Environmental Scientists and Hydrologists

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Significant Points

- Environmental scientists and hydrologists often split their work between offices, laboratories, and field sites.
- Federal, State, and local governments employ over half of all environmental scientists and hydrologists.
- Although a bachelor's degree in an earth science is adequate for a few entry-level jobs, employers increasingly prefer a master's degree; a Ph.D. degree is required for most high-level research or college teaching positions.
- The strongest job growth should be in private-sector consulting firms.

Environmental scientists conduct research to identify and reduce or eliminate sources of pollutants or hazards that affect people, wildlife, and their environments.

Nature of the Work

Environmental scientists and hydrologists use their knowledge of the physical makeup and history of the Earth to protect the environment, study the properties of underground and surface waters, locate water and energy resources, predict water-related geologic hazards, and offer environmental site assessments and advice on indoor air quality and hazardous-waste-site remediation.

Environmental scientists conduct research to identify and abate or eliminate sources of pollutants or hazards that affect people, wildlife, and their environments. These workers analyze and report measurements or observations of air, food, water, soil, and other sources and make recommendations on how best to clean and preserve the environment. Understanding the issues involved in protecting the environment—degradation, conservation, recycling, and replenishment—is central to the work of environmental scientists, who often use their skills and knowledge to design and monitor waste disposal sites, preserve water supplies, and reclaim contaminated land and water to comply with Federal environmental regulations.

Many environmental scientists do work and have training that is similar to other physical or life scientists, but is applied to environmental areas. Many specialize in some specific area, such as environmental ecology and conservation, environmental chemistry, environmental biology, or fisheries science. Most environmental scientists are further classified by the specific activity they perform, although recent advances in the understanding of basic life processes within the ecosystem have blurred some traditional classifications. For example, *environmental ecologists* study the relationships between organisms and their environments and the effects of influences such as population size, pollutants, rainfall, temperature, and altitude. Utilizing their knowledge of various scientific disciplines, they may collect, study, and report data on air, food, soil, and water. *Ecological modelers* study ecosystems, the control of environmental pollution, and the management of resources. These environmental scientists may use mathematical modeling, systems analysis, thermodynamics, and computer techniques. *Environmental chemists* may study the toxicity of various chemicals—how those chemicals affect plants, animals, and people.

Hydrologists study the quantity, distribution, circulation, and physical properties of underground and surface waters. Often, they specialize in either underground water or surface water. They examine the form and intensity of precipitation, its rate of infiltration into the soil, its movement through the earth, and its return to the ocean and atmosphere. Hydrologists use sophisticated techniques and instruments. For example, they may use remote sensing technology, data assimilation, and numerical modeling to monitor the change in regional and global water cycles. Some surface-water hydrologists use sensitive stream-measuring devices to assess flow rates and the quality of water. The work hydrologists do is particularly important in flood control and environmental preservation, including ground-water decontamination.

Many environmental scientists and hydrologists work at consulting firms, advising and helping businesses and government agencies comply with environmental policy, particularly with regard to ground-water decontamination and flood control. Environmental scientists and hydrologists at consulting firms are generally hired to solve problems. Most firms fall into two categories: large multidisciplinary engineering companies, the largest of which may employ more than 15,000 workers, and small niche firms that may employ fewer than 50 workers. When entering the field, prospects should consider the type of firm and the scope of the projects it undertakes. In larger firms, environmental scientists are more likely to engage in large, long-term projects in which their role will mesh with those of workers in other scientific disciplines. In smaller specialty firms, however, they may be responsible for many skills beyond traditional environmental disciplines, such as working with environmental laws and regulations, making environmental risk assessments, writing technical proposals, giving presentations to managers and regulators, and working with other specialists on a variety of issues, including engineering remediation.

Environmental scientists who determine policy may help identify how human behavior can be modified in the future to avoid such problems as ground-water contamination and depletion of the ozone layer. Some environmental scientists work in managerial positions, usually after spending some time performing research or learning about environmental laws and regulations. (Information on geoscientists, whose work is closely related to that of environmental scientists and hydrologists, is located elsewhere in the *Handbook*.)

Working Conditions

Most entry-level environmental scientists and hydrologists spend the majority of their time in the field, while more experienced workers generally devote more of their time to office or laboratory work. Many beginning hydrologists and some environmental scientists, such as environmental ecologists and environmental chemists, often take field trips that involve physical activity. Environmental scientists and hydrologists in the field may work in warm or cold climates, in all kinds of weather. In their research, they may dig or

chip with a hammer, scoop with a net, come in contact with water, and carry equipment in a backpack. Travel often is required to meet with prospective clients or investors. Those in laboratories may conduct tests, run experiments, record results, and compile data.

Environmental scientists and hydrologists in research positions with the Federal Government or in colleges and universities frequently are required to design programs and write grant proposals in order to continue their data collection and research. Environmental scientists and hydrologists in consulting jobs face similar pressures to market their skills and write proposals so that they will have steady work. Occasionally, those who write technical reports to business clients and regulators may be under pressure to meet deadlines.

