Careers in Water Conservation

James Hamilton

September 2013 — Report 12

Water is society's most valuable resource. Without it, we cannot sustain life. Water is also important to the wildlife, including fish, migrating waterfowl, and other animal species, that need water to survive.

However, our supply of fresh water is limited. Fresh water makes up less than 3 percent of the water on the Earth's surface, but most of this water is trapped in polar ice caps, glaciers, or located in very remote areas. This means humans have access to about 1 percent of the water on Earth.[1] Water conservation pertains mostly to fresh water, because it is a limited resource. Although it is important to protect other types of water, fresh water is vital for civilization. Water conservation helps to ensure that available water supplies are used in the most efficient ways possible. Individuals and households can conserve water, as can businesses, and local, regional, and federal governments practice and encourage water conservation as well. Water conservation focuses on household, municipal, commercial, industrial, and agricultural water use.

This report describes where water comes from in the first section, and explains what water conservation is in the second section, who has a role in conserving water in the third section, and how water is conserved in the fourth section. The fifth section profiles key occupations in water conservation. The information for each occupation includes a brief job description; the credentials needed to work in these occupations, such as education, training, certification, or licensure; and wage data.

James Hamilton is an economist in the Office of Employment and Unemployment Statistics, BLS. James Hamilton is available at (202) 691-7877 or *hamilton.james@bls.gov*.

Where does our water come from?

Fresh water comes from a variety of sources, and each of these sources provides only a limited amount of water.

Water is collected from rivers, lakes, and streams or may come from an aquifer—an underground layer of water that is usually pumped to the surface through a well. After water is collected from the original source, it is transported through pipes or aqueducts to a reservoir, or it may flow directly into a water treatment plant where it is filtered and purified before use. After water is used, it is collected in sewers and is directed to a wastewater or sewage treatment plant, where it is again cleaned and purified before being released back into the environment or reclaimed for use in landscaping.

What is water conservation?

Water conservation focuses on limiting or decreasing total water use so that the rate at which water is used does not exceed the rate at which it is replenished. Conservation may also include finding new sources of water to meet current and growing demand. Factors affecting the demand for water include the size of the population and its growth, where people live, and household income.[2] At least 36 states currently face water shortages.[3] Increased population growth in dry areas of the United States, such as the southwest, has made water an increasingly scarce resource in those areas. As a household's income grows, the household has greater personal demands for water, such as to maintain gardens, lawns, and swimming pools. Global climate change may pose even greater threats to our water supply. Global warming can affect water supply by causing moisture to evaporate from the soil. Because of this, some areas may experience more frequent and severe droughts in the future.[4]

There are many reasons to conserve water. Water conservation helps to ensure that there is enough water available to meet society's needs, now and for future generations. Another reason is energy conservation; it takes a lot of energy to pump water from the source to the final user.

Water conservation can also preserve natural habitats. Minimizing water use prevents these habitats from being damaged, either from a lack of water or from the need to build new dams and reservoirs. Building dams and reservoirs is expensive and can have an impact on the environment significantly. Because they impede natural water flows, dams and reservoirs change the temperature and mineral content of the water and block wildlife access to land or water.[5] Man-made reservoirs also flood previously dry land, making it unavailable for any productive uses.

Conserving water also has financial benefits. Most households and businesses must pay a water bill, and that bill will be lower if they use less water. Households can save hundreds of dollars a year by using water more efficiently and large companies save much more by conserving water.[6]

Who has a role in water conservation?

Water conservation typically begins at the household level, with individuals and families conserving water by limiting the amount they use for daily activities. Businesses can also conserve water through techniques that vary based on the type of business. Agriculture is the largest user of water (crop irrigation accounts for 70 percent of the world's fresh water use), and improved irrigation and farming techniques play a large role in water conservation. Local or municipal water conservation is typically carried out by local utilities or governments. In addition, state and federal regulations are in place to conserve water.

