DEFINING WATER MANAGEMENT

ATEEC

Advanced Technology
Environmental and Energy Center

Defining Water Management

A Report of the Defining Water Management Forum
January 21 and 22, 2013 in San Diego, CA

The Advanced Technology Environmental and Energy Center (ATEEC) acknowledges and thanks the water technology professionals who generously shared their time and expertise in defining the water management career field. Their professional insights are critical to developing water education and training programs that clarify occupations and meet workforce needs. Without this group, the guidance disseminated in this report would not be possible. The forum participants are listed individually in the Acknowledgments section of this report.

We would also like to express our gratitude to Paul Bishop and Sheena Kennedy from the Association of Boards of Certification (ABC) and Christine Radke from the Water Environment Federation (WEF) for their invaluable assistance in recruiting some of the top water technology professionals in the field from their organizations' memberships to participate in ATEEC's Defining Water Management Forum.

Finally, ATEEC thanks the Advanced Technological Education (ATE) program of the National Science Foundation (NSF) for its support and foresight in recognizing that improvements in water technology education must begin with obtaining a clear picture of what stakeholders need to ensure the water technology workforce adapts to a rapidly changing and increasingly critical field of water management.

TABLE OF CONTENTS

CONTENTS

This project was supported, in part, by the Advanced Technological Education Program at the National Science Foundation. The opinions expressed in this report are those of the forum participants and do not necessarily represent NSF policy.

Additional copies of this report can be downloaded at ATEEC's Web site: www.ateec.org.

INTRODUCTION

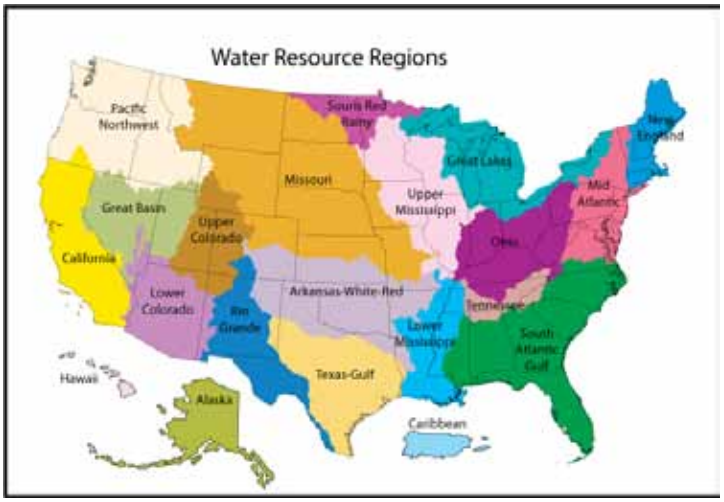
THE ISSUES

An international freshwater crisis in the foreseeable future will encompass many challenges—water pollution and scarcity; competing urban, rural, and ecosystem water needs; climate change; environmental and public health impacts; resource security; and economic implications.[1] In the United States, due to the impending retirement of current water and wastewater treatment workers, there is a critical need to expand and update water and wastewater environmental programs at the community college level to meet the demands for water quality and conservation in the coming years.

> **We need to make sure there are enough qualified human resources to resolve current and upcoming water quality issues. We have probably reached the max in terms of "doing more with less" people—we need more human resources at this point.**
>
> **Ken Kerri, Forum Participant**
> *California State University-Sacramento*

The study of water involves physical, chemical, and biological components and technology programs are needed for biological technicians, environmental technicians, fisheries technicians, hydrologic technicians, water quality technicians, water resources technicians, wastewater technicians, and watershed technicians. In particular, there is an increasing need for technicians in the investigation, interpretation, and analysis of data for proper monitoring and management of water resources. The Association of Boards of Certification promotes certification as a critical means of advancing water quality and integrity, and protecting public health and the environment.[2]

There is little doubt that U.S. drinking water and wastewater infrastructures are in dire need of an overhaul, as well as source water quality concerns. The American Water Works Association reports that there are several fundamental concerns including source water availability, aging infrastructure, remediation, and workforce issues.[3] The U.S. Geologic Survey estimates that the U.S. wastes six billion gallons of clean drinking water each day, or 14% of total use, through leaky pipes in need of repair.[4] The American Society of Civil Engineers gave a grade of D- to both the nation's drinking water and wastewater infrastructures.[5] According to the Water Environment Federation, one and a half million miles of pipeline comprise this infrastructure, most of which was built nearly a century ago and is literally falling apart. Most pipelines only have a lifespan of 50 to 100 years and were originally designed for populations half their current size.[6]



References are listed at the end of this section.

A growing population and the increasingly suburban geography of the U.S. are expected to boost demand for water and wastewater treatment services. The EPA estimates that up to 3.5 million Americans fall sick each year from swimming in waters contaminated by sanitary sewer overflows.[7] Water is used in energy resource extraction, refining and processing, and transportation; is an integral part of electric-power generation; is used directly in hydroelectric generation; and is used extensively in cooling and emissions scrubbing in thermoelectric generation. As the U.S. seeks to replace imported petroleum and natural gas with fuels from domestic sources such as biofuels, synfuel from coal, hydrogen, previously inaccessible natural gas, and possibly oil shale, the demand for water to produce energy fuels could grow significantly.[8] The U.S. National Science Foundation (NSF) has recently worked with EPA regarding the protection of water quality in public water systems, remediation of contaminated sites, sediments and groundwater, and restoration of ecosystems.[9]

In 2008, the Johnson Foundation at Wingspread initiated a summit with leaders from business, agriculture, academia, government, foundations, and communities to discuss freshwater issues including the impact of climate change on freshwater resources, infrastructure, agriculture and food production, the water/energy interface, and public health. The forum identified several calls to action, including a recommendation to higher education institutions to address job creation and identify and establish "mechanisms for enhanced coordination of research and policy development efforts, as well as interdisciplinary collaboration among organizations and institutions to advance freshwater solutions." Efficiencies and new sources of water must come from better management, better coordination, more efficient use of the water we have, and additional use of nontraditional or alternative water resources such as wastewater reuse or desalination. This will become the goal for water development in the U.S. in the next 50 years.[10]

INTRODUCTION (cont.)

According to the U.S. Bureau of Labor Statistics (BLS), water and wastewater treatment plant and system operator jobs are expected to grow much faster than average for all occupations. Currently local governments are the largest employers of water and wastewater treatment plant and system operators, but employment in privately owned facilities will grow as federal certification requirements have increased utilities' reliance on private firms specializing in the operation and management of water and wastewater treatment facilities. It is estimated that 25%–50% of the approximately 52,500 wastewater management workers will retire within the next five years.[11] The prospect of losing the expertise acquired over their decades of service is daunting.[12] [13] [14]

A NEXT STEP

On January 20th and 21st in 2013, the Advanced Technology Environmental and Energy Center (ATEEC) conducted a national forum for defining water management, sponsored by the NSF. The forum goal was to definitize and expand upon the categories of water quality and wastewater management from a previous ATEEC report, Defining Environmental Technology.[15] Due to the increasing importance of water issues, NSF tasked ATEEC with performing a more thorough occupational analysis of the water management field. Skill sets traditionally associated with water management are cutting across both traditional and emerging technologies. The advent of new technology, the increased role of water and energy in national security issues, changes in national and regional regulatory compliance requirements, a retiring workforce, and the changing demands of industry call for a realignment of academia, industry, business, and government in order to ensure the efficacy of the U.S. water infrastructure.

