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Section 4

Water Quality: Environmental Stressors

Section 4, 5, 6, and 7 of this document are closely linked, providing the foundation for the water quality concerns in the basin, identifying the priority issues based on these concerns, and finally, recommending management strategies to address these concerns. Therefore, the reader will probably wish to refer back and forth between sections to track specific issues.

This section describes the important environmental stressors that impair or threaten water quality in the Tallapoosa River basin. Section 4.1 first discusses the major sources of environmental stressors. Section 4.2 then provides a summary of individual stressor types as they relate to all sources. These include both traditional chemical stressors, such as metals or oxygen demanding waste, and less traditional stressors, such as modification of the flow regime (hydromodification) and alteration of physical habitat.

4.1 Sources and Types of Environmental Stressors

This section describes the major potential sources of environmental stressors within the Coosa River basin. These sources include point source discharges, nonpoint source contributions from land-use activities, and temperature and flow modifications. The sources are discussed by type, which provides a match to regulatory lines of authority for permitting and management.

4.1.1 Point Sources and Nondischarging Waste Disposal Facilities

Point sources are defined as the permitted discharges of treated wastewater to the river and its tributaries, regulated under the National Pollutant Discharge Elimination System (NPDES). These are divided into two main types—permitted wastewater discharges, which tend to be discharged at relatively stable rates, and permitted storm water discharges, which tend to be discharged at highly irregular, intermittent rates, depending on precipitation. Nondischarging waste disposal facilities, including land application systems and landfills, which do not discharge wastewater effluent to surface waters, are also discussed in this section.

NPDES Permitted Wastewater Discharges

The EPD NPDES permit program regulates treated municipal and industrial wastewater discharges, monitors compliance with limitations, and takes appropriate enforcement action for violations. For point source discharges, the permit establishes specific effluent limitations and specifies compliance schedules that must be met by the discharger. Effluent limitations are designed to achieve water quality standards in the receiving water and are reevaluated periodically (at least every 5 years).

Table 4-1 displays the municipal wastewater treatment plants with permitted discharges in the Tallapoosa River basin. The geographic distribution of dischargers is shown in Figure 4-1. Only one of these dischargers, the Tallapoosa WPCP, constitutes a major discharger with at least 1 million gallons per day (MGD) permitted flow. The minor dischargers (<1.0 MGD) have the potential to cause localized stream impacts, but they are relatively insignificant from a basin perspective.

Municipal Wastewater Discharges

Municipal wastewater treatment plants are among the most significant point sources regulated under the NPDES program in the Tallapoosa River basin, accounting for the majority of the total point source effluent flow. These plants collect, treat, and release treated wastewater. Pollutants associated with treated wastewater include pathogens, nutrients, oxygen-demanding waste, metals, and chlorine residuals. Over the past several decades, Georgia has invested more than $15 million in construction and upgrade of municipal water pollution control plants in the Tallapoosa River basin. A summary of these investments is provided in Appendix C. These upgrades have resulted in significant reductions in pollutant loading and consequent improvements in water quality below wastewater treatment plant outfalls. As of the 1996-1997 water quality assessment, only one segment (1 mile) of river/streams was identified in which municipal discharges contributed to not fully supporting designated uses in the Tallapoosa Basin.

Most urban wastewater treatment plants also receive industrial process and nonprocess wastewater, which can contain a variety of conventional and toxic pollutants. Control of industrial pollutants in municipal wastewater is addressed through pretreatment programs. The City of Carrollton wastewater treatment plant has developed and implemented approved local industrial pretreatment program. Through this program, the wastewater treatment plant has established effluent limitations for significant industrial dischargers (those which discharge in excess of 25,000 gallons per day of process wastewater or are regulated by a Federal Categorical Standard) and monitors the industrial user's compliance with those limits. The treatment plant is able to control the discharge of organics and metals into the sewerage system through the controls placed on industrial users.

Industrial Wastewater Discharges

Industrial and federal wastewater discharges are also significant point sources regulated under the NPDES program. There are a total of 11 permitted municipal, state, federal, private, and industrial wastewater and process water discharges in the Tallapoosa River basin, as summarized in Table 4-2. The complete permit list is summarized in Appendix D.

The flow rates for industrial discharges in the Tallapoosa basin are relatively low. However, because the nature of industrial discharges varies widely compared to discharges from municipal plants, effluent flow is not usually a good measure of the significance of an industrial discharge. Industrial discharges can consist of organic, heavy oxygen-demanding waste loads from facilities such as pulp and paper mills; large

Table 4-1. Municipal Wastewater Treatment Plants in the Tallapoosa River Basin

NPDES Permit #	Facility Name	Authority	County	Receiving Stream	Permitted Monthly Average Flow (MGD)
HUC 03150108					
GA0020982	Tallapoosa WPCP	Tallapoosa	Haralson	Green Creek	1.000
GA0021008	Bremen, Baxter Creek	Bremen	Haralson	Baxter Creek	0.200
GA0037435	Bremen, Buck Creek	Bremen	Haralson	Buck Creek	0.900
GA0021512	Buchanan WPCP	Buchanan	Haralson	Cochran Creek	0.170
GA0035921	DIT #144, Haralson Co.		Haralson	Williams Creek	0.009
GA0023493	Bowdon WPCP	Bowdon	Carroll	Indian Creek	0.400
GA0027162	Villa Rica, Tallapoosa	Villa Rica	Carroll	Little Tallapoosa River	0.260

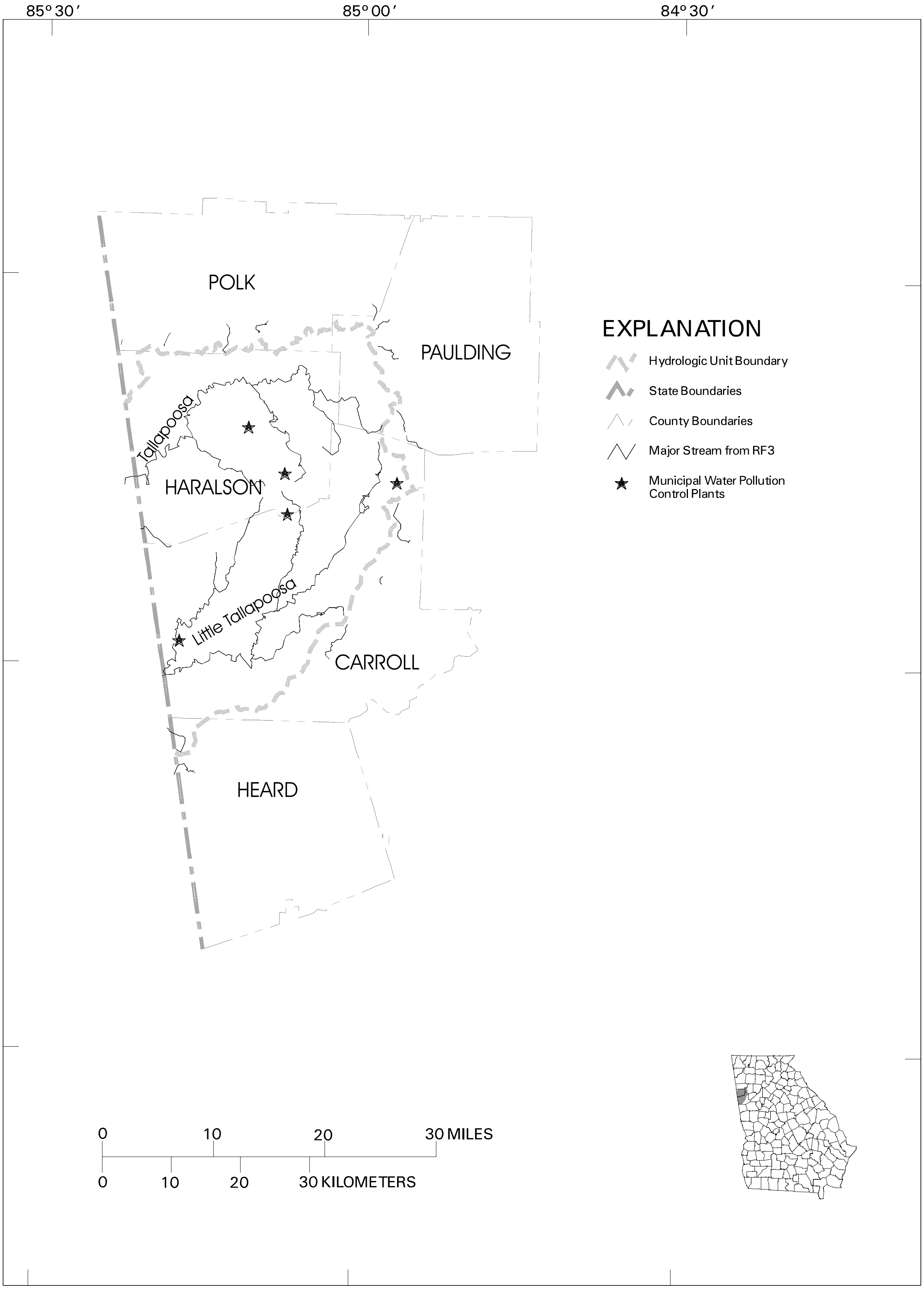


Figure 4-l. Location of Municipal Wastewater-Treatment Plants in the Tallapoosa River Basin

Table 4-2. Summary of NPDES Permits in the Tallapoosa River Basin

HUC	Major Municipal Facilities	Major Industrial and Federal Facilities	Minor Public Facilities	Minor Private and Industrial Facilities	*Total*
03150108	1	0	6	4	*11*

quantities of noncontact cooling water from facilities such as power plants; pit pumpout and surface runoff from mining and quarrying operations, where the principal source of pollutants is the land disturbing activity rather than the addition of any chemicals or organic materials; or complex mixtures of organic and inorganic pollutants from chemical manufacturing, textile processing, metal finishing, etc. Pathogens and chlorine residuals are rarely of concern with industrial discharges, but other conventional and toxic pollutants must be addressed on a case-by-case basis through the NPDES permitting process. Georgia's water quality assessment report identified one segment (2 miles) of river/stream in the basin where permitted industrial discharges contributed to a failure to support designated uses. This is being addressed through the NPDES permitting process.

