GUIDELINES FOR SEWAGE COLLECTION SYSTEMS

State of Georgia
Department of Natural Resources
Environmental Protection Division
Watershed Protection Branch
4220 International Parkway, Suite 101
Atlanta, Georgia 30354

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INTRODUCTION

Wherever there are people, there are sewers, and the health and safety of those people depend on the proper design, installation and maintenance of the sanitary sewage collection systems.

Purpose

Collection sewers (gravity, low-pressure and vacuum systems) are used to transport sanitary sewage and wastewater from residential, commercial, and industrial establishments to wastewater treatment facilities. In Georgia there are State-mandated review and approvals that must precede sewer construction. This guidance provides information and recommendations for the Environmental Protection Division's (EPD's) staff to use in reviewing the plans and specifications of sewer projects. The guidance also gives design engineers a clearer understanding of EPD's expectation of the data required for approval in a typical review, and helps ensure that engineers design effective sewer systems. The guidelines will be periodically updated as standard methods for the design and installation of collection sewers are revised.

Requirements to Submit and Obtain Approval

The Georgia Rules and Regulations (391-3-6-.02(3)(2)) require that all sewer plans and specifications (P&S) be submitted and approved by EPD prior to construction. The only exception to this requirement is where the City/County in which the work will take place has been delegated by EPD to review sewers. The review of certain types of sewer projects may be delegated by EPD to local governments that have demonstrated the capability for such reviews. Sewer delegations are addressed further in Appendix D.

Plans and specifications must have the seal and signature of a professional engineer (PE) or registered land surveyor (RLS) who is registered in the State of Georgia. RLSs can only certify sewer P&S within a subdivision.

EPD has complied a list of common problems encountered during sewer reviews which is included as Appendix C. By avoiding these problems it may be possible to reduce the length of time it takes to get consensus with EPD on what constitutes an acceptable submittal.

Submittal Requirements

There are specific documents that must be submitted to obtain approval for a sewer project. A detailed list is attached as Appendix B. In general, the requirements include the Sanitary Sewer Extension Submittal form (SSES, Appendix A), design data, information about the capacity of the receiving sewer and wastewater treatment plant, and P&S that contain detailed design data. Incomplete/Inadequate submittals will be returned. The remainder of this guidance document is about information that should be reflected in the submittal.

Throughout this document, references are made to recognized product and installation standards.

STANDARD TERMS AND DEFINITIONS FOR GRAVITY SEWERS

Average Daily Flow (ADF) - The average daily flow is the average flow that occurs over a 24-hour period based on annual flow data. It is the total annual flow divided by 365 days.

Collector - Generally an 8" through 15" pipe that collects sewage from neighborhoods and groups of business and delivers sewage into a single, larger interceptor pipe.

Cleanouts - Cleanouts provide access to laterals for various maintenance tasks and are typically located at the upstream end of the lateral segment. The cleanouts are typically installed with wye fittings, brought to just below ground surface, and enclosed in a valve box. A cleanout is not the same thing as a manhole.

Inflow/Infiltration (I/I) - Seepage of groundwater/stormwater into the sanitary sewer system through pipe joints, cracks or openings in manholes of a gravity sewer system.

Interceptor - An interceptor sewer is generally a large pipe that gathers sewage flow from several smaller collector pipe connections and transports the sewage to a larger downstream infrastructure.

Lateral - A lateral is an extension from a building drain to a public sewer. A lateral is less than eight inches in diameter, does not contain manholes, may contain clean outs and is less than 250 feet in length.

Low Pressure – A method used to move residential wastewater by pumping through small diameter pipes to collection facilities.

Manhole – A covered opening in a street or other area that provides access for cleaning and repair of the sewer beneath. A manhole is not the same thing as a cleanout.

Peak Hydraulic Flow - The peak sustained hourly flow rate.

Sewer - A hydraulically designed, usually subterranean conduit used to transport wastewater. A sewer is eight inches or greater in diameter and/or contains manholes.

Septic Tank Effluent Pump (STEP) – A system that consist of a septic tank and effluent pump to convey wastewater to a treatment process plant.

Vacuum sewer – Vacuum sewers use differential air pressure to move sewage from residential areas to collection facilities.

CONFORMANCE WITH APPROVED SERVICE DELIVERY PLANS

EPD can only approve sewers that conform to the Department of Community Affairs (DCA)-approved Service Delivery Strategy for the City/County. DCA maintains service plans and other information on their website at http://www.georgiaplanning.com/planners/Sdmaps. Service delivery requirements only pertain to publicly owned sewers. Confirmation that the proposed sewer is in accordance with the approved Service Delivery Strategy is required as a part of the SSES (Appendix A).

PROTECTION OF POTABLE AND RECLAIMED WATER

One of the most important elements in sewer design is protection of the potable water system from contamination by sewage. Even though reclaimed water is not used for drinking or bathing, it is also

important to keep the highly treated reclaimed water, which is a high quality water, from being potentially degraded through contact with sewage. Many design criteria relate to protection of these waters.

No Cross-Connections
There can be no physical connections between a public or private potable water or reclaimed water supply system and a sewer, or appurtenance thereto which would permit the passage of any wastewater or polluted water into the potable or reclaimed water supply. No potable water or reclaimed water pipe can pass through or come into contact with any part of a sewer manhole.

Proximity to Water Supplies
Sewer lines cannot be placed within a body of water, particularly a water supply lake or reservoir. Whenever possible a sewer line that is to be placed adjacent to a water reservoir should be placed down gradient rather than up gradient of the reservoir embankment. It is recommended that ductile iron pipe be used when placement of the sewer line is adjacent to a water reservoir.

Required Separation of Sewer and Water Lines
The following paragraphs described the required separation between sanitary sewer lines and either potable or reclaimed water lines.

Maximum obtainable separation of reclaimed waterlines and potable water lines shall be practiced. A minimum horizontal separation of three feet (outside of pipe to outside of pipe) shall be maintained between reclaimed water lines and either potable water mains or sewage collection lines. A minimum of 18 inches shall be provided between the bottom of any potable water supply line and the top of the reuse line.

Sewers must be laid at least 10 feet horizontally from an existing or proposed water main. In cases where it is not practical to maintain a 10-foot separation, EPD may allow a deviation on a case-by-case basis, if supported by data from the design engineer. Supporting data could consist of documenting the presence of bedrock or a similar situation. Such deviation may allow installation of the sewer closer to a water main, provided that the water main is in a separate trench or on an undisturbed earth shelf located on one side of the sewer and at an elevation so the bottom of the water main is at least 18 inches above the top of the sewer.

Sewers crossing water mains shall be laid to provide a minimum vertical distance of 18 inches between the outside of the water main and the outside of the sewer. This shall be the case where the water main is either above or below the sewer. The crossing shall be arranged so that the sewer joints will be equidistant and as far as possible from the water main joints. Where a water main crosses under a sewer, adequate structural support shall be provided for the sewer to maintain line and grade.

When it is impossible to obtain proper horizontal and vertical separation, the sewer is to be designed and constructed equal to water pipe or either the water main or the sewer line may be encased in a watertight carrier pipe which extends 10 feet on both sides of the crossing, measured perpendicular to the water main. The section of the sewer in the vicinity of the water line must be pressure tested to 150 psi to assure watertightness.

Proximity to Septic Tanks
Sewer lines must not cross a septic tank nitrification field.

LOCATION AND SITE CONSIDERATIONS

Proximity to Wastewater Treatment Plant
Ideally wastewater transport to the wastewater treatment facility should be by means of a gravity sewer rather than by pump stations and force mains. Gravity sewers require a minimal amount of maintenance and require less energy to operate.

Site Conditions
Determine whether any existing site conditions such as bedrock, sinkholes, wetlands, abandoned sanitary landfills, etc., are present so avoidance or mitigation can prevent or reduce delays in the project construction. Check buffer requirements and erosion and sedimentation control plan and permitting requirements.

Stream Buffers
Sewers should not be installed within the 25-foot buffer of State waters or within 100 feet of trout streams. Additional local requirements may apply.

Karst Topography
If the project is located in an area where the state that has sedimentary rock formations and karst topography then special site investigations consisting of ultrasonic sounding of the construction and easement areas should be performed. Karst topography can cause differential settling of the trench area or a possible collapse of a section of the sewer line. The general location of karst topography can be determined by looking at the USEPA 2000 map entitled "Ecoregions of Alabama and Georgia." If the project is located in areas 65g, 65h, 65o, 67f, 67g, or 67 h, additional studies should be conducted. A map of the counties where karst topography has been identified is also attached as Figure 1 entitled *General Location of Karst Areas in Georgia.*

If the project is located in an area where karst topography has been identified, then a letter is required from a professional geologist registered in the State of Georgia stating that the site is either not located in Karst topography or that differential settling and/or sewer collapse due to karst topography is not likely to occur.