The 2013 forum's objectives included the following:

- Title and definition of the field of water management;
- Definition of technician;
- Water management occupational categories;
- Technician-level occupational titles; and
- Job functions typically performed in each occupation.

ATEEC collaborated with the Partnership for Environmental Technology Education (PETE), the Association of Boards of Certification (ABC), and the Water Environment Federation (WEF) to recruit participants for the forum. ATEEC invited experienced practitioners in the water management field who brought to the table a broad perspective of the various occupational areas included in this field. The participants who attended the workshop included business, industry, and government agency representatives. ATEEC attempted to gather as broad a regional representation of the country as possible, a variety of water technology areas, and industries that would employ water technicians.

The audience for this report includes:

- Counselors, advisors, faculty, and administrators of academic institutions at all levels but particularly in two-year colleges and high schools;
- Students, technicians, and employers of technicians (e.g., companies, government agencies);
- Leaders of professional societies; and
- Federal, state, and local government officials responsible for the quality and quantity of the nation's technical workforce.

A primary purpose of this report is to enhance counselor, teacher, and student awareness of the critical nature of water management careers at the technician level. Ultimately, the report should contribute to addressing the workforce development needs of business, industry, and government by providing educators with information needed to better inform students of the professional opportunities and to develop relevant curriculum that prepares students for water management careers.

The report is also being used to provide direction for ATEEC, as an NSF Center of Excellence in the Advanced Technological Education program. The Center brings together institutions from across the nation to promote and assist environmental technology programs, with a special focus on water management. ATEEC's core partners in these efforts are PETE, University of Northern Iowa, and the NSF.

We need to convey to potential students what a valuable and important line of work water can be—not many consider it as a career, but it's a great career path. It's largely immune to external abnormalities and cannot be exported outside the U.S.

Steve Harrison, Forum Participant
Water Environment Federation

INTRODUCTION (cont.)

THE FORUM

The 2013 Defining Forum participants considered these questions:

- What title and definition accurately describe the water management field?
- What definition of "technician" accurately describes the position?
- How would you broadly categorize occupations in the water management field?
- What specific technician-level occupations are typically found in each occupational category?
- What technician-level job functions are typically performed in each occupational category?
- What are the emerging issues and future trends in the water management field?
- What is the role of community colleges in technician education and training?

The forum began on January 20th in San Diego, California. Participants were welcomed and presented with information on ATEEC's mission and goals. The group then reviewed the agenda, objectives, and work processes for the forum. Initial reference materials used to jump start the discussions were ATEEC's Defining Environmental Technology report and the "Water Sector Competency Model"[16] developed by the U.S. Department of Labor, U.S. Environmental Protection Agency, American Water Works Association, and the Water Environment Federation.

To begin the forum process, the first two action items were the participants' discussions of the title and definition of the water management field and the definition of "technician." It was noted that the educational background for technicians in different regions and municipalities can range from a high school diploma plus on-the-job training to advanced degrees. In order to elicit effective information to enable educators to better understand business and industry needs and incorporate them into the curricula, it was agreed to view technicians as having completed a two-year associate degree in an applied technology program. The following definitions were developed.

What is the Water Management field?

Water Management is a career field that applies the principles of science, math, technology, engineering, communication, economics, management, and law to ensure water quality and to sustainably manage water as a resource to protect public health and the environment.

What is a Water Professional?

A Water Professional applies knowledge, skills, and abilities to perform scientific, technical, managerial, regulatory, and communication tasks and responsibilities.

The participants then broke up into small groups, in the category areas where they felt their specific expertise would be of most value. The majority of the small-group work was spent in creating, revising, and refining technician-level job titles and job functions. Many of the occupations developed at this time reflect well-established and well-defined jobs (e.g., electrician, GIS tech, surveyor, customer service representative) that incorporate new water technologies as part of the traditional, existing job functions. Participants felt that while these types of jobs should be listed in the applicable category and are critical to the water management field, it wasn't necessary to list job functions for the purposes of this forum.

Participants also stressed the general observation that many job functions in water/wastewater plants are very dependent on the size of the operation. For example, a water professional's duties in a small operation are highly likely to cross over between these job titles. Similarly, depending on the region or individual plant, knowledge, skills, and functions are often cross-cutting among job titles.

INTRODUCTION (cont.)

THE FORUM (cont.)

The small groups then shared and discussed their specific results with the large group, reaching a large-group forum consensus on the material covered in this report. The remainder of the workshop was spent identifying emerging issues and trends in the water management field.

Following the forum in San Diego, an online discussion site was created for participants to review and spend further time refining the materials they had developed. Additional experts in the field from business, education, and government organizations were then invited to review and comment on the initial documentation from the forum, resulting in a validation and consensus of expert opinions. ATEEC will continue to solicit and update additional occupational data through online input.

THE RESULTS

The next section of this document contains the occupational chart, "What is the Water Management field?," providing a valuable snapshot of a wide-reaching topic area. Included in the chart are the Water Management definition and the Water Professional definition, as well as representative technician-level job titles for each of the occupational categories. Following the chart are more detailed listings of job titles, the majority of which also list the specific job functions developed during the forum.

The last section of the report presents emerging issues and future trends in water management that were identified during the forum. It also provides several recommendations for community college and high school educators to encourage students to consider the field.

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What is the Water Management field?

Administration

- Customer Service Representative
- Health and Safety Coordinator
- Information Technology (IT) Professional
- Project Manager
- Public Relations and Human Resources Specialist
- Regulatory Compliance Manager
- Security Coordinator

Engineering

- Construction Inspector
- Construction Supervisor
- Corrosion Control Specialist
- Geographic Information Systems (GIS) Specialist
- Hydraulic Specialist
- Hydrology Technician
- Surveyor

Laboratory

- Environmental Sampling/Monitoring Technician
- Instrumentation Technician
- Lab Analysis Technician
- Laboratory Health and Safety Supervisor
- Quality Assurance/ Quality Control (QA/QC) Technician

Plant Maintenance

- High Voltage Electrician
- Low Voltage Electrician
- Plant Maintenance Supervisor
- Plant Maintenance Technician

NSF

EASTERN IOWA COMMUNITY COLLEGES
CLINTON ♦ MUSCATINE ♦ SCOTT

Water Management is a career field that applies the principles of science, math, technology, engineering, communication, economics, management, and law to ensure water quality and to sustainably manage water as a resource to protect public health and the environment.

What is a Water Professional?

A water professional applies knowledge, skills, and abilities to perform scientific, technical, managerial, regulatory, and communication tasks and responsibilities.