The locations of permitted point source discharges of treated wastewater in the Tallapoosa River basin are shown in Figure 4-2.

Combined Sewer Overflows

Combined sewers are sewers that carry both storm water runoff and sanitary sewage in the same pipe. However, during wet weather, when significant storm water is carried in the combined system, the sanitary sewer capacity is exceeded and a combined sewer overflow (CSO) occurs. The surface discharge is a mixture of storm water and sanitary waste. There are no known CSOs within the Tallapoosa Basin.

NPDES Permitted Storm Water Discharges

Urban storm water however, during wet weather, has been identified as a major source of stressors from pollutants such as oxygen-demanding waste (BOD) and fecal coliform bacteria. Storm water can flow directly to streams as a diffuse, nonpoint process or can be collected and discharged through a storm sewer system. Storm sewers are now subject to NPDES permitting and are discussed in this section. Contributions from nonpoint storm water is discussed in later sections.

Pollutants typically found in urban storm water runoff include pathogens (such as bacteria and viruses from human and animal waste), heavy metals, debris, oil and grease, petroleum hydrocarbons and a variety of compounds toxic to aquatic life. In addition, the runoff often contains sediment, excess organic material, fertilizers (particularly nitrogen and phosphorus compounds), herbicides, and pesticides, which can upset the natural balance of aquatic life in lakes and streams. Storm water runoff can also increase the temperature of a receiving stream during warm weather which can have an adverse impact on aquatic life. All of these pollutants, and many others, influence the quality of storm water runoff. There are also many potential problems related to the quantity of urban runoff, which can contribute to flooding and erosion in the immediate drainage area and downstream.

Municipal Storm Water Discharges

In accordance with Federal "Phase I" storm water regulations, the state of Georgia has issued individual areawide NPDES municipal separate storm sewer system (MS4) permits to 58 cities and counties in municipal areas with populations greater than 100,000 persons. There are no MS4 permits in the Tallapoosa basin.

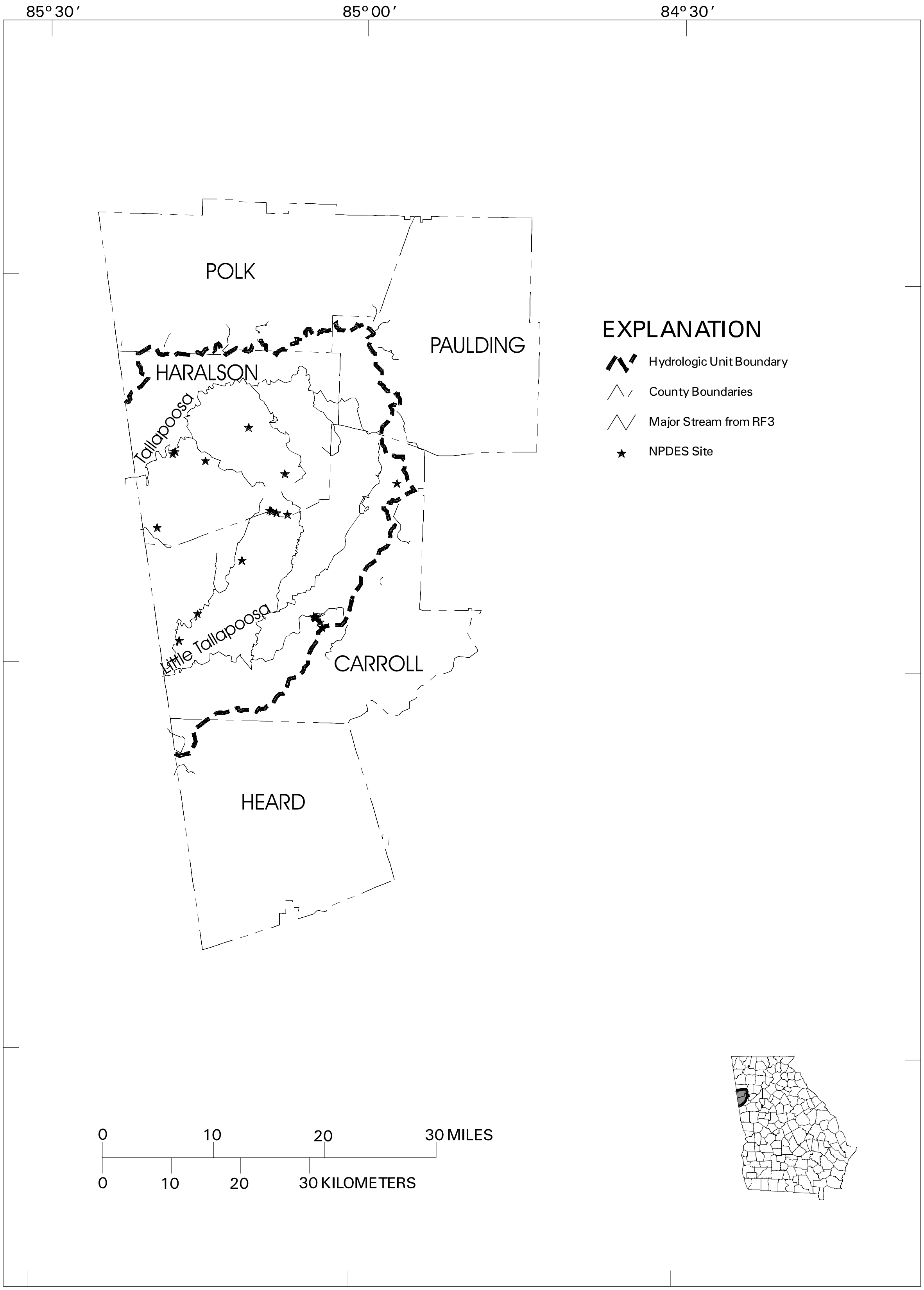


Figure 4-2. NPDES Sites Permitted by GAEPD, Tallapoosa River Basin

Industrial Storm Water Discharges

Industrial sites often have their own storm water conveyance systems. The volume and quality of storm water discharges associated with industrial activity is dependent on a number of factors, such as the industrial activities occurring at the facility, the nature of the precipitation, and the degree of surface imperviousness. These discharges are of intermittent duration with short-term pollutant loadings that can be high enough to have shock loading effects on the receiving waters. The types of pollutants from industrial facilities are generally similar to those found in storm water discharges from commercial and residential sites; however, industrial facilities have a significant potential for discharging at higher pollutant concentrations and may include specific types of pollutants associated with a given industrial activity.

EPD has issued one general permit regulating storm water discharges for 10 of 11 federally regulated industrial subcategories. The 11th subcategory, construction activities, will be covered under a separate general permit. The general permit for industrial activities requires the submission of a Notice of Intent (NOI) for coverage under the general permit; the preparation and implementation of a storm water pollution prevention plan; and, in some cases, the monitoring of storm water discharges from the facility. As with the municipal storm water permits, implementation of site-specific best management practices is the preferred method for controlling storm water runoff. As of March 1998, 50 NOIs had been filed for the Tallapoosa basin.

Nondischarging Waste Disposal Facilities

Land Application Systems (LASs)

In addition to permits for point source discharges, EPD has developed and implemented a permit system for land application systems (LASs). LASs for final disposal of treated wastewaters have been encouraged in Georgia and are designed to eliminate surface discharges of effluent to waterbodies. LASs are used as alternatives to advanced levels of treatment or as the only alternative in some environmentally sensitive areas.

When properly operated, a LAS should not be a source of stressors to surface waters. The locations of LASs are, however, worth noting because of the (small) possibility that a LAS could malfunction and become a source of stressor loading.

In excess of 200 permits for land application systems were in effect in Georgia in 1998. Land application systems within the Tallapoosa Basin are listed in Table 4-3. The locations of all LASs within the basin are shown in Figure 4-3.

