ASDWA

Association of State Drinking Water Administrators

National Analysis of State Drinking Water Programs in the Areas of Water Availability, Variability, and Sustainability (WAVS)

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"Safe drinking water is essential to sustain public health and the economy."

INTRODUCTION

ABOUT ASDWA

The Association of State Drinking Water Administrators (ASDWA) is the professional Association serving state drinking water programs. ASDWA's members are the drinking water program administrators in each of the 50 states, territories, the Navajo Nation, and the District of Columbia. ASDWA supports its members in their efforts to protect public health through the provision of drinking water.

ASDWA WATER AVILABILITY, VARIABILITY, AND SUSTAINABILITY (WAVS) PROJECT

ASDWA began the WAVS Project to help ASDWA members address short and long-term drinking water sustainability and public health issues associated with extreme meteorological events -- exacerbated by the effects of climate change -- such as prolonged droughts and flooding of increasing frequency and intensity. There is a growing need to address these issues as all of the states and territories seek to prepare for and mitigate the impacts of these events through multiple planning and coordination efforts with all levels of government, the private sector, and the general public.

This White Paper was developed with the assistance of ASDWA's WAVS Workgroup. The WAVS Workgroup is comprised of representatives from 11 states (WA, MI, LA, UT, GA, CA, CT, NY, ID, ME, and VA) and representatives of EPA's Office of Ground Water and Drinking Water. To begin this effort, ASDWA surveyed its members to determine what state drinking water programs are doing in this area and what tools/information they need to enhance their efforts. The survey included questions about legal/regulatory frameworks, statewide water use and withdrawals, state water conservation strategies and policies, and ASDWA member priorities and needs. The workgroup used the survey results to develop this White Paper. ASDWA and state drinking water programs will use this White Paper to help direct coordination efforts with other state and Federal agencies, water utilities, local government entities, and other stakeholders.

RESULTS OF ASDWA WAVS SURVEY OF STATE DRINKING WATER PROGRAMS

ASDWA conducted the survey between February and April 2008. A total of 38 states and two territories (Guam and American Samoa) completed (either partially or fully) the WAVS Survey. In some cases, the state drinking water program forwarded the survey to their state water resources agency to respond on its behalf. The results of the survey are included in the charts and graphs throughout this White Paper.

PURPOSE OF WHITE PAPER

The purpose of this document is severalfold: It explains the various roles that state drinking water programs have, will have, and can play in water quantity and conservation issues. This document also examines the regulatory capacity of states and state drinking water programs; provides a foundation of support to enhance these efforts; promotes coordination with other agencies and governments; and portrays the importance of state drinking water program involvement in water resource management and climate change efforts. This document considers the importance of coordination between and among all levels of government -- particularly with regard to the development of policies, plans, and strategies by Congress, EPA, and other Federal, state, and local agencies to address short and long-term drinking water availability, variability, and sustainability issues.

BACKGROUND

CLIMATE CHANGE

Current research and recent events provide an indication of how climate change will affect drinking water source quantity (availability) and usage, as well as water quality. Following are the leading national and international think tanks that are working on climate change research:

- **U.S. Climate Change Science Program (CCSP)[1]:** The CCSP is sponsored by thirteen Federal agencies. The program integrates Federal research on climate and global change.
- **United Nations Intergovernmental Panel on Climate Change (IPCC):** The IPCC's *Fourth Assessment Report*[2] and *Technical Paper on Climate Change and Water*[3] assess current scientific knowledge and projections. Detailed information about water-related impacts of climate change can be found in these IPCC documents.

Water Impacts of Climate Change *(This section is excerpted, in part, from the "EPA National Water Program Strategy: Response to Climate Change[4]" which is based, in part, on the IPCC Report.):* These impacts vary in different parts of North America, but can be briefly summarized as follows:

1. **Increases in Water Pollution Problems:** Runoff from urban areas, farmland, and animal feedlots, coupled with weather variances from drought to increased precipitation and flooding, can cause pollutants to enter water supplies and lead to serious public health risks. These pollutants include: pesticides and fecal matter from farms, chemicals from industrial processes, and fuel and organic compounds from vehicles and transportation routes. In addition, warmer air temperatures will result in warmer water that will:
    - Hold less dissolved oxygen making instances of low oxygen levels and "hypoxia" (i.e., when dissolved oxygen declines to the point where aquatic species can no longer survive) more likely; and
    - Foster harmful algal blooms and change the toxicity of some pollutants. The number of waters recognized as "impaired" is likely to increase, even if pollution levels are stable.
2. **More Extreme Water-Related Events:** Heavier precipitation from tropical hurricanes and inland storms will likely increase the risks of flooding, expand floodplains, increase the variability of streamflows (i.e., higher high flows and lower low flows (during periods of drought)), increase the velocity of water during high flow periods and increase erosion. These changes will have adverse effects on water quality and aquatic system health. For example, increases in intense rainfall result in more nutrients, pathogens, and toxins being washed into water bodies.
3. **Changes to the Availability of Drinking Water Supplies:** In some parts of the country, droughts, changing patterns of precipitation and snowmelt, and increased water loss due to evaporation as a result of warmer air temperatures will result in changes in the availability of water for drinking. In other areas, sea level rise and salt water intrusion will have the same effect. Warmer air temperatures may also result in increased demands on drinking water supplies. The water needs for agriculture, industry, and energy production are also likely to increase.
4. **Waterbody Boundary Movement and Displacement:** Rising sea levels will likely move ocean and estuarine shorelines by inundating lowlands, displacing wetlands, and altering the tidal range in rivers and bays. Changing water flow to lakes and streams, increasing evaporation, and changing precipitation in some areas, will affect the size of wetlands and lakes, including the Great Lakes.

5. **Changing Aquatic Biology:** Studies indicate that animals and plants are showing changes consistent with climate trends. Temperature changes can also affect species through changes in moisture availability. Ecosystem responses in ecological communities could possibly cause decoupling of species from their food sources, a disruption of symbiotic or facilitative relationships between species, and changes in competition between species. As waters become warmer, the aquatic life they now support will be replaced by other species better adapted to the warmer water (i.e., cold water fish will be replaced by warm water fish). This process, however, will occur at an uneven pace, disrupting aquatic system health and possibly allowing non-indigenous and/or invasive species to become established. In the long-term (i.e., 50 years), warmer water and changing flows may result in significant deterioration of aquatic ecosystem health in some areas.

6. **Collective Impacts on Coastal Areas:** Most areas of the United States will see some of the water-related effects of climate change, but coastal areas are likely to see multiple impacts. These impacts caninclude sea level rise, increased damage from floods and storms, changes in drinking water supplies, and increasing temperature and acidification of the oceans. These overlapping impacts of climate change make protecting water resources in coastal areas especially challenging. Changes in the timing and volume of freshwater runoff will affect salinity, sediment and nutrient availability, and moisture regimes in coastal ecosystems. Climate change can affect each of these variables by altering precipitation and locally driven runoff or, more importantly, runoff from watersheds that drain into the coastal zone. Hydrology has a strong influence on the distribution of coastal wetland plant communities, which typically change, going from coast to inland, from salt, to brackish, to freshwater species.

REGIONAL ATTRIBUTES AND DIFFERENCES

Drinking water source requirements, treatment needs, and infrastructure needs – designed to accommodate the diverse regional geographies and climates throughout the U.S. – are expected to change as weather patterns change. IPCC research indicates, for instance, that, "Climate change impacts in North America will reflect a high degree of regional variability, and as such, adaptive strategies must take this variation into account." However, even water rich areas are vulnerable to variable local and regional conditions. A regional emphasis will allow for a more tailored and coordinated planning approach to address climate change impacts throughout the nation. Following are examples of some of the factors that are expected to affect particular areas and geographic regions of the United States.

- **Mid-Atlantic and the Northeast** – The Atlantic Coast and the northeastern U.S. is mainly governed by riparian water rights and has a varied topography with both surface and ground water sources of drinking water. Areas further inland feature rolling hills and temperate forests. The Appalachian Mountains form a line of low mountains separating the eastern seaboard from the Great Lakes and the Mississippi Basin. Many Mid-Atlantic states have coastal cities that experience hurricanes and will be subject to sea level rise. In addition, the Northeast has some home rule states where there are no county government entities to coordinate local municipal government climate change strategies. Thus, adaptation efforts are expected to be more fragmented and independent.

"Climate change impacts in North America will reflect a high degree of regional variability, and as such, adaptive strategies must take this variation into account."

- **The Gulf Coast and the Southeast** – A broad, flat coastal plain lines the Gulf and Atlantic shores, and includes the Florida peninsula. This Southeast region contains subtropical forests and, near the Gulf Coast, mangrove wetlands, especially in Florida. This area of the nation is experiencing drought and is instigating, in many cases, new state-wide water planning activities. There are a number of coastal cities and areas that were developed on land below sea level and more hurricanes occur here than in most other coastal areas of the U.S.

- **Great Lakes Basin** – The region is subject to heavy rain and flooding. The Great Lakes Basin Commission (made up of eight states) provides policy development, coordination, and advocacy on integrated and comprehensive development, use and conservation of water resources, and other issues of regional concern, as well as communication and research services.

- **Mississippi River Basin** – The Mississippi River Basin and two large eastern tributaries, the Ohio River and the Tennessee River lie west of the Appalachian Mountains. The Ohio and Tennessee Valleys and the Midwest consist largely of rolling hills and productive farmland, stretching south to the Gulf Coast. Throughout history, this area of the U.S. has been subject to periodic intense rainfall and flooding.

- **Mid-West** – The geography in this region is rich with oil and gas and supports agricultural farmlands that withdraw ground water for irrigation. The Ogallala aquifer flows beneath Kansas, Nebraska, and Oklahoma. This ground water source is subject to the direct impacts of oil and gas extraction, as well as ethanol production in these states. The region is also subject to sometimes devastating tornadoes.

- **Southwest** – This region is largely dry and arid, dependent on deep wells (sometimes with high levels of naturally occurring contaminants) and snowpack for drinking water. States in this area of the U.S. have historically had to prepare for and address long-term sustainability issues. Several states have negotiated water rights agreements for use of the water from the Colorado River.

- **Northwest** – Water rights and legal issues of landowners are predominant factors that drive legislation and policymaking efforts in the northwest U.S. states. The availability of drinking water in this area is dependent on snowpack and subject to heavy rain, flooding, and volcanic activity.

WATER RIGHTS – RIPARIAN RIGHTS OF LANDOWNERS VERSUS PRIOR APPROPRIATION DOCTRINE

The two principal types of water rights frameworks that exist in the U.S. are as follows:

Riparian: Riparian water rights is a system of allocating water among those who possess land adjacent to a water source. It has its origins in English common law. It is used in the United Kingdom and states in the eastern U.S., in contrast to the western states, where water rights are generally allocated under the principle of prior appropriation doctrine which is derived from Spanish law and treats water as a resource unrelated to land.

Under the riparian principle, all landowners whose property is adjacent to a body of water have the right to make reasonable use of it. If there is not enough water to satisfy all users, allotments are generally fixed in proportion to frontage on the water source. These rights cannot be sold or transferred other than with the adjoining land, and water cannot be transferred out of the watershed.

Riparian rights include such uses as the right to access for swimming, boating and fishing; the right to wharf out to a point of navigability; the right to erect structures such as docks, piers, and boat lifts; the right to use the water for domestic purposes; and the right to accretions caused by water level fluctuations. Riparian rights also depend upon "reasonable use" as it relates to other riparian owners, to ensure that the rights of one riparian owner are weighed fairly and equitably with the rights of adjacent riparian owners.

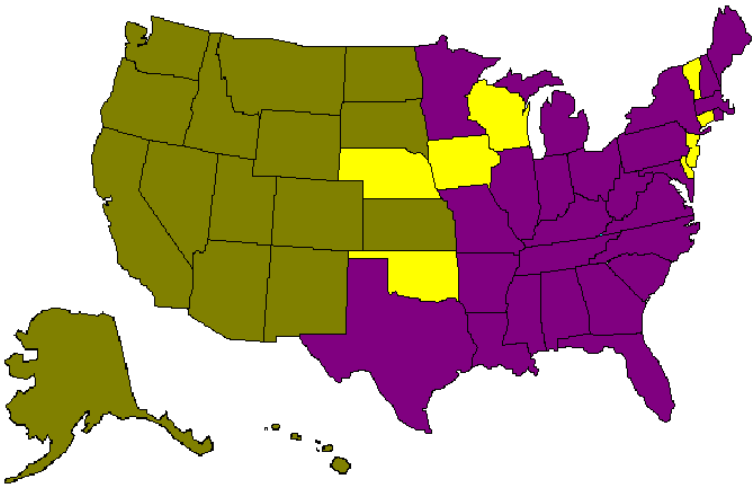
Prior Appropriation Doctrine: Water law in the western U.S. generally follows the appropriation doctrine. This doctrine is derived from Spanish law and treats water as a resource unrelated to land. The legal details vary from state to state; however, the general principle is that water rights are unconnected to land ownership, and can be sold or mortgaged like other property. The first person to use a quantity of water from a water source for a beneficial use has the right to continue to use that quantity of water for that purpose. Subsequent users can use the remaining water for their own beneficial purposes, provided that they do not impinge on the rights of previous users.