Regulations and Compliance

- Biosolids Land Application Technician
- Cross-Connection Control Specialist
- CSO/SSO Monitoring Specialist
- Enforcement Specialist
- Environmental Compliance Technician
- Fats/Oils/Grease (FOG) Manager
- FOG Inspector
- Industrial Pretreatment Specialist
- Large Animal Confinement Inspector
- Permit Specialist
- Pretreatment Manager
- Stormwater Compliance Inspector

Wastewater Operations

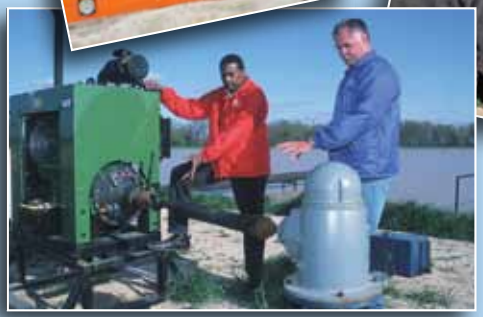
- Chief Operator
- Collection System Operator*
- Industrial Pretreatment Operator
- Instrumentation Technician*
- Plant Operator* (treatment, biosolids, reclamation, construction)
- Pretreatment Coordinator
- Process Control Operator**

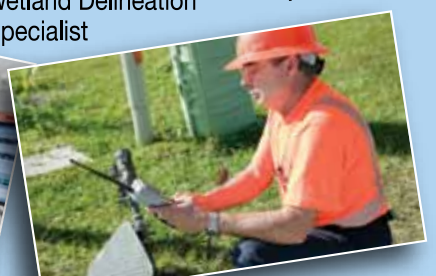
Water Operations

- Cross-Connection Control Specialist
- Distribution Operator/Foreman
- Heavy Equipment Operator
- Industrial Water Systems Operator
- Instrumentation Technician
- Leak Detection Technician
- Meter Reader/Installer
- Meter Tester/Mechanic
- PLC/SCADA Programmer
- Treatment Plant Mechanic
- Utility Locator ("Dig Safe")
- Water Treatment Operator

Watershed and Runoff Control

- Agricultural Water Specialist
- Aquatic Habitat Restoration Technician
- Dredge Operator
- Forestry Technician
- Ground Water Remediation Technician
- Hydrogeology Technician
- Hydrology Technician
- Modeling Technician
- Residential Water Purification Technician
- Septic Tank Maintenance Technician
- Source Water GIS Technician
- Stormwater/MS4 Technician
- Surface Water Monitoring Technician
- Sustainable Landscaper
- Water Conservation Technician
- Well Driller
- Wetland Delineation Specialist





* Various levels (e.g., supervisor, team leader, senior lead, shift supervisor, operator I, operator II, operator III, non-certified maintenance worker, operator-in-training (OIT))

** Various levels (e.g., operator, engineer, supervisor)

OCCUPATIONAL CATEGORIES, TITLES, AND FUNCTIONS

IMPORTANT NOTES: 1) To avoid unnecessary duplication, the following section assumes that all occupations must adhere to all health and safety procedures (including selection and use of proper personal protective equipment) and follow applicable standard operating procedures (SOPs). 2) The following job titles and functions are dependent on system size and scale of operation. Many jobs may be combined and there is often a great deal of crossover of skill sets.

ADMINISTRATION

- Customer Service Representative
- Health and Safety Coordinator
- Information Technology (IT) Professional
- Project Manager
- Public Relations and Human Resources Specialist
- Regulatory Compliance Manager
- Security Coordinator

Customer Service Representative

Health and Safety Coordinator
- Implement and oversee safety program.
- Facilitate health and safety training.
- Enforce health and safety rules and regulations.
- Perform health and safety inspections.

Information Technology (IT) Professional
- Implement efficient IT protocols.
- Generate and maintain effective IT security.
- Manage software and hardware (including servers).

Project Manager
- Explain and apply procurement policy.
- Demonstrate enhanced energy management.
- Coordinate and manage capital projects within a budget.
- Evaluate and implement process improvements.
- Examine contract document and apply to project.

Public Relations/Human Resources Specialist
- Promote a positive image of the company and industry.
- Analyze and interpret public perception of the company and industry.
- Develop a positive media relationship.
- Communicate effective public education and interactions.
- Describe and communicate to others the regulatory and legislative processes.
- Assist in allocation of workforce.
- Investigate and resolve public and employee complaints.

Regulatory Compliance Manager
- Develop and maintain billing software.
- Stay current with legislation and upcoming changes.
- Lobby in the best interests of the industry.
- Prepare reports for local government.
- Develop cost analysis for impending legislation.

Security Coordinator
- Develop and implement security programs.
- Identify and assess critical infrastructure.
- Recommend security measures.
- Prioritize and evaluate security risks.
- Develop Emergency Response Plan.

ENGINEERING

- **Construction Inspector**
- **Construction Supervisor**
- **Corrosion Control Specialist**
- **Geographic Information Systems (GIS) Specialist**
- **Hydraulic Specialist**
- **Hydrology Technician**
- **Surveyor**

JOB FUNCTIONS

Construction Inspector
- Review construction site management plans.
- Audit construction sites for compliance with erosion control and stormwater runoff management.

Construction Supervisor
- Determine and implement best management methods for erosion control and stormwater runoff on construction sites.
- Ensure compliance with regulatory requirements for potable and non-potable water.
- Ensure safety of construction site workers involved with water issues.
- Ensure protection of the environment from contaminated water found or created on site.

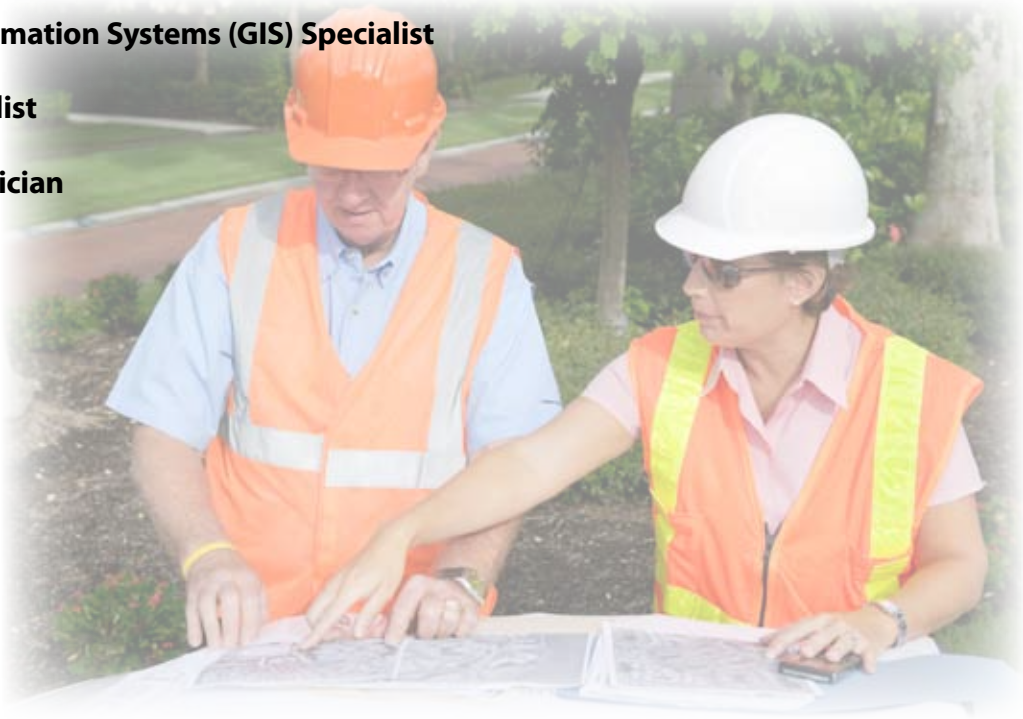
Corrosion Control Specialist

Geographic Information Systems (GIS) Specialist

Hydraulic Specialist

Hydrology Technician

Surveyor



JOB FUNCTIONS

LABORATORY

- **Environmental Sampling/Monitoring Technician**
- **Instrumentation Technician**
- **Lab Analysis Technician**
- **Laboratory Health and Safety Supervisor**
- **Quality Assurance/Quality Control (QA/QC) Technician**

Environmental Sampling/Monitoring Technician

- Collect and preserve samples.
- Calibrate field meters and analysis equipment.
- Perform field analyses.
- Instruct others on proper sample collection, preservation, and analysis.
- Operate field sampling/monitoring equipment (including watercraft).
- Follow chain of custody procedures for sample collection and handling.