The average person uses about 80 to 100 gallons of water per day.[7] This includes water for drinking and for other uses, such as bathing, washing hands, brushing teeth, washing dishes, doing laundry, flushing toilets, and watering plants and lawns. Household water conservation begins with individuals and families limiting their daily water use. They can conserve water by paying attention to the amount of water they use or by implementing water-saving technologies, such as low-flush toilets.

Water conservation at the commercial and industrial level uses many technologies that are similar to those at the household level. Technologies increasingly being adopted for commercial use include water-saving sensors in kitchen and bathroom sinks, waterless urinals, waterless carwashes, and pressure washers.

In these settings, the amount of water used depends on the type of business. For example, restaurants typically use

large amounts of water for preparing food and cleaning. Most offices use relatively little water for daily operations. In addition, the type of business determines which water-saving technologies are most appropriate and effective. For example, hotels conserve a lot of water by not laundering towels and linens each day for guests who stay multiple days. Many hotels give guests the option to reuse these items instead of having them laundered each day.

Agriculture is the biggest user of water in the world, so finding ways to reduce the amount of water used for agriculture is important.[8] Farmers and ranchers have a variety of methods for reducing agricultural water conservation. These include improved irrigation methods, choosing crops that require less water, and more efficient land use. For example, many farms have switched to overhead irrigation, which is more efficient than flood irrigation.

State, local, and federal governments all have a role in conserving water. In states with dry climates, such as California,[9] state government programs help ensure that water is used wisely. Regulations or incentives at various government levels support water conservation, such as those for building codes that specify rules and rebates and for tax breaks with the purchase of water-saving plumbing fixtures or appliances.[10] In addition, local utilities and municipal governments may promote water conservation by imposing restrictions on how water may be used, such as by prohibiting lawn watering or car washing during certain times of year or when the water supply is low. They may also use public outreach campaigns to encourage water conservation. Finally, some areas have tiered water rates—charging progressively higher prices as water use increases.

At the federal level, several laws pertain to water use. The Clean Water Act is one of the most important environmental laws in the United States. The Act regulates the types of chemicals and pollution and the amount of wastewater that can be released into rivers, lakes, streams, and aquifers. It also sets standards for wastewater treatment.[11] By limiting water pollution, the Clean Water Act helps ensure that our water supplies are free from contamination and are available for use.

How is water conserved?

There are many technologies and methods to conserve water. Some of them are appropriate for individual households or businesses; others are suitable for large-scale applications. There are also ways to use nonfresh-water sources, such as greywater and desalinated water, in place of fresh water.

Among the most effective technologies for water conservation are water-efficient plumbing fixtures and appliances. Low-flow aerators limit the amount of water coming out of a faucet by blocking a portion of the mouth of the faucet. The water that flows out of the faucet is separated into several different streams instead of a single, solid one. Some models add pressurized air to the stream of water, allowing the faucet to emit less water while maintaining high water pressure.[12] Modern appliances—including dishwashers, water heaters, and washing machines—are designed with water conservation in mind. These appliances use significantly less water than older models. Moreover, replacing older appliances with newer, water-efficient ones greatly cuts down on cost and water use.

Water-efficient toilets are another effective way to reduce water consumption. Dual-flush toilets have two different settings: one for solid waste, the other for liquid waste. Older toilets use about 5 gallons of water for each flush, but new ones may use only 1.6 gallons per flush for solid waste and less than 1 gallon for liquid waste.[13] Waterless urinals also save water.

Water that is not suitable for drinking may be used for other purposes, such as watering plants or flushing toilets. Known as greywater, this water is recycled from showers, bathroom sinks, washing machines, and drinking fountains. Rainwater can be collected as runoff and used for the same purposes as greywater. Plumbers must install additional pipes and storage tanks to keep greywater and rainwater separate from drinking water.

