either 12.5-mm or 9.5-mm, placed in two (2) one and a half (1-1/2) inch lifts.

502.3 – Concrete Combination Curb and Gutter. Curb and gutter shall be required on all streets and roadways. Curb and gutter shall be 6-24 type with barrier curb.

502.4 – Driveway Aprons. Driveway aprons on the right-of-way shall be hard surfaced (asphalt or concrete). If the driveway is in a location where curb and gutter and/or sidewalks are planned or existing, the driveway shall be concrete.

When adding a driveway apron to an existing curb-and-gutter street section, the entire curb and gutter section shall be removed to construct the concrete driveway apron. Breaking the curb or sawing off the curb and leaving the gutter to construct a driveway apron will shall not be acceptable.

502.5 – Green Space Behind Curb. There shall be a green "buffer" area in between the back of the curb and concrete sidewalks, if sidewalks are required. The green "buffer" area shall be at a minimum two (2) feet in width.

All streets shall be graded to a minimum line extending seven (7) feet from the back of the curb, with a minimum rise of not less than eight (8) inches, and a maximum of not more than fifteen (15) inches from the flow line of the gutter, unless the topography is such as to make this requirement prohibitive.

502.6 – Concrete Sidewalk. Sidewalks shall be required along both sides of an arterial street. Along other lesser streets, sidewalks shall be required on at least one side.

Sidewalks shall be at least five (5) feet in width and four (4) inches thickness.

All sidewalks on the public right-of-way shall meet accessibility guidelines as outlined in the *Public Right-of-Way Accessibility Guidelines (PROWAG)* as published by the U.S. Access Board. Curb-cut ramps with truncated domes shall be required on all sidewalks at street intersections.

502.7 – Traffic Signs. Traffic signs shall be of the size, shape, and designation as required by the Manual on Uniform Traffic Control Devices (MUTCD), latest edition, and their placement location shall be guided by the MUTCD.

All traffic signs shall have reflectorized, encapsulated lens sheeting. All traffic signs shall be installed with the bottom of the lowest sign seven (7) feet from the top of the back of curb.

502.8 – Traffic Stripe. All traffic stripe shall be thermoplastic material.

Centerline stripe shall be four (4) inches wide.

Stop lines shall be required at all intersections with a "stop" condition, and shall be twenty-four (24) inches wide on arterial streets and twelve (12) inches wide on lesser streets.

Crosswalks shall be required at all intersections where sidewalks create a pedestrian path on either side of the street. Crosswalks shall be five (5) feet in width and their placement shall be guided by the MUTCD.

SECTION 503 – ROAD AND STREET PLANS

503.1 – General. All plans for roads and streets shall bear a suitable title. They shall show the scale in feet, a graphical scale, the north point, date, and the name of the Engineer, with his/her certificate number and imprint of his/her registration seal. A space should be provided for signature and/or approval stamp of the appropriate reviewing agencies.

The plans shall be clear and legible (suitable for scanning). They shall be drawn to a scale which will permit all necessary information to be plainly shown. Generally, the size of the plans should not be larger than 24 inches by 36 inches. Datum used should be indicated. Locations and logs of test borings, when made, shall be shown on the plans. Blueprints shall not be submitted.

503.2 – Plan Requirements. Road and street plans submitted shall include the following:

a) Topography and elevations – existing and/or proposed streets and all streams or ditch crossings, with direction of flow noted, shall be shown. Contour lines at one (1) foot intervals should be included.
b) Plan and profile views – profiles should have a horizontal scale of not more than 1 inch = 100 feet and a vertical scale of not more than 1 inch = 10 feet. Plan views should be drawn to the corresponding horizontal scale and be shown on the same sheet. Plan and profile sheets shall show:

i. Vertical curve data and percent grades between vertical curves
ii. Existing and proposed centerline elevations at vertical scale intervals
iii. Elevations of proposed stream or ditch crossing with high water elevations
iv. All known existing structures and utilities, both above ground and below the ground, which might interfere with the proposed construction, particularly water mains, gas mains, storm drains, and telephone and power conduits
v. Horizontal alignment and curve data
vi. Locations of proposed sidewalks and curb-cut ramps
vii. Locations of proposed traffic signs, stop lines, and crosswalks
viii. Existing and proposed right-of-way width at all locations, including intersections

c) Typical sections – typical sections should show dimensions and thicknesses of all proposed right-of-way corridor elements. Right-of-way limits should also be shown.

SECTION 504 – RIGHT-OF-WAY CORRIDOR CONSTRUCTION

504.1 – Construction Requirements. Construction of roads, streets, curbs and gutters, and sidewalk shall follow the requirements of the following Sections of the "Mississippi Standard Specifications for State Aid Road and Bridge Construction, latest edition" (the Green Book):

Section S-200 – Earthwork
Section S-300 – Subbases and Bases
Section S-400 – Bituminous Pavements
Section S-608 – Concrete Sidewalks and Driveways
Section S-609 – Concrete Gutter, Curb, and Combination Curb and Gutter
Section S-621 – Thermoplastic Traffic Markings
Section S-630 – Traffic Signs and Delineators