Instrumentation Technician

- Set up and calibrate lab instruments and equipment.
- Perform preventive and corrective maintenance on lab instruments.
- Deploy and set up field sampling/monitoring equipment.

Lab Analysis Technician

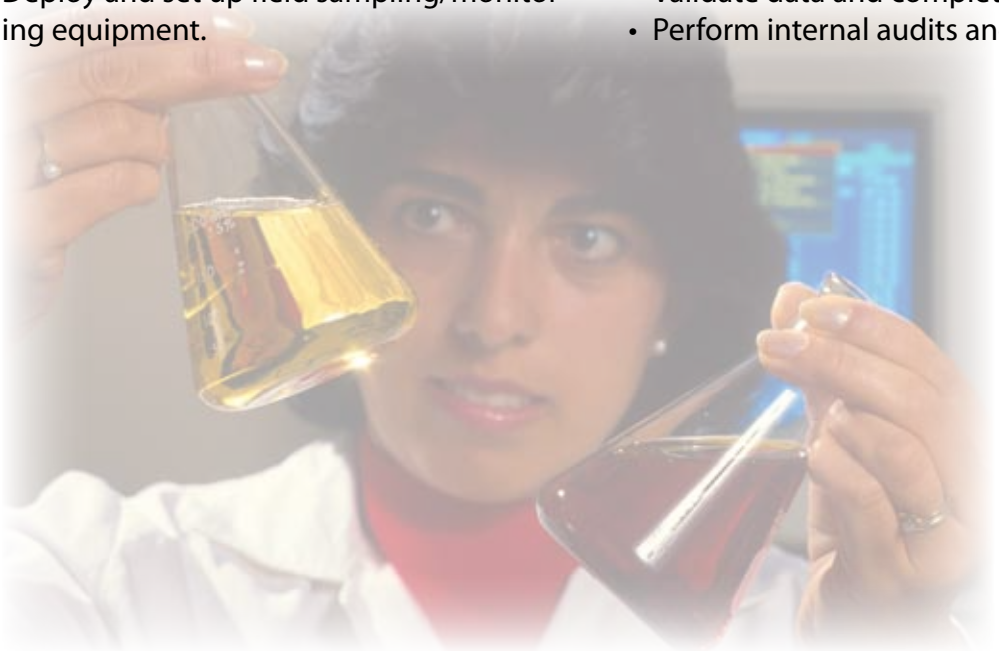
- Analyze samples, calculate results, and develop reports.
- Interpret and explain lab analysis results to clients.
- Follow quality assurance/quality control (QA/QC) program procedures.
- Interpret QA/QC results.

Laboratory Health and Safety Supervisor

- Manage health and safety data.
- Train staff on health and safety SOPs.

Quality Assurance/Quality Control (QA/QC) Technician

- Develop QA/QC standard operating procedure (SOP) for program.
- Complete analyses and calculations.
- Validate data and complete reports.
- Perform internal audits and reviews.



PLANT MAINTENANCE

- High Voltage Electrician
- Low Voltage Electrician
- Plant Maintenance Supervisor
- Plant Maintenance Technician

JOB FUNCTIONS

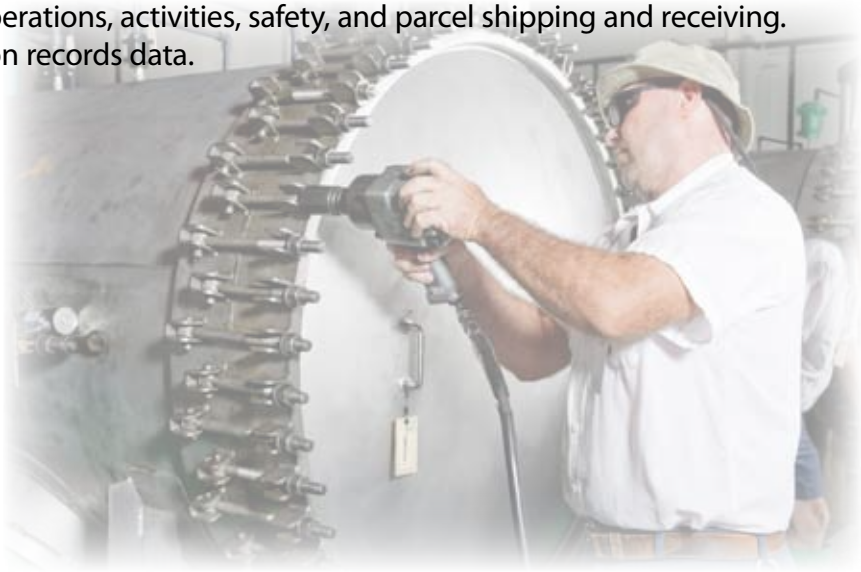
High Voltage Electrician

Low Voltage Electrician

Plant Maintenance Supervisor

Plant Maintenance Technician

- Perform preventive and routine maintenance on plant equipment.
- Identify equipment needs, and scheduled and completed maintenance records.
- Conduct performance tests of plant equipment.
- Diagnose, troubleshoot, update, and repair malfunctioning plant equipment.
- Maintain, repair, and overhaul plant equipment (e.g., aeration blowers, barminutors, pumps, motors, compressors, belt press, valves, drive units, hydraulic control units, chlorinators, chemical feeders, pneumatic equipment, hydraulic pressure systems, emergency generators).
- Participate in the installation of plant equipment.
- Participate in the modification of equipment for maximum treatment process performance.
- Perform pipefitting for installation and repair of air, sewer, and hydraulic piping systems.
- Interpret drawings, blueprints, schematics, and diagrams for water/wastewater systems.
- Assist with maintenance of Supervisory Control and Data Acquisition (SCADA) system and instrumentation.
- Maintain records of plant function readings and equipment history.
- Maintain records on plant operations, activities, safety, and parcel shipping and receiving.
- Prepare a variety of reports on records data.



REGULATIONS AND COMPLIANCE

JOB FUNCTIONS

- Biosolids Land Application Technician
- Combined Sewer Overflow (CSO)/Sanitary Sewer Overflow (SSO) Monitoring Specialist
- Cross-Connection Control Specialist
- Enforcement Specialist
- Environmental Compliance Technician
- Fats/Oils/Grease (FOG) Manager
- FOG Inspector
- Industrial Pretreatment Specialist
- Large Animal Confinement Inspector
- Permit Specialist
- Pretreatment Manager
- Stormwater Compliance Inspector

Biosolids Land Application Technician (Soil Science)
- Assist in determining where biosolids can be applied on land.
- Assist in reviewing soil analysis results.
- Assist in developing land application management plan.
- Assist in reviewing emerging state and federal land application regulatory requirements.