Beneficial use is commonly defined as agricultural, industrial, or household use. Ecological purposes, such as maintaining a natural body of water and the wildlife that depends on it, were not initially deemed as beneficial uses in some Western states but have been accepted in some jurisdictions. The extent to which private parties may own such rights varies among the states.

Each water right has a yearly quantity allocation and an appropriation date. Each year, the user with the earliest appropriation date (known as the "senior appropriator") may use up to their full allocation (provided the water source can supply it). Then the user with the next earliest appropriation date may use their full allocation and so on. In times of drought, users with junior appropriation dates might not receive their full allocation or even any water at all.

When a water right is sold, it retains its original appropriation date. Only the amount of water historically consumed can be transferred if a water right is sold. For example, if alfalfa is grown using flood irrigation, the amount of the return flow may not be transferred, only the amount that would be necessary to irrigate the amount of alfalfa historically grown. If a water right is not used for a beneficial purpose for a period of time, it may lapse under the doctrine of abandonment. Abandonment of a water right is rare, but occurred in Colorado in a case involving the South Fork of San Isabel Creek in Saguache County, Colorado[5].

Legal Allocation of Water: 48% (shown in purple) of the 50 states allocate water by riparian rights of landowners and 38% (shown in green) by prior appropriation doctrine (the right to use the water). The other states (shown in yellow) have a mix of laws or some other type of authority.



In many cases, the water right of agricultural landowners holds more dollar value than the land that they own. The value of the water right creates a conflict of interest for those landowners to conserve or use less water – if they use less water, they will abandon their right to the water. For water sources with many users, a government or quasi-government agency is usually charged with overseeing allocations. Allocations involving water sources that cross state borders or international borders can be quite contentious, and are generally governed by Federal court rulings, interstate agreements, and international treaties.

"In many cases, the value of the water right creates a conflict of interest for landowners to conserve or use less water."

As shown in the previous map, most eastern states legally allocate water by riparian rights of landowners. By contrast, the majority of western states legally allocate water by prior appropriation doctrine. A smaller number of states use both types of legal allocations or some other mix of laws that apply to circumstances. The following examples describe some of the implications of these various types of water rights for state WAVS strategies.

- **Washington:** Although shown as a prior appropriation state, in Washington, water belongs to the public and cannot be owned by any one individual or group. Instead, individuals or groups may be granted rights to use the water. A water right is a legal authorization to use a predefined, reasonable quantity for a beneficial, non-wasteful use, such as domestic water supply, irrigation, or power generation. New users must receive approval prior to using water – in the form of a water right permit or certificate. There has been much dispute over who has rights to both surface and ground water sources and as water gets scarcer, the fight for water gets tougher. Water rights decisions are made by the state's environmental protection agency, the Washington State Department of Ecology. The drinking water program is managed within the Washington State Department of Health.

  Washington water law is constantly evolving. In recent years, the state legislature has enacted new laws addressing a range of water resource and water management related issues. It is likely to continue changing in the near future in light of population growth when much of the available water is already being used; as water priorities change; as difficulties and cost issues arise from new water development; and as the demands to improve natural environments that depend on water (streams, etc) increase.

- **Georgia Court Case on Lake Lanier Water Rights:** The states of Georgia, Alabama, and Florida are continuing to debate whether Georgia should be allowed to use Lake Lanier as the primary drinking water supply for more than three million residents in the Atlanta area. This debate began when Alabama filed the first federal lawsuit against the U.S. Army Corps of Engineers in 1990. Alabama and Florida maintain that Congress established only three purposes for use of the Federal reservoir: to control floods, to float barges downstream, and to generate power. Georgia disagrees and has promised to prove in court that Congress intended the lake to serve as a primary drinking water supply.

Examples of states that have a mix of laws or other type of authority include:

- **New Hampshire:** All water is basically riparian, although the legislature has "given" water rights to municipalities and public water suppliers in some instances.

- **Connecticut:** The state does not have a single integrated allocation authority. Management of water resources is divided among three separate state agencies with different water resource missions.

- **Iowa:** All water belongs to the state and is allocated for beneficial use via water allocation and use permits that are issued for periods of up to 10 years.

- **Delaware:** All water is considered public property and only rights to serve particular geographic areas are issued.

- **Wisconsin:** Access to water is generally governed by riparian rights in combination with reasonable use. To some extent, prior appropriation applies to surface water in that applicants for new withdrawals must receive consent from existing riparian users.

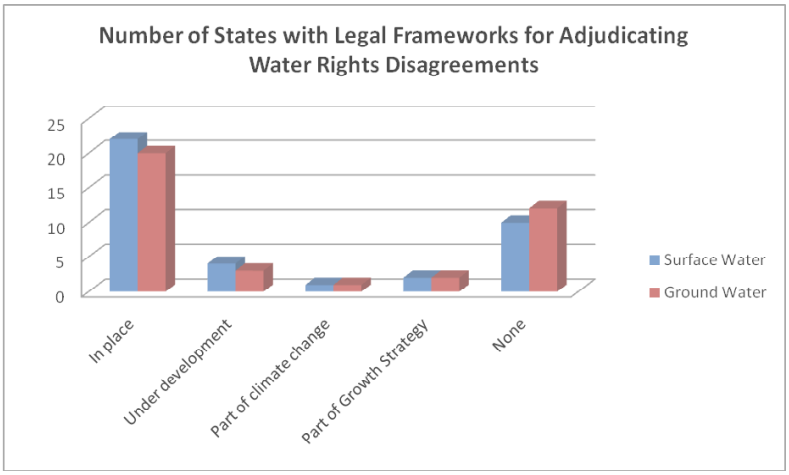
Following are some examples of how states relinquish water rights:

Montana: In Montana, there is an administrative process that the Montana State Water Court can use to relinquish water rights that are found to be abandoned (are no longer being used). However, this process cannot commence until at least 10 years after the water rights were decreed in that basin. As of yet, there are no final decrees in Montana, and therefore no water rights have ever been relinquished.

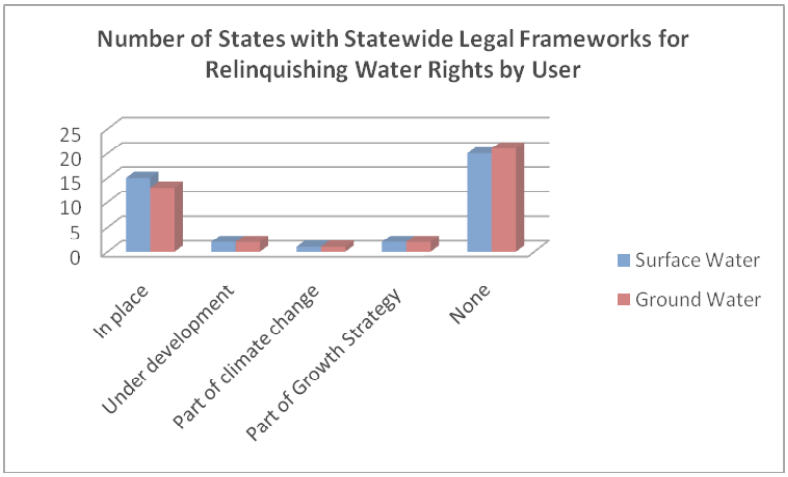
Florida: Water is a "resource of the state" and users are required to obtain water use permits. A user can give up a permit, or a permit can expire.

Washington: Washington's new Municipal Water Law includes a provision for water right relinquishment and exemptions to be limited based on beneficial use and the timing of that use.

Legal Frameworks to Adjudicate Water Rights Disagreements: About two-thirds or more of the states that responded to ASDWA's WAVS Survey have statewide legal frameworks in place or under development to adjudicate water rights disagreements. The chart below shows the survey response totals and numbers for whether the state has a framework in place or under development, or if a framework is included as part of a larger state climate change or growth/development strategy.



Legal Frameworks for Relinquishing Water Rights: Just under half of the states that responded to ASDWA's WAVS Survey have statewide frameworks in place to relinquish water rights. The chart below shows the survey response totals and numbers for whether the state has a framework in place or if a framework is included in part of a larger state climate change or growth/development strategy.



EXTREME SCARCITY OR DROUGHT VERSUS ABUNDANCE OR FLOODING

Drinking water systems and state drinking water programs will likely continue to need to prepare for and adapt to extreme variations in weather and water availability. Previous state adaptive practices may well need to be revised or expanded for what is likely to be required in the future. The benefits of mutual aid agreements and emergency preparedness efforts,

including coordination among all levels of government, are critical to ensuring sustainability of drinking water sources and drinking water system continuity of operations.

Drought: The state drinking water program role in preparing for extended periods of drought and assisting water systems during drought may be multi-faceted and extend beyond tasks traditionally carried out by program personnel. A considerable number of public water systems are located in states where precipitation is expected to decrease, including some of the highest growth regions (e.g., the West, Southwest, South, and Southeast).

- **Preparedness:** State drought preparedness efforts may include conducting drills and exercises to test: multi-jurisdictional responses to drought emergencies in different areas of the state; the logistics of acquiring and distributing bottled water to a large population; the mass evacuation of an urban area that has run out of water; as well as engaging public officials in these drought response exercises. Other state drinking water program activities may include improving communication and understanding between water systems and emergency management agencies; providing opportunities for water systems to test and refine their water shortage response plans; and identifying alternative water supply sources.

- **Response:** The state drinking water program drought response role may involve making determinations about whether to issue permits for new wells and assisting communities in implementing emergency water supplies and interconnections to share scarce supplies. Another state drinking water program role is to help water utilities determine whether to issue a public notice such as a "do-not-drink" or "boil-water" order and how to treat more concentrated water sources and wastewater streams. If there is no water or ability to provide water, states and utilities will have to make decisions that consider the availability of emergency water supplies – such as whether to truck in and distribute bottled water or use water buffalos, and when to make a final call for "evacuation and relocation."

  - **Montana:** Montana's Drought Plan extends beyond emergency type preparedness and response to include preventative water conservation goals and strategies. For more information about drought plans, see "Types of State Strategies and Plans" section.

  - **North Carolina:** North Carolina's Emergency Management Commission conducted a drought exercise with multiple state agencies and water utilities to test preparedness and response efforts. From this exercise, the state has also developed a Drought Response Toolbox. Additional water conservation strategies are being carried out by local governments (For more information, see "Water Conservation/Efficiency Policies and Options" section)

Flooding: Heavy or extreme precipitation and heavy runoff from hurricanes, as well as tropical and inland storms increase the risks of flooding and expanding floodplains, the variability of streamflows, the velocity of water during high flow periods, and erosion. These changes have adverse effects on water quality and aquatic system health. These events can contaminate recreational waters and inundate drinking water supplies, causing an increase in waterborne disease outbreaks from higher levels of bacteria, nutrients, pathogens, and toxins being washed into water bodies (*excerpted from EPA CC Strategy*). A significant number of public water systems are located in 100 year flood plains or hurricane surge zones. These facts underscore the need for states and utilities in flood prone areas to develop flood preparedness plans or backups to minimize administrative down time.

- **Mississippi Hurricane Preparedness and Response:** Preparations for weather events such as hurricanes begin long before the season ever begins in Mississippi and other coastal states. The drinking water programs spend countless hours training water system personnel on the importance of preparedness and communication with the state. That training paid off when Hurricane Katrina made landfall in 2005. Mississippi's public water supplies immediately began notifying the state of their status and needs. This allowed the state to rapidly send assistance so that water could be restored to customers of affected systems. In addition, the state drinking water program was able to provide information to sister agencies concerning wastewater issues and health concerns.

  Since Katrina, the Mississippi drinking water program has stressed the need for water systems to obtain alternative/backup water supply sources, emergency tie-ins, and/or generators. During the annual sanitary survey, systems that have not made provisions for a back up water supply source find that it negatively affects their capacity assessment score. This score is the result of the Capacity Assessment Rating that Mississippi uses to rate public water supplies on managerial, financial, and technical capability. Since its inception, the Capacity Assessment scores have sparked friendly "competition" among water supplies. Higher scores communicate to customers the good job the system is doing, while lower scores communicate the need for improvement or the need for upgrades to the systems. These scores and the aftermath of Hurricane Katrina have raised awareness of needs that ensure the sustainability of the water supply.

