Protecting Human Health

Protecting human health, one of EPD's most important objectives, is a major focus of the state laws that created EPD's regulatory and monitoring programs.

To meet this objective, EPD implements laws, rules and policies and enforces state and national standards. To ensure this objective is being met, EPD tracks pollutants in the state's drinking water and surface waters (lakes, rivers and streams), on the land and in the air.

In this chapter, 10 indicators are used to evaluate progress toward the objective of protecting human health (Table 1.1). Indicators measure the condition of the state's water, land and air and track human activities that affect these resources.

Human activities that alter the condition of the state's natural resources include nonpoint source water pollution, waste generation and disposal, and emissions of air pollutants.

Table 1.1 *Indicators of the condition of the state's natural resources.*

Natural resource	Indicators of condition
Drinking water	Community water systems meeting drinking water standards
Surface water	Bacteria levels in surface water
	Contaminants in fish tissue
	Non-point sources of pollution
Land	Land contaminated above health-based standards
	Solid waste disposal
	Hazardous waste generation
Outdoor air	Levels of air pollutants
	Non-attainment areas
	Emissions of air pollutants

Community Water Systems Meeting Drinking Water Standards

Indicator of the quality of Georgia's **Drinking Water**

What are public and community water systems?

A public water system is defined by the U.S. Environmental Protection Agency (EPA) to serve at least 25 people for at least 60 days a year. Community water systems are public systems that supply water to the same population year-round. EPA tracks the performance of community drinking water systems in all states to measure progress toward meeting the objective of protecting human health.

How do Georgia's results compare with those for the Southeast?

The performance by Georgia's community water systems has generally exceeded that of drinking water systems in the Southeast as a whole. Over the past decade, Georgia's community water systems outperformed Southeastern systems in eight out of 10 years.

Between 1998 and 2007, the percentage of the state's population served by community water systems that met all health-based standards averaged 96 percent. In the Southeast as a whole, the average for the same time period was 94 percent.

Georgia's drinking water comes from surface waters (rivers, lakes, streams, ponds and reservoirs) and from groundwater (springs and wells). More than 80 percent of the state's population gets its drinking water from public water systems (Figure 1.1), most of which treat the water before it is distributed.

To ensure that the drinking water provided by these systems is safe, the U.S. Environmental Protection Agency (EPA) and EPD set standards that limit the amount of 83 contaminants, including chemicals and disease-causing microorganisms (bacteria and protozoa), that can be present in the water. Owners and operators of public drinking water systems are required to monitor the water for these contaminants. Standards are violated when a contaminant exceeds the limits set for it in the regulations.

In 2007, 94 percent of the population served by community water systems in Georgia received water that met all health-based standards (Table 1.2); EPA's target for the southeastern states was 91 percent. The most common reason for not meeting the standards is high levels of total coliform bacteria (see page 9 for more on this contaminant). An increase in violations in 2006 and 2007 was due to new and more stringent federal and state drinking water regulations.

Less than 20 percent of Georgians get their drinking water from small non-public systems or wells. Since these sources are not required to meet specific standards and are not systematically monitored, the quality of drinking water for that portion of the state's population cannot be assessed.

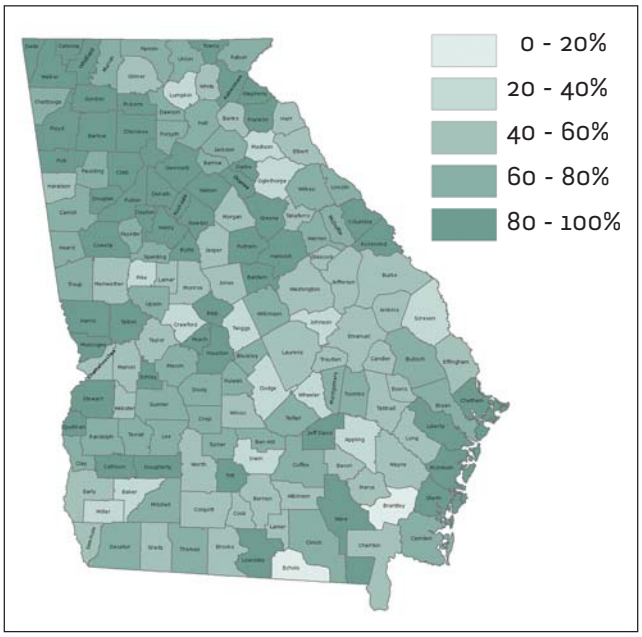


Figure 1.1 *Percent of population on a public water system, by county, 2007. (EPD)*

Table 1.2 *Community water systems meeting health-based standards. (EPA, based on Georgia Safe Drinking Water Information System data)*

Fiscal year	Number of systems meeting health-based standards	Percent of systems state-wide meeting health-based standards	Population served by systems meeting health-based standards	Percent of population* served by systems meeting health-based standards
1998	1,574	95	6,230,632	97
1999	1,605	96	6,109,616	94
2000	1,621	97	6,497,878	99
2001	1,592	95	6,690,688	98
2002	1,599	96	6,910,480	98
2003	1,593	95	6,623,343	93
2004	1,643	97	7,239,274	98
2005	1,619	96	7,031,704	95
2006	1,612	94	7,033,525	95

*Population on community water systems only.

Backgrounder

What are coliform bacteria?

Drinking or coming into contact with water containing high levels of fecal bacteria increases the chance of illness (fever, nausea or stomach cramps) from harmful bacteria entering the body through the mouth, nose, ears or cuts in the skin.

Even in polluted waters, harmful organisms are generally few in number and, unfortunately, difficult to identify. Routine monitoring is either impossible or impractical; therefore, scientists and public health officials typically monitor bacteria that are associated with those transmitted by fecal contamination, which are easier to measure.

These bacteria are known as indicator organisms and are assumed to indicate the presence of harmful organisms. The presence of indicator bacteria does not mean the water contains harmful microorganisms, but rather that the potential exists. Types of indicator bacteria include:

Total coliforms are a group of bacteria that are widespread throughout the natural environment. All members of the total coliform group can occur in human feces, but some can also be present in animal manure, soil, submerged wood and in other places in the environment. Total coliforms are the standard test for drinking water because their presence indicates that a water supply has been contaminated by an outside source.

Fecal coliform bacteria, a subset of total coliform bacteria, are more likely to originate in feces. Georgia and many other states have used this group of bacteria as the primary indicator for contamination of recreational waters.

Recently, EPA began recommending two other bacteria, E. coli and enterococci, as better indicators of health risks from water. Following this guidance, Georgia's fecal coliform standard will be evaluated and updated to improve the tracking of public health risks. Until this evaluation is complete, EPD will continue to use fecal coliform as a primary indicator of water quality.

Escherichia coli (E. coli) is a species in the fecal coliform group commonly found in the intestinal tract of humans, mammals and birds. This bacteria is one of the best indicators for freshwater recreation because its presence is direct evidence of fecal contamination from warmblooded animals.

Enterococci are a subgroup within the bacterial coccus group that are also commonly found in the intestinal tract of humans and animals. Because Enterococci can survive in salt water, EPA recommends this group as the indicator of health risk in salt water used for recreation.

Bacteria Levels in Surface Water

Indicator of the quality of Georgia's **Surface Water**

What are water quality standards?

Water quality standards define the goals for a water body by designating its uses and setting criteria to protect those uses.

All waters in the state have a specific designated use, such as drinking water, fishing, recreation, wild and scenic or coastal fishing. There are also special designations for trout streams, waters that support shell fishing and outstanding natural resource waters. All waters are protected for recreation during the swimming season (May - October). All major lakes, a portion of the Chattahoochee River and the coast are designated for recreation year round.

Water quality criteria are designed to protect each water body's designated use. Some criteria are narrative — text descriptions of required water quality conditions. Others are numeric criteria that define limits on acceptable amounts of specific pollutants. To help ensure that the state's water bodies meet their designated uses, EPD monitors their condition to determine whether or not the water quality criteria are met.

Two indicators are tracked to assess the quality of surface water from the perspective of human health: bacteria levels in surface water and contaminants in fish tissue.

This report uses three methods to evaluate bacteria in surface waters. The first is the trend in fecal coliform levels at 40 long-term or trend monitoring stations. The second, the number of miles of rivers that violate the fecal coliform standards, is based on measurements from a larger number of sites in the river basin monitoring program. The third comes from monitoring waters at public beaches.

Tracking bacteria levels is important because water contaminated with bacteria can cause illness not only if it is ingested, but also if it comes in contact with the ears, nose, mouth or cuts in the skin. [See page 9 for more information on bacteria and page 11 for more on monitoring.]

Each year, fecal coliform and other contaminants are measured monthly at 40 trend monitoring sites around the state. Water samples have been taken since the early 1970s, so long-term trends in water quality can be evaluated. Analysis of this data shows a consistent decline in fecal coliform levels since the early 1970s. This decline is primarily due to major improvements in wastewater treatment by industries and municipalities.

Because people tend to swim and engage in other water-related activities more during the summer, the standard for fecal coliform is stricter between May and October. Since the early 1990s, average summer levels of the bacteria have been below the health-based water quality standard (Figure 1.2). Winter levels of fecal coliform have also shown a similar trend, with average levels falling below the winter standard since 1975.

Data from the 40 trend monitoring sites provides valuable information. However, other information, including data on short-term variation in water quality and on water quality in other rivers and streams, is needed for a fuller picture of the bacteria levels in surface waters.

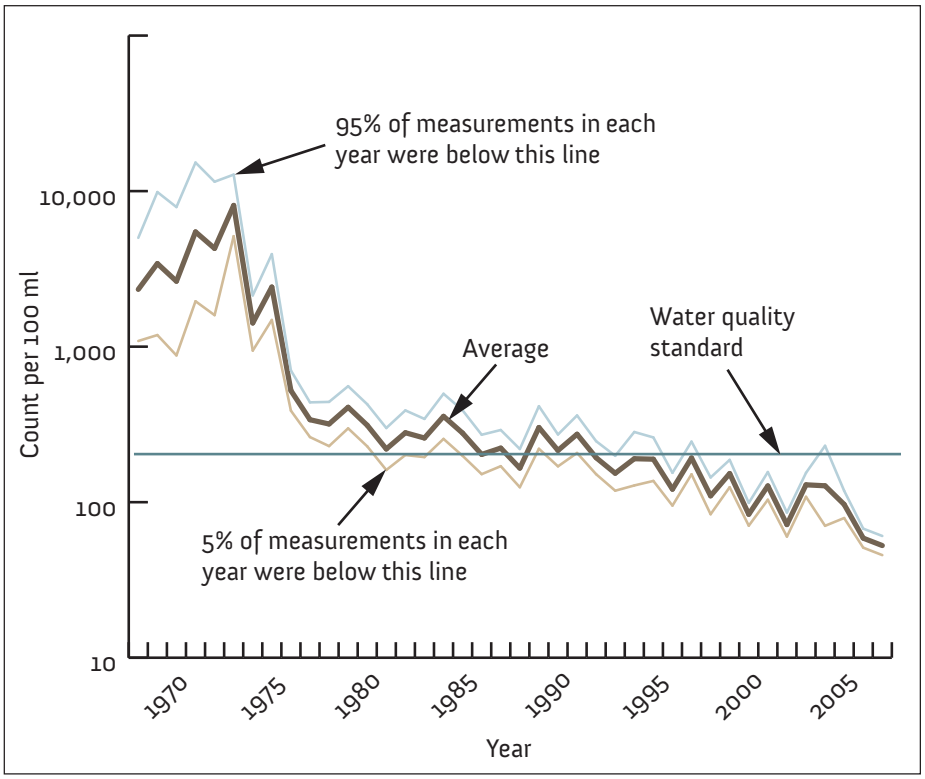


Figure 1.2 *Average fecal coliform counts at 40 trend monitoring stations, May - October. Swimming and other recreational contact with surface waters is greatest between these months, making this the most critical time to monitor fecal coliform levels. (EPD)*

Backgrounder

How do we monitor the quality of Georgia's surface water?

