WORKFORCE INVESTMENT BOARD OF VENTURA COUNTY

CLEAN/GREEN COMMITTEE MEETING

Friday, March 20, 2015
8:00 a.m. - 9:30 a.m.

VCCF Nonprofit Center (Community Room)
4001 Mission Oaks Blvd., Camarillo, CA

AGENDA

8:00 a.m.	**1.0 Call to Order and Agenda Review**	Nancy Williams
8:02 a.m.	**2.0 Public Comments** Procedure: The public is welcome to comment. All comments not related to items on the agenda may be made at the beginning of the meeting only.	Nancy Williams
8:05 a.m.	**3.0 Approval of Minutes:** January 16, 2015	Nancy Williams
	4.0 Ventura County Regional Strategic Workforce Development Plan	
8:10 a.m.	• Spot Light: The Energy Coalition	Douglas O'Brien
8:35 a.m.	• Ventura County Green Innovation Hub Workgroup Update	Valeria Makarova
8:45 a.m.	• Deputy Sector Navigator Update	Margaret Lau
8:55 a.m.	• Water and Wastewater Occupations –C.O.E. Environmental Scan	Patricia Duffy Margaret Lau
9:15 a.m.	• Career Pathways Update	Tiffany Morse
9:25 a.m.	**5.0 Committee Member Comments**	Committee Members
9:30 a.m.	**6.0 Adjournment**	Nancy Williams

Next Meeting
May 22, 2015 (8:00 a.m.-9:30 a.m.)
VCCF Nonprofit Center
4001 Mission Oaks Blvd., Camarillo, CA

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WIB Clean/Green Committee Meeting
January 16, 2015

MINUTES

Meeting Attendees

Committee	WIB Staff	Guests
Victor Dollar (Chair)*	Patricia Duffy	Martha Amram (WattzOn)
John Brooks	Cheryl Moore	Kay Faulconer Boger (STEPS Program)
Rebekah Evans		Dr. Richard Forde (Ventura College)
Dave Fleisch		Marybeth Jacobsen (Workforce Education Coalition)
Paul Grossgold		Celine Park (Ventura County Community College District)
Eric Humel		Angelica Sagum (OpTerra)
Teresa Johnson*		Alekso Stankoski (OpTerra)
Valeria Makarova		
Kimberly Nilsson*		
Wayne Pendrey		

**WIB Members*

1.0 Call to Order:

Victor Dollar called the meeting to order at 8:05 a.m. No changes were made to the agenda.

2.0 Public Comments

There were no public comments.

3.0 Approval of Minutes: November 21, 2014

Motion to approve: Rebekah Evans
Second: John Brooks
Abstain: Paul Grossgold
Motion carried

4.0 Ventura County Regional Strategic Workforce Development Plan

- Ventura College Water Science Program

  Dr. Richard Forde, Water Science Professor, presented on the Ventura College Water Science Program. This program offers two Certificates of Achievement, two Associate of Science Degrees and preparation for five different licenses. Students have the opportunity to participate in technical training to enter careers in the water or wastewater industry. Dr. Forde explained the value of this program which offers paths and career options, leading to high wage jobs in a high demand, high growth industry. The presentation aligned with the current work of the Clean/Green Committee, which has been working to identify industry employment needs and career pathways that lead to living wage jobs and have high growth potential.

- Ventura County Green Innovation Hub Evaluation: USC Local Government Challenge

  John Brooks gave an update on the Clean/Green Committee's proposal submitted to the USC Local Government Case Challenge. Graduate students from USC work in teams to research

the challenge. The proposal submitted by the Committee was to analyze Ventura County's potential to become a Green Innovation Hub. The proposal was not selected, however the update generated Committee interest in continuing to pursue this idea.

- The Capacity Project: A Public/Private Partnership

  Martha Amram (WattzOn) and Alekso Stankoski (OpTerra) presented on The Capacity Project. The Capacity Project leverages municipal energy strategies into a community-wide program for residential energy savings, workforce development and local economic development. The Capacity Project is a partnership between OpTerra Energy and WattzOn. Simi Valley is one of the first Southern California implementations.

- Career Pathways

  Celine Park reported on the progress of the Career Pathways Trust Grants, *Alliance for Linked Learning* and *VC Innovates*. Ms. Park reported that a series of "Entree to Employment" dinners will be held for students, teachers and business representatives to facilitate discussion of joint needs. In addition, the Ventura County Office of Education and the Oxnard Union High School District are collaborating to apply for a second round of funding for Career Pathways Trust Grant.

- Accelerator Grant and Ventura County STEPS Program

  Kay Faulconer Boger provided an overview of the STEPS Program, which is a partnership between the County of Ventura Probation Agency and the Human Services Agency/Community Services Department (CSD), supplemented by the WIB through its Workforce Accelerator Grant funding. STEPS provides re-entry employment services for non-violent, non-sexual offenders, on probation and connects them with employers after careful screening by both the Probation Agency and CSD. The STEPS Program offers re-entry job seekers with ongoing education, training and employment guidance.

5.0 Committee Member Comments

There were no comments.

6.0 Adjournment

The Committee meeting was adjourned at 9:40 a.m.

Next Meeting
Friday, March 20, 2015 (8:00 a.m. - 9:30 a.m.)
VCCF Nonprofit Center (Community Room)
4001 Mission Oaks Blvd., Camarillo

Advanced Technology
ATEEC Environmental and Energy Center

What is Environmental Technology?

Environmental Technology is a career field that applies the principles of math, science, technology, engineering, communication, economics, and law to ensure the health and safety of the worker and community, and protection of the environment. This career field encompasses the management and conservation of natural resources, regulatory compliance, and sustainability.

What is an Environmental Technician?

An environmental technician communicates and applies knowledge, skills, and abilities, and is qualified to perform scientific, technical, and regulatory tasks. Local, state, federal, and/or professional credentials (certifications or licenses) may be required for certain occupations.