Wastewater—water that has already been used and collected through sewer systems—may be used for non-drinking purposes after being treated. This water, known as reclaimed water, is processed at a wastewater treatment

plant to remove contaminants. Often, reclaimed water is cleaner than drinking water, but it is almost always limited to use in landscaping. Many cities use reclaimed water to maintain parks, golf courses, and other outdoor facilities.

Households and businesses can look to green landscaping practices to cut down on their water use. Landscaping is water intensive, but a technique known as xeriscaping uses significantly less water than the amount required for traditional landscaping. Xeriscaping uses native plants that do not require as much water and minimizes the number of plants in a landscape. For example, a common practice in xeriscaping is replacing grass either with plants that do not need much water or with rock gardens. Xeriscaping may also use water-efficient sprinkler systems that operate at times other than peak sunlight hours to reduce evaporation.

Traditionally, farmland has been watered using flood irrigation, in which the entire field is immersed in water. This is often wasteful because some parts of a field may receive excess water, while other parts of the field receive sufficient water. Overhead irrigation—water that is sprayed onto plants from sprinklers—is a more direct way to deliver water to crops. Another method is drip irrigation, in which water is slowly piped into the soil around crops to minimize runoff and evaporation, but it is expensive and not suitable for large-scale farming.

Often, upgrading existing irrigation systems can conserve large amounts of water. This can be done by creating dikes to prevent runoff and using soil moisture and rainfall sensors deliver water only when and where it is needed.

Another way of increasing the available water supply is to use desalination, the process of making fresh water out of salt water. Desalination would allow areas near the ocean to use the expansive supply of ocean water to meet their needs. However, desalination is energy-intensive and expensive, so it is currently not practical for widespread use.

Water conservation occupations

Many different types of workers are involved in water conservation. Scientists may find new sources of water or find ways to use water more efficiently. Engineers design and develop new products and procedures for saving water. Planning and outreach workers ensure that communities and landscaped areas use water efficiently, and they educate people about water conservation. Construction and water operations workers implement water-saving devices and procedures. Agriculture and grounds maintenance workers help reduce the use of water for farming and landscaping.

Those who work in water conservation are employed within various industries, including federal, state, and local governments; utilities; construction; and agriculture, among others. However, the U.S. Bureau of Labor Statistics (BLS) does not have a count of those who work solely in water conservation.

Science occupations

Scientists who work in water conservation devise technical solutions for reducing water use and develop ways to tap into new sources of fresh water. They plan strategies to conserve water resources and ensure that water is used as efficiently as possible. Scientists are also involved in reducing water use and ensuring that our water is safe. They measure levels of pollution and chemical contamination. Some scientists are involved in preserving water ecosystems and habitats.

Scientists generally work as part of a team that includes other types of scientists, engineers, and science technicians. Science technicians work under the supervision of scientists and assist them in their duties.

Scientists often work in an office or laboratory, and many spend time working outdoors. They may be employed by government agencies, universities, or private companies. Some scientists are hired as advisors for special projects.

Microbiologists work in laboratories studying water samples to ensure that the samples are free of harmful parasites, and that any microorganisms found in the water are not harmful to humans or the natural environment. Microbiologists study these microorganisms and their effects on the environment and human health. They may devise ways to remove harmful microorganisms from our drinking water, or use them clean up pollution. For example, oil spills are often treated with special microorganisms that break down the chemicals in the oil. Microorganisms such as bacteria and other parasites can pose health problems in humans. If water is not treated properly, large numbers of people can become infected. The water coming out of municipal water systems' treatment plants must be free of harmful microorganisms. Treated wastewater must also be safe to release back into the natural environment.

Water conservationists are conservation scientists who give technical help to people concerned with the conservation of water. They help private landowners and governments by advising on water quality, preserving water supplies, preventing groundwater contamination, and conserving water.

Chemists analyze the chemicals found in water to make sure it is safe for use. Water may contain pollutants, such as fertilizers from farm runoff or industrial chemicals that have been released into the environment. In addition, water typically contains many dissolved minerals from natural sources. They also handle water purification, using chemicals to kill harmful microorganisms and processes to remove harmful chemicals.