  Have these efforts worked? As Mississippi wrapped up the response to Hurricane Gustav (September 2008), they were pleased to report that only 28 systems lost pressure due a lack of generators. This is impressive when compared to the hundreds that lost pressure during Katrina.

- **2008 Iowa Floods:** Flooding started in Iowa in early June of 2008, with 82 of the 99 counties eventually declared presidential disaster areas due to record-setting flood levels, tornadoes, and severe storms. The flood level in Cedar Rapids, the second largest city in Iowa, was 12 feet above the previous record, with over 1,600 city blocks inundated.

  The state water supply program, housed in the Department of Natural Resources, assisted utilities and other government agencies in a variety of ways: field staff collected samples to ensure bacterially-safe distribution systems and assisted operators in recovery efforts; conservation, fisheries, and park personnel used their boats to assist in river rescues as well as to ferry essential personnel; central office staff provided inventory information and developed guidance for well recovery, temporary overland connections, stream crossing repair, and system assessments; and several staff were deployed to the state emergency operations center to support and relay information to the rest of the staff.

At the onset of the flooding, the water supply central office staff were evacuated, which provided them with new insight into the disruption that occurs during such events. The office was only vacated for a week and ultimately was not flooded, but it still took several more weeks to fully recover the computer networks and return to routine operations.

Overall, Iowa was fortunate in that only a handful of public water supply systems lost infrastructure. One municipal system, Oakville, took two months from the time of the flooding to get their system back up. While the mitigation efforts have continued in Iowa, it will be a long and expensive process to repair the thousands of uninhabitable homes, businesses, and damaged infrastructure.

- **1993 Missouri Flooding Experience:** The duration of the "Great Flood of 93" in Missouri disrupted state drinking water program operations for months. For weeks during the peak of the flood, program staff manned a 24-hour hot line to answer questions from local officials, water systems, and the public about the status of water supplies and the safety of drinking water. Many of the callers also requested fact sheets on drinking water safety issues related to flooding, and use and restoration information for private wells. The drinking water program provided a daily report for the Governor on the status of water systems during the flood and produced periodic reports for weeks afterward until all water systems were back on line. An even less obvious impact was on the determination of compliance. State regulators had to track when systems were in operation to know what reports to expect and whether violations for failure to monitor were legitimate.

  Routine work was put on hold for months in the state's regional offices as field engineers and operational experts tracked the operational status of water systems, assisted water systems with emergency service and recovery operations, and assisted the Corps of Engineers and FEMA with damage assessments. Some state field staff stayed at local water plants 24 hours a day until reliable service was restored. State drinking water staff also assisted water systems in securing alternate water sources and providing notice to the public about boil orders or other measures in place to protect their health.

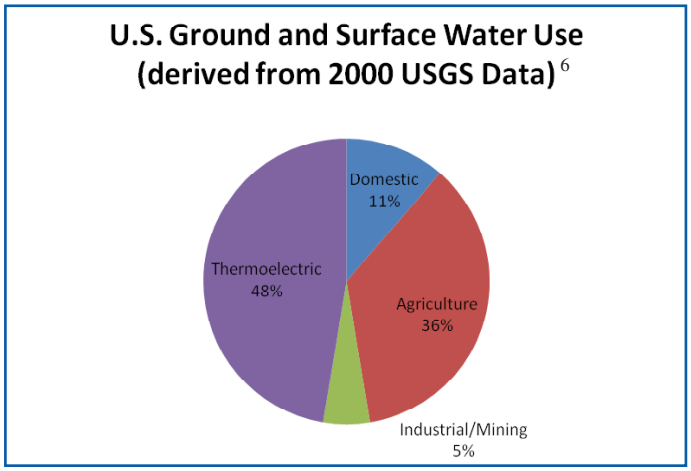
  In Missouri, the state provides laboratory services for public water systems. Routine demand was down somewhat due to water systems that were out of service but there was a spike in demand for special analysis to determine whether water in impacted systems was safe. The state's main Public Health Laboratory that conducts coliform analysis was inundated with flood waters. In order to maintain essential service, the Department of Health analysts were moved into the Department of Natural Resources chemistry lab building.

  For water systems, a flooded water plant or well was not always the problem. Many plants were forced to interrupt service because flooding in the vicinity took out the power lines. After the flood, most systems had a second power feed installed or purchased generators to be better prepared next time. Flash flooding often washed out water mains and disrupted service in localized areas, even though the main water plant continued to operate. Systems using surface water were challenged to adequately treat flood water loaded with silt, debris, and unknown hazards. State staff helped operators deal with rapidly changing source water quality, even in some ground water systems. Because of the location of many water plants, the water service was sometimes out when most of the town was still inhabited. The critical need in these cases was to find alternate water sources, either through connection to another water system or to provide bottled or trucked water directly to residents.

COMPETING USES OF WATER

Competition for water resources among residential, agricultural, thermoelectric power production, and industrial/mining users creates some unique water supply challenges as described below.

Agriculture/Biofuel Production: The previous chart (derived from USGS Estimated 2000 U.S. Water Use Data[6]) shows that agriculture is the second largest water user in the U.S. However, agriculture can arguably be considered the largest user because thermoelectric use is nearly one-third marine water and is not necessarily considered a consumptive use. Taken together, the following two reports provide information about how increasing ethanol production from corn could significantly impact water quality and availability, including drinking water supplies, if new practices and techniques are not employed.



- **NAS Report on Water Quality and Quantity Effects of Ethanol Production[7]:** The 2007 National Academy of Sciences report entitled, "Water Implications of Biofuels Production in the United States," provides suggestions and considerations for addressing water quality and quantity issues associated with crop cultivation and ethanol production processes including:

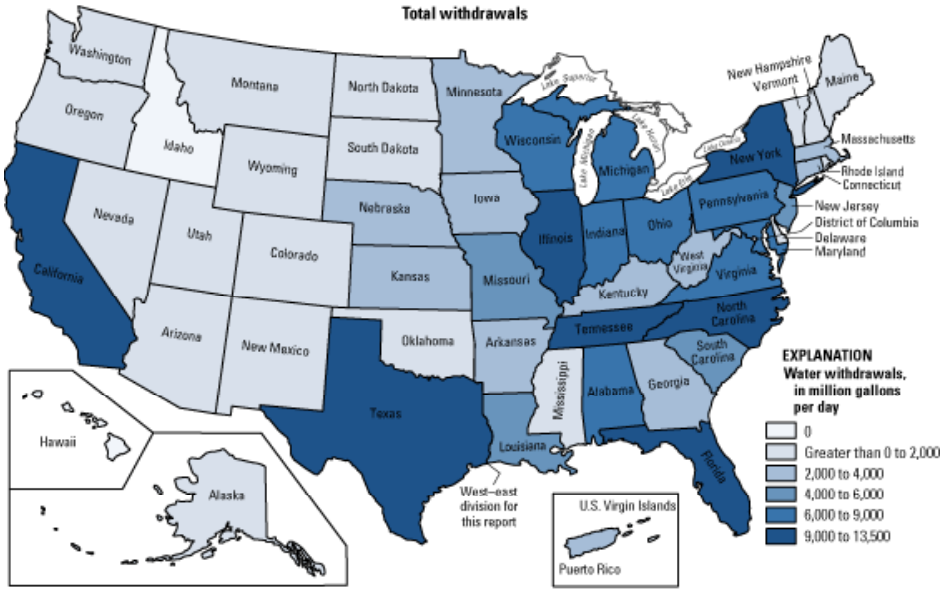
  - Encouraging the use of other crops, such as soybeans and switchgrass, that yield more efficient cultivation and ethanol production processes than corn;

  - Considering nutrient and sediment runoff, and recycled domestic water use for irrigation, in water management strategies and agricultural practices; and

  - Adjusting agricultural practices to help prevent the impacts of high levels of nitrogen, from pesticide and fertilizer use, on water quality.

- **Environmental Defense Report - Potential Impacts of Biofuels Expansion on Natural Resources[8]:** This report explores challenges and solutions of producing biofuels in the Ogallala aquifer region, including how ethanol production could strain resources. For example, approximately 1,000 gallons of water are needed to irrigate 19 pounds of corn, along with approximately five gallons more to convert the corn to produce one gallon of ethanol. Rising corn demand and commodity prices related to the expansion of corn ethanol also put U.S. Conservation Reserve Program (CRP) lands and untilled native grasslands at risk. The United States Department of Agriculture (USDA) has halted new enrollment of lands into CRP acreage in 2007 and anticipates that farmers are planning to put 4.6 million acres of CRP lands back into crops when their contracts expire in the next four years.

Thermoelectric Water Use: Water for thermoelectric power is used in generating electricity with steam-driven turbine generators. Thermoelectric-power withdrawals are shown by State in the following map. USGS6 estimates that the total quantity of water withdrawn for thermoelectric power for 2000 was an estimated 195,000 mgd, or 219,000 acre-feet per year. Surface water was the source for more than 99 percent of total thermoelectric-power withdrawals. Thermoelectric-power withdrawals accounted for 48 percent of total water use. However, because nearly one-third of the surface water used was saline and thermoelectric use can arguably be considered non-consumptive, we can revise this percentage to an estimate of 32 percent.



Domestic Water Use: Domestic water use for indoor and outdoor household purposes is either delivered by a public water supplier or is self-supplied. In the USGS Report 6, domestic use refers to self-supplied withdrawals (from private wells) only. All self-supplied domestic withdrawals were considered freshwater in the report. For 2000, USGS estimates that withdrawals at 3,590 mgd or 4,030 thousand acre-feet per year. Self-supplied domestic withdrawals were about one percent of total freshwater withdrawals and about two percent of total freshwater withdrawals for all water withdrawals, excluding thermoelectric power. Ground water withdrawal involves some unique challenges, as outlined in the following textbox from the Ground Water Protection Council's "Call to Action".

- **Wisconsin:** Wisconsin has a new Groundwater Quantity Protection Rule (NR 820, Wisconsin Administrative Code[10]), which took effect on September 1, 2007. It designates areas of the state for regional planning and management to minimize and manage future impacts from groundwater drawdown and pumpage. This rule also establishes review criteria applicable to high capacity well applications involving wells situated near springs, trout streams, outstanding resource waters, and exceptional resources waters.

Ground Water Protection Council's Ground Water Report to the Nation: A Call to Action[9] (excerpt): Ground water is a renewable, yet finite, resource. It is generally pumped from the subsurface in the absence of a sound understanding of how much remains available for sustainable use. Over-withdrawal of ground water supplies can lead to dried-up wells and springs, shrinking wetlands, reduced stream flows and lake levels, saltwater intrusion in coastal areas, and land subsidence. These impacts have serious economic ramifications, which are only worsened when coupled with drought conditions. More effective means are needed to manage the way we use ground water to deter current practices of withdrawing ground water at unsustainable rates that will ultimately lead to significant social, economic, and ecological costs.

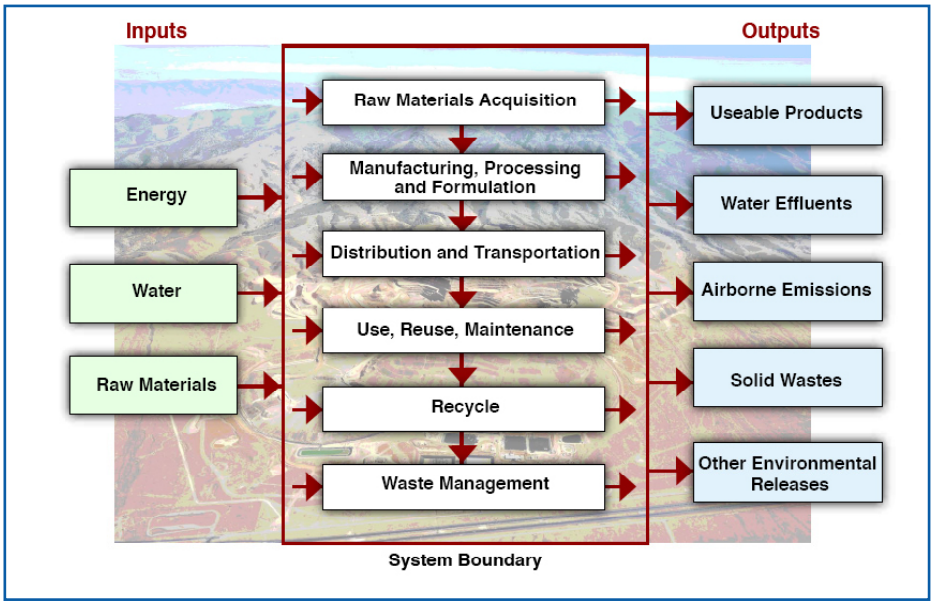
Our land-use decisions and water-use policies must consider the interrelationship between ground water and surface water supplies and the capacity of individual watersheds to sustain existing, as well as future, water uses. To ensure the long-term availability of water and aquifer yields, we as a nation must use water more efficiently and better tailor our land- and water-use planning to effectively bridge the gap between water law and science.

