



SECTION 9

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SECTION 9

WASTE WATER COLLECTION

9.1 PURPOSE

This section establishes the minimum standards and technical design criteria for sanitary sewer collection systems within the Board's service area. Adherence to these standards will expedite review and approval of plans. Any departure from these design requirements should be brought to the attention of the Board's engineer and discussed prior to submission of plans for approval. Such departure shall be documented and justified.

9.2 DEFINITIONS/ABBREVIATIONS

Where the following words, terms, or abbreviations (or pronouns in place of them) are used in this Section, the intent and meaning shall be interpreted as follows:

1. Approval – Approval of Plans – A review by the Board's Engineer of plans, stating that the plans are in substantial compliance with the Board's specifications.
2. And/Or - An option of the Board's Engineer or representative.
3. ASCE – American Society of Civil Engineers.
4. ASTM – American Society for Testing and Materials.
5. AWWA – American Water Works Association.
6. Board- The Water Works and Sanitary Sewer Board of the City of Montgomery, or its authorized representative.
7. Board's Attorney – The law firm and/or attorney hired and/or retained by the Board.
8. Board's Engineer – The regular employed staff engineer of the Water Works and Sanitary Sewer Board.
9. Contractor – The individual, partnership, firm, corporation, or any acceptable combination thereof licensed in the State of Alabama and contracting for the prescribed work.
10. Developer – The party or parties paying for the installation of the water main and appurtenances.
11. Developer's Engineer – The professional engineer (licensed in the state of Alabama) employed by the Developer who is responsible for the submission of engineering plans and project development.

12. Drop Manhole – A precast, concrete, structure used where one sewer joins another several feet below. The lower sewer enters the manhole at the bottom in the usual manner. The upper sewer, however, turns down sharply just outside the manhole and enters it at the bottom. To permit cleaning of the upper sewer from the manhole, the upper sewer also extends to the manhole at constant slope past the sharp drop through which the sewage flows.
13. Easement – A right to use or control the property of another for designated purposes.
14. Inspector – The Board’s authorized representative assigned to make detailed inspection of contract performance.
15. Job Site – The location of the project where sewer mains and appurtenances are to be or being built.
16. Lateral – A sewer that discharges into a branch or sewer main from a property.
17. Manhole – A concrete (precast or poured in place) structure providing access to a sewer. The lower portion is cylindrical, with an inside diameter of at least 4 ft. The upper portion generally tapers to an opening of approximately 2 ft. The opening is capped with a heavy cast-iron cover seated on a cast iron frame.
18. Owner – The person who has legal or equitable title to any premises.
19. Paving – The surface of a street, or treatment thereof.
20. Right of Way (ROW) – A general term denoting lands, property or interest therein, usually in a strip, acquired for or devoted to transportation purposes.
21. Sewer Main – A pipe or conduit that carries wastewater. Belonging to the Board, the pipe in the street, easement, avenue or alley, extending parallel or nearly parallel to the line of property abutting thereon.
22. Standard Drawings – Drawings approved for repetitive use, showing details to be used where appropriate.
23. Street – Every way or place of whatever nature, whether within or without the corporate limits of the City of Montgomery, open to the use of the public, including streets, alleys, highways, park, or other road, and all public places.

9.3 GENERAL LOCATION CRITERIA

Sewers shall be located using sound engineering judgment to determine the most cost-effective and environmentally sensitive alignment which best serves the needs of the entire tributary area. Additionally, it is imperative that all alternatives worthy of consideration receive maximum and equal consideration with regard to environmental impact. The cost for acquisition of easements can be significant; therefore, sewers should be located within existing easements and rights-of-way whenever feasible and practical.

When selecting the sewer alignment, consideration shall be given, but shall not be limited to, the following general location criteria:

1. Elevation requirements necessary to provide appropriate service with due consideration of sanitary facilities in basements.
2. Environmentally sensitive areas and constraints such as creeks, wetlands, trees, protected habitats, etc.
3. Existing utilities, railroads, highways, and overhead facilities.
4. Location of other existing and proposed sewerage facilities.
5. Property values, easement needs and potential damages to the affected properties.
6. Existing and proposed high water elevations, including high water for appropriate design periods.
7. Anticipated extension of existing streets and the potential for the development of contiguous areas.
8. Continuity with adjacent design segments.

9.3.1 HORIZONTAL ALIGNMENT CRITERIA

Whenever possible all sanitary sewer mains shall be located within the pavement. The sewer main shall have straight alignment between sewer manholes and be typically located within 5 feet of the center line of the roadway.

When sanitary sewer must be constructed out of pavement but still within a public right of way, the following rules shall be observed:

1. Sanitary sewer mains are preferred on the North and West sides of the R.O.W. They shall be located approximately six and a half feet (6.5') from the back of curb, centered in the sidewalk (if applicable).
2. Water mains are preferred on the South and East sides of the R.O.W.

Sanitary sewer laterals must extend six feet (6') beyond limits of all utility easements on both sides of the street (reference standard drawings).

9.3.2 VERTICAL ALIGNMENT CRITERIA

In establishing the elevation of the proposed sanitary sewer, the elevations of existing or proposed interceptor sewers, or the elevations of inflow pipes to existing pump stations or wastewater treatment plants and all other utilities, shall be considered.

9.4 DESIGN FLOW DETERMINATION

The design flow for each segment of the sewer system shall be determined as follows:

1. Prepare a drainage map which defines the tributaries for each element of the sewer.

2. Examine each tributary area to determine its potential land use and equivalent population.
3. Determine the average daily flow based upon the equivalent population.
4. Determine the design or peak flow based upon the average daily flow and the appropriate peaking factor.