Combined Sewer Overflow (CSO)/Sanitary Sewer Overflow (SSO) Monitoring Specialist
- Oversee compliance with regulatory requirements for CSOs and SSOs.
- Conduct monitoring following CSO and SSO events.
- Conduct community outreach and lead public education efforts.

Cross-Connection Control Specialist
- Inspect cross-connection control devices.
- Enforce provisions of cross-connection control ordinance.
- Complete reports.

Enforcement Specialist
- Cite entities that violate environmental ordinances.
- Present cases in court.
- Work with violators to remedy ordinance violations.

Environmental Compliance Technician
- Assists with compliance reviews of regulatory permits.
- Assists with oversight of environmental compliance programs (e.g., FOG, pretreatment, cross-connection control).
- Assists with reviewing emerging state and federal regulations.

Fats/Oils/Grease (FOG) Manager
- Develop and update the FOG ordinance.
- Develop and implement the FOG program.
- Stay current with FOG regulatory requirements.

FOG Inspector
- Review plans.
- Inspect grease interceptor installations.
- Complete reports.

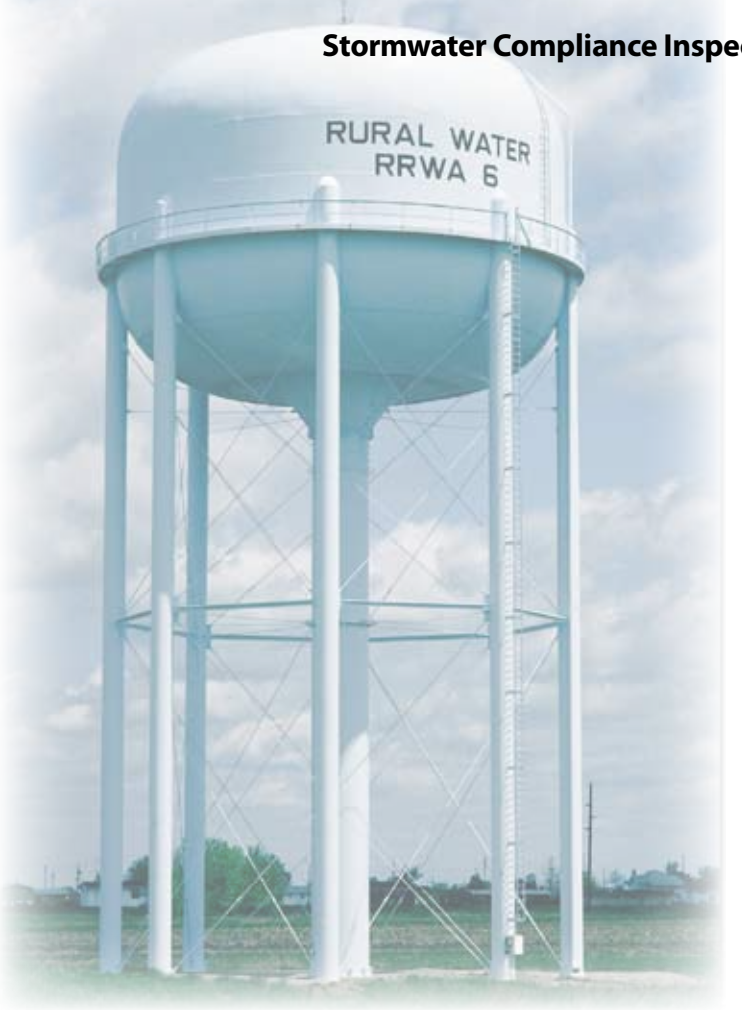
Industrial Pretreatment Specialist
- Conduct industrial monitoring and inspection.
- Review industrial discharge monitoring reports.

Large Animal Confinement Inspector

Permit Specialist
- Complete permit applications.
- Review and interpret state and federal regulations.

Pretreatment Manager
- Oversee all aspects of the industrial pretreatment program.
- Develop and update pretreatment ordinance.
- Determine which industries need permits.

Stormwater Compliance Inspector



JOB FUNCTIONS

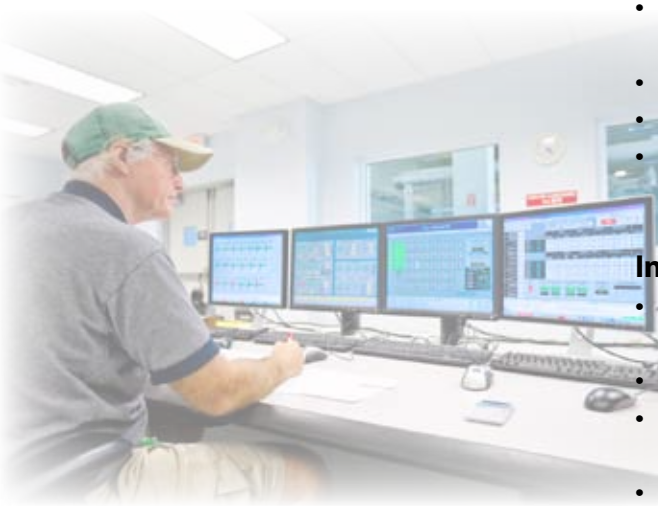
JOB FUNCTIONS

WASTEWATER OPERATIONS

- Chief Operator
- Collection System Operator*
- Industrial Pretreatment Operator
- Instrumentation Technician*
- Plant Operator*
- Pretreatment Coordinator
- Process Control Operator**

Chief Operator
(permit, management)

- Manage overall activity.
- Perform plant operator duties, as necessary.
- Report noncompliance with internal standards and government regulations.
- Provide information to governing boards.
- Oversee safety compliance.
- Plan emergency activities.
- Set budget.
- Sign Discharge Monitoring Report (DMR).
- Hire/monitor for proper, qualified staff.
- Provide disciplinary directives/employee professional development.
- Perform operator training.
- Communicate with public.
- Recommend equipment replacement.
- Maintain licensure and continuing education requirements.



Collection System Operator*
(construction, inspection, pump stations, line repair/cleaning)

- Operate and maintain heavy equipment (e.g., sewer cleaning and vacuum trucks).
- Clean, inspect, and maintain equipment, lines, and related light equipment.
- Perform operator training.
- Maintain equipment and supply inventory.
- Prepare work orders and service requests.
- Perform pretreatment tasks (adding chemicals and inspecting businesses).
- Respond to complaints and emergencies (combined sewer overflow (CSO) and sanitary sewer overflow (SSO)).
- Repair, replace, and reline manholes, pipes, etc.
- Properly dispose of solid wastes (e.g., grit, debris).
- Apply compliance standards and regulations to applicable processes.
- Locate inflow and infiltration, and eliminate.
- Conduct smoke testing.
- Maintain licensure and continuing education requirements.

Industrial Pretreatment Operator

- Operate and adjust pumps, equipment, vehicles, and hand tools.
- Troubleshoot process problems.
- Collect, handle, analyze, and evaluate samples.
- Prepare work orders and service requests.
- Maintain chemical and supply inventory.