Table 4-3. Wastewater Land Application Systems in the Tallapoosa Basin

Operator	Location	Permit No.	Permitted Flow (MGD)
Bremen LAS	Carroll Co.	GA02-142	0.200
Carrollton LAS	Carroll Co.	GA02-126	7.000
Temple LAS	Carroll Co.	GA02-134	0.200

Landfills

Permitted landfills are required to contain and treat any leachate or contaminated run-off prior to discharge to any surface water. The permitting process encourages either direct connection to a publicly owned treatment works (although vehicular transportation is allowed in certain cases) or treatment and recirculation on site to achieve a no-discharge system. Direct discharge in compliance with NPDES requirements is allowed

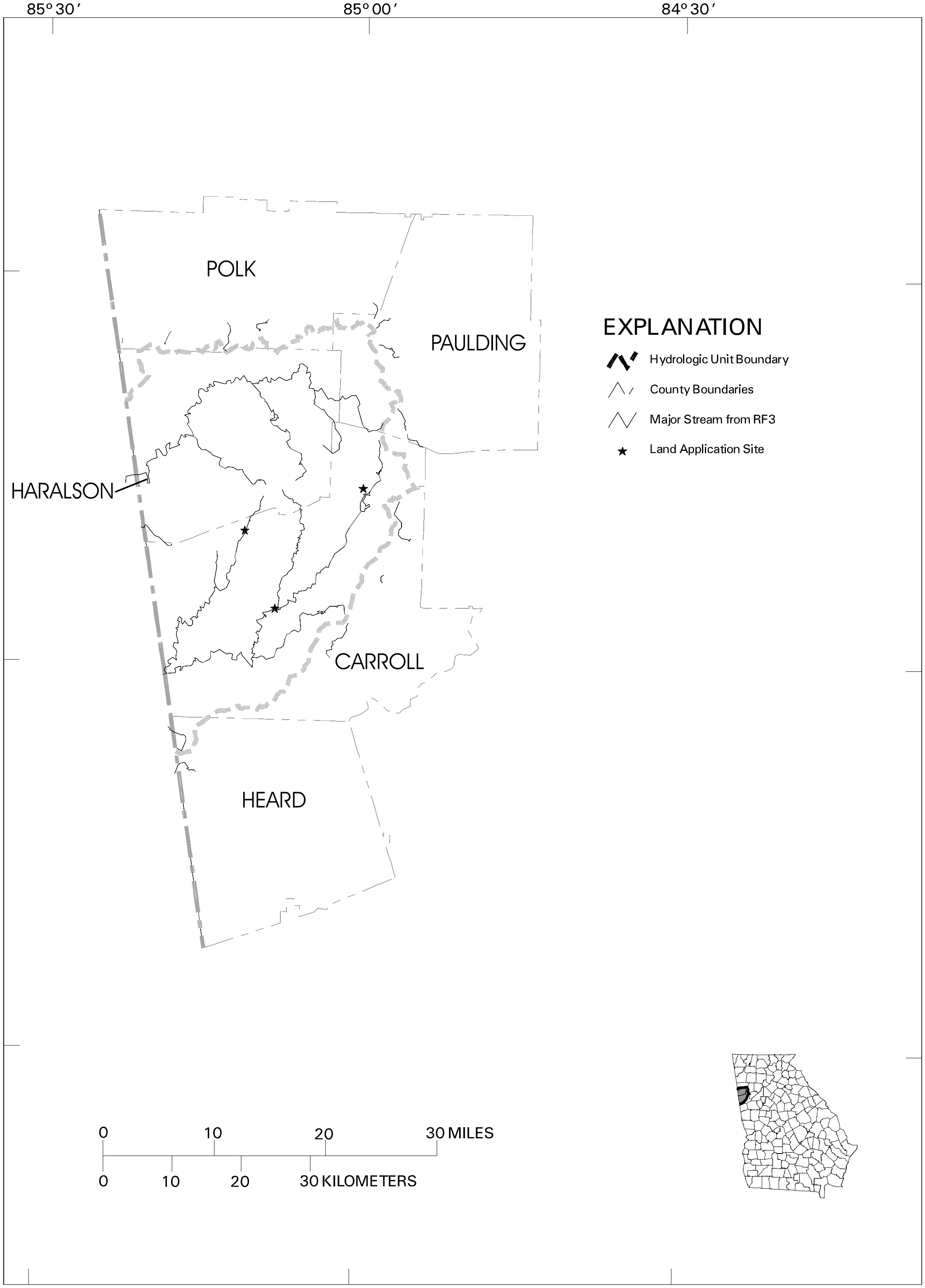


Figure 4-3. Land Application Systems, Tallapoosa River Basin

but not currently practiced at any landfills in Georgia. Ground water contaminated by landfill leachate from older, unlined landfills represents a potential threat to waters of the State. Ground water and surface water monitoring and corrective action requirements are in place for all landfills operated after 1988 to identify and remediate potential threats. The provisions of the Hazardous Sites Response Act address threats posed by older landfills as releases of hazardous constituents are identified. All new municipal solid waste landfills are required to be lined and to have a leachate collection system installed.

EPD's Land Protection Branch is responsible for permitting and compliance of municipal and industrial Subtitle D landfills. The locations of permitted landfills within the basin are shown in Table 4-4 and Figure 4-4.

Table 4-4. Permitted Landfills in the Tallapoosa River Basin

PERMIT NO.	NAME	COUNTY	TYPE
022-004D(L)	Nobles Sludge Disposal Co.	Carroll	Landfill
022-008D(SL)*	Carrollton SR 166	Carroll	Sanitary Landfill
071-004D(SL)	US 78 Bremen PH1	Haralson	Sanitary Landfill
071-005D(SL)	US 78 Bremen PH2	Haralson	Sanitary Landfill

** Landfill owner currently implementing closure procedures.*

4.1.2 Nonpoint Sources

The pollution impact on Georgia's streams has radically shifted over the last two decades. Streams are no longer dominated by untreated or partially treated sewage discharges, which had resulted in little or no oxygen and little or no aquatic life. The sewage is now treated, oxygen levels have recovered, and healthy fisheries have followed. Industrial discharges have also been placed under strict regulation. However, other sources of pollution are still affecting Georgia's streams. These sources are referred to as *nonpoint sources*. Nonpoint sources are diffuse in nature. Nonpoint source pollution can generally be defined as the pollution caused by rainfall or snowmelt moving over and through the ground. As water moves over and through the soil, it picks up and carries away natural pollutants and pollutants resulting from human activities, finally depositing them in lakes, rivers, wetlands, coastal waters, or ground water. Habitat alteration (e.g., removal of riparian vegetation) and hydrological modification (e.g., channelization, bridge construction) can cause adverse effects on the biological integrity of surface waters and are also treated as nonpoint sources of pollution.

Nonpoint pollutant loading comprises a wide variety of sources not subject to point source control through NPDES permits. The most significant nonpoint sources are those associated with precipitation, washoff, and erosion, which can move pollutants from the land surface to water bodies. Both rural and urban land uses can contribute significant amounts of nonpoint pollution. A review of 1996-1997 water quality assessment results for the Tallapoosa basin indicates that urban runoff and rural nonpoint sources contribute significantly to lack of full support for designated uses. The major categories of stressors for nonpoint sources are discussed below.

Nonpoint Sources from Agriculture

Agricultural operations can contribute stressors to water bodies in a variety of ways. Tillage and other soil-disturbing activities can promote erosion and loading of sediment to water bodies, unless controlled by management practices. Nutrients contained in fertilizers, animal wastes, or natural soils may be transported from agricultural land to streams in either sediment-attached or dissolved forms. Loading of pesticides and pathogens is also of concern for various agricultural operations.