In the late 1960s, EPD began monitoring the quality of Georgia's surface water. Since then, 40 sites, representing all the state's major river basins, have been continuously monitored. These sites are mostly on large streams or rivers along Georgia's borders and track the quality of water coming in from other states, as well as the quality of the water leaving Georgia.

In addition to sampling at these core stations, EPD also monitors all river basins on a rotating schedule — generating an in-depth study of each basin every five years. In recent years, water quality data have been collected from 125 to 240 sites every year. The number of stations monitored partly depends on state, federal and non-governmental funding.

While the program does not evaluate water quality in every body of water in the state, it does track changes in water quality conditions across the state. For example, water quality is monitored in waters with significant recreational or municipal uses, waters threatened by contamination from polluted runoff, and waters that receive wastewater or stormwater discharges. EPD also tracks efforts to improve water quality after problems are discovered.

As of 2008, water quality in more than 20 percent of the state's river and stream miles and in more than 93 percent of the acres in the state's major lakes had been evaluated. EPD reviews its water quality monitoring strategy every three to five years, with the goal of increasing the number of stream miles and lake acres it evaluates.

What happens when water quality standards are not met?

The federal Clean Water Act requires each state to maintain a list of waters that do not meet water quality standards. States must rank these waters in order of priority and set a limit for the maximum amount of a contaminant the water body can receive and still meet water quality standards. This limit, called a total maximum daily load (TMDL), is established to ensure that the water body supports its designated uses.

Developing the TMDL typically involves intensive monitoring to describe the water quality problem more fully, identify potential sources of pollution, and determine the level of pollution reduction necessary to meet the target.

Once the TMDL is established, EPD develops a plan describing how the TMDL, and ultimately the water quality standards, will be achieved. Once the water quality standards are met, the state may remove the water body from the list.

Keeping swimmers on Georgia's coast safe from bacteria

To protect swimmers on the coast, the state also monitors waters at designated public beaches for enterococcus bacteria. [See page 9 for more on why this specific bacteria is tracked.] If high levels of bacteria are found, the local health department issues an advisory recommending the public not swim there, although the beach is not closed.

Twenty-seven beaches were monitored between 2005 and 2007. Of the beaches monitored in 2007, 14 had at least one advisory (see table below). Overall, EPA concluded that Georgia beaches were affected by high levels of enterococcus bacteria on only 2 percent of the total number of beach days* in the 2007 swimming season. Nationally, beaches were affected by high levels of bacteria on 5 percent of beach days in 2007.

Beach advisories, 2004 - 2007.

	Beaches with advisories	% of beach days affected
2005	17	10
2006	11	3
2007	14	2

**The total number of beach days equals the number of beaches monitored multiplied by the number of days in the swimming season. (EPA)*

To supplement trend monitoring data, EPD also monitors all river basins on a rotating, five-year cycle. This monitoring gives a more detailed snapshot of water quality in each river basin and provides much of the information EPD uses to determine whether water quality standards are being met.

Periodic river basin monitoring shows that, while long-term trends in fecal coliform have steadily improved, there are still sections of streams and rivers where fecal coliform levels exceed the water quality standard (Table 1.3).

Of the river miles tested, 34 percent do not meet water quality standards for fecal coliform, indicating potential human health risks from contact with those waters. Fecal contamination affects all 14 river basins in the state, and it is currently the most common water quality problem in all but four.

Table 1.3 *Percent of assessed miles of rivers not meeting the water quality standard for fecal coliform, 2006 - 2007. The location of each river basin is shown in Figure 1.3. (EPD)*

River basin	Total river miles	Percent of river miles assessed	Percent of assessed miles not meeting fecal coliform standard
Altamaha	3,430	16%	31%
Chattahoochee	8,172	23%	39%
Coosa	7,126	25%	37%
Flint	9,122	18%	19%
Ochlockonee	1,716	15%	49%
Ocmulgee	7,268	25%	34%
Oconee	6,773	20%	40%
Ogeechee	6,981	12%	21%
Satilla	3,629	21%	32%
Savannah	7,413	15%	31%
Suwannee	4,961	20%	19%
St. Marys	485	33%	9%
Tallapoosa	774	31%	35%
Tennessee	2,300	24%	35%
Total	70,150	20%	32%

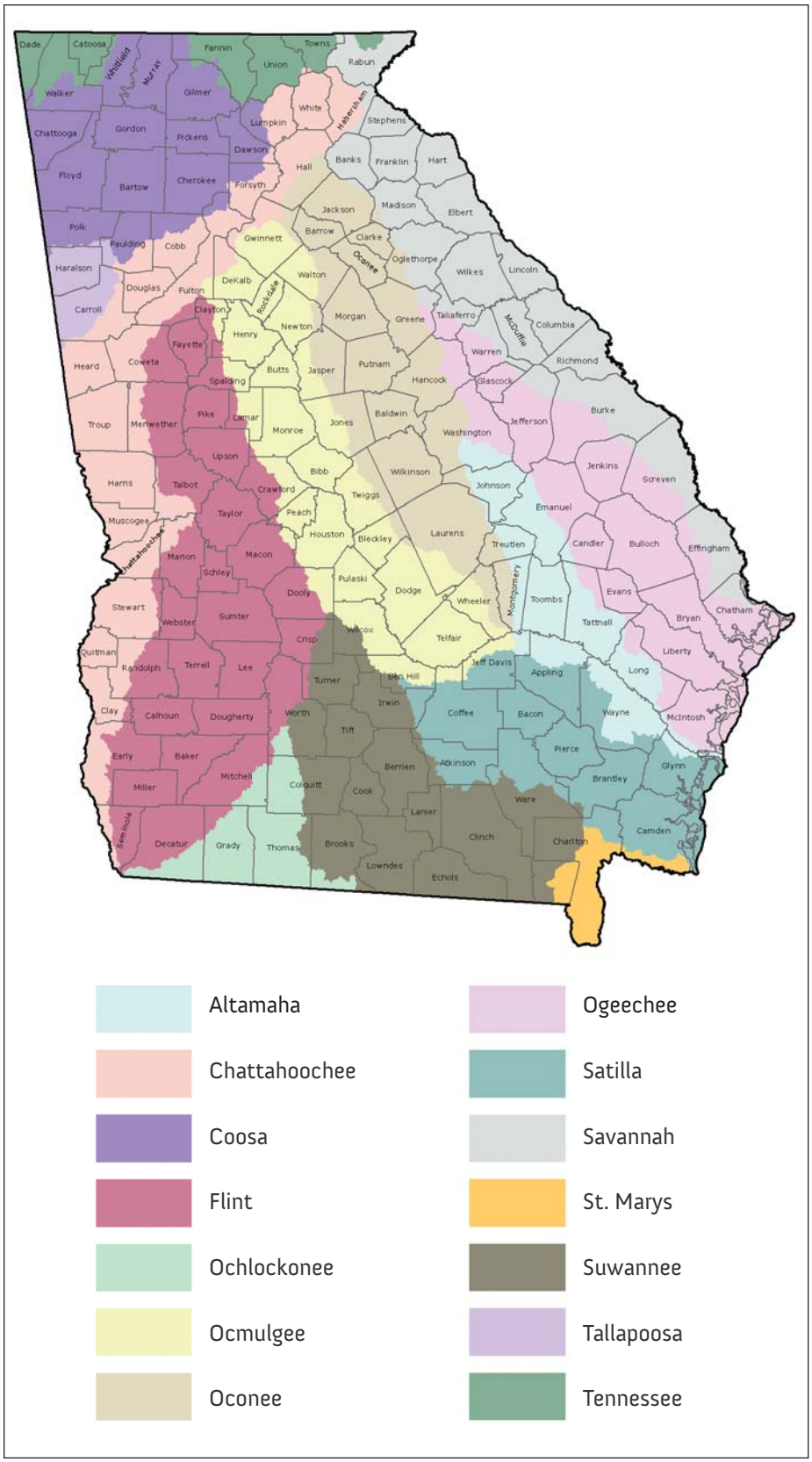


Figure 1.3 *Georgia's 14 major river basins. (EPD)*

What is a watershed?

A watershed is an area of land where all the water drains to the lowest point – usually a stream, lake or river. Rain runs off land in the watershed through a network of gullies, creeks and streams to the point defined as the outlet of the watershed. That point may be on a stream, river or lake.

The boundary of a watershed is formed by the highest mountains or hills around a stream, river or lake and ends at the bottom or lowest point of the land where water flows out of the watershed.

Small watersheds include small streams known as headwater streams, and may have one connecting stream.

Small watersheds that contribute water to the same large stream or river are part of the same large watershed. For instance, the land that drains into southwest Georgia's Ichawaynochaway Creek is an example of a large watershed. The land that drains into the Upper Ocmulgee River in the central part of the state and the land that drains into the Broad River in northeast Georgia also are examples of large watersheds.

There are 52 large watersheds in Georgia (for a map, see http://www.georgiaplanning.com/documents/atlas/52watersheds.pdf). These large watersheds drain into the state's 14 major river basins (Figure 1.3).

Contaminants in Fish Tissue

Indicator of the quality of Georgia's **Surface Water**

Some contaminants build up in fish tissue and may pose risks to human health when the fish is consumed. Longer-lived fish (and the animals that eat them) can contain more contaminants, and therefore can pose greater risks for human consumption.

EPD monitors for 40 types of contaminants in fish in rivers, lakes and streams commonly used for fishing. These areas include 26 major reservoirs that make up more than 90 percent of the state's lake acreage, rivers visited by large numbers of fishermen, and some rivers downstream from urban or industrial sources.

Each year, the state issues risk-based guidelines recommending people limit their consumption of species by water body, based on the levels of contaminants found in the fish. These guidelines are intended to protect sensitive groups (such as children and women of childbearing age) from health risks associated with long-term, chronic exposure to the contaminants.

The contaminants monitored fall into two general categories: human-made chemicals called organochlorines and naturally occurring metals. Organochlorines that contribute to recommended restrictions on fish consumption include polychlorinated biphenyls (PCBs); DDT and its by-products; and the pesticides dieldren, chlordane and toxaphene. Mercury is the only metal that contributes significantly to the recommended restrictions.

In the early years of monitoring, organochlorines accounted for most of the restrictions (Figure 1.4). However in the late 1990s, restrictions due to mercury became more prevalent and continue to account for the majority of advisories today (see the sidebar on page 15 for one reason for this change).

Fish consumption guidelines due to mercury are more common in the state's rivers than in its lakes. They are also more stringent in the southern parts of the state. The chemical conditions in streams found in south Georgia lead to the transformation of mercury into a form that poses the greatest threat to human health (methylmercury); this form of mercury also easily builds up in fish tissue.