Environmental scientists and specialists protect natural water sources from pollutants and other contamination by studying the sources and effects of this pollution and determining ways to clean it up and prevent further pollution. They may also work to reclaim contaminated water by devising ways to clean the water and determining suitable uses for the water after it is cleaned. Environmental scientists ensure regulations are followed so that the water is healthy to use and any damage to the environment from water use is minimal.

Hydrologists study water and the water cycle and analyze how they influence the surrounding environment. They study the movement, distribution, and other properties of water and may measure bodies of water, such as volume and stream flow. They may also research how to improve water conservation and preservation. Some hydrologists use computer models to forecast future water supplies, the spread of pollution, and to find new sources of fresh water. Hydrologists are also vital in evaluating the feasibility of water-related projects, such as hydroelectric power plants, irrigation systems, and waste treatment facilities.

Credentials

Most scientists need at least a bachelor's degree from a program that includes both coursework and laboratory hours. A scientist who is leading a research team or conducting independent research typically needs a master's or doctoral degree. Hydrologists typically need a master's degree. It is common for scientists to pursue a specialized degree in a subfield, such as bacteriology or toxicology.

Analytical skills are important for those conducting experiments and determining an outcome or a reasonable way to continue an experiment. Scientists also need oral and written communication skills because they often work as part of a team, and must be able to share the results of their analyses with others. In addition, scientists must be detail-oriented when conducting experiments and recording data.

Wages

The table that follows shows wages for selected science occupations in May 2012. The wages shown are median annual wages for the United States as a whole; wages vary by employer and location.

Table 1. Selected science occupations	Median annual wages, May 2012[1]
Microbiologists	$66,260
Conservation scientists	61,100
Chemists	71,770
Environmental scientists and specialists, including health	63,570
Hydrologists	75,530

[1] Occupational Employment Statistics data are available at **www.bls.gov/oes**. Data do not include benefits.

Engineering occupations

Engineers' role in water conservation is to apply strategies that reduce the use of water. They may develop new technologies that decrease the amount of water used for certain activities. They may also design water delivery and storage systems and water treatment facilities.

Engineers work alongside scientists, engineering technicians, and others to apply technical solutions to water conservation. Engineering technicians work under the supervision of engineers and assist them in their duties.

Engineers may design and test various types of machinery and water-efficient appliances. They ensure quality control and oversee compliance with standard operating procedures and federal, state, and local regulations. Engineering technicians work under the supervision of engineers to complete many engineering tasks.

Agricultural engineers find technological solutions to reduce water use on farms. They may design agricultural machinery and equipment or irrigation systems that use water more efficiently, and help determine how to deliver the most water for a given type of crop. Agricultural engineers may also be involved in pollution management, preventing runoff from fields that could pollute local water sources.

Civil engineers design and supervise large construction projects. They may be responsible for the design or upkeep of a city-wide water distribution system or sewer system. They are involved in significant construction projects and may design and supervise construction of a "green" building with water conservation in mind.

Environmental engineers develop ways to improve and protect the water supply. They may prepare, review, and update environmental investigation reports and design projects leading to environmental protection, such as water reclamation facilities. Environmental engineers are

also involved with cleaning up pollution or hazardous materials, where they evaluate the extent of the pollution or the significance of a hazard. They may also help with the design of municipal water supply and industrial wastewater treatment systems, and they research the environmental impact of proposed projects.

Industrial engineers are involved in improving industrial practices and increasing efficiency. They devise ways to use less water more efficiently. They may design systems that contain or cleanse water that has become contaminated through industrial processes.

Mining and geological engineers use their knowledge to evaluate sources of water, particularly underground sources. Groundwater is typically in aquifers, which may be made up of porous rock, sand, or gravel. Engineers may help identify the boundaries of an aquifer and determine which sites are best for drilling wells to bring water to the surface.

