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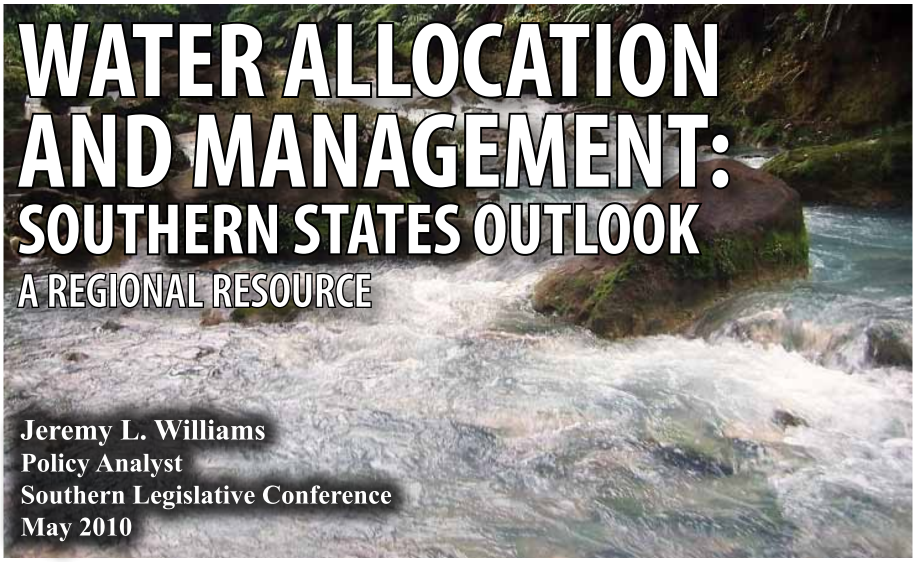

WATER ALLOCATION AND MANAGEMENT: SOUTHERN STATES OUTLOOK

A REGIONAL RESOURCE

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When the well's dry, we know the worth of water.
~ Benjamin Franklin

Introduction

There is a finite amount of fresh water available on the planet. Through the hydrologic cycle, water vapor condenses and forms clouds which, moved by winds across the skies, spread water vapor to different regions of the Earth. Clouds release this moisture in the form of rain or snow, which then either seeps into the ground to replenish aquifers or runs into lakes, streams or rivers. Approximately 100 billion gallons of water travel through this process each year. This water, which amounts to less than one-half of 1 percent of all water on the planet,[1] is the only water available to humans for consumption. Most schoolchildren learn about these basic processes by which water moves from place to place. However, many of the nuances of what actually happens to this water as it is traveling are not well known, or are often ignored.

Due to pollution, diversion and depletion of the Earth's finite water resources, the world is running out of fresh water. Every day, the number of people living without access to clean water is increasing. The WorldWatch Institute has stated that water scarcity may be the most overlooked global environmental challenge of today.[2] Almost 2 billion people live in regions of the world that do not have enough water to meet their daily needs. By 2025, it is estimated that as many as two-thirds of the world's population will face a scarcity of water.[3]

Water scarcity (when available water resources are insufficient for meeting all the demands of a state or region) poses serious health and environmental threats to people throughout the world. The World Health Organization reports that water-related diseases are a leading cause of death worldwide, and that the spectrum of diseases, as well as incidence, is increasing.[4] Another study has shown that every year approximately 1.8 million children die as a result of diseases caused by unclean water and poor sanitation.[5]

Drought is responsible for a variety of environmental hazards, such as threats to endangered species, disruptions of ecosystems, soil damage and other

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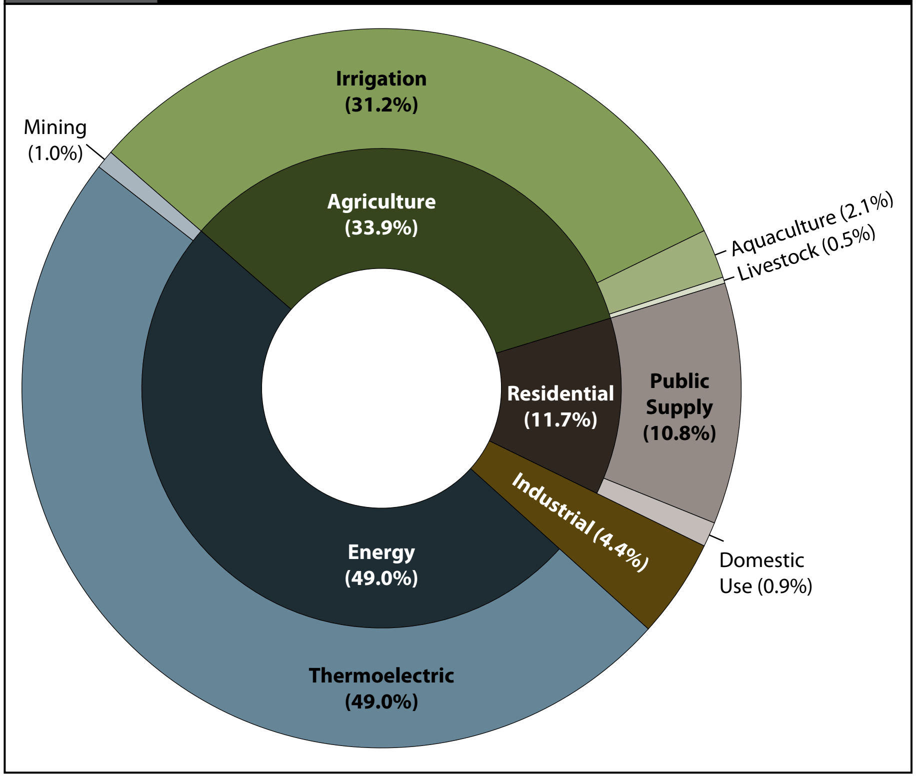
Figure 1 Total Water Withdrawals by Water-Use Category 2005



agricultural problems. In addition, water acts as a regulator of extreme weather conditions; the more water that is in the atmosphere, the stronger the moderating effects on temperature and weather. Human beings now use more than half of all available water in the world, which leaves little for ecosystems and other species. Between the 1970s and the early 2000s, the percentage of land on Earth experiencing drought has more than doubled.[6] Some estimates predict that by the end of this century, as much as one-third of the planet will be affected by "extreme drought."[7]

The matter of water scarcity is not as perilous in the United States. However, the threats posed to the country's businesses, communities, cities and states, not to mention the health and wellbeing of its citizens, are growing every day. In addition, pollution threatens the existing accessible water sources in the United States. The pollution of water has a serious impact on all living creatures, and can negatively affect the use of water for drinking, household needs, recreation, fishing, transportation and commerce. In the United States, the federal Environmental Protection Agency (EPA) enforces federal clean water and safe drinking water laws, provides support for municipal wastewater treatment plants, and takes part in pollution prevention efforts aimed at protecting watersheds and sources of drinking water.

There are four major uses for freshwater: energy, including thermoelectric production and mining; agricultural, including irrigation, water for livestock and aquaculture; residential, such as public supply and domestic water use; and industrial production. In 2005, the most recent year in which the U.S. Geological Survey has assessed national water withdrawals, energy-related activities comprised 50 percent of all withdrawals, with thermoelectric production accounting for 49 percent. That same year, agricultural uses accounted for 34 percent of total withdrawals, with irrigation accounting for 31 percent alone. Residential use comprised 12 percent, 11 percent of which was for public supply. Finally, a scant 4 percent of total withdrawals was attributed to industrial use.

Methodology

In order to collect information regarding water laws in the South, surveys[8] were sent to departments of environmental quality, natural resources, water supply or other applicable agencies in all 15 SLC member states. Participants responded to questions concerning the percentage of water withdrawals in the state from both surface and groundwater sources; percentage of water withdrawals for specific uses; policies that govern withdrawals from and returns to surface water and groundwater sources; interbasin transfer policies; water pollution policies; efficiency and conservation policies; and major obstacles associated with droughts and developing new water sources. There was an additional section provided for any information each department considered relevant and important to a characterization of their state's strategy regarding water. Reponses were received from all 15 states. This information was coupled with information gleaned from general research. Unless explicitly stated otherwise, the following state sections reflect the survey responses submitted by each state department.

Sources, Uses and Mechanisms for Acquiring Water

In considering what general functions water has in society, there are three major questions that can be asked: Where does water come from? What uses are there for water? And what important mechanisms are used to divert, transport, capture, store and make water available for public use?

What Are the Sources of Water?

Freshwater is accessed through two sources, surface water and groundwater, both of which are becoming increasingly scarce in the United States and throughout the world. Surface water makes up approximately 76 percent of the freshwater supply in the United States, and groundwater accounts for 24 percent, overall.[1]

Nationally, three-quarters of all water withdrawals are from surface water. Currently, water in approximately 40 percent of rivers and streams, 46 percent of lakes, and more than 65 percent of estuaries and bays in the United States is considered too dangerous for fishing, swimming or drinking. Similar problems exist throughout the world. According to the European Commission, approximately 20 percent of all surface water on the continent is "seriously threatened."[2] In the eastern* United States, where annual precipitation generally ranges from 30 to 60 inches, 84 percent of freshwater comes from surface sources and 16 percent from groundwater sources. In the western part of the country, where annual precipitation generally ranges from five to 20 inches, 67 percent of freshwater comes from surface water sources and 33 percent from groundwater sources.

The reliance on groundwater is growing rapidly, with approximately 2 billion people, or one-third of the world's population, depending primarily upon these sources for water on a daily basis and withdrawing approximately 20 percent of global water annually.[3] For this reason, groundwater sources also are becoming depleted. As a result of reduced amounts of available clean surface water, cities, industries and farms are now turning to groundwater as a primary source of water. This often requires sophisticated technologies for drilling and removing water from aquifers deep within the ground. The new practice of "water mining" is quite different than simply accessing well water, a method routinely done throughout history.

The United States is now dependent on nonrenewable groundwater for approximately 50 percent of its daily water needs. Sixty-five percent of drinking water in Europe comes from groundwater. The European Commission estimates that 60 percent of European cities are overexploiting their available groundwater sources, and 50 percent of wetlands on the continent have reached "endangered status" due to groundwater exploitation.[4] While the United States' reliance on groundwater is less acute than Europe, it is nonetheless reason for concern.

Easy access to groundwater is likewise problematic. In almost every state, a landowner can drill a domestic well anywhere on his or her property, accessing water from aquifers. In addition, most states do not require permits for commercial wells unless pumping will exceed 100,000 gallons a day, or 36.5 million gallons a year, per well. The federal government is unable to estimate the total number of wells located across the country and, in many regions, where the number of wells are known, the government still does not know how much water is being pumped, because wells are not required to be metered.

What Uses Are There for Water?

The availability of clean water is decreasing for myriad reasons, though a few are more significant than others. Rising seas and coastal erosion have contributed to the continued eradication of wetlands. Since wetlands filter and purify dirt and toxins before they reach rivers, lakes and aquifers, their destruction is inextricably tied to the pollution of major freshwater sources. As wetlands disappear or become consumed by seas and oceans, water in freshwater systems becomes dirtier. For the same reason, receding glaciers at sea are thought to be a threat to freshwater sources as well. In addition to contributing to rising sea levels, glaciers are themselves a source of freshwater that no longer are contributing to local watersheds, but rather dissolving at sea and essentially becoming salt water.

Part of the reason the availability of clean water is diminishing is that it has so many applications. Water plays an important role in agriculture; energy production, including ethanol and the many fossil fuels produced in the United States; urban development and sustenance; as well as the water industry itself. All of these play a very important role in creating healthier and more comfortable lives for Americans. Therefore, an assessment of how important water is to these industries and, correspondingly, how greater efficiencies can be found during a time when water is becoming increasingly scarce, is warranted.

Agriculture

Agriculture is the largest user of water in the world and, in industrialized countries, accounts for approximately 59 percent of total water withdraw-

* Since this report draws on a number of sources, the uses of "east" or "eastern," "west" or "western," and "south" or "southern," do not always correspond to the "Eastern," "Western" or "Southern" demarcations for CSG states.

als.[5] Agriculture is the second largest source of water use in the United States, behind energy-related uses. Since 1950, the national acreage of land being irrigated has doubled, largely due to the use of flood irrigation for the mass production of food.[6] Historically, in an effort to meet the food demands of developing nations, scientists developed high-yield crop varieties that required vast amounts of water. While this method produces large amounts of food, it requires the use of copious amounts of pesticides and fertilizers in addition to increased amounts of water. As a result, many countries have abandoned the practice. Large-scale factory farms, in particular, produce huge amounts of manure and depend on intensive use of antibiotics, nitrogen fertilizers and pesticides, all of which play a part in contaminating the water supply.

Pollution of freshwater largely is attributable to runoff from industrial farms and large livestock operations, including approximately 1 billion pounds of industrial weed killer used throughout the nation every year. Annually, an estimated 1.5 million metric tons of nitrogen pollution flow down the Mississippi River into the Gulf of Mexico.[7]

In addition, loss of freshwater is a result of it being massively displaced through what is known as "virtual water," or water that is used in the production of crops or other manufactured goods that are then exported. Such water is considered "virtual" because the water itself is not contained in the product, but rather is consumed in the processes inherent to the commodity of the product. If the end products are exported, this amounts to exporting water in a "virtual" form. Although no freshwater is technically being traded or sold, water contained in the products, such as fruits and vegetables, is leaving the United States. Net exports of water from the United States amount to approximately one-third of the total water withdrawn within the country.[8]

Ethanol

The United States is the largest producer of corn in the world. In 2008, farmers in the United States planted approximately 94 million acres of corn, a 15 percent increase from 2006, and the most corn planted since World War II. If the current rate of increase continues, farmers may be planting as much as 112 million acres of corn.[9] Ethanol production accounts for more than 3.6 billion bushels of corn annually, over one-fourth of the more than 13 billion bushels of corn produced in the United States every year.[10]

The price of corn tripled between 2006 and 2008. This severely affected the agriculture industry, especially those that use corn for feed. Beverage and other food manufacturing companies that use sizeable amounts of corn syrup have seen the effects of these increased prices as well. For these two reasons alone, Americans have seen food prices escalate. Further, the rise in the price of corn has at least a small amount to do with the rise in the production of ethanol, which in itself is a huge consumer of water. Increased production of biofuels have come under heavy scrutiny in recent years, due to both their occupation of agricultural land that traditionally was used to cultivate energy-intensive crops and because their production requires a great deal of water.

David Pimentel, professor of ecology and agriculture at Cornell University, has reported that, when one calculates the water used to grow and process corn that is being converted to biofuel, one gallon of ethanol requires almost 450 gallons of water. Considering one acre of U.S. corn yields approximately 7,110 pounds of grain for processing into 328 gallons of ethanol, and that planting, growing and harvesting that amount of corn requires the use of 140 gallons of fossil fuels costing approximately $347, even before corn is converted into ethanol, the feedstock costs about $1.05 per gallon of production. When production costs are added, ethanol costs around $1.74 per gallon, compared with about 95 cents to produce a gallon of gasoline. In addition, corn production in the United States erodes soil about 12 times faster than the soil can be reformed, and irrigating corn mines groundwater about 25 percent faster than the natural recharge rate, adding to the environmental costs of ethanol production.[11]

Specifically, the initial stages of the ethanol production process involve a huge amount of water. Water is added to the ground feedstock and is used in cooking and cooling the mash. Even though many ethanol plants recycle a great deal of the water they use, some estimates show that it takes approximately four gallons of water to produce one gallon of ethanol. In general, water utilization runs approximately 10 gallons per minute for each 1 million gallons of yearly ethanol production. This means that an ethanol plant that produces 50 million gallons per year would require approximately 500 gallons of water per minute.[12]

Ongoing assessments to determine if ethanol's "energy return on investment" (EROI), or the ratio of the energy delivered by a process to the energy used directly or indirectly in that process, combined with evaluations of the agricultural and environmental implication of ethanol production, will determine the role of ethanol in America's energy future.[13] The U.S. Department of Agriculture and the U.S. Department of Energy assert that ethanol produced from corn has an EROI of about 1.6, meaning it takes one unit of energy for every 1.6 units of ethanol produced.*

* This is much lower than gasoline, which has an EROI of approximately five. When an energy resources EROI is equal to or lower than one, then it is considered to be an "energy sink," i.e., it takes at least as much energy to produce the fuel than the energy output of the product itself, and so is not advantageous to produce.

Due in large part to the Energy Policy Act of 2005, which requires the gasoline supply of the United States to include 7.5 billion gallons of ethanol by 2012, ethanol production is growing rapidly. There are more than 140 ethanol plants in the United States today, up from just 54 in 2000, and there are more than 60 refineries currently under construction. Based on the refining capacity of these plants, the United States soon will be able to produce approximately 12 billion gallons of ethanol annually. Refining this much ethanol will consume approximately 48 billion gallons of water per year.[14]

Fossil Fuels and Nuclear

Water is inextricably linked to energy production, since energy production requires water and since the diversion, transportation and cleansing of water requires energy. Water is important to the energy industry, not merely for production purposes, but also for the mining, refining, processing, and transporting of oil, natural gas, coal and other fuels. One gallon of petroleum requires approximately two to 2.5 gallons of water for refinement into gasoline. Alternatively, approximately 0.5 to 0.7 gallons of water per kilowatt is used for the production of electricity at a coal-fired power plant. A typical 1,000 megawatt plant uses around 10,000 gallons of water a minute through evaporation. The average American uses about 12,000 kilowatts of electricity every year. A single 60 watt light bulb that burns for 12 hours per day uses 3,000 to 6,300 gallons of water per year.[15]

Nuclear and fossil fuel production require approximately 140,000 billion gallons of water daily, equal to approximately 39 percent of the country's use, although most of this is nonconsumptive. Petroleum, natural gas and coal production also require a great deal of water. However, natural gas requires approximately three gallons of water to produce 1 million British thermal units (BTUs), whereas ethanol requires more than 29,000 gallons.[16]

Coal-fired and nuclear power plants consume significant amounts of water. Most electricity in this country is produced by burning coal to heat water, which in turn evaporates and drives a steam turbine. The turbine runs a generator that produces an alternating current at high voltage, which can be distributed to substation and step-down transformers. In various states, including Idaho, Arizona and Montana, inadequate water has led regulators to deny permits for new coal-fired power plants. Although some nuclear power plants use gases, liquid metals, or molten salt to cool their reactor cores, water is the most common coolant. The heated water produces steam for turbines through the use of pressurized water reactors or directly at the rector's core. Nuclear power plants use water for cooling large reactors. Hydroelectric power, on the other hand, is produced merely by water moving through turbines on rivers or at dams. The water continues down river and can be used for other purposes, which is why the process is considered nonconsumptive. In general, the shifting of energy production to areas like the South and Midwest has exacerbated energy shortages in these regions.

Population Growth and Urbanization

Population growth and urbanization are perhaps the greatest causes of increased water demands. Between 2000 and 2007, the population of the United States grew from 285 million to 300 million. The U.S. Census Bureau projects that the country's population will increase by approximately 120 million people by 2050, reaching about 420 million total.[17] This is the equivalent to the addition of one person every 11.3 seconds. The Southwest has seen the greatest surge in population growth. Further, according to the United Nations, in 2007, the number of people living in cities surpassed the number of people living in rural areas for the first time in history.[18] This growth has had vast effects on the availability and accessibility of freshwater resources, largely through deforestation and the slowing of water soaking into the urban landscape, rendering it unavailable and unable to absorb heat. Some projections show that, with the growing population of the country, the United States will require approximately 393,000 megawatts of new generating capacity by 2020.[19]

Deforestation is the most significant result of population growth and urbanization, and greatly contributes to the increased scarcity of freshwater resources in the world and lack of water in the atmosphere. The basic lack of water in the atmosphere is a result of deforestation. Transpiration is the process by which plants and trees release water into the atmosphere, similar to sweating in human beings. Removing vegetation disrupts the water cycle, and water vapor is lost to the local watershed.