Industrial Water Use: Industrial water use includes water used for such purposes as fabricating, processing, washing, diluting, cooling, or transporting a product; incorporating water into a product; or for sanitation needs within the manufacturing facility. Some industries that use large amounts of water produce such commodities as food, paper, chemicals, refined petroleum, or primary metals. Water for industrial use may be delivered from a public supplier or be self-supplied. In the USGS Report 6, industrial use refers to self-supplied withdrawals only. For 2000, withdrawals were an estimated 19,700 mgd, or 22,100 thousand acre-feet per year. Industrial withdrawals were about five percent of total withdrawals. Surface water was the source for 82 percent of total industrial withdrawals. Nearly all (92 percent) of the surface-water withdrawals and nearly all (99 percent) of the ground-water withdrawals for industrial use were freshwater.

Mining Water Use: Mining water use is water for the extraction of minerals that may be in the form of such solids as coal, iron, sand, and gravel; such liquids as crude petroleum; and such gases as natural gas. The category includes quarrying, milling (crushing, screening, washing, and flotation of mined materials), re-injecting extracted water for secondary oil recovery, and other operations associated with mining activities. For 2000, the USGS Report 6 estimates mining water use from 22 states with the largest mining withdrawals, rather than an estimate from all states. Mining withdrawals were estimated at 3,490 mgd or 3,920 thousand acre-feet per year. Mining withdrawals were nearly one percent of total withdrawals. Ground water was the source for 58 percent of total withdrawals for mining. Most of the ground-water withdrawals for mining (62 percent) were saline, and most of the surface-water withdrawals (85 percent) were freshwater. Saline ground-water withdrawals and fresh surface-water withdrawals each represented 36 percent of the total withdrawals for mining.

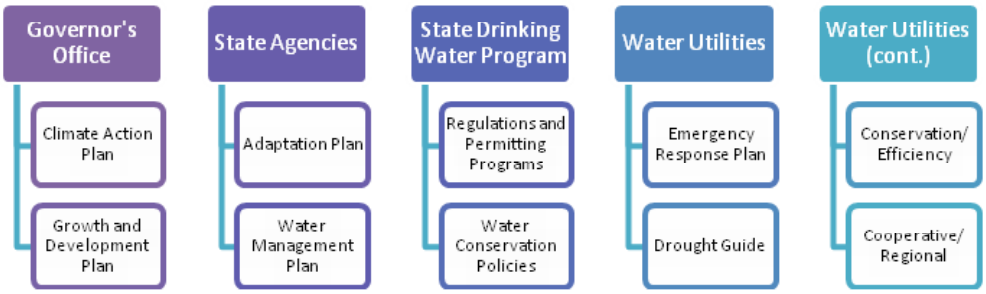
Life-cycle Analysis[11]: EPA has begun conducting lifecycle greenhouse gas (GHG) analyses as part of a new rulemaking implementation effort to meet the requirements of the Energy Independence and Security Act of 2007 (PL 110-140). A life-cycle analysis attempts to quantify the full range of environmental impacts associated with a product by considering all inputs of resources and materials and all outputs of wastes and pollution at each stage of the product's life.

Life-cycle analyses for GHG emission-reduction policies focuses the method on products that are manufactured or purchased within a specific region and can identify energy-saving and GHG emission-reduction opportunities that may be specific to that region. The life-cycle analyses graphic shown here was developed by the Lawrence Berkley National Laboratory (U.S. Department of Energy). The graphic shows the variables that are considered when conducting lifecycle analysis including: acquiring raw materials; manufacturing and distributing the product; the consumer's use and maintenance of the product; and its ultimate disposal. For water purposes, life-cycle analysis offers a holistic approach for evaluating the effects of energy and biofuel production on water quantity and quality and for developing GHG emission reduction policies and regulations that consider sustainability of the nation's water supplies.



TYPES OF STATE STRATEGIES AND PLANS

According to ASDWA's survey, various types of state strategies or plans that address WAVS issues exist (or are under development) in each of the states. They vary in scope and complexity, in view of the unique challenges, organizational structure, and challenges of individual states. The preceding graphic shows who develops or directs the development of the strategies or plans (in the shaded boxes at the top), as well as the types of strategies and plans. The connecting lines indicate the principal interrelationships between water quantity and conservation strategies and plans under the various levels of government and authorities.



Each of the strategies and plans in the graphic are summarized below. Most states have developed (or are developing) at least one, if not all, of the following types of plans. Any of these plans may include preparedness and response activities related to Drinking Water Availability, Variability, and Sustainability (WAVS).

Climate Action Plans: Many states have either completed comprehensive Climate Action Plans or are in the process of revising or developing one under the direction of the Governor. The plans mostly focus on Greenhouse Gas Mitigation and detail steps that the states can take to reduce their contribution to climate change. The process of developing a Climate Action Plan can identify cost-effective opportunities to reduce GHG emissions. The individual characteristics of each state's location, economy, resource base, and political structure lead to Climate Action Plans that may vary greatly from state to state.

Growth and Development Plans: State Growth and Development Plans are directed toward land use patterns and generally consider water supply availability and protection issues. As an example:

- **New Hampshire:** The purpose of the New Hampshire 2007 State Development Plan is to support New Hampshire's prosperity and unique quality of life, as well as the state's natural and built environment through innovative approaches to planning, preservation and development at the state, regional and local levels. The plan's implementation activities include:

  - Developing policies and actions necessary to assure safe and reliable utility services to better account for New Hampshire's changing demographics and promote energy efficiency.
  - Encouraging demand reduction through energy efficient development while pursuing renewable energy production and purchasing.
  - Promoting a diverse and affordable range of heating fuel options for New Hampshire's residents and businesses.
  - Developing and providing for maintenance and upgrades of water supply, wastewater, and stormwater management systems that protect natural resources.
  - Establishing opportunities to create community water and septic systems as well as regional connections between independent water and sewer systems.

Adaptation Plans: The State Adaptation Plans are based, in part, on the Climate Action Plans, but more specifically, detail the actions to prepare for and mitigate the impacts of climate change. These plans include drinking water and other infrastructure sectors and are typically initiated in coastal states and coastal cities that are expected to feel the brunt of climate change impacts.

Water Management Plans: Water Management Plans are typically developed by state water resources agencies. According to the ASDWA WAVS survey, more than half of the responding states have exclusive water management responsibility. The other states share responsibility with one or more Federal agencies (e.g., Bureau of Land Management, U.S. Forest Service) or with local government. Georgia provides a good example:

- **Georgia:** The Georgia Water Council has adopted the state's first comprehensive water-use plan to address severe drought conditions. Representatives from local and state government (including the Georgia Department of Natural Resources, home of the drinking water program), industry, and the Georgia AWWA and NRWA state affiliates make up the membership of the Council and were directly involved in developing the state's plan. The plan calls for the establishment of 11 regional management districts that will oversee the measurement and withdrawals of water from lakes, rivers, and aquifers. The estimated cost to gather data and create regional water plans for the districts over the next three years is approximately $30 million. The regional water plans will likely involve local governments and include growth and development strategies based on water availability.

Regulations and Permitting Programs: The following table was derived from ASDWA WAVS Survey responses. The numbers in the cells represent how many states (the median number for both surface and ground waters) have legal and regulatory frameworks in place or under review for measuring and/or controlling water withdrawals (through regulations and permitting programs), or whether these issues are addressed in their Climate and Growth Plans. The number of states with regulations and permitting programs for water withdrawals are indicated as "In Place." More information on the various aspects of these Regulations and Permitting Programs are provided in the following section on "Legal/Regulatory Frameworks for Water Withdrawals."

Legal/Regulatory Frameworks for Water Withdrawals	In Place	Under Development or Legislative Review	Part of Climate Change Strategy	Part of Growth and Development Strategy	None
Measuring Water Withdrawals by the User (e.g., Metering)	27	2	1	3	3
Controlling Water Withdrawals by User (e.g. through Water Districts)	21	6	0	3	6

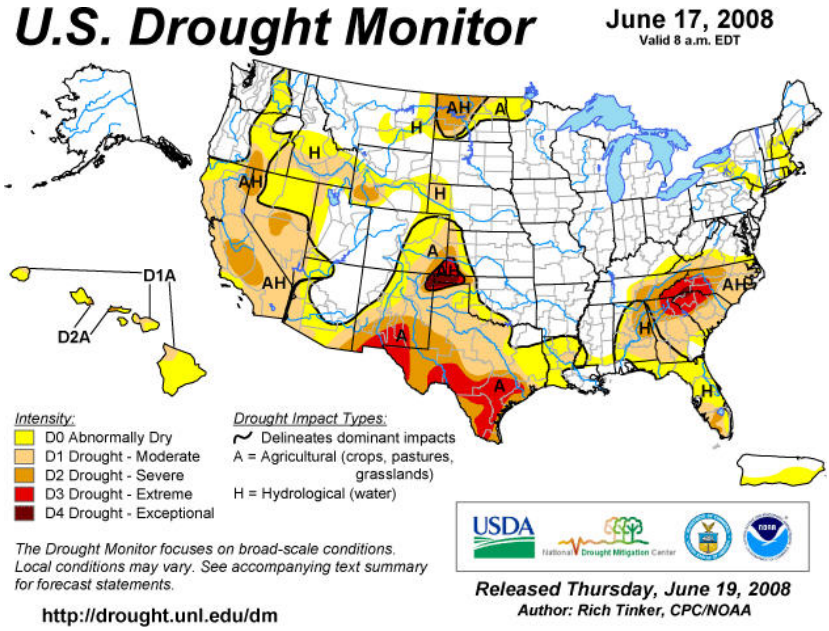
Water Conservation Policies: Most states have either developed, or are in the process of developing, a strategy for addressing water conservation, have policies in place, or rely on voluntary programs for implementation of conservation efforts. For the states that do have strategies and policies, these policies may be directed at the whole state or at specific geographic areas and are sometimes dependent on weather related events. Increasingly, such strategies are expected to be applied state-wide. In the case where they are weather-related, states and localities will implement varying phases of mandatory water conservation and demand management policies and practices depending on the severity of the weather event, flooding, or drought. Some examples of strategies and experiences tied to weather patterns are provided in the background section of this document under "Extreme Scarcity of Drought Versus Abundance or Flooding."

Emergency Preparedness and Response Plans: All states have developed and updated their Emergency Response Plans (ERPs) under the DHS National Response Plan and preparedness directives and objectives to address all hazards and emergencies. The state as a whole, the state drinking water program, and all of the water utilities have developed separate ERPs, though they are typically interrelated. These ERPs typically include both flood and drought response action plans, depending on the regional geographic and weather related variables. For more information, see background section "Extreme Scarcity or Drought Versus Abundance or Flooding".

- **Flood Plans:** As noted previously, Flood Plans are typically developed as part of the ERPs of the state, of the state drinking water program, and of the water utilities. The state and water utility ERPs are complementary, and are based on their respective roles.

  - **West Virginia:** The West Virginia Conservation Agency and the Corps of Engineers have developed a State Flood Plan[12] in partnership with numerous Federal and state agencies that provides a comprehensive strategy for reducing flood damage in the state. The flood recovery assistance role of the Department of Environmental Protection's Division of Water and Waste Management is to provide up-to-date information on the status of drinking water and wastewater treatment systems damaged or inoperable because of a flood event. The Department provides technical assistance to the owners/operators of such systems to expeditiously return them to compliance.

Drought Guides and Plans: Drought Guides and Plans are usually developed at the state level for all of the water systems in a state. They are also typically developed under the direction of a state agency, though they may not necessarily be developed directly by the state. Like the state Flood Plans, the state Drought Guides and Plans may be part of a larger state plan, may be specific to water systems, and/or may be part of a water utility's emergency response plan.



- **Florida:** The Florida Rural Water Drought Manual was developed for small water systems. It includes helpful preparedness and response coordination and actions that systems can take to sustain water supplies during a drought.