Training, Other Qualifications, and Advancement

A bachelor's degree is adequate for a few entry-level positions, but environmental scientists are increasingly needing a master's degree in a natural science. A master's degree also is the minimum educational requirement for most entry-level applied research positions in private industry, in State and Federal agencies, and at State geological surveys. A doctoral degree is necessary for college teaching and most high-level research positions.

Many environmental scientists earn degrees in life science, chemistry, geology, geophysics, atmospheric science, or physics and then, either through further education or through their research interests and work experience, apply their education to environmental areas. Others earn a degree in environmental science. A bachelor's degree in environmental science offers an interdisciplinary approach to the natural sciences, with an emphasis on biology, chemistry, and geology. In addition, undergraduate environmental science majors should focus on data analysis and physical geography, particularly if they are interested in studying pollution abatement, water resources, or ecosystem protection, restoration, or management. Understanding the geochemistry of inorganic compounds is becoming increasingly important in developing remediation goals. Those students interested in working in the environmental or regulatory fields, either in environmental consulting firms or for Federal or State governments, should take courses in hydrology, hazardous-waste management, environmental legislation, chemistry, fluid mechanics, and geologic logging. An understanding of environmental regulations and government permit issues also is valuable for those planning to work in mining and oil and gas extraction.

Students interested in the field of hydrology should take courses in the physical sciences, geophysics, chemistry, engineering science, soil science, mathematics, aquatic biology, atmospheric science, geology, oceanography, hydrogeology, and the management or conservation of water resources. In some cases, graduates with a bachelor's degree in a hydrologic science are qualified for positions in environmental consulting and planning regarding water quality or wastewater treatment. Curricula for advanced degrees often emphasize the natural sciences, but not all universities offer all curricula.

The American Institute of Hydrology offers certification programs in professional hydrology. Certification is recommended for those seeking advancement and for those seeking to upgrade their knowledge.

For environmental scientists and hydrologists who enter the field of consulting, courses in business, finance, marketing, or economics may be useful. In addition, combining environmental science training with other disciplines such as engineering, or a technical degree coupled with a master's degree in business administration, qualifies these scientists for the widest range of jobs. Environmental scientists and hydrologists also should have some knowledge of the potential liabilities associated with some environmental work.

Computer skills are essential for prospective environmental scientists and hydrologists. Students who have some experience with computer modeling, data analysis and integration, digital mapping, remote sensing, and geographic information systems will be the most prepared to enter the job market. A knowledge of the Geographic Information System (GIS) and Global Positioning System (GPS)—a locator system that uses satellites—is vital.

Environmental scientists and hydrologists must have excellent interpersonal skills, because they usually work as part of a team with other scientists, engineers, and technicians. Strong oral and written communication skills also are essential, because writing technical reports and research proposals and communicating technical and research results to company managers, regulators, and the public are important aspects of the work. Those involved in fieldwork must have physical stamina.

Environmental scientists and hydrologists often begin their careers in field exploration or, occasionally, as research assistants or technicians in laboratories or offices. They are given more difficult assignments as they gain experience. Eventually, they may be promoted to project leader, program manager, or some other management and research position.

Because international work is becoming increasingly pervasive, knowledge of a second language can be a valuable skill to employers.

Employment

Environmental scientists and hydrologists held about 81,000 jobs in 2004. Jobs for hydrologists accounted for only 10 percent of the total. Many more individuals held environmental science faculty positions in colleges and universities, but they are classified as college and university faculty. (See the statement on teachers—postsecondary elsewhere in the *Handbook*.)

About 44 percent of environmental scientists were employed in State and local governments; 15 percent in management, scientific, and technical consulting services; 14 percent in architectural, engineering and related services; and 8 percent in the Federal Government. About 5 percent were self-employed.

Among hydrologists, 22 percent were employed in architectural, engineering, and related services, and 18 percent worked for management, scientific, and technical consulting services. In 2004, the Federal Government employed about 2,500 hydrologists, mostly within the U.S. Department of the Interior for the U.S. Geological Survey (USGS) and within the U.S. Department of Defense. Another 15 percent worked for State agencies, such as State geological surveys and State departments of conservation. About 5 percent of hydrologists were self-employed, most as consultants to industry or government.

Job Outlook

Employment of environmental scientists is expected to grow about as fast as the average for all occupations through 2014, while employment of hydrologists should grow much faster than the average. Job growth for environmental scientists and hydrologists should be strongest at private-sector consulting firms. Demand for environmental scientists and hydrologists will be spurred largely by public policy, which will oblige companies and organizations to comply with complex environmental laws and regulations, particularly those regarding ground-water decontamination, clean air, and flood control.