It is not only the displacement of rivers and streams themselves that contributes to shortages, but when water is unable to return to fields, meadows and wetlands, there is less water in the soil and local water systems and, therefore, less water is evaporated from the land.† If landscapes are unable to retain water, this means that less precipitation remains in the river basins and continental watersheds, and is simply carried out to sea. As a consequence, there is less water in the hydraulic cycle of a region that is heavily urbanized and deforested.[20]

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† During or immediately following drought cycles, it oftentimes is the case that water usage for sod production tends to increase. Ironically, drought causes lawns to die, and then even more water is needed to grow turf to replace it.

The Water Industry

Ironically, the water industry itself uses a great deal of energy. There are 60,000 water systems and 15,000 wastewater systems in the United States, using approximately 75 billion kilowatts of electricity, about 3 percent of the nation's total energy consumption, every year. Energy is needed for pumping, transporting, treating and distributing water, as well as treating wastewater. California uses approximately 19 percent of the state's electricity, 30 percent of its natural gas, and 88 billion gallons of diesel fuel to transport, treat, and distribute water and wastewater. Desalination of ocean or brackish water also consumes large amounts of energy. Since water is heavy, at about two pounds per quart, it requires a substantial investment of energy to transport it through canals and pipes. Nationwide, delivering water and treating wastewater amounts to 4 percent of all electricity usage.

In 2006, Americans spent approximately $11 billion on bottled water. The market for bottled water in this country has expanded rapidly in recent years, contributing greatly to water shortages worldwide. In 2007, Americans consumed approximately 9 billion gallons of water from bottles, almost 28 gallons per person. Since these bottles are made from polyethylene terephthalate (PET), a petroleum product, eliminating these bottles would be equivalent to annually taking 100,000 cars off the road.[21] In 2010, bottled water is expected to outsell soda for the first time ever.

Although bottled water consumption is only a small fraction of overall water usage, it poses a few very serious problems. Perhaps the chief reason for concern about the rise in bottled water consumption is the amount of energy and water it takes to manufacture, distribute and dispose of bottles. Approximately 2 million tons of PET bottles are discarded every year in the United States,[22] requiring significant energy use for their production and disposal. Yet even converting scrap PET into a recycled product is fairly energy-intensive. Still, the Container Recycling Institute estimates that the equivalent of 18 million barrels of crude oil would be needed to replace the bottles not recycled in the United States in 2005 alone.[23] Manufacturing plastic bottles requires about twice as much water as the bottles actually contain. In addition, the filtering processes require three to nine times the amount of water that is bottled.[24] Finally, transportation fuels are needed to ship these products across what are oftentimes long distances, from manufacturers, such as those in Calistoga or Fiji, to the consumer.

What Mechanisms Are Used to Acquire Water?

While there are significant challenges to maintaining the quantity and quality of freshwater sources, feasible solutions to these impediments are available. Three major "high-technology" mechanisms exist for saving freshwater: dams, diversions and desalination. There are both advantages and disadvantages to investing in each. While technological answers to water shortages can contribute to making more water available, they are not a silver bullet to solving a state or region's water problems. Recycling and desalinating water, in addition to conserving it, may help to alleviate the crisis, but it will not solve it.

Dams

There are more than 45,000 large dams in the world.* Dams can provide a variety of benefits, including the potential to generate large amounts of electricity. Approximately 5.8 percent of all electricity generated in the United States is by hydroelectric power, which comes from both river systems and dams.[25] For the former, water is diverted from a river to turn turbines. These power plants rely on river flows, since little or no water is stored for producing electricity. The disadvantage is that when natural river flows are low, then less electricity is produced. With dams, however, flowing water accumulates in reservoirs. The water then falls through a pipe (called a "penstock") and applies pressure against turbine blades, which drive a generator to produce electricity. In addition to supplying water to surrounding areas and producing electricity, dams also can help control floods and facilitate navigation on rivers.

However, dams also have the tendency to trap organic materials, such as rotting vegetation from submerged land which, in turn, can create a great deal of methane gas, a greenhouse gas that is 20 times more effective at trapping heat than carbon dioxide. This is especially true with larger dams. In addition, it is estimated that as much as 60 percent of the world's major rivers have been fragmented by dams. The World Wildlife Fund claims that only 21 of the world's 177 rivers that run longer than 600 miles flow uninhibited to the sea, and that dams are partly to blame for this.[26] Dams also have been implicated in the endangerment or extinction of many freshwater fish and other aquatic species, as well as the disappearance of various birds, forests, farmland and coastal deltas.[27]

Desalination

Desalination, the process by which salt is removed from seawater or brackish water, is a second method of contributing to available freshwater. The process is accomplished either through evaporation or by forcing salty water through tiny reverse osmosis membranes, which serve as filters. The result is clean water that can be used for any industrial or household use. There are approximately 12,300 desalination plants in the world, with a collective capacity to produce 12.5

* "Large dams" are ones that are more than 50 feet high.

billion gallons of water daily.[28] While there are 30 large-scale ocean desalination plants in the planning stage in California alone, most of these plants are small and are used for localized industrial needs.

Desalination has some limitations. The desalination process is extremely energy-intensive and can add additional strain on local power grids. Also, desalination can pose threats to the environment and to human health due to the release of a poisonous byproduct that is a combination of brine, chemicals and heavy metals used in the production process. These substances are used to prevent salt erosion and to clean and maintain the reverse osmosis membranes, but on discharge can severely damage local marine life. A final limitation is that the reverse osmosis process does not necessarily filter out all dangerous contaminates, such as viruses and bacteria; some chemical toxins such as pharmaceuticals and personal care products; and algal pollutants such as paralytic shellfish poisoning.

Diversions

Diversions also can help optimize existing freshwater resources. Traditionally, water was diverted through canals, and in many places in the United States this is still the case. However, today it is more common to use pipes to divert water from one water basin to another, commonly referred to as "interbasin transfer," which allows water to be transplanted far from its original source. One drawback is that pipelines are very expensive, particularly in colder regions where they must be constructed in permafrost and, like pipelines that transport oil and gas, can be disruptive to wildlife and ecosystems.

In practice, the main issue with interbasin transfer is management. What entity determines when transfers are necessary? What water uses are considered appropriate for legitimizing transfers? Will interested parties in the basins of origin have equal control as those receiving water regarding processes of transfer? For instance, while interbasin transfers often provide the receiving basin with additional sources of water for continuing support of economic growth and expanding population, the long-term economic prosperity and quality of life in the basin of origin can be threatened. Ensuring that this does not happen depends upon thoroughly gauging both the current and long-term water needs of the basin of origin.

Access to both surface water and groundwater is regulated differently in each state. Water withdrawals are allocated on the basis of state laws that determine the property rights to use it. Likewise, transfers of water by sale, lease or exchange also are constrained by the ways in which states determine property rights regarding water usage. A basic principle of interbasin transfer is that water should be allocated for the "highest and best use."[29] If this principle is based solely on economic efficiency, then it follows that the most economically advantageous plan for water allocation is the most desired one. Therefore, when an interbasin transfer proves to provide a better financial return compared to use of the water in the basin of origin, the transfer is deemed successful. However, this equation fails to take into account the environmental, health and social effects of such transfers.

Four major factors tend to augment demand pressures in states: the settlement of Indian tribes' claims on water rights currently held by others; environmental laws that require greater amounts of water be retained in natural sources; growing populations in arid states; and the recurring impacts of droughts, which may continue to increase in frequency and intensity as a result of shifts in precipitation patterns. It is important for states to understand the implications for surface water and groundwater affected by interbasin transfers. It also is important to distinguish between interbasin transfers of water that has been treated by municipal supplies and those involving water that is "raw," or directly from the source basin. In addition, it is important to emphasize why laws for interbasin transfer must be upheld.

The effects interbasin transfers have on public health within the basin of origin is another aspect to consider. One basic characteristic of clean water is its ability to assimilate pollutants. The Clean Water Act requires that discharges from point sources be adequately treated to meet human health safety standards. However, non-point discharges generally are treated only through assimilation by the water body that receives the discharges. To address this problem, the Clean Water Act imposes the Total Maximum Daily Load (TMDL) limit, which restricts the allowable percentage of pollutants in a given body of water. Loss of water within a basin of origin can make it very difficult to meet TMDL standards, which can inhibit economic growth as well as quality of life in the region. Variable and uncertain changes in climate also make decisions regarding how to protect the aquatic environment more difficult.

Furthermore, the significant, indirect costs to the basin of origin associated with water transfers often are difficult to assess. For instance, one such cost is the opportunity cost of future economic growth and prosperity.[30] There is almost always a productive use that could be found in the basin of origin, either in terms of increased output for existing uses or potential future uses of the water. Any values associated with the potential use of water in the basin of origin that are not actualized as a result of the water transfer should be included as a cost to the proposed interbasin transfer.[31]

Water Allocation

Overview

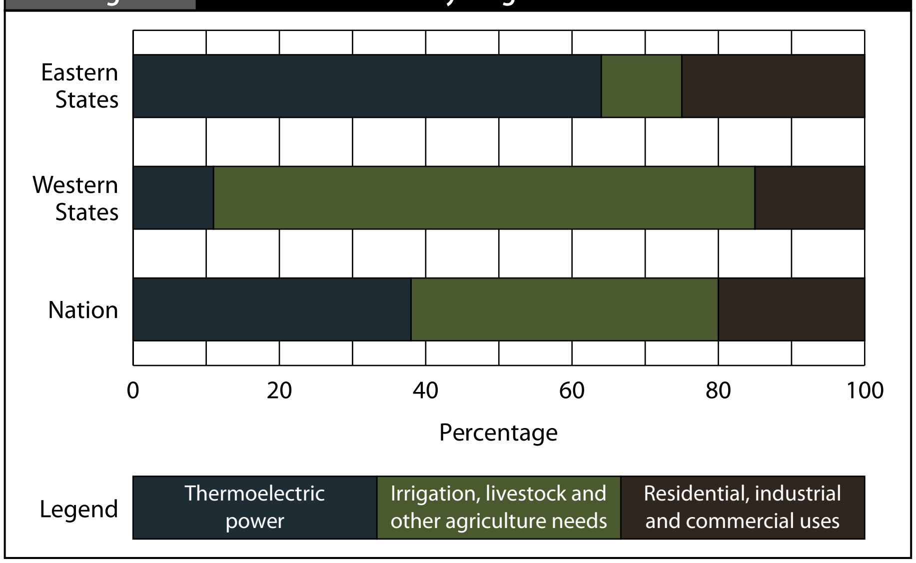
In general, water resources historically have been allocated on the basis of one social criterion: maintaining the community by ensuring that water is available for human consumption, sanitation purposes and food production. Societies have invested capital in infrastructure to maintain this allocation. Yet social change, including changes in (and greater understanding of) how goods are distributed, has produced new issues in water allocation. Population growth has made water scarcity a major problem in many countries and water pollution, while by no means a recent problem, is more widespread than ever before. Traditionally, the state has played a dominant role in managing water resources. But inefficient use of water, poor cost recovery for operation and maintenance expenses, the mounting cost of developing new water sources and problems with the quality of services in agency-managed systems has led to a search for alternatives that make water allocation and management more efficient.

Water allocation differs greatly in western states than it does in eastern states. This is because the eastern United States, including the South, has vastly different uses for water than western states. For instance, in the western region of the United States, only 11 percent of water is used for thermoelectric power. In eastern states, this portion is much higher at 64 percent, for a national average of 38 percent. However, in eastern states, only 11 percent of freshwater withdrawals are used for irrigation, livestock or other agriculture needs. In western states, approximately 74 percent of all freshwater withdrawals are for these purposes, for a national average of 42 percent. Approximately 25 percent of freshwater withdrawals in the eastern portion of the United States are for residential, industrial and commercial uses. In western states, approximately 15 percent of withdrawals are for these same purposes, bringing the national average to 20 percent.[1]

The rights to use water may be based on the notion that water is a shared public resource, an ownership of underlying land (known as the "correlative rights doctrine"), established uses (or "prior appropriation rights") or some combination of the three precepts. Most states do not recognize private ownership rights to groundwater and consider it subject to management as public property. As a result, users could lose access to the resource and have no recourse. States that rely on the correlative rights doctrine limit landowners to a "reasonable" share of the total groundwater supply, usually based on the acreage they own. Alternatively, states that recognize prior appropriation rights to groundwater may modify allocations to reasonable pumping levels. This is more commonly known as the "Colorado Doctrine," in reference to a 1922 U.S. Supreme Court decision, *Wyoming v. Colorado*, in which the state of Wyoming brought action against Colorado in order to prevent diversion of water from the Laramie River. Wyoming argued that since they were using the water first, this prior appropriation granted them rights to the water. The Court upheld Wyoming's argument, but allowed Colorado to divert a smaller amount of water, as long as it did not interfere with Wyoming's supply. This standard has been applied throughout western states since the decision.

The eastern United States, including the South, can learn a great deal from how western states traditionally have regulated water resources. Most western states rely on water markets for general water use and allocation. Water markets exist when water withdrawal permits are legally allowed to be traded between users. Water markets are more common in the western United States where water is generally allocated based on prior appropriation. Typically, water markets use prices to allocate scarce resources across various uses in order to maximize the overall net benefits to society. Water prices typically reflect the expense associated with physically accessing and delivering the water. Proponents of the use of water markets argue that the lack of markets re-

Figure 2 Water Allocation by Region



Source: Congress of the United States Congressional Budget Office, How Federal Policies Affect the Allocation of Water, 2006.

duces the prospective gains to a state economy from the most advantageous use of water resources by hiding opportunity costs. Without water markets, water resources are dedicated to a particular use and make allocation less flexible, rather than allocating to the highest-value user.

Broader use of markets in deciding how scarce water resources are allocated could improve the current system of administrative allocation that has emerged under many state laws. To formulate efficient water use policies, subsidies to support the use of water at prices that do not reflect opportunity costs, as well as subsidies for agriculture production that encourage additional planting and excess irrigation, could be eliminated. In addition, state governments can assess the impact of refining additional withdrawals or expanding programs that address the demand for water directly, using approaches such as cost-sharing for improvement to irrigation systems and conservation plans for irrigators who get water from federal infrastructure projects.[2]

In western states, the right to use a quantity of water generally belongs to anyone who first diverts that water from its natural setting and puts it to a "beneficial use" elsewhere. A water right is specified in terms of the date it is established, its purpose, the quantity of water used, the rate of flow, the point of diversion and the time when the water may be taken. The right based on prior appropriation remains valid as long as it continues to be used for the purpose for which it was established. All states relying on the prior appropriation doctrine consider agriculture, residential, commercial and industrial uses as beneficial uses. The doctrine shields appropriators' rights from impingement associated with changes in terms of water rights and accords no preference to uses with higher economic or social value compared with uses established earlier in time. When water is in short supply, right holders who have made appropriate claims earlier have priority over parties who made later claims to water from the same source—these later appropriators may receive only some, or none, of the water to which they have rights.

Riparian water allocation dramatically differs from the prior appropriation doctrine. All 15 SLC states determine residential water usage under what is termed "riparian doctrine," which states that whoever owns the land adjacent to a body of water has the right to use the water in a reasonable way. This often yields a situation whereby qualifying landowners can begin or cease use at any time, thereby making it so that users affected by these changes must adjust usage in response. In other words, all qualifying landowners can make reasonable use of the water to which they have access regardless of the consequences for others who use the same source for withdrawals. However, most SLC states have slightly more restrictive policies for governing commercial usage, such as irrigation and industrial purposes.

State laws determine private property rights to use water, and users are constrained under state laws in two respects. First, the laws incorporate restraints on water use, and thus on water transfers, which would interfere with the water rights of others. Second, in times of water shortages, holders of water rights are either subject to proportional reductions in use or obligated to reduce their use so that those who preceded them in obtaining rights to the same source of water can claim their full allocation. These two elements of state law differ in form under the riparian doctrine common in the eastern United States and the prior appropriation doctrine common in western states.

Throughout all regions, owners of riparian land must obtain permits from a state agency to use water. Permits also may be available to others who do not own riparian land. The charters incorporating most cities give them power to procure water for public purposes and to supply the domestic needs of their residents, and states have modified the riparian doctrine by introducing exceptions that allow municipal uses. Determining what is reasonable involves consideration of the purpose of the withdrawal, the suitability of the use for the body of water, economic and social values of the use, the extent of harm caused, the practicality of avoiding any harm by adjusting the quantities of use and the fairness of making the user who causes harm bear losses.

When the water supply is deemed insufficient to satisfy the reasonable needs of all qualifying landowners, they must reduce their use in proportion to their rights—sometimes based on the amount of adjacent land they own. Under the riparian doctrine, water rights transfer with the transfer of land. A qualifying landowner can transfer the water rights separately only if the recipient uses the water on the riparian land and meets the rest of the conditions of reasonable use. An owner of riparian land cannot transfer water out of a watershed.

Historically, the South has experienced an abundance of water. It has only been in recent years that water scarcity has become an issue for SLC states. Water scarcity in the region has resulted from a recent and prolonged drought; increased demand by many municipal, industrial, and agricultural sectors; and heightened attention given to the importance of in-stream water flow in supporting aquatic ecosystems and recreational interests.

Water scarcity in the South means that decisions must be made about how water is allocated in the region. There are alternatives to unrestricted riparian allocation methods. Florida, for instance, has no formally established trading scheme for recognizing rights that require approved water supplies, but does have "concurrency requirements" that can impede development in areas with water supply shortages. In order to circumvent these restrictions, developers in the southwestern part of Florida have created informal trading mechanisms. The same is true for farmers in the Piedmont area of North Carolina, where water from streams is traded between farmers for whatever price they agree upon.[3]

Arguments have been made against the idea that water markets are ideal institutions for managing water. Since water is an ambient resource where the actions of one user necessarily affect all other users, it is misleading to attribute value to water based on the quantity of a withdrawal, diversion or trade. Considering the almost immeasurable implications of a single withdrawal, ideally water markets should organize particular allocations among all holders of water rights. However, the cost of organizing can be prohibitive. Therefore, water is a public good for which markets cannot properly work as a distributing mechanism.[4] Nevertheless, regulation is imperative, particularly in water-strapped areas. Finally, viewing water merely as a public good can lead to overexploitation by one or many parties.

A "regulated riparian" model may be most advantageous for many water districts. This mode of water management operates on the basis that water is inherently a public asset, about which basic allocation and distribution decisions must be made by public agencies. Further, this means of regulation sometimes is known as a "quasi-market," since trades are regulated, but the water resources are considered to be a public good. A variety of economic incentives can be helpful in carrying out fair and appropriate allocation. These can include fees, taxes, or "water banks," an external mechanism that can help facilitate water exchanges. Such measures can play an important role in managing this public resource.

What Happens When the Water Runs Out?