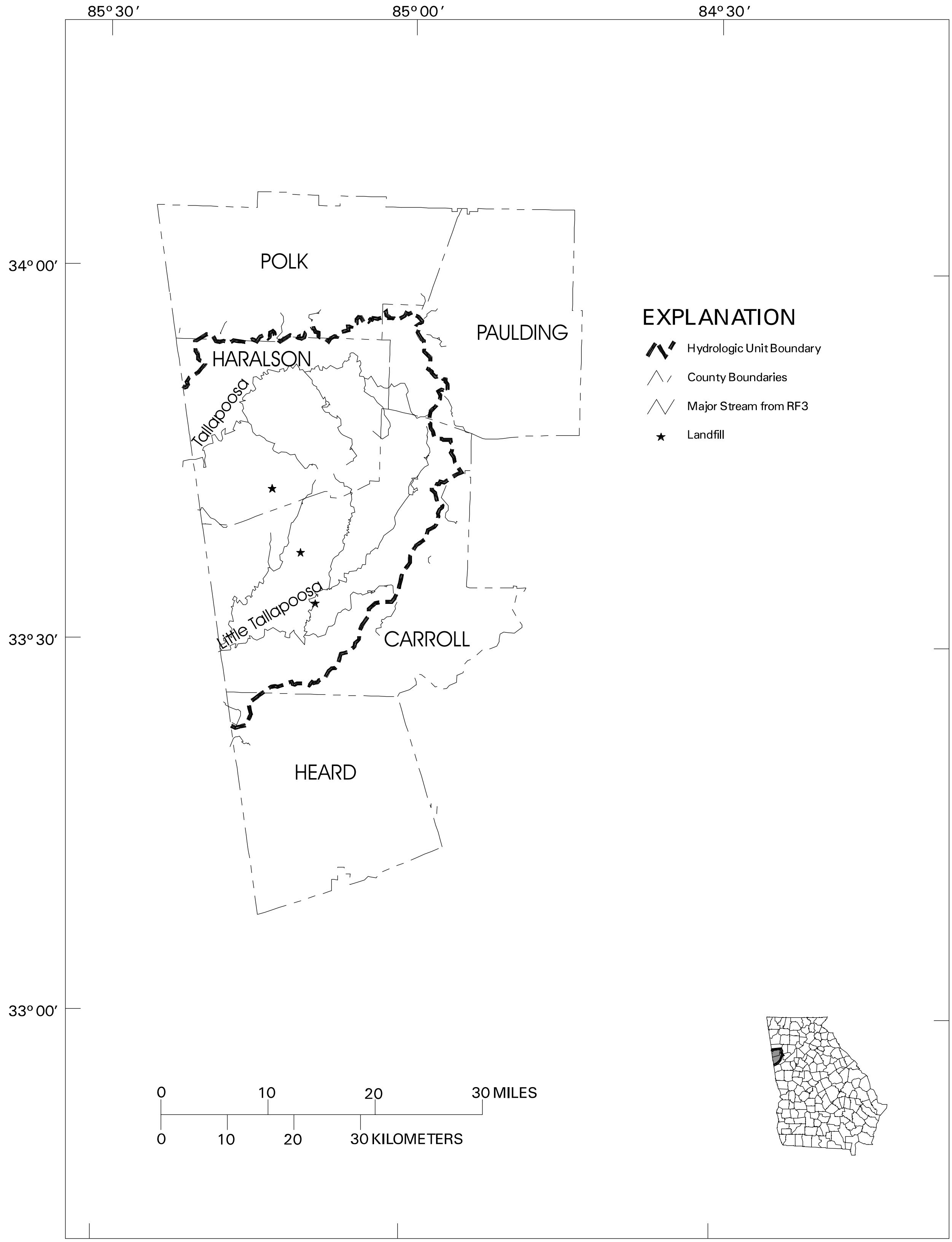


Figure 4-4. Landfills, Tallapoosa River Basin

Sediment and Nutrients

Sediment is the most common pollutant resulting from agricultural operations. It consists mainly of mineral fragments resulting from the erosion of soils, but it can also include crop debris and animal wastes. Excess sediment loads can damage aquatic habitat by smothering and shading food organisms, altering natural substrate, and destroying spawning areas. Runoff with elevated sediment concentrations can also scour aquatic habitat, causing significant impacts on the biological community. Excess sediment can also increase water treatment costs, interfere with recreational uses of water bodies, create navigation problems, and increase flooding damage. In addition, a high percentage of nutrients lost from agricultural lands, particularly phosphorus, is transported attached to sediment. Many organic chemicals used as pesticides or herbicides are also transported predominantly attached to sediment.

Agriculture can be a significant source of nutrients, which can lead to excess or nuisance growth of aquatic plants and depletion of dissolved oxygen. The nutrients of most concern from agricultural land uses are nitrogen (N) and phosphorus (P), which may come from commercial fertilizer or land application of animal wastes. Both nutrients assume a variety of chemical forms, including soluble ionic forms (nitrate and phosphate) and less-soluble organic forms. Less soluble forms tend to travel with sediment, whereas more soluble forms move with water. Nitrate-nitrogen is very weakly adsorbed by soil and sediment and is therefore transported entirely in water. Because of the mobility of the nitrate-nitrogen the major route of nitrate loss is to streams by interflow or to ground water in deep seepage.

Phosphorus transport is a complex process that involves different components of phosphorus. Soil and sediment contain a pool of adsorbed phosphorus which tends to be in equilibrium with the phosphorus in solution (phosphate) as water flows over the soil surface. The concentrations established in solution are determined by soil properties and fertility status. Adsorbed phosphorus attached to soil particles suspended in runoff also equilibrates with the phosphorus in solution.

In 1993, the Soil Conservation Service (SCS, now NRCS) completed a study to identify hydrologic units in Georgia with high potential for nonpoint source pollution problems resulting from agricultural land uses (SCS, 1993). This study concluded that there is not a major statewide agricultural pollution problem in Georgia. However, the assessment shows that some watersheds have sufficient agricultural loadings to potentially impair their designated uses, based on estimates of transported sediments, nutrients, and animal waste from agricultural lands (Table 4-5).

Table 4-5. Estimated Loads from Agricultural Lands by County (SCS, 1993)

County	Percent of Area in Basin	Acres with nutrient application	Sediment (tons)	Sediment (ppm)	Nitrogen (tons)	Nitrogen (ppm)	Phosphorus (tons)	Phosphorus (ppm)
Carroll	67	74,757	57,736	24.4	307	0.15	101	0.048
Haralson	97	23,554	22,232	33.1	142	0.21	42	0.063
Paulding	10	42,409	9,882	8.2	58	0.05	20	0.017

Note: Mass estimates are based on county-wide averages, weighted by percent of area in the basin. Concentration estimates are average event runoff concentration from agricultural lands in the basin.

In July and August 1996, EPA conducted biological assessments on Georgia watersheds that had sufficient agricultural loading to potentially impair designated stream use to determine which of those waters should be added Georgia's Section 303(d) list of streams with water quality-limited segments. Those waters identified by EPA as potentially impaired by agricultural nonpoint source loading and added to the 303(d) TMDL list in December 1996 are shown in Table 4-6.

Table 4-6. Waters Identified as Potentially Impacted by Agricultural Nonpoint Source Loading and Added to the Georgia 303(d) List

Waterbody	County	Pollutant(s) of Concern
Lower Little Tallapoosa River	Carroll	Habitat/Sediment
Little Tallapoosa River	Carroll	Biota, Habitat

Animal waste

In addition to contributing to nutrient loads, animal waste may contribute high loads of oxygen-demanding chemicals and bacterial and microbial pathogens. The waste may reach surface waters through direct runoff as solids or in their soluble form. Soluble forms may reach ground water through runoff, seepage, or percolation and reach surface water as return flow. As the organic materials decompose, they place an oxygen demand on the receiving waters, which may adversely affect fisheries; and cause other problems with taste, odor, and color. When waters are contaminated by waste from mammals, the possible presence of pathogens that affect human health, including fecal bacteria, is of particular concern when waters are contaminated by waste from mammals. In addition to being a source of bacteria, cattle waste might be an important source of the infectious oocysts of the protozoan parasite *Cryptosporidium parvum*.

Pesticides

Pesticides applied in agricultural production can be insoluble or soluble and include herbicides, insecticides, miticides, and fungicides. They are primarily transported directly through surface runoff, either in dissolved form or attached to sediment particles. Some pesticides can cause acute and chronic toxicity problems in the water or throughout the entire food chain. Others are suspected human carcinogens, although the use of such pesticides has generally been discouraged in recent years.

The major agricultural pesticides/herbicides used within the basin include 2,4D, Weedmaster, Hoelon, Trifluralin/Treflan/Trilin, AAtrex/Atrazine, and Gramoxone (compiled from the Georgia Herbicide Use Survey Summary [Monks and Brown, 1991]).

Nonherbicide pesticide use is difficult to estimate. According to Stell et al. (1995), pesticides other than herbicides are currently used only when necessary to control some type of infestation (nematodes, fungi, insects). Other common nonherbicide pesticides include chlorothalonil, aldicarb, chlorpyrifos, methomyl, thiodicarb, carbaryl, acephate, fonofos, methyl parathion, terbufos, disulfoton, phorate, triphenyltin hydroxide (TPTH), and synthetic pyrethroids/pyrethrins. Application periods of the principal agricultural pesticides span the calendar year in the basin. However, agricultural pesticides are applied most intensively and on a broader range of crop types from March 1 to September 30 of any given year.

It should be noted that past uses of persistent agricultural pesticides that are now banned might continue to affect water quality within the basin, particularly through residual concentrations present in bottom sediments.

A survey of pesticide concentration data by Stell et al. (1995) found that two groups of compounds had concentrations at or above minimum reporting levels in nearly 56 percent of the water and sediment analyses in the Apalachicola-Chattahouchee-Flint basin. The first group included DDT and metabolites, and chlordane and related compounds (heptachlor, heptachlor epoxide), while dieldrin was also frequently detected. All these pesticides are now banned by US EPA for use in the United States, but they might persist in the environment for long periods of time.

Nonpoint Sources from Urban, Industrial, and Residential Lands

Water quality in urban waterbodies is affected by both point source discharges and diverse land use activities in the drainage basin (i.e., nonpoint sources). One of the most important sources of environmental stressors in the Tallapoosa basin, particularly in the developed and rapidly growing areas close to Atlanta, is diffuse runoff from urban, industrial, and residential land uses (jointly referred to as "urban runoff"). Nonpoint source contamination can impair streams that drain extensive commercial and industrial areas, due to inputs of storm water runoff, unauthorized discharges, and/or accidental spills. Wet weather urban runoff can carry high concentrations of many of the same pollutants found in point source discharges, such as oxygen-demanding waste, suspended solids, synthetic organic chemicals, oil and grease, nutrients, lead and other metals, and bacteria. The major difference is that urban runoff occurs only intermittently, in response to precipitation events.

The characteristics of nonpoint urban sources of pollution are generally similar to those of NPDES permitted storm water discharges (these are discussed in the previous section). Separate storm water systems, however, are typically found in developed areas with high imperviousness and, frequently, sanitary sewer systems. Nonpoint urban sources of pollution include drainage from some built-up areas with similar characteristics, but also includes less highly developed areas with greater amounts of pervious surfaces. Nonpoint urban sources of pollution include drainage from areas with impervious surfaces, as well as, less highly developed areas with greater amounts of pervious surfaces such as lawn, gardens, and septic tanks, all of which may be sources of nutrient loading.