Landfills
None of the sewers, services or any other utilities can be constructed on, or serve structures constructed or proposed to be constructed on solid waste landfills.

Fault Zones
The design engineer needs to determine whether the sewer will be constructed in the vicinity of a fault zone. The location of fault lines can be determined by looking at the Georgia Geological Survey map titled Georgia Geologic Map. The major fault lines in the state are the Cartersville Fault, Brevard Fault, Rome Fault, Towaliga Fault, Goat Rock Fault and the Bartlett's Ferry Fault. The sewer should not be constructed perpendicular to a fault zone when ever possible due to the potential for deferential movement of the land. An example is the Carterville Fault line near Fairmount, Georgia. On the eastern side of the fault line the bedrock consists of sedimentary rock.

Differential movement along the fault has caused damage to sewers, water lines and railroad tressels. If a sewer needs to cross the fault line, the sewer should have flexible compensating gaskets installed and the sewer line should be supported in a spring adjusting pipe cradle.

Swelling Clays

The design engineer needs to determine whether the collection system will be constructed in the vicinity of a swelling clay area. Swelling clays have been discovered in Dougherty County. These clays act like Benonite clay expanding several times their size. Expanding clays can cause major deflections of a collection system, which could result in raw wastewater leaking into the ground.

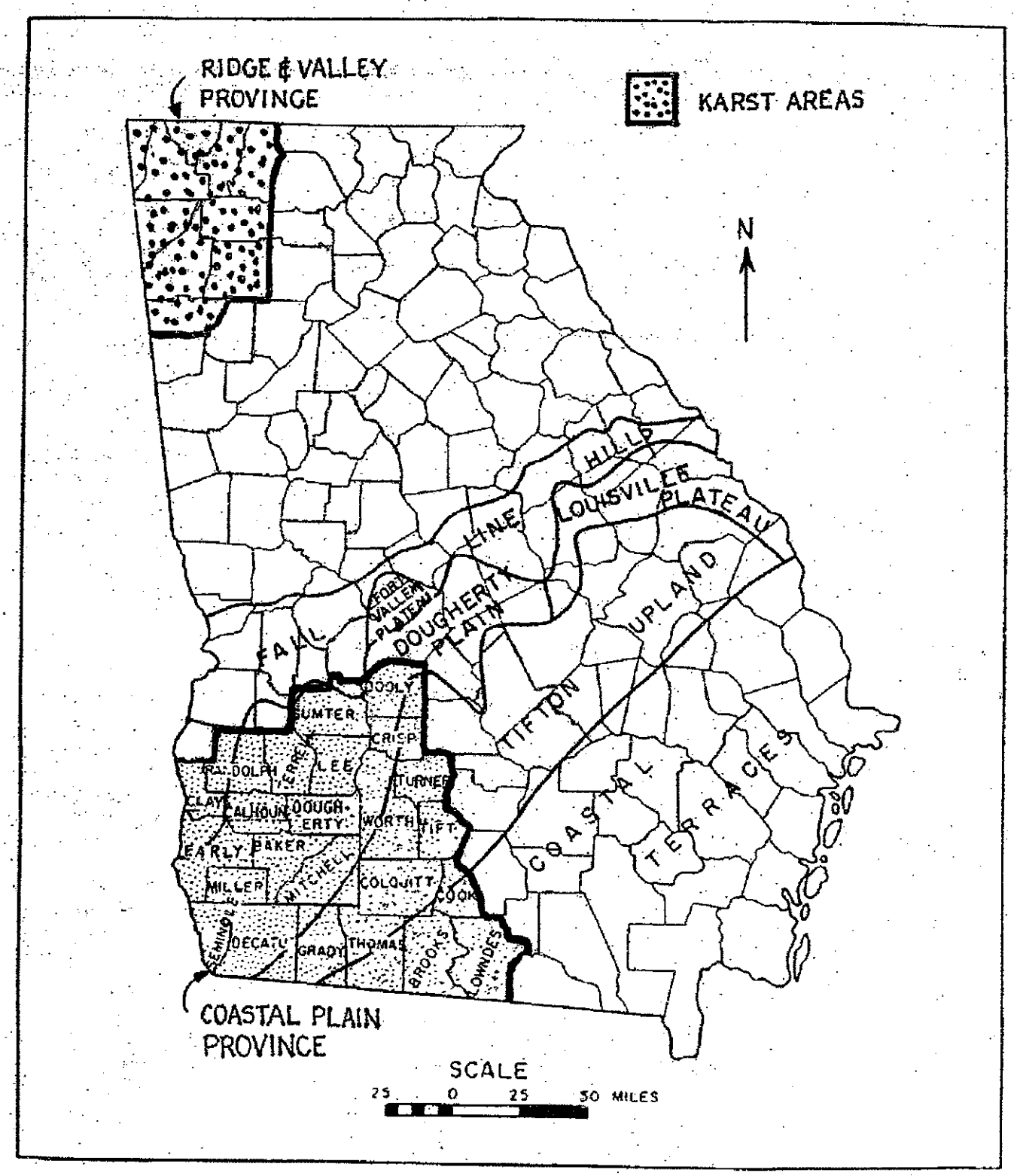

Figure 1 – General location of karst areas in Georgia

Stream Crossings

The top of all sewers entering or crossing streams must be at a sufficient depth below the natural bottom of the streambed to protect the sewer line. Sewer lines crossing streams should be designed to cross the stream as nearly perpendicular to the stream flow as possible and must be free from change in grade. Sewer systems must be designed to minimize the number of stream crossings. In general, the following cover requirements must be met:

1. One foot of cover where the sewer is located in rock.
2. Three feet of cover in other material. In a major stream, more than three feet of cover may be required. Buoyancy calculations should determine the potential for flotation. The design should also make provisions for stream erosion from high flow rates.
3. In paved stream channels, the top of the sewer line should be placed below the bottom of the channel pavement.

Aerial Crossings

Support must be provided for all joints in pipes utilized for aerial crossings. The supports must be designed to prevent frost heave, overturning, and settlement.

Precautions against freezing, such as insulation and increased slope, must be provided. Expansion jointing should be provided between above ground and below ground sewers. Where buried sewers change to aerial sewers, special construction techniques should be considered used to minimize frost heaving.

For aerial stream crossings, the impact of flood waters and debris shall be considered. The bottom of the pipe should be placed no lower than the elevation of the 50-year flood. Ductile iron pipe with mechanical joints is recommended.

Wetlands

The design professional whose seal appears on the drawings must certify that: 1) the National Wetlands Inventory maps have been consulted; and 2) the appropriate plan sheet does/does not indicate areas of United States Army Corps of Engineers jurisdictional wetlands as shown on the maps. If jurisdictional wetlands are indicated, the landowner or developer must obtain a Federal Wetlands Alteration (Section 404) permit prior to land disturbance of the protected wetlands. There are permits that may need to be obtained before initiating construction activity.

Landscaping

Trees and bushes should not be planted near the collection system. The plant roots may possibly enter the collection system at joints causing blockages and cracked pipes. However, some planting stabilizing the site after construction is usually required. The specifications must require that disturbed areas be restored to original or better condition, stabilizing the site erosion, and should define what constitutes an acceptable condition. Typically grass areas are considered acceptable when a viable stand of grass covers at least 98% of the total area with no bare spots exceeding one sq. ft. and the ground surface is fully stabilized against erosion. The specifications must define whose responsibility it is to install, water and maintain plantings until they reach an acceptable condition or until another defined milestone is achieved. It is also necessary to specify who is

responsible for the protection of tops, trunks and roots of existing trees that are to remain on the project site or in parks, lawns or other improved areas.

DESIGN AND CONSTRUCTION STANDARDS

Sanitary sewer infrastructure represents significant investment by the public. EPD works to protect this investment by review of proposed projects, using industry standard practices as the benchmark for acceptance. Sewers must be designed in accordance with acceptable provisions of recognized design references in general use. Recognized design references include:

WEF Manuals(s) of Practice,

ASCE Manuals and Reports on Engineering Practice,

Recommended Standards for Sewage Works, latest Edition, Great Lakes Upper Mississippi River Board of State Sanitary Engineers (10-State Standards),

Environmental Protection Agency (EPA) Publications,

WEF Journals, and

Other technical publications widely recognized in establishing design standards.