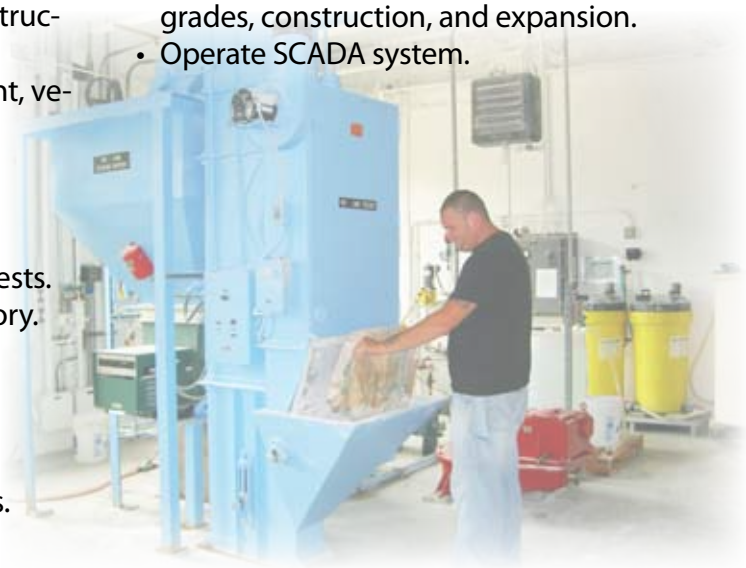
- Respond to emergencies.
- Monitor instruments, equipment, and processes.
- Develop procedures.
- Interact with and prepare reports for regulatory entities.
- Interpret and apply regulatory requirements.
- Maintain licensure and continuing education requirements.

Instrumentation Technician*
- Maintain, repair, and calibrate instruments.
- Coordinate activities with others (e.g., compliance, engineering, laboratory).
- Evaluate and recommend new instruments.
- Prepare instrument specifications.
- Order parts.
- Install and operate equipment.
- Develop operating procedures.
- Train operators.
- Communicate with information technology department on computer controlled systems.
- Operate and maintain ancillary systems (e.g., HVAC, cogeneration).
- Assist vendors/manufacturer representatives.
- Adhere to safety procedures.

Plant Operator*
(treatment, biosolids, reclamation, construction)
- Operate and adjust pumps, equipment, vehicles, and hand tools.
- Troubleshoot process problems.
- Collect, handle, analyze, and evaluate samples.
- Prepare work orders and service requests.
- Maintain chemical and supply inventory.
- Respond to emergencies.
- Monitor instruments, equipment, and processes.
- Develop procedures.
- Properly handle and process biosolids.
- Maintain licensure and continuing education requirements.
- Operate computer and SCADA systems.

Pretreatment Coordinator
- Apply compliance standards and regulations to applicable processes.
- Perform business inspections/sampling.
- Testify in court as expert.
- Develop and apply local limits.
- Administer/oversee proper dosing of pretreatment chemicals.
- Generate applicable reports and documentation.
- Communicate with regulators, business, and public.
- Operate samplers and meters (e.g., flow, pH).
- Coordinate activities with others (e.g., operations, engineering, process control).

Process Control Operator**
- Use laboratory data to evaluate processes.
- Develop control parameters and procedures.
- Review permits for compliance with government regulations.
- Perform process adjustments as needed.
- Perform operator training.
- Evaluate and provide input on plant upgrades, construction, and expansion.
- Operate SCADA system.



*Various levels, e.g., supervisor, team leader, senior lead, shift supervisor, operator I, operator II, operator III, non-certified maintenance worker, operator-in-training (OIT)

**Various levels, e.g., operator, engineer, supervisor

WATER OPERATIONS

JOB FUNCTIONS

- Cross-Connection Control Specialist
- Distribution Operator/Foreman
- Heavy Equipment Operator
- Industrial Water Systems Operator
- Instrumentation Technician
- Leak Detection Technician
- Meter Reader/Installer
- Meter Tester/Mechanic
- Programmable Logic Controller (PLC) Programmer/SCADA
- Treatment Plant Mechanic
- Utility Locator ("Dig Safe")
- Water Treatment Operator

Cross-Connection Control Specialist
- Operate, calibrate, and maintain backflow test equipment.
- Conduct cross-connection surveys.
- Maintain records and report to regulatory authority.
- Review plans and new installations.

Distribution Operator/Foreman
- Install and repair pipes and other water appurtenances.
- Sample, test, and interpret sampling results.
- Follow chain of custody procedures for sample collection and handling.
- Monitor flows/pressures and tank levels.
- De-chlorinate discharge water.
- Flush and maintain hydrants.
- Inspect and exercise valves.
- Operate and maintain remote sensing equipment.
- Develop standard operating procedures (SOPs).
- Monitor and evaluate system conditions.
- Interact with contractors, site owners, regulatory agencies, and the public.
- Coach, mentor, and cross-train co-workers.
- Perform hydrant fire flow testing.
- Prepare work orders.

Heavy Equipment Operator
- Operate and maintain heavy equipment.
- Assess working conditions and environment, and manage work site accordingly.
- Verify utility line locations.
- Confirm traffic control and safety conditions.
- Communicate with on-site staff.
- Perform and record daily equipment inspections.
- Assist in evaluating changing trench conditions.

Industrial Water Systems Operator
- Operate systems to purify water for utility and industrial use (e.g., boiler, condenser).
- Manage industrial systems condensate.
- Make chemical additions to water for industrial use.
- Manage cooling water and cooling tower systems.

Instrumentation Technician
- Operate, calibrate, and maintain process control equipment.
- Record measurements and document frequency of calibration.
- Install/replace process control equipment.
- Communicate with plant operators.

Leak Detection Technician
- Calibrate, operate, and maintain leak detection equipment.
- Perform leak detection surveys.
- Report leaks and document progress.
- Implement traffic control as required.

Meter Reader/Installer
- Install and replace meters.
- Read meters and record readings.
- Generate report for billing.
- Maintain customer service relations.
- Report anomalies to customer.

Meter Tester/Mechanic
- Operate, calibrate, and maintain meter testing equipment.
- Periodically remove, test, and replace meters.
- Schedule customer appointments.
- Develop and follow SOPs pertaining to confined space and air monitoring.
- Interact with customers.

Programmable Logic Controller (PLC) Programmer/SCADA
- Maintain plant software logic.
- Write variations based on operator input.
- Stay current with new technologies and processes.
- Perform lockout/tagout as required.
- Coach, mentor, and cross-train co-workers.
- Design, develop, and install new software applications.
- Train operator on use of software applications.
- Focus on professional development.

Treatment Plant Mechanic

Utility Locator ("Dig Safe")
- Operate, calibrate, and maintain line locate equipment.
- Accurately mark facilities.
- Develop documentation for contractor on locating site/area.
- Implement traffic control and safety measures.
- Follow utility-specific standard operating procedures (SOPs).
- Report inaccurate location information to GIS/mapping group for correction.