DEFINING ENVIRONMENTAL TECHNOLOGY

Air Quality
- Air Process Tech
- Air Quality Tech
- Ambient Air Monitoring Tech
- Geospatial Tech
- Greenhouse Gas Emissions Specialist
- Indoor Air Quality Tech
- Instrumentation Tech
- Mobile Monitoring Tech (Vehicle Emissions)
- Source Sampling Tech

Emergency Preparedness & Response
- Emergency Planning Specialist (All Hazards)
- Emergency Preparedness & Response Trainer
- First Responder (Police/Fire/EMS/Security)
- Hazardous Materials Tech
- Hazardous Materials Trainer
- Homeland Security Specialist

Energy Technologies & Services*
- Buying & Selling Energy Tech
- Energy Assessment Tech
- Energy Efficient Building Construction, Project Engineering, & Implementation Tech
- Exploration & Extraction Tech
- Generation & Utility-Scale Construction Tech
- Regulatory Compliance Tech
- Transmission & Distribution Tech
- Transportation (Mobile) Services Tech

Environmental Information Collection & Analysis
- Environmental Education & Outreach Tech
- Environmental Database Tech
- Environmental Compliance Tech
- Geospatial (GIS, GPS, RS) Tech
- Logistics Tech

Environmental Laboratory Services
- Biofuels Tech
- Biological/ Microbiological Lab Tech/Analyst
- Chemist/Analytical Lab Tech
- Instrumentation Tech
- Quality Assurance/ Quality Control (QA/QC) Specialist
- Sample Collection & Preparation Tech
- Soil/Geotechnical Properties Tech/ Analyst

Environmental Site Management
- Asbestos Tech (Inspector, Abatement Worker, Supervisor)
- Compliance Tech
- Environmental Site Assessor
- Field Services Tech (e.g., Sampling, Monitoring)
- Geology Tech
- Geospatial Tech
- Hazardous Materials Tech
- Land Survey Tech
- Land Use Planning/ Redevelopment Tech
- Lead Tech (Inspector, Abatement Worker, Supervisor)
- Mining Reclamation Tech
- Mold Remediation Tech
- Pollution Prevention Tech
- Remediation Tech
- Underground Storage Tank Tech

Natural Resources Management
- Aquatic/Marine Habitat Tech
- Botany Tech
- Coastal Zone Management Tech
- Conservation Officer
- Cultural Resource Management Tech
- Fire Resources Tech
- Fisheries Tech
- Forestry Tech
- Habitat Restoration Tech
- Geology Tech
- Geospatial Tech
- Horticulture/ Landscape Tech
- Hydrogeology Tech
- Irrigation Tech
- Naturalist
- Noise Monitoring Tech
- Parks & Recreation Tech
- Precision Agriculture Specialist
- Rangeland Tech
- Regulatory Compliance Specialist
- Soil Conservation Tech
- Survey Tech
- Urban Ecology Tech
- Vet Tech (e.g., Animal Rescue)
- Wetlands Management Tech
- Wildlife/Terrestrial Habitat Tech

Safety & Health
- Chemical Hygiene Officer
- Compliance Officer
- Hazardous Materials Tech
- Health & Safety Tech
- Health Physics/ Radiation Safety Tech
- Loss Control/ Prevention Tech
- Industrial Hygiene Specialist (e.g., Indoor, Air, Noise)
- Industrial Nurse
- Risk Manager
- Safety & Health Auditor
- Safety & Health Coordinator
- Safety & Health Specialist
- Safety & Health Trainer/ Industrial Trainer
- Site Safety & Health Manager

Solid & Hazardous Waste Management
- Biohazard Tech
- Hazardous Waste Tech
- Household Hazardous Waste Tech
- Landfill Tech
- Nuclear Waste Handling/Disposal Tech
- Recycling Tech
- Solid Waste Tech
- Treatment, Storage, & Disposal Facility Tech
- Waste Reduction Tech
- Waste-to-Energy-Tech

Sustainability
- Climate Change Adaptation Specialist
- Climate Change Mitigation Analyst
- Ecological Footprint Analyst
- Efficient Landscaping Tech
- Energy Resource Mgr
- Global Equity Specialist
- Green Product Specialist
- LEED Tech
- Lifecycle Analysis/ Product Stewardship Tech
- Permaculture Design Tech
- Smart Growth Tech
- Sustainability Coordinator
- Sustainability Educator/Trainer
- Sustainability Systems Analyst
- Sustainable Design Tech
- Sustainable Process & Procedures Manager
- Transportation & Logistics Specialist
- Urban Agriculture Tech

Wastewater Management**
- Biosolids Management Tech
- Cross-Connection Control Tech
- Decentralized Treatment System Operator
- Fats/Oils/Grease (FOG) Tech
- Graywater Systems Treatment Operator
- Industrial Pretreatment Coordinator
- Industrial Wastewater Treatment Operator
- Instrumentation Tech
- Laboratory Tech
- Land Application Tech
- Municipal Wastewater Treatment Operator
- Plant Maintenance Tech
- Regulatory Compliance Specialist
- Waste-to-Energy-Tech
- Wastewater Collection System Operator

Water Supply & Treatment**
- Desalination Tech
- Drinking Water Lab Tech
- Industrial Water System Operator
- Instrumentation Tech
- Municipal Water Treatment Plant Operator
- Plant Maintenance Tech
- Public Educator
- Regulatory Compliance Specialist
- Source Water Protection Specialist
- Water Conservation Specialist
- Water Distribution System Operator
- Water Meter Tech
- Water Rights Tech
- Water Security & Emergency Preparedness Specialist
- Well Drilling Tech

Watershed Management**
- Equipment Maintenance Tech
- Erosion Sediment Control Tech
- Geospatial Tech
- Ground Water Remediation Systems Tech
- Habitat Restoration Tech
- Heavy Equipment Operator
- Hydrology Tech
- Interbasin Transfer Specialist
- Modeling Tech
- Nutrient Management Specialist
- Permitting Specialist
- Public Educator
- Stormwater Management Tech
- Taxonomy Specialist
- Water Quality Monitoring Tech
- Wetlands Delineation Tech

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*Refer to ATEEC's *Defining Energy Technologies & Services* report for further breakdown of occupations and functions.