Credentials

Engineers usually need at least a bachelor's degree in an engineering field. Engineers in water conservation may specialize, as described above, and usually work solely in that specialty. Licensure as a professional engineer (PE) is recommended and often required, depending on an engineer's specialty. Entry-level engineers work under the direction of senior or supervisory engineers and may assist senior engineers on sustainability projects.

Wages

The table that follows shows wages for selected engineering occupations in May 2012. The wages shown are median annual wages for the United States as a whole; wages vary by employer and location.

Table 2. Selected engineering occupations	Median annual wages, May 2012[1]
Agricultural engineers	$74,000
Civil engineers	79,340
Environmental engineers	80,890
Industrial engineers, including health and safety	78,690
Mining and geological engineers, including mining safety engineers	84,320

[1] Occupational Employment Statistics data are available at **www.bls.gov/oes**. Data do not include benefits.

Planning and outreach occupations

Water conservation requires planning and outreach. When new communities or large infrastructure projects are planned, water use must be taken into account. Water conservation is a concern especially in drier areas that are being developed. Water utilities and government water agencies may employ planning and outreach workers to educate the public about water conservation and to develop and implement conservation strategies. These workers typically are in offices.

Urban and regional planners and operations research analysts are active in these large-scale strategies for water use. Landscape architects design grounds that minimize water use but remain aesthetically pleasing. In addition, outreach is important to inform the public about water conservation. Public relations specialists educate the community about water conservation, and work to increase its support.

Urban and regional planners develop strategies for land use. They create plans for new communities, to accommodate growth, or to revitalize areas. Water supply and use are two of the biggest factors to take into account when planning new communities. Planners must ensure that there is enough water available to support development. Urban and regional planners have a broad view with respect to community development, and their preparation is essential to ensure efficient use of water.

Operations research analysts use sophisticated computer software, such as databases and statistical and modeling packages, to solve problems. They decide how to allocate water when communities or new structures are being planned, and help utilities and other organizations figure out the most effective way to distribute water. They evaluate costs and benefits of water projects and work with scientists, engineers, and others to develop solutions to water distribution, sanitation, and conservation problems.

Landscape architects plan and design land areas for parks, recreational facilities, highways, and other properties. They confer with their clients to understand a project and prepare site plans, specifications, and cost estimates. They may practice xeriscaping to choose the type and quantity of plants for a landscaped area. Part of their job is to determine how much water their landscapes require and to plan ways to ensure that the land is properly watered and drained. They may plan automatic sprinkler layouts that minimize overlapping spray patterns and that operate at night or in the early morning to minimize water loss through evaporation.

Public relations specialists educate people about water conservation. Because water conservation requires the participation and cooperation of the general public, public relations specialists inform people about what they can do—and what utilities and local governments are doing—to conserve water. Public relations specialists may work for utilities or government agencies and develop strategies to publicize water conservation initiatives. They may write materials for media releases, plan and direct public relations programs, and answer media inquiries.

Credentials

Workers in the above water conservation planning and outreach occupations typically need a bachelor's or master's degree to enter the occupation. Most urban and regional planners have a master's degree from an accredited urban or regional planning program. These programs accept students with a variety of undergraduate backgrounds, including economics, geography, political science, or environmental design. Operations research analysts need a master's degree for most research positions, but a bachelor's degree may be enough for most entry-level positions. Many analysts have a degree in a related field, such as mathematics, statistics, or computer science.

Landscape architects usually need a bachelor's or master's degree in landscape architecture. Many employers recommend that prospective landscape architects complete an internship with a landscape architecture firm during their formal education. Public relations specialists typically have at least a bachelor's degree in public relations, journalism, communications, or a related field. They are then trained on the job for 1 month to 1 year.

Wages

The table that follows shows wages for selected planning occupations in May 2012. The wages shown are median annual wages for the United States as a whole; wages vary by employer and location.