Wastewater Characteristics (Flow and Contents)

In designing sewers, average, peak and minimum flows are considered. Average flow is determined or selected and a factor applied to arrive at the peak flow, which is used for selecting pipe size. Minimum project flows should be checked to determine if particle suspension velocities can be maintained to prevent deposition of solids. Flow estimates must be based on industry standards and the industry standard reference should be documented in the submittal.

As an alternative to industry standard flow estimates, three consecutive years of flow data from a similar collection system may be considered for approval by EPD. The collection system should be similar in both function and size to the system for which the estimate will be used.

Type of Sewage and the Percent of Domestic Sewage

Determine the type and percentage of domestic, commercial and industrial wastewater collected in the sewer system. A BOD loading must be assigned to each type of wastewater, based on industry standards. The industry standard should be referenced in the submittal. Certain industries produce wastewater that is not suitable for domestic sewer without pretreatment. If the industrial portion of the sewage contains constituents the receiving wastewater plant is not equipped to handle, industrial pretreatment may be required.

Corrosive Nature of Sewage, Need to Line Receiving Manholes, Coatings

Sewage has the potential to create toxic and corrosive gases. Manholes and riser sections should be epoxy-coated in situations where high concentrations of hydrogen sulfide gas are likely to be expected. Where manholes receive pumped sewage or experience low flows or other conditions that create hydrogen sulfide gas, the interior of the manhole should be coated with a corrosion resistant coating.

Oil and Grease
Excessive oil and grease in the sewer is known to cause pump failures and sewage spills. Determine whether the City/County has an oil grease trap ordinance or program. If they do not have a program it is encouraged that they start one.

Materials of Construction
Sewers (pipe, fittings, joints and valves) must be constructed of cement- or epoxy-lined ductile iron, clay, PVC, HDPE or other material that is suitable for transportation of sewage that contains large concentrations of solids and is corrosive in nature. Valves must be specifically suited for sewage service. Material specifications should be in accordance with industry standards and should specifically reference ASTM or other nationally recognized material specifications. A list that includes some of the nationally recognized material specifications that are typically used is attached as Appendix E.

Bury Depth of Construction and Load Bearing Equations
All sewers shall be designed to prevent damage from superimposed live, dead and frost-induced loads. Proper allowances for loads on the sewer shall be made in accordance with soil and potential ground water conditions, as well as the width and depth of the trench. The weight of soil above the sewer and the weight and buoyancy forces associated with the water must be taken into account. Submit load bearing equations or other supporting information for burial depths of over 20 feet.

Minimum Gravity Sewer Pipe Size
No gravity sewer conveying raw wastewater shall be less than 8 inches in diameter. EPD will not allow sewer size of 6-inch to be installed in cul-de-sacs, on hilltops, etc.

Pipe Capacity Flow Diagram

The owner of the sewer must certify that there is adequate transport capacity is available to convey the proposed wastewater to the treatment plant. A pipe capacity diagram must be provided in the sewer calculations for the existing sewer into which the proposed sewer would be connected. Evaluate a minimum of the first 400 feet of sewer. In certain circumstances, the first 400 feet, refers to the first 400 feet of the next sewer section. The pipe capacity diagram must indicate the diameter, capacity, amount of wastewater currently being transported, amount of inflow/infiltration (I/I), pipe material, and date the sewer was installed. The diagram should show that the pipe capacity minus the existing flow, minus the proposed flow, minus I/I, results in a wastewater reserve flow. The downstream gravity sewer should be evaluated based on the peak flow from the proposed project as well as peak flows already tributary to the downstream gravity sewer.

GRAVITY SEWER SIZING FORMULAS

Chezy Formula
Most gravity sewers are designed to flow as open channels and not under pressure. When water enters a pipe or channel at a constant rate and discharges at the lower end, steady uniform flow will be established. Steady flow occurs when the same volume of liquid flows past any given point in each unit of time. Uniform flow is free from changes in velocity along the course of the conduit. In most sewer design, steady flow is assumed. Uniform flow may be expected in straight sewer lines,

but velocity changes will occur at obstacles and changes in cross section of pipe or channels which will need to be considered in making hydraulic calculations. Water flows downstream in a pipe or channel by the force of gravity. It will flow at a velocity that the head or fall will be used up in overcoming friction and in attaining kinetic energy or velocity head. The amount of friction that must be overcome varies directly with the roughness of the surface of the pipe or channel and directly with the area of the contact surface. This is approximately the square of the velocity and a factor of the density of the liquid. The contact surface is the wetted perimeter of the conduit multiplied by its length. These relationships can be expressed as a formula, which is known as Chezy formula.

$$V = C \times (R \times s)^{0.5}$$

V = Mean velocity in feet per second
R = Hydraulic radius or area of the stream divided by the wetted perimeter, feet
s = Slope of the hydraulic grade line or in open channels, the slope of the water surface for uniform flow (dimensionless)
C = Experimental coefficient, feet $^{0.5}$/sec

Since the effects of roughness and velocity are approximate values, the value of C is not constant but varies with V, R and s according to the Kutters formula, which is

$$C = (41.65 + 0.00281/s + 1.811/n)/(1 + (n/(R^{0.5}) \times (41.65 + 0.00281/s)))$$

In this formula the variable "n" is introduced, a dimensionless number. It is related to the roughness of the pipe or channel surface and affects the velocity inversely.

Values of "n" in the Kutter and Manning Formulas

"n"	Character of the Surface
0.009	Plastic Pipe
0.009	Well planed timber, laid evenly
0.010	Smooth cement, very smooth pipe
0.012	Unplaned timber, cast iron pipe of ordinary roughness
0.013	Well laid brickwork, good concrete, riveted steel pipe, well laid vitrified clay pipe
0.015	Vitrified tile and concrete pipe poorly jointed and unevenly settled, average brickwork
0.017	Rough brick
0.020	Smooth earths or firm gravel
0.030	Ditches and rivers in good order with some stones and weeds
0.040	Ditches and rivers with rough bottoms and much vegetation

Manning's Formula

An alternative way of determining the design pipe size is Manning's formula. After a design flow has been determined, pipe size is selected using Manning's equation. The pipe should be designed as if the pipe is flowing half full. The equation can be solved by selecting a pipe roughness coefficient and assuming a pipe size and slope. Manning's equation for selecting pipe size is:

$$Q = (1.486/n) \times A \times R^{0.67} \times S^{0.5}$$

Q = Design flow, mgd (ft^3/sec)
A = Area of the pipe (ft^2)
R = Hydraulic Radius (ft)
S = Slope of the hydraulic grade line or in open channels, the slope of the water surface for uniform flow.
n = Manning's value, a roughness coefficient of the selected pipe material or channel surface. Manning's "n" for this formula is the same as the Kutters "n."

Velocity

An important consideration in the design of sewers is the velocity of the wastewater in the sewers. A velocity of not less than 2ft/s is required to prevent solids from settling in the sewer. All sewers shall be designed and constructed to give mean velocities, when flowing full, of not less than 2 ft/s, based on Mannings formula using an "n" for the material selected.

Minimum/Maximum Slope

The following are recommended minimum slopes, which should be provided.

Sewer Size	Minimum Slope in Feet Per 100 Feet
8 inches	0.40
10 inches	0.28
12 inches	0.22
14 inches	0.17
15 inches	0.15
16 inches	0.14
18 inches	0.12
21 inches	0.10
24 inches	0.08
27 inches	0.067
30 inches	0.058
33 inches	0.052
36 inches	0.046
39 inches	0.041
42 inches	0.037

Where velocities greater than 15 feet per second are attained, special provisions shall be made to protect against displacement and erosion. Drop manholes and/or steel erosion plates can be constructed to reduce the impact of high velocity. For velocities greater than 15 feet per second,

erosion measures and line anchors must be documented on the "Record Drawings" and in the Engineer's Certification.

A drop manhole must be provided for a sewer entering a manhole at an elevation of 24 inches or more above the manhole invert. Where the difference in elevation between the incoming sewer and the manhole invert is less than 24 inches, the invert must be filleted to prevent solids deposition. Drop manholes must be constructed with an outside drop connection. When necessary, inside drop connections must be secured to the interior wall of the manhole and must provide access for cleaning. Inside drop manholes should be minimized and should require justification. Due to the unequal earth pressures that would result from the backfilling operation in the vicinity of the manhole, the entire outside drop connection must be encased in concrete. A high-strength concrete (greater than 4000 PSI) can be used to protect as well.