**Refer to ATEEC's *Defining Water Management* report for further breakdown of occupations and functions.

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Environmental and Energy Center

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.

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

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

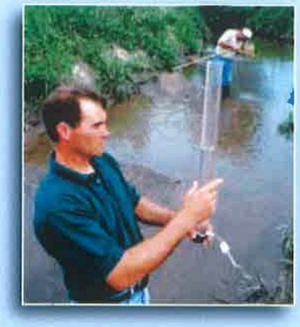
- Chief Operator
- Collection System Operator*
- Industrial Pretreatment Operator
- Instrumentation Technician*
- Plant Operator* (treatment, biosolids, reclamation, construction)
- Pretreatment Coordinator
- Process Control Operator**

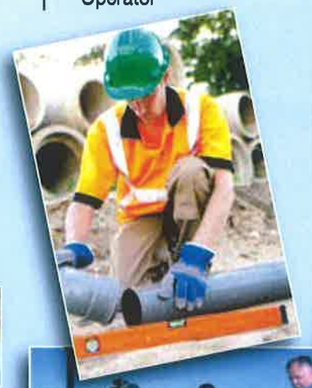
Water Operations

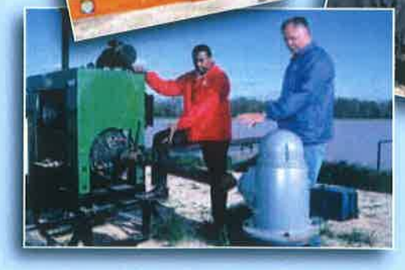
- Cross-Connection Control Specialist
- Distribution Operator/Foreman
- Heavy Equipment Operator
- Industrial Water Systems Operator
- Instrumentation Technician
- Leak Detection Technician
- Meter Reader/Installer
- Meter Tester/Mechanic
- PLC/SCADA Programmer
- Treatment Plant Mechanic
- Utility Locator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

NSF

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DEFINING WATER MANAGEMENT

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.

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.

  Nutrients management is a coastal concern; not so much of a problem in the middle of the country.

  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.

  Centralized facilities tend to be used for economy of scale, but the trend is now moving back in the opposite direction.

  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.

Emerging Issues & Future Trends

How can high schools & community colleges contribute to the Water Management field?

High school and community college guidance counselors and advisors can 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.

www.ateec.org

Technology

- Green infrastructure
- Sustainable and resilient systems
- Energy recovery
- Nutrient recovery
- Desalinization
- 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, etc).

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

ATEEC *Advanced Technology* ***Environmental and Energy Center***

201 North Harrison Street, Suite 101 • Davenport, IA 52801
563.441.4081 • 866.419.6761 • www.ateec.org

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BAYWORK
bay area water/wastewater
workforce development
collaborative

ENVIRONMENTAL SCAN

WATER AND WASTEWATER OCCUPATIONS

Bay Region

NOVEMBER 2009

BAYWORK

Cheryl Davis, Chair
ckd@sfwater.org

CENTERS OF EXCELLENCE

San Francisco Bay

City College of San Francisco
jcarrese@ccsf.edu

Greater Silicon Valley

West Valley College
elaineg@elaineg.net

www.coeccc.net/water

An Initiative of

ECONOMIC & WORKFORCE DEVELOPMENT
through the
CALIFORNIA COMMUNITY COLLEGES

The Bay Region Water and Wastewater Occupations environmental scan is a joint project of:

BAYWORK
bay area water/wastewater workforce development collaborative

C·O·E CENTERS OF EXCELLENCE
Inform Connect Advance

Mission: The Centers of Excellence, in partnership with business and industry, deliver regional workforce research customized for community college decision making and resource development.

Vision: We aspire to be the premier source of regional economic and workforce information and insight for community colleges.

Please consider the environment before printing. This document is designed for double-sided printing.

Contents:

Acknowledgements

This project would not have been possible without our industry partner on this study: BAYWORK, the Bay Area Water/Wastewater Workforce Development Collaborative. BAYWORK supported the project in the design phase by providing subject matter expertise, information on agencies and utilities in the water and wastewater sector, and input on the survey instrument used for the workforce study. BAYWORK also took the lead role in researching contact information for water and wastewater agencies/utilities, distributing the survey, encouraging staff at utilities to complete the survey, and helping collect the data with an on-line survey tool. BAYWORK also reviewed both the Key Findings research brief and the full environmental scan report.

Members of the BAYWORK Executive Committee who deserve special recognition are:

Cheryl Davis, BAYWORK Chair and San Francisco Public Utilities Commission

Ray Yep, BAYWORK Vice-Chair and Santa Clara Valley Water District

Jim Smith, BAYWORK Executive Committee and East Bay Municipal Utility District

Elaine Lew-Smith, BAYWORK Executive Committee and East Bay Municipal Utility District

James McPherson, BAYWORK Executive Committee and Union Sanitary District

Catherine Curtis, BAYWORK Executive Committee and San Francisco Public Utilities Commission

Joanna De Sa, BAYWORK Executive Committee and City of Sunnyvale Water Pollution Control Plant

The Centers of Excellence and BAYWORK would also like to thank the forty-five agencies and utilities in the six county region of the Bay Area who took the time to complete the survey. These survey results have provided critical information about the workforce needs and requirements of water and wastewater agencies and utilities. This information is vital for Bay Region community colleges that are developing and strengthening training and education programs for the water and wastewater sector.