The U.S. Geological Survey (USGS) ranks Nevada as the top per capita water user, at 303 gallons per person per day. Utah was a distant second at 245 gallons per day. Even though the two states have made great strides in conservation, they also are the two most arid states in the nation. In addition, more than one-fourth of the total water used in the United States is from withdrawals made in California, Texas, Idaho and Florida. California accounted for 11 percent of all withdrawals in the United States, and Texas accounted for approximately 7 percent of all withdrawals nationally.[5]

Rapidly decreasing access to freshwater resources inevitably has led to disputes among states. Some estimates claim that more than 35 of the contiguous 48 states are fighting with their neighbors over water supplies.[6] Perhaps one of the most famous conflicts is the ongoing dilemma over how to allocate withdrawals from the Colorado River among the seven western states (Arizona, California, Colorado, Nevada, New Mexico, Utah and Wyoming) that rely upon its water. The already scarce amount of freshwater in the region is becoming increasingly coveted due to freshwater shortages. These longstanding problems recently were exacerbated by a drought that persisted in the Colorado River Basin from 1999 until 2006. Some estimates show California with a 20-year supply of freshwater. New Mexico has approximately 10 years left. Arizona's situation is much more desperate. The state is out of water supplies and now imports all of its drinking water. Last year many Colorado farmers suffered substantial crop loss due to lack of irrigation water. Water shortages in California prompted farmers to clip the tops of hundreds of healthy, mature avocado trees in a desperate attempt to keep them alive. In Riverside County, California, water shortages forced the water district to place a hold on several proposed residential and commercial developments.

Colorado River States

States in which the Colorado River is a major source of water have employed myriad measures to make the best use of this available resource. Most recently, in October 2009, the California Legislature met for a special session to address the state's water problems. Conservation of the state's dwindling and inadequate water resources, as well as balancing water rights with monitoring how property owners access and use groundwater, were the main initiatives. Governor Arnold Schwarzenegger was pushing for the construction of more reservoirs and canals in a system that largely was constructed in the 1960s in order to improve the state's capacity for storing and transporting water. The Legislature passed, and the governor signed, a comprehensive water package comprising four bills and an $11 billion bond, which included aggressive water conservation policies, mandates for ensuring better groundwater monitoring, and monetary allocations for the State Water Resources Control Board to address illegal water diversions. The bond funds programs for drought relief; water supply reliability; statewide water system operational improvements; conservation and watershed protection; groundwater protection; water recycling and conservation programs; and sustainability in the Sacramento-San Joaquin Delta.

The Colorado River runs for approximately 1,450 miles from the Rocky Mountains to the Gulf of California.

As it makes this journey it decreases in capacity, as western states tap it, while increasing in salt compounds, due largely to runoff from soil and rocks, as well as waste from some of the largest agriculture operations in the world. In addition, western states, which largely were settled by the federal government as an agrarian endeavor, are becoming increasingly urban.

Although canals are the traditional method of transporting water in the region, piping water from one state or region to another increasingly is becoming the preferred method of water transportation in western states. The Southern Nevada Water Authority has proposed that more water be diverted from southern Nevada to Las Vegas through the construction of a 300-mile pipeline. Utah has proposed the construction of a 125-mile pipeline that would run from Lake Powell to serve residents in St. George and Washington counties, two major areas of population growth in the state.

Allocation of the region's water resources, including the Colorado River, is not limited to negotiations among states. Border disputes between Mexico and the United States exist as well. The "salad bowl" of southern Arizona was once one of the most productive farmland regions in the nation. In order to keep the nearby Colorado River free of agricultural wastewater, which often is extremely heavy in salt compounds disruptive to drinking and other water uses, runoff from that region is now channeled into the barren plain steppe of the Sonoran Desert in Mexico. This inadvertently has produced a burgeoning wetland, the Ciénega de Santa Clara, just south of the U.S.-Mexico border, the largest in the river's delta, and has become the site of migratory recesses for a number of birds, as well as a vital, permanent dwelling for many endangered and threatened species.

Currently there are plans in Arizona to withdraw some of the water, purify it at a desalination plant—a $256 million federal facility—and redirect it for other uses. There is some controversy surrounding the opening of the plant, which was completed approximately 17 years ago but never opened for operation, making it known as one of the largest "white elephants" of the federal government. The plant would draw water from a nearby agricultural drain built in the early 1970s as a short-term runoff solution. It is estimated that the plant could produce enough clean water to supply the needs of approximately 500,000 people and would allow western states to preserve that amount upriver for their use, rather than send it to Mexico, which is required now through treaty requirements.

The pact reached by governments, environmental groups and water agencies is to first test the plant at one-third capacity. Criticism has been levied against the United States for making long-term commitments regarding the project without consideration for the environmental consequences on the Ciénega. The U.S. Bureau of Reclamation, which currently oversees distribution of water from the Colorado River, will supervise operations at the plant. The Bureau released a report in August 2009 which concluded that operation of the plant would yield no significant harm to the surrounding environment.

Las Vegas: Water and the Urban Crisis

During the 1920s, Nevada had plenty of water and its prospects for growth were very small. The construction of the Hoover Dam in 1936 provided a water supply, Lake Mead, and plenty of hydroelectric power. However, scientists at the Scripps Institution of Oceanography have predicted that Lake Mead, which supplies water to Los Angeles and Phoenix, could be completely dry by 2021, due largely to the demand placed on it by cities such as Las Vegas.[7]

Since the 1930s, Las Vegas has become the largest user of water in the western region. The city is now the premier convention destination in the country. There are more than 150,000 hotel rooms and more than 9 million square feet of meeting space in the city, and currently 11,000 more hotel rooms are under construction with another 35,000 planned for future development. The city hosts innumerable conventions, conferences, expositions, fairs, rodeos, and trade shows, all of which provide a great deal of support to the bustling economy of the city and, in turn, the state. By 2020, the population of Las Vegas is expected to grow by 1.2 million.

By the late 1980s, Las Vegas' per capita water consumption was up to 350 gallons per day, double that of New York City, which receives about twice as much rainfall as Las Vegas.[8] Currently, Las Vegas has exhausted its rights to water from the Colorado River and Lake Mead, and the city is scrambling to find additional water sources. The city water authority has filed claims to groundwater located in aquifers scattered throughout the state, as well as some water sources outside Nevada. In 2005, the city began negotiating with San Diego and Tijuana, offering to pay for the construction of desalination plants that would use Pacific Ocean water, in exchange for portions of their Colorado River allocations.

In 2007, the states in the Colorado River Basin agreed upon sweeping revisions to the allocation of river water which gave more flexibility to Nevada and Las Vegas. One of these changes allows the state greater flexibility to fund conservation projects in other states and use the conserved water in exchange. For instance, if a farmer in southern California's Imperial Valley orders water from the U.S. Bureau of Reclamation, that water is released from the Hoover Dam. Since it takes approximately three days for the water to reach the intake point for the canal that will carry it to the Imperial Valley, if the water becomes available to the farmer because of rain, then the water from the dam is diverted from the river to the Drop 2 Storage Reservoir, which captures and stores the water. Located in southeastern California, approximately 25 miles west of the Colorado River near the All-American Canal, this reservoir cost $172 million to construct and was completely funded by the Southern Nevada Water Authority. The deal also entailed the exchange of rights to 40,000 acre-feet* of water per year for seven years. This method keeps the water from flowing down the Colorado River into the Sea of Cortéz and allows it to be utilized by U.S. or Mexican farmers, and others. Although the water would nourish the Colorado River Delta estuary at the Sea of Cortéz, from the perspective of municipal water providers, this water is wasted.

In 2002, the Southern Nevada Water Authority implemented a conservation program aimed at limiting outdoor water use, which accounts for approximately 70 percent of the region's water usage. The restrictions include a ban on certain lawn grasses that require large amounts of water; limitations on the number of hours and days individuals and businesses can water lawns; the imposition of strict water budgets for golf courses; and levying fines on individuals and businesses that fail to comply with the regulations. There also are incentives for homeowners to replace lawns with water-smart landscaping—$2 is given for every square foot of grass removed. Environmental and conservation groups have praised the program for its success. From 2002 to 2006, the Las Vegas Valley cut its water demand by more than 18 billion gallons a year, even though its population grew by approximately 330,000 during that time.[9]

Although casinos are contributors to Las Vegas' water problems, many have become vehemently involved in conservation efforts. Many casinos have made great strides in curbing water use in their hotel rooms and fountains. For instance, most casinos have installed low-flow water fixtures, as well as drip irrigation systems. A few casinos have built their own reverse osmosis wastewater treatment systems. Water from sinks and showers can be treated and reused in other parts of the facilities.

Las Vegas is a perfect example of how the low cost of water in the United States exacerbates the problem. The average household in Las Vegas uses 17,000 gallons of water in a typical summer month, but only pays $37 for that water, or approximately one penny for every five gallons. Studies show that residents of Las Vegas use more water per person than those of other western cities like Tucson or Albuquerque, which charge much higher rates for water.[10]

The Southern Nevada Water Authority has considered plans to import water from as far away as the Mississippi River. They have estimated that at the junction of the Mississippi and Ohio rivers, approximately 436,000 million acre-feet of water flows by every year. A pipeline that would run across Missouri, Kansas, Colorado, and New Mexico could give Las Vegas up to an extra 6 million extra acre-feet of water per year, drastically augmenting its water supply while simultaneously reducing flood threats to downriver cities like New Orleans. Currently, plans to move forward with such a drastic proposal are at a standstill. Also, the Water Authority has plans to construct a $2 billion pipeline that would transport approximately 91,000 acre-feet of water to Las Vegas from the Spring Valley and Snake Valley, both in western Utah, every year. However, this plan has provoked a mini-water war over the "least chub" fish and other endangered species in the valleys.

Alabama, Florida and Georgia

Water does not adhere to lines drawn on a map, and population growth and other factors that increase demand for water do not necessarily coincide with areas where water is plentiful. The tri-state dispute among Alabama, Florida and Georgia over water in the Apalachicola, Chattahoochee and Flint river systems illustrates the problems facing eastern states, which have seldom faced supply problems in the past. Georgia and Alabama need to satisfy growing urban drinking and waste water needs, while Florida is concerned about reduced flows into a bay that supports 90 percent of its oyster harvest. All three states rely on the riparian doctrine of water use, which allows for reasonable use of water subject to equally reasonable uses in other states. The problem is that what is reasonable varies in time, place and in response to changing needs and, until recently, there has been little incentive to establish more secure and equitable water management systems.

The beginning of this dispute dates back to 1990, when Florida and Alabama both filed federal lawsuits to stop Metro Atlanta from diverting more and more water from Lake Lanier. The three states reached an agreement in 1997, known as the Apalachicola-Chattahoochee-Flint River Basin Interstate Compact, which actually was nothing more than an acknowledgment that the three states would develop a formula for allocating water withdrawals from the river system by 1998. Negotiations languished, which meant that the only re-

* One acre-foot equals approximately 325,000 gallons.

course for Alabama and Florida was to pursue litigation.

In 2004, the two states resurrected their 1990 lawsuit against Georgia. Ostensibly, in November 2007, the three governors agreed to have a plan of action by February 15, 2008. However, that same month, the U.S. Army Corps of Engineers temporarily reduced releases from Lake Lanier without fear of jeopardizing the safety of endangered species in Florida. The state pursued further legal action. In February 2008, the U.S. Court of Appeals ruled that Georgia was not permitted to withdraw water at its discretion from Lake Lanier.

Metropolitan Atlanta withdraws approximately 270 million gallons daily from the Chattahoochee River, which is fed by Lake Lanier located about 50 miles north of the metropolitan area. Another 170 million gallons come from the region's small rivers. Atlanta's current water usage stands at 652 million gallons a day, which is expected to increase by 53 percent by 2035, to approximately 1 billion gallons daily.

In 2007, Atlanta came within a few months of running out of water, even after banning unnecessary outdoor water use, such as washing cars, watering lawns and filling swimming pools. In October 2007, Rob Hunter, Atlanta's watershed commissioner, issued a statement saying that without rain, Atlanta's water reserves would be completely depleted. Other federal and state officials predicted that Lake Lanier would go dry in three months. A two-year drought had dropped the lake's water level by 15 feet, a severe danger to the principle water source for the more than 5 million people living in the Metro Atlanta area. The surface of Lake Lanier covers 38,000 acres, an area approximately twice the size of Manhattan. More than 7.5 million people use the lake every year for recreational purposes. Vacation homes occupy approximately 692 miles of the lake's shoreline. The state declared a Level 4 drought emergency and banned all outdoor watering, with exceptions for agriculture and "essential" business uses. The governor's office asked businesses and utilities in the northern part of the state to cut water use by 10 percent.

At issue was water being released from Lake Lanier by the U.S. Army Corps of Engineers, which flowed downstream to the Apalachicola River and Bay in Florida, where two types of mussels and the Gulf sturgeon rely on these waters to survive. Also, the freshwater flowing downstream plays a pivotal role in sustaining Florida's $134 million annual commercial oyster industry. Alabama relies on the water mainly for industrial uses, such as cooling nuclear reactors at a plant near the border between the two states. Governor Sonny Perdue asked a federal court to issue an injunction to restrict these releases from Lake Lanier. He also asked the Bush Administration to grant emergency drought relief and to temporarily exempt Georgia from the Endangered Species Act, while both of Georgia's U.S. senators introduced legislation to create such an exemption. However, both Florida Governor Charlie Crist and Alabama Governor Bob Riley petitioned President Bush to reject Georgia's requests, which he did.

A major challenge for Georgia is the geographic locations of its rivers and aquifers and the areas that most need water from them. The concentration of Georgia's population is located in the northern part of the state, in the headwaters region, where source water is limited. Almost 54 percent of the population of Georgia lives in the northern part of the state. In addition, the river basins within the Atlanta metropolitan region are long and narrow. Therefore, many of the cities in the region are spread over more than one water district and may require regular transfers.

In addition, Georgia is a high growth state. In Georgia, as in most states, water management gravely affects the economic prosperity and quality of life. It is essential to the prosperity of a variety of businesses and industries, including automobile manufacturers; steel plants; copper and gold mines; defense industries; semiconductor manufacturers; and a number of energy-related fields, such as coal mining, oil and gas refineries, power plants and hydroelectric generating facilities.

Along with its economy, Georgia's population continues to grow. The state expects to add another 2 million new residents by the year 2015 to its 9 million residents, bringing the population to 11 million. The population of Metro Atlanta alone is expected to increase by 50 percent by the year 2030. Also, by 2030, six out of every 10 Georgia residents will live in Metro Atlanta.[11] As Georgia's population increased from 3.4 million in 1950 to 8.2 million in 2000, the state's water usage likewise rose from approximately 150 million to 1.3 billion gallons every day. Population growth was particularly relevant to the increase in water usage in the northern part of the state, but an unexpected increase in usage also came from the rise of large-scale agriculture operations in the southern part of the state. Statewide, agriculture water use, which mostly came from escalated groundwater use, increased twelvefold between 1950 and 1980, and has doubled again since then, reaching 1.1 billion gallons per day.

Surprisingly, Georgia has extraordinary water resources, including 70,000 miles of streams; 40,000 acres of lakes; 4.5 million acres of wetlands; 384,000 acres of tidal wetlands; 854 square miles of estuaries; and 100 miles of coastline. In addition, the state receives approximately 49 inches of rainfall every year.[12] The major problem in Georgia is not lack of water, but an uneven distribution of water resources, along with a growing economy, population, and agriculture industry.*

There have been other disputes between Georgia and Alabama in the past. The Alabama-Coosa-Tallapoosa River Basin has been the battleground of coveted water resources to which both states have laid claim. Again, Metro Atlanta relies on a great deal of water from Allatoona Lake, which resides just northwest of the city and holds water flowing predominantly from the Etowah River. The Etowah River eventually becomes part of the Coosa River, which flows into Alabama. Water from this river is critical to various downstream businesses, including major paper mills and hydroelectric plants, and the Joseph M. Farley Nuclear Power Plant, which supplies Alabama Power with approximately 20 percent of its electricity. Low river flows significantly threaten the livelihood of such businesses.

The U.S. Supreme Court, which has sole jurisdiction over disputes between states, in the past has ruled on interstate river water allocation. The Court ruled that it is "essentially irrelevant" where the headwaters of a river begin. In other words, in situations such as the one between Alabama, Florida, and Georgia, the fact these rivers begin in Georgia and end in Alabama and Florida would have no bearing on how the water from these rivers should be allocated. In the past, the Court has not permitted upstream states to hoard water that is vital to downstream states.

Georgia has investigated other avenues for acquiring more water, including diverting an additional 126 billion gallons a year from the Chattahoochee and Etowah Rivers to be stored in four ancillary reservoirs, which cumulatively could hold an additional 33 billion gallons. However, no plans have been actualized at this time. Georgia has not begun restricting new uses of water. Evidenced by a thriving well-drilling business in the state, water permits are required only if more than 100,000 gallons of water are being diverted or pumped. Permits, when required, are approved based on a first-come, first-served basis.

In 2008, an examination was conducted to determine where the Georgia-Tennessee border actually lies. This action was prompted by a resolution passed by the Georgia General Assembly which asserted that due a flawed 1818 land survey, the border between Georgia and Tennessee was located approximately one mile south of where it should be. If the border were readjusted, Georgia feasibly would have access to water from the Tennessee River.

Governor Perdue of Georgia has established a task force to examine contingency plans for the state as they seek alternatives to Lake Lanier as a regional water source. The Georgia Statewide Water Management Plan is an integral part of how Georgia formulates and develops its interbasin transfer laws and policies. According to the governor's office, one aspect of the Plan addresses the impact of the aforementioned federal court ruling, with the other three being: developing negotiations with Florida and Alabama; encouraging Congressional approval of legislation that would authorize Lake Lanier as a water supply; and appealing the decision. As recently as December 2009, the three governors have met to discuss water sharing options. No agreement has been reached at the time of this report.

In addition to the interstate dispute with Alabama and Florida, Georgia has other water woes. Water districts in Savannah, Georgia, and Hilton Head, South Carolina, have been fighting over water for the last few years. The Port of Savannah, the fourth busiest and fastest growing container terminal in the country, has contributed greatly to suburban growth in the area. Target, IKEA and Heineken all recently opened new distribution centers in the area to take advantage of the Port. Before this significant growth, water flowed through the Upper Floridan Aquifer and discharged into the Port Royal Sound in South Carolina. Increased pumping in Savannah, which uses six times more groundwater than Hilton Head, has led to a reversal in the direction of groundwater flow. This alteration has caused sea water to migrate laterally, contaminating freshwater wells. The Hilton Head Public Service District has at times shut down as many as five of its 12 wells due to increased chloride levels resulting from this saltwater migration. Savannah's wells, which are located in a much deeper part of the aquifer, are unaffected by this dynamic.

Although South Carolina has considered legal action, they have decided to explore alternative water sources instead. Two utilities that serve Hilton Head have spent approximately $90 million constructing a reverse osmosis saltwater desalination plant, which offsets their water losses from the Upper Floridan Aquifer.

However, in 2008, reduced flow in the Savannah River led the Nuclear Regulatory Commission's Atomic Safety and Licensing Board to withhold approval of two proposed nuclear reactors operated by Southern Nuclear Operating Company. The reactors would have required as much as 83 million gallons of water a day for cooling and other processes.

* Other operations, such as Georgia's first ethanol refinery which will come on line in 2010, will further exacerbate the strain on water systems. It will require approximately 500 million gallons of water per year.

Southern states secure approximately 79 percent of their water from surface water sources, and most water withdrawals are used for thermoelectric power generation. Irrigation is the second largest use of water in Southern states, comprising about 17 percent of all withdrawals and almost one-half of all non-thermoelectric withdrawals. Public supply is the third largest user of water, accounting for more than 10 percent of all withdrawals and more than one-fourth of all withdrawals not associated with thermoelectric power generation. About 7 percent of all withdrawals in Southern states is for industrial uses. Aquaculture accounts for about 2 percent of all water withdrawals in Southern states, and mining, domestic use and livestock each account for approximately 1 percent or less of all withdrawals.