INSTALLATION

Minimum Soil Cover

Sewers shall be sufficiently deep to receive wastewater from basements, to protect the pipe from earth and live loads, and to prevent freezing. During grading it may be necessary for heavy construction equipment to travel over an installed pipe. Unless adequate protection is provided, the pipe may be subjected to load concentrations in excess of the pipe design loads. Before heavy construction equipment is permitted to cross over a pipe, an earth fill should be constructed to an elevation at least three feet over the top of the pipe. Under installed conditions the vertical load on a pipe is distributed over its width in accordance with the type of bedding. When the pipe strength used in design has been determined by factory testing, load factors must be determined to relate the in-situ supporting strength to the factory test strength. The load factor is the ratio of the strength of the pipe under installed conditions of loading and bedding to the strength of the pipe in the factory test.

In determining the required soil cover and live load transmitted to a pipe installed under railroad tracks, an airport runway or a highway it is recommended that reference should be made to Chapter 4 of the American Concrete Pipe Association – Design Manual. Calculated design live loads will indicate to the designer the proper strength of the pipe needed.

Alignment

Sewers 24 inches or less in diameter shall be laid with straight alignment between manholes. Straight alignment shall be checked by either using a laser beam or lamping. Each segment between manholes must show at least 90 percent of the full pipe circle visible when looking from manhole to manhole. If unacceptable sags are detected, the pipe must be taken up and relaid.

Trenching

All excavation should be open cut. Topsoil or A horizon soils may be removed by machine methods. B horizon soils may also be removed by machine methods but should be supplemented by hand dressing or leveling as may be required to conform to line and grades. Ideally, the bottom of trenches should be shaped and compacted to the contour of the outside of the pipe. At the least, the barrel of the pipe should be supported along its entire length.Any pipe that rests directly on rock is subject to breakage or damage under the weight of backfill, live loads or soils movements. In rocky trenches, place a minimum four-inch layer of selected backfill material to provide bedding for the pipe. To accomplish this, rock should be excavated below the required grade and at least four inches of select fill used to bring the pipe to grade.

Where pipes are encased in concrete or placed in a carrier pipe, details must be provided, and the starting and stopping points of special construction must be clearly identified on the plan and profile sheets.

Trench Dewatering

Trenches must be dewatered for sewer pipe laying. Crushed stone or gravel may be used as a subdrain to aid in drainage to a trench or sump pumps. It is a good practice to provide clay dams in the subdrain to minimize the possibility of undercutting the sewer from excessive ground water flows. An excessive amount of ground water may require the use of a well point pumping system. This system consists of a series of perforated pipes driven or jetted into the water bearing soil on either side of the trench and connected with a header pipe leading to a pump. The water produced by dewatering shall be disposed of in an environmentally sound manner and shall not create sediment or erode adjacent areas. If water from dewatering is to reach waters of the State, an NPDES permit is required.

Rigid Pipe Bedding

Bedding classes A, B, and C as described in ASTM C 12, or Types 3, 4, and 5 as described in AWWA C151, shall be used and compacted for all rigid pipe provided the proper strength pipe is used with the specified bedding to support the anticipated load, based on the soil encountered and the potential ground water conditions. Bedding types where the barrel of the pipe is laid directly on undisturbed soil are not acceptable.

Flexible Pipe Bedding

PVC gravity sewer must be bedded in accordance with the requirements of Laying Conditions Types 3, 4 or 5, of ASTM D 2321 or an equally stringent standard.

Embedment Materials for Bedding, Haunching and Initial Backfill

The specification should reference ASTM D 2321 and D 2487, and should contain a narrative defining suitable and unsuitable bedding and backfill materials based upon the Unified Soil Classification System (USCS). Suitable and unsuitable soils are then specified by the USCS lettering system. For both Type 3 and Type 4 bedding, embedment material must be compacted to a minimum of 85% Standard Proctor for GW, GP, SW and SP soils and a minimum of 90% Standard Proctor for GM, GC, SM, SC, ML and CL soils. Water compaction is not allowed.

Where specified, provide a State of Georgia reference for #57 stone (ASTM C 33), # 67 stone (ASTM D 448), Construction Exit Stone, # 1, ASTM D 448 (if applicable) or Ga. DOT Section 800.

Haunching

The soil placed at the sides of a pipe from the bedding up to the spring line is the haunching. For flexible pipe, compaction of the haunching material is essential. For rigid pipe, compaction can ensure better distribution of the forces on the pipe. Material used for sewer pipe haunching should be shovel sliced or otherwise placed to provide uniform support for the pipe barrel and to fill completely all voids under the pipe. Material used for haunching may be crushed stone or sand, or a well graded granular material of intermediate size. Sand should not be used if the pipe zone area is

subject to a fluctuating groundwater table or where there is the possibility of the sand migrating into the pipe bedding or trench walls.

Backfill
In improved streets or streets that are to be paved, a modified Proctor density test should be required. Boulders or loose rocks, which might bear against the pipe, will not be allowed in the trench bottom or in the backfill to a depth of two feet above the pipe. Bottoms of the trench, which are loose granular soils, should be compacted by a hand vibratory compactor. All forms, bracing, lumber and debris should be removed before backfilling. Backfill in trenches where pipe has been laid should be placed in layers and thoroughly consolidated around the pipe to a height of eighteen inches above the top of the pipe. This backfilling must be done before any fill is deposited directly from a machine bucket, crane, truck or other vehicles. In all cases the bucket must be lowered so that the shock of falling soil will not damage the pipe.

Final Backfill
Final backfill shall be of a suitable material removed from excavation except where other material is specified. Debris, frozen material, large clods or stones, organic matter, or other unstable materials shall not be used for final backfill within 2 feet of the top of the pipe. Final backfill shall be placed in such a manner as not to disturb the alignment of the pipe.

Compaction
Compaction must be specified and method and test frequency, using Proctor or Modified Proctor, for all but granular material. The level of compaction, size of lifts, and compaction test frequency must be specified or indicated on the drawings. Hand tamping is acceptable for granular material only.

Pipe Joints
The installation of joints and the material used shall be included in the specifications. Sewer joints shall be designed to minimize infiltration and to prevent the entrance of roots.

Jack & Bore
Whenever possible collection lines should be jacked or bored under a highway. Installation of a jack and bore should be consistent with Georgia DOT Standard Specifications Section 615. All jacking or boring under highways must be coordinated with the applicable City, County or State transportation department.

Road Crossing /Pavement Repair
All pavement restoration should be in accordance with Georgia DOT requirements.

Piers
Support shall be provided for all joints in pipes utilized for aerial crossings. The support shall be designed to prevent overturning and settlement. Expansion jointing shall be provided between above ground and below ground sewers.

Concrete Anchors
Sewers with a velocity of 15 FPS or higher or 20 percent slopes or greater shall be anchored securely with concrete anchors spaced as follows:

1. Not over 36 feet center to center on grades 20 percent and up to 35 percent.
2. Not over 24 feet center to center on grades 35 percent and up to 50 percent.
3. Not over 16 feet center to center on grades 50 percent and over.

Buoyancy
Buoyancy of sewers shall be considered and floatation of the pipe shall be prevented with additional soil cover and/ or concrete anchor blocks where high ground water conditions are anticipated.

Erosion and Sedimentation & Siltation
An erosion and sedimentation control plan must be prepared for each sewer project. However, there are specification requirements for erosion and sediment control (see Appendix B) and if the project involves disturbing an acre or more of land, the owner must file a Notice of Intent (NOI) to be covered under one of the NPDES general construction permits (GAR100001, GAR100002, or GAR100003). Information about filing requirements and a copy of the General Permits can be found at www.gaepd.org/Documents/techguide_wpb.html#sw. Erosion and Sedimentation details should be submitted to EPD. EPD don't review E&S plans or details, but details should be included.

Construction methods that minimize siltation and erosion shall be employed. The design engineer shall include in the project specifications the method(s) to be employed in the construction of sewers in or near streams. Such methods shall provide adequate control of siltation and erosion by limiting unnecessary excavation, disturbing or uprooting trees and vegetation, dumping of soil or debris, or pumping silt-laden water into the stream. Specifications shall require that cleanup, grading, seeding, and planting or restoration of all work areas begin immediately. Exposed areas shall not remain unprotected for more than seven days. No more than 500 linear feet of trench shall be opened at a time.

Manholes
Manholes must be installed at the end of each sewer line and at changes in grade, size, alignment and intersections. Sewers must maintain a uniform slope between manholes. Manholes must have a minimum of 0.05 ft drop between the inlet and outlet.

Manholes Distances
Manholes must be placed at distances not greater than 400 feet for sewers 15 inches or less in diameter, and 500 feet for sewers 18 inches to 30 inches, except that distances up to 600 feet may be approved in cases where adequate cleaning equipment for such spacing is provided. Greater spacing may be permitted in large sewers. Cleanouts may be used in lieu of manholes for 6-inch private sewer lines with distance between cleanouts not to exceed 100 feet.