This project was greatly enhanced by the excellent work performed by the following community college colleagues: Kelley Karandjeff for her research assistance throughout the project, drafting sections of the report and reviewing the final report; Laura Coleman from the Center of Excellence Research Hub, hosted at the Los Rios Community College District for her work on the survey instrument, expert data analysis and creating the Key Findings research brief; and Kitty O'Doherty for her role in convening community colleges over the last year to facilitate discussions about how community colleges can best respond to the workforce needs of the utilities and agencies in the region.

Based on a 2009 survey of water and wastewater agencies and utilities in six Bay Area counties, employers are projected to need as many as 677 new and replacement workers in seven mission critical occupations over the next five years.

Source: BAYWORK/Centers of Excellence

Executive Summary

In 2009, the San Francisco Bay and Greater Silicon Valley Centers of Excellence (COE) partnered with BAYWORK (the Bay Area Water/Wastewater Workforce Development Collaborative) to survey water and wastewater agencies and utilities in six Bay Area counties.[1] The research study was designed to identify the workforce needs of employers related to seven mission critical occupations:

- Water Treatment Operator
- Water Distribution Operator
- Wastewater Treatment Operator
- Wastewater Collections Operator
- Mechanic/Machinist
- Electrician/Electrician Technician
- Electronic Maintenance Technician/Instrument Technician

These occupations were selected for study by BAYWORK because (1) their work is essential to reliable water and wastewater operations and (2) there were concerns about whether sufficient numbers of qualified candidates would be available to fill upcoming vacancies. The segment of the workforce being studied in detail in this report is primarily the technician level/mid-level occupations most closely aligned with community college education programs, as opposed to professional level occupations.

Data about the demand for skilled workers in this industry was needed to inform community colleges. If the need was demonstrated, colleges could respond by providing training and education programs to prepare workers for projected openings. With this in mind, employers were surveyed from July through September 2009. The workforce study focused on gathering the following quantitative and qualitative data:

- The current number and size of utilities/agencies, as well as geographic concentration.
- Future job growth over the next one to three years in water and wastewater occupations relevant to community colleges.
- Employer needs and challenges in hiring and training employees.
- Skill sets and education requirements needed for these key occupations.
- Career ladders and lattices within the water and wastewater sector.
- Current and future salary ranges for these key occupations.
- Industry interest in accessing community college education and training programs.

[1] San Francisco, Marin, Alameda, Contra Costa, San Mateo, Santa Clara

A total of forty-five (45) employers out of the seventy-seven (77) utilities and agencies that were identified by BAYWORK in the six-county region responded to the survey. The survey yielded a rich set of data that is highlighted in this report. Water and Wastewater agencies and utilities in the six counties studied reported that they **will need as many as 677 workers over the next five years in these seven mission critical occupations.**

The vast majority of these workers—as many as 600—will be needed due to current workers who are eligible to retire during that same time period. Employers reported that 77 workers will be needed due to new jobs being created. While the analysis reflects future employee eligibility to retire, it is understood that all employees will not retire as soon as they are eligible. On the other hand, some job turnover occurs among employees prior to their eligibility for retirement.

Two occupations, Wastewater Treatment Operator and Water Treatment Operator, will need the most workers (both new jobs and replacements combined) over the next five years; 214 and 106 respectively.

The survey results indicate that over 50% of employers are having difficulty hiring qualified candidates for all seven occupations, and over 80% of employers indicated difficulty in hiring Electricians/Electrician Technicians and Electronic Maintenance Technicians/Instrument Technicians. Employers also expressed great interest in education programs that can be developed by community colleges, including student internships.

In addition, a survey of community college programs related to water and wastewater occupations was conducted. The survey results identify existing as well as planned college courses and programs and can be used to inform program expansion and/or adaptation in the region. No community college currently provides specific preparation for the four mission critical water and wastewater operator occupations in the three sub-regions of the San Francisco Bay Area which serve as the focus of this environmental scan—San Francisco and Marin, the East Bay (Alameda and Contra Costa Counties) and the South Bay (San Mateo and Santa Clara Counties). Solano College and Santa Rosa Junior College located in the North Bay do offer courses and programs for water and wastewater operator occupations and will no doubt play a role in responding to the workforce needs outlined in this report. There appears to be some need for course and/or program development to more fully meet the operator workforce needs of employers, particularly in the South Bay.

Eleven of the 19 community colleges in the six-county region of the Bay Area studied were identified as offering courses and/or programs related to the three maintenance/operations support occupations identified by employers for this study.[2] There will be employment opportunities for students in the short term due to retiring workers from this industry and regional colleges should respond to documented employer workforce needs in a coordinated and flexible manner.

[2] Mechanic/Machinist; Electrician/Electrician Technician; Electronic Maintenance Technician/Instrument Technician

Introduction

The California Community Colleges System has charged the Economic and Workforce Development (EWD) Network with identifying industries and occupations with unmet employee development needs and with initiating partnerships that hold potential for the colleges' programs. The San Francisco Bay Center of Excellence serves the fifteen community colleges in the Northern and Eastern counties of the 12-county Bay Area.

BAYWORK, the Bay Area Water/Wastewater Workforce Development Collaborative, is a regional collaborative of water and wastewater utilities and agencies with mutual concerns about their future workforce needs and challenges. The four water and wastewater utilities who initially formed BAYWORK are: the San Francisco Public Utilities Commission, East Bay Municipal Utility District, Santa Clara Valley Water District, and Union Sanitary District.

This report is a product of the collaboration between the San Francisco Bay Center of Excellence and BAYWORK. The findings of this study will be used by Bay Area community colleges to help assess the nature of the support they can provide the water/wastewater industry, so that qualified candidates are available to fill vacant positions.

Why Study the Water Industry?

Rarely do we stop to think about turning on our tap, taking a drink from a water fountain or washing our hands at work and yet, the availability of water is at the heart of our social and economic stability. Clean drinking water is vital to our public health and quality of life and a safe, reliable water source is a key factor in the success of nearly all parts of our economy. According to the American Water Works Association, Americans are among the world's leading water consumers, using an estimated 339 billion gallons of water a day.