Alabama

Alabama relies on surface water for approximately 95 percent of the state's water withdrawals. As part of the state's ongoing water resources planning efforts, the Department of Economic and Community Affairs' Office of Water Resources (OWR) operates the Water Use Reporting Program, which requires all major, non-public or irrigation water users to register use with this office. The OWR also administers programs for river basin management, river assessment, water supply assistance, water conservation, flood mapping, the National Flood Insurance Program and water resources development. In addition, the OWR serves as a liaison to federal agencies dealing with major projects related to water resources. The OWR also conducts technical studies and publishes regular reports on the status of water resources in the state.

The state uses most of its water withdrawals—83 percent—for thermoelectric power generation, producing about 114,144 gigawatt hours of electricity annually. About 98 percent of all water withdrawn in the state for thermoelectric use is for "once-through cooling," and then is returned to the original surface water source. Withdrawals for public supply make up about 8 percent of total water withdrawals in the state, or almost half of all water withdrawals for uses other than thermoelectric power. Industrial uses comprise approximately 6 percent of total water withdrawals and about 33 percent of all non-thermoelectric withdrawals. The major industrial uses of surface water in the state are paper and allied product operations. Chemical and allied products operations account for the greatest groundwater withdrawals

Figure 3 Water Withdrawals in Alabama

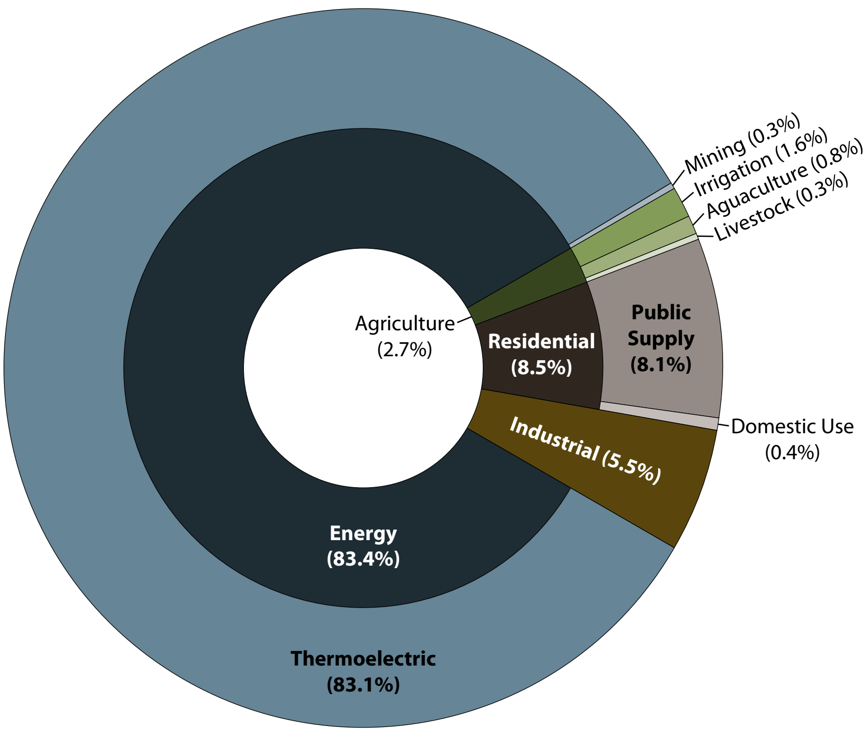


Table 1 Water Withdrawals in Alabama

Withdrawals by Source (Mgal/d)		Total Withdrawals	Withdrawals by Use (Mgal/d)							
			Energy		Agriculture			Residential		Industrial
Groundwater	Surface Water		Thermoelectric	Mining	Irrigation	Aquaculture	Livestock	Public Supply	Domestic Use	
490	9,466	9,956	8,271	28	161	75	29	802	40	550

Table 2 Water Withdrawals in Arkansas

Withdrawals by Source (Mgal/d)		Total Withdrawals	Withdrawals by Use (Mgal/d)							
			Energy		Agriculture			Residential		Industrial
Groundwater	Surface Water		Thermoelectric	Mining	Irrigation	Aquaculture	Livestock	Public Supply	Domestic Use	
7,510	3,920	11,430	2,000	2	8,530	256	40	404	19	179

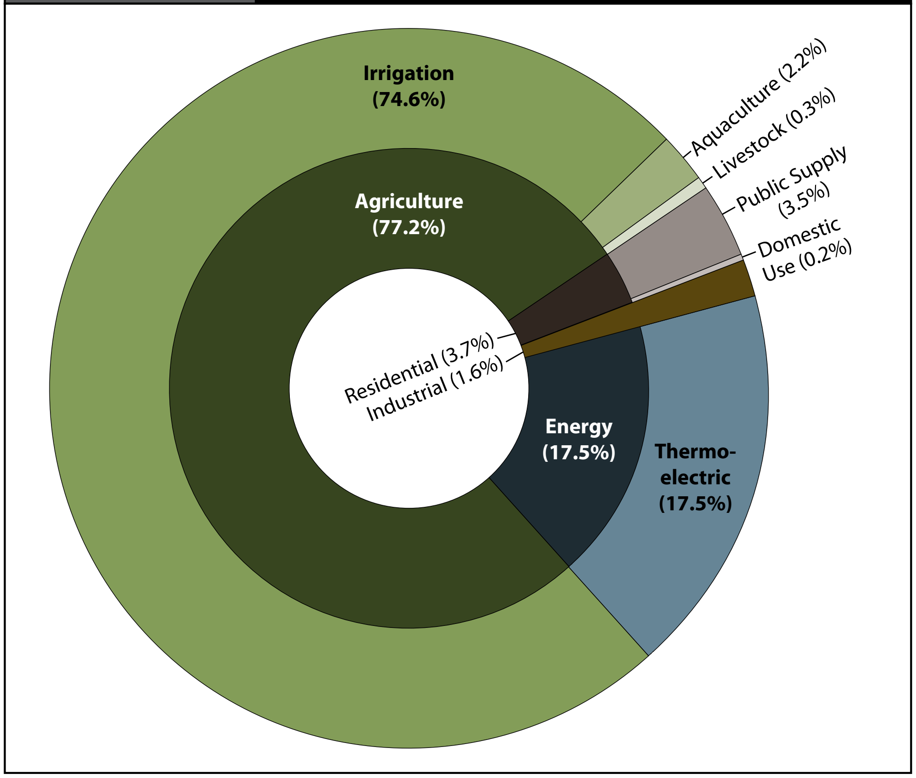
for industrial use. Water withdrawals for irrigation make up about 2 percent of all withdrawals and 10 percent of non-thermoelectric withdrawals. Water withdrawals for aquaculture, domestic use, mining, and livestock each account for less than 1 percent of all water withdrawals.

From 1960 to 1980, water withdrawals increased by 145 percent in the state, from approximately 4,220 million gallons per day (Mgal/d) to 10,350 Mgal/d. This largely is attributable to a population increase of about 19 percent during this period, as well as expansion of industry and other business development in the state. The population of the state increased another 17 percent from 1980 to 2005, but withdrawals actually declined somewhat to 9,956 Mgal/d in 2005. Withdrawals have remained somewhat constant since 2000, partly due to conservation efforts and the subsequent decline in gross per capita use. For instance, in 1980, per capita use was about 2,661 gallons per day (gal/d), versus 2,185 gal/d in 2005.[1]

Arkansas

The Arkansas Natural Resources Commission works to manage and protect water resources in the state. The state relies on groundwater for approximately 66 percent of its water withdrawals, and approximately 75 percent of the state's water withdrawals are for irrigation. Withdrawals for thermoelectric energy production make up about 18 percent of the state's total water withdrawals and 69 percent of all non-irrigation withdrawals. Public supply accounts for approximately 4 percent of all withdrawals, and about 14 percent of all non-irrigation withdrawals. Aquaculture accounts for 2 percent of all state withdrawals, and 9 percent of all withdrawals excluding irrigation. Industrial uses comprise approximately 2 percent of all withdrawals, and account for about 6 percent of all non-irrigation withdrawals. One percent or less of all water withdrawals in the state are for livestock and domestic use. Withdrawals for mining are negligible.

Figure 4 Water Withdrawals in Arkansas



Florida

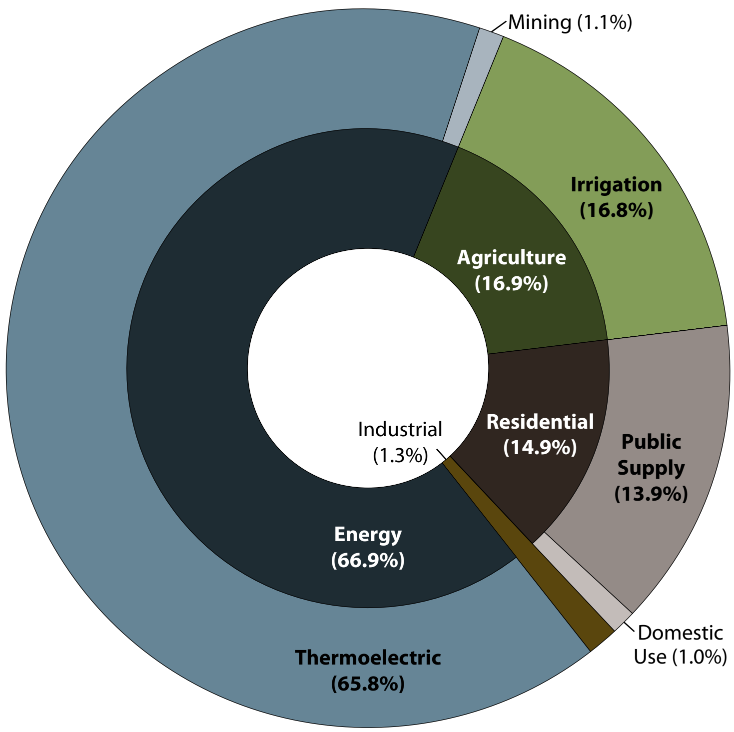
Florida relies on surface water for more than three-fourths of its water withdrawals. However, Florida's population is growing by more than 1,000 residents daily, and the state is now, more than ever, relying increasingly on groundwater sources for its water supply.

Approximately 66 percent of the state's water withdrawals are for thermoelectric power generation. The state is known for its lush lawns and green golf courses, all of which require large

Table 3 Water Withdrawals in Florida

Withdrawals by Source (Mgal/d)		Total Withdrawals	Withdrawals by Use (Mgal/d)							
			Energy		Agriculture			Residential		Industrial
Groundwater	Surface Water		Thermoelectric	Mining	Irrigation	Aquaculture	Livestock	Public Supply	Domestic Use	
4,203	14,120	18,323	12,058	195	3,070	9	17	2,540	190	244

Figure 5 Water Withdrawals in Florida



amounts of water for irrigation, which is the second largest category of water withdrawal in the state, comprising 17 percent of all withdrawals and almost half of all withdrawals excluding those associated with thermoelectric power generation. Water for public supply is the third major water withdrawal purpose in the state, making up about 14 percent and approximately 40 percent of all non-thermoelectric withdrawals. Industrial uses, mining and domestic use each contribute about 1 percent to total water withdrawals. Livestock and aquaculture withdrawals are negligible.

The Department of Environmental Protection is involved in managing the quality and quantity of water in the state's five water management districts: Northwest Florida Water Management District; Suwannee River Water Management District; St. Johns River Water Management District; South Florida Water Management District; and Southwest Florida Water Management District. The districts administer flood protection programs, perform technical investigations into water resources, develop water management plans for water shortages in times of drought and work to acquire and manage lands for water management purposes under the Save Our Rivers program. Regulatory programs delegated to the districts include programs to manage the consumptive use of water, aquifer recharge, well construction and surface water management.

Florida does permit inter-district (and thus interbasin) water transfer. It is permitted by both statute and rule. The rule requires export of water out of a water management district to meet certain criteria. In addition, Florida's water management districts have water shortages rules that they have implemented, as necessary, during recent droughts. Under these rules, the districts respond to droughts by implementing a system of water shortage phases. Each phase includes increasingly stringent restrictions on water use that can be implemented sequentially as drought conditions worsen. This approach attempts to "share the burden" of a water shortage among all water users and use types that rely on the affected water source.

Consumptive Use Permitting rules govern surface and groundwater withdrawals in the state. Florida's five water management districts are responsible for issuing consumptive use permits within their jurisdictions. In addition, the Department's non-point source and storm water management programs regulate discharges of water. This increases the district's contact with local governments by direct-

"The availability and abundance of clean water sources are paramount to the state of Georgia. Guaranteed water sources are necessary to sustain and grow Georgia's population, agriculture and businesses, as well as to remain competitive in encouraging overall economic development. Georgia requires top-notch water management and allocation."

~ Representative Chuck Martin, Georgia
Vice Chair, SLC Energy and Environment Committee

ing the districts to help with the development of the water elements in local government comprehensive plans.

The Committee on Landscape Irrigation and Florida-Friendly Design Standards convened and developed the standards. The standards have been published in a booklet called Landscape Irrigation and Florida-Friendly Design Standards. The 2004 Legislature directed the water management districts to work with interested parties to develop landscape irrigation and Florida-Friendly design standards for new construction. Local governments are required to use the standards and guidelines when developing landscape irrigation and Florida-Friendly ordinances.

Florida also has a comprehensive water supply planning effort to identify future water demand and develop ways to meet this demand. The water management districts accomplish this through regional water supply planning. In 2005, the Legislature recognized that the development of alternative water supplies was crucial to meeting future water demand and established the Water Protection and Sustainability Program. Alternative water supplies include non-groundwater sources such as salt water, brackish water, reclaimed water, storm water, and other nontraditional sources. The program provides matching state funds to the water management districts for construction of alternative water supply projects identified in the regional water supply plans. For fiscal years 2006 and 2007, matching fund levels were $160 million from the state, approximately $132 million from the water management districts, and about $1.6 billion from water suppliers for 238 projects. Like many states, economic hardship has drastically affected funding for water projects in the state, leading to fewer alternative water supply projects to deal with shortages.

Florida's water management districts require utilities to include water conservation plans when they apply for or renew a water use permit. Some districts also have year-round water conservation rules for irrigation. One recent effort to assist utilities with permit water conservation plans is the Conserve Florida program. Conserve Florida provides information and tools to improve water conservation through development of utility-specific, goal-based water conservation programs. This task is accomplished through the use of the Guide (an on-line software application). Conserve Florida also operates a clearinghouse that collects, analyzes, and makes available reliable information and technical assistance to public water supply utilities and water managers. In addition, many of the utilities in the state have programs for storing reclaimed water or captured surface waters for later use in aquifer storage and recovery wells.

Georgia

Georgia receives approximately 79 percent of its water for withdrawals from surface water sources. However, in many parts of northern Georgia, where water scarcity is a major problem and water is underlain by crystalline rocks, groundwater has been investigated as a potentially feasible alternative water supply to supplement diminished surface water flows during severe drought periods.

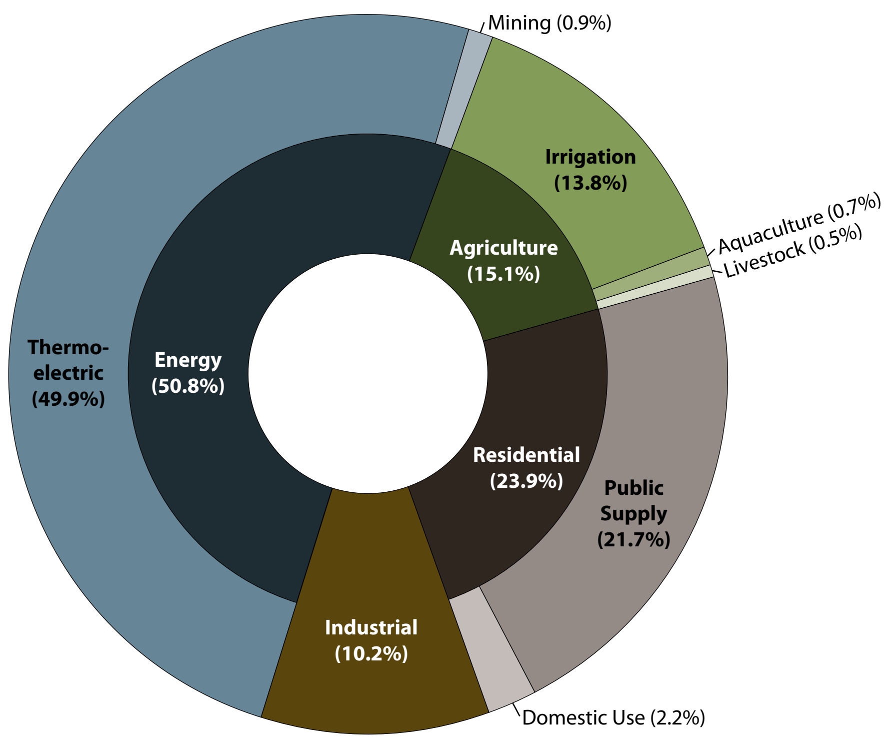
The Georgia Drought Management Plan establishes water conservation measures as part of drought response strategies and requires water withdrawal permit holders to prepare water conservation plans that encourage irrigation efficiency. In addition, new or modified agricultural water use permits issued after January 1, 2006, promote irrigation efficiency and water conservation by requiring irrigation systems to have shut-off switches, leak prevention, and repair plans. Pump safety shutdown systems are required for all center-pivot irrigation systems.

The largest single use of water in the state is for thermoelectric power generation, comprising approximately half of all water withdrawals in the state. Public supply is the second leading use of water in the state, comprising almost 22 percent of all withdrawals, and about 43 percent of all non-thermoelectric withdrawals. Irrigation also is a major user of water, contributing to approximately 14 percent of all withdrawals and about 28 percent of all withdrawals excluding those for thermoelectric power generation. Industrial uses for water make up about 10 percent of all withdraw-

Table 4 Water Withdrawals in Georgia

Withdrawals by Source (Mgal/d)		Total Withdrawals	Withdrawals by Use (Mgal/d)							
			Energy		Agriculture			Residential		Industrial
Groundwater	Surface Water		Thermoelectric	Mining	Irrigation	Aquaculture	Livestock	Public Supply	Domestic Use	
1,160	4,280	5,440	2,717	49	752	38	29	1,180	120	555

Figure 6 Water Withdrawals in Georgia



als, and one-fifth of all non-thermoelectric withdrawals. Domestic use comprises about 2 percent of all withdrawals, and mining, aquaculture and livestock each comprise 1 percent or less of all water withdrawals.

Georgia has access to water from 14 major rivers and six major aquifers and allows interbasin transfers among these resources. Along with the protection of water at its point of origin, interbasin water transfer is perhaps the most important water issue for the state.[2] The Georgia Code authorizes interbasin transfers simply by allowing the Environmental Protection Division to grant permits that allow transfers of water "if such diversions are in the public interest."[3] The surface water withdrawal statute requires that the director of the Environmental Protection Division "give due consideration"[4] to existing uses and applications of the water in the basin of origin before granting a permit for transfer. For the 16-county area in the Metropolitan North Georgia Water Planning District, which includes Atlanta, law requires that the district, in formulating its water supply plan, "shall neither study nor include in any plan any interbasin transfer of water from outside the district area."[5] Currently, Georgia law has no provision that requires compensation to the basin of origin for the costs associated with interbasin transfer.