Diameter
The minimum diameter of manholes should be 4 feet. Larger diameters are preferable for large diameter sewers. A minimum access diameter of 22 inches should be provided. The minimum diameter for inside drop manholes shall be 5 feet.

Flow Channel and Bench
The flow channel straight through a manhole shall be made to conform as closely as possible in shape, and slope to that of the connection sewers. The channel walls shall be formed or shaped to three quarters (3/4) of the height of the crown of the outlet sewer in such a manner as to not obstruct maintenance, inspection or flow in the sewers. A bench shall be provided on each side of any manhole channel when the pipe diameters are less than the manhole diameter. The bench shall be sloped no less than 1/5 inch per foot (4 percent). The invert elevation of any lateral sewer, service connection, or drop manhole pipe shall be above the bench surface elevation. No invert shall be located directly on the surface of the bench.

Watertight Manholes
Manholes should be of either pre-cast concrete or cast in place concrete that is poured in place. Manhole lift holes and grade adjustment rings should be sealed with non-shrinking mortar or other suitable material.

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

Watertight manhole covers are to be used wherever the manhole tops may be flooded by street runoff or high water. Watertight manholes tops are gasketed and bolted in place. When the manhole is located outside a street or throughway, the top of the manhole can be set above the 100-year flood or high water elevation. Locked or spot-welded covers may be desirable in isolated easement locations or where vandalism may be a problem.

Corrosion Protection for Manholes
Manholes and riser sections should be epoxy coated in situations where high concentrations of hydrogen sulfide gas are expected. . Where corrosive conditions due to septicity or other causes are anticipated, consideration shall be given to providing corrosion protection on the interior of the manholes.

Special attention must be given to the termination of a forcemain to minimize turbulence and the resulting release of hydrogen sulfide gas.

a) Termination into the gravity sewer manhole should align the crown of the forcemain with the crown of the sewer at the receiving manhole with the 90-degree bend of the forcemain directed upward. If the gravity sewer manhole is too deep, a connection manhole and a short section of gravity sewer with a standard outside drop inlet should be provided.

b) If the termination of the gravity sewer or force main does not enter the pumping station wetwell (precast manhole) at the pump off level, an inside drop inlet may be used where suitable.

Manhole Vacuum Test
Manholes must be tested separately from sewer lines. A vacuum test shall be performed on each manhole to assure water-tightness in accordance with ASTM C 1244. As an alternative the manhole can be filled with water and allowed to stand for 24 hours. The test is considered acceptable if the

water level has not changed more than ¼ inch over that period. Pre-wetting of the concrete is recommended.

Concrete
Concrete must have strength of 4,000 PSI at 28 days. Reinforcement shall be as specified in ASTM C478.

Precast Concrete
Precast concrete manholes should consist of precast reinforced concrete sections, a conical flat slab top section. Precast manhole sections are to be manufacture tested and marked in accordance with ASTM C-478. Maximum allowable absorption of concrete is not to exceed eight percent of dry weight.

Verify that the following items have been addressed in the plans and specifications:

Other manhole types that may be acceptable are polyethylene or brick. If used, the material, strength, and components should be specified in detail, and the foundation and connection details must be coordinated. Ensure that details are added to the plans.

Venting
Manholes may be vented in an effort to release a buildup of gases such as hydrogen sulfide and methane. Manholes shall be vented 24 inches (2 foot) above the 100-year flood elevation. The top of the vent pipe should be curved in a U shape, with the outlet hole of the pipe located above the 100-year flood elevation. Manholes shall be vented every 1,000 feet or every other manhole, whichever is greater.

TESTING

Alignment
Straight alignment shall be checked by either using a laser beam or lamping. Each segment between manholes must show at least 90 percent of the full pipe circle visible when looking from manhole to manhole.

Deflection
Deflection tests shall be performed on all flexible pipes. The test shall be conducted after the final backfill has been in place at least 30 days to permit stabilization of the soil-pipe system.

No pipe shall exceed a deflection of 5 percent. If deflection exceeds 5 percent, replacement or correction should be made.

The rigid ball or mandrel used for the deflection test shall have a diameter not less than 95 percent of the base inside diameter or average diameter of the pipe depending on which is specified in the ASTM specification, to which the pipe is manufactured. The pipe shall be measured in compliance with ASTM D 2122 Standard Test Method of Determining Dimensions of Thermoplastic Pipe and Fittings. The test shall be performed without mechanical pulling devices.

Pressure and Leakage Testing

I/I Exfiltration Test

Leakage testing shall include appropriate specifications for hydrostatic or low pressure air testing. The testing methods selected should take into consideration the range in ground water elevations during the test.

The leakage exfiltration or infiltration from hydrostatic (water) testing shall not exceed 25 gallons per inch of pipe diameter per mile per day (0.019 cubic meters per millimeter of pipe diameter per kilometer per day) for any section of the system. An exfiltration or infiltration test shall be performed with a minimum positive head of 22 feet (610 mm).

Low Pressure Air Testing

A low pressure air test may also be used to detect leaks in sewers where hydrostatic testing is not practical. As an example, if an adequate supply of water is not readily available, the hydrostatic test should not be used and the air test used as an alternate.

Two air test methods used are the constant pressure method and the time pressure method. The time pressure drop method is the most commonly used method. The constant pressure method utilizes an airflow measuring device operated at 3 psi greater than the average back pressure of the groundwater. In the time pressure drop method, the air supply is disconnected and the time required for the pressure to drop from 3.5 psi to 2.5-psi gauge is determined. The air tests should conform to ASTM C 828 for clay pipe and ASTM C 924 for concrete pipe. For PVC or other plastic material pipe, the minimum time required for a 0.5-psi drop from 3.5 psi to 3 psi should conform to Uni-Bell, UNI-B-6.

Damaged Material (Hauling, Delivery and Storage of Pipes)

Cracked or damaged pipe material must not be used and should be properly disposed. In all handling operations, care shall be exercised to avoid damage to the pipes and fittings. All pipes shall be stored according to manufacturer's recommendations.

APPENDIX A

Department of Natural Resources, Environmental Protection Division (EPD)-Watershed Protection Branch

SANITARY SEWER EXTENSION SUBMITTAL FORM (SSES)

Submit this form to:
Engineering & Technical Support Program
4220 International Parkway, Suite 101; Atlanta, Georgia 30354
or
Applicable EPD District Office

(Assistance with this form: An explanation of each required entry is provided at the end of this form. Example letters for items 7 and 8 are included as attachments. For sanitary sewer design criteria see EPD's "*Guidelines for Sewage Collection Systems*" (Guidance) at www.gaepd.org.) Incomplete/Inadequate submittals will be returned.

Submitted for review pursuant W. Q. Rules section 391-3-6-.02(3)(a) are this form and (as applicable, check all that apply and are included):

[ ] Project description, design data (one copy; project narrative; assumptions; flow, loading calculations and pipe capacity flow diagram calculations)

[ ] Plans (one copy; general map of proposed sewer extensions, outlined proposed service area, connection to the existing system, flood plain contours, line plan and profiles, details, see Guidance for other plan requirements)

[ ] Project–specific or [ ] Standard Specifications (one copy; see Guidance for specification requirements)
City/county name of standard specifications _____

[ ] Certified statement as indicated in Item 7

[ ] Certified statement as indicated in Item 8

[ ] Certified statement as indicated in Item 9

1A. Name of local government _____

1B. Local government official _____

Mailing
Address _____

City, County, State, Zip Code _____

1C. Project name or identification _____

1E. Designing engineer(s) _____

GA P.E. # _____ Expiration Date _____

_____
Mailing Address

2A. Wastewater treatment plant to which extensions are tributary

Name _____

Permit flow _____MGD Permit # _____

2B. List by month the average daily flow (MGD) and effluent concentration (mg/l) for 5-day biochemical oxygen demand (BOD_5) and total suspended solids (TSS) for the immediately preceding 12 months (as shown on the discharge monitoring reports (DMRs)) of the wastewater from the facility that will receive this sewage.

Month/Year	Flow	BOD_5	TSS

3A. Name of developer (if not a local government, a certified statement as indicated in 7 is required with this submittal). See attached example.

_____

Developer Name

_____

Mailing Address

_____

City, County, State, Zip Code

3B. Proposed service area (this project).