Manufacturing, agriculture, healthcare, and just simple thirst quenching account for this enormous use of water."[3] A recent Bay Area Council report drives home the importance of a secure and safe water system to our own region's health and wellbeing. Estimating the economic and social impact of an interruption to the local water supply from Hetch Hetchy, the report predicts damages of "at least $28.7 billion for a major earthquake on the San Andreas Fault and $17.2 billion for a similar event on the Hayward Fault. Commercial and industrial losses alone are estimated to be at least $14.2 and $9.9 billion respectively."[4]

Maintaining our region's water system depends heavily on an adequate and prepared workforce. Local water and wastewater utilities are keenly aware of this issue and are aggressively strategizing to address their current and future workforce needs.

In May of 2008, Santa Clara Valley Water District, the San Francisco Public Utilities Commission, and Cal/Nevada American Water Works Association co-sponsored a West Coast Water/Wastewater Workshop on Workforce Development. The workshop was attended by a number of utilities and stakeholders (including community colleges, the Department of Labor, and workforce development boards). Findings from the workshop were used as the basis for the work of a Workforce Development Task Force which was subsequently created in connection with a Water Research Foundation project related to potential benefits of regional collaboration. Agencies which participated in the work of the task force included Santa Clara

[3] http://www.awwa.org/careercenter/resources/docs/waterindustrytrends.cfm
[4] Bay Area Council; http://www.bayeconfor.org/pdf/hetchhetchyfinal2.pdf

Valley Water District, East Bay Municipal Utility District, Union Sanitary District, and the San Francisco Public Utilities Commission. The intent of this task force was to look for opportunities for water and wastewater utilities to maximize the cost-effectiveness of their workforce development efforts through collaboration. One of the work products of this task force was a preliminary assessment of future labor needs in relation to five mission-critical classifications (water treatment operator, wastewater treatment operator, electrician/electrical worker, electronic maintenance technician/instrument technician, and mechanic/machinist).

Based on the benefits seen from the collaborative efforts of the four-agency group, a decision was made by the Steering Committee of the Water Research Foundation Project to endorse the creation of a group that would address the needs of water and wastewater utilities in six counties: San Mateo, Santa Clara, San Francisco, Alameda, Contra Costa, and Marin. This group, chartered as BAYWORK, held its first meeting in June of 2009. BAYWORK's charter included a Roadmap which referenced four principal strategies for meeting short- and long-term labor needs. Three of these potentially involve contributions from community colleges:

- Get enough of the right people in mission-critical job categories;
- Give staff the information they need to do quality work; and
- Maximize cost-effectiveness of workforce development efforts through collaboration.

This environmental scan is one way BAYWORK is engaging with community colleges to better identify and act on opportunities for collaboration. The San Francisco Bay Center of Excellence and BAYWORK jointly developed this environmental scan, building on significant research and assessment of workforce needs already performed by BAYWORK beginning in 2008. This report will focus on seven "mission critical" occupations identified by BAYWORK for which community colleges can provide partial or total training. These occupations include:

- Water Treatment Operator
- Water Distribution Operator
- Wastewater Treatment Operator
- Wastewater Collections Operator
- Mechanic/Machinist
- Electrician/Electrician Technician
- Electronic Maintenance Technician/Instrument Technician

This report summarizes related literature and presents the results from two primary research activities. The first activity was conducting a workforce survey with Bay Area water and wastewater utilities, using a survey co-created by the Center of Excellence and BAYWORK. The survey was sent to 77 employers between July and September 2009, resulting in 45 responses. This workforce study focused on gathering both quantitative and qualitative data from these employers about the following:

- The current number and size of utilities/agencies, as well as geographic concentration.
- Future job growth over the next one to three years in water and wastewater occupations relevant to community colleges.

- Employer needs and challenges in hiring and training employees.
- Skill sets and education requirements needed for these key occupations.
- Career ladders and lattices within the water and wastewater sector.
- Current and future salary ranges for these key occupations.
- Industry interest in accessing community college education and training programs.

The second research activity included a survey of Bay Area community college programs related directly to water and wastewater operations as well as those that prepare individuals for maintenance/operations support occupations such as mechanic, electrician and electronic maintenance technician. The survey results identified existing and planned courses and programs and can be used to inform program development, expansion and/or adaptation in the region.

Industry Overview

According to the U.S. Department of Labor, a majority of employment related to water and wastewater collections, treatment and distribution is concentrated in local government and private water, sewage and others systems utilities. To better understand how this workforce functions, recognizing the difference between water and wastewater systems is useful. Water is generally pumped from natural sources such as wells, rivers, streams and reservoirs to water treatment plants, treated and distributed to consumers. Wastewater usually travels through sewage pipes to treatment plants where it is treated and returned to streams, rivers, or other natural sources or used for irrigation and landscaping.[5] In California, there are approximately 1,200 water districts that perform these services.[6]

Over the past several decades, the federal government has approved two major statutes to regulate our nation's water supply. These include the *Safe Drinking Water Act* which establishes standards for drinking water and the *Clean Water Act* which limits the discharge of pollutants. In California, nine major agencies are involved in managing water systems and ensuring state compliance with these regulations.[7] Two primary agencies deal with related workforce regulation and certification including the Department of Public Health's Division of Drinking Water and Environmental Management, which focuses on drinking water treatment and distribution, and the State Water Resources Control Board, which focuses on wastewater collections and treatment.

Public awareness has driven these legislative responses to water standardization as consumers express growing interest in improved water quality. In turn, regulation is increasingly stringent and this atmosphere has significant implications for the water workforce (as discussed below). Moreover, increased consumption coupled with water shortages in particular regions like the Bay Area, which some connect to climate change, are driving conservation movements and requiring new approaches to water management for many districts and utilities across the nation. Given these public health and environmental concerns, employment in the water industry is increasingly viewed as a "green" occupation contributing directly to the stewardship of one of our most vital natural resources.