- **California:** The California Department of Water Resources Urban Drought Guidebook was updated in 2008 to help local agencies and communities prepare for the possibility of an especially dry season and water supply interruptions.

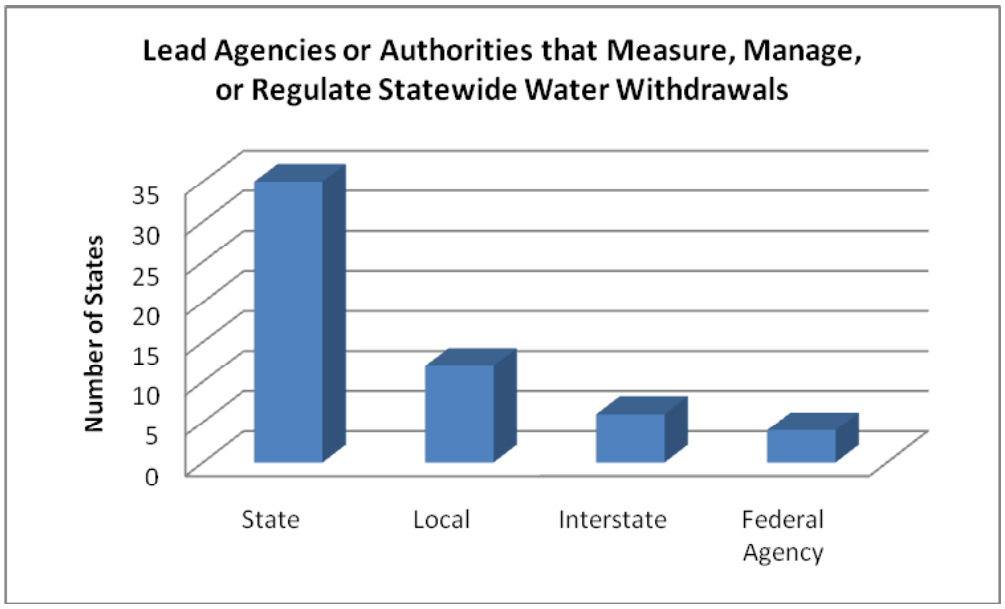
LEGAL/REGULATORY FRAMEWORKS FOR WATER WITHDRAWLS

Various types of legal and regulatory water withdrawal constructs exist in each of the states. The following graphs and explanations provide an overview of these frameworks as well as some examples. The graphs were derived from the ASDWA WAVS Survey results. Some of the more detailed information was derived from state responses to the New England Interstate Water Pollution Control Commission survey of New England states and New York[13].

A state's water resources board (or equivalent body) is often broadly responsible, in coordination with the state's environmental department, for administration of a state's water laws governing domestic use. State water withdrawal authorities are sometimes fragmented across state programs and local jurisdictions. In some cases, historic state water withdrawal laws may actually impede implementation of more recent state water management plans (e.g., where minimum withdrawal amounts are required to maintain water rights under a prior appropriations doctrine and cannot be amended without the consent of the water rights owner). Mississippi offers a good example of coordination:

- **Mississippi:** In Mississippi, the issuance of ground water withdrawal permits for public water systems by the Mississippi Department of Environmental Quality (MDEQ) is coordinated with acquiring final approval for system designs/upgrades by the Mississippi State Department of Health (MDOH). Permit issuance for public water supply wells is tied to the completion of preliminary assessment reports that scrutinize the susceptibility of proposed sites to potential sources of contamination. The Mississippi MDOH, in turn, will not approve system designs/upgrades until MDEQ issues the ground water withdrawal permits.

Who Regulates: Withdrawals may be regulated by local, state, interstate, or Federal agencies such as the Army Corps of Engineers (ACE). The following chart shows the number of states indicating which entity is the lead authority for measuring, managing, and regulating water withdrawals.



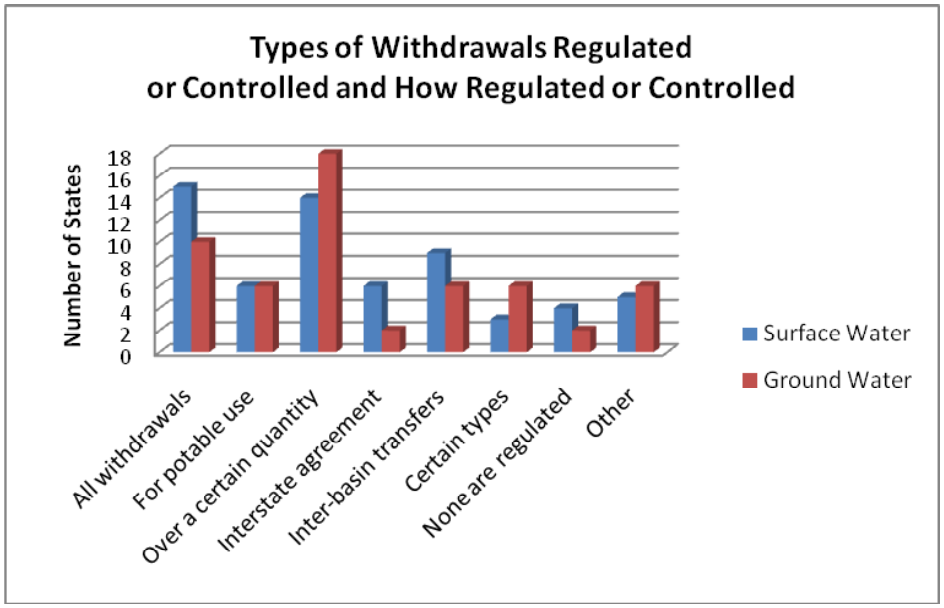
The following examples show the mix of authorities for withdrawal regulations and permitting processes in some states.

- **State Agencies:** While in some states such as Connecticut and Massachusetts, the Departments of Environmental Protection are the sole decision making agencies, they do involve other state agencies in water withdrawal regulations. In Maine, three different agencies: the Department of Environmental Protection; the Land Use Regulatory Commission; and the Department of Health and Human Services' Drinking Water Program are involved in some type of water withdrawal permitting.

- **Local Agencies:** In New Hampshire, the Department of Environmental Services (DES) issues permits for large groundwater withdrawals. DES also administers the regulations and statutory requirements associated with dam management, pilot in-stream flow regulations, and surface water quality standards. For the large groundwater withdrawal permits, regional planning commissions, and municipalities are provided copies of documents associated with the project for review and comment. Other state and Federal agencies also sometimes provide comments on application materials.

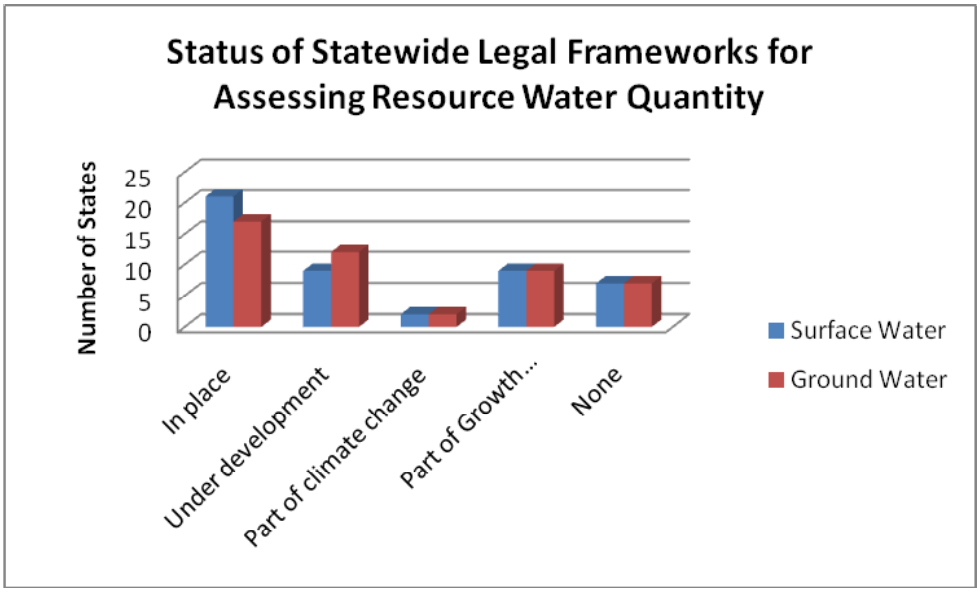
- **Interstate and Federal Agencies:** Withdrawals from specific water bodies throughout the nation may be used to supply drinking water for one or more states. These states, either individually, or together, typically have agreements with each other, and additionally with other Federal agencies. For example, the Colorado River Compact is an agreement among seven states (Colorado, New Mexico, Utah, Wyoming, Nevada, Arizona, and California) that governs the allocation of the river's water. As well, the Colorado River water levels flowing through the Hoover Dam are controlled by the U.S. Bureau of Reclamation. Another example comes from the state of Georgia, where water withdrawals from Lake Lanier are regulated by the U.S. Army Corps of Engineers.

Types of Withdrawal Regulations: Withdrawal laws or regulations may be directed at certain types of withdrawals (i.e., surface or ground water); withdrawals over a certain size; or by inter-basin transfers or agreements. For example, the state of Connecticut requires permits for all ground water and surface withdrawals over 100,000 gallons per day (gpd), with a maximum withdrawal amount of 250,000 gpd; though there are some exceptions.



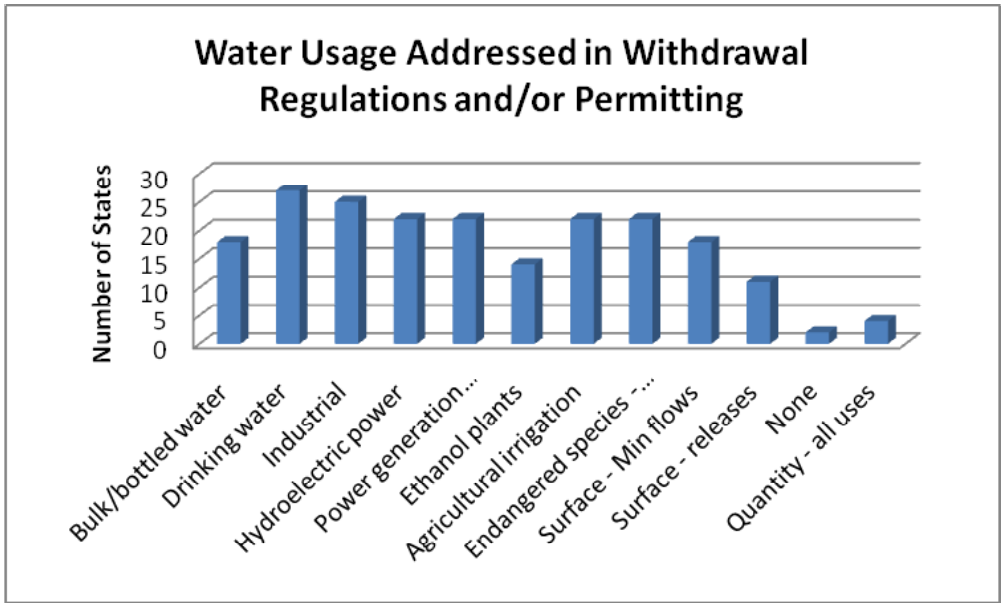
- **New York:** The state of New York has developed regulations to establish a permitting process for groundwater withdrawals that exceed 57,600 gpd from a well or well(s) sited after July 1998 at a single property or place of business. Additionally, state law requires that any entity developing a new surface water withdrawal or diversion that requires a 401 Water Quality Certificate[14] or that exceeds 20,000 gpd, demonstrate compliance with state surface water quality standards. Regulations have also been developed for a pilot process to: 1) Determine in-stream flows on two river reaches; and 2) Develop basin-specific conservation and water use management plans that apply to existing and new water withdrawals. Once the pilot in-stream flow program is implemented, the Legislature will have an opportunity to evaluate its benefits and costs and determine if the pilot rules and management plan derived from the rules should become law and extend to other surface waters.

Water Quantity Assessment Frameworks: State drinking water programs who responded to the ASDWA WAVS Survey expressed a serious need for water quantity and usage data to address drinking water sustainability issues. While the following graph shows that about 75 percent of those states have frameworks in place or under development for assessing source water quantity, there continues to be a severe lack of state funding to implement these efforts. All states are working with the U.S. Geological Survey (USGS), to some extent, through USGS' Cooperative Water Program. This program is based on a cost-sharing partnership with state, local, and tribal water resource agencies to provide water quantity and quality data. However, much more data and funding is still needed.