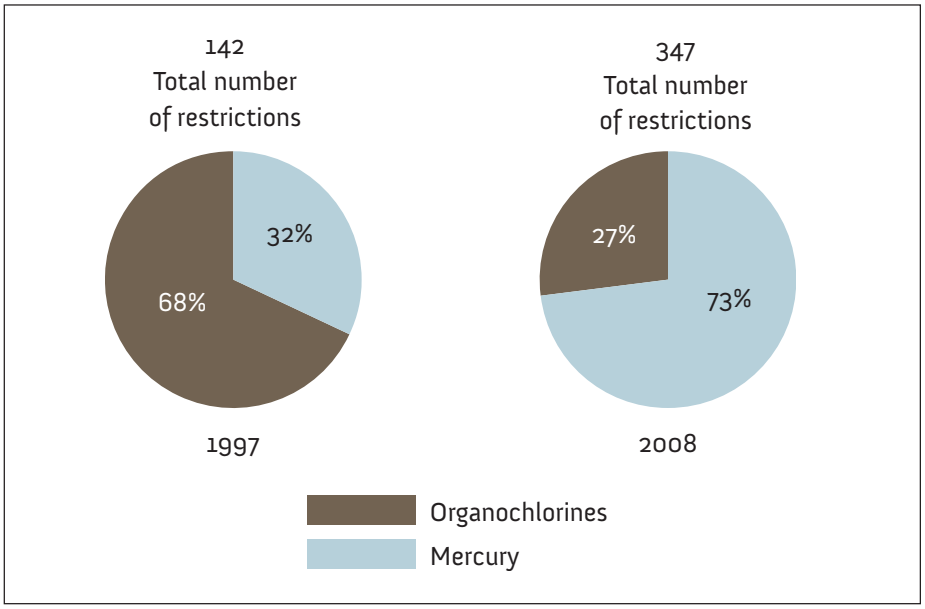


Figure 1.4 *Percentages of recommended fish consumption restrictions due to mercury and organochlorines, 1997 and 2008. (EPD)*

Restrictions recommended due to PCB contamination vary across the state, with more occurring in the Chattahoochee, Coosa, Ocmulgee, Satilla and Savannah basins. Rivers and lakes seem to be equally affected by PCBs. There is a ban on the manufacture of new products containing PCBs, but old equipment can still be a source. Also, contamination can remain in the environment a long time because PCBs break down very slowly.

Pesticide contamination results in the fewest number of recommendations limiting fish consumption. Use of the pesticides that contribute to fish consumption guidelines has been banned or restricted in the U.S. However, like PCBs, they are still present in the environment because of how slowly they break down.

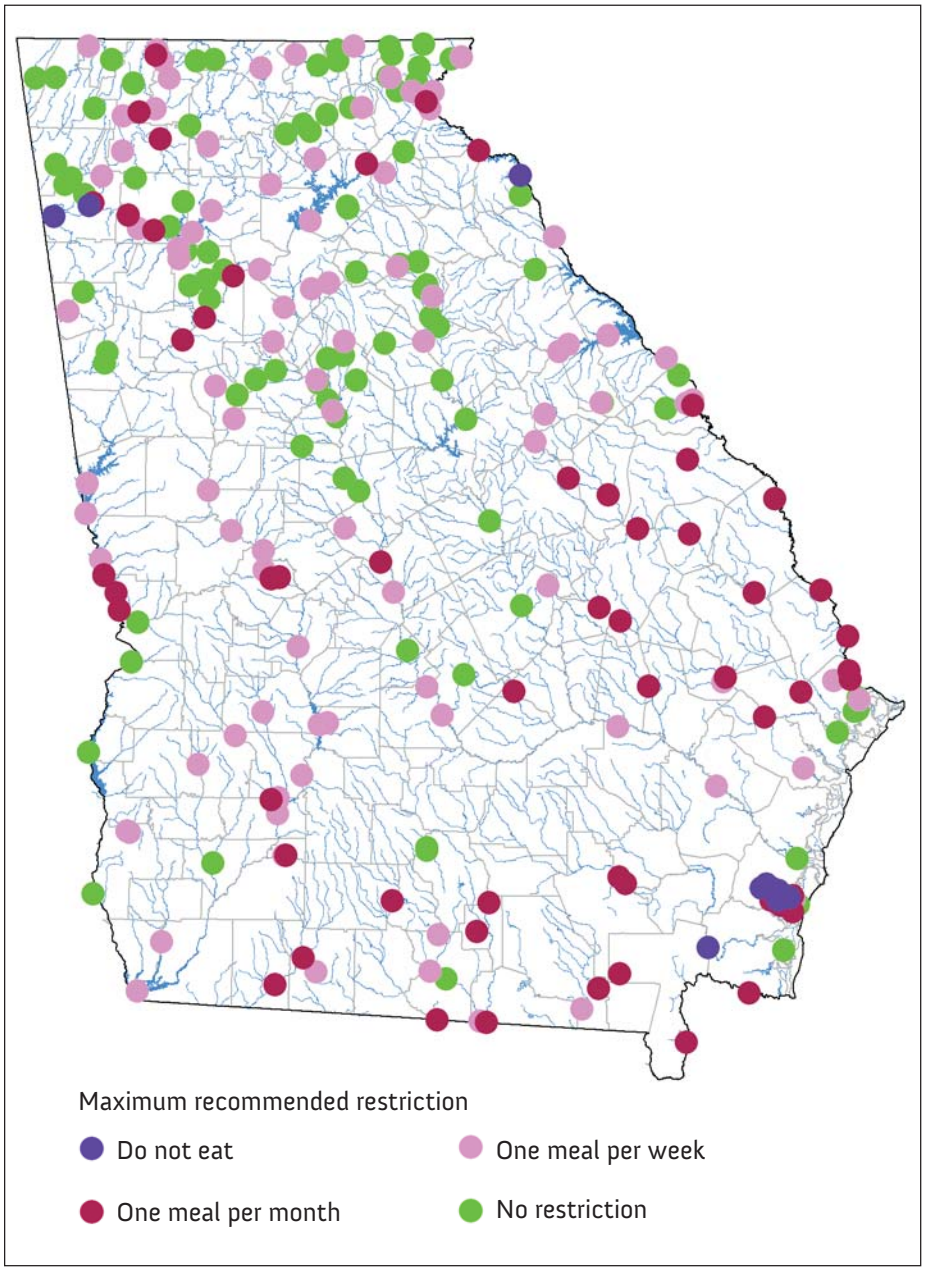


Figure 1.5 *Fish consumption guidelines, 2008. (EPD)*

Why are fish consumption restrictions due to mercury more common today?

One reason that restrictions due to mercury are more prevalent in Georgia today is because of changes EPA made in how it evaluates risk from contaminants.

On the basis of new research, in the late 1990s, EPA tripled the estimated toxicity of mercury and lowered the estimated toxicity of two important organochlorines (PCBs and chlordane).

The new values decreased the importance of organochlorines in the overall scheme of Georgia's advisories and greatly increased the significance of mercury.

Where can I find the fish consumption guidelines?

The booklet, "Guidelines for Eating Fish from Georgia Waters," is available online at www.gaepd.org/Documents/fish_guide.html.

New guidelines are issued each year based on changing conditions in the state's lakes and rivers.

Nonpoint Sources of Pollution

Indicator of the quality of Georgia's **Surface Water**

What are nonpoint sources?

Nonpoint sources of water pollution include:

- Bacteria and nutrients from livestock, pet wastes and faulty septic systems
- Sediments from improperly managed construction sites, crop and forestlands and eroding stream banks
- Oil, grease and toxic chemicals from urban runoff and energy production
- Excess fertilizers, herbicides and insecticides from agricultural lands and residential areas
- Mercury from coal-fired power plants and other sources of combustion

The quality of Georgia's surface waters is affected by pollution from point and nonpoint sources. Point sources include wastewater flowing from a single source — e.g., a pipe, an industrial facility or a wastewater treatment plant. Nonpoint source pollution, in contrast, can be created by a variety of human activities.

Pollution from nonpoint sources is generally carried by rainfall or snowmelt moving over the ground. As this water moves across the land, it picks up and carries pollutants with it, finally depositing them into lakes, rivers, wetlands and coastal waters.

Some contaminants, like mercury, also can settle directly out of the air and into a body of water. Together, pollution from these different nonpoint sources can slow progress toward the objective of protecting human health (and toward other environmental objectives, as will be discussed later).

Mercury: the air-land-water connection

Mercury in fish tissue, and the fish consumption guidelines that result, are nonpoint source problems. Although the risk to human health comes from eating fish, the mercury does not come from the water body. Instead, much of the mercury in our streams and rivers has been deposited out of the air after originating from combustion sources.

There are several different chemical forms of mercury. Metallic and inorganic forms can be toxic at high levels. However, an organic form called methylmercury is of greater concern, because it is a powerful toxin, it remains in the environment for a long time, and it readily enters the food chain and can accumulate in the bodies of fish, animals and humans.

Because mercury, like some other pollutants, can remain in the environment for a long time, it can be carried great distances by air currents and then settle onto soil or into lakes and streams, far from the original source. Once on land or in water, mercury can undergo a complex series of chemical reactions to create methylmercury. The natural chemical conditions that lead to this transformation are more common in south Georgia than in north Georgia, which contributes to the higher number of mercury-based fish consumption restrictions in the southern part of the state.

Today, most human-made mercury that enters the environment comes through emissions to the air from combustion sources such as coal-burning power plants. Some of this mercury may enter a global pool of mercury in the atmosphere. Much of it, however, falls out locally, near the point where it was emitted, or is deposited in other parts of the state or southeastern U.S.

All of these factors contribute to the management challenge posed by mercury. In 2008, mercury accounted for nearly three-fourths of all advisories on reduced fish consumption in Georgia. EPA assessments indicate that local industrial facilities were the primary source of mercury in some of these water bodies. For others, however, EPA's results suggest that as much as 72 percent of the mercury came from coal-fired power plants in other parts of the state.

To address these sources, the state recently adopted regulations that require new and existing power plants to install technologies that reduce the amount of mercury they release. The regulations also require additional monitoring and evaluation of mercury sources, information that will be critical to improving our management of mercury's air-land-water connection and decreasing risks to human health.

For more information on mercury transport, see the 1997 EPA report to Congress available at http://www.epa.gov/mercury/report.htm. Information on mercury in Georgia waters is available in the data sources listed at the end of this report.

Bacteria: the land-water connection

Nonpoint sources also contribute to bacteria levels in surface water. Storm water runoff is one source of high bacteria levels. Fecal coliform bacteria in stormwater may come from wildlife and domestic animals, urban development (including sewer collection lines), leaking septic tanks, manure applied to agricultural land, or animals with access to streams.

During rainy weather, the levels of fecal coliform in surface water are often higher than in the same streams under dry conditions (Table 1.5). This effect is generally more pronounced in urban and suburban areas due to the large amount of paved surfaces and extensive drainage systems that efficiently carry contaminants into streams.

Bacteria levels in surface water also can be affected by failing septic systems. Septic systems that are properly sited, installed and maintained do not pose risks to human health and on-site sewage management is an important part of wastewater management in Georgia. When systems fail, however, bacteria can enter groundwater or be transported into streams and other water bodies.

While all county health departments oversee the siting and installation of septic systems, there are few monitoring programs or maintenance requirements in Georgia. The only local requirements for septic system maintenance are in the city of Berkley Lake in Gwinnett County and in a portion of Douglas County that lies in the watershed of the drinking water reservoir.

There have been no comprehensive studies of septic system failure rates across the state. A study in Gwinnett County found failures that resulted in wastewater backing up onto the ground surface in less than 1 percent of septic systems. In the 16-county metro Atlanta area, the North Georgia Metropolitan Water Planning District estimates that approximately 1 percent of septic systems fail each year.

Information on septic system repairs from the Georgia Department of Human Resources, however, suggests that failure rates may be higher in some counties. Failure rates are likely to vary with regional soil and groundwater conditions, and may be higher in areas with high water tables, like the coast.

The impact of failing septic systems is not just determined by failure rates; location is also a factor. If systems are built in unsuitable soils or next to surface water bodies, bacteria can readily be transported from failing systems directly to groundwater or nearby surface waters.

Even with low failure rates, without monitoring or maintenance programs, areas with large numbers of septic systems may face greater risks to water quality. The Georgia Department of Human Resources reports that, in the past five years, the highest numbers of new installations of septic systems have occurred in counties at the edge of and surrounding the metro Atlanta area. High numbers have also been seen in some counties in the north Georgia mountains and in a few counties along the coast.