Immediate _____ acres; Ultimate _____ acres

3C. Type of developments: (check as applicable)

Industrial _____ Residential _____ Commercial _____ Other_____ (explain)

3D. Population to be served

Population _____ Density/acre _____

3E. Per capita wastewater contribution

Average _____ GPD Peak_____

3F. If receiving commercial/industrial wastewater, describe commercial/industrial waste characteristics.

_____

_____

_____

_____

Quantity _____ GPD. Describe pretreatment received (if any): _____

_____

(use extra sheet if needed)

4A. Average Design Flow (this project) _____ GPD; Peaking factor _____

Peak Hydraulic Flow (this project) _____ GPD

4B. Design BOD_5 Average (this project) _____ lbs/day

4C. List nominal pipe diameter, length, and type for each diameter

_____

_____

_____

_____

4D. Quantity, capacity (GPM), total dynamic head (feet) and type of pumps (if any)

_____

_____

(Submit pump manufacturer, head and system curves, and design calculations, and pipe capacity flow diagram with this form.)

5. Source of project funding

_____

6. Name of the local government who will own and maintain the proposed sewers if it is different from the authority responsible for treatment of wastewater from this project.

   Name_____

7. Provide a certified statement by the authority responsible for treatment of wastewater from the project stating: a) it has reviewed this project, b) it has adequate transport and treatment capacity to treat wastewater from this project, c) is willing to accept the project wastewater for treatment, d) all provisions of erosion and sediment control program will be enforced.

8. Provide a certified statement by the local government who will own and maintain the proposed sewers that the sewers are not constructed on or serving structures constructed or proposed to be constructed on solid waste landfills.

9. If the sewer is for a City/County, provide a certified statement from an authorized City/County official, within whose service area the sewer will reside, that the project conforms to the Department of Community Affairs-approved Service Delivery Strategy for the City/County.

10. Provide a pipe capacity diagram as part of the sewer calculations for the existing sewer into which the proposed sewer would be connected. Evaluate a minimum of the first 400 feet of existing sewer. The pipe capacity diagram must indicate the diameter, capacity, amount of wastewater currently being transported, the wastewater flow promised to other new users, amount of inflow/infiltration (I/I), pipe material, and date the sewer was installed. The diagram should show that the pipe capacity minus the existing flow, minus the proposed flow, minus I/I, results in a wastewater reserve flow.

To the best of my knowledge, I certify that the above information is true and correct.

Signature_____

Signature of Responsible Local Official/Permittee

Name (Print)_____

Title or Position

_____

Date

_____

Information Sheet
Sanitary Sewer Extension Submittal

The following information is provided to help you understand the reasons that a form must be completed and accompany each sanitary sewer extension request.

Question: Why is a form needed?

Answer: To enable us to process the extension request efficiently and to let us know if further review information is needed.

Question: How does one complete the form?

Answer: Each question is addressed by number. Refer also to **"Guidelines For Sewage Collection Systems (Guidance) at www.gaepd.org.**

1A. The name of the local government in which the proposed sewer extension will be located. The name of the local government official whom the correspondence should be addressed to.

1D. The name of firm which prepares the sewerage plans and specifications. The name of the signed Georgia registered professional engineer on the plans.

2A. The name of the wastewater treatment facility to which the proposed sewer extension(s) will be tributary. Permitted flow in million gallons per day to the wastewater treatment facility listed in 2A.

2B. From the discharge monitoring reports for the wastewater treatment facility, list the appropriate month, flow, biochemical oxygen demand (BOD_5) and total suspended solids (TSS) for the 12 months preceding the sewer extension submittal.

3A. The name and address of the developer (firm) requesting the sewer extension. If the party responsible for initiating the sewer extension request is not a local government, a certified statement as indicated in 8 will be required.

3B. Immediate acres to be served by this project includes development directly tributary to the proposed sewer extension. Ultimate acres to be served by this project includes development that will be tributary to the proposed sewer extension in the future.

3D. Population density for the immediate service area should be listed. Dividing the population served by the immediate acres should equal the density per acre.

3E. Average gallons per day per capita wastewater contribution should be based on realistic, preferably documentable data for residential development and documentable, equivalent

flows for commercial and industrial development. The peaking factor should reflect documentable flow data for the appropriate types of development.

3F. List pollutants and their concentration in mg/l and quantity in gallons per day of industrial wastewater discharging to the proposed sewer extension. Briefly describe the industrial pretreatment process employed.

4A. The average flow in gallons per day for the proposed sewer extension for the immediate service is calculated. The second blank shows either the capacity of the sewer pipe for the proposed sewer extension or the ultimate flow in gallons per day if it is less than the pipe capacity.

4B. Biochemical oxygen demand (5-day) for the immediate service area.

4C. A list of nominal pipe diameters to be used in this project is placed in this blank (8-inch, 12-inch, etc.).

5. List agencies which are funding the project; i.e. local, private, FmHA, CDBG, DCA, GEFA, SRF, etc.

6. The EPD requires all sewers to be owned and maintained by the local government which extensions are tributary to.

7. The local government must provide a certified statement that it is willing to accept ownership of the extension and, the project wastewater for treatment. The local government that has erosion and sediment control permitting program must certify that all provisions of program will be enforced.

8. The EPD requires certification that the proposed sewers are not constructed on or serving structures constructed or proposed to be constructed on solid waste landfills.

9. By law EPD can only approve sanitary sewer construction that is in accordance with the DCA-Approved Service Delivery Strategy.

ATTACHMENT NO. 1

(Example Letter for Item 7)

Date_____

Georgia Environmental Protection Division
Engineering & Technical Support Program
4220 International Parkway, Suite 101
Atlanta, Georgia 30354

RE: (Name of Project)

Dear Sir/Madam:

This is to certify that (a) the (name of local government) has reviewed this project, that (b) (name of local government) has adequate transport and treatment capacity to treat wastewater from this project, (c) (name of local government) is willing to accept the project wastewater from the project for treatment and (d) (name of local government) ensures that all provisions of applicable erosion and sediment control programs will be enforced and will own and maintain.

Sincerely,

(Signature and Title of Responsible Local Government Official)

ATTACHMENT NO. 2

(Example Letter for Item 8)

Date_____

Georgia Environmental Protection Division
Engineering & Technical Support Program
4220 International Parkway, Suite 101
Atlanta, Georgia 30354

RE: (Name of Project) _____

Dear Sir/Madam:

This is to certify that according to the records of the (name of local government), none of the sewers, services or any other utilities associated with this project are constructed on or serving structures constructed or proposed to be constructed on solid waste landfills.

Sincerely,

(Signature and Title of Responsible Local Government Official)

APPENDIX B

DETAILED LIST OF SUBMITTAL REQUIREMENTS

1. Sanitary Sewer Extension Submittal Form (SSES) with attachments
    a. Proximity to landfill letter
    b. Wastewater treatment capacity (and erosion and sedimentation control) letter
    c. Downstream capacity diagram
    d. Confirmation the project conforms to the Department of Community Affairs-approved Service Delivery Strategy for the City/County
2. Design basis
3. Construction specifications (see list below) or requirement to construct in accordance with an approved set of City/County construction specifications (When standard specifications are used, some project specific specifications may still be required.)
4. Construction drawings (see list below)

MINIMUM CONSTRUCTION SPECIFICATIONS (RECOMMENDED LIST)

1. Title page with PE seal and signature
2. Scope of work
3. General conditions
4. Safety Ensure that work along roadways shall be in compliance with all of Georgia Department of Transportation with reference to construction operations, safety, traffic control, road maintenance and repair.
5. Clearing and grubbing
6. Protection of existing underground utilities
7. Construction along highways, streets and roadways
8. Removal and restoration of pavement
9. Erosion and sediment control
10. Demolition
11. Dewatering
12. Excavation and compaction
13. Pipe laying and alignment
14. Pipe materials and properties, pipe fittings, pipe accessories
15. Pipe bedding and backfilling
16. Pipe inspection and testing
17. Manholes
18. Protection and restoration of the work area
19. Grassing

MINIMUM CONSTRUCTION DRAWINGS
(RECOMMENDED LIST)

1. Cover sheet with drawing index and PE seal and signature
2. Topographic plan of the work area with north arrow, drainage areas, sewer route, streams, drainage swales, wetlands, 100-year flood plain and elevation, and other features
3. Plan and profiles of the sewer lines
4. Grading of disturbed areas
5. Details are required for the following if applicable:
    a. Tie-in to existing sewer or manhole
    b. Standard precast manhole
    c. Drop manhole
    d. Manhole step
    e. Standard manhole ring and cover
    f. Manhole top if located within the flood plain
    g. Pipe bedding and backfill
    h. Thrust blocking (force mains)
    i. Aerial stream crossings (include pier details)
    j. Buried stream crossings
    k. Jack and bore
    l. Concrete encasement
    m. Carrier pipes
    n. Transition collars
    o. Anchors
    p. Pavement patching
6. Erosion and sediment control – It is not a requirement to submit erosion and sediment control drawings with the sewer package to ETSP. However, if the project involves disturbing an acre or more of land, the owner must file a Notice of Intent (NOI) to be covered under one of the NPDES general construction permits (GAR100001, GAR100002, or GAR100003). Information about filing requirements and a copy of the General Permits can be found at www.gaepd.org/Documents/techguide_wpb.html#sw.