[5] Water and Liquid Waste Treatment Plan and System Operators, Bureau of Labor Statistics, Occupational Outlook Handbook (2008-2009), www.bls.gov
[6] California Water: An LAO Primer, California Legislative Analysts Office, October 2008
[7] California Water: An LAO Primer, California Legislative Analysts Office, October 2008

Understanding the U.S. Water Workforce

As noted above, the water workforce includes occupations that relate directly to collections, treatment and distribution of water or wastewater as well as the maintenance and repair of related systems, technology and infrastructure. It is difficult to fully define the size and scope of the workforce due to the incorporation of public utility employment data in government sector data (as opposed to its own separate classification) or integration of those performing support functions for the industry into broader occupational groups (e.g., mechanic/machinist). In 2006, water and wastewater treatment plant and systems operators alone held 111,000 jobs; 4 in 5 of these operators worked for local governments.[8]

Recognizing Forces Driving Workforce Demand

Like many industries, water and wastewater agencies are confronting a series of changes to their workforce at the same time they are managing an evolution in the way they perform and deliver their services. A 2006 Water Research Foundation study highlighted the following four key factors impacting the industry's workforce:

- Employment growth in the water supply and sanitary services sector due to regulations, infrastructure growth, security, and customer demands
- Baby boomer retirements
- Increased complexity of work (e.g. changing water quality and environmental regulations, technologies, facilities and processes)
- Shrinking pool of available, technically skilled and trained workers

The American Water Works Association 2008 *State of the Industry Report* confirmed that the industry is increasingly concerned with how to proactively address these factors. This annual report collects information on water professionals perceptions of the industry's greatest challenges and in 2008, respondents identified workforce development as one of the top five critical concerns facing the sector. Respondents are grouped by region and Region 7, which includes CA, identified workforce development as a "long-term critical issue" more frequently than peers in other regions. As noted in the report, the water workforce is hampered by retirements coupled with more lucrative and higher-prestige jobs luring younger workers to other industries and strong competition for recent graduates from college and trades programs. The study quoted one respondent as saying, "The loss of current workers and fewer qualified replacements are occurring as our infrastructure ages, needs replacement, and must meet regulations. We need good people to drive results."[9]

BAYWORK echoes the same factors identified by the American Water Works Association and the Water Research Foundation and has further refined them for the purposes of regional water agencies and organizations. Research conducted in connection with the Workforce Development Initiative of the Water Enterprise of the San Francisco Public Utilities Commission in 2007 indicated that operational reliability was at risk in relation to mission-critical functions because of potential deficiencies in terms of both the numbers of qualified candidates available and the adequacy of the information and tools provided to employees.

[8] Water and Liquid Waste Treatment Plan and System Operators, Bureau of Labor Statistics, Occupational Outlook Handbook (2008-2009), www.bls.gov

[9] (p. 71). http://www.awwa.org/publications/AWWAJournalArticle.cfm?itemnumber=41500

Changing regulatory requirements, facilities, processes, procedures, and equipment, and inadequate knowledge management systems were identified as challenges compounding the anticipated retirement of Baby Boomer employees. Similar results were found in pre-conference research conducted with 12 water and wastewater utilities in connection with the West Coast Water/Wastewater Workshop on Workforce Development in May of 2008.

BAYWORK expresses additional concern with the general lack of awareness among young people and their families about jobs in the water industry including the skills required for water-related occupations, the type of work environment, the pay and benefits. This lack of awareness combined with the predicted retirements lead to an anticipated shortage of workers in these mission-critical positions, if water utilities and districts proceed with the status quo.

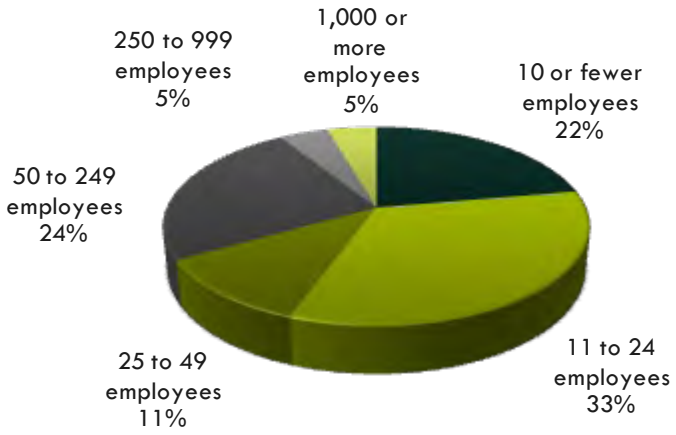
BAYWORK also underscores agencies' particular concern with ensuring that those who do enter the industry are prepared with the skills, knowledge and abilities necessary for success and that the industry itself can adequately articulate and assess for those requirements. Given continuous advancements in technology, equipment, work processes and procedures, employers indicate that workers need to enter employment with proficiency in math, science, computers and technology and continue their learning on the job. Changes in regulatory requirements also mean ongoing training and development.

Bay Area water industry representatives indicate a need to improve both how they generate a pipeline of new, prepared employees as well as how they guarantee these workers can continue to upgrade skills once employed. Part of this challenge includes not only updating how to deliver training and support, but also addressing how to effectively document and retain existing knowledge such that it can be passed on to a new generation of workers.

Number and Size of Firms in the Six Bay Area Counties

In the six counties that BAYWORK currently is focused on, there are at least 77 water and wastewater utilities and agencies. Of these, 45 responded to the survey. The data in this document represents the information submitted by this group of employers.