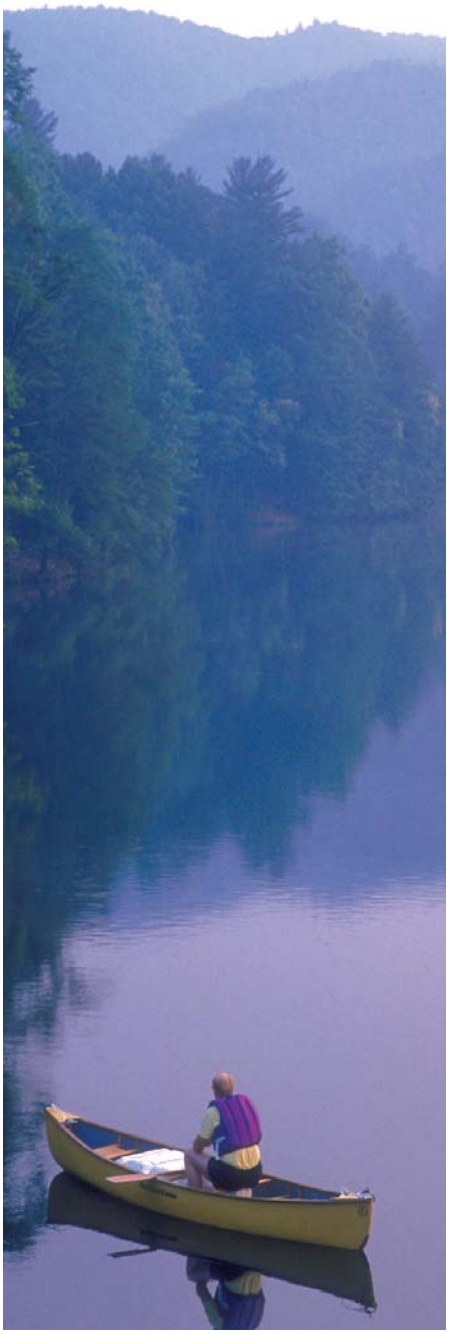


Table 1.5 *Fecal coliform levels during dry and wet weather, 1998 - 2005 (counts per 100 ml). (EPD)*

	Streams in rural areas		Streams in urban areas	
	Average	Range	Average	Range
Dry weather	160	51 - 744	225	28 - 5,289
Wet weather	414	158 - 4,480	2,514	148 - 41,611

Land Contaminated Above Health-based Standards

Indicator of the quality of Georgia's **Land**

The management of Georgia's land-based resources differs markedly from that for air and water. There are no major federal laws that specify overall standards for land quality. There are, however, federal and state laws that establish health-based standards for land contaminated with hazardous substances. At sites where humans can be exposed to contamination, cleanup standards are established to ensure the protection of human health.

Land contaminated above health-based standards can pose significant threats to human health in the immediate area, either through direct exposure to soil or contamination of drinking water sources. The number of acres contaminated above health-based standards that have been identified and measured is an indicator of the condition of Georgia's land from a human-health perspective.

EPD currently monitors land contamination from four primary sources: landfills, underground storage tanks, sites where hazardous waste is treated or stored, and sites known to be contaminated with hazardous substances. Contamination can also be caused by a number of other sources that are not routinely monitored. As a result, the total amount of land contaminated above health-based standards is not known. However, the acreage and number of contaminated sites currently tracked by EPD provide two measures of the condition of Georgia's land from the perspective of human health.

Landfills, if not properly managed, can result in contamination of surface and groundwater from liquid leaving the landfill. This liquid, known as leachate, is created as rain or groundwater filters through the landfill, picking up contaminants along the way.

Underground storage tanks are used by gas stations and other businesses to hold gasoline, oil and other petroleum products. Ingredients in these products, such as benzene and toluene, can cause cancer and other human illnesses. Corroded or leaking tanks can pose a serious threat to groundwater.

Sites where hazardous waste is treated or stored are tracked and managed under the federal Resource Conservation and Recovery Act. Land at a portion of these sites has been contaminated above health-based standards.

Other sites contaminated with hazardous substances also are tracked on Georgia's Hazardous Site Inventory (HSI) — a list of sites in the state where there has been a release (or a suspected release) of a hazardous substance above a specific amount. These sites also have not met the health-based, cleanup standards established by the state.

Table 1.6 presents information on the extent of soil and groundwater known to be contaminated above health-based standards, where that information is available. This amount has been determined by the extent of land contamination that has been identified (for which acreages can be estimated)

Table 1.6 *Estimate of land contaminated above health-based standards, 2006. (EPD)*

	Number of sites	Acres of contaminated land	Acres of contaminated groundwater
Solid waste landfills	126	13,230	13,775
Underground storage tank sites	3,011	3,011	1,983
Sites where hazardous waste is stored or treated	69	3,095	5,787
Georgia's Hazardous Site Inventory	550	not available	not available

minus land that has already been cleaned up. The data exclude land on the Hazardous Site Inventory, as the acreage of these sites is not currently available.

Compared to the acreage of the state as a whole (about 38 million acres), the extent of land known to be contaminated at levels above health-based standards is small. But, these lands are more concentrated in urban areas where the potential for human exposure is higher. They can pose significant threats to human health in the immediate area, either through direct exposure to soil or contamination of drinking water sources. Identifying these sites and controlling and cleaning up contamination are important steps in making progress toward the objective of protecting human health.

Since the total number of acres on the HSI is not available, EPD tracks the number of sites on the inventory as another indicator of land contamination. The first step in adding a site to the HSI is notifying EPD of a spill or contamination.

Of the sites with spills or contamination that are reported to EPD, only those with an exposure pathway — a physical route to the human body through drinking water or contact with soil — pose a risk to human health and are added to the Inventory. If there is not currently an exposure pathway, then the site is not added. Between the creation of the HSI in 1994 and 2007, EPD received 2,173 notifications of spills or contamination and evaluated an additional 1,106 sites. Of the 3,279 sites evaluated, 779 were added to the Inventory.

At the same time that new sites are added, others are cleaned up and removed from the list (Figure 1.7). By 2007, a total of 566 sites remained on the list. These sites are found across the state, but tend to be concentrated in larger cities, including Atlanta, Augusta and Savannah, because of the history of industrial activity in those areas.

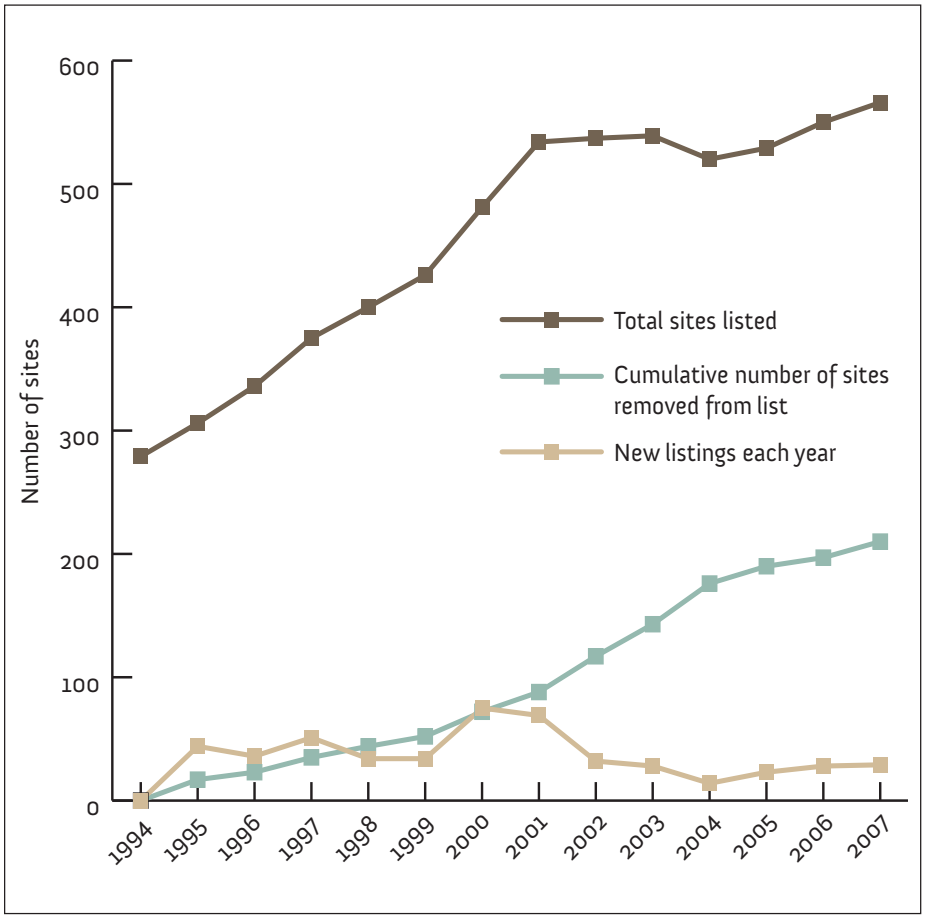


Figure 1.7 *Sites on the state's Hazardous Site Inventory, 1994 - 2007. (EPD)*

How much contaminated land has been cleaned up?

Once contaminated sites are identified, EPD must ensure they are cleaned up to levels that no longer pose a threat to human health.

- By 2007, **210 sites** listed on **Georgia's Hazardous Site Inventory** had been cleaned up to meet health-based standards.
- As of 2006, **18 sites and 588 acres** of **sites where hazardous waste is treated or stored** had been cleaned up.
- Also as of 2006, **246 acres** at two **landfills** had been cleaned up.
- There has been notable progress cleaning up lands contaminated by leaking **underground storage tanks**:
  - By 2006, 69 percent of the contaminated soil area — or **6,745 acres** — had been cleaned up to levels no longer threatening to human health.
  - Contaminated groundwater lying under **3,441 acres** — or 63 percent of the affected area — had been cleaned up to meet the standards or, because there is currently no exposure route, were found not to threaten human health.

Cleanup of lands contaminated above the health-based standards will continue. Reaching contaminant levels that no longer threaten human health may, however, take longer than in the past. Many of the less contaminated sites already have been cleaned up, leaving sites that are more challenging and can take longer to clean.

Solid Waste Disposal

Indicator of the quality of Georgia's **Land**

Georgia's wasteful ways

Georgia's per capita rate of municipal solid waste (MSW) disposal — 6.44 pounds per person per day — is more than twice the national average (see table below). This figure does not even include waste imported from other states. Imported waste added another 1.13 pounds per person per day in 2007, 10 percent higher than in 2004. An average of 2.3 pounds per person is also disposed of in construction and demolition landfills.

To address the high rate of solid waste disposal, the state promotes recycling and waste reduction through technical assistance and education and grants to local governments to build recycling infrastructure. Specific projects include establishing regional recycling collection hubs and mounting a statewide campaign to increase awareness about recycling.

Per capita MSW disposal rates for Georgia and the U.S., 2004 - 2007 (lbs per person per day) (EPD)

	GA MSW disposed	U.S. MSW disposed
2004	6.39	3.21
2005	6.44	3.16
2006	6.39	3.15
2007	6.44	3.08

EPD tracks the amount of waste disposed in municipal solid waste (MSW) landfills and construction and demolition (C&D) debris landfills. MSW landfills accept waste from households and businesses, and nonhazardous waste from industries. C&D landfills accept building materials and debris from construction, renovation and demolition. As of 2006, there were 119 active landfills accepting solid waste in Georgia.

From a human health perspective, one of the biggest improvements in solid waste disposal has been a shift to MSW landfills with liners and leachate collection systems. Since 1993, MSW landfills have been required by federal regulations to have these systems to protect groundwater and soil from liquids (known as leachate) that percolate through the landfill and pick up contaminants from the waste.