Table 3. Selected planning occupations	Median annual wages May 2012[1]
Urban and regional planners	$65,230
Operations research analysts	72,100
Landscape architects	64,180
Public relations specialists	54,170

[1] Occupational Employment Statistics data are available at **www.bls.gov/oes**. Data do not include benefits.

Construction occupations

Construction workers—including construction managers, construction laborers, construction equipment operators, pipelayers, plumbers, and septic tank servicers and sewer pipe cleaners—build and install the infrastructure for conserving water. They build new water delivery and storage systems. They also build new dams and reservoirs, dig wells, lay new pipes, and install water-efficient appliances and irrigation systems. Construction workers typically are employed by construction companies and spend much of their time outdoors. Their work can be physically demanding.

Construction managers oversee building projects. These may include constructing reservoirs and water treatment plants or installing new pipes and water delivery systems. Construction managers are employed by construction companies or utilities. On large assignments, a project manager typically oversees several construction managers who supervise individual aspects of the assignment. The construction manager's time is split between working at the construction site and an office that may be either onsite or offsite.

The primary duties of a construction manager include administering permits, contracts, and the budget. Onsite, construction managers monitor progress and inspect the project for quality control. They oversee the contracting process and manage various subcontractors. They also ensure a safe work environment.

Construction laborers do many of the basic physical tasks onsite. They may clean and prepare construction sites, load or unload building materials, dig trenches, backfill holes, or compact earth to prepare for construction. They do a variety of tasks, from easy to difficult and even hazardous, on almost all construction sites.

Equipment operators use heavy machinery to move construction materials, earth, and other heavy materials at a construction site. They may dig trenches for pipes or clear a large area for a planned reservoir. Equipment operators also control cranes to lift and place heavy objects, such as collectors and storage tanks for rainwater or greywater. They set up, inspect, and adjust equipment and do some maintenance and minor repair.

Pipelayers place pipes outdoors. They install large-diameter pipes, such as water mains, or smaller pipes that

carry water from the main to houses or buildings. Pipelayers may also install sewage systems that carry waste to treatment plants. The pipes must also be protected and reinforced before the ground covers them.

Plumbers follow detailed construction drawings to install pipes and appliances in buildings. They may remove older fixtures and replace them with water-efficient ones, such as dual-flush toilets and low-flow faucets. Plumbers may also replace leaky pipes or install plumbing systems that accommodate both drinkable and non-drinkable water and thereby allow a building to use rainwater and greywater.

To conserve resources, plumbers lay out their materials and fit the pipes into the building's structure. They measure and mark areas in which pipes will be installed and connected while checking for obstructions, such as electrical wiring. To assemble a system, plumbers use saws, pipe cutters, and pipe-bending machines to fit, shape, and link lengths of pipe. When the system is ready, plumbers install appliances that use water and connect them to the water supply.

Septic tank servicers and sewer pipe cleaners ensure that septic tanks—tanks that store human waste when sewers are not available—and sewer pipes are clean and that waste material is able to flow through them properly. If septic tanks or sewers become blocked, the waste material backs up and may flow up through drains or seep into the ground nearby, which can contaminate the water supply.

Credentials

Construction managers typically need a degree in construction management, business management, or engineering and have experience working in construction. Experience is important for construction managers, so it may substitute for some educational requirements. Workers who have an associate's or bachelor's degree in construction management or engineering but do not have significant construction experience may be hired as assistants to construction managers. Construction laborers are not required to have a formal education.

Equipment operators often learn on the job, complete an apprenticeship, or do a combination of both to become certified. Becoming certified involves training and testing to ensure competence and safety. Because of safety concerns and the potential danger of operating this equipment, most construction workers are required to pass regular drug screenings.

Pipelayers typically need a high school diploma and are trained on the job in 1 month or less. Plumbers also typically have a high school diploma and receive training through an apprenticeship, which usually lasts 4 to 5 years and involves about 1,700 to 2,000 hours of paid on-the-job training and at least 246 hours of related technical instruction.