9.4.1 DRAINAGE MAP

If required by the Board, the developer shall prepare a drainage map to aid in the review of the design. The map shall show the actual area to be served by the proposed project, the location of the existing and proposed sewers, the portion of the project area tributary to each individual sewer element and any points of inflow which contribute additional flow from adjacent areas. Adjacent future contributing areas shall be shown in entirety on the Drainage Map. The Drainage Map shall be prepared on a standard size sheet at an appropriate scale to show the entire project and adjacent future contributing areas. Two or more sheets may be used for large scale projects. The purpose of the Drainage Map is to graphically depict the basis for the design flow calculations. Specific information required includes, but is not limited to, the following:

1. A key map showing the general location of the project area, including any areas not within the project area but which contribute to the proposed system.
2. A general layout of the proposed system with the drainage area tributary to each major element of the system defined.
3. The basis for determining the number of existing and future users and the equivalent population for each drainage area, i.e., the number of single family or multi-family dwelling units; type and size of existing commercial, industrial and institutional users; and the number of acres of undeveloped land by zoning classification.
4. A zoning designation, such as M-1, for each drainage area.
5. A designation for each sewer line.
6. A numbering system for manholes which shall be carried out to the computation sheets.
7. All proposed sewer sizes.
8. The location of estimated or actual flow entering the proposed system from outside areas, undeveloped or developed. These areas are to be shown in entirety on the Drainage Map and shall include the same types of information required for the proposed service area.
9. An adequate number of spot elevations must be obtained in areas of undeveloped land to show the natural drainage of the area if necessary.

10. An indication of the existing system's ability to receive the proposed flow with sufficient capacity.

If requested, the Drainage Map and design calculations shall be presented for review with submittal of the preliminary and construction plans.

9.4.2 DESIGN FLOW

9.4.2.1 Collector Sewers

Collector sewers are primarily installed to receive wastewater directly from property service connections. A major change in land use within a tributary area can have a significant impact on the collector system's ability to transport the necessary flow. Collector sewers should, therefore, be designed to transport the saturation population (final build out) flow which might be expected during their service life (flowing full).

9.4.2.2 Interceptor Sewers

An interceptor sewer is a principal sewer to which collector sewers are tributary. All interceptor sewers should be designed for saturation population unless otherwise directed by Board.

For a major industrial water user or undeveloped industrial land in the tributary area, the Board will require the engineer to supply an estimated average daily flow.

9.4.3 HYDRAULIC DESIGN CRITERIA

Manning's Equation shall be used to determine proper pipe size and slope to transport the design flow. Design shall be for full flow at saturation conditions (include a peaking factor of 3) with the following characteristics:

Roughness coefficient	$n = 0.013$ (Sanitary Sewers Only- Ten State Standards)*
Minimum velocity	$v = 2$ feet/second
Minimum pipe size	$D = 8$ inches
Minimum acceptable grades	(See 9.4.3.3)

- * Due to potential of a slime layer build up in a sewer line, the referenced roughness coefficient shall be the only one used in calculations.

9.4.3.1 Hydraulic Grade Line

The hydraulic grade line should not rise above the crown of the sewer pipe. When critical, the hydraulic grade line shall be computed to show its elevation at manholes, transition structures, and junction points of flow in pipes, and shall provide for the losses and the differences in elevation. If velocity entering a manhole is above critical, the hydraulic grade line must be computed to ensure that no service connections are surcharged.

9.4.3.1.1 Elevation Change at Manholes

The pipe exiting the manhole must be adjusted in elevation to ensure the energy gradient remains level across the manhole. The minimum elevation change between the pipe invert entering the manhole and the pipe invert exiting shall be 1/10 foot or as approved by the Board’s Engineer.

9.4.3.2 Velocity

All gravity sanitary sewers shall be designed to carry the design flow (including any peaking factor) at a minimum velocity of 2.0 feet per second. The maximum allowable design velocity allowed shall be 15 feet per second based on the design flow. When severe topographic or other unusual conditions require a design velocity greater than 15 feet per second, the hydraulic design and pipe material must be specifically approved in writing by the Board’s Engineer.

9.4.3.3 Minimum Sanitary Sewer Grades

The minimum acceptable grades for various sewer main sizes are indicated below:

MAIN SIZE	MINIMUM ACCEPTABLE GRADE	
8"	0.40%*	4' PER 1000'
10"	0.28%	2.8' PER 1000'
12"	0.22%	2.2' PER 1000'
15"	0.15%	1.5' PER 1000'
16"	0.14%	1.4' PER 1000'
18"	0.12%	1.2' PER 1000'
21"	0.10%	1' PER 1000'
OTHER	AS DIRECTED BY THE BOARD'S ENGINEER	

Note: * Eight-inch sewers shall be designed to have a minimum slope of 0.005 ft/ft (0.50%) in the upper 400 feet of length.

9.4.3.4 Sewer Size Changes

Sewer size changes shall only take place within a manhole or junction box structure. To ensure that the energy gradient is maintained, the following general criteria shall be used:

1. Pipes 24" in Diameter or Smaller
 - a) When increasing the sewer size by 6 inches or less, crown elevations shall match at the centerline of the manhole.
 - b) When increasing the sewer size by more than 6 inches, the springlines of the smaller and larger sewer shall match at the centerline of the manhole. However, for the hydraulic design calculations, the Design Engineer shall match crown

elevations at the centerline of the manhole by raising the elevation of the smaller sewer.

2. Pipes 27" in Diameter or Larger

Sewer pipe larger than 27" in diameter shall be handled on a case-by-case basis.

9.5 DESIGN CRITERIA

9.5.1 SEWER PIPE

9.5.1.1 Size

The minimum allowable inside diameter for sewer pipe, other than property service connections, shall be 8 inches. All property service connections shall have a minimum inside diameter of 6 inches; however, commercial or industrial connections shall be individually considered.

9.5.1.2 Transitions

Where ductile iron, plastic solid wall, plastic profile wall, or fiberglass pipe connects to another pipe material (i.e. clay concrete, brick, etc.) a concrete collar and an appropriate fitting for joining the two materials shall be used.

9.5.1.3 Depth Requirements

If the grade at any time (during or after) construction is greater than 14 feet from the top of the sanitary sewer main, then ductile iron pipe will be required. If the grade at any time (during or after) construction is less than 3 feet from the top of the sanitary sewer pipe, then ductile iron pipe will also be required. Board approved solid wall pvc plastic pipe can be used in areas where the cover above the pipe is in the range of 3 to 14 feet.

9.5.1.4 Sewer Gradient Elevations

All sewer gradient elevations shall be referenced to the North American Vertical Datum 88 (NAVD 88). When connecting into or extending existing sewer facilities that were constructed using another datum, an elevation equation shall be shown on the plans. Datum shall be verified by a licensed Land Surveyor.