NOTE: All drawings should be to scale with the scale displayed or noted except for some standard details such as bedding and backfill, transition collars, etc. Inadequate submittals will not be reviewed and will be returned.

APPENDIX C

Gravity Sewer Submittal
Common Problems List

8/24/10

COMMON PROBLEMS

(This is not a cookbook recipe for preparing gravity sewer plans and specifications (P&S) for submittal to EPD, but is a list of the common problems we see that have to be resolved. By avoiding these problems, we hope to reduce the length of time it takes to get consensus between the submitter and EPD on what constitutes acceptable gravity sewer P&S.)

1. If publicly owned, the project is not consistent with the Department of Community Affairs-approved Service Delivery Strategy for the area.
2. P&S not signed and sealed by an engineer registered in the State of Georgia.
3. Satisfactory Sanitary Sewer Extension Submittal (SSES) form not furnished.
4. SSES incomplete, unsigned, or inconsistent.
5. Certification of treatment capacity and Erosion and Sedimentation (E&S) control not provided.
6. Certification that the sewer and structures tributary to it will not be built in a landfill not furnished.
7. Sewer owner not defined.
8. Flow estimate inaccurate or not in accordance with industry standards.
9. Pipe Capacity diagram to be included in the sewer calculations.
10. BOD loading estimate inaccurate or not in accordance with industry standards.
11. Receiving WPCP has capacity and/or compliance issues.
12. E&S specifications not provided.
13. Requirement to start E&S controls with the initiation of land disturbing activities not included.
14. Sewer does not cross stream at near-90 degree angle.
15. Stream buffer variance appears required and is not addressed.
16. P&S not finished and/or missing the work of a discipline such as civil.
17. Documents not checked and revised prior to submittal. (EPD cannot provide QA/QC.)
18. Gravity sewer profiles not provided.
19. Piping not shown in adequate detail (elevation, size, material, industry standard specification, etc.).
20. Water and utility crossings not shown on profile.
21. Insufficient pipe details provided for items such as stream crossings, jack and bore, and tie-ins. Details inadequate or not in accordance with standard industry practices.
22. Specifications are not project-specific or contain information for other, unrelated work.
23. Utilities Locators (Utilities Protection, Inc., "Call Before You Dig", 800-282-7411, or 811) not called out in the plans or in the specifications.
24. Topographic map showing 100-year flood plain, proposed gravity sewer route, streams, drainage swales, wetlands and other features not provided.
25. 100-year flood plain elevation not identified.
26. Plans views not provided with north arrow.
27. Drawings not to scale or the scale is not called out.
28. Clearing and grubbing not addressed.
29. Dewatering not addressed.
30. Bedding material not defined or not defined in accordance with industry standards.
31. Specified materials are not referenced to industry standards.
32. Specifications do not prohibit the spill of sewage during construction and testing to grade, trench, or waters of the State.
33. Appurtenances such as pipe supports, wall sleeves, tie-in boots, etc., not specified.
34. Work not required to be done in accordance with OSHA standards.
35. Site appears subject to Karst topography or swelling clays and supporting information from a registered geologist indicating the site is suitable has not been furnished.
36. Information demonstrating that the receiving sewer has adequate capacity to accept the project flows not provided.

37. Sewer and potable water lines not separated 10 feet horizontally and/or 18 inches vertically, with the water line on top.
38. Sewer is less than 8 inches in size.
39. Sewers not straight or not run at a uniform slope between manholes.
40. Sewers do not have adequate capacity (size and slope) to transport project flow.
41. Distance between manholes is over 400 feet.
42. Sewers velocity is under 2 FPS.
43. Sewers at 15 FPS or 20 percent slope and above are not anchored.
44. Sewers materials and/or coatings with suitable corrosion resistance not specified.
45. Flexible boot or other connector between sewer and manhole not specified or detailed.
46. Drop manholes not provided for incoming sewer pipes more than 2 feet above the manhole invert.
47. Manhole bottom not channeled and benched for incoming sewer pipes.
48. Manholes, manhole grout or gaskets, ladder rungs, and covers not detailed or not specified to industry standards.
49. Manhole diameter is less than 48 inches.
50. Manhole cover opening is less than 22 inches.
51. Manhole ladder rungs not slip-proof.
52. Manholes within the 100-year flood plain not specified with bolt-down and gasketed covers, or required to have top elevations a minimum of 2 feet above the flood plain.
53. Deep-buried sewers not constructed of high strength material.
54. Stream crossings not constructed of high strength material such as ductile iron pipe.
55. Aerial crossings not provided with concrete piers, or pier design not furnished.
56. Aerial crossing bottom of pipe set below the 50-year flood elevation.
57. Buried stream crossings not protected by a casing, concrete encasement, riprap, or other.
58. High loading areas such as traffic crossings not protected by a casing and/or high strength pipe material.
59. Tie-in to the existing sewer not detailed.
60. Requirement to take up and relay pipe disturbed after installation not included.
61. Burial depth is less than 36 inches above the top of pipe.
62. Locator tape and detector wire not required and/or specified for non-metallic pipe.
63. Plastic pipe not bedded per ASTM D 2321.
64. Ductile iron pipe not bedded per ASTM D 2321, AWWA C151, ASTM C 12, or other industry standards.
65. Gravity sewer pipe laid directly on undisturbed earth (example: Class D bedding, ASTM C 12).
66. Bedding details not adequate or not in accordance with industry standards.
67. Bedding, haunching and backfill material not specified or not in accordance with industry standards.
68. Compaction not specified.
69. Alignment testing by laser or lamping during construction not required.
70. Mandrel test not specified for non-metallic pipe, or not required a minimum of 30 days after the completion of construction.
71. Acceptable mandrel deflection not limited to 5%.
72. Pressure testing or infiltration/exfiltration testing not specified.
73. Sewers not low-pressure tested per ASTM F 1417 or high-pressure tested per AWWA C600, C605, or other industry standards.
74. Infiltration/exfiltration testing not specified to ASTM C 969, C 1091, or another industry standard, with the exception that leakage must be limited to 25 GPD/inch of diameter/mile.
75. Manholes not vacuum tested per ASTM C 1244 or not hydraulically tested to leak less than ¼ inch of level over 24 hours.
76. Site restoration not addressed or not specified to industry standards.
77. Transportation work along roadways shall be in accordance with the applicable regulations of the Georgia Department of Transportation with reference to construction operations, safety, traffic control, road maintenance and repair.

APPENDIX D
HOW TO OBTAIN SEWER DELEGATION

1.0 PURPOSE

Pursuant to the *Rules and Regulations for Water Quality Control,* Chapter 391-3-6 paragraph .02, the Environmental Protection Division (EPD) can delegate the review and approval of certain types of sewer system extensions to local governments that have demonstrated the capability for such review and approval. This delegation of responsibilities to local governments means the local governments are authorized by the Division to review and approve the sewer extensions for construction. Sewer systems include: new systems, extensions to new areas and replacement sanitary sewers. Types of sewer systems are limited to: gravity sewers, force mains and pumping stations.

Sewers in the Metropolitan River Protection Act area are excluded from delegation if the sewers are within 2,000 ft. of the Chattahoochee River. EPD may elect to enter into a delegation agreement for reclaimed water transmission lines with communities that have the capability to review their reuse system extensions. Delegations are generally written for sewers up to 36-inch diameter and pump stations with a capacity of less than 700 gallons per minute. EPD may consider delegating larger size sewers and pump stations.

2.0 STANDARD SPECIFICATIONS AND EPD REVIEW

EPD will not delegate the review and approval of sanitary sewer systems in the service area of a local government until they prepare and submit Standard Specifications for Sanitary Sewers to the Georgia EPD for review, and obtain approval.

3.0 QUALIFIED REVIEWERS

The EPD requires that only Professional Engineers registered with the Georgia Secretary of State review and approve sanitary sewer submittals. The delegated agency must provide the following items to the EPD to verify compliance with this requirement:

- Name, affiliation, and address of the responsible professional engineer.
- Name, affiliation, and address of the person who will review City/County and private developments.