- **USGS National Water Census Action Plan[15]:** As USGS, states, and local public water supply agencies are the primary entities involved in gathering and assessing water quantity in the U.S., one particular effort of interest is the USGS' proposed development of a National Water Census[15] Action Plan. This Plan positions the USGS as the premier agency to gather national water quantity and quality data to better inform Federal, state, and local climate change policy decisions in the years to come. This plan, along the National Oceanic and Atmospheric Administration precipitation projections will form the two main components of national water supply sustainability estimates. The USGS is planning to move forward with this effort; however, it is dependent on Congressional funding, which has not yet been fully appropriated.

Water Use Withdrawal Regulations and Requirements: State water withdrawal laws/regulations and/or permitting requirements may address one or more water uses including: drinking water, hydroelectric power generation, ethanol plants, agricultural irrigation, endangered species and/or industrial purposes; minimum flow requirements; and/or control provisions for release of excess waters. Some states such as Indiana, New Hampshire, Louisiana, and North Dakota have requirements based on volume only, and do not consider the use of the water at all. The following graph shows the number of states that address the various types of uses in their regulations and permitting processes.



STATE WATER CONSERVATION/EFFICIENCY POLICIES AND OPTIONS

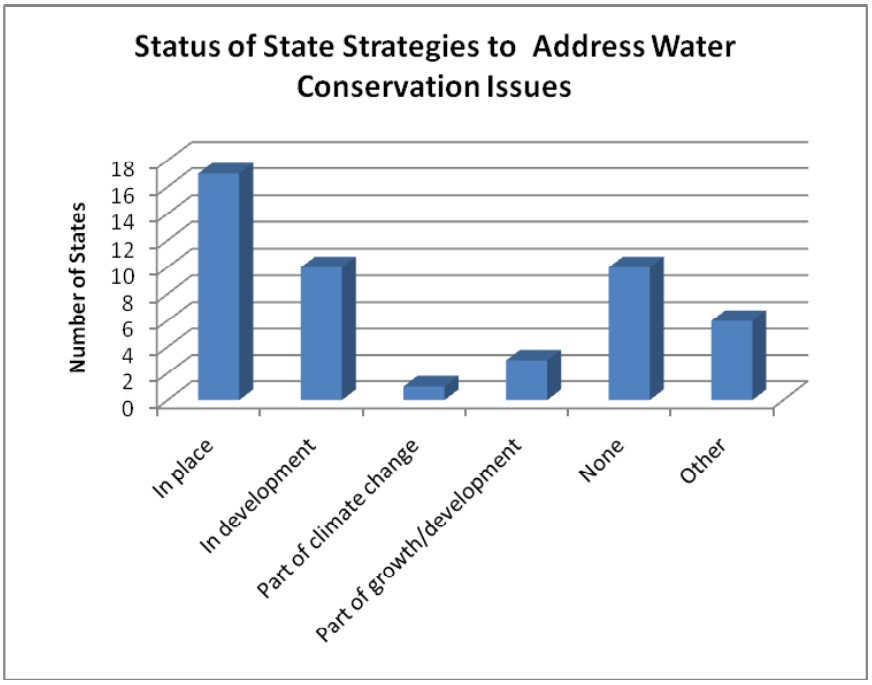
Water conservation policies may be mandated by state or local governmental entities through regulations and ordinances, including building codes, retrofit requirements, or permitting programs. Approximately 66 percent of ASDWA WAVS Survey respondents noted that they have a statewide water conservation policy "In Place" or "In Development" as shown in the following graph.

State Water Conservation Policies and Strategies: The scope and breadth of water conservation policies varies by state and may be included as part of a larger policy or strategy for water demand management (e.g., conservation pricing, mandates, and efficiency) and/or water supply management (e.g., storage, reuse, and leak mitigation). Taken together, these efforts can make up the framework of a comprehensive water resource management plan. Following are examples of the variety of strategies states are using to address water issues.

- **Illinois:** The Illinois Governor's Executive Order 2006-1 calls on the Illinois Department of Natural Resources, in coordination with the State Water Survey, to define a comprehensive program for state and regional water supply planning and management, and assess the quantity of surface water and ground water.

- **New Hampshire:** In New Hampshire, all new withdrawals are required to implement water conservation, though there is no specific state strategy in this regard.

- **Wisconsin:** The state of Wisconsin has a number of individual programs that address water conservation. They consist of wellhead protection plan requirements, a high capacity well regulation, plumbing codes, and water accounting and loss control for public drinking water utilities.



- **Arizona:** Mandatory water conservation is required in the state's five Active Management Areas (AMAs). These areas were established to provide long-term management and conservation of the limited groundwater supplies. In order to accomplish this, the AMAs administer state laws; explore ways of augmenting water supplies to meet future needs; and routinely work to develop public policy in order to promote efficient use and an equitable allocation of available water supplies. The AMAs also have drought and conservation planning and reporting requirements.

- **Iowa:** The state of Iowa has legislative authority to mandate water conservation, but has not yet developed a comprehensive strategy. Nor has the state required water users to develop their own emergency conservation or long term conservation plans.

- **Massachusetts:** The state adopted revised state-wide Water Conservation Standards in July 2006, that are required through water withdrawal authorizations. Municipalities may implement their own requirements as well.

- **Maryland:** Maryland mandates water use restrictions only during drought emergencies. Local governments require voluntary or mandatory water use restrictions as needed and the state plumbing code limits the maximum flow for fixtures.

State Water Conservation Mandates: A number of states have drought mitigation plans, laws, or policies such as: requiring water systems to decrease water usage; requiring water systems to install source and service meters within specific time frames; requiring permits for water withdrawals; requiring leak detection and repair programs; and establishing water conservation standards. Following are some exemplary approaches that states may wish to consider.

- **Delaware Water Supply Self-Sufficiency Act:** This legislation directs all larger water utilities operating in northern Delaware to charge residential customers a higher rate if they exceed a certain level of water use. By 2010, northern Delaware utilities will be required to have secured sufficient sources of supply within the state to manage in the event of another severe drought. The legislation also requires periodic water supply information from investor-owned utilities to ensure that supplies are keeping up with demand. In conjunction with this legislation, funding

was established to provide low-interest loans and/or hardship grants throughout the state to individuals with older, leaking plumbing systems that cause water loss, or failed domestic wells. Additional elements of the law require:

- Applications for new or expanded water withdrawals to include water conservation plans and/or describe water-conserving practices and technologies designed to minimize the use of water by municipal, industrial, and agricultural users;
- Metering, recording, and reporting of all water withdrawals in excess of 100,000 gallons per day (gpd);
- Purveyors to develop and undertake leak detection and repair programs if they distribute water in excess of 100,000 gpd;
- Purveyors to install meters associated with the provision or maintenance of service at the retail level described in 1998 mandate;
- Water conservation (efficiency) performance standards for plumbing fixtures and fittings; and
- Water usage reporting.

- **Wisconsin:** The Wisconsin Department of Natural Resources is leading an inter-agency workgroup in developing the state's water conservation and efficiency objectives for the Wisconsin portion of the Great Lakes-St. Lawrence River Basin Sustainable Water Resources Agreement. In the Agreement, the Governors and Premiers committed to developing regional water conservation and efficiency goals and objectives which would then be used to inform the development of state and provincial goals and objectives.

- **Maryland:** In 2002, Maryland passed the Maryland Water Conservation Act[16] which requires certain public drinking water systems to include a description of best management practices when applying for a new or expanded water appropriation permit. As part of these requirements, the Maryland Department of the Environment developed written guidance for public water systems on best management practices for conserving water.[17]

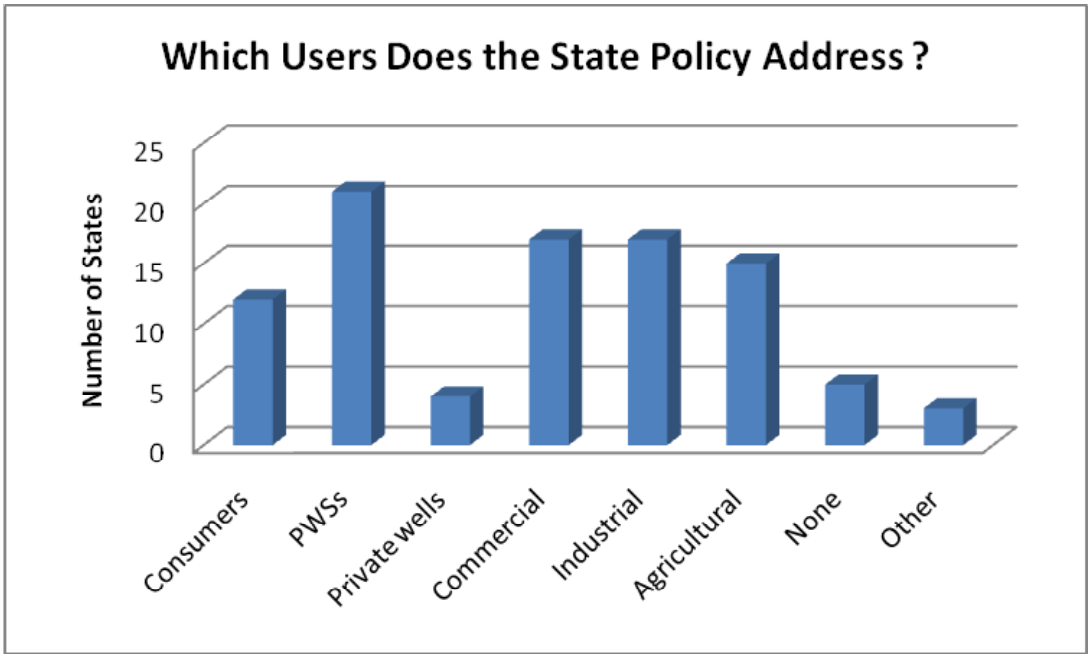
- **Iowa:** Iowa rules require regulated users to reduce their consumptive use by 50 percent during drought emergencies and have stream flow criteria that prohibits consumptive withdrawals for streams by all users except public water systems.

- **Washington:** In 2003, the state passed the Municipal Water Law which gave water systems more flexibility and certainty about their water rights. In exchange, the law requires the water systems to use water more efficiently. The Department of Health's Office of Drinking Water adopted a rule that requires these water suppliers to establish water saving goals through a public process, install service meters within 10 years, meet a distribution system leakage standard, and develop and carry out a water use efficiency program. They must report annually on progress towards meeting goals and using water efficiently. Legal cases have also had an effect on water resource management in Washington. Supreme Court cases that have had a direct impact on public water systems include the following.

  - Obligations of water users to maintain efficient water delivery and use systems that are not wasteful (Grimes v. Department of Ecology, 1993).
  - Authorization for the Department of Ecology to place new conditions on extensions for water right permits and issue certificates of water rights only when that water is put to actual beneficial use (Department of Ecology v. George Theodoratus, 1998).
  - Water right relinquishment and exemptions being limited based on beneficial use and the timing of that use (R.D. Merrill Co. v. Pollution Control Hearings Board, 1999).

- Land developments that are supplied with domestic water from several wells when those wells together will pump more than 5,000 gallons per day do not qualify for a water right exemption (Department of Ecology v. Campbell & Gwinn, LLC, et al).

State Water Conservation Policies for Specific Users: State water conservation policies may be directed at residential, commercial, industrial, or agricultural users, as well as specific areas or groups within each category of users. For example, Rhode Island requires large and medium sized public water systems (serving populations over 3,300) to have water conservation plans.



- **Water Reuse or Reclaimed Water Programs:** An increasing number of states are considering use of recycled and reclaimed water for a variety of purposes (i.e., on golf courses and for power plants). Twenty-seven percent of ASDWA WAVS Survey respondents were not currently active or planning activities in this program area, while 73 percent were. In addition, 48 percent of responding states indicated that they have regulations regarding the quality of reclaimed water and reuse site control practices. Three of those states indicated that the regulations are being implemented through their Clean Water Act program.

  - **California:** California Code of Regulations Title 22 allows for many uses of recycled water. In San Diego, the uses for recycled water include irrigation of food crops, parks, playgrounds, school yards, residential landscaping, cemeteries, freeway landscaping, golf courses, ornamental nurseries, pasture for animals, orchards, and vineyards. In addition, recycled water can be used for fishing or boating recreational impoundments, fish hatcheries, cooling towers and decorative fountains. Other allowable uses include flushing toilets and urinals, industrial process water, commercial laundries, making artificial snow making, soil compaction, concrete mixing, and flushing sanitary sewers.