Septic tank servicers and sewer pipe cleaners need less than a high school diploma. They are normally trained on the job and are competent in performing their jobs with 1 to 12 months of training.

Wages

The table that follows shows wages for selected construction occupations in May 2012. The wages shown are median annual wages for the United States as a whole; wages vary by employer and location.

Table 4. Selected construction occupations	Median annual wages, May 2012[1]
Construction managers	$82,790
Construction laborers	29,990
Construction equipment operators	40,980
Pipelayers	36,180
Plumbers, pipefitters, and steamfitters	49,140
Septic tank servicers and sewer pipe cleaners	34,020

[1] Occupational Employment Statistics data are available at **www.bls.gov/oes**. Data do not include benefits.

Agriculture and grounds maintenance occupations

Because agriculture is the largest consumer of water resources, agricultural and grounds maintenance workers have a vital role in water conservation. In the past, fields were either flooded or watered without regard to how much water was being used. Now, agricultural workers use more efficient irrigation techniques that provide crops with the optimal amount of water while minimizing water loss. Landscaping and groundskeeping workers maintain outdoor spaces. They ensure that these areas are properly kept up and watered.

Most agricultural and grounds maintenance workers spend the majority of their time outdoors, and some of the work is physically demanding. Agricultural workers are employed by farms; grounds maintenance workers may be employed by a landscaping company or by any organization that has a large area of landscaped land.

Farmers oversee the production of crops. They supervise all steps of crop production, including planting, fertilizing, watering, and harvesting. They determine how to raise crops, taking into account the amount of water needed and the most efficient way to deliver it. They work with agricultural engineers and other workers to design irrigation systems for their fields and oversee the regular watering of crops.

Agricultural equipment operators use a variety of farm machines to plow fields, sow seeds, and maintain and harvest crops. They also operate heavy machinery to dig irrigation ditches or trenches for pipes. Some operate irrigation equipment, such as overhead sprayers. Equipment operators may also make adjustments or minor repairs.

Farmworkers and laborers handle numerous tasks related to growing and harvesting crops. They may ensure that crops receive enough water and remove weeds or unwanted plants that would consume water.

Landscaping and groundskeeping workers ensure that the grounds of houses, businesses, and parks are attractive, orderly, and healthy. They plant and care for flowers, shrubs, trees, and grass. These workers ensure that outdoor areas are properly and efficiently watered. For example, they may water only in the early morning or in the evening, so that water is not lost through evaporation. They may also adjust sprinkler systems so that sprinkler sprays do not overlap or waste water by spraying sidewalks or other non-planted areas.

Credentials

Most farmers need a high school diploma, and some have a bachelor's degree from a college of agriculture. Some farmers gain experience growing crops, tending livestock, or working part-time on a farm, others learn through an internship or other farm-based training program. Agricultural equipment operators require between 1 and 12 months of on-the-job training or a formal training program. Farmworkers and laborers need less than a high school diploma, but may need up to a year of on-the-job training. Landscaping and groundskeeping workers typically do not need any formal education and are trained on-the-job in less than 1 month.

Wages

The table that follows shows wages for selected agriculture and grounds maintenance occupations in May 2012. The wages shown are median annual wages for the United States as a whole; wages vary by employer and location.

Table 5. Selected agriculture and grounds maintenance occupations	Median annual wages, May 2012[1]
Farmers, ranchers, and other agricultural managers	$69,300
Agricultural equipment operators	25,860
Farmworkers and laborers, crop, nursery, and greenhouse	18,670
Landscaping and groundskeeping workers	23,570

[1] Occupational Employment Statistics data are available at **www.bls.gov/oes**. Data do not include benefits.

Water operations occupations

Workers in water operations occupations keep the water flowing by pumping water out of the ground and controlling water and wastewater treatment plants. They are employed by water utilities or local governments. Water and wastewater treatment plant operators work indoors in water or sewage treatment plants. Pump operators may work outdoors or in pumping facilities.