4.0 PROCEDURES

In order to fulfill the terms of the agreement, the delegated agency must enact written procedures to accomplish the following:

4.1 Determine that the water pollution control plant (WPCP) to which the proposed sewer extensions will be tributary is capable of accepting the project wastewater for treatment.

4.2 Determine that the sub-main, principal sewer and interceptor to which the proposed sewers are tributary are capable of transporting the project's wastewater to the WPCP for treatment. Pump and haul, pump and storage, and offline storage tanks are not allowed.

4.3 Determine that the sewers are not constructed on or serving structures constructed or proposed to be constructed on solid waste landfills.

4.4 Coordinate erosion and sedimentation control permitting and sewer variance review procedures. Verify that the owner of the project has a LDA permit prior to construction.

4.5 Determine that the proposed sewers are designed by registered professionals in accordance with acceptable provisions of recognized design references in general use. Recognized design references include:

- WEF Manuals(s) of Practice,
- ASCE Manuals and Reports on Engineering Practice,
- Recommended Standards for Sewage Works, latest Edition, Great Lakes Upper Mississippi River Board of State Sanitary Engineers (10-State Standards),
- Environmental Protection Agency (EPA) Publications,
- WEF Journals, and
- Other technical publications widely recognized in establishing design standards.

4.6 Review and approve completed plans and specifications for technical adequacy and conformance to applicable requirements and determine that they are suitable for bid and construction purposes. A review checklist (Example Attached) is highly recommended by the Georgia EPD. Plans and specifications must be prepared by registered professionals in accordance with Code Section 43-15-2 of the Official Code of Georgia Annotated relating to the regulation and certification of professional engineers and land surveyors and in accordance with *Georgia Rules and Regulations for Water Quality Control* 391-3-6-.02. Construction specifications must be approved by the EPD prior to adopting as the delegated agency's Standard Construction Specifications.

4.7 Ensure the reviews are performed under the supervision of a professional engineer registered in the State of Georgia.

4.8 Conduct construction inspections during construction to ensure that the construction is done in accordance with the approved plans and specifications and the Erosion and Sedimentation Act 12-7-1 et. seq. and all other related Acts and ordinances.

4.9 Ensure the construction inspections are performed under the supervision of a professional engineer registered in the State of Georgia.

4.10 Determine that the construction is in accordance with approved plans and specifications prior to project acceptance.

4.11 Own and maintain the sewer system after project acceptance.

4.12 Maintain in a responsible manner all records, documentation, drawings, specifications, letters, forms, checklists, etc. for all projects approved under this delegation agreement for overview by EPD.

4.13 Maintain an up-to-date set of sewer maps.

Make the procedures available in a form that allows those submitting requests to understand and comply with their requirements.

5.0 LOCAL REVIEW AND APPROVAL

Once the Standard Specifications and Plans for Sanitary Sewers and the review procedures are approved by the Georgia EPD, the local government must require that all sewer construction under its jurisdiction be submitted to them for review following the approved procedures and standards. All plans and specifications for sanitary sewers submitted to the local authority for review and approval must incorporate the EPD approved Standard Specifications for Sanitary Sewers by reference.

6.0 OVERVIEW

In order to ensure compliance with this agreement, the entity must agree to cooperate with the EPD in an annual joint overview of the sewer approval files.

7.0 DISSOLUTION OF AGREEMENT

The agreement may be canceled without prior notice by the action of either party giving written notice of intent to cancel.

Appendix E
Pipe Materials and Standards

Pipe materials selected should be appropriate for conditions such as wastewater characteristics, soil characteristics, external loadings, potential for septic conditions, abrasion, corrosion, etc.

Plastic, or flexible pipe is commonly used in sewage collection systems. Polyvinyl chloride (PVC) and high density polyethylene (HDPE) are 2 of the more commonly-used plastic pipe materials.

The following are some of the common standards, test methods, etc. recommended for plastic pipe installations:

AASHTO M304 Standard Specification for Poly(Vinyl Chloride) (PVC) Profile Wall Drain Pipe and Fittings Based on Controlled Inside Diameter

ASTM F477 Standard Specification for Elastomeric Seals (Gaskets) for joining Plastic Pipe

ASTM D1784 Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds

ASTM D3034 Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings

ASTM D2321 Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications

ASTM D3212 Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals

ASTM D2241 Standard Specification for Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)

ASTM F794 Standard Specification for Poly (Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter

ASTM F1417 Standard Test Method for Installation Acceptance of Plastic Gravity Sewer Lines Using Low-Pressure Air

ASTM D3035 Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter

ASTM F714 Standard Specification for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter

ASTM F894 Standard Specification for Polyethylene (PE) Large Diameter Profile Wall Sewer and Drain Pipe

ASTM F585 Standard Practice for Insertion of Flexible Polyethylene Pipe into Existing Sewers

ASTM D3350 Standard Specification for Polyethylene Plastic Pipe and Fittings Materials

ASTM D3261 Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing

ASTM D2774 Standard Practice for Underground Installation of Thermoplastic Pressure Piping

ASTM D2680 Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) and Poly(Vinyl Chloride) (PVC) Composite Sewer Piping

ASTM D3262 Standard Specification for "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Sewer Pipe

ASTM D3754 Standard Specification for "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Sewer and Industrial Pressure Pipe

AWWA C900 Standard for Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 Inches through 12 Inches, for Water Transmission and Distribution

Uni-Bell UNI-B-6 Recommended Practice for Low-Pressure Air Testing of Installed Sewer Pipe

Uni-Bell UNI-B-9 Recommended Performance Specifications for Polyvinyl Chloride (PVC) Profile Wall Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter (Normal Pipe Sizes 4-48 inches) Rigid pipe is also frequently used in sewage collection systems. Ductile iron, steel, concrete pipe is typically used when a higher strength material is required. Vitrified clay is frequently found in older sewerage systems.

The following are standards, test methods, etc. recommended for rigid pipe installations:

ANSI/AWWA C600 AWWA Standard for Installation of Ductile-Iron Mains and Their Appurtenances

ANSI/AWWA C151/A21.51-09, AWWA Standard for Ductile-Iron Pipe, Centrifugally Cast

ANSI/AWWA C104/A21.4 -- American National Standard for Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water

ANSI/AWWA C111/A21.11 -- American National Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings

ASTM A746 Standard Specification for Ductile Iron Gravity Sewer Pipe

ASTM A134 Standard Specification for Pipe, Steel, Electric-Fusion (Arc)-Welded (Sizes NPS 16 and Over)

ASTM A139 Standard Specification for Electric-Fusion (Arc)-Welded Steel Pipe (NPS 4 and Over)

ASTM A760 Standard Specification for Corrugated Steel Pipe, Metallic-Coated for Sewers and Drains

ASTM A762 Standard Specification for Corrugated Steel Pipe, Polymer Precoated for Sewers and Drains

ASTM C301, Standard Test Methods for Vitrified Clay Pipe

ASTM C700 Standard Specification for Vitrified Clay Pipe, Extra Strength, Standard Strength, and Perforated

ASTM C12 Standard Practice for Installing Vitrified Clay Pipe Lines

ASTM C 828 Standard Test Method for Low-Pressure Air Test of Vitrified Clay Pipe Lines

APPENDIX F

REFERENCES

1. Recommended Standards for Wastewater Facilities (10-States Standards); Wastewater Committee of the Great Lakes-Upper Mississippi River; most recent edition.
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3. Handbook of PVC Pipe, Design and Construction; UniBell PVC Pipe Association, 4th Edition, 2001.
4. Hydraulic Analysis of Ductile Iron Pipe; Ductile Iron Pipe Research Association, 2006.
5. Design of Ductile Iron Pipe; Ductile Iron Pipe Research Association, 2003.
6. Ductile Iron Pipe for Wastewater Applications; Ductile Iron Pipe Research Association, 1999.
7. ASTM C 12; Standard Practice for Installing Vitrified Clay Pipe Lines; American Society for Testing and Materials; 1998.
8. ASTM D 2321; Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications; American Society for Testing and Materials; 2000.
9. ATSM D 2487; Classification of Soils for Engineering Purposes (Unified Soil Classification System); American Society for Testing and Materials; 2010.
10. ANSI/AWWA C151; Ductile-Iron Pipe, Centrifugally Cast, for Water; American Water Works Association; 2002.
11. Wastewater Engineering: Collection and Pumping of Wastewater; Metcalf & Eddy; latest edition.
12. Wastewater Engineering, Treatment, Disposal and Reuse; Metcalf & Eddy; latest edition.