- **Alternative Water Supplies – Advanced treatment for poor source water quality:** Emergency response planning has forced drinking water systems to consider alternate and sometimes lower quality sources of drinking water as a means to prevent service disruptions caused by a natural disaster or contamination incident. State Water and Wastewater Agency

Response Networks (WARNs) have helped put mutual aid agreements in place for water systems to share resources and help each other through emergencies.

- **Desalination projects:** States and water systems continue to develop new technology and consider desalination options as growing populations place increasing demands on fresh drinking water sources.

  - **California:** California has approved a plan to build the Western Hemisphere's largest desalination plant. This $300 million project is expected to eventually produce 10 percent of San Diego County's water supply from ocean water. Final approval will be contingent on the ability of the plant to be carbon neutral and to restore wetlands to make up for the marine life that would be destroyed by the plant's intake system.

  - **Massachusetts:** Massachusetts has a draft desalination policy under development. The state will soon have its first large desalination facility going on-line in 2008.

- **Aquifer Storage and Recovery (ASR):** A number of states are considering or using aquifer storage and recovery. ASR involves injecting water into an aquifer through wells or by surface spreading and infiltration and then pumping it out when needed. The aquifer essentially functions as a water bank. Deposits are made in times of surplus, typically during the rainy season, and withdrawals occur when available water falls short of demand. Following are some state examples:

  - **Iowa:** Iowa has several ASR wells in place and under consideration.

  - **New Hampshire:** Public water systems in New Hampshire have been considering ASR over the last few years and the state has one recharge enhancement project underway.

  - **Oregon:** Oregon is considering ASR options.

  - **Montana:** Funds were appropriated for the Montana Bureau of Mines and Geology to conduct an ASR study.

- **Other alternatives:** A number of states are examining other alternative water supply options such as cisterns and rain catchment. Following are some examples of these efforts that exist in some states:

  - **Mississippi:** Regulations have established drinking water supply as the top priority beneficial use in the state. This has allowed the state to manage its resources more effectively by promoting the use of its prolific deeper aquifers that typically contain poorer quality ground water. For example, energy companies requiring large volumes of water for power production or salt dome leaching for natural gas storage are often required to tap deeper aquifers.

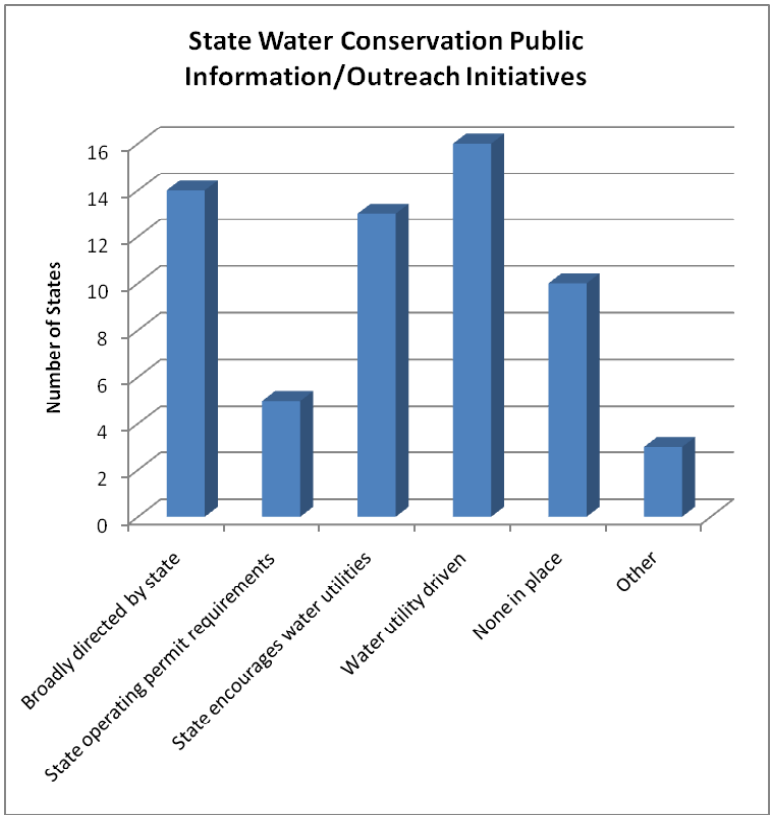
  - **Massachusetts:** State water conservation standards promote cisterns and stormwater management in Massachusetts and water withdrawal permits may include conditions requiring or promoting such systems.

  - **Arizona:** The state of Arizona has some local programs for rain water harvesting.

PUBLIC INFORMATION, OUTREACH INITIATIVES, AND INCENTIVE PROGRAMS FOR WATER CONSERVATION/EFFICIENCY

The following chart provides an overview (based on ASDWA's WAVS Survey responses) of the variety of ways that water conservation public information and/or outreach initiatives are carried out. Again, these efforts differ greatly in how they are directed, whom they are aimed at, and what they address. Following are some details and examples of these various types of initiatives.

Residential and Commercial Programs: A variety of water conservation programs that address personal water use, plumbing fixtures, and/or lawn care have been initiated throughout the U.S. For example, some public water systems have implemented rebate programs for installing energy efficient plumbing fixtures. Following are some specific programs and initiatives in these areas.



- **WaterSense and Energy Star Programs[18]:** EPA's program promotes water-efficient products and services, including "Energy Star" for water utility processes. "WaterSense" is a partnership program sponsored by EPA that seeks to protect the future of our nation's water supply by promoting water efficiency and enhancing the market for water-efficient products, programs, and practices.

  WaterSense will help consumers identify water-efficient products and programs. The WaterSense label will indicate that these products and programs meet water efficiency and performance criteria. WaterSense labeled products will perform well, help save money, and encourage innovation in manufacturing.

  WaterSense is partnering with irrigation professionals and irrigation certification programs to promote water-efficient landscape irrigation practices. WaterSense is also partnering with manufacturers, retailers and distributors, and utilities to bring WaterSense products to the marketplace and make it easy to purchase high-performing, water-efficient products.

- **Nexus Between Energy Use and Water Infrastructure:** Providing drinking water and wastewater services to citizens across the nation obviously requires a lot of energy. The Energy Star program estimates that about $4 billion is spent annually for energy costs to run drinking water and wastewater utilities. EPA efforts on water and energy include outreach to promote water efficiency through the WaterSense program, as well as a suite of activities and tools that focus on energy use at utilities. The Agency recommends that, in our collective work with the water utility industry, we encourage our counterparts to identify approaches to integrate energy efficient practices into their daily management and long-term planning.

- **Water Utility Climate Alliance:** United by the fact that climate change poses a major long-term challenge to delivering high-quality drinking water, eight of the nation's largest water utilities announced the formation of a coalition, the Water Utility Climate Alliance (WUCA). The alliance will work to improve research into the impacts of climate change on water utilities, develop strategies for adapting to climate change, and implement tactics to reduce their greenhouse gas emissions. The Climate Alliance is comprised of: Denver Water, the Metropolitan Water District of Southern California, New York City Department of Environmental Protection, Portland Water Bureau, San Diego County Water Authority, the San Francisco Public Utilities Commission, Seattle Public Utilities and the Southern Nevada Water Authority. The WUCA members supply drinking water for more than 36 million people throughout the United States.

ASDWA Water Availability, Variability & Sustainability (WAVS) Survey Observations: *While legal frameworks provide a platform for state oversight and management activities, they do not necessarily signify state involvement in all of the areas covered by these frameworks.*

Of the highest importance to states in terms of priorities that need attention.

- *Inadequate State Resources/Capacity to Manage Water Use*
- *Inadequate State Capacity to Limit Growth of Water Demand (i.e., using smart growth principles)*

POTENTIAL INVOLVEMENT AREAS – STATE DRINKING WATER PRIORITIES AND NEEDS

The initiatives and activities that have been discussed throughout this document are just the beginning of a multitude of efforts that will be necessary to address the nation's water availability, variability, and sustainability issues in the coming years. The following suggested action items are provided as a means for state drinking water programs to reach out and further these efforts to help create solutions. The following involvement areas represent opportunities for state drinking water programs to help promote and encourage water supply sustainability, conservation, and general preparedness across state agencies, as well as at the national and local levels.

- **Action Items for State Drinking Water Programs Across All Involvement Areas:**

  - **Provide input into the development of other agency plans and initiatives:** Work with your Governor's office, state water resource agency, state clean water agency, and state emergency management agency to coordinate the development of your state's Climate Action, Adaptation, Growth and Development, and Water Management Plans;

  - **Get involved in efforts of other agencies, organizations, and programs:** Coordinate and promote the involvement of your state drinking water program staff and water industry stakeholders, including your water utilities in the councils and workgroups that develop and implement state and local water supply management plans;

  - **Support and develop new laws and policies:** Work with your state's legislature and stakeholder groups to advocate and develop laws and policies that are protective of current and future drinking water sources and promote the long-term sustainability of water supplies; and

  - **Provide technical assistance, training, and/or guidance to water utilities:** Use the resources you have available (e.g., staff, non-profits, contractors, and/or technical assistance providers) to integrate water supply management concepts into your routine business and services as regulators and drinking water program implementers.

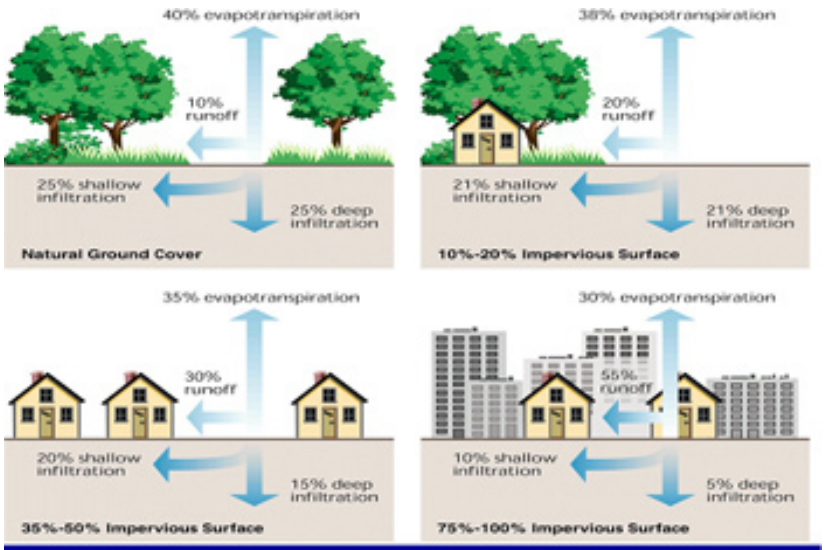
- **Integrate Comprehensive Water Resource Management Concepts:** State drinking water programs may want to integrate comprehensive water resource management concepts into their rulemaking processes, as well as their coordination efforts with their water utilities and other government programs as the nation moves forward with efforts to ensure the sustainability of drinking water supplies. These concepts are discussed in the American Water Works Association Research Foundation's publication entitled, *Total Water Management (TWM): Practices for a Sustainable Future*.[19] This document puts forth a framework to help government, utilities, and businesses ensure that adequate drinking water is available for future generations. TWM also provides a solid foundation for developing a comprehensive state water management plan (see page 19 – Georgia example). In addition, each of the water supply control mechanisms described throughout this White Paper can be related to the following TWM elements.

  - **Regional Planning:** Encourage regional watershed and aquifer based planning, management, and implementation that adapts to changing conditions;
  - **Competing Uses:** Balance competing uses of water through efficient allocation that addresses social values, cost effectiveness, and environmental benefits and costs;
  - **Government and Stakeholder Coordination:** Require the participation of all units of

government and stakeholders in decision-making through a process of coordination and conflict resolution;

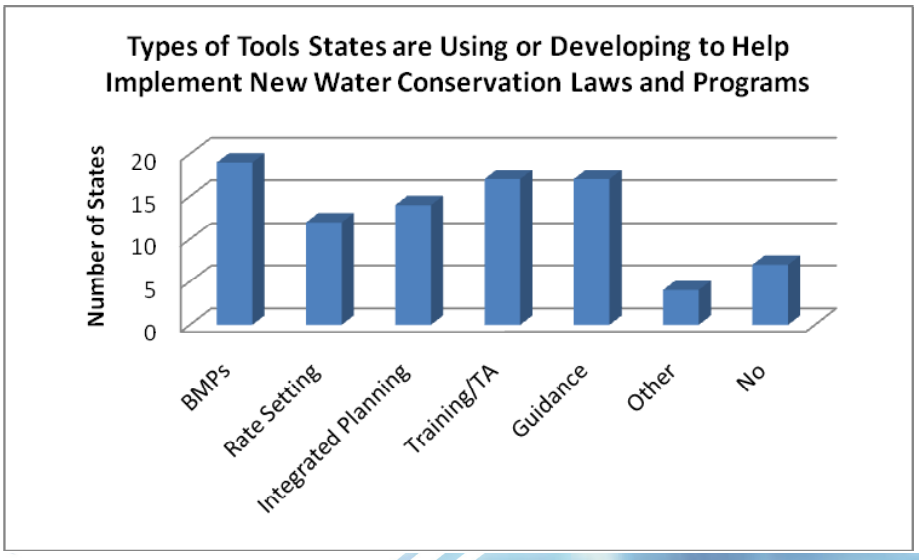
- **Water Supply Strategies:** Promote water conservation pricing, efficiency, demand management, reuse, storage, source protection, and supply development to enhance water quality and quantity; and
- **Public Welfare:** Foster public health, safety, and community goodwill.