Water and wastewater treatment plant operators manage the systems of machines that transfer or treat water or wastewater. They add chemicals to disinfect water, inspect plant equipment, and monitor operating conditions, meters, and gauges. These workers also collect and test water and sewage material and operate the equipment that purifies water and disposes of sewage.

Water must go through a treatment plant at some point between the original source and the local water supply. Water treatment plant operators ensure that water is clean and safe to drink before it reaches customers. After water is used, it flows through sewer systems to a wastewater treatment plant. There, it is cleaned and filtered before being released back into the environment or being reclaimed.

Pump operators, except wellhead pumpers operate the pumps that move water through pipes to another area. These pipes can be very large and move huge volumes of water over mountains or other terrain, or they may be smaller pumps that move water from one area of a treatment plant to another. Pump operators monitor the flow of water, ensuring that the pump functions properly, and do routine maintenance or repair as needed.

Credentials

Workers in these occupations usually get on-the-job training to prepare for their jobs. Water and wastewater treatment plant operators typically need a high school diploma and receive more than 12 months of on-the-job training. Formal education is not required to become a pump operator. These workers are typically trained on the job for 1 to 12 months.

Wages

The table below shows wages for selected operations occupations in May 2012. The wages shown are median annual wages for the United States as a whole; wages vary by employer and location.

Table 6. Selected operations occupations	Median annual wages, May 2012[1]
Water and wastewater treatment plant and system operators	$42,760
Pump operators, except wellhead pumpers	44,610

[1] Occupational Employment Statistics data are available at **www.bls.gov/oes**. Data do not include benefits.

Conclusion

Fresh water is one of Earth's most important resources. Without it, life would be impossible. Because our available fresh water sources are limited, water conservation is an important aspect of our green economy. Water conservation workers ensure that our fresh water supplies remain adequate for human consumption and wildlife use. Careers in water conservation include those in science, engineering, planning and outreach, construction, agriculture and grounds maintenance, and water operations. The educational requirements for these careers span from no formal requirements to postsecondary education. Most of the occupations in water conservation had annual median wages that were near or above the national median annual wage of $34,750 in May 2012.

Notes

[1] *The World's Water* (U.S. Geological Survey, 2013) **http://ga.water.usgs.gov/edu/earthwherewater.html**.

[2] Water Facts and Trends (World Business Council for Sustainable Development, 2006) **http://www.unwater.org/downloads/Water_facts_and_trends.pdf**.

[3] *Water Conservation* (U.S. Environmental Protection Agency, 2012) **http://www.epa.gov/oaintrnt/water/**.

[4] *Climate Change 2007: Working Group II: Impacts, Adaptation and Vulnerability* (Intergovernmental Panel on Climate Change, 2007).

[5] Environmental Impacts of Dams (International Rivers) **http://www.internationalrivers.org/environmental-impacts-of-dams**.

[6] *Conserving Water* (U.S. Environmental Protection Agency, 2012) **http://www.epa.gov/greenhomes/ConserveWater.htm**.

[7] *Water Questions and Answers* (U.S. Geological Survey, 2013) **http://ga.water.usgs.gov/edu/qa-home-percapita.html**.

[8] *Thirsty Food* (National Geographic, 2011) **http://environment.nationalgeographic.com/environment/freshwater/food**.

[9] *The Water Conservation Act of 2009* (California Department of Water Resources, 2013) **http://www.water.ca.gov/wateruseefficiency/sb7/**.

[10] *Using Water Efficiently* (U.S. Environmental Protection Agency, 2013) **http://www.epa.gov/WaterSense/pubs/utilities.html**.

[11] *Summary of the Clean Water Act* (U.S. Environmental Protection Agency, 2013) **http://www2.epa.gov/laws-regulations/summary-clean-water-act**.

[12] *Careers in Green Construction* (U.S. Bureau of Labor Statistics, 2011) **http://www.bls.gov/green/construction/**.

[13] Ibid.