There is little site-specific data available to quantify loading in nonpoint urban runoff in the Tallapoosa River basin, although estimates of loading rates by land use types have been widely applied in other areas. Data for metals, organic chemicals, biological conditions, and suspended sediment were generally unavailable. Peters and Kandell (1997) present a water quality index for streams in the Atlanta region, based primarily on nutrients and nutrient-related parameters. They report that the annual average index of water quality conditions generally improved at most long-term monitoring sites between 1986 and 1995. However, conditions markedly worsened between 1994 and 1995 at several sites where major development was ongoing.

Pesticides and Herbicides from Urban and Residential Lands

Urban and suburban land uses are also a potential source of pesticides and herbicides through application to lawns and turf, roadsides, and gardens and beds. Stell et al. (1995) provide a summary of usage in the Atlanta Metropolitan Statistical Area (MSA). The herbicides most commonly used by the lawn-care industry are combinations of dicamba, 2,4-D, mecoprop (MCPP), 2,4-DP, and MCPA, or other phenoxy-acid herbicides. Most commercially available weed control products contain one or more of the following compounds: glyphosphate, methyl sulfometuron, benefin (benfluralin), bensulide, acifluorfen, 2,4-D, 2,4-DP, and dicamba. Atrazine was also available for purchase until it was restricted by the state of Georgia on January 1, 1993. The main herbicides used by local and state governments are glyphosphate, methyl sulfometuron, MSMA, 2,4-D, 2,4-DP, dicamba, and chlorsulforon. Herbicides are used for preemergent control of crabgrass in February and October and for postemergent control in the summer. Data from the 1991 Georgia Pest Control Handbook (Delaplane, 1991) and a survey of CES and SCS personnel conducted by Stell *et al*. indicate that several insecticides could be considered ubiquitous in urban/suburban use, including chlorpyrifos, diazinon, malathion, acephate, carbaryl, lindane, and dimethoate. Chlorothalonil, a fungicide, is also widely used in urban and suburban areas.

Other Urban/Residential Sources

Urban and residential storm water also potentially includes pollutant loads from a number of other terrestrial sources:

Septic Systems. Poorly sited and improperly operating septic systems can contribute to the discharge of pathogens and oxygen-demanding pollutants to receiving streams. This problem is addressed through septic system inspections by the appropriate County Health Department, extension of sanitary sewer service and local regulations governing minimum lot sizes and required pump-out schedules for septic systems.

Leaking Underground Storage Tanks. The identification and remediation of leaking underground storage tanks (LUSTs) is the responsibility of the EPD Land Protection Branch. Petroleum hydrocarbons and lead are typically the pollutants associated with such tanks.

Nonpoint Sources from Forestry

Forest is the dominant land cover in the Tallapoosa Basin, accounting for 97 percent of the land area in 1989. Undisturbed forest land generally presents very low stressor loading compared to other land uses, while conversion of forest to urban/residential land uses is often associated with water quality degradation. From 1982 through 1989, the area classified as commercial forest land within the Tallapoosa basin decreased by approximately 2,412 acres, or 1 percent.

Silvicultural operations may serve as sources of stressors, primarily contributing excess sediment loads to streams, when best management practices (BMPs) are not followed. From a water quality standpoint, woods roads pose the greatest potential threat of any of the typical forest practices. It has been documented that 90 percent of the sediment that entered streams from a forestry operation was typically related to either poorly located or poorly constructed roads. The potential impact on water from erosion and sedimentation is increased if BMPs are not adhered to.

Statewide BMP Implementation Survey

In 1992, the Georgia Forestry Commission (CFC) conducted a statewide BMP implementation survey to determine to what extent forestry BMPs were being implemented. Within the Tallapoosa basin, the GFC evaluated 3 sites of which two were

located on private lands and one was located on forest industry land. Overall compliance with BMPs was 81 percent.

Almost half of main haul roads on two sites were in compliance with BMPs. Problems were noted where roads did not follow the contour and where water diversions to slow surface water flow and divert the flow out of the road on either site were needed but were not installed. By ownership, compliance was 54 percent on the 1.3 miles of forest industry road and 0 percent on the 0.3 miles of private land owner road. The roads, however, did not cross any streams and there was no threat to water quality.

Eighty-one percent of the 250 harvested acres evaluated on 3 sites were in compliance with BMPs. Problems were noted where water bars were not installed in skid trails sites on sloping terrain. Two out of three log decks were stabilized. Equipment was improperly serviced on two of three sites. Harvesting within the recommended Streamside Management Zones (SMZs) resulted in 50 percent of the zones being rutted or damaged and excess logging debris left in the streams on 50 percent of the sites. Log decks were usually properly located outside recommended zone. Temporary stream crossings occurred on one site and was properly removed after the harvest. By ownership, compliance was 46 percent on 50 total acres of two private tracts and 90 percent on the 200 acre forest industry tract.

Pesticides and Herbicides from Silviculture

Silviculture is also a potential source of pesticides/herbicides. According to Stell et al. (1995), pesticides are mainly applied during site preparation after clear-cutting and during the first few years of new forest growth. Site preparation occurs on a 25-year cycle on most pine plantation land, so the area of commercial forest with pesticide application in a given year is relatively small. The herbicides glyphosate (Accord), sulfometuron methyl (Oust), hexazinone (Velpar), imazapyr (Arsenal), and metsulfuron methyl (Escort) account for 95 percent of the herbicides used for site preparation to control grasses, weeds, and broadleaves in pine stands. Dicamba, 2,4-D, 2,4,-DP (Banvel), triclopyr (Garlon), and picloram (Tordon) are minor use chemicals used to control hard to kill hardwoods and kudzu. The use of triclopyr and picloram has decreased since the early 1970s.

Most herbicides are not mobile in the soil and are targeted to plants, not animals. Applications made following the label instructions and in conjunction with BMPs should pose little threat to water quality.

Chemical control of insects and diseases is not widely practice except in forest tree nurseries, which is a very minor land use. No nurseries are in the basin.

Atmospheric Deposition

Atmospheric deposition can be a significant source of nitrogen and acidity in watersheds. Nutrients from atmospheric deposition, primarily nitrogen, are distributed throughout the entire basin in precipitation. The primary source of nitrogen in atmospheric deposition is nitrogen oxide emissions from combustion of fossil fuels. The rate of atmospheric deposition is a function of topography, nutrient sources, and spatial and temporal variations in climatic conditions.

Atmospheric deposition may also be a source of certain mobile toxic pollutants, including mercury, PCBs, and other organic chemicals.

4.1.3 Flow and Temperature Modification

Many species of aquatic life are adapted to specific flow and temperature regimes. In addition, both flow and temperature affect the dissolved oxygen balance in water, and changes in flow regime can have important impacts on physical habitat. Temperature is particularly critical for the cold-water trout fishery. Georgia is located at the extreme southern edge of trout habitat, and therefore many trout waters approach maximum tolerable temperatures during the hottest summer months, even under natural conditions. Trout need cold water to survive and reproduce well, so any practices that cause stream warming can have adverse effects.

Thus, flow and temperature modifications can be important environmental stressors. They also interact with one another to affect the oxygen balance: Flow energy helps control reaeration rate, while water temperature controls the solubility of dissolved oxygen. Higher water temperatures reduce oxygen solubility and thus tend to reduce dissolved oxygen concentrations. Further, increased water temperature increases the rate of metabolic activity in natural waters, which in turn can increase oxygen consumption by aquatic species.

Natural flows in the Georgia portion of the Tallapoosa basin remain essentially unaltered except for the limited impact of small watershed impoundments. Water temperature in many streams is cooler than many otherwise similar Piedmont streams because of numerous springs in the basin.

Trout waters in the Tallapoosa basin are potentially threatened by the impact of small impoundments. All of the trout streams in the basin are secondary trout streams (they are cold enough to support trout populations but no natural reproduction occurs) and actual trout fisheries are limited by the supply of trout for stocking. Even small impoundments, if not specifically designed to prevent stream warming, may impact temperatures for several miles downstream.

4.1.4 Physical Habitat Alteration

Many forms of aquatic life are sensitive to physical habitat disturbances. Probably the major disturbing factor is erosion and loading of excess sediment, which changes the nature of the stream substrate. Trout waters are particularly sensitive to sedimentation as trout need clean substrate to survive and reproduce well. Thus, any land use practices that cause excess sediment input can have significant impacts. Because of rapid development in the mountainous areas, the quality of trout streams is often compromised by sedimentation from land disturbing activities.

Physical habitat disturbance is also evident in many urban streams. Increased impervious cover in urban areas results in higher peak flows and lower drought flows. Higher peak flows increase bank erosion and lower low flows reduce the instream habitat available to aquatic life during drought periods. In addition, construction and other land-disturbing activities produce excessive sediment loads, resulting in choking of the natural substrate and altering the physical form of streams with mounds of sand and silt.

4.2 Summary of Stressors Affecting Water Quality

Section 4.1 described the major sources of loads of pollutants (and other types of stressors) to the Tallapoosa basin. Impacts within a waterbody are often the result of the combined effect of many different types of loading, including point and nonpoint sources. For instance, excess concentrations of nutrients may result from the combined loads of wastewater treatment plant discharges, runoff from agriculture, runoff from residential lots, and other sources. Accordingly, Section 4.2 brings together the information contained in Section 4.1 to focus on individual stressor types, as derived from all sources.