- **Support and Promote Source Water Protection, Land Use, Smart Growth, and Green Infrastructure:** State drinking water programs should support and promote environmentally sound approaches to source water protection and sustainability through the implementation of: environmental cleanup, preservation, and protection efforts; land conservation; local land use zoning and ordinances; targeted and environmentally friendly and protective development practices and approaches; and green buildings and infrastructure, including stormwater management.



Development increases the volume and rate of runoff from a site, and reduces groundwater recharge and evapotranspiration.

- **Promote Tools and Information Sharing:** State drinking water programs should share tools and information about water conservation strategies and approaches, as well as promote and support efforts of other agencies and organizations. The following chart represents the number of states (from ASDWA's WAVS Survey) that indicated they have or are developing tools to help implement water conservation laws and programs. These types of tools (e.g., BMPS, rate setting, training, and guidance) may be applicable and adaptable for use by other states (see examples under State Water Conservation/Efficiency Policies and Options).



- **Foster Coordination and Partnerships:** State drinking water programs should take advantage of and promote opportunities for involvement in other state agency programs and activities, Federal mandates, national programs, scientific research, and local projects, including, but not limited to, the following efforts.

  - **EPA Office of Water Climate Change Strategy:** *National Water Program Strategy: Response to Climate Change*[4] includes background information and key actions for water program mitigation, adaptation, and research goals. The Strategy is based on the limited scope and responsibility and resources of EPA's Office of Water and is to be coordinated with other Federal agencies and the Water Sector, including state drinking water programs.

  - **Federal, State, and Local Agency Programs and Activities:** Coordination and partnerships with other Federal and state regulatory programs that have authority for clean water, environmental, and natural resource protection, agriculture, energy, as well as control of dams and waterways (i.e., the U.S. Army Corps of Engineers) will be particularly important to ensure sustainable drinking water supplies.

  - **State Water Program Adaptation:** State Drinking Water, Clean Water, Ground Water, and UIC programs should work together to coordinate policies and approaches toward sustainable water supplies at both aquifer-based and watershed-based resource levels. Water quality program coordination with the National Pollutant Discharge Elimination System (NPDES) permitting and Total Maximum Daily Loads (TMDL) programs that address point source and non-point sources of water contamination will also be particularly important for ensuring long-term water supply sustainability. For example, determining the amount of instream flow needed to maintain water quality standards for aquatic habitat and assessing ground water contributions to those stream flows are prerequisites for assessing current water availability under different stream flow regimes which sets the baseline for assessing source water sustainability under varying use scenarios.

  - **Congressional Mandates - Energy Policy Act:** The Energy Policy Act of 2005[20] promotes alternative technologies, biofuels, and conservation. It is the leading driver for energy policy, greenhouse gas emissions reductions, and biofuel production. The Department of Energy is working with EPA on the water and air issues detailed in this law.

  - **Water Utilities and Utility Organizations:** ASDWA and state drinking water programs will want to promote infrastructure adaptation for water variability and climate change impacts, as well as coordinate water quantity and conservation efforts, with water utilities and national water associations. This will be particularly important as efforts are carried out in relation to the "Water Sector Statement on Climate Change and Water Resources" that was developed by a group of national water associations. That statement calls on Congress to:

    - Establish a Federally sponsored research program;
    - Increase financial support to help water utilities adapt to climate change impacts and address environment and public health risks; and
    - Provide Federal support and initiatives to enable utilities to reduce GHG emissions when feasible.

> *"As people accept that climate change is real and here to stay, they are likely to realize that while reducing greenhouse gasses is all about energy, adapting to climate change will be all about water." - Frank Rijsberman*

- **Support and Promote Water Quantity Data Gathering and Assessment Efforts:** Appropriate Federal agencies and state drinking water programs should support and promote the gathering and assessment of water quantity data to further their own state's ability to make informed decisions about water management and planning efforts. ASDWA WAVS Survey responses indicated states' considerable needs for data and information pertaining to water withdrawals, conservation, and availability as follows:

  - Web based electronic reporting of water usage.
  - Processing data submitted from PWSs.
  - Mapping the location of all water withdrawals in the state, in terms of quantity, type of use, etc.
  - Better information regarding the link between groundwater withdrawals and the effect they have on surface water in-stream flows.
  - Funding for studies of coastal plain aquifer systems.
  - Thorough inventories of water resources and future growth demand. Identification of those areas that have the greatest need.
  - Information on creative and tested approaches to quantitatively achieving water conservation.
  - Modeling of sole source aquifers to determine the actual yield capacity.
  - Data on actual water withdrawal rates/capacities from irrigation and industrial users.
  - More data on the range of variability, and changes in hydrology.

- **Identify and Create Sources of Funding:** State drinking water programs will want to use existing state and Federal funding sources, as well as investigate and identify new ones, to further the sustainability of water supplies. This is in addition to maximizing the use of any resources that states already can devote toward water sustainability and conservation initiatives and activities. As more emphasis continues to be placed on climate change, sustainability of drinking water supplies, and subsequent public health implications, more Federal funding options may become available for both state and water utility mitigation and adaptation activities.

  - **DWSRF Funds:** States may use Drinking Water State Revolving Loan Fund (DWSRF) set-asides under capacity development to: assess and project water availability, variability and sustainability (availability minus use) or protect and preserve current or prospective drinking water supplies, or use the DWSRF to provide water systems with loans and/or grants to make operational and/or infrastructure adjustments to adapt to changes in the variability of their water supply quantity and quality.

  - **Other Programs, Loans, and Grants:** States should also consider if and how funds from other state and Federal programs might be pooled or could be directed toward creating grant programs for water utilities. In addition, state drinking water programs will want to work with their state and local counterparts (e.g., Clean Water Act (CWA) programs and soil and water conservation districts) to promote the use funds from the Clean Water State Revolving Loan Fund (CWSRF) and Nonpoint Source Management Program (§319, CWA), and the U.S. Department of Agriculture (USDA) National Resource Conservation Service's Conservation Reserve Program and Environmental Quality Incentive Program for source water (watershed) protection and conservation projects.

From 1997 through 2007, states provided $12.6 billion in DWSRF loans for 5,555 projects to promote and support sustainable drinking water infrastructure - EPA 2007 Annual DWSRF Report

- **Host and Support Conferences and Seminars:** Another way for state drinking water programs to promote, support, and take action to help ensure the sustainability of water supplies is by attending and/or conducting conferences and seminars, particularly in concert with their water resource management counterparts. Again, many other agencies and programs are already holding these types of meetings to provide information about what they are doing as wells as asking for stakeholder input on their efforts. In addition, state drinking water programs can be proactive by arranging a meeting with nearby states, working with other agencies in their state to coordinate meetings, or hosting meetings for and with their water utilities.

- **Conduct Outreach:** State drinking water programs will need to be proactive to ensure involvement in national climate change adaptation strategies and initiatives. As many of these national initiatives move forward and local communities struggle to adapt to changes in water supply from the effects of energy production and greenhouse gas emissions, as well as natural and manmade disasters, it will become increasingly necessary to provide information and reach out to, as well as foster relationships with, other agencies and organizations.

- **Further Public Education:** Some examples of state public information and outreach initiatives were provided throughout this document. State drinking water programs should take the initiative to actively promote the value of drinking water in all of their efforts and particularly continue to stress this with regard to water supply and sustainability issues. Safe drinking water is essential to public health and the economy.

Smart Growth Principles for Building Communities that Protect Water Resources

- Establish community goals for water resources in the watershed
- Direct development where most appropriate for watershed health
- Minimize adverse impacts of development on watershed health
- Promote opportunities for restoration
- Assess and prevent unintended consequences of Federal, state or local decisions affecting watershed health
- Plan for safe, adequate, and affordable water supplies as an integral part of growth
- Consider the cumulative impacts of growth management decisions on the watershed
- Monitor and evaluate success of initiatives

For additional principles see http://www.smartgrowth.org/about/principles/default.asp

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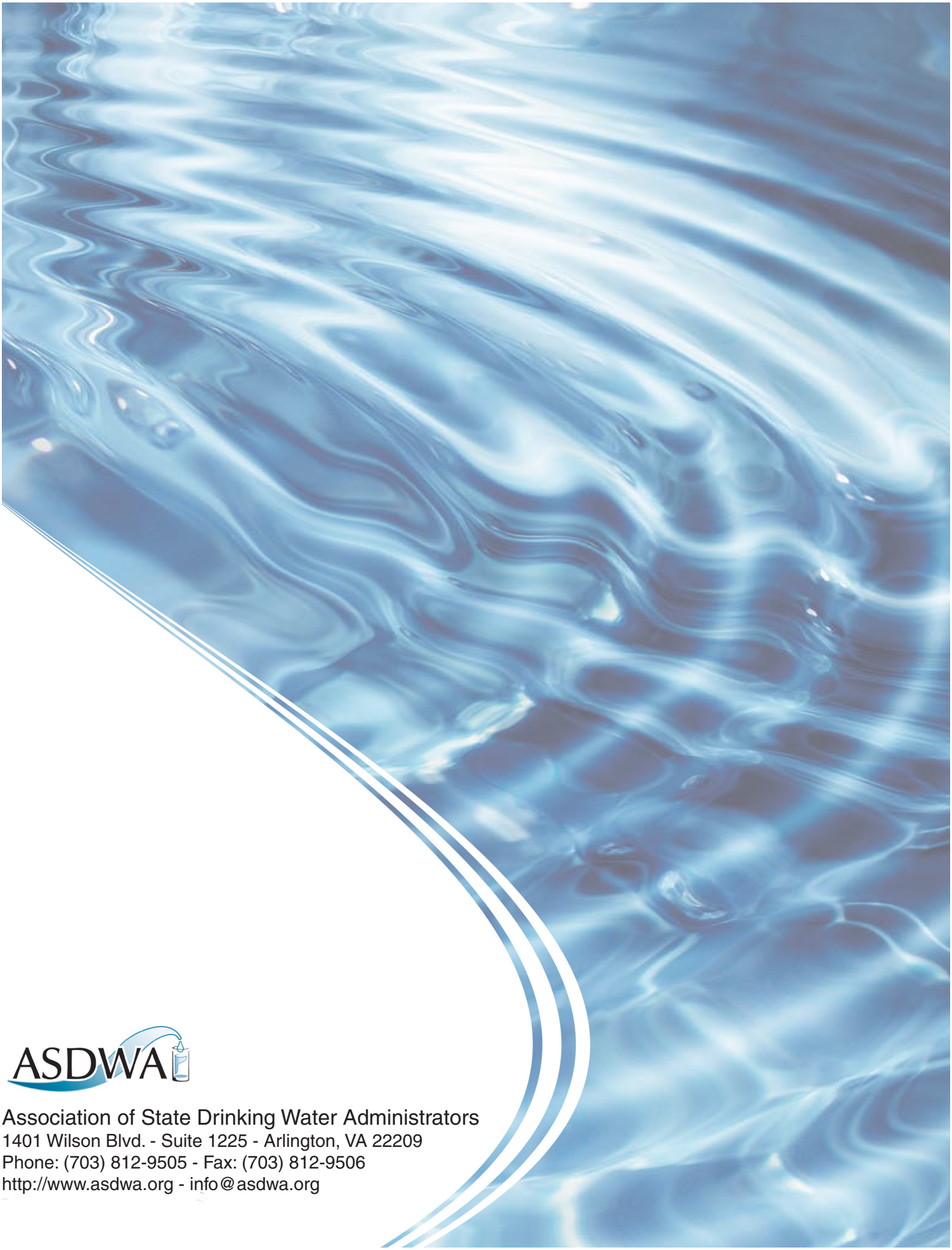

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