All proposed transfers are evaluated based on the regulations passed in the Georgia Comprehensive Statewide Water Management Plan, which ensures that water is carefully managed in order to meet the long-term water needs of the state. Georgia is one of the fastest growing states in the nation, and population growth and economic prosperity in the state are inextricably tied to water resources. As the state's population and economy grow, demand on the state's water will continue to grow as well. The Plan is an effort to determine how much water can be removed from rivers, lakes and aquifers without creating unacceptable negative impacts and how much wastewater and storm water streams can handle before water quality begins to degrade. Further, it provides a framework to measure water resources, forecasts how much water supply and assimilative capacity will be needed to support future growth, and identifies regional solutions to water needs.

The state also is working to develop a better understanding of how much water is, and needs to be, returned to the state's natural systems, and alternative ways to meet the state's long-term water needs are being evaluated. In addition, a comprehensive state plan hinges on development of regional water plans to be implemented by the various water users in the re-

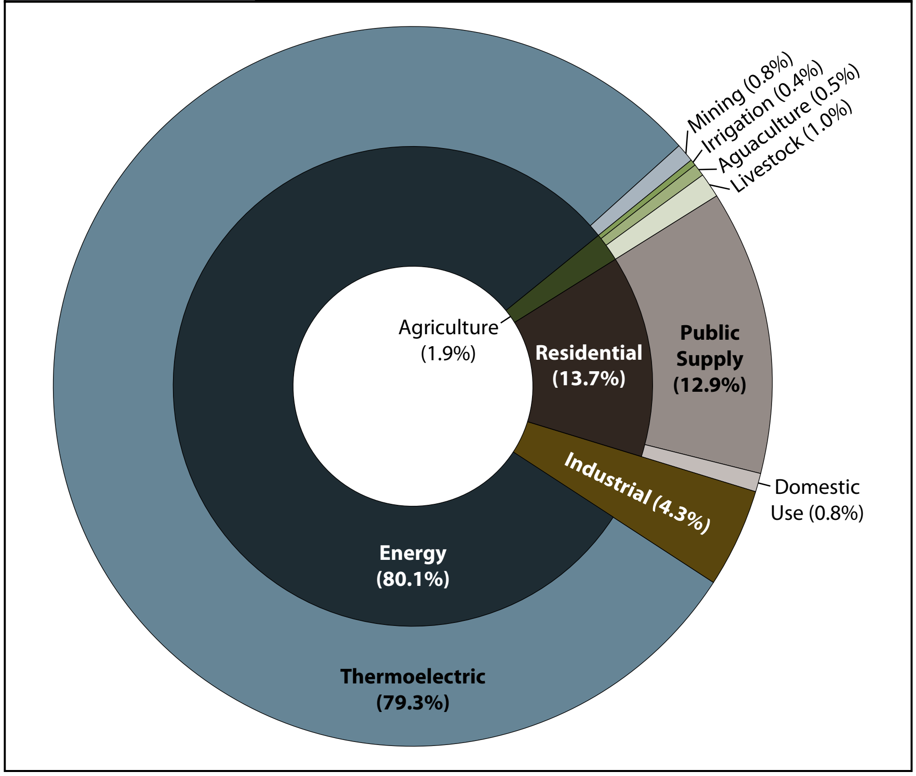
Table 5 Water Withdrawals in Kentucky											
Withdrawals by Source (Mgal/d)		Total Withdrawals	Withdrawals by Use (Mgal/d)								
			Energy		Agriculture			Residential		Industrial
Groundwater	Surface Water		Thermoelectric	Mining	Irrigation	Aquaculture	Livestock	Public Supply	Domestic Use	
157	4,170	4,327	3,430	36	18	20	45	558	34	186

gion, with state permitting and financial assistance.

Three challenges currently face Georgia when it comes to interbasin transfer. First, it must be determined what, if any, restrictions should be applied to transfers. Second, there needs to be an assessment of how the basin of origin can be protected from serious, perhaps irreversible, damage stemming from transfers. Finally, lawmakers must discern how state law should be structured in order to prompt efficient and effective transfers for both receiving basins and basins of origin.[6]

The 2010 General Assembly passed legislation that provides incentives to conserve water, including provisions that require builders to install low-flow toilets and faucets in new construction projects. The legislation also includes a watering ban during some daylight hours in warmer months of the year.

Figure 7 Water Withdrawals in Kentucky



Kentucky

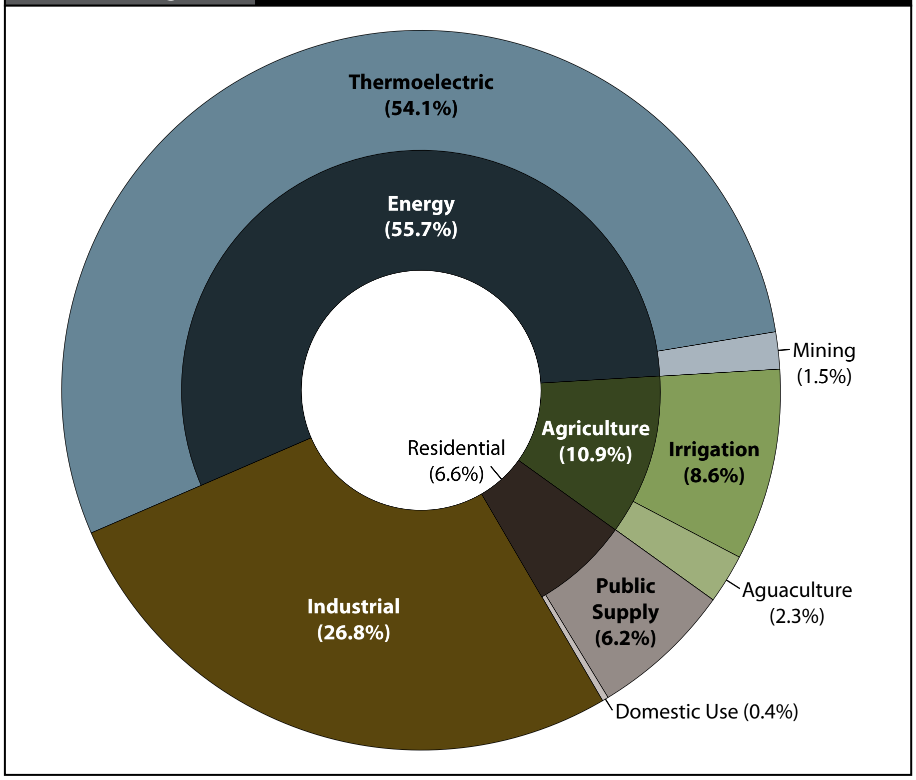
More than 96 percent of all water withdrawals in the commonwealth come from surface water sources, while the total number of permits for surface water and groundwater withdrawals is 470 and 197, respectively. Thermoelectric power use comprises more than 79 percent of all water withdrawals. The second largest usage of water is for public supply, which makes up 13 percent of all withdrawals and 62 percent of all non-thermoelectric withdrawals. Industrial use is the third largest consumer of water, comprising more than 4 percent of all withdrawals and 21 percent of all withdrawals excepting those for thermoelectric power production. Livestock, mining, domestic use, aquaculture and irrigation each make up approximately 1 percent or less of all withdrawals.

The Environmental and Public Protection Cabinet facilitates the process of water supply planning and determines source water availability. Kentucky law states that no person, business, industry, city, county, water district, or other political subdivision has the right to withdraw, divert, or transfer public water from a stream, lake, groundwater source or other body of water, unless that entity has been granted permission by the Cabinet. However, the use of water for agriculture and domestic purposes, including irrigation; water used in the production of most in-state steam-generating plants; and withdrawals that are less than a daily average of 10,000 gallons are exempt from water withdrawal permitting. Thermoelectric power water use is monitored by discharge rates filed with the Kentucky Pollutant Discharge Elimination System Branch of the Division of Water. Approximately 90 percent of all water

Table 6 Water Withdrawals in Louisiana

Withdrawals by Source (Mgal/d)		Total Withdrawals	Withdrawals by Use (Mgal/d)							
			Energy		Agriculture			Residential		
Groundwater	Surface Water		Thermoelectric	Mining	Irrigation	Aquaculture	Livestock	Public Supply	Domestic Use	Industrial
1,780	9,820	11,600	6,280	177	992	271	7	719	44	3,110

Figure 8 Water Withdrawals in Louisiana



use in Kentucky is accounted for by reporting or permitting.

Some obstacles faced by Kentucky in developing new water sources include disagreement between stakeholders and other interested parties on local water supply issues; environmental and permitting requirements associated with construction of new dams and impoundments; and project funding. As mentioned, the Cabinet, with the approval of the secretary, may issue a permit for the transfer or diversion of public water from one stream or watershed to another, where such transfer is consistent with the prudent use of public water and is in the best interest of the public.

Recent droughts have prompted the reassessment of how this program allocates water during drought flows. Areas of study include available withdrawal rates during low-flow periods; recalculations and required water shortage response actions at those flows; and improved yield estimates for water supply lakes during drought periods. Work currently is underway to develop a statewide drought mitigation and response plan through the newly formed Drought Mitigation and Response Advisory Council. In addition to the anticipated statewide drought plan, a possible product of this group's work is further improvements to water allocation methods.

The promotion of conservation and wise water use is encouraged through the Water Supply Planning program. For example, the program requires water suppliers whose leakage losses are greater than 15 percent to find and repair leaks, and the program estimates repair costs for these suppliers. If the supplier's water use is not metered, the planning representative estimates the cost of meter installation.

Louisiana

More than 85 percent of all water withdrawals in the state come from surface water sources, and thermoelectric power accounts for more than half of all withdrawals in the state. Industrial use is the second major withdrawal category in Louisiana, with more than one-quarter allocated for this purpose and, excluding withdrawals for thermoelectric power generation, accounting for approximately 58 percent of all withdrawals. Irrigation plays a major role in water usage in the state. Almost 9 percent of all withdrawals is for irrigation purposes, and 19 percent of all non-thermoelectric withdrawals are for these purposes. Aquaculture and mining play a slightly larger role in Louisiana than in many other states, each accounting for about 2 percent of all withdrawals. Domestic use accounts for less than 1 percent of all water withdrawals. Withdrawals for livestock are negligible.

Table 7 Water Withdrawals in Mississippi

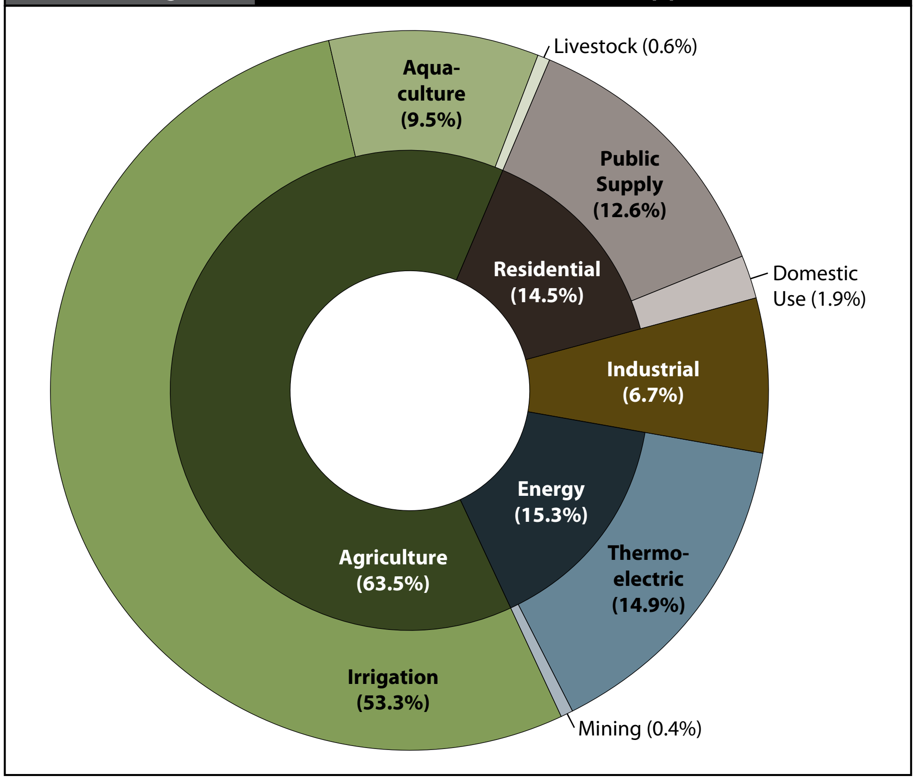
Withdrawals by Source (Mgal/d)		Total Withdrawals	Withdrawals by Use (Mgal/d)								
			Energy		Agriculture			Residential		Industrial
Groundwater	Surface Water		Thermoelectric	Mining	Irrigation	Aquaculture	Livestock	Public Supply	Domestic Use	
2,190	736	2,926	437	11	1,560	279	18	368	56	197

Withdrawals from surface water are not regulated in Louisiana, except in accordance with the federal Clean Water Act of 1972, which relates to environmental impacts from cooling water intake structures. Similarly, discharges into surface waters are regulated in accordance with the federal National Pollutant Discharge Elimination System. A water discharge permit is required to discharge pollutants from a point source into waters of the state, obtained from the state Department of Environmental Quality.

In 2003, the Legislature created the Office of Conservation within the Department of Natural Resources, responsible for the administration of all matters related to the management of Louisiana's groundwater resources, to ensure sustainability of water resources. In order to do this, the Office closely monitors the ongoing use of aquifers in the state. In addition, the Department of Transportation and Development and its Office of Public Works both contribute to policies regarding the use of groundwater in geothermal heat pump systems, which extract heat from nearby warm water sources in the ground.

Interbasin transfers are allowed in the state. Transfers particularly are common with respect to pumping stations for storm water. For instance, the Houston River Water District, located in the Calcasieu Basin, pumps water out of the Sabine River in the Sabine Basin and transports the water by a diversion canal to Lake Charles, for the purpose of an additional source of freshwater. Also, diversion of water from the Mississippi River is used to counter salt water intrusion into the adjacent wetlands.

Figure 9 Water Withdrawals in Mississippi



There are a number of ongoing water concerns in the state. For instance, the Sparta Aquifer, the only viable source of clean water for many communities in northern Louisiana, is especially stressed, with dropping water levels in wells indicating limited sustainability if action is not taken. There also is danger of salt water encroachment in a number of aquifers in the state as a result of excessive pumping. The Department of Natural Resources is working to address these issues by creating groundwater conservation boards and encouraging local governments to develop action plans.

In recent years, there have been no changes in the state with respect to the availability and usage of surface waters.

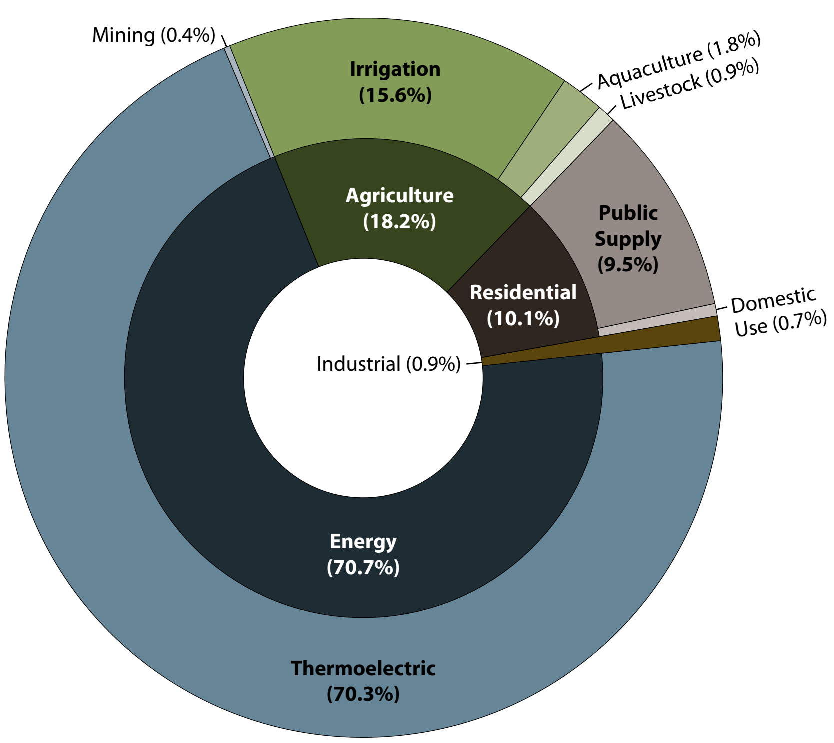
Mississippi

Mississippi relies on groundwater sources for three-fourths of its water needs, the largest percentage of the 15 SLC states. Due to the state's vast

Table 8 Water Withdrawals in Missouri

Withdrawals by Source (Mgal/d)			Withdrawals by Use (Mgal/d)							
			Energy		Agriculture			Residential		
Groundwater	Surface Water	Total Withdrawals	Thermoelectric	Mining	Irrigation	Aquaculture	Livestock	Public Supply	Domestic Use	Industrial
1,745	7,045	8,790	6,180	35	1,370	156	77	831	60	81

Figure 10 Water Withdrawals in Missouri



agricultural base, more than one-half of these withdrawals is used for irrigation purposes. Including aquaculture and livestock, agricultural usage of water comprises approximately 64 percent of all water withdrawn. Aquaculture in Mississippi is responsible for a much larger use of water than in other states, accounting for about 10 percent of all withdrawals, and 14 percent of all non-irrigation withdrawals. Thermoelectric power production is the second largest single user of water, accounting for approximately 15 percent of all withdrawals and 32 percent of all non-irrigation withdrawals. Public supply accounts for 13 percent of all withdrawals, and more than 27 percent of all withdrawals, excluding those for irrigation. Industrial use is the final application of water, constituting 7 percent of all withdrawals. Domestic use accounts for 2 percent of total withdrawals. Mining uses less than 1 percent.

Mississippi does allow interbasin transfers. State law requires all surface water users to obtain diversion permits from the Department of Environmental Quality (MDEQ). The basic principles of regulated riparian rights apply in most cases. Surface water returns are regulated through federal National Pollutant Discharge Elimination System (NPDES) program requirements, and the MDEQ maintains state primacy over the program.

State law also requires groundwater users to obtain withdrawal permits from MDEQ for large capacity wells. Returns to groundwater are regulated through various requirements pertaining to the NPDES program. The injection or disposal of any "waste" into the subsurface is typically discouraged by MDEQ and, in many cases, must be justified.

The MDEQ continues to work with the agriculture community to identify and encourage the implementation of effective conservation practices, and the tracking of these practices is being pursued by the Department.