9.5.1.5 Flooding and Ponding Areas

The top of sanitary manhole elevations shall be a minimum of 2 feet above existing, proposed, or projected 100-year high water elevations. However, when this minimum elevation causes the manhole to be above the natural ground creating obstructive mounds, the top of the manhole elevation shall be lowered to the natural ground elevation and a watertight manhole lid and frame shall be specified.

9.5.1.6 Water Main Clearance Criteria

The minimum horizontal clearance between the sewer and water mains shall be 10 feet. The vertical clearance shall be at least 18 inches. If at all possible, the sewer shall be located below the water main. Should it become necessary for the sewer to cross over the water main, special precautions will be required. Such cases shall require review and written approval by Board.

9.5.1.7 Disturbed Soil

Ductile iron pipe shall be required in all fill areas and areas of disturbed ground.

9.5.1.8 Lot Lines/Limited Access Areas

All sewer mains located along lot lines or between areas of limited access shall be D.I. from property line to property line. When it becomes necessary to run a sanitary sewer down lot lines between adjacent streets, none or as few as possible offsets in the sanitary sewer line will be allowed. Where offsets are necessary, they should be approved by the Board's Engineer.

9.5.1.9 Encasements

Ductile iron pipe will be required in encasements unless specifically authorized by the Board's engineer on approved plans. Sanitary sewer mains that run through storm sewer, storm boxes, other utility mains, boxes manholes or conduits may be ductile iron and required to be encased.

9.5.2 MANHOLES

9.5.2.1 Manhole Locations

Manholes shall be required at the following:

1. Changes in sewer grades or alignment.
2. Sewer junctions.
3. Where required not to exceed the maximum manhole spacing.
4. Changes in sewer diameters.
5. Termination points. The exact location of the terminal manhole in each sewer line shall be based on many factors including manhole spacing, driveway locations, the position of improvements on the lots being served, and the location of present temporary sanitary facilities, such as septic tanks, etc. A definitive single policy cannot be established to cover all circumstances, although the sewer line would normally terminate a minimum of 25 feet past the lot line of the last property served. This is to allow enough room for the last lot to have a wye and lateral run into the sanitary sewer main without encroaching adjacent property.

9.5.2.2 Maximum Manhole Spacing

The following maximum manhole spacing distances shall be employed in the design of all new sanitary sewer collection system construction. When certain conditions warrant, such as the elimination of a manhole, the manhole spacing can be exceeded with the approval of the Board’s engineer.

SIZE OF SEWER MAIN	SPACING (DISTANCE IN FEET)
8” - 16”	400’
18” – 30”	500’
33” – 60”	AS DIRECTED BY THE BOARD’S ENGINEER

9.5.2.3 Manhole Diameter

The minimum diameter of a manhole shall be as indicated in the table below. Regardless of the recommendations offered, all manholes shall be checked to ensure that sufficient wall is supplied between pipe openings to meet all pre-cast manhole criteria.

SIZE OF SEWER MAIN	MINIMUM MANHOLE DIAMETER
8” - 18”	4’ (OR 48”)
20” – 42”	5’ (OR 60”)
GREATER THAN 48”	AS DIRECTED BY THE BOARD’S ENGINEER

9.5.2.4 Manhole Classification

All manholes shall be classified as Class I, Class II, or Class III depending on the level of corrosion protection required.

Class I – Manholes shall be of standard manhole construction with no specified admixtures or protective coatings (lining system or grouting). Class I manholes may be used on any sewer main up to 12” in diameter where the Board’s Engineer has determined no significant corrosion hazard is present.

Class II – Class II manholes shall be constructed with specified concrete admixtures at the time of casting to provide the manhole a measure of waterproofing. In addition to the concrete admixture, the invert and benches of the manhole shall have a 0.5” to 1” layer of corrosion resistant troweled on material applied. Class II manholes typically shall be required on all sewer mains between 12” and 18” in diameter. In addition to the requirements as described above, the Board may extend the use of the concrete admixtures and troweled on invert material to include the first two segments (or 500 ft. of sewer main) of any branch sewer emanating from the 12” – 18” sewer mains.

Class III –In addition to the requirements of Class II manholes as described above, Class III manholes shall incorporate a specified protective liner system at the time of casting in order to provide a physical layer of corrosion resistant material over the exposed concrete. Class III manholes shall be required on all outfall lines (18” and greater in diameter). In addition to the requirement as described above, the Board may extend the use of protective liner to include the first two segments (or 500 ft. of sewer main) of any branch sewer emanating from the interceptor/outfall lines.

9.5.2.5 Watertightness

Watertight manholes and covers are to be used whenever the manhole covers may be flooded by street runoff or anticipated high water.

9.5.2.6 Drop Inlets

Where the distance between a manhole invert and the line coming into the manhole is greater than 6 inches (0.5 ft), the grade of the incoming line shall be changed to bring this distance down to 6 inches or a drop connection shall be installed (except youthful lines 10 inches or greater where invert may match crown of said youthful). The grade distance between the influent and effluent shall be 6 inches (0.5 ft) or less, except for standard drop connection construction. The minimum distance (from manhole invert to invert of incoming line) required for a drop connection is 22 inches. This is the distance needed for installing a required Memphis tee and ¼ bend.

9.5.2.7 Manhole Collars

A 6-inch collar shall be used when it is absolutely certain the manhole rim will not be lowered in the future. When it is anticipated that the manhole rim may be lowered, a 12-inch or greater collar shall be specified.

Manholes will be adjusted to the final grade by pre-cast extensions /grade rings. Manhole extensions will not exceed more than 30 inches of chimney as measured from the top of the manhole rim to the point where the manhole starts to increase in size.

9.5.2.8 Raised Manhole Frame and Cover

A ball-hinge manhole frame and lid shall be required when a manhole stands two or more feet above the surrounding grade.

9.5.3 LATERALS

Each platted lot shall have its own individual sanitary sewer lateral. Each duplex, apartment, or condominium that has the potential to be sold as an individual dwelling on its own lot shall have a separate sanitary sewer lateral. If a single-family dwelling is built upon several lots, only one sanitary sewer lateral will be required. It is intended that each single-family owned unit shall have its own separate sanitary lateral.