Water Treatment Operator
- Install, calibrate, operate, troubleshoot, and repair equipment.
- Identify system upset and correct by adjusting process control equipment.
- Monitor flow rates, pressures, tank levels, reading gauges, meters, and charts.
- Monitor for plant security.
- Interpret sample results.
- Analyze samples for physical, chemical, and biological results.
- Follow chain of custody procedures for sample collection and handling.
- Evaluate water filtration/sedimentation processes.
- Maintain and evaluate monthly/quarterly/yearly water quality reports.
- Maintain chemical supply inventory.
- Operate computers and SCADA systems.
- Maintain professional certification.
- Troubleshoot operational problems and take corrective action.
- Forecast trends in water field.
- Notify regulatory agencies and public of noncompliance.
- Develop standard operating procedures (SOPs).
- Coach, mentor, and cross-train co-workers.
- Operate and maintain disinfection equipment.
- Operate and maintain process control for chemical dosages.
- Coordinate with other groups on water loss.

JOB FUNCTIONS

WATERSHED AND RUNOFF CONTROL

- Agricultural Water Specialist
- Aquatic Habitat Restoration Technician
- Dredge Operator
- Forestry Technician
- Ground Water Remediation Technician
- Hydrogeology Technician
- Hydrology Technician
- Modeling Technician
- Residential Water Purification Technician
- Septic Tank Maintenance Technician
- Source Water GIS Technician
- Stormwater/MS4 Technician
- Surface Water Monitoring Technician
- Sustainable Landscaper
- Water Conservation Technician
- Well Driller
- Wetland Delineation Specialist

Agricultural Water Specialist

Aquatic Habitat Restoration Technician

Dredge Operator

Forestry Technician
- Assist with development of plans to maintain appropriate timber management.
- Assist with development of plans to ensure water integrity.
- Assist with development of policies for source water protection.
- Collect samples.
- Investigate source water area issues.
- Perform risk assessment.

Ground Water Remediation Technician

Hydrogeology Technician
- Assist in performing assessment and data validation.
- Assist in development of new water sources (e.g., aquifer definition, dam construction).

Hydrology Technician
- Assist with determining stream bed characteristics and measuring stream flow.
- Assist in monitoring water movement to project water quantity.
- Assist with measuring storm impacts on water quantity and quality.
- Assist in predicting and planning to meet future water needs.
- Assist in flood mitigation and flood control activities.
- Assist in validating data and preparing reports.

Modeling Technician
- Input and interpret computer data results.
- Determine pollutant discharge impacts.
- Predict weather/population growth/other impacts.

Residential Water Purification Technician

Septic Tank Maintenance Technician

Source Water GIS Technician
- Input data and map geological features.
- Prepare reports and map overlays.
- Validate data integrity.

Stormwater/MS4 Technician
- Assist in developing stormwater management plans.
- Assist in developing program regulations.
- Perform inspections and maintain compliance with stormwater discharge permit requirements.
- Collect stormwater samples, interpret results, and assist in preparing reports to regulatory entity.
- Develop and implement best management practices to minimize stormwater runoff from property and minimize stormwater contact with equipment, products, and pollutants.

Surface Water Monitoring Technician
- Collect and analyze samples.
- Follow chain of custody procedures for sample collection and handling.
- Perform field analyses.
- Log data.
- Maintain marine equipment (e.g., boats).