Missouri

Missouri derives more than 80 percent of its water from surface water sources, and thermoelectric power generation is the predominant consumer of water in the state, responsible for approximately 70 percent of all withdrawals. Irrigation is the second largest user of water in the state, making up 16 percent of all withdrawals and more than one-half of all non-thermoelectric withdrawals. Public supply also plays a major role in water consumption. About 10 percent of all withdrawals, and 32 percent of all withdrawals excluding thermoelectric power generation, are attributed to

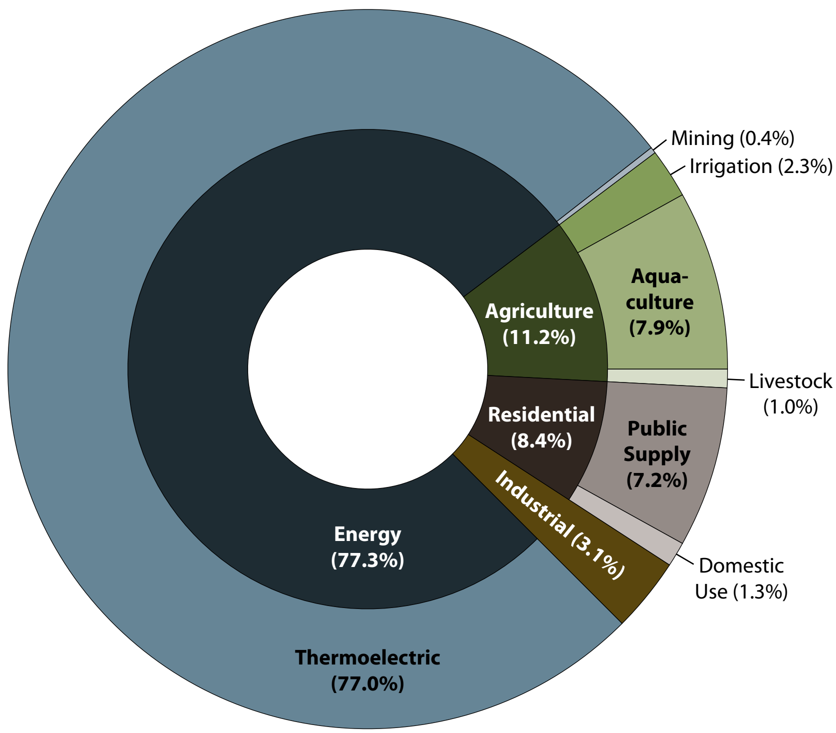
Table 9 Water Withdrawals in North Carolina

Withdrawals by Source (Mgal/d)		Total Withdrawals	Withdrawals by Use (Mgal/d)							
			Energy		Agriculture			Residential		Industrial
Groundwater	Surface Water		Thermo-electric	Mining	Irrigation	Aqua-culture	Livestock	Public Supply	Domestic Use	
700	12,160	12,860	9,900	46	292	1,020	126	921	161	394

public supply of water. Aquaculture plays a small part in the amount of overall water withdrawn in the state, at approximately 2 percent. Industrial use, livestock, domestic use and mining all play minor roles in regard to water consumption in the state, each responsible for 1 percent or less of all water withdrawals.

Missouri does allow interbasin transfers within the state. In recent years, extreme events such as drought and flood began to affect the state's ability to control and monitor water pollution in the state. Since water quality declines during a drought, the concentration of pollutants increases as water evaporates and becomes stagnant. Pollutants accumulate on the land surface and catchment area, often harming vegetation. Also, precipitation following a drought affects water quality by rapidly flushing large loads of pollutants into surface water bodies. Floodwaters often contain biological and chemical contaminants that can enter the water supply if source waters or any part of the water distribution system are flooded. Floodwater also can enter the distribution system if a significant loss of pressure occurs when the service area is flooded. Contaminants can enter the groundwater supply by flooding the wellhead or the immediate area around the wellhead. In addition, it is not uncommon during flood events for raw sewage to affect downstream water quality. The Department of Natural Resources (DNR) is working to address these issues.

Figure 11 Water Withdrawals in North Carolina



Developing energy conservation and efficiency initiatives is a priority for the state. The DNR is taking steps to monitor more thoroughly the irrigation demands, including the installation of 250 well meters in southwest Missouri. Working toward developing a reliable water inventory is a priority to ensure that more comprehensive policy initiatives can be introduced.

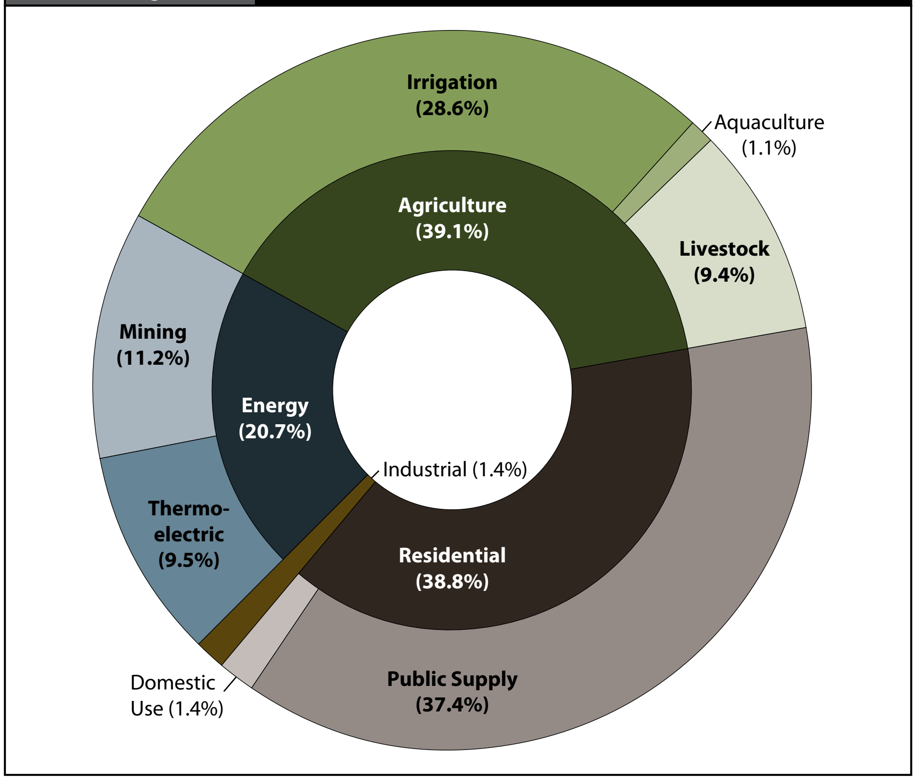
North Carolina

More than 95 percent of North Carolina's water comes from surface water sources. The major use of water in the state is thermoelectric power generation, responsible for more than three-fourths of all withdrawals in the state. Aquaculture and public supply are the next largest uses of water, each responsible for more than 7 percent, and, combined, more than 60 percent of all withdrawals not associated with thermoelectric power generation. Industrial use is responsible for approximately 3 percent of all withdrawals, and about 13 percent of all non-thermoelectric withdrawals. Irrigation is responsible for approximately 2 percent of all withdrawals. Domestic use, livestock and mining each use about 1 percent or less of water in the state.

Table 10 Water Withdrawals in Oklahoma

Withdrawals by Source (Mgal/d)		Total Withdrawals	Withdrawals by Use (Mgal/d)							
			Energy		Agriculture			Residential		Industrial
Groundwater	Surface Water		Thermo-electric	Mining	Irrigation	Aqua-culture	Livestock	Public Supply	Domestic Use	
755	973	1,728	164	193	495	19	162	646	25	24

Figure 12 Water Withdrawals in Oklahoma



The state requires the registration of water withdrawals of 100,000 gallons per day or more for non-agriculture operations and more than 1 Mgal/d or more for agriculture operations. The Water Use Act of 1967 requires all major water users obtain permits for withdrawals of surface water or groundwater in any area of the state designated as a “capacity use area.” Returns to surface waters are governed by the requirements of the federal National Pollutant Discharge Elimination System program. Groundwater withdrawals are not regulated in the state, with the exception of the Central Coastal Plain Capacity Use Area. Also, wastewater not discharged to surface waters is controlled by specific regulations in the state.

North Carolina does allow interbasin transfers. Transfers of 2 Mgal/d or more are only allowed after receiving permission from the Environmental Management Commission. The General Assembly recently established a study commission to investigate how the state manages water allocations.

The Department of Environment and Natural Resources Division of Water Resources has stated that it is important to consider the cumulative impacts of all withdrawals and wastewater return flows within a river basin. A major priority of the state is to discern more diligently how much of the water withdrawn is returned to the surface water system to maintain flows and aquatic habitats and support downstream withdrawers.

Oklahoma

Oklahoma relies on surface water for just over one-half of its water needs. Public supply is the major application of water in the state, responsible for approximately 37 percent of all withdrawals. Irrigation is the second largest use of water, making up 29 percent of all withdrawals and almost half of all withdrawals excluding public supply. Mining, thermoelectric power generation and livestock each are responsible for approximately 10 percent of all water withdrawals and, collectively, almost half of all non-public supply withdrawals in the state. Domestic use, industrial use and aquaculture each account for less than 2 percent.

In Oklahoma, stream water is considered to be publicly owned and subject to appropriation by the Oklahoma Water Resources Board (OWRB), with the exception of the Grand River Basin. Appropriative rights are fundamental to use of stream water in the state. Exceptions are made for domestic uses by the riparian landowner and exempt them from permitting requirements. According to the OWRB, water quality standards are the cor-

Table 11 Water Withdrawals in South Carolina

Withdrawals by Source (Mgal/d): Groundwater	Withdrawals by Source (Mgal/d): Surface Water	Total Withdrawals	Energy: Thermoelectric	Energy: Mining	Agriculture: Irrigation	Agriculture: Aquaculture	Agriculture: Livestock	Residential: Public Supply	Residential: Domestic Use	Industrial
378	7,470	7,848	6,540	9	92	2	12	647	127	419

Withdrawals by Use (Mgal/d)

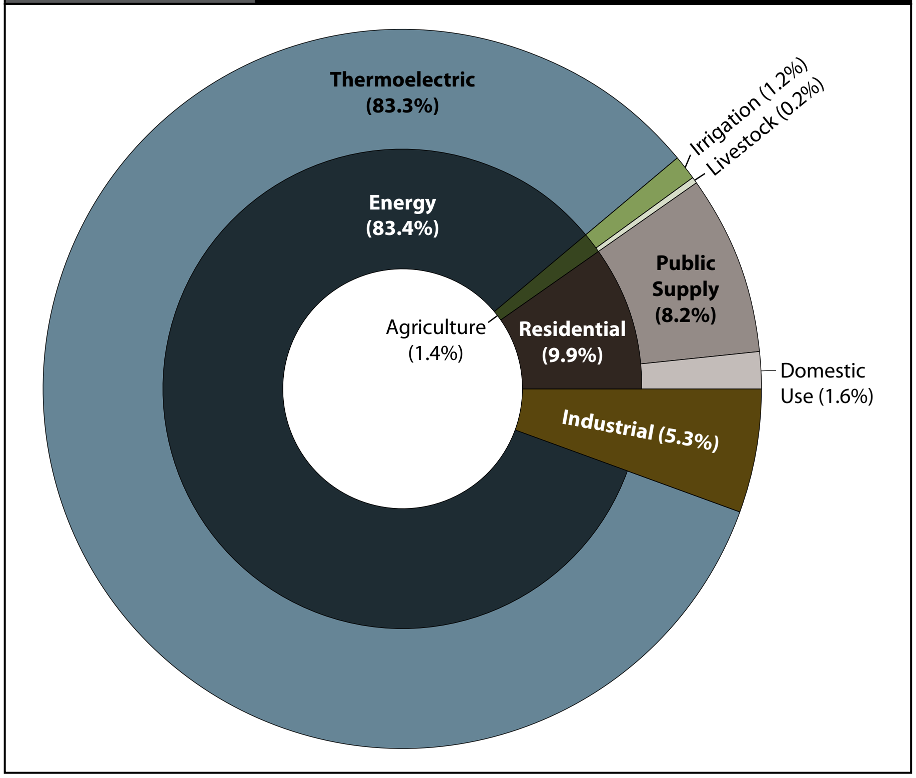
nerstone in developing water quality-based discharge permits which specify treatment levels required of industrial and municipal wastewaters returned to streams.

Groundwater is considered private property that belongs to the overlying surface owner. However, it is subject to reasonable regulation by the OWRB. Each applicant annually is allotted two acre-feet per acre of land in basins where maximum annual yield studies have not yet been completed, and slightly more than that amount in basins where studies have determined how much water may be safely withdrawn. As with stream water, before actual use of the water for any purpose other than domestic use, persons intending to use groundwater must submit a permit application to the OWRB.

According to the OWRB, one of the biggest challenges is funding for conservation and water protection initiatives. Also, there is speculation that the most suitable reservoir sites already have been exhausted, and the potential for expanding future storage is extremely limited. For this and other reasons, competition for available water is quite aggressive.

Oklahoma does permit interbasin transfers. The OWRB mediates conflicts between water rights' holders. Also, policies that improve conservation and efficiency are promoted through education, research and demonstration projects of the OWRB.

Figure 13 Water Withdrawals in South Carolina



South Carolina

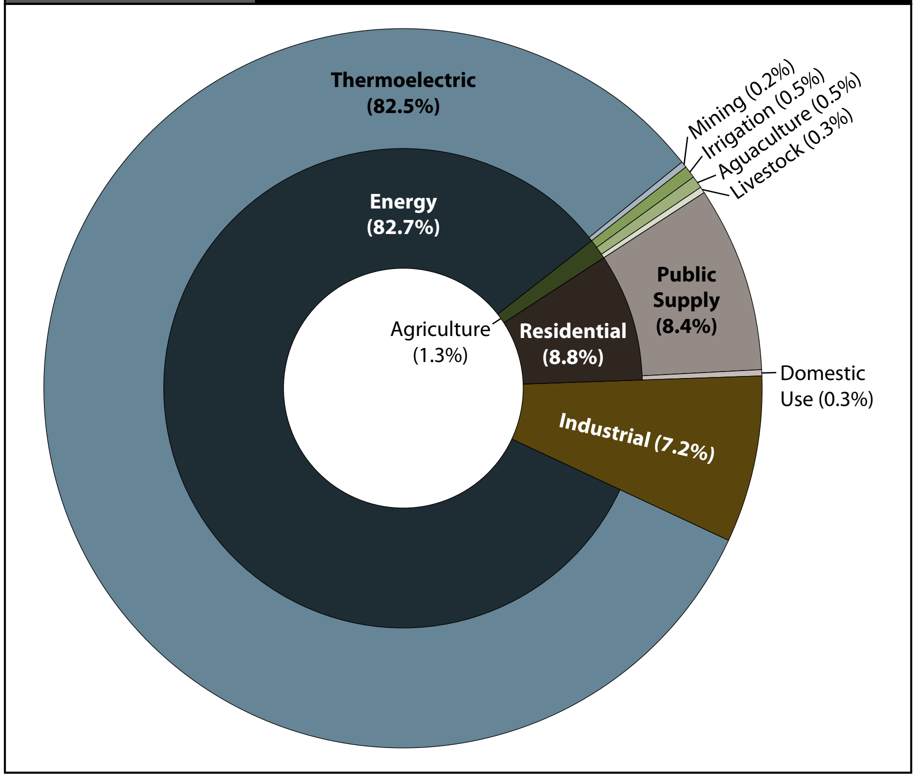
Approximately 95 percent of South Carolina's water is derived from surface water sources. The major user of water in the state is thermoelectric power production, which is responsible for about 83 percent of all withdrawals. Public supply is the second largest consumer of water, comprising approximately 8 percent of all withdrawals and almost half of all non-thermoelectric-related withdrawals. Industrial use comprises 5 percent, and is responsible for almost one-third of all withdrawals not associated with thermoelectric power production. Domestic use accounts for approximately 2 percent of all withdrawals. Irrigation, livestock and agriculture are the smallest users, each contributing about 1 percent or less to overall water withdrawals. Withdrawals for mining are negligible.

According to the South Carolina Department of Health and Environmental Control (DHEC), all withdrawals of more than 3 million gallons per month from surface water and groundwater sources must be registered as a water user and annually report water usage. Additionally, major groundwater withdrawals that are located in desig-

Table 12 Water Withdrawals in Tennessee

Withdrawals by Source (Mgal/d)		Total Withdrawals	Withdrawals by Use (Mgal/d)							
			Energy		Agriculture			Residential		Industrial
Groundwater	Surface Water		Thermoelectric	Mining	Irrigation	Aquaculture	Livestock	Public Supply	Domestic Use	
489	10,348	10,837	8,940	21	55	59	29	914	36	783

Figure 14 Water Withdrawals in Tennessee



nated "capacity use areas" must obtain an additional Groundwater Withdraw Permit. Surface water returns in the state are governed by the federal National Pollutant Discharge Elimination System permitting guidelines. Injections to the subsurface require an Underground Injection Control permit. According to the DHEC, recent droughts have increased the number of applications for groundwater withdrawal permits as users look to develop backup water supplies.

The DHEC has indicated that the state faces a number of obstacles pertaining to water quality and quantity. For example, urban and suburban development is causing water shortages, particularly development in source water protection areas. Such difficulties have far-reaching repercussions; at a plant in Bowater, South Carolina, hundreds of workers lost their jobs because low river flows prevented the plant from discharging its wastewater.

Similar limitations exist for developing new sources of water. According to the DHEC, the most significant changes in the amount of available water in the state are related to droughts. That is, water withdrawals in the state typically have little effect on the available water except during droughts. Also, during severe droughts, wastewater discharge amounts and limits are closely monitored to protect water quality.

The DHEC is working to improve water quality in the state. For instance, users applying for Groundwater Withdraw Permits are required to submit a Best Management Plan to reduce water consumption, which includes irrigation standards. Additionally, the DHEC has outreach efforts to promote water conservation and protection across the state.

South Carolina does permit interbasin transfers. The state limits individual interbasin transfers to 5 percent of the seven-day, 10-year low flow, or 1 million gallons or more of water a day.

Tennessee

Tennessee relies on surface water for more than 95 percent of its water needs. The single largest user of water in the state is thermoelectric power generation, which comprises approximately 83 percent of all withdrawals. Public supply is the second largest user of water in the state, responsible for about 8 percent of all withdrawals. About 7 percent of all withdrawals are attributed to industrial uses. Public supply and industrial use together are responsible for almost 90 percent of all non-thermoelectric withdrawals. Aquaculture, irrigation, domestic use, livestock and mining each are responsible for approximately 1 percent or less.

Good water resource management means more in southern states today than "flood control" of days gone by. In West Tennessee, we're mapping and safeguarding the subterranean aquifers, like the Memphis Sands, which provide drinking water to millions of mid-southerners. We support the Groundwater Institute at the University of Memphis which is dedicated to this cause. But we are also working on improvements to groundwater management by restoring hydrological ecosystems along the Mississippi River and its tributaries. The SLC is well positioned to facilitate similar initiatives by providing resources and forums to coordinate and leverage legislative opportunities among the states.

~ Senator Mark Norris, Tennessee
Chair Elect, Southern Legislative Conference

All major surface water withdrawals are regulated under the Tennessee Aquatic Resource Alteration Permit process, and all surface water returns are subject to the federal National Pollutant Discharge Elimination System process. Groundwater withdrawals are regulated under the Aquatic Resource Alteration Permit Process, and returns are subject to the Underground Injection Control Regulations.

The state does allow interbasin transfers, provided certain fees and other conditions are met. Generally, allocation issues are left up to the local water utility. In most cases, these entities limit certain practices during times of water shortage, such as lawn irrigation, car washing and any uses identified as non-essential.

According to the Tennessee Department of Environment and Conservation's Division of Water Supply, the state is focusing a great deal of attention on maintenance of in-stream flows for protection of biota. Waste assimilation within watersheds also is an important area of concern in the state. Finally, the Division has stated that a major obstacle for the state in regard to developing new water source is balancing the competing interests of stakeholders and environmentalists for development, dams, biota protection, energy conservation, and other issues.