In 1994, 54 percent of the state's municipal solid waste was disposed in unlined landfills without systems to capture and treat leachate. By 2006, 98 percent of MSW was disposed in lined landfills with collection systems.

Federal regulations also require groundwater monitoring at landfills to ensure leachate does not reach the water table. Groundwater monitoring is conducted at active landfills (those currently accepting waste) and at those closed after June 1991. As of 2006, 305 active and closed landfills were subject to groundwater monitoring requirements.

Groundwater contamination has been found at approximately 150 of these sites (affecting roughly 16,000 acres). However, most is contained within the landfill boundaries. Only 546 acres of groundwater outside the boundaries are affected. Of the 305 landfills with groundwater monitoring, 119 are active and 186 are closed. In 2006, only 19 percent of the active landfills showed evidence of groundwater contamination while 71 percent of the closed sites had groundwater contamination.

The quantity of waste disposed in Georgia has risen consistently in recent years (Figure 1.8). In 2007, more than 17 million tons of solid waste was disposed. Of that total, more than 12.7 million tons was disposed in MSW landfills, up from 10.7 million tons in 2001. The amount of C&D waste disposed grew by 71 percent in the same time period. Disposal of waste from other states also increased in this period — almost 2 million tons of waste were imported in fiscal year (FY) 2007, compared to approximately 900,000 tons in FY 2001.

Increases in population, economic growth and landfill capacity all contrib-

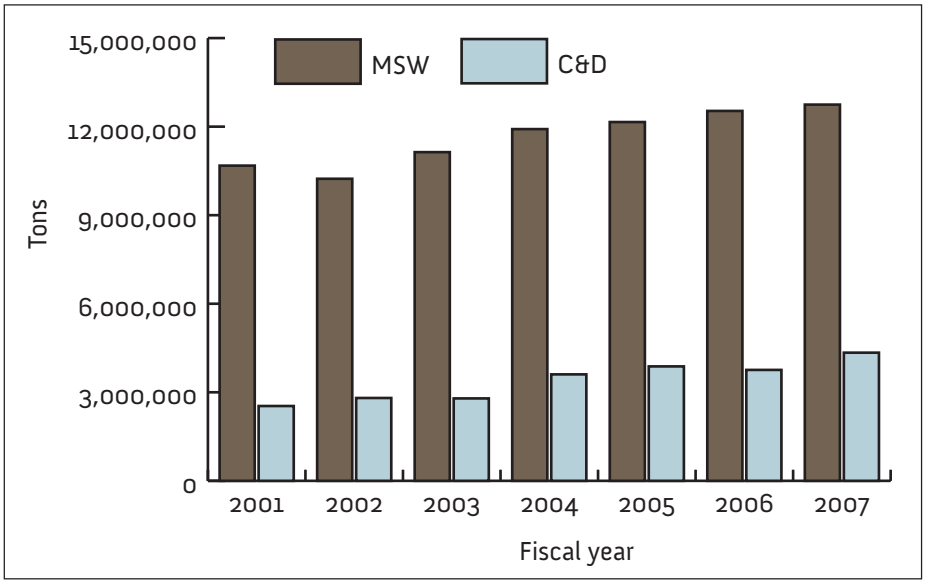


Figure 1.8 *Waste disposed of in Georgia municipal solid waste and construction and demolition debris landfills, 2001 - 2007. (EPD)*

ute to these trends. The cost to dispose of solid waste (known as tipping fees) also is relatively low in Georgia. In 2005, the average tipping fee for MSW in Georgia was $35.38 per ton and for C&D debris was $30.21 per ton. This was about $5 per ton lower than the average in the Southeast and nearly $30 per ton lower than the average in the Northeast.

Backgrounder

Scrap Tires: A recycling success

A long-standing priority of the state has been to assure clean up and recycling of scrap tires. Scrap tires may not seem like a threat to human health, but when filled with rainwater they provide the perfect breeding ground for mosquitoes, including those that carry dangerous viruses, such as the West Nile Virus and Eastern Equine Encephalitis. Large tire dumps also are fire risks. In 1992, a fire at an abandoned scrap tire processing facility in Palmetto burned approximately 3 million tires. Runoff containing pyrolytic oil from the burning tires contaminated the groundwater.

The state's scrap tire program focuses, in part, on removing illegally dumped scrap tires. Since the program began in 1992, more than 13.7 million scrap tires have been removed from illegal dumps and recycled. In FY 2007 alone, 268,000 illegally dumped tires were collected and recycled. The estimated number of illegally dumped tires dropped from 3.2 million in FY 1999 to 415,000 in FY 2006, a reduction of 85 percent.

Each year, approximately 9 million scrap tires are generated in Georgia. To ensure the scrap tires generated in Georgia, plus the millions more imported, are properly managed, EPD tracks them from the point of generation to final disposition at a processor or recycler. Scrap tires can be processed as an alternate fuel source or recycled into products such as artificial turf, paving tiles or rubberized asphalt. In FY 2006, an estimated 15 million tires were processed or recycled by scrap tire industries in Georgia.

What do recycled tires become?

As the largest processor of scrap tires in the state, Liberty Tire Recycling processes about 95 percent of the scrap tires generated in Georgia. At its three facilities, scrap tires are processed to create either tire-derived fuel or crumb rubber.

Tire-derived fuel is an alternate energy source produced by grinding whole tires into chips. This fuel has an energy content that is nearly equal to natural gas and is higher than most types of coal. Compared to many other solid fuels, tire-derived fuel also can be burned in ways that produce less ash and release less air pollution (sulfur dioxide and nitrogen oxides, specifically). Production of this fuel is a major use of scrap tires, using more than half of the number of tires generated nationally.

Crumb rubber is a finely ground rubber produced from whole tires. It is used as a raw material in the production of a variety of new rubber products, including door mats, flooring, automobile parts, railroad ties and new passenger tires. Liberty Tire Recycling also provides crumb rubber to refiners, who reprocess the material to a consistency finer than talcum powder for use in other rubber goods and automobile parts.

Recyclables: An economic resource

Recycling is not only a key strategy to reduce waste, it also supports local businesses and creates jobs. Georgia is home to more than 50 manufacturers that use recovered materials in their processes. One-third of the plastic beverage containers (PET #1) recycled in North America are used by Georgia's carpet industry, and nearly 8 percent of the paper recovered in the U.S. is used by Georgia's paper industry.

The Department of Community Affairs estimates that 2.6 million tons of easily recyclable commodities are currently discarded in Georgia (including cardboard, office paper, aluminum cans and plastic beverage bottles). While commodity prices fluctuate with economic conditions, as of February 2008, the estimated value of these materials was more than $300 million.

Recycling also saves energy. Recycling just 10 percent of the 2.6 million tons of recoverable material that is currently disposed in Georgia would save energy equivalent to taking nearly 58,000 passenger cars off the road each year.

However, the infrastructure to collect and process recyclable materials is limited, forcing Georgia industries to import materials from other states. Expanding the recycling infrastructure in the state would increase the amount of recyclable materials available locally to support Georgia industries.

Hazardous Waste Generation

Indicator of the quality of Georgia's **Land**

How does hazardous waste generation in Georgia compare to the rest of the nation?

In 2001, 2003 and 2005, the amount of hazardous waste generated in the U.S. ranged from 30.1 to 40.1 million tons each year. The hazardous waste generated in Georgia was less than 2 percent of the national total in each of those years.

Since economic conditions affect the amount of hazardous waste generated each year, one way to compare Georgia with the nation is with a measure based on economic activity: the tons of hazardous waste generated per dollar of gross domestic product. As shown in the table below, the amount of hazardous waste generated in Georgia per dollar of gross domestic product has been consistently lower than the national figure.

Hazardous waste generated in GA and the U.S., 2001 - 2005. (EPD)

	Georgia hazardous waste generation[1]	U.S. hazardous waste generation[2]
2001	2.5	4.1
2003	0.6	2.8
2005	1.3	3.1

[1]Tons per million dollars of state gross domestic product.
[2]Tons per million dollars of national gross domestic product.

Land can become contaminated when wastes and other materials are not properly handled and/or disposed. When toxic or hazardous materials are being manufactured, stored, transported or used, there is always the chance that they may spill or leak, which also can contaminate Georgia's land. Many common household items, such as paint, electronics and pesticides, are hazardous and, if not properly managed, can lead to land contamination.

Hazardous waste is managed under the federal Resource Conservation and Recovery Act (RCRA). Under that Act, EPD in partnership with EPA has the authority to regulate all facets of hazardous waste to reduce potential hazards and ensure that waste is handled in an environmentally sound manner. This includes the generation, treatment, storage and disposal of hazardous waste.

Table 1.7 shows the changes in the volume of hazardous waste generated or managed (i.e., treated or stored) in Georgia between 2001 and 2007. It also shows the amount of waste that Georgia facilities received from other states and the amount that Georgia facilities shipped to other states for handling or disposal. There are no commercial hazardous waste disposal facilities in Georgia, so waste is shipped to other states for disposal.

The amount of hazardous waste generated and managed in Georgia varies considerably from year to year depending in part on economic conditions. When the economy is less robust, industry generally produces less, and in turn, less waste is generated. Stronger economic conditions lead to increases in industrial production and in waste generation.

Another factor affecting the changing amounts of hazardous waste managed is the number of facilities permitted to manage hazardous waste in Georgia and neighboring states in a given year. For example, between 2003 and 2005 the quantity of hazardous waste managed and received from other states declined, but the quantity shipped to other states increased. Two major commercial facilities in Georgia that handled hazardous waste closed during this period, presumably sending the waste to other states.

Table 1.7 *RCRA hazardous waste in Georgia, 2001 - 2007 (tons). (EPD)**

	Hazardous waste generated	Hazardous waste treated or stored	Hazardous waste received from other states	Hazardous waste shipped to other states
2001	760,043	682,924	12,663	106,512
2003	203,298	2,094,734	8,837	84,031
2005	480,269	862,647	4,361	319,506
2007	102,636	738,718	3,462	52,315

**Information on hazardous waste is reported to EPA by all the states every two years. Because EPA changed its reporting requirements in 2001, data from previous years are inconsistent and cannot be compared with the numbers shown here.*

Levels of Air Pollutants

Indicator of the quality of Georgia's **Outdoor Air**

The federal Clean Air Act defines two major categories of air pollution: criteria pollutants and toxic air pollutants. EPA has set health-based, air quality standards for criteria pollutants. As discussed below, there are no standards for toxic air pollutants defined under the Clean Air Act, and monitoring is underway to build the information base needed to assess risks from air toxics.

There are six criteria pollutants: carbon monoxide, sulfur dioxide, lead, ozone, nitrogen dioxide and particulate matter. These pollutants are called "criteria" pollutants because the Clean Air Act requires that EPA set standards or criteria for them to protect human health and the environment. These standards define acceptable levels of each pollutant. Primary standards are designed to protect human health by protecting the most sensitive individuals, including children, the elderly, and those with chronic diseases. Under the Clean Air Act, these standards are to be set without regard to cost.

EPD tracks the levels of criteria pollutants in outdoor air as one indicator of progress toward the objective of protecting human health. The health-based air quality standards can be used as a benchmark to evaluate the levels of specific pollutants.

Since monitoring began more than 30 years ago, the levels of three criteria pollutants — carbon monoxide, sulfur dioxide and nitrogen dioxide — have been well below the health-based standards and have not directly posed risks to human health in Georgia.

Lead levels in outdoor air used to be high enough to pose human health risks. When standards were first established in the 1970s, leaded gasoline was commonly used and lead levels in Georgia's air were higher than the standard until 1972. Removing lead from gasoline resulted in a rapid drop in the amount of lead in outdoor air and, since the mid-1980s, levels have stabilized well below both the 1978 standard and the new standard established in 2008 (Figure 1.9).