Water and wastewater utilities and agencies were asked how many full-time permanent employees work in their water and/or wastewater department or section. The 45 employers represent a combined workforce of more than 5,400 employees in water and/or wastewater departments or sections. The survey data reveals that there will be 74 new positions created over three years (1.4% growth) and 124 new positions created over five years (2.3% growth) in water and/or wastewater departments or sections. The data compiled on the size of overall employment reveals that most of the departments or sections are small, with a majority (55%) reporting fewer than 25 employees. More data on the size of firms is shown in the pie chart below:



Identifying Mission Critical Occupations

BAYWORK selected these seven occupations for further study because (1) their work is essential to reliable water and wastewater operations and (2) there were concerns about whether sufficient numbers of qualified candidates would be available to fill upcoming vacancies. The segment of the workforce being studied in detail in this report is primarily the technician level occupations most closely aligned with community college education programs, as opposed to professional level occupations (that are also employed by utilities/agencies). The seven "mission critical" occupations are defined on the following page.

Seven Occupations Studied

- Water Treatment Operator
- Water Distribution Operator
- Wastewater Treatment Operator
- Wastewater Collections Operator
- Mechanic/Machinist
- Electrician/Electrician Technician
- Electronic Maintenance Tech/Instrument Tech

Water Treatment Operator: Performs water treatment function. T-3 certification from Department of Health Services is generally where the journey level starts.

Water Distribution Operator: Operates water transmission and distribution systems (e.g., pumps and valves), often using a SCADA control system. Generally does not perform construction, maintenance, or plumbing work. D-3 certification from Department of Health Services is generally where the journey level starts.

Wastewater Treatment Operator: Performs wastewater treatment function. Usually requires Grade 3 certification by Regional Water Quality Control Board.

Wastewater Collections Operator: Performs wastewater collections function. Usually requires Grade 2 certification by California Water Environment Association.

Mechanic/Machinist: Maintains mechanical equipment associated with water and wastewater transmission, distribution, storage, and treatment.

Electrician/Electrician Technician: Maintains, repairs, tests, installs, modifies, calibrates, and trouble-shoots electrical equipment used in the facilities and systems of water and wastewater utilities.

Electronic Maintenance Technician/Instrument Technician: Maintains, repairs, tests, installs, modifies, calibrates, and trouble-shoots electronic, pneumatic, and control equipment associated with the facilities and systems of water and wastewater utilities.

Occupational Overview

Occupations Studied

The occupations chosen for inclusion in the survey were identified by BAYWORK as "mission critical" and were also occupations that community colleges could address in their education and training offerings. The current employment and employment projections reported by employers for the seven occupations studied over a three-year and five-year time frame are listed in the tables on the following page.

Additional sample data related to budgeted positions below journey-level and current vacancies for budgeted positions can be found in Appendix B. Extrapolated data for the total known population of water and wastewater utilities/agencies in the six Bay Area counties included in this study can be found in Appendix C.

The following table contains sample data collected for the **seven mission critical occupations in the Water and Wastewater Occupations study, using a 3-year time frame.** Employers were asked to detail their current employment, project future growth (new jobs), and estimate retirement eligibility (replacement jobs). For each occupation, the following job levels were included: apprentice or trainee, journey-level, and supervisory.

Water and Wastewater Occupations	2009 Employment	3-year Growth Rate (total new job growth)	Eligible to Retire in 3 years (total replacement rate)	New & Replacement Jobs (3 year total)
Water Treatment Operator	238	2%	33%	80
Water Distribution Operator	202	1%	21%	43
Wastewater Treatment Operator	433	4%	42%	191
Wastewater Collections Operator	212	9%	24%	69
Mechanic/Machinist	229	3%	33%	79
Electrician/Electrician Technician	126	1%	35%	42
Electronic Maintenance Technician/Instrument Technician	134	6%	34%	51
Total	**1,575**	**4%**	**32%**	**555**

The following table contains the sample data collected for the **seven mission critical occupations in the Water and Wastewater Occupations study, using a 5-year time frame.**

Water and Wastewater Occupations	2009 Employment	5-year Growth Rate (total new job growth)	Eligible to Retire in 5 years (total replacement rate)	New & Replacement Jobs (5 year total)
Water Treatment Operator	238	1%	45%	106
Water Distribution Operator	202	1%	24%	49
Wastewater Treatment Operator	433	6%	45%	214
Wastewater Collections Operator	212	15%	28%	90
Mechanic/Machinist	229	2%	43%	101
Electrician/Electrician Technician	126	2%	43%	52
Electronic Maintenance Technician/Instrument Technician	134	4%	47%	65
Total	**1,575**	**5%**	**40%**	**677**