Memphis, along with several nearby municipalities, recently adopted an increased storm water fee based on the amount of water running off a property. Revenue from the fees will be used to help repair the city's 140-year-old sewer system, which delivers approximately 150 million gallons of wastewater every day for treatment. In September 2009, the federal Environmental Protection Agency, which has recently intensified enforcement of the Clean Water Act across the country, along with the state of Tennessee, filed a lawsuit accusing the city of violating federal and state clean water laws. City officials had stated that they would take steps to update the sewer system, including initiating stronger cleaning procedures, expanding public education programs, increasing industrial discharge surveillance, expanding maintenance efforts and broadening plant treatment activities. Such initiatives are very costly and could further exacerbate economic strains already afflicting the city.

Texas

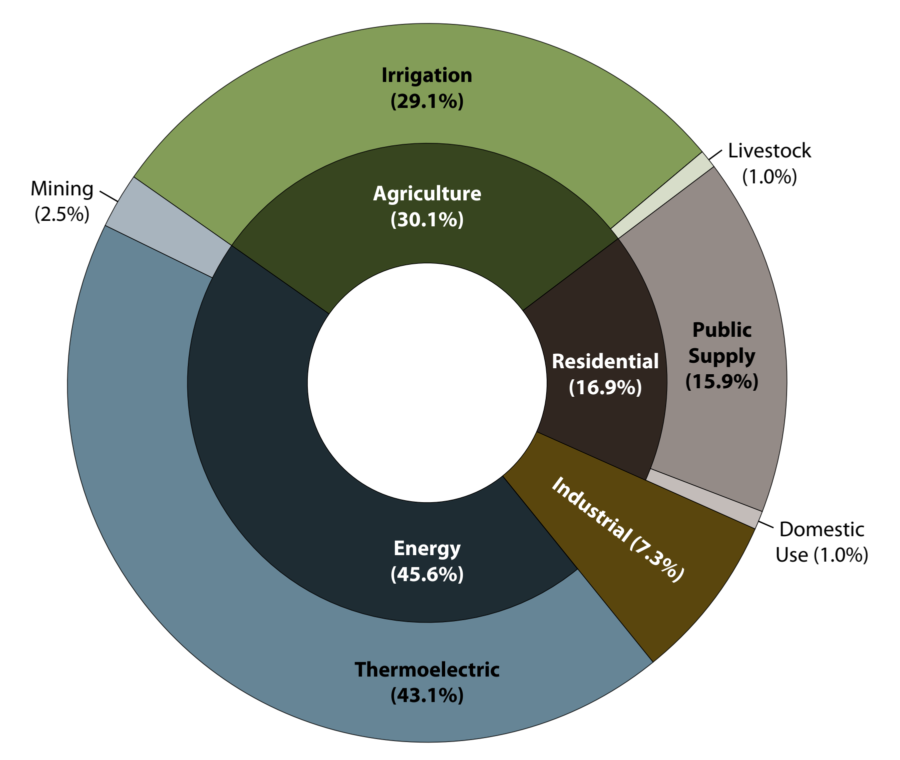
Texas relies on surface water for approximately 68 percent of its water needs. The single largest user of water in the state is thermoelectric power generation, which comprises approximately 43 percent of all withdrawals. Irrigation is the second largest user of water, responsible for about 29 percent and more than half of all withdrawals not associated with thermoelectric power generation. Public supply is responsible for about 16 percent of all withdrawals, and more than one-fourth of all non-thermoelectric withdrawals. Industrial use comprises about 7 percent and 13 percent of all withdrawals excluding thermoelectric uses. Uses associated with mining make up less than 3 percent, and livestock and domestic use each are responsible for 1 percent or less. Withdrawals for aquaculture are negligible.

In 1997, in response to recent droughts, the 75th Legislature passed a bill to address water management and planning. This measure put in place a regional approach to water planning, in which 16 districts were created across the state based on water resources, river basins, economic growth centers and other factors unique to the areas. In each region, a Regional Water Planning Group (RWPG) was established to identify available water supplies and projected demands for the next 50 years. The RWPG also identifies water management strategies for all water-using entities with projected

Table 13 Water Withdrawals in Texas

Withdrawals by Source (Mgal/d)		Total Withdrawals	Withdrawals by Use (Mgal/d)							
			Energy		Agriculture			Residential		Industrial
Groundwater	Surface Water		Thermoelectric	Mining	Irrigation	Aquaculture	Livestock	Public Supply	Domestic Use	
8,570	18,210	26,780	11,540	675	7,800	14	258	4,270	257	1,966

Figure 15 Water Withdrawals in Texas



shortages in the region. In addition, RWPG conducts studies and surveys to estimate water uses and needs for the region.

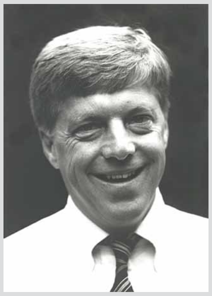
In Texas, a water district is "a local, governmental entity that provides limited services to its customers and residents, depending on the district type."[7] The Commission on Environmental Quality (TCEQ), along with the county commissioner's court, can create water districts. The TCEQ does not control a district's daily operations, but TCEQ staff helps district board members and their consultants understand the complex and varied laws and regulations under which a district must operate. There are four common types of water districts in the state: Municipal Utility Districts (MUD), Water Control and Improvement Districts (WCID), Special Utility Districts (SUD), and River Authorities.

A MUD engages in the supply of water for conservation; irrigation; drainage; fire fighting; solid waste and garbage collection; disposal, including recycling activities; wastewater and sewage treatment; and recreational facilities. A WCID has broader authority, organizing the supply and storage of water for domestic, commercial and industrial use, as well as operating sanitary wastewater systems. It also provides irrigation, drainage, and water quality services. The SUD provides water, wastewater, and firefighting services, but cannot levy taxes. River Authorities are "special law" districts that operate major reservoirs and sell untreated water on a wholesale basis. The Authorities often have responsibilities associated with flood control, soil conservation, and protecting water quality.

Many River Authorities also generate hydroelectric power, provide retail water and wastewater services and develop recreational facilities. Most River Authorities have no authority to levy taxes, but can issue revenue bonds based on the projected revenues from the sale of water or electric power. River Authorities often encompass entire river basins, reaching many counties.

State law gives water districts the power to establish the authority, rights and duties necessary to accomplish the specific purposes for which they are created. The powers of districts created under general law are determined by the type of district. A special law district's powers are determined by its enabling legislation. Most districts have the following powers:

» Incurring debt – Districts can issue bonds and other forms of debt; must be approved by district voters; and the TCEQ must approve most district bonds.



"In the Southern region of the United States, there generally are more than ample freshwater resources to meet the needs of residents and businesses. The major issue is providing adequate storage of water for dissemination to users through proper management of reservoirs and other storage facilities. Water management must include long-range planning for future needs as population growth dictates, and effective management of resources is not possible without the legislative will to create and enforce reasonable permitting schemes and to bring new reservoirs and storage facilities online."

~ Senator Frank Wagner, Virginia
SLC Energy and Environment Committee

» Levying taxes – Not all districts have the power to levy taxes. For example, most River Authorities cannot do so. On the other hand, water districts may ask voters to authorize unlimited tax bonds. After these bonds are issued, the district's board of directors must levy an annual property tax sufficient to cover the district's outstanding debt.

» Charging for services and adopting rules – Water districts may adopt rules to govern their methods, terms and conditions of service. Persons who violate a district's rules can be subject to penalties. Water districts may employ peace officers with the authority to arrest individuals whose actions violate district rules on land owned or controlled by the district. These peace officers also can make arrests to prevent violations of state laws.

» Entering contracts – Water districts may contract for goods and services.

» Obtaining easements – Water districts can obtain and use easements to access land owned by another person in order to install, repair and maintain water transportation systems.

» Condemning property – Most districts have the right to eminent domain, which grants them the power to condemn any land, easement, or other property inside or outside the district's boundaries when the district needs that property for any district project or purpose, such as a water, sewer storm drainage, flood drainage, or flood control project.

Water district directors are responsible for the general business of the district. They administer and control the financial management, employment and purchasing needs of the district. Directors establish policies to manage this process. Voters in the water district elect permanent directors. Some special law districts are governed by a board of directors appointed by a city or other governmental agencies. For example, a River Authority's director may be appointed by the governor, the Texas Water Development Board (TWDB), or the cities that purchase water from the River Authority. Directors of general law districts must meet the qualifications for serving as stated in the Water Code. Although directors of general law districts do not receive a salary, they can choose to be paid a per diem or receive "fees of office" for conducting the affairs of the district. District directors may receive $150 for each day engaged in work for the district. Compensation levels for directors of special law districts usually are established by each district's enabling legislation. Texas law does not provide for the recall of district directors.

The TCEQ only has authority over the allocation and permitting of surface water, not groundwater. The TWDB reports over both surface water and groundwater sources. The TCEQ has stated that major obstacles for Texas, pertaining to water quality and quantity, include a rapidly growing population and increasing demand for clean water. Climactic influences, such as drought, only exacerbate these difficulties.

Texas does allow interbasin transfers. Currently, the TCEQ collects data from 2,050 routine water quality monitoring sites. The methods that TCEQ uses to control water pollution are determined by the amount of water available at these monitoring sites, rather than levels of contamination.

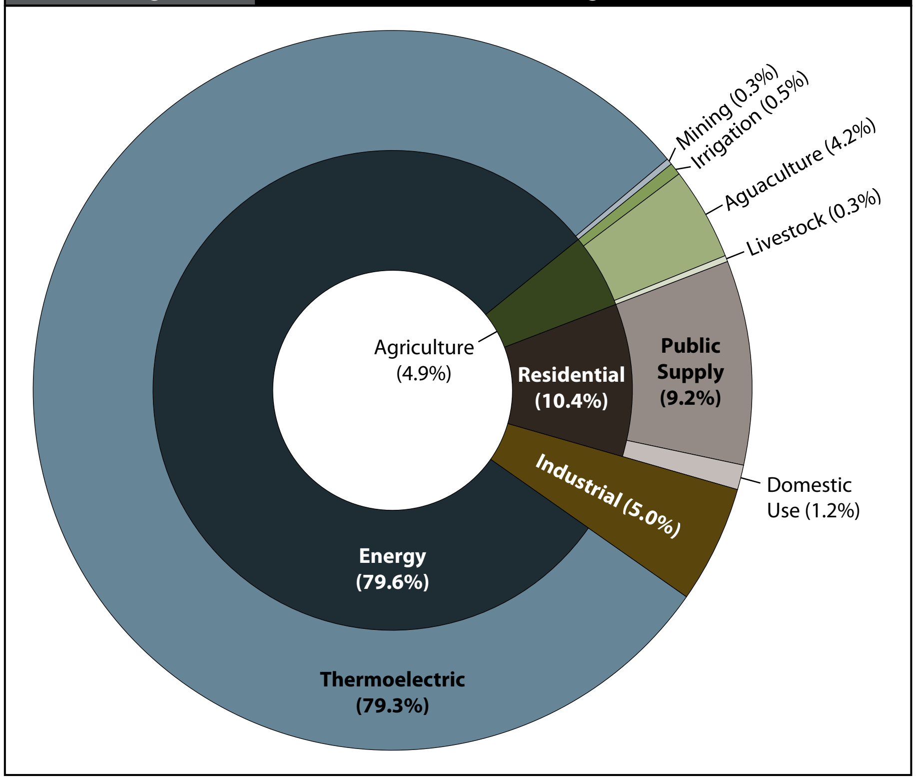
On a statewide basis, Texas Water Allocation Assessments predict the need for over $17 billion in improvements in order to meet the projected demands by 2050. For many entities these improvements cannot be completed without outside assistance, and present local and state resources may not be sufficient. In response, the Texas Congressional Delegation has requested a study on the potential for federal regulatory assistance in Texas.

In fiscal year 2001, initial funds were appropriated by the U.S. Congress for

Table 14 Water Withdrawals in Virginia

Withdrawals by Source (Mgal/d)		Total Withdrawals	Withdrawals by Use (Mgal/d)								
			Energy		Agriculture			Residential		Industrial
Groundwater	Surface Water		Thermoelectric	Mining	Irrigation	Aquaculture	Livestock	Public Supply	Domestic Use	
349	10,277	10,626	8,430	30	48	444	30	982	126	536

Figure 16 Water Withdrawals in Virginia



the U.S. Corps of Engineers to assist the state in determining if existing water could be better allocated to support more balanced water use and to meet future needs. This evaluation was designated as the Texas Water Allocation Assessment, and a wide array of studies have been initiated under this authority.

Conservation is an important part of TCEQ's policies. For instance, the TCEQ requires irrigators to have specific, quantitative goals for water use improvements. In addition, the Texas Department of Agriculture has programs for on-farm irrigation assistance. The Texas Water Conservation Advisory Council recently was formed to focus on improving efficiency in all areas of water use. The Texas Water Resources Institute, a research and educational outreach program at Texas A&M University, provides leadership to stimulate priority research and educational programs in water resource development throughout the state. There also are numerous public organizations that work in various capacities with state offices to assist with ongoing irrigation efficiency issues.

The Legislature recently enacted legislation that allows the TCEQ to include specified stream flow restrictions in surface water use permits for the protection of in-stream uses, bays and estuaries. The Environmental Flows Science Advisory Committee was created to advise the TCEQ in creating the rules for these restrictions.

Virginia

Virginia receives approximately 97 percent of its water from surface water sources. The largest user of water in the commonwealth is thermoelectric power generation, comprising about 79 percent of all water withdrawals. Public supply is the second largest, making up 9 percent of all withdrawals and about 45 percent of all withdrawals except those for thermoelectric power generation. Industrial use accounts for about 5 percent of all withdrawals and 25 percent of all non-thermoelectric withdrawals. Aquaculture uses slightly less, accounting for approximately 4 percent and 20 percent of all non-thermoelectric withdrawals. Domestic use, irrigation, mining and livestock each account for approximately 1 percent or less.

According to the Virginia Association of Soil and Water, the commonwealth employs the use "conservation districts." More than 50 years ago, the General Assembly recognized the need to support grassroots conservation efforts. The Soil and Water Conservation Districts Law was passed authorizing the creation of these entities. Today, there is a conservation district established in every county, with the exception of Arlington. These districts are political subdivisions that utilize the resources of the commonwealth, federal government and private sector to solve water distribution problems. The governing philosophy of all districts suggests that decisions on conservation issues should be made at the local level, by local people, with technical assistance provided by the government. Each conservation district is led by a board of directors made up of local residents. Created to serve as stewards of natural resources, these directors approach conservation and protection with a focus on the ecosystem of the region, and a vision of helping all citizens of their district to have productive communities in harmony with the environment. There are 330 conservation district directors and more than 150 full- and part-time employees.

The commonwealth does permit interbasin transfers, but not as a specific activity. The transfers are evaluated like any other consumptive water withdrawal. Surface water withdrawals are governed by the Water Protection Permit and the Virginia Water Protection Permit Regulation. For returns to surface water, the commonwealth implements the Virginia Discharge Elimination System Regulation. The Groundwater Act of 1992 governs groundwater withdrawals and returns. Proposed withdrawals are evaluated by a regional groundwater flow model. For groundwater returns, the commonwealth uses the federal Underground Injection Control Regulation and commonwealth Groundwater Anti-degradation Standards.

According to the Department of Environmental Quality, water richness has made it difficult to convey the seriousness of water availability limitations. Widespread use of water as a local revenue source has created the view of water as a commodity which complicates resource management. For instance, stringent allocation limitations exist for groundwater in the coastal plain. This limited availability of suitable sites within the coastal plain and in other areas with increased shortages is of particular concern. There also has been a push in recent years by urban jurisdictions looking for rural host localities for building reservoirs. Also, according the Department, the perception of prohibitive costs and permitting for brine disposal has limited further investigation into the feasibility of seawater or brackish water desalination plants.

Recent droughts have resulted in legislative activity that created the new comprehensive Local and Regional Water Supply Planning Regulation, which requires development of water demand management that focuses on local implementation of long-term efficiency and conservation strategies. Most major water users also are required to have short-term drought response plans that contain conservation measures. In addition, the commonwealth has made changes to the Virginia Water Protection Permit Regulation and developed a Water Reuse Regulation program. A Decision Support System to evaluate cumulative impacts to beneficial use flows from all surface water withdrawals, including those that are grandfathered in, also has been created.

Information obtained from the Local and Regional Water Supply Planning Regulation and similar programs will be compiled for the first commonwealth-wide, locally derived estimate of water demand for the next 30 years. This information will be combined with the Decision Support System to determine where there are conflicts among localities for the same water resource and anticipate problems with these resources. The Department expects some areas to have allocation issues that will need to be addressed through the legislative process.

The Department of Environmental Quality has used the federal EPA WaterSense Program as a means of providing information on actions that can be taken locally to address irrigation efficiency. The Department currently is collaborating with local Farm Bureau Boards of Directors, Golf Course Superintendents Organization, and other similar organizations in these efforts.

West Virginia

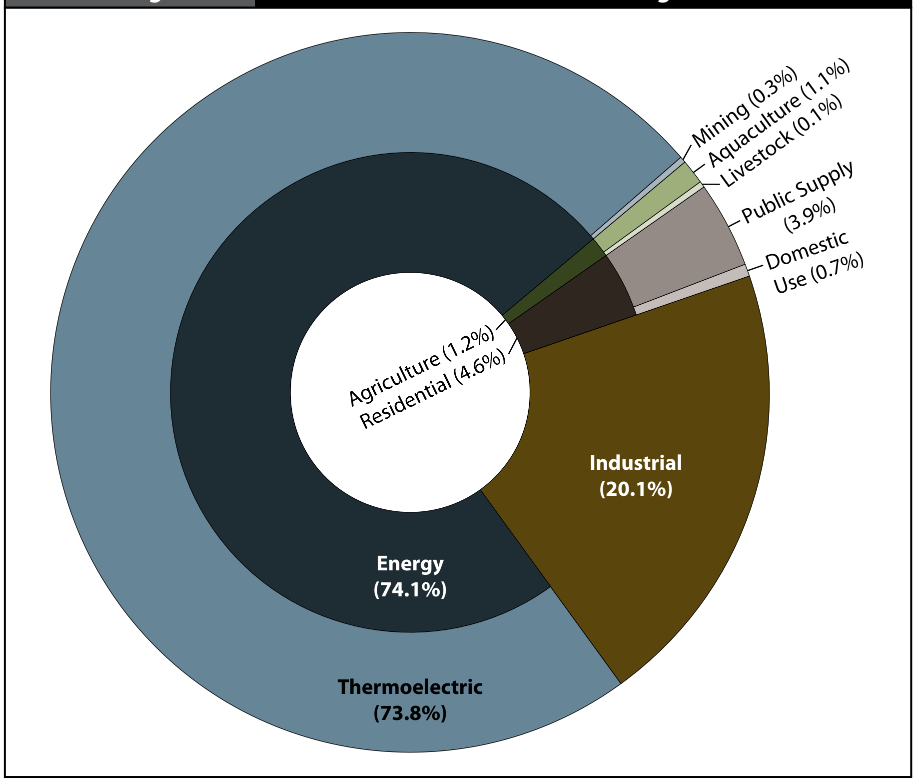
West Virginia relies on surface water for approximately 97 percent of its water needs. Thermoelectric power production accounts for almost three-fourths of all water withdrawals in the state. Industrial use is the second largest consumer of water, comprising approximately 20 percent of all withdrawals and more than three-fourths of all non-thermoelectric water use in the state. Public supply accounts for 4 percent of all withdrawals and approximately 15 percent of all withdrawals, except those associated with thermoelectric power production. Aquaculture, domestic use, mining and livestock each account for approximately 1 percent or less of all withdrawals in the state. Withdrawals for irrigation are negligible.