Job opportunities also will be spurred by a continued general awareness regarding the need to monitor the quality of the environment, to interpret the impact of human actions on terrestrial and aquatic ecosystems, and to develop strategies for restoring ecosystems.

Many environmental scientists and hydrologists work in consulting. Consulting firms have hired these scientists to advise

and help businesses and government comply with new regulations on issues related to underground tanks, land disposal areas, and other hazardous-waste-management facilities. Currently, environmental consulting is maturing and evolving from investigations to remediation and engineering solutions. At the same time, the regulatory climate is evolving from a rigid structure to a more flexible risk-based approach. These factors, coupled with new Federal and State initiatives that integrate environmental activities into the business process itself, will result in a greater focus on waste minimization, resource recovery, pollution prevention, and the consideration of environmental effects during product development. This shift in focus from reactive solutions to preventive management will provide many new opportunities for environmental scientists and hydrologists in consulting roles.

Some opportunities are expected for environmental scientists at State geological surveys, stemming from the need to conduct environmental site assessments for local governments to help improve the flow of railroad and automobile traffic in urban areas. In addition, environmental scientists will be needed to help planners and communities develop and construct buildings, transportation corridors, and utilities that protect water resources and reflect efficient and beneficial land use.

Opportunities will be better for hydrologists as the population increases and moves to more environmentally sensitive locations. For example, as people increasingly migrate toward coastal regions, hydrologists will be needed to assess building sites for potential geologic hazards and to mitigate the effects of natural hazards such as floods and landslides. Hydrologists also will be needed to conduct research on hazardous-waste sites in order to determine the impact of hazardous pollutants on soil and ground water so that engineers can design remediation systems. Demand is growing for hydrologists who understand both the scientific and engineering aspects of waste remediation. As States design initiatives to improve water resources by preventing pollution, there should be opportunities for hydrologists in State government. Increased government regulations, such as those regarding the management of storm water, and issues related to water conservation, deteriorating coastal environments, and rising sea levels also will stimulate employment growth for these workers.

Federal and State geological surveys depend to a large extent on the public climate and the current budget. Thus, job security for environmental scientists and hydrologists within a State survey may be cyclical. During periods of economic recession, layoffs of environmental scientists and hydrologists may occur in consulting firms; layoffs are much less likely in government.

Earnings

Median annual earnings of environmental scientists were $51,080 in May 2004. The middle 50 percent earned between $39,100 and $67,360. The lowest 10 percent earned less than $31,610, and the highest 10 percent earned more than $85,940.

Median annual earnings of hydrologists were $61,510 in May 2004, with the middle 50 percent earning between $47,080 and $77,910, the lowest 10 percent earning less than $38,580, and the highest 10 percent earning more than $94,460.

Median annual earnings in the industries employing the largest number of environmental scientists in May 2004 were as follows:

Federal Government	$73,530
Management, scientific, and technical consulting services	51,190
Architectural, engineering, and related services	49,160
Local government	48,870
State government	46,850

According to the National Association of Colleges and Employers, beginning salary offers in July 2005 for graduates with bachelor's degrees in a environmental science averaged $31,366 a year.

In 2005, the Federal Government's average salary for hydrologists in managerial, supervisory, and nonsupervisory positions was $77,182.

Related Occupations

Environmental scientists and hydrologists perform investigations for the purpose of abating or eliminating sources of pollutants or hazards that affect the environment or some population—plant, animal, or human. Many other occupations deal with preserving or researching the natural environment, including conservation scientists and foresters, atmospheric scientists, and some biological scientists and science and engineering technicians. Environmental scientists and hydrologists have extensive training in physical sciences, and many apply their knowledge of chemistry, physics, biology, and mathematics to explain certain phenomena closely related to the work of geoscientists.

Using their qualitative and quantitative problem-solving skills, physicists; chemists; engineers; mathematicians; surveyors, cartographers, photogrammetrists, and surveying technicians; computer systems analysts; and computer scientists and database administrators may perform similar work in environment-related activities.

Sources of Additional Information

Information on training and career opportunities for environmental scientists is available from:

➤ American Geological Institute, 4220 King St., Alexandria, VA 22302-1502. Internet: **http://www.agiweb.org**

For information on careers in hydrology, contact:

➤ American Institute of Hydrology, 300 Village Green Circle, Suite #201, Smyrna, GA 30080. Internet: **http://www.aihydro.org**

For career information and a list of education and training programs in oceanography and related fields, contact:

➤ Marine Technology Society, 5565 Sterrett Place, Suite 108, Columbia, MD 21004. Internet: **http://www.mtsociety.org**

Information on obtaining a position as a hydrologist or an environmental protection specialist with the Federal Government is available from the Office of Personnel Management through USAJOBS, the Federal Government's official employment information system. This resource for locating and applying for job opportunities can be accessed through the Internet at **http://www.usajobs.opm.gov** or through an interactive voice response telephone system at (703) 724-1850 or TDD (978) 461-8404. These numbers are not tollfree, and charges may result.