9.5.3.1 Taps on Existing Sewer Mains

Pipe shall be thoroughly cleaned to remove any dirt or foreign material and leave smooth sealing surface for gasket of sewer saddle tee. Opening made in pipe shall be clean, smooth, circular (not segmented), in symmetry with branch of sewer saddle tee, with no projections to allow grease or rags to build-up. Preferred method for cutting opening is with use of a diamond grit hole-saw, complete with pilot and segmented teeth. Install sewer saddle tee with branch rotated to 10 o'clock or 2 o'clock position or as directed by the Board's Engineer and/or representative.

9.5.3.2 Minimum Size and Grade

Sanitary sewer laterals shall be a minimum of 6 inches in diameter and run perpendicular to the sanitary sewer line. Laterals located in cul-de-sacs are not required to run perpendicular to the sewer main. Laterals shall have a minimum slope of 1/8-inch per foot (1%) for property service connections. However, in all cases, the invert elevation of the property service connection at the easement or property line shall be equal to or higher than the crown of the sewer.

9.5.3.3 Lateral Stacks

In order to minimize lateral pipe "Punch Through", wye or tee fittings shall be installed at an angle no greater than 45 degrees from the horizontal centerline. Lateral Stacks (installing wyes or tees at 90 degrees from the horizontal centerline) are prohibited.

9.5.3.4 Lateral Location

The sanitary sewer lateral shall extend perpendicular from the main to a point a minimum of 6 feet beyond the street right-of-way, property line or utility easement. In areas where the main is in a dedicated easement, the lateral shall extend 6 feet beyond the edge of the easement on to private property. The end of the sanitary sewer lateral shall be placed no shallower than 3 feet and no deeper than 8 feet deep with respect to final grade.

Sanitary sewer laterals on lots that have less than 15' of street frontage shall be extended on to property to within 5 feet of the building line.

When a sewer main runs along a lot line, laterals shall be stubbed outside building limits to prevent any possible conflict with the building slab.

In addition to providing accurate as-built data indicating location of laterals, all laterals shall be marked in the field at the terminus point with a color coded electronic marker.

9.5.4 GREASE INTERCEPTORS

Grease Interceptors shall be required at any facility where, in the Board's judgment, some component(s) in its wastewater (i.e. grease, grit, etc.) may interfere with the operation and maintenance of the sewer collection system.

9.5.5 DUMPSTER PAD AND COVER

A building consisting of three walls and a roof shall be required over any dumpster that drains to the sanitary sewer. The dumpster pad must be elevated to prevent surrounding surface water runoff from entering the sewer collection system.

9.5.6 EPOXY COATINGS

All ductile iron pipe, and other sewer system components on interceptor/outfall lines (sewer mains with diameters of 18" and greater) shall be protected from corrosion by the use of factory applied epoxy coatings. In addition to the epoxy coating requirement as described above, the Board may extend the use of protective coatings to include the first two segments (or 500 ft. of sewer main) of any branch sewer emanating from the interceptor/outfall lines. The Board further reserves the right to require protective coatings on any manhole, ductile iron pipe, or component of any collector line (less than 18" in diameter) as is deemed necessary by the Board's engineer.

9.5.7 FLOTATION

All sewers and sewer structures to be constructed where high groundwater conditions exist or where flooding of the trench is anticipated shall be designed to prevent flotation or excessive pipe flexing.

9.5.8 CONCRETE ENCASEMENTS

Concrete encasement shall extend a minimum length of 2 feet beyond the point where a 4-foot depth of cover is reached or to a point 5 feet beyond the tops of banks when crossing a ditch or stream. Concrete encasements may be used when it is necessary to prevent floatation, when crossing streams, ditches, or existing storm drains, where soil conditions may indicate the possibility of heavy erosion, where crossing over or under utilities with less than 2-feet of clearance, or in areas where the sewer has less than the required minimum cover.

9.5.9 ENCASEMENT REQUIREMENTS

9.5.9.1 General

Encasement is required when crossing all State highways, railroad, and some County and City roadways which have excessive traffic flow or other critical situations (such as protecting building foundations). Encasement and mains shall cross the roadway and/or railroads as near as possible perpendicular to the roadbed. In all cases the agency requiring the encasement shall have the final approval of the engineering design. Ductile iron pipe will be required in encasements unless specifically authorized by the Board's engineer on the approved plans.

9.5.9.2 Encasement Pipe

Pipe to be installed under pavement where open trenching is not permitted shall be installed through steel casing, which has been jacked and/or bored. Casing shall extend out past both sides of pavement a minimum of 3 feet or past toe of slope whichever is greater.

9.5.9.3 Encasement Spacers

DI Pipe

Sewer mains shall be pushed or pulled through the encasement piping on spacers placed no more than 10 feet apart. A minimum of two spacers/runners per joint of pipe shall be required. The spacer shall have a clearance range of 1 to 1.5 inches between the spacer and the inside of the encasement piping. Spacers shall be required in the first foot of each end of the encasement.

PVC Pipe (C900 and C909)

Sewer mains shall be pushed or pulled through the encasement piping on spacers placed no more apart than 6 feet apart. A minimum of three spacers/runners per joint of pipe shall be required. The spacer shall have a clearance range of 1 to 1.5 inches between the spacer and the inside of the encasement piping. Spacers shall be required in the first foot of each end of the encasement.

9.5.9.4 Encasement Ends

All casing ends shall be sealed with neoprene end seal designed for the size pipe/casing. End seal shall be a seamless, pullover type with any associated hardware or accessories constructed of either Grade 304 or 316 stainless steel. No rigid end seals will be allowed. For products that have been approved for installation see Section 8, Water Distribution Systems.