Projected Need for the Seven Occupations

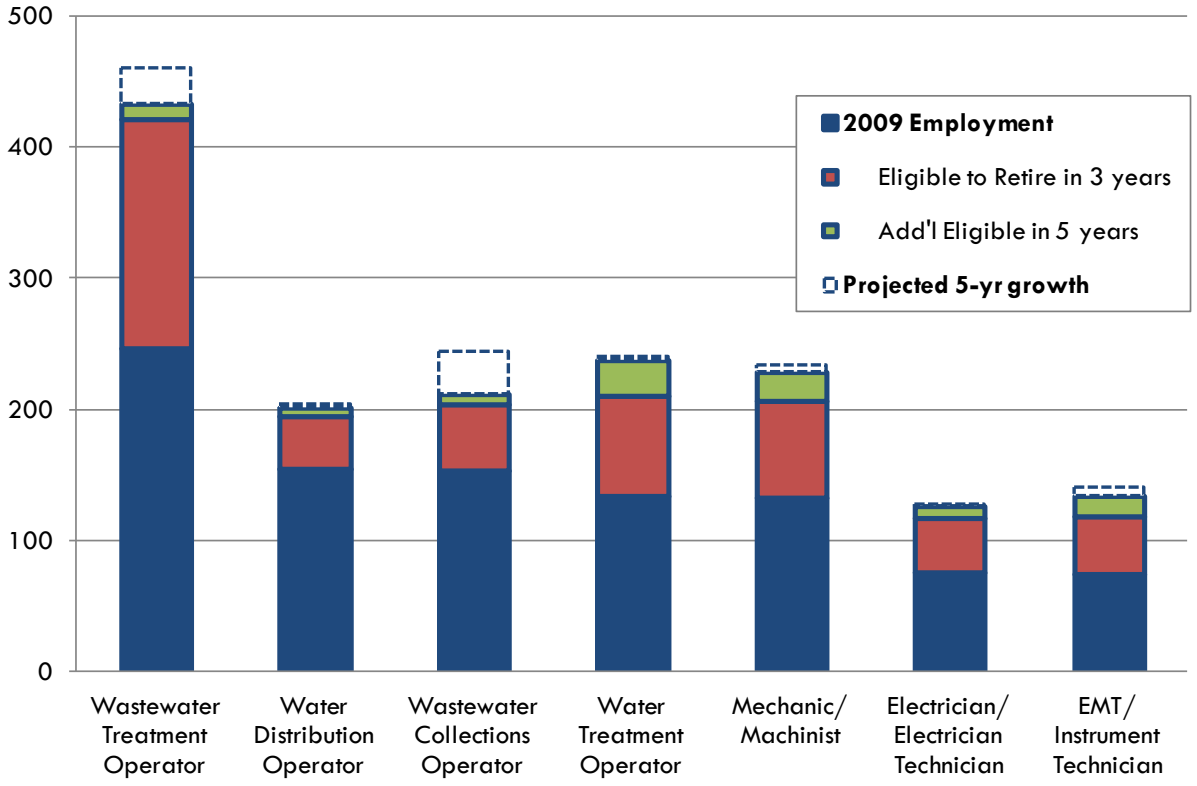
Based on the survey responses, the combined totals for the seven occupations over the **next 3 years** could result in at least **555 new and replacement jobs for the Bay Area economy.**

Based on the survey responses, the combined totals for the seven occupations over the **next 5 years** could result in at least **677 new and replacement jobs for the Bay Area economy.**

Other highlights include:

- The 45 water and wastewater utilities and agencies that responded to the workforce survey collectively employ almost 1,600 workers in the target occupations.
- Wastewater treatment operator is the largest occupation surveyed, with more than 430 jobs in 2009. Retirement eligibility for wastewater treatment operators may be as high as 45% over the next five years and the demand for workers could exceed 210 jobs (new and replacement jobs).
- Water treatment operator is the second largest occupation of the group, with close to 240 workers currently employed. With replacement rates of 45%, Bay Area employers may need workers to fill as many as 106 positions within five years.

The following bar graph displays the key components that employers were asked about for each occupation: current employment, number of workers eligible to retire in 3 and 5 years and growth from new positions. The bar graph below displays current employment levels (including the blue segment and up through the blue outlined segments). Eligibility to retire levels (red and green segments) are shown as subsets of current employment (as indicated by the blue outlines). Five-year growth projections (new positions) are shown in the blue dotted segment.



Wages and Career Pathways

Water and wastewater jobs pay well and provide opportunities for advancement along a career pathway of increasing skills and wages. Most of the seven jobs studied for this report are middle-skill jobs requiring more education than high school, but less than a four-year degree—and are well within reach for lower-skilled and low-income workers, as long as they have access to effective training programs and appropriate supports.

Employers were asked to provide the **minimum and maximum monthly pay step** for each occupation, from apprentice/trainee to journey-level to supervisory employees (wages only, not including benefits). The results from the 45 respondents are summarized in the table below:

Table 1: Minimum and Maximum Monthly Pay Step for Each Occupation

	Apprentice/Trainee		Journey-level		Supervisory	
Occupation	**minimum**	**maximum**	**minimum**	**maximum**	**minimum**	**maximum**
Water Treatment Operator	$4,405	$5,609	$5,649	$7,042	$7,144	$9,000
Water Distribution Operator	$3,929	$4,973	$5,052	$6,364	$6,448	$8,473
Wastewater Treatment Operator	$4,171	$5,222	$5,432	$6,627	$6,429	$8,389
Wastewater Collections Operator	$3,982	$4,859	$4,654	$6,004	$5,972	$7,852
Mechanic/Machinist	$4,058	$5,034	$5,327	$6,457	$6,523	$8,190
Electrician/Electrician Technician	$3,497	$4,435	$5,812	$7,033	$7,455	$9,349
Electronic Maintenance Technician/Instrument Technicians	$3,959	$4,883	$6,006	$7,417	$7,279	$9,034

Occupational profiles for each of the seven occupations can be found in Appendix D. Within each profile, there is a Career Pathways section that provides more information on career advancement opportunities for that occupation. In addition, Appendix E contains a Career Pathways graphic for Wastewater Treatment Plant Operator as an example of one career pathway that a worker could experience in the industry.

Emerging Position – Recycled Water Program Coordinator

While water/wastewater is a mature industry with clearly defined and stable occupations, the burgeoning focus on water conservation and the "greening" of its operations may lead to the development of new occupations or job functions. One occupation that may be on the industry's horizon focuses on water reclamation. According to plant manager Steve Dominguez, the Delta Diablo Sanitation District plans to hire a **Recycled Water Program Coordinator** in the near future. Perhaps the first of its kind in the Bay Area, Dominguez describes the role at this wastewater treatment facility as a "hybrid position, a cross between water purifier and purveyor." Reflective of a growing national movement to address water supply challenges, this position aims to help Delta Diablo grow its water recycling movement, which includes construction of a new plant in Antioch as part of the Federal Stimulus effort. The job description outlines the essential functions of this position as leading the District's recycled water program and distribution services, including integration with continuous wastewater treatment operations as well as developing unique recycled water systems operations. The work will include planning, designing, constructing and implement related programs and projects. Dominquez

notes that this position will require applicants to hold an advanced wastewater certification as well as possess some water distribution experience. For more information on Delta Diablo's water recycling efforts, visit: http://www.ddsd.org/recycled.html.

Employer Needs and Challenges