4.2.1 Nutrients

All plants require certain nutrients for growth, including the algae and rooted plants found in lakes, rivers, and streams. Nutrients required in the greatest amounts include nitrogen and phosphorus. Some loading of these nutrients is needed to support normal growth of aquatic plants, an important part of the food chain. Too much loading of nutrients can, however, result in an over abundance of algal growth with a variety of undesirable impacts. The condition of excessive nutrient-induced plant production is known as eutrophication, and waters affected by this condition are said to be eutrophic. Eutrophic waters often experience dense blooms of algae, which can lead to unaesthetic scums and odors and interfere with recreation. In addition, overnight respiration of living algae, and decay of dead algae and other plant material, can deplete oxygen from the water, stressing or killing fish. Eutrophication of lakes typically results in a shift in fish populations to less desirable, pollution tolerant species. Finally, eutrophication may result in blooms of certain species of blue-green algae that have the capability of producing toxins.

For freshwater aquatic systems, the nutrient in the shortest supply relative to plant demands is usually phosphorus. Phosphorus is then said to be the “limiting nutrient” because the concentration of phosphorus limits potential plant growth. Control of nutrient loading to reduce eutrophication thus focuses on phosphorus control.

Point and nonpoint sources to the Tallapoosa also discharge large quantities of nitrogen, but nitrogen is usually present in excess of amounts required to match the available phosphorus. Nitrogen (unlike phosphorus) is also readily available in the atmosphere and ground water, so it is not usually the target of management to control eutrophication in freshwater. The bulk of the nitrogen in fresh water systems is found in one of three ionic forms—ammonium (NH_4^+), nitrite (NO_2^-), or nitrate(NO_3^-). Nitrite and nitrate are more readily taken up by most algae, but ammonia is of particular concern because it can be toxic to fish and other aquatic life. Accordingly, wastewater treatment plant upgrades have focused on reducing the toxic ammonia component of nitrogen discharges, with corresponding increase in the nitrate fraction.

Nutrient Loads

The major sources of nutrient loading in the Tallapoosa basin are wastewater treatment facilities, urban runoff and storm water, and agricultural runoff. Concentrations found within rivers and lakes of the Tallapoosa basin represent a combination of a variety of point and nonpoint source contributions.

Point source loads can be quantified from permit and effluent monitoring data, but nonpoint loads are difficult to quantify. Rough estimates of average nutrient loading rates from agriculture are available; however, nonpoint loads from urban/residential sources in the basin have not yet been quantified. The net load arising from all sources may, however, be examined from instream monitoring. Long-term trends in nutrients within the Tallapoosa River basin can be obtained by examining results from EPD long-term trend monitoring stations.

Trend monitoring of total phosphorus is summarized in Table 4-7. Total phosphorus concentrations are relatively low in this basin, particularly in the Tallapoosa River, reflecting the low population and small level of development in the basin. Trends in loading of total phosphorus over time can be seen by examining trend monitoring data, as shown in Figure 4-5. Phosphorus concentrations in the Little Tallapoosa peaked in the late 1970s, and have generally declined since. This decline represents improved management of both point and nonpoint sources, with additional declines after 1989 attributable to legislation restricting the use of phosphate detergents. Phosphorus concentrations in the mainstem Tallapoosa River have remained relatively constant over time.

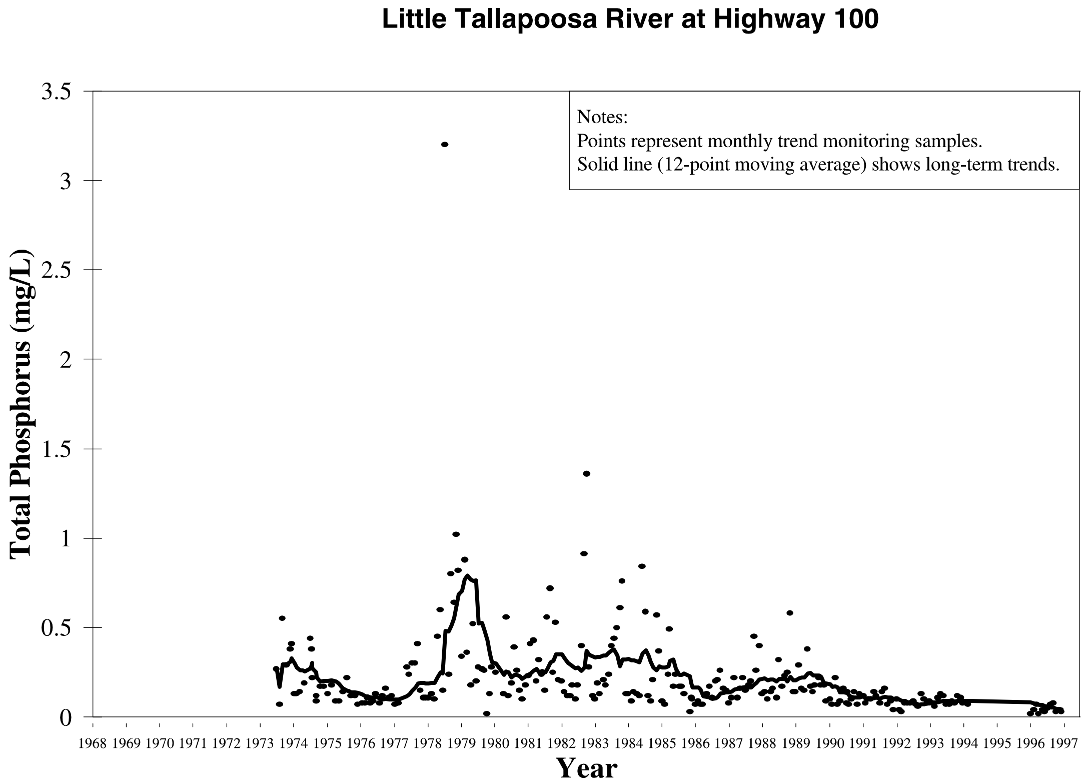
4.2.2 Oxygen Depletion

Oxygen is required to support aquatic life, and Georgia water quality standards specify minimum and daily average dissolved oxygen concentration standards for all waters. Problems with oxygen depletion in rivers and streams of the Tallapoosa basin are associated with oxygen-demanding wastes from point and nonpoint sources. Trend monitoring since 1973 indicates that dissolved oxygen concentrations in the Tallapoosa Basin are generally in excess of both the state instantaneous minimum of 4.0 mg/L and the state daily average minimum of 5.0 mg/L (Table 4-8). Concentrations between 4.0

Table 4-7. Trend Monitoring Summary for Total Phosphorus (mg/L) in the Tallapoosa River Basin

Station	Years	Average	Maximum	Minimum
Tallapoosa at Hwy.8 Station 13030001	1973-1996	0.06	0.29	0.02
Little Tallapoosa at Hwy. 100 Station 13010001	1973-1996	0.22	3.2*	0.02

** The next highest concentration observed during the period of record was 1.4 mg/L.*



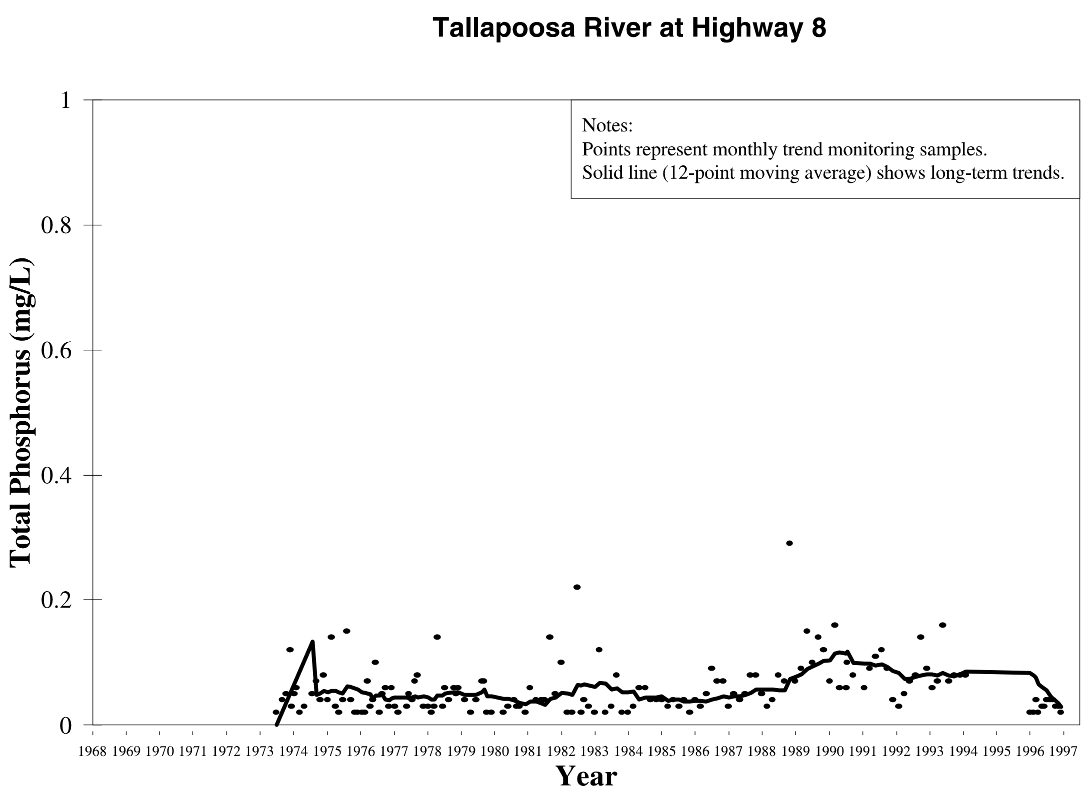


Figure 4-5. Total Phosphorus Concentrations in the Tallapoosa and Little Tallapoosa Rivers

Table 4-8. Trend Monitoring Summary for Dissolved Oxygen (mg/L) in the Tallapoosa River Basin

Station	Years	Average	Maximum	Minimum
Tallapoosa at Hwy. 8 Station 13030001	1973-1996	8.9	13.6	5.8
Little Tallapoosa at Hwy. 100 Station 13010001	1973-1996	8.2	12.7	4.1

and 5.0 mg/L have occasionally been observed in the Little Tallapoosa, but only prior to 1982, as shown in Figure 4-6. Dissolved oxygen concentrations have generally shown a slight increase with time at this station and have remained relatively stable at the mainstem Tallapoosa station.