9.5.10 RAILROAD CROSSINGS

9.5.10.1 Criteria

In addition to the individual railroad's design requirements the following criteria shall be strictly adhered to when the planning for sewer construction affects railroad rights-of-way and facilities (railroad may specify more stringent requirements):

1. Sewers shall cross tracks at an angle as close to 90 degrees as practical, but preferably never less than 45 degrees. Sewers shall not be placed under railroad bridges where there is a likelihood of restricting the required waterway area of the bridge or where there is a possibility of endangering the foundations.
2. Sewer lines crossing under railroad tracks and rights-of-way shall be bored and jacked casings unless the railroad company grants written permission for open-cut construction.
3. Sewer lines laid longitudinally along railroad rights-of-way shall be located as far as practical from any tracks or other important structures. If located within 25 feet of the centerline of any track, or should there be danger of damage from leakage to any bridge, building or other important structure, the sewer shall be encased.
4. When placed along railroad rights-of-way, the top of the pipe shall have a minimum cover of 4 feet.

9.5.10.2 Railroad Conflict Drawings

Railroad conflict drawings shall conform to the following criteria:

1. Drawings shall be prepared to scale showing the relationship between the proposed sewer and the railroad, angle of crossing, location of utilities, original survey station of the railroad (when available), right-of-way lines, topography and general layout. The profile established from a field survey shall show the sewer in relation to the actual ground and tracks. The limits of boring or tunneling by station, sewer line soundings and borings and all other pertinent information shall be shown on the drawing.
2. Railroad conflict drawings shall be submitted along with a complete questionnaire which shall be furnished by the railroad company.

9.5.11 HIGHWAY CROSSING

Sewer pipe installations under State, County, or City maintained roadways which are designated by their governing agencies shall meet the following requirements (more stringent criteria may be required on a project specific basis):

1. Sewers shall cross roadways at an angle as close to 90 degrees as practical, but preferably never less than 45 degrees. Sewers shall not be placed under roadway bridges where there is a likelihood of restricting the required area of the bridge or where there is a possibility of endangering the foundations.
2. Borings under roadways shall have a minimum depth of 4 feet from the surface elevation to the top of the boring. The top of the tunnel lining shall not be above the invert of existing or proposed ditches.
3. Borings under roadways shall extend a minimum of 10 feet outside the existing pavement, as measured at right angles to the roadway, or to the toe of the slope when the roadway is on fill and the toe of slope exceeds 10 feet outside the existing paving.
4. Sewer lines laid in a longitudinal direction on highway rights-of-way shall be located a sufficient distance from the edge of the pavement to allow adequate working room and to provide maximum safety to the motorist when the roadway is to remain open to traffic. Those sewer lines within the roadway rights-of-way, but not located under paved areas, shall have no less than 5 feet of cover.
5. Detectable tape shall be laid in the trench above ALL PVC pipe from edge of pavement to the right-of-way line or from end of tunnel to right-of-way line on all crossings of State R.O.W.s.

9.5.12 INTERRUPTION OF EXISTING SEWER SERVICE

Existing sewer customers shall not be placed out of service in order to connect or lay new sewer piping. The Contractor shall coordinate with the Board all service interruptions prior to construction. The Contractor shall be responsible for providing temporary service through by-pass pumping if necessary to all of the Board's customers affected by the construction.

9.5.13 TRENCH PREPARATION

9.5.13.1 *Excavation*

All excavation shall be done in accordance with OSHA Code of Regulation Part 1926 (latest revision). A trench shall be opened so that the pipe can be installed to the alignment and depth required. It shall be excavated only so far in advance of pipe laying as necessary.

The trench shall be excavated to the depth required so as to provide a uniform and continuous bearing support for the pipe on undisturbed ground. Bell holes shall be provided at each joint to permit jointing to be made and inspected properly.

During excavation, if ashes, cinders, muck or other organic material considered unstable is uncovered at the bottom of the trench at subgrade, it shall be removed and backfilled with approved material for a depth not less than 12 inches. This material shall be tamped in layers of 6 inches to provide a uniform and continuous bearing characteristic of that area's soil condition. Where the bottom of the trench at subgrade consists of unstable material to such a degree that it cannot be removed and replaced with an approved material to support the pipe properly, a suitable foundation shall be constructed. Excavated material shall be piled in such a manner that it will not endanger work, obstruct natural watercourse, sidewalks or driveways.

Fire hydrants, valve boxes, or other utility controls shall be left unobstructed and accessible at all times. Street gutters shall be kept clear or other satisfactory provisions made for street drainage. All surface materials, which are suitable for reuse in restoring the surface, shall be kept separate from the excavated materials.

9.5.13.2 *Sheeting and Bracing*

Open cut trenches shall be sheeted and braced as required by OSHA Code of Regulations Part 1926 (latest revision) and as may be necessary to protect life, property or the work. Trench bracing may be removed after the backfilling has been completed or has been brought up to such an elevation as to permit its safe removal. The use of a trenching box may be used in place of sheeting and bracing as long as said box is in compliance with above referenced OSHA Code.

9.5.13.3 *Dewatering*

Water shall not be allowed in the trench at any time. An adequate supply of well points, headers and pumps, all in first class operating condition, shall be used to remove the ground water. The use of gravel and pumps shall also be an acceptable means of removing the water on a case by case basis as approved by the Board. At no time shall any pumps emit an unacceptable noise level as determined by the Boards' Engineer or contractor will be required to shut down pumping operations.

The trench shall be excavated no more than the available pumping facilities are capable of handling. The discharge from pumps shall be routed to settling basins or other acceptable erosion and sedimentation control devices prior to discharging to natural or existing drainage

channels or storm sewers. Any and all permits required for Dewatering are the responsibility of the Contractor and shall be obtained prior to commencement of construction.

9.5.14 PIPE LINE CONSTRUCTION

9.5.14.1 *Pipe Laying*

All sewer mains, laterals, and appurtenances shall be installed as specified in these technical provisions, manufacturers recommendations, and in accordance with the approved Plans and appropriate standard detail sheets as provided herein.

The bottom of the trench shall not be excavated below the specified grade. If undercutting occurs, the bottom of the trench shall be brought up to the original grade with approved material, thoroughly compacted as directed by the Board's Engineer and/or his representative.

Before placing pipe into the trench, the outside of the spigot and the inside of the bell shall be wiped clean and dry, free from oil and grease. Every precaution shall be taken to prevent foreign material from entering the pipe. During laying operating, no debris, tools, clothing or other material shall be placed in the pipe.