Two criteria pollutants currently have a significant impact on air quality in Georgia: ozone and fine particulate matter. Levels of both are higher than the health-based standards in parts of the state.

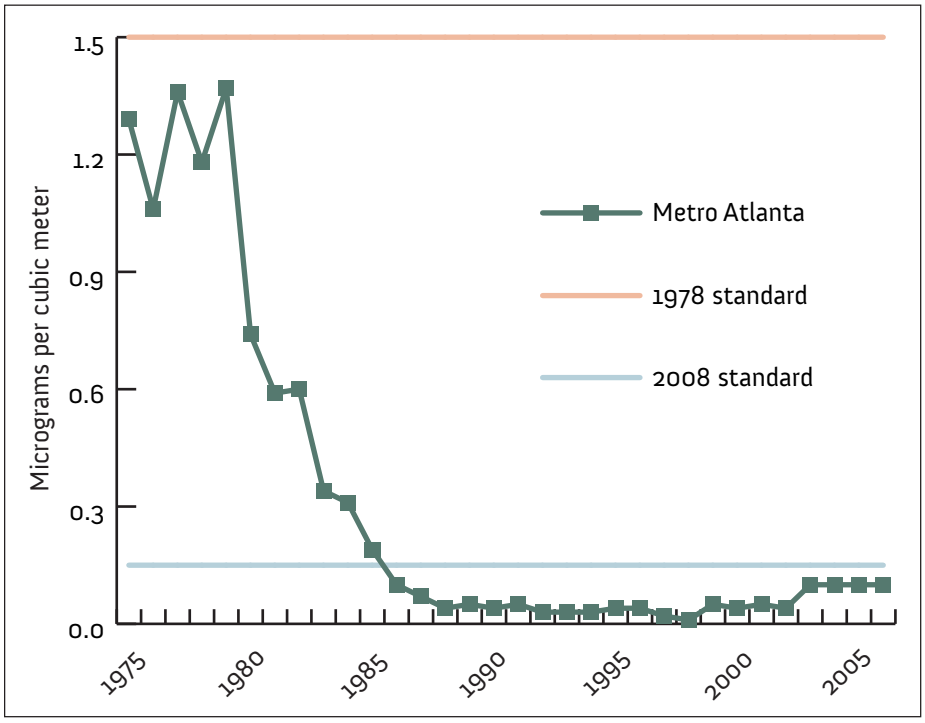


Figure 1.9 *Lead levels at a representative air quality monitor; quarterly average. (EPD)*

What are ozone and particulate matter?

Ozone is a gas that forms when nitrogen oxides and volatile organic compounds react in the presence of sunlight. This ground-level ozone can inflame and damage the lining of the lungs, reduce lung function and aggravate asthma.

Ozone is rarely emitted directly into the atmosphere. It forms in the atmosphere from compounds called precursors. Volatile organic compounds and nitrogen oxides are the primary precursors of ozone.

Particulate matter includes smoke, dust, fly ash and liquid droplets that can remain suspended in the air for long periods of time. Fine particulate matter, which includes particles that are less than 1/20th of the diameter of a strand of human hair, poses the greatest threat to human health. Particles this small can penetrate deep into the human respiratory system and contribute to respiratory and cardiopulmonary disease.

Particulate matter results from all types of burning, including combustion of fuels in motor vehicles, power plants, and industrial facilities. Particulate matter is directly emitted into the atmosphere from a number of sources. It also forms in the atmosphere through the reaction of precursors including sulfur dioxide, nitrogen oxides, and various hydrocarbons.

Ozone levels at three representative air quality monitors are shown in Figure 1.10. These monitors are located in or on the downwind side of three major metropolitan areas: Augusta, Columbus and Atlanta.

Trends in ozone levels at these monitors highlight some progress as well as continuing air quality challenges. Weather has a strong influence on ozone levels and some of the fluctuations in ozone levels are due to year-to-year variations in temperature, wind, and rainfall.

Trends in ozone concentration also reflect controls on emissions from different sources of pollution. The trend at each monitor shows a peak in 1998-1999 followed by a drop in ozone concentration. This drop reflects state controls on emissions from industrial sources and national requirements for fuels and vehicles that were phased in during the 1990s. A second decline is seen at each monitor in 2002-2003, which reflects controls on emissions from coal-fired power plants.

As these controls have taken effect, however, the scientific understanding of ozone impacts on human health has improved and, as a result, standards have been tightened. The current 8-hour standard, shown in light blue in Figure 1.10, was adopted in 2008. As of October 2008, ozone levels at monitors tracking air quality in 26 counties were higher than the current ozone standard.

Levels of fine particulate matter at two representative monitors are shown in Figure 1.11. Levels at these monitors were highest in 1999 and have been lower since. The drop in fine particulates after 1999 most likely reflects controls on fuels and vehicles that were put in place to address ozone. Because emission controls for fine particulate matter may reduce ozone precursors and vice versa, control of one pollutant can help manage the other. Declining levels of sulfur dioxide, a precursor of fine particulate matter, have also contributed to this drop (Figure 1.12).

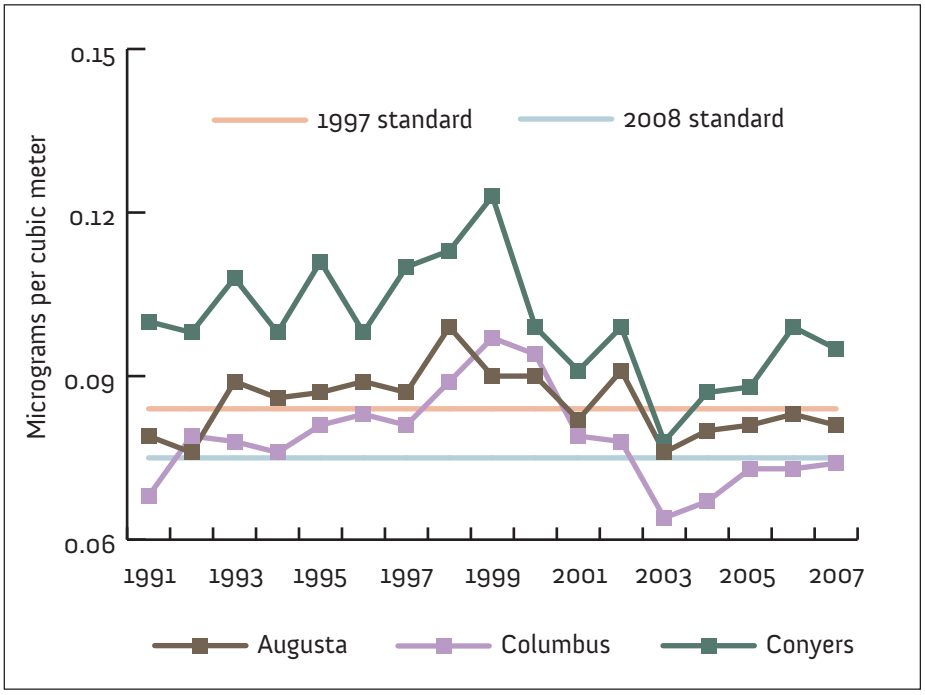


Figure 1.10 *Ozone levels at selected monitors in or downwind of major metropolitan areas; eight-hour average. Meteorological conditions during the summer promote ozone formation and ozone concentrations are monitored from March to October each year. (EPD)*

Despite this progress, these and other monitors still show levels of fine particulates that exceed the current standard. As of October 2008, levels of fine particulates at monitors tracking air quality in 29 counties exceeded the current standard (ozone levels were also exceeded in 24 of these counties).

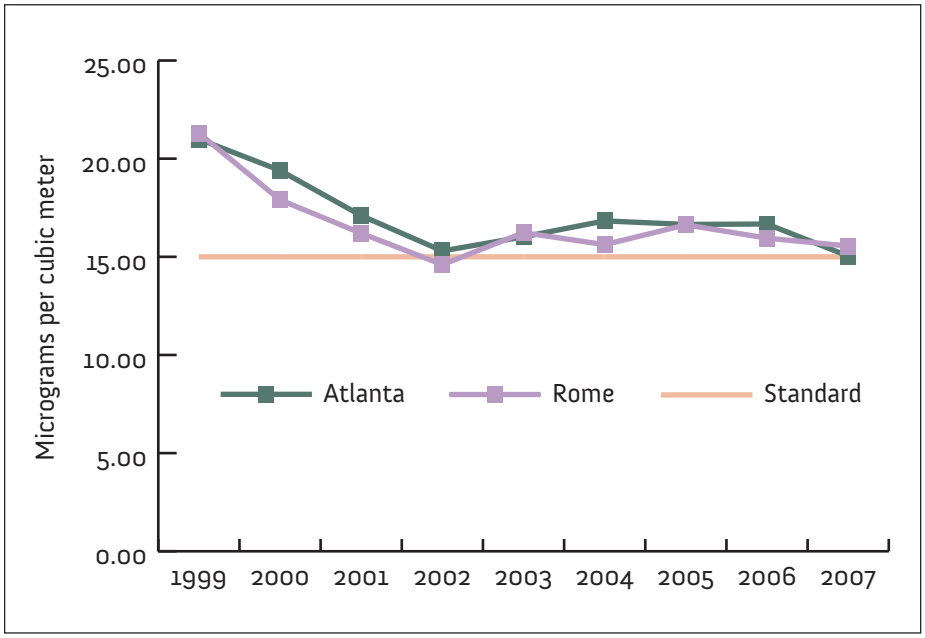


Figure 1.11 *Levels of fine particulate matter at selected monitors in major metropolitan areas; annual average. Particulate matter can be high anytime of the year and fine particulate matter is monitored year round. (EPD)*

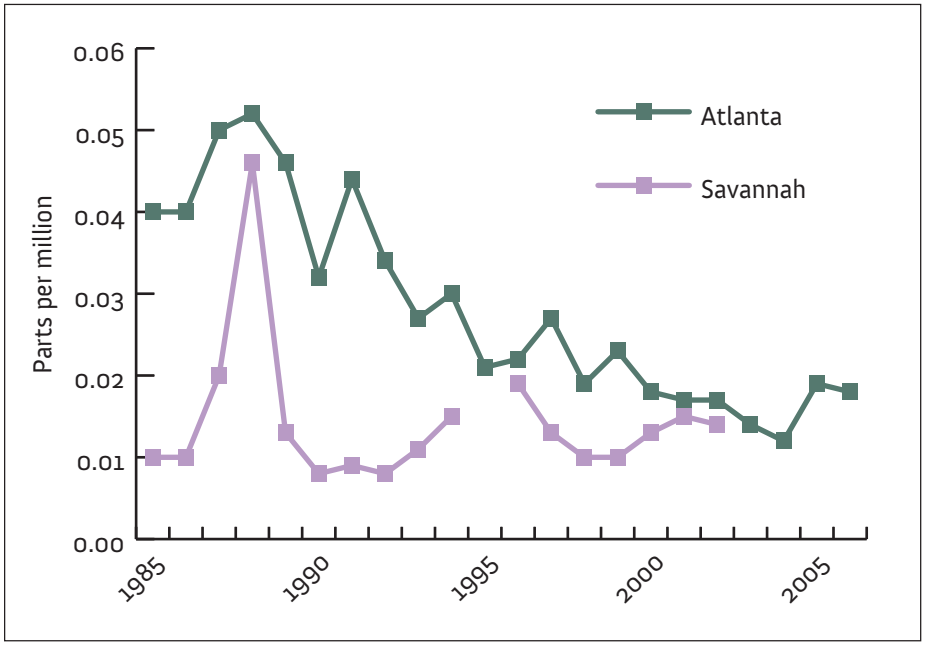


Figure 1.12 *Levels of sulfur dioxide at selected monitors in major metropolitan areas; 24-hour average. Levels in Savannah reflect industrial activity in the area, with the decline after 1988 due to the closing of a major industrial source. In Atlanta, declining levels are due to controls on industrial emissions and the use of low sulfur fuel, which began in 2004. (EPD)*

Scientific advances lead to changes in air quality standards

Health-based air quality standards are determined by the best science available at the time of their adoption. As research progresses, the scientific understanding of a pollutant's impacts on human health can improve, which may lead to tighter standards.