In 2004, West Virginia became the final SLC state to enact statutory water allocation laws. Two factors prompted this move: a desire to drive economic development and concerns that, with continued rapid growth in the D.C. suburbs, residents of West Virginia's panhandle—a rapidly growing area that sends increasing numbers of commuters to D.C. each year—might face reduced flows on the Potomac River as demand increases. Economic development also was a factor. If the state

Table 15 Water Withdrawals in West Virginia

Withdrawals by Source (Mgal/d)		Total Withdrawals	Withdrawals by Use (Mgal/d)							
			Energy		Agriculture			Residential		Industrial
Groundwater	Surface Water		Thermoelectric	Mining	Irrigation	Aquaculture	Livestock	Public Supply	Domestic Use	
141	4,670	4,811	3,550	15	1	52	5	189	33	966

Figure 17 Water Withdrawals in West Virginia



could not ensure sufficient supplies to businesses that relied on the resource, those companies might locate to areas with better water management. The Legislature passed a bill that moved the state beyond a system where water rights previously were determined in courts with few guiding principles. Further, the legislation requires the Department of Environmental Protection to survey surface water and groundwater withdrawals in the state and directs every person who uses more than 750,000 gallons per month to register with the Department. Also, the Department must make recommendations to the Legislature regarding water use management in areas that are currently facing shortfalls or are in danger of experiencing future shortages.

There currently are no existing policies governing withdrawals or returns to surface water in the state. However, permits must be obtained if a permanent structure is to be placed in a stream and also for any discharges, based on National Pollutant Discharge Elimination System guidelines. There are no existing policies governing withdrawals from groundwater, but permits must be obtained to drill wells. Returns to groundwater are governed by the federal Underground Injection Control program.

The Department of Environmental Protection is not involved with developing new sources of water. West Virginia usually has an abundance of water with control structures, such as dams, built for flood control or maintenance of navigable channels, which may be secondary sources of water supply. Water supplies generally are developed and maintained at the county level or by private industry.

Conclusion: A Case for Efficiency and Conservation

Water, both as a resource and a commodity, is a pivotal variable in the equation relating to the future health and vitality of the United States. Americans are accustomed to turning a faucet to access, what is assumed to be, limitless amounts of fresh, clean water for less money than is used to heat a home or fill a vehicle with gasoline. The average individual needs approximately 13 gallons of water per day for drinking, basic cooking and sanitation purposes. The average North American uses almost 160 gallons every day.[1] Due to increased consumption, along with pollution, diversion and depletion of the region's finite water supply, the South is running out of freshwater sources.

Pollution threatens the existing accessible water sources in the United States, has a serious impact on all living creatures and can negatively affect the water used for drinking, household needs, recreation, transportation and commerce. In addition, other environmental hazards, from threats to endangered species, to disruptions of ecosystems, to soil damage and other agricultural problems associated with drought, will continue to plague the region. The threats that water scarcity pose to the region's businesses, communities, cities and states, not to mention the health and wellbeing of its citizens, are mounting daily.

In addition, massive urbanization and deforestation have contributed greatly to the increased scarcity of freshwater resources throughout the region. When water is prevented from returning to fields, meadows and wetlands, there is less water in the soil and local water systems and, therefore, less water evaporating from the land. While urbanization is inseparable from economic development, and population growth perhaps the greatest cause of increased water demand, continued development of new conservation methods for "greener" buildings and better use of urban landscapes should be supported.

Also, as the United States becomes increasingly reliant on technology, it will need more energy to meet the demands of daily life. As populations in Southern states continue to grow, demand for water will increase as well. As fiscal conditions improve and economic development accelerates, states likely will be vying to attract more businesses, which will in turn increase water needs. Since there is only a finite amount of freshwater supply available, states must find new ways to access or extract it, as well as

Table 16 Water Withdrawals in SLC States

	Withdrawals by Source (Mgal/d)		Total Withdrawals	Withdrawals by Use (Mgal/d)							
				Energy		Agriculture			Residential		Industrial
State	Ground Water	Surface Water		Thermoelectric	Mining	Irrigation	Aquaculture	Livestock	Public Supply	Domestic Use	
Alabama	490	9,466	9,956	8,271	28	161	75	29	802	40	550
Arkansas	7,510	3,920	11,430	2,000	2	8,530	256	40	404	19	179
Florida	4,203	14,120	18,323	12,058	195	3,070	9	17	2,540	190	244
Georgia	1,160	4,280	5,440	2,717	49	752	38	29	1,180	120	555
Kentucky	157	4,170	4,327	3,430	36	18	20	45	558	34	186
Louisiana	1,780	9,820	11,600	6,280	177	992	271	7	719	44	3,110
Mississippi	2,190	736	2,926	437	11	1,560	279	18	368	56	197
Missouri	1,745	7,045	8,790	6,180	35	1,370	156	77	831	60	81
North Carolina	700	12,160	12,860	9,900	46	292	1,020	126	921	161	394
Oklahoma	755	973	1,728	164	193	495	19	162	646	25	24
South Carolina	378	7,470	7,848	6,540	9	92	2	12	647	127	419
Tennessee	489	10,348	10,837	8,940	21	55	59	29	914	36	783
Texas	8,570	18,210	26,780	11,540	675	7,800	14	258	4,270	257	1,966
Virginia	349	10,277	10,626	8,430	30	48	444	30	982	126	536
West Virginia	141	4,670	4,811	3,550	15	1	52	5	189	33	966
Total	30,617	117,665	148,282	90,437	1,522	25,236	2,714	884	15,971	1,328	10,190

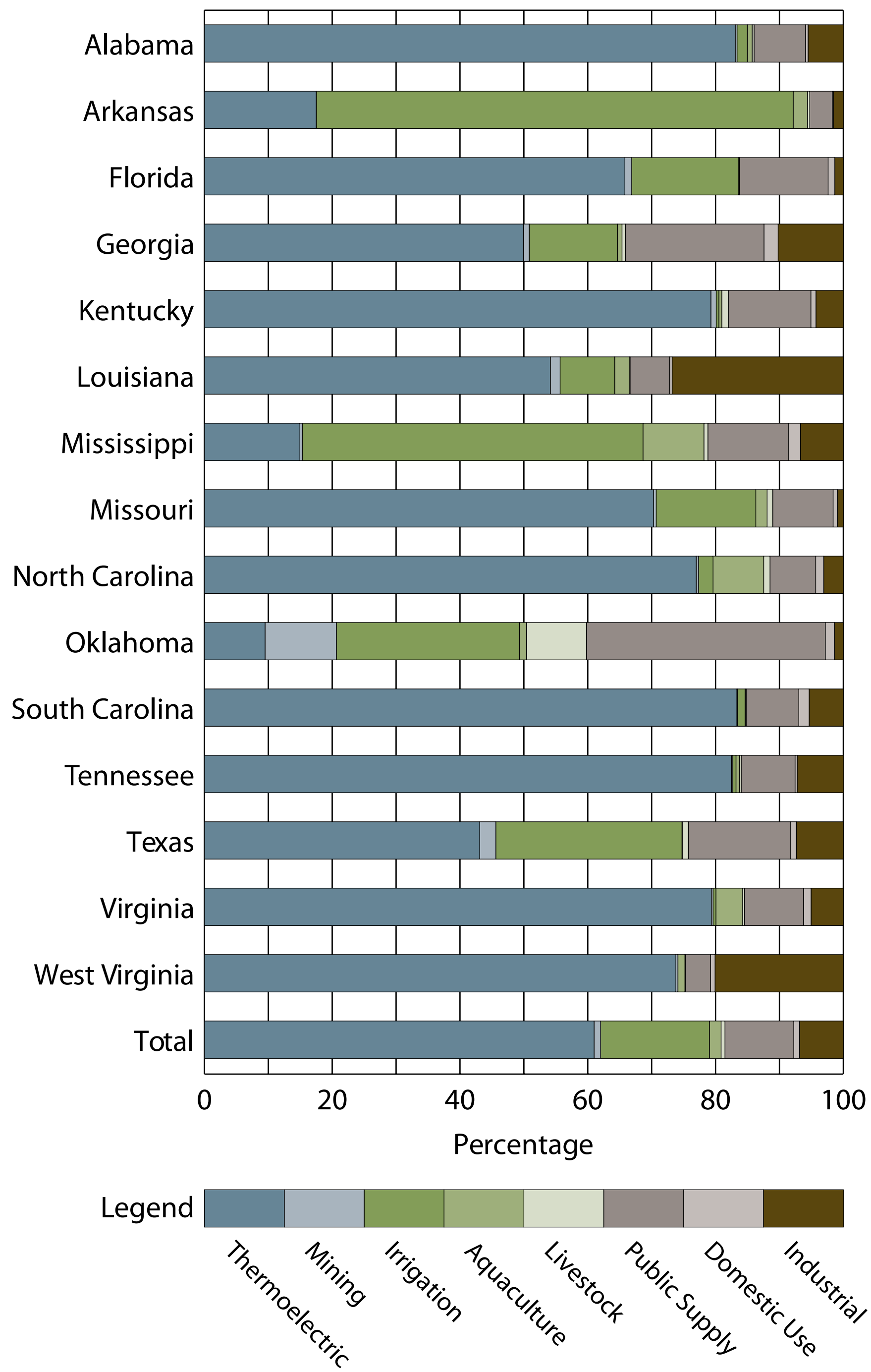
more efficient ways of using and sharing current allocations.

Additionally, rising seas and coastal erosion will continue to play a significant role in the South's water problems. Laws that protect wetlands will allow them to more effectively filter and purify dirt and toxins before these contaminants reach the region's rivers, lakes and aquifers. Stricter regulations on industrial farms and large livestock operations, particularly those addressing the use of high-potency herbicides, are more prevalent in the equation.

Water is inextricably linked to energy production, since energy production requires water and since the diversion, transportation and cleansing of water requires energy. Water also is important to the energy industry not merely for production purposes, but for mining, refining, processing, and transporting of oil, natural gas, coal, and other fuels as well. This is where conservation can be particularly effective; minimizing the use of electricity conserves water. Programs and policies that encourage more efficient use of energy will inevitably have a significant impact on water use in the region. While ethanol production is an important component of energy security in the United States, and particularly for the agricultural South, the industry's impact on water sources must be evaluated as well.

Although bottled water consumption is only a small fraction of overall water usage, it does pose some serious problems, namely the amount of energy and water it requires to manufacture, distribute and dispose of bottles. Programs that recycle or convert scrap bottles can help curb this growing concern, and policies that encourage the use and availability of water fountains and tap water are gaining attention in states around the region. Also, educational programs that relay information about the safety of local

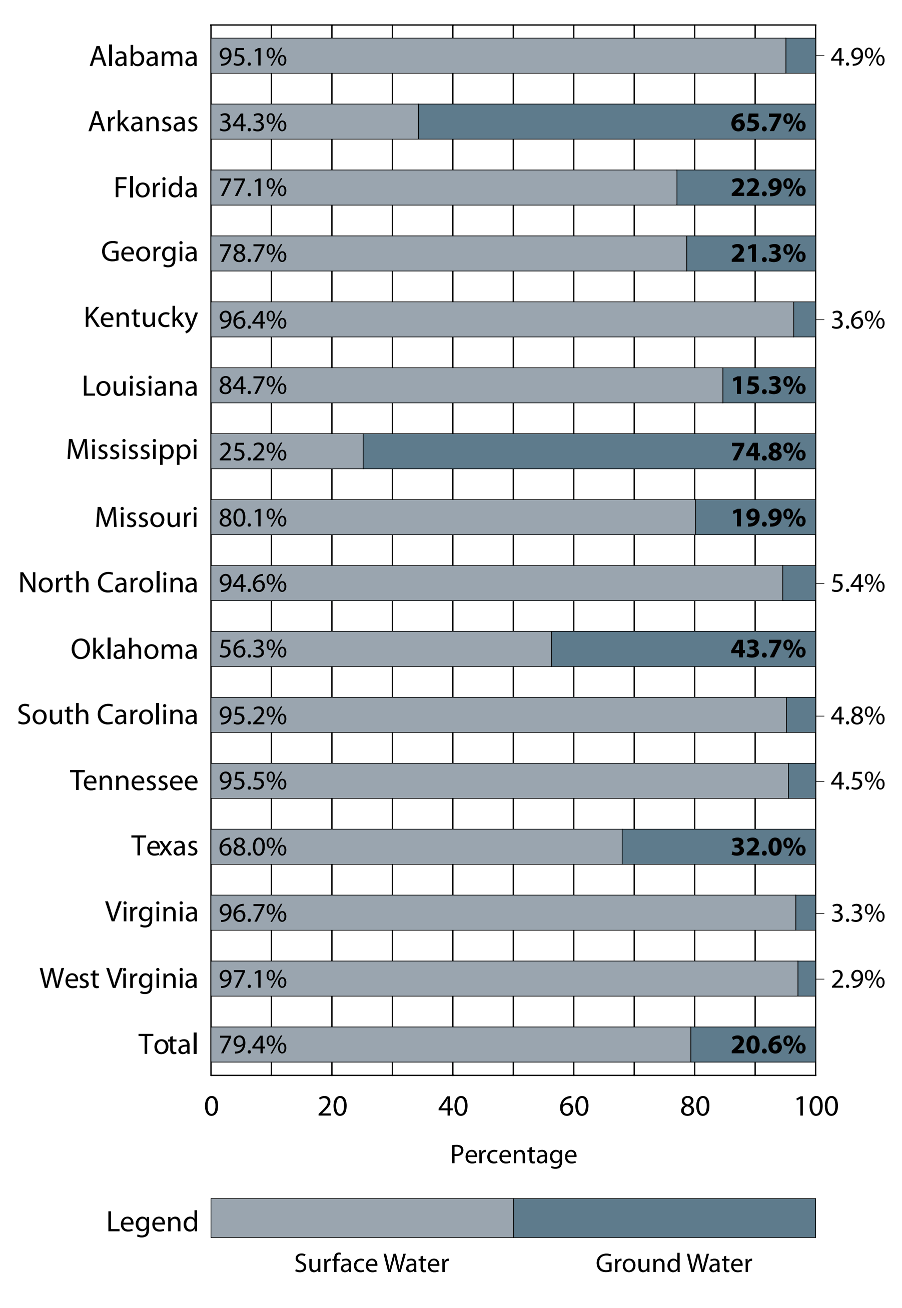
Figure 18 Water Withdrawals by Use in SLC States



tap water, verses that of bottle water, can aid in this regard.

Although these problems are formidable, there are a variety of ways states can address them. For instance, interbasin transfer laws should take into account the continued ability of the basin of origin to effectively support businesses and industries, tourism and outdoor recreation, as well as maintain the regions public health and ecology. Protections for the basin of origin can take several forms: limitations on interbasin water transfers; financial compensation; return of transferred water; and means to legal action for harm caused by transfers.

Figure 19 Water Withdrawals by Source in SLC States



Limitations or prohibitions against transfers can be based on clearly defined conditions, such as distance limitations; restrictions on basins of origin that do not meet Clean Water Act TMDL standards; or during periods of drought. Also, limitations can be placed on the cumulative amounts of interbasin transfers that occur at any given time.

Financial compensation to the basin of origin for the loss of water also may serve as a protection. Several compensation strategies exist, including payment to a designated authority and reimbursement of all costs associated with loss of water, such as new programs necessary to meet TMDL standards. Another method is to base compensation on the share of the economic gain provided to the receiving area as a result of the interbasin transfer. A provision that requires all non-consumed water be returned to the basin of origin, if such a return is reasonable and practical, is another method of transfer protection. Finally, providing a legal option for basins of origin to seek compensation is an option, which simply allows private cause of action for riparians in donor basins, thereby letting the judicial system remediate the compensation owed to the basin or origin.[2]

Since water is a finite resource, states must develop new, innovative ways of using what is available. This is no easy task, but there are a few basic steps states can take.

» Develop a comprehensive state water management plan is imperative for proper and fair water distribution and interbasin transfers.

» Examine what conservation methods are not being employed in water districts and encourage the implementation of such.

» Encourage the development of new technologies, such as those pertaining to desalination and efficiencies pertaining to reservoirs, for producing and supplying more water.

In addition to regulating how water resources are distributed and used, states and municipalities can optimize existing water resources by encouraging conservation. Targeting wasteful practices and providing incentives for conservation can achieve great strides toward making the most of what is available to a state or region. This can be accomplished using price signals and market forces. Generally, doing so would encourage users to reassess their behaviors and decide on a level of consumption for themselves based on the value of specific amounts of water and their intended purpose.[3]

A case in point: some studies state that Metropolitan Atlanta could save from $300 million to $700 million annually simply by implementing such conservation measures as offering rebates on low-flow fixtures for businesses and homes, increasing funding to repair leaky pipes (Atlanta loses approximately 20 percent of its daily water consumption to leakage.), and encouraging better practices regarding landscaping. Such practices could result in water savings of approximately 130 million to 210 million gallons a day, which is roughly what Metropolitan Atlanta withdraws daily from Lake Lanier. Moreover, the Georgia Environmental Facilities Authority estimates that if just 25 percent of Georgia households replaced existing toilets and water faucets with low-flow fixtures, it could save the state nearly 10 billion gallons of water per year. It also has been estimated that conservation initiatives can be 27 times cheaper than building new reservoirs.

Water scarcity poses serious health and environmental threats to people throughout the region. It is important to recognize that water scarcity is a national problem and not isolated to one state, group of states, or region. However, as a region, states can work together to address the water needs of their neighbors and develop programs that will allow them to affectively share and distribute water resources that will meet their energy, residential, agricultural, industrial and economic demands.

List of Tables and Figures

Acknowledgements

For a number of years the Energy and Environment Committee of the Southern Legislative Conference (SLC), currently chaired by Representative Rocky Adkins, Kentucky, has been examining Southern states' policies regarding water allocation and withdrawals. This Regional Resource investigates the continuing trends that have played a role in the South's numerous water crises and explores ways in which states can better develop policies regarding withdrawal, regulation, diversion, and conservation of water resources.

The Committee extends a special thanks to officials in the state departments of environmental quality and natural resources and other participants who contributed information for this report.

This report was prepared by Jeremy Williams, policy analyst for the Southern Legislative Conference of The Council of State Governments, under the chairmanship of Speaker Bobby Harrell, South Carolina.

Survey Questionnaire for the Southern Legislative Conference Report
"Water Allocation in Southern States"

Name:
Title:
Agency Name:
Address:
State:
Phone #:
Email:

1. What percentage of water withdrawals in your state comes from surface water sources? What percentage comes from groundwater sources?
2. What percentage of the water withdrawals in your state is attributable to the following:
   c) Irrigation, livestock and agricultural needs?
   d) Thermoelectric power?
   e) Residential, commercial, and industrial entities?
   f) Other sources (e.g. aquaculture and mining)?
7. What policies govern withdrawals from and returns to surface water in your state?
8. What policies govern withdrawals from and returns to groundwater in your state?
9. What are your office's major obstacles associated with developing new water sources?
10. Does your state permit interbasin transfers?
11. In what ways, if any, have recent droughts affected your office's policies regarding water allocation?
12. In what ways, if any, have changes in the amount of available water in your state affected the ability to monitor and control water pollution?
13. What policies, if any, exist in your state to encourage irrigation efficiency and conservation?
14. Please provide any other information you consider relevant and important in examining the responsibilities associated with water allocation in your state.

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