All slip joints shall be made up in strict accordance with the manufacturer's specifications. The bell shall be carefully cleaned before the gasket is inserted.

After placing a length of pipe in the trench, the spigot end shall be centered in the bell, the pipe forced home, and brought to correct alignment.

9.5.14.2 *Backfilling*

All backfilling material shall be free from cinders, ashes, refuse, vegetable or organic material, boulders, rocks, stones or other material which is considered unsuitable. The Contractor shall not backfill any connection or appurtenances that requires the Board's inspection. Failure to provide the opportunity for inspection shall be grounds for the removal and replacement of all disputed items. All such inspections shall be scheduled two (2) *working days in advance*.

9.5.14.3 *Electronic Location Marker*

After the placement of pipe zone material on any pressurized PVC sewer pipeline construction (force mains), the contractor shall place a color coded electronic marker at each bell, fitting, tee, valve, cap, and buried appurtenance. In addition to the electronic markers, warning tape shall be placed along the entire length of construction.

9.5.14.4 *Safeguarding Newly Installed Sewer Main*

To prevent unwanted contaminates from entering newly installed sewer mains, the Contractor shall at the end of each day, secure the main through the use of a temporary, non-pressure,

water tight, friction gasket plug. The Contractor shall maintain the use of these plugs until such time as sewer (manholes and main) have been installed, manholes stacked out, and the system is secured from the threat of the potential contaminants.

9.5.15 REPAIR CLAMPS

The number of repair clamps allowed on any one segment of newly installed main shall be limited to four (4). If a segment of newly installed sewer main requires more than four (4) repair clamps the main shall be removed and relayed. No more than two repair clamps will be allowed for any one joint of pipe.

9.5.16 SEWER ABANDONMENT

9.5.16.1 Sewer Main

Sewer mains scheduled to be abandoned shall be completely removed from the trench and the void filled with suitable compacted backfill material. If approved by the Board's Engineer, sewer main can be abandoned in place by capping the pipe ends and filling pipe void with flowable grout.

9.5.16.2 Sewer Manholes

Sewer manholes scheduled to be abandoned shall be prepared by punching through the invert of the manhole where water can freely drain into and out of the manhole structure. The manhole shall be filled with sand to within three feet of grade. The walls of the manhole will be removed or broken down to three feet below grade and the remaining void filled with sand to 6" of the surface grade. Surface restoration to grade shall be performed to match surrounding areas.

9.6 MATERIAL REQUIREMENTS

9.6.1 INSPECTIONS OF MATERIALS

All materials delivered to the job site are subject to inspection by the Board's representative. Any materials found during inspection or during the progress of the work to be defective or not meeting specifications shall be rejected and removed from the job site without delay. Materials and/or work not inspected by the Board's representative prior to installation shall be uncovered by the Contractor at his expense in order to verify compliance. Copies of the Packing List shall be furnished on demand. All materials used for sanitary sewer construction shall be new and of domestic origin. No used material shall be allowed.

9.6.2 MATERIALS MANUFACTURER

Like items on a project shall be of same manufacturer. The Contractor will not be allowed to mix like items from different manufacturers on a project (i.e. American Ductile Iron pipe and U.S Ductile Iron).

9.6.3 PIPE

9.6.3.1 Ductile Iron Pipe

Ductile iron gravity sewer pipe shall be push-on joint in accordance with ASTM A 746-latest version and ANSI/AWWA C111/A21.11. Pipe wall thickness shall be in accordance to bury depth as specified in AWWA C150/A21.50 latest edition. The pipe shall be cement mortar-lined and seal-coated in accordance with ANSI/AWWA Standard C104/A21.4. All ductile iron pipe for underground installation shall be outside coated with a 1-mil thick bituminous material applied by means of airless spray or other factory approved method. For products that have been approved for installation see Section 8, Water Distribution Systems.

9.6.3.2 Plastic Solid Wall Pipe (8" – 15")

Solid wall PVC pipe shall be push-on joint in accordance with ASTM D3034 (latest version). Minimum pipe stiffness, when measured in accordance with ASTM F679 shall be 115 psi. The pipe shall be colored green for in-ground identification as sewer pipe. The thermoplastic material shall meet or exceed cell class 12454 or 12364 as defined in ASTM D1784. The following products have been approved for installation:

MANUFACTURER	PRODUCT
Diamond Plastics Corporation	Sani-21 SDR26
JM Eagle	Ring-Tite
Hawk Plastics	Hawk PSM PVC Heavy Wall Sewer Pipe
Vulcan Plastics	Gravity Sewer Pipe – SDR 26

9.6.3.3 Plastic Solid Wall Pipe (18" – 30")

Solid wall PVC pipe shall have integral push-on bell joint with gaskets meeting ASTM F477. Minimum pipe stiffness, when measured in accordance with ASTM D2412 shall be 115 psi. The pipe shall be colored green for in-ground identification as sewer pipe. The thermoplastic material shall meet or exceed Cell class 1254 or 12364 as defined in ASTM D1784.

9.6.3.4 Centrifugally Cast Fiberglass Mortar (CCFM) Pipe (18" –30")

Centrifugally Cast Fiberglass Mortar (CCFM) pipe shall be manufactured according to ASTM D3262 for non-pressure sanitary sewer. Minimum pipe stiffness, when measured in accordance with ASTM D2412, shall be 46 psi. HOBAS Pipe USA, Inc. with FWC coupling for direct-bury non-pressure has been approved for installation.

9.6.3.5 Polyvinyl Chloride (PVC) Pipe – Force Mains

PVC Pipe shall be in accordance with ANSI/AWWA C900 or C909. Push-on and restrained pipe shall have a minimum rated working pressure of 235 psi and be provided in ductile iron

outside diameter. Pipe wall thickness shall be as specified in the above referenced AWWA standard, latest edition. Pipe color shall be green from manufacturer. Restrained joint pipe per Section 8, Water Distribution Systems, shall be required where the Board deems necessary. The following products have been approved for installation:

MANUFACTURER	PRODUCT
Diamond Plastics Corporation	AWWA C900
JM Eagle	AWWA C900 / AWWA C909
North American Pipe Corporation	AWWA C900
Vulcan Plastics	AWWA C900

9.6.4 LATERALS

Laterals shall match main materials (ductile iron or solid wall PVC) and be 6 inch conforming to the requirements of ASTM A746 or ASTM D3034. Solid wall lateral pipe may be SDR 23.5 or SDR 26.