Since their adoption in the early 1970s, standards for ozone, particulate matter, and lead have been tightened. In the 1990s, to be more protective, the ozone standard was lowered and changed from a 1-hour average to an 8-hour average. The 8-hour standard, in turn, was tightened in 2008.

For particulate matter, standards were changed to shift from measurement of larger particles to focus on the fine particulates that pose the greatest health risk. The fine particulate matter standard was tightened again in 2006. A tighter standard for lead in outdoor air also was adopted in 2008.

Changes in air quality standards may lead to expanded monitoring, new assessment of pollutant levels in outdoor air and, ultimately, identification of new or expanded non-attainment areas (as described in the next section).

Non-attainment areas

Indicator of the quality of Georgia's **Outdoor Air**

Sensitive populations in non-attainment areas

Approximately 17 percent of the state's population falls into "sensitive" categories, meaning that they are less than five years old, more than 65 years old, or have weakened immune systems or symptoms of asthma.

People in these sensitive groups may feel greater effects from poor air quality, and air quality standards are set at levels to protect them. Of this population, more than 50 percent — approximately 850,000 — live in areas that have been declared non-attainment for either ozone or particulate matter or both. Actions to improve air quality are important to protect their health.

The primary air quality standards set limits on air pollution that are based on human health impacts. An area with air quality cleaner than the primary standard is called an "attainment" area; areas that do not meet the primary standard are called "non-attainment" areas.

Non-attainment areas are determined by the number of times a pollutant surpasses the air quality standard for a specific period of time, which is called an exceedance. Non-attainment areas are declared when there are more exceedances than allowed in a given time period. There is a built-in allowance for levels of a pollutant to exceed the standard occasionally and still protect human health.

Air pollution can move large distances from the place it is emitted, so non-attainment areas may be defined as multiple counties or as a region, even if exceedances are only monitored in one county. Also, if a county contains a source (e.g., a power plant) that contributes to exceedances in another area, the portion of the county containing the source is also considered non-attainment.

A non-attainment designation is based on a specific pollutant. This means that the same area could meet the standard for one pollutant, but be designated non-attainment for another. Non-attainment areas for different pollutants also may overlap or share common boundaries.

Georgia's non-attainment areas are a second indicator of air quality (Figure 1.13). As described in the previous section, Georgia meets the standards and is an attainment area for four of the criteria pollutants: lead, sulfur dioxide, carbon monoxide and nitrogen dioxide.

For ozone and fine particulate matter, however, levels exceed the standard in several parts of the state, leading to non-attainment designations for both pollutants. Twenty full counties in Georgia have been designated non-attainment for ozone and 24 full counties and three partial counties have been designated non-attainment for fine particulates.

These counties contain more than half of the state's population: 55.2 percent of the state's population lives in counties where the ozone levels are sometimes higher than the standard and 57.6 percent live in areas where levels of fine particulates are sometimes higher than the standard.

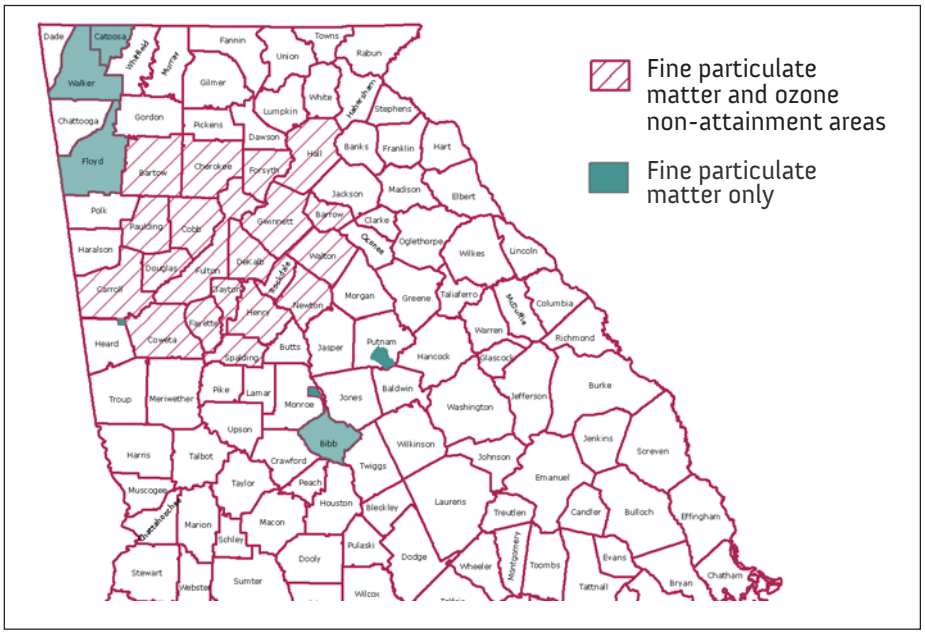


Figure 1.13 *Air quality non-attainment areas: Ozone and fine particulate matter, 2008. (EPD)*

Backgrounder

Air Quality Index

The Air Quality Index (AQI) is a national rating system developed by EPA. The AQI indicates whether or not the air quality presents a potential threat to human health on any given day. This system is designed to provide information on the risk of acute health effects over time periods of 24 hours or less. It does not provide information on chronic exposure to pollution over months or years.

The AQI is not a direct measure of air quality or air pollution. The level of pollutants measured in the air each day is converted to a number on a scale of 0 to 500 — the larger the number, the greater the level of air pollution and the greater the expectation of potential adverse health effects. Depending on the day's rating, EPD will declare the day's air quality as good, moderate, unhealthy for sensitive groups, unhealthy or very unhealthy.

AIR QUALITY INDEX

Air Quality Index (AQI) Values	Levels of Health Concern
0 to 50	Good
51-100	Moderate
101-150	Unhealthy for Sensitive Groups
151-200	Unhealthy
201-300	Very Unhealthy
301 to 500	Hazardous

EPD reports the AQI for five of the criteria pollutants: ozone, fine particulates, sulfur dioxide, nitrogen dioxide and carbon monoxide. The AQI is reported on a daily basis, year round.

AQI values are reported to inform the public about the health risks of outdoor activities on a given day. A rating of 100 represents the dividing line between moderate air quality and air that is unhealthy for sensitive groups.

To see AQI ratings across the country, go to http://airnow.gov/. Air quality forecasts for Atlanta and other Georgia cities are available at: http://www.air.dnr.state.ga.us/smogforecast.

What happens when air quality standards are not met?

States must develop implementation plans that outline how standards will be met and maintained. When an area is designated non-attainment, the state must revise the plan to assess current and projected air quality, estimate emissions from sources that currently affect air quality, and specify actions to bring air quality back into compliance with the standards.

Once a non-attainment area meets the standards and the plan is revised again to show that the standards will be able to be met for another 10 years, EPA changes the designation back to attainment.

In 1999, EPD developed a plan to meet the 1-hour ozone standard then in place in the 13-county metro Atlanta non-attainment area. The plan focused on three emission sources: cars and trucks, electricity-generating plants and large industry. Actions taken under this plan helped improve the region's air quality and, in 2005, the metro Atlanta area met the 1-hour standard for ozone.

At the same time, however, the scientific understanding of health risks from ozone improved and EPA adopted a more stringent 8-hour standard. The metro Atlanta ozone non-attainment area, based on the new 8-hour standard, now covers 20 counties.

How is Georgia's air quality monitored?

Like the state's water quality monitoring, EPD's monitoring of air quality has evolved since it began more than 30 years ago. The list of compounds monitored has grown from the original six criteria pollutants to more than 200 pollutants, including air toxics and compounds that contribute to the formation of criteria pollutants. EPD has more than 150 air quality monitors at 68 locations around the state.

Information from these monitors is used to track air quality trends and compliance with air quality standards. Ozone levels in the metro Atlanta area have been tracked consistently since 1990, and monitoring of fine particulate matter in metro Atlanta was added in 1999. Monitoring of ozone and fine particulate matter was expanded to include other cities around the state as the standards were strengthened in the late 1990s and Georgia's population outside the metro Atlanta area grew.

The monitoring network is designed to track levels of air pollution throughout Georgia. Monitor locations are selected to meet specific objectives, which include measuring concentrations in areas of high population density, measuring the highest observable concentration, and determining normal background levels.

Some gaps in information remain, however. Air quality monitors are located in 38 counties; some counties have multiple monitors while others do not have any. Monitors only sample the air that passes over them, so that information on the air quality between monitors is limited.

Emerging Issue
Risks from Air Toxics

Unlike the criteria pollutants, air toxics have no established, health-based standards. While many of these pollutants are known to cause, or are suspected of causing, cancer and other serious illnesses, the quantities at which they become dangerous and the significance of various exposure routes are not yet fully understood.

Since 1990, managing air toxics has focused on controlling their release from stationary sources, such as factories, refineries and power plants. To assess the levels of these pollutants in Georgia's air, EPD began operating a statewide monitoring system in 1998. The system monitors a common set of toxic compounds and provides information on air quality in urban and rural areas. It does not provide information on the air quality impacts or health risks from individual facilities or industries.

The air monitoring system provides data on the frequency of detection and concentrations of toxic air pollutants. It does not provide any information on actual exposure to people. However, by making some general assumptions about how people spend their time (e.g., indoor vs. outdoor activities), EPD scientists can make conservative estimates of exposure. These estimates provide a preliminary assessment of the potential risks of adverse health effects from air toxics.

Georgia's air toxics monitoring system tracks about 70 of the chemicals that EPA has designated as hazardous air pollutants. Most of the 70 have not been detected and fewer than 10 of the 70 are detected often enough to indicate potential risks to human health. Benzene, acetaldehyde and formaldehyde are among the compounds that are detected most frequently.

While the monitoring system is relatively new, early indications suggest that concentrations of some toxic air pollutants are declining. While air toxics can come from a variety of sources, monitoring results also suggest that cars, trucks and other on- and off-road vehicles may be significant contributors.

However, the current understanding of how people are exposed to air toxics and of the toxicity of many of these chemicals is too limited to allow accurate predictions of risk at this time. Improved inventories, models and measurement techniques are needed to better evaluate the risk from air toxics. Data from Georgia's air monitoring program provides one piece of the information needed to improve our ability to assess the risks from air toxics.

Most air pollution comes from human-made sources, such as smokestack emissions from factories and exhaust from motor vehicles. EPA divides these sources into two categories: stationary and mobile. Stationary sources include factories, power plants, refineries, incinerators, dry cleaners, service stations and residential backyard burning.

Mobile sources include vehicles that travel on roads, such as gasoline- or diesel-powered motor vehicles (e.g., cars, trucks, buses and motorcycles) and those that do not. This second group includes equipment used in construction, farming, and lawn and garden activities, as well as off-road recreational vehicles, aircraft and trains.

Not all pollutants enter the atmosphere directly. Some are formed when other emissions, called "precursors," enter the atmosphere and react with chemicals in the presence of sunlight and high temperatures. For example, ozone, a pollutant of concern in Georgia, is rarely emitted directly into the atmosphere. Instead, it forms in the atmosphere when precursors including nitrogen oxides (NOx) react in the presence of sunlight and high temperatures.