4.2.3 Metals

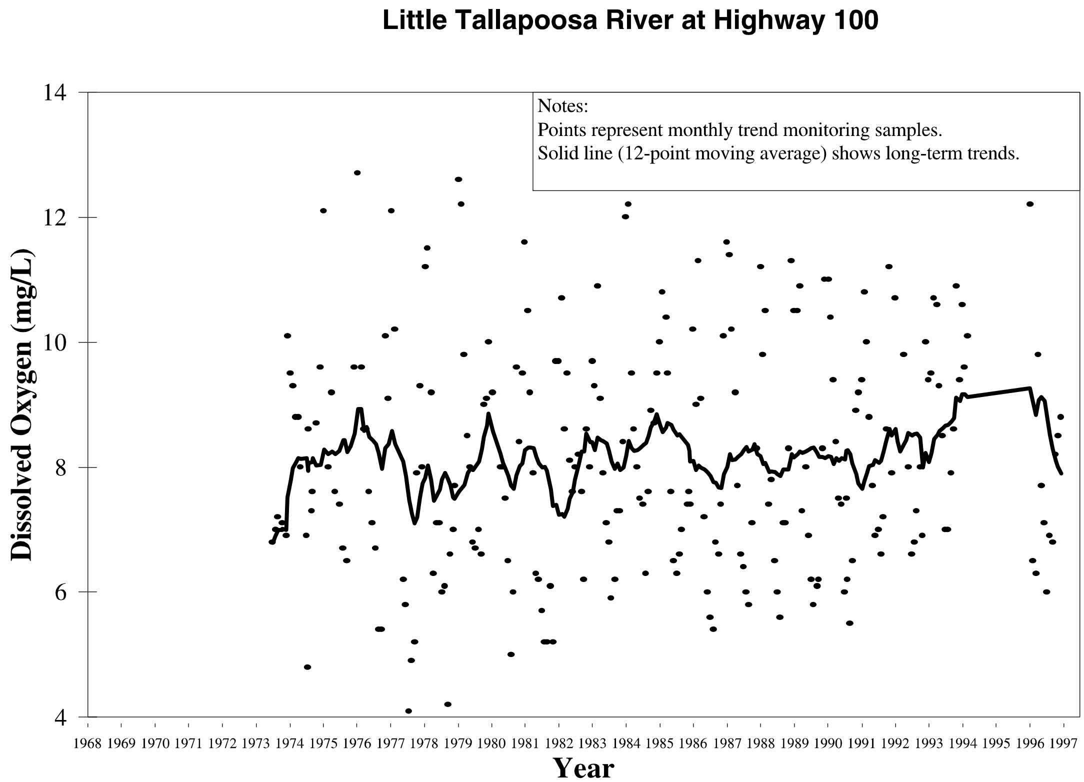
Violations of water quality standards for metals (e.g., lead, copper, zinc) were the second most commonly listed causes of nonsupport of designated uses in the 1996-1997 water quality assessment of the Tallapoosa basin, after fecal coliform bacteria. In most cases, these metals are attributed to nonpoint urban runoff and storm water. Point sources also contribute metals loads; however, major point sources of metals in the Tallapoosa basin (wastewater treatment plants and certain industrial discharges) have been brought into compliance with permit limits, leaving the more-difficult-to-control nonpoint sources as the primary cause of impairment.

It should be noted that sample data on metals in many streams is rather sparse, and there are concerns regarding the quality of some of the older data. Although urban runoff appears to be the primary source of loading of these stressors, loading rates have not been quantified and will require additional study.

4.2.4 Fecal Coliform Bacteria

Violations of the standard for fecal coliform bacteria were the most commonly listed cause of nonsupport of designated uses in the 1996-1997 water quality assessment. Fecal coliform bacteria are monitored as an indicator of fecal contamination and the possible presence of human bacterial and protozoan pathogens in water. Fecal coliform bacteria may arise from many of the different point and nonpoint sources discussed in Section 4.1. Human waste is of greatest concern as a potential source of bacteria and other pathogens. One primary function of wastewater treatment plants is to reduce this risk through disinfection. Observed violations of the fecal coliform standard below several wastewater treatment plants on the Tallapoosa River have generally been rapidly corrected in recent years.

Table 4-9 summarizes long term trend monitoring data for fecal coliform bacteria in the Tallapoosa River basin. State water quality standards for the fishing classification specify a 30-day geometric mean (four samples over 30 days) of 200 MPN/100 ml for May through October, and a geometric mean (four samples over 30 days) of 1,000 MPN/100 ml for November through April. Occasional high concentrations are expected during wet weather events, and are allowed for in the standard. The median or 50^{th} percentile value is a useful summary of fecal coliform concentrations which is less sensitive to occasional high values than the average. At both Tallapoosa basin stations, the median is in the neighborhood of 200 MPN/100 ml, while the geometric means of the complete data series are 299 and 370 for the Tallapoosa and Little Tallapoosa.



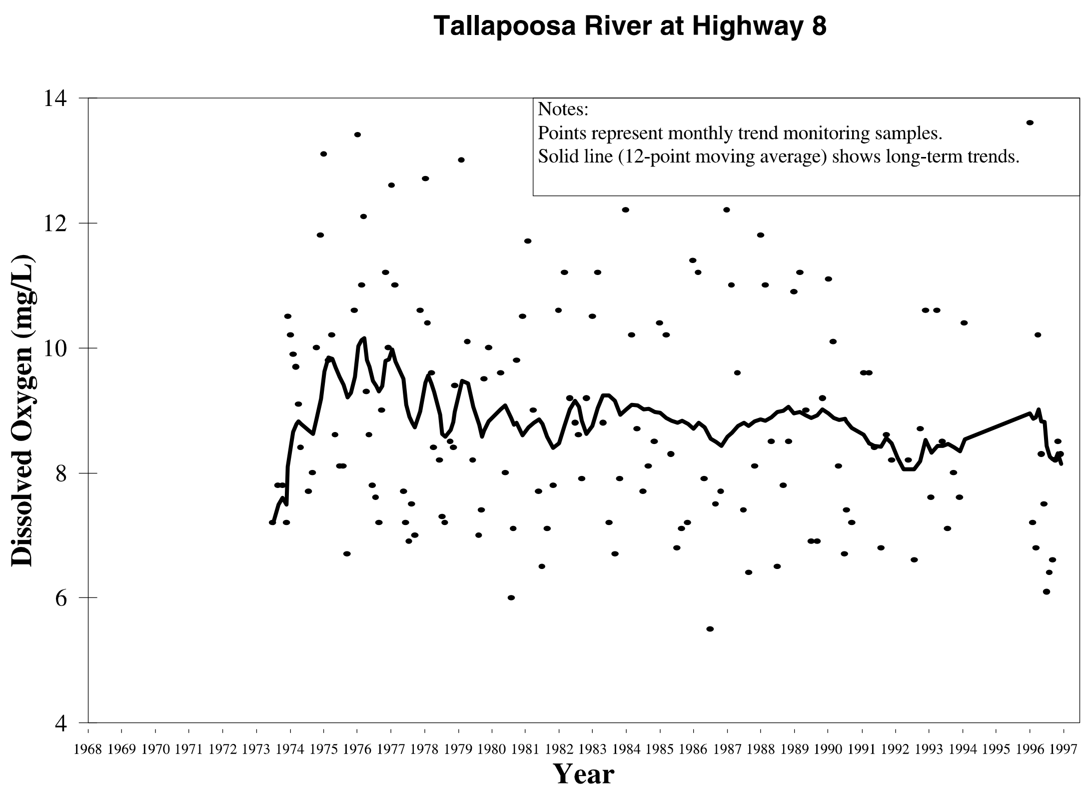


Figure 4-6. Dissolved Oxygen Concentrations in the Tallapoosa and Little Tallapoosa Rivers

Table 4-9. Trend Monitoring Summary for Fecal Coliform Bacteria (MPN/100 ml) in the Tallapoosa River Basin

Station	Years	Average	Geometric Mean	Maximum	Median
Tallapoosa at Hwy.8 13030001	1973-1996	1289	299	43000	170
Little Tallapoosa at Hwy. 100 13010001	1973-1996	1329	370	43000	230

Monthly trend-monitoring sampling is not sufficient to establish 30-day geometric means for comparison to the standard. The long-term averages and medians shown in Table 4-9 are generally inflated by data from earlier years prior to WPCP upgrades. For instance, monitoring in the Tallapoosa River at Georgia Highway 8 (Figure 4-7) shows a generally declining trend in fecal coliform bacteria concentrations from the late 1970s to the present (note the use of a logarithmic scale). In monitoring from 1990–1996, the median summer (May through October) concentration in the Tallapoosa River was 170 MPN/100 ml, which is below the geometric mean standard. In the Little Tallapoosa River at Highway 100 the median of 1990–1996 summer concentrations was 490 MPN/100 ml, indicating the need for continued improvements.