9.6.4.1 Lateral Service Connections

All lateral service connections shall provide a water tight connection in accordance with ASTM D3212.

9.6.4.1.1 New Sewer Main

Lateral service connections on newly laid sewer main (not previously mandrel tested) shall be made with a prefabricated wye fitting of same material as the main.

9.6.4.1.2 Taps on Existing Sewer Main

Lateral service connections on existing sewer main shall be made with an all stainless steel sewer saddle tee and hardware manufactured by Cascade Waterworks Manufacturing, series CSWRT. Inlet branch of tee shall be connected to sewer lateral by a flexible coupling with stainless steel bands and stainless steel shear ring manufactured by Fernco.

9.6.5 FITTINGS

9.6.5.1 Iron Fittings

Fittings shall be cast iron or ductile iron and shall be designated and manufactured in accordance with ANSI A21.1 latest version. Fittings shall be cement mortar-lined and seal coated in accordance with ANSI/AWWA C104/A21.4

9.6.5.2 Plastic Fittings

All fittings for PVC composite pipe shall conform to ASTM D2680-90.

9.6.6 COUPLINGS AND CONNECTORS

Couplings and connectors may be used to join similar and dissimilar materials as well as pipes of the same diameter or of different diameters. Indiana Seal Flexible Couplings or Flex-Seal Couplings (Mission Rubber Co.) using series 300 stainless steel hose clamps shall be used.

9.6.7 NON-PRESSURE PLUG

Temporary plugs used to secure sewer mains from contaminants during construction shall be non-pressure, friction gasket, and water tight plugs as manufactured by Taylor Made Plastics, Inc. or approved other. In lieu of a temporary plastic plug as stated above, the Contractor may use a permanent water tight plug designed for a pressure application. Pressurized/inflatable plugs will not be allowed for this purpose.

9.6.8 POLYETHYLENE WRAP

Due to the corrosive nature of soils in and around the Board's service area, all ductile iron pipe/fittings shall be polyethylene wrapped in accordance with ANSI/AWWA C105/A21.5. Wrapping shall be a 3 layer, linear low-density polyethylene (LLDPE), enhanced with a corrosion inhibitor and biocide, manufactured by V-Bio™.

9.6.9 ELECTRONIC UTILITY MARKERS

All pressurized PVC sewer pipe installations shall require electronic utility markers to be buried at every bell, valve, tee, fitting, cap, reducer, and any buried appurtenance. The markers shall be color coded for its use (green for sewer). Markers shall be centered above the pipe at the edge of the pipe zone but not buried any deeper than 4 ft. Markers shall be 3M EMS Ball Marker 1404-XR.

9.6.10 WARNING TAPE

In addition to the electronic utility markers required above, all PVC pressure pipe (force main) shall require underground warning tape buried above the electronic utility markers. Tape shall be green, detectable, 6-inch minimum width, heavy gauge, 5 mil minimum overall thickness polyethylene tape with metallic core, and shall read "Caution, Buried Sewer Force Main Below."

9.6.11 EPOXY COATINGS

9.6.11.1 Concrete and Masonry

Epoxy coatings on concrete and masonry (manholes, concrete pipes, etc.) shall be a polyamide coal tar epoxy, Series 46H-413 Hi-Build Tneme-Tar or approved equal. The epoxy shall be applied to a 16 –20 mils dry film thickness on the inside of the structure. A seal coat of epoxy shall be applied to the outside of the structure per the manufacture's recommendations.

9.6.11.2 *Ductile Iron*

Epoxy coatings on ductile iron pipe and fittings shall have a ceramic epoxy lining on the interior and a bituminous coating on the exterior except for 6" back from the spigot end. The bituminous coating shall not be applied to the first 6" of the exterior of the spigot ends. The material used for the lining shall be a two component amine cured epoxy. Epoxy shall be Protecto 401 by Vulcan Painters, Birmingham, AL or approved equal. The epoxy shall be applied to a thickness of at least 40 mils.

9.6.12 MANHOLES

9.6.12.1 *Precast Manholes*

Precast manholes shall be reinforced concrete conforming to the requirements of ASTM C478. The concrete when tested in compression shall be not less than 4000 psi (as supplied by Throckmorton Concrete, Forterra, Foley Products, or approved equal).

9.6.12.2 *Cast in place Manholes*

Cast in place manholes shall be reviewed on a case by case basis. Wherever possible a precast manhole shall be used.

9.6.12.3 *Manhole Rim and Casting*

Ferrous casting shall be of uniform quality, free from blowholes, shrinkage, distortion or other defects. Metal used in the manufacture of castings shall conform to ASTM A-48 (latest revision) Class 35B for Gray Iron. All castings shall be manufactured true to pattern; component parts shall fit together in a satisfactory manner. Component parts of a specified design shall be interchangeable. Round frames and covers shall have continuously machined bearing surfaces to prevent rocking and rattling. Tolerances shall be accepted foundry standards as outlined in the Iron Castings Handbook published by the American Cast Metals Institute (tolerances shall not exceed +/- 1/16 inch per foot of major dimension).

9.6.12.4 *Raised Manhole Frame and Cover*

Approved frames include John Bouchard & Sons Co. R-1650 LM Frame and Cover, Neenah Foundry Company Lifetime Hinge System, or an engineer-approved equal.

9.6.12.5 *Manhole Steps*

Manhole steps shall be copolymer polypropylene plastic with ½" diameter grade 60 reinforcements and shall conform to ASTM C478. All steps shall be built into the walls of the precast sections in straight alignment so as to form a continuous ladder with a maximum distance of 16 inches between steps.

9.6.12.6 Corrosion-Resistant Invert and Bench Grout

Corrosion-Resistant Benches and Inverts in Class II and Class III manholes shall be coated with a .5" – 1" layer of acid-resistant cementitious materials manufactured from 100% pure calcium aluminate cement and enhanced with high density chemically stable aggregates. Materials may contain inert poly fiber reinforcement and chemical admixtures. Approved materials shall be Quadex Aluminaliner as manufactured by Quadex, Inc., SewperCoat 2000HS as manufactured by Lafarge Calcium Aluminates, Strongseal Hi-performance by StrongLite Products Corporation, or approved equal.