Because nitrogen oxides are the major precursor of ozone, EPD tracks trends in NOx emissions as an indicator of air quality. Since federal law established emissions in 1990 as a baseline, EPD uses data from the original 13-county, 1-hour ozone non-attainment area to evaluate progress in reducing emissions of air pollutants.

Figure 1.14 shows NOx emissions by source in the 13-county metro Atlanta area for 1990, 2002 and 2005. Methods for estimating emissions have changed over time, meaning that we can only look at trends using the years for which data have been adjusted to be comparable to the 1990 baseline (2002 and 2005).

Total NOx emissions in the 13-county metro Atlanta area declined 43 percent between 1990 and 2005. This progress was achieved, in part, by reducing emissions from large stationary sources in the area, which declined by more than 60 percent during this time period.

EPD has determined that power plants *outside* the 13-county area contribute a significant portion of the NOx emissions that drift into the Atlanta area. Controls on these plants have also reduced NOx emissions, even as energy production increased. During this time period, NOx emissions from power plants decreased by more than 60 percent while energy production in Georgia increased by approximately 32 percent. NOx controls at power plants, including a chemical reaction in which a catalyst helps convert nitrogen oxides to gaseous nitrogen and water, were put in place at a cost of $800 million.

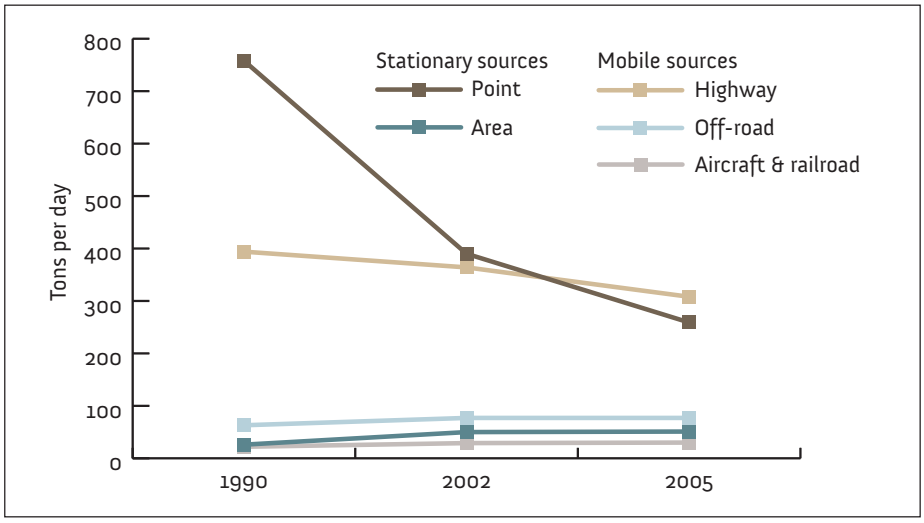


Figure 1.14 *Sources of nitrogen oxides (NOx) emissions in the 13-county metro Atlanta area. (EPD)*

Emissions of Air Pollutants

Indicator of the quality of Georgia's **Outdoor Air**

What are the sources of nitrogen oxides in the metro Atlanta area?

In 2005, 725 tons of nitrogen oxides were emitted daily in the 13-county metro Atlanta ozone non-attainment area.

Mobile sources contributed more than half of the total, with 42 percent from on-road motor vehicles and an additional 15 percent from off-road vehicles, such as equipment used in construction, as well as aircraft and trains.

Stationary sources contributed the remaining 43 percent. Of this amount, 36 percent came from point sources — power plants and factories that release pollutants from a single smokestack or point. Seven percent came from area sources, such as automobile service stations, with small but numerous contributions.

Decreasing emissions from cars and other mobile sources also contributed to the decline in total emissions. Between 1990 and 2005, NOx emissions from on-road mobile sources decreased by about 22 percent. This decline resulted from advances in engine and exhaust technologies and new fuel formulations, and outweighed a 53 percent increase in the number of vehicle miles traveled (VMT) on a daily basis.

Looking ahead, control of NOx emissions from mobile sources will be increasingly important to improve air quality in the metro Atlanta area. For on-road mobile sources, projected population growth means that the number of vehicle miles traveled daily is expected to increase for at least the next 25 years. The benefits of the new technologies that led to recent reduction in emissions will eventually be offset by this VMT growth.

Off-road mobile sources have already grown as a contributor to total NOx emissions. Unlike stationary sources and on-road mobile sources, NOx emissions from off-road mobile sources in the Atlanta area increased between 1990 and 2005 — almost 25 percent. These sources represent the last largely uncontrolled or under-controlled sources of emissions, as most efforts to date have focused on controlling other emission sources.

EPA has begun to issue more stringent emissions standards for off-road vehicles and equipment. However, since these vehicles are designed to last 20 years or longer, it will take time before emission reductions are seen. Incentives for retrofitting or repowering existing equipment would contribute to more rapid reductions in emissions from these sources.

Fine particulate matter differs from ozone in several ways. First, fine particulates are emitted directly from some sources. This is called primary particulate matter. Fine particles in the atmosphere also include particles that form through the reactions of precursors, called secondary particulate matter.

Second, the standard for fine particulate matter is newer than the ozone standard and emissions have not been measured over as long a period. In addition, due to the mixing of primary and secondary particulate matter, it is more difficult to identify sources;

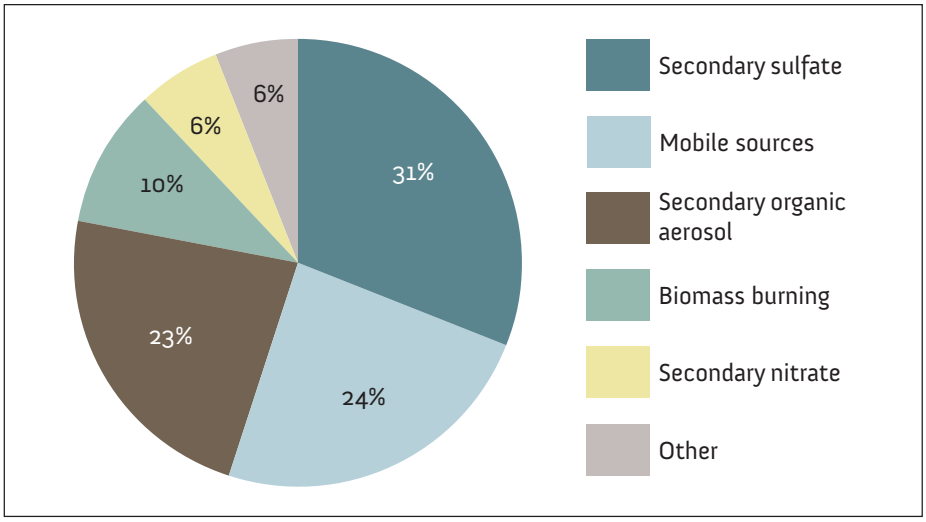


Figure 1.15 *Average contribution to fine particulate matter concentrations in the metro Atlanta area by source, 2001 - 2005. "Secondary" refers to particulate matter that forms in the atmosphere. Secondary sulfate comes primarily from power plants, with a small amount from other industrial sources. Secondary organic aerosols come from natural sources, gasoline and solvent use and combustion of fuels. Secondary nitrate comes from power plants and mobile sources. Sources that contribute to the "other" category include soil, limestone/minerals, sodium from sea-salt or pulp and paper processes, oil burning and road dust. (EPD)*

estimating contributions from different sources requires multiple years of data. As a result, information on emissions and sources of fine particulates presented here is a composite snapshot for the metro Atlanta area from 2001-2005.

Figure 1.15 shows the relative contribution of various sources to particulate matter in the metro Atlanta area between 2001 and 2005. Organic aerosols are a major contributor — at 22.8 percent. About half of this contribution comes from natural sources, including vegetation. The remainder is from gasoline evaporation, use of solvents and the combustion of fuels in power plants, vehicles and other sources.

Vehicles and other mobile sources are also major contributors — at 23.6 percent. Of the contributions from mobile sources, one-third comes from vehicles burning gasoline and the remainder from those using diesel fuel. Emissions of fine particulates from vehicles have declined in recent years, due to increased numbers of vehicles subject to tighter emissions standards and cleaner fuel requirements that took effect in the mid-2000s.

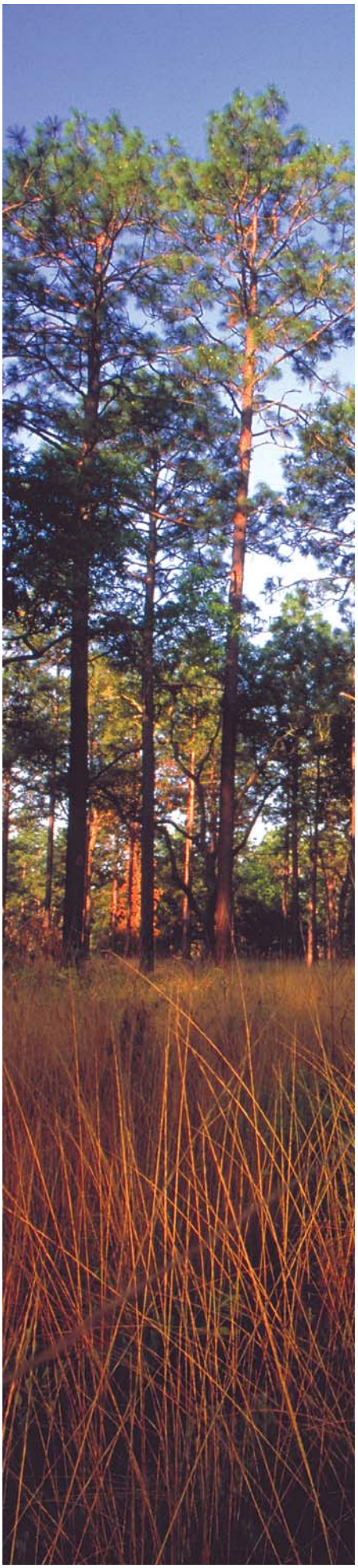
The largest contributor is secondary sulfate — at 30.9 percent. Secondary sulfates form in the atmosphere from reactions of sulfur dioxide, a precursor that primarily comes from coal-fired power plants. Controls on these emissions are currently being put in place and the contribution of secondary sulfate to levels of fine particulates is expected to fall as these controls are fully phased in over the next 10 years.

Emerging Issue

Prescribed burning: Managing Georgia's lands and protecting air quality

Between 2000 and 2004, biomass burning contributed approximately 10 percent of the fine particulate matter in metro Atlanta's air. Biomass burning includes wildfires as well as planned or prescribed burning of forests and other lands.

Prescribed burning uses fire as an economical and practical tool to maintain the vitality and value of Georgia forests, farms and wildlands. This tool is used by federal, state and private landowners and managers to maintain natural forests, support fire-dependent species, improve wildlife habitat or forage for livestock, and control insects and disease. Prescribed burns also reduce hazardous fuel (buildup of wood debris, underbrush and other natural ground litter) and suppress wildfires.

The Nemours Wildlife Federation estimates that 1 million acres are burned in Georgia every year. If not coordinated and well managed, prescribed burning can have unacceptable air quality impacts far from a burn site. In February 2007, for example, prescribed fires in central Georgia caused a large spike in concentrations of particulate matter in the metro Atlanta area.

The state recently adopted a Smoke Management Plan to help achieve air quality goals while improving the quality of Georgia lands. The plan requires authorization from the Georgia Forestry Commission before conducting open burning (except agricultural burning and burning of small leaf piles). The Commission evaluates impacts from individual burns as well as cumulative impacts of multiple fires. The plan also includes provisions for coordinated monitoring of air quality and outdoor burning, smoke management training for practitioners, and public notice and outreach.