Sustainable Landscaper

Water Conservation Technician

Well Driller

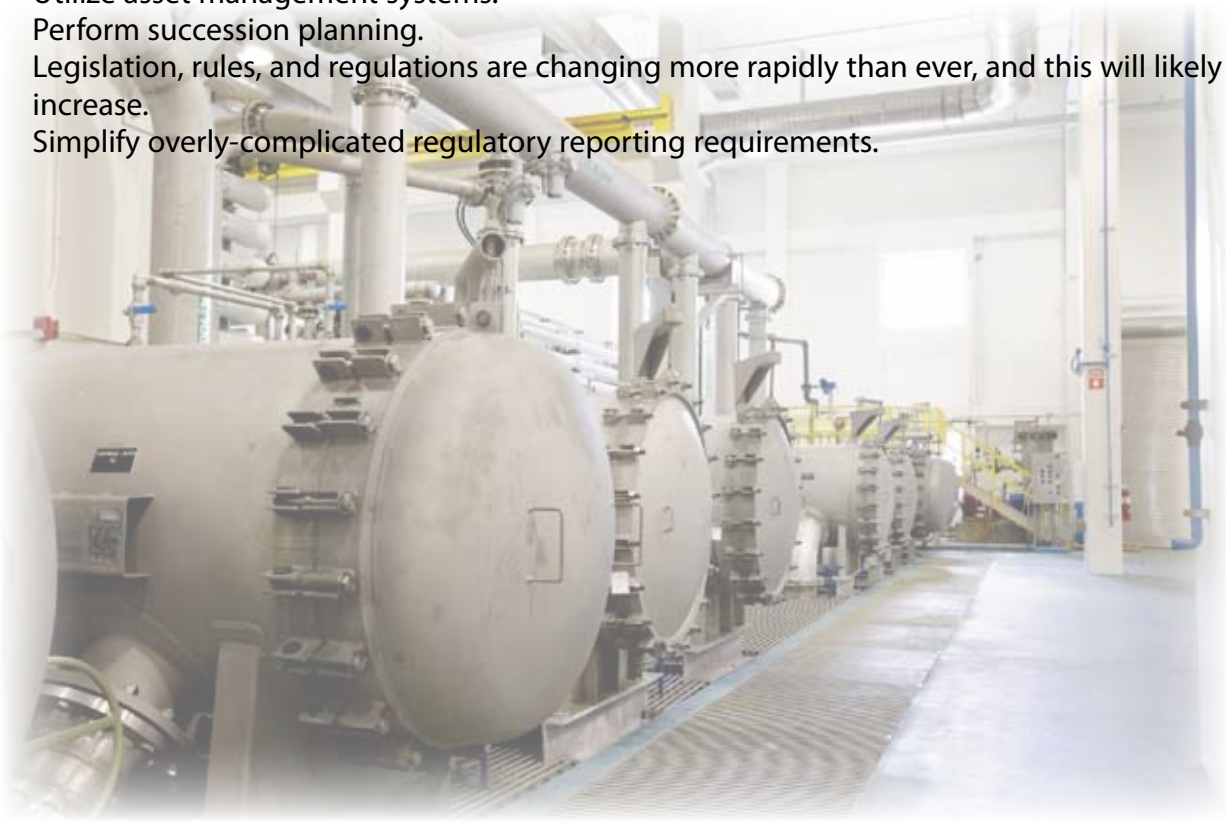
Wetland Delineation Specialist

JOB FUNCTIONS

EMERGING ISSUES AND FUTURE TRENDS

Administration

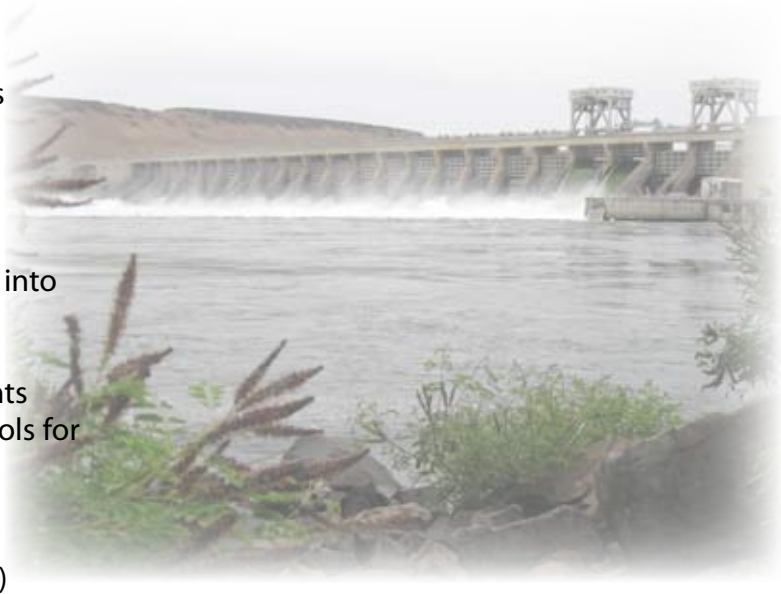
- Manage limited business resources—do more with less. Systems are growing, but budgets are not.
- Provide adequate human resources.
- Retain employees.
- Target research and emphasize regional differences as to water/wastewater needs.
  - o Nutrients management is a coastal concern; not so much of a problem in the middle of the country.
  - o Majority of water plants are small—many size differentials, based on region.
- Systems have historically been decentralized, then became large and centralized. Now they're heading back to being more decentralized.
  - o Centralized facilities tend to be used for economy of scale, but the trend is now moving back in the opposite direction.
  - o Decentralization promotes reclamation and reuse (i.e., reclaim and reuse water at the point of generation).
- Build durability in systems for emergency response, including preparedness for extreme weather and other natural and human-made disasters.
- Address homeland security issues (e.g., training for human-made disasters and emergencies).
- Identify and recover operation maintenance cost between new development and users (full cost recovery).
- Determine how to pay for needed infrastructure.
- Prepare for pollutant credit trading programs.
- Manage distribution and collection for system optimization.
- Utilize asset management systems.
- Perform succession planning.
- Legislation, rules, and regulations are changing more rapidly than ever, and this will likely increase.
- Simplify overly-complicated regulatory reporting requirements.



Outreach
- Perform more public outreach and education.
- Promote public awareness of water issues and recognition of true value of water—cost will only rise.
- Social media is becoming an important communication tool and a means of knowledge transfer.
- Promote conservation (using less water, etc.).

Sustainability
- Plan for systems sustainability and resiliency.
- Water professionals need to be more aware of production of greenhouse gases from various treatment processes.
- Promote energy efficiency and plant optimization.
- Consider gray water systems.
- Consider reclaimed water—direct and indirect water reuse.
- Manage nonpoint source pollution.

Technology
- Green infrastructure
- Sustainable and resilient systems
- Energy recovery
- Nutrient recovery
- Desalination
- Resources reuse
- Integration of renewable energy into facilities (energy recovery, etc.)
- Quality assurance technology
- Management of microconstituents
- Increased use of computer controls for treatment processes
- Advances in analyzing data
- Zero discharge technologies
- AMR (Automated Meter Reading)
- Global access to safe drinking water (wells, purification)



Training
- Funding
- Distance training
- Encourage operators to become trainers, to utilize experienced operators' knowledge in training.
- Standardize the requirements for Continuing Education Units (CEUs) and contact hours across the country (currently developed state by state).
- Mandatory certification for wastewater
- Stormwater certification
- Promote knowledge transfer and ability to operate facility in a manual mode during an emergency and/or disaster.
- Leadership development

HOW CAN HIGH SCHOOLS AND COMMUNITY COLLEGES CONTRIBUTE TO THE WATER MANAGEMENT FIELD?

High school and community college guidance counselors and advisors need to convey to potential students what a valuable and important line of work Water Management can be. Not many people initially consider the water field, but it's a great and relatively stable career path. Additionally, it's largely immune to external anomalies and cannot be exported outside the U.S. This report is an excellent tool for outreach to middle schools, high schools, and colleges to promote Water Management as the up-and-coming, critical career field it has become.

Community colleges need to research the specific type of need for water professionals in their area and region (needs analysis and/or occupational analysis). Advisory committees comprised of local and regional practitioners in the water management field must be developed and collaboration established with business and industry. Business and industry partners must be involved in establishing the real-world occupational tasks that students, as potential employees, must perform (e.g., job task analysis or DACUM). Finally, educators must ensure that this industry input is incorporated into community college programs, to ensure both student and business needs are met (curriculum development) to produce the next generation of Water Professionals in the Water Management field. Again, we hope this Defining Water Management report can facilitate these activities and provide the background and documentation needed to help start new or expanded workforce training opportunities.

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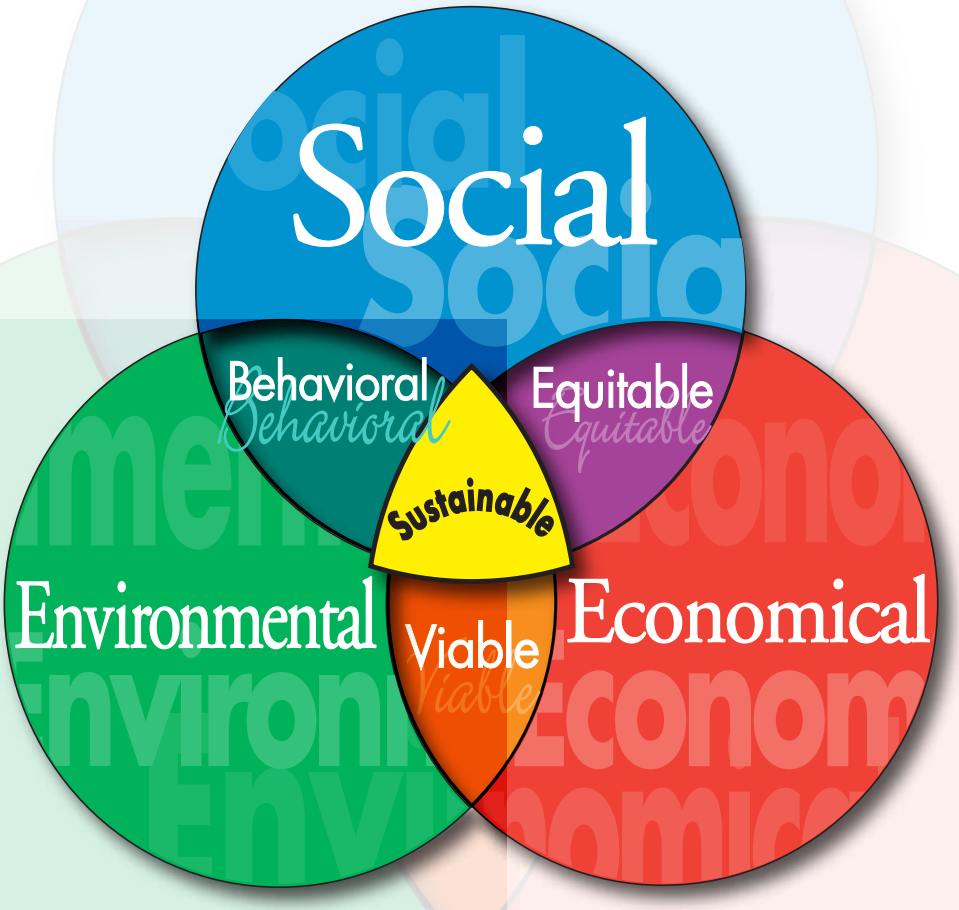

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