9.6.12.7 Concrete Admixture

Concrete used in Class II and Class III manholes shall include admixtures added to the concrete during the mixing process to provide increased waterproofing and durability. Amounts of admixture shall be in accordance with the manufacturer's recommendations for the specific product. Admixtures shall include a dye or tracer to allow field verification of presence of the admixture. Pre-approved admixtures are as follows: Xypex Admix C-1000R as manufactured by Xypex Chemical Corporation, IPANEX Admix as manufactured by Cement Chemistry Systems, LP, Krystol Waterproofing Admixture System by Kryton Group Companies, or approved equal.

9.6.12.8 Manhole Protective Liner

Manhole liner systems used in Class III manholes shall be manufactured from sheets of thermoplastic materials, such as polyethylene (P.E.), Polypropylene (P.P.) and Polyvinyl Chloride (PVC) that are resistant to the chemical environment normally found in wastewater transmission systems. The liner shall be a non-load bearing component integrally cast and adequately anchored inside pre-cast manhole sections. Joints shall be fused together to form a continuous sheet of lining material. Pre-approved lining systems include: Atlas Mineral and Chemicals, inc. Anchor Lok, Agru America Inc. Sure Grip, Sprayroq Inc., Spraywall or approved equal.

9.6.12.9 Manhole Joint

Joints between manhole sections shall be made with a preformed butyl sealant. Butyl sealants shall meet the hydrostatic performance requirements of ASTM C990. Use ConSeal CS-102 or approved equal. Only lifting eyes shall be grouted (interior and exterior). Manhole joints shall remain un-grouted to allow butyl sealant to compress and form a bond with manhole segments.

9.6.12.10 Stacking out Brick

Brick shall be hard burned common brick meeting ASTM C32 Grade NA. Brick shall be standard brick size.

9.6.12.11 Hydraulic Cement

Use a rapid setting, non shrink, hydraulic cement especially formulated for underwater use. The cement shall be non-staining, containing no organic materials. Use BONSAL Instant Hydraulic Cement or approved equal.

9.6.12.12 Pipe-to-Manhole Connector Assembly

Flexible connector assemblies shall be made of a rubber compound especially formulated to resist weather, ozone, oils, acids, alkalis, and animal/vegetable fats with a stainless internal band and external clamp. The assembly shall be inserted into the precast manhole at the factory and shall meet the requirements of ASTM C923. Use Kor-N-Seal[®] manufactured by Trelleborg or approved equivalent.

9.6.13 GREASE INTERCEPTORS

Precast grease interceptors shall be reinforced concrete conforming to the requirements of ASTM C1613-06 (Standard Specification for Precast Concrete Grease Interceptor Tanks). The Tanks shall be H-20 load rated and the concrete when tested in compression shall be not less than 4000 psi (as supplied by Throckmorton, Hanson Pipe, Foley Products, Jarret Concrete Products or approved equal).

9.6.14 STEEL ENCASEMENTS

Where sanitary sewer borings are required, the encasement pipe shall conform the requirements of ASTM A53 or A139, Grade B steel piping (for sizes 24” and smaller). The encasement shall be set straight and true to grade as indicated on the construction plans. Each end shall be sealed with a neoprene end seal as specified and encasement shall be of such a size as to assure a final correct grade on the sanitary sewer main. Straight seamed or seamless encasement piping is required; no spiral encasement pipe shall be allowed.

Where it is necessary to adjust the sanitary sewer pipe within the encasement, appropriate chairs (supports) for grade adjustment will be required. Borings under railroads or State highways shall meet their respective permit requirements.

Casing size and thickness shall be as indicated below:

DIAMETER OF SEWER MAIN (INCHES)	MINIMUM CASING DIAMETER (INCHES)	MINIMUM CASING THICKNESS (INCHES)	ASTM / AWWA STANDARD
4"	12"	.25"	ASTM A53
6"	14"	.25"	ASTM A53
8"	16"	.25"	ASTM A53
10"	18"	.25"	ASTM A53

12"- 14"	24"	.25"	ASTM A53
16"-20"	30"	.3125"	AWWA C200
24"	36"	.3125"	AWWA C200
Larger than 24"	As approved by Board Engineer	As approved by Board Engineer	As approved by Board Engineer

9.6.14.1 Encasement Spacers

Spacers for 4” –12” piping shall be stainless steel with 8” wide bands as shown on the applicable details. Spacers for piping larger than 12” shall be reviewed on a case by case basis. For products that have been approved for installation see Section 8, Water Distribution Systems.

9.6.15 BACKFILL

9.6.15.1 Gravel

Coarse aggregate (gravel) shall be white or very light colored gravel, limestone, marble, or granite, subject to the approval of the Board. Gravel shall be crushed angular stone conforming to No. 57 stone as provided for in Section 801 “Coarse Aggregate” of ALDOT’s standard specifications.

9.6.15.2 Crusher Run

Crusher run shall consist of 100 percent crushed aggregates conforming to the requirements of Section 825.02 Type A “Crushed Aggregate Base Materials” of ALDOT’s standard specifications.

9.6.15.3 Sand

Sand shall be local “washed” material consisting of grains of hard, predominantly quartz or other hard rock, including friable, loosely bound deposits of sandstone conglomerate. The sand shall be free from lumps of clay, loam, organic matter, or other foreign material. Sand shall meet the requirements of Section 826 .02 (b) “Local Sand and Sand Gravel for Miscellaneous Construction Use” of ALDOT’s standard specifications.

9.6.15.4 Pit Run/Clay Gravel

Pit run (clay gravel) shall be local material consisting of grains of hard, predominantly quartz or other hard rock, including friable, loosely bound deposits of sandstone conglomerate. The coarse aggregate and sand shall be free from lumps of clay, loam, organic matter, or other foreign material. Pit run shall meet the requirements of Section 826 .02 (c) “Local Sand and Sand Gravel for Miscellaneous Construction Use” of ALDOT’s standard specifications.