As point sources have been brought under control, nonpoint sources have become increasingly important as potential sources of fecal coliform bacteria. Nonpoint sources may include

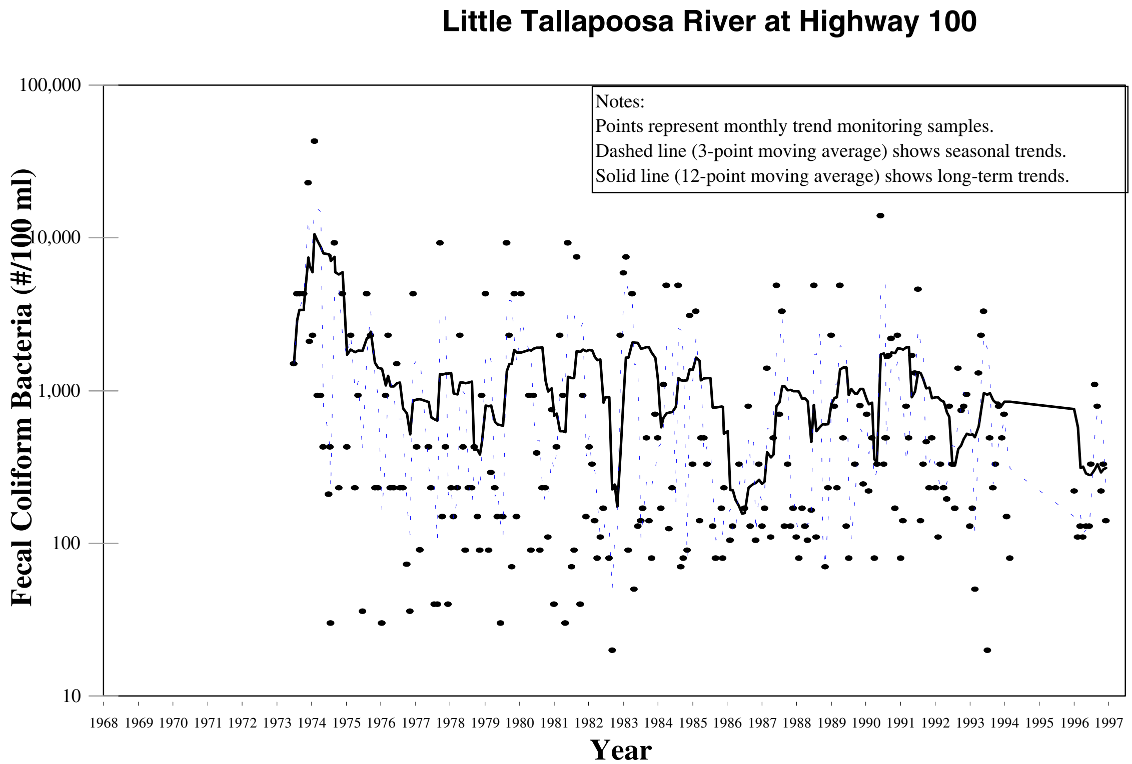
- Agricultural nonpoint sources, including concentrated animal operations and spreading and/or disposal of animal wastes.
- Runoff from urban areas transporting surface dirt and litter, which may include both human and animal fecal matter, as well as a fecal component derived from sanitary sewer overflows.
- Urban and rural input from failed or ponding septic systems.

4.2.5 Synthetic Organic Chemicals

Synthetic organic chemicals (SOCs) include pesticides, herbicides, and other man-made toxic chemicals. SOCs may be discharged to waterbodies in a variety of ways, including

- Industrial point source discharges.
- Wastewater treatment plant point source discharges, which often include industrial effluent as well as SOCs from household disposal of products such as cleaning agents and insecticides.
- Nonpoint runoff from agricultural and silvicultural land with pesticide and herbicide applications.
- Nonpoint runoff from urban areas, which may load a variety of SOCs such as horticultural chemicals and termiticides.
- Illegal disposal and dumping of wastes.

To date, SOCs have not been detected in the surface waters of the Tallapoosa River basin in problem concentrations. It should be noted, however, that most monitoring has been targeted to waters located below point sources where potential problems were suspected.



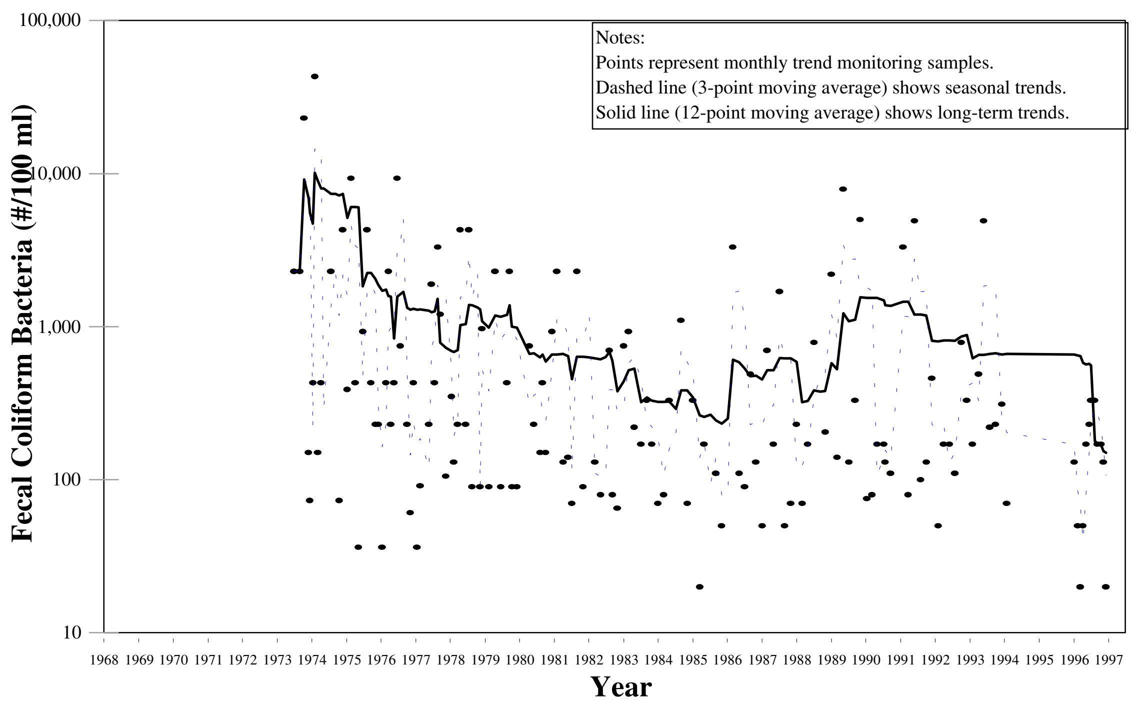


Figure 4-7. Fecal Coliform Bacteria Concentrations (MPN/100 ml) in the Tallapoosa and Little Tallapoosa Rivers

4.2.6 Stressors from Flow and Temperature Modification

Stress from flow modification in the Tallapoosa is primarily associated with the increased storm flows in smaller streams in developing areas as the percentage of impervious surfaces increases. During drought periods, the potential exists for flow depletion below water withdrawals in the basins. Expected natural minimum flows in streams of the basin vary with geology. Seven-day two-year recurrence low flows (7Q2) expressed on an areal basis for streams in this basin are estimated to range from about 0.16 to 0.28 cubic feet per second per square mile (Journey and Atkins, 1996).

Stress from temperature modifications is primarily a problem in small streams in designated trout watersheds. Small impoundments on such streams permanently alter water temperature regimes unless specific provisions are made to prevent such changes.

4.2.7 Sediment

Erosion and discharge of sediment can have a number of adverse impacts on water quality. First, sediment can carry attached nutrients, pesticides, and metals into streams. Second, sediment is itself a stressor. Excess sediment loads can alter habitat, destroy spawning substrate, and choke aquatic life, while high turbidity also impairs recreational and drinking water uses. Sediment loading is of concern throughout the basin, but is of greatest concern in the developing metropolitan areas and major transportation corridors. The rural areas are of lesser concern with the exception of rural unpaved road systems and areas where cultivated cropland exceeds 20 percent of the total land cover.

4.2.8 Habitat Degradation and Loss

In many parts of the Tallapoosa basin, support for native aquatic life is threatened by degradation of aquatic habitat. Habitat degradation is closely tied to sediment loading, and excess sediment is the main threat to habitat in rural areas with extensive land disturbing activities, as well as in urban areas where increased flow peaks and construction can choke and alter stream bottom substrates.

Water temperature increases due to the impacts of small impoundments also threaten trout habitat throughout the basin. As development increases in the basin, and as demand for water grows, the integrity of aquatic habitat may be threatened by reduced flows, particularly during the late summer and fall when stream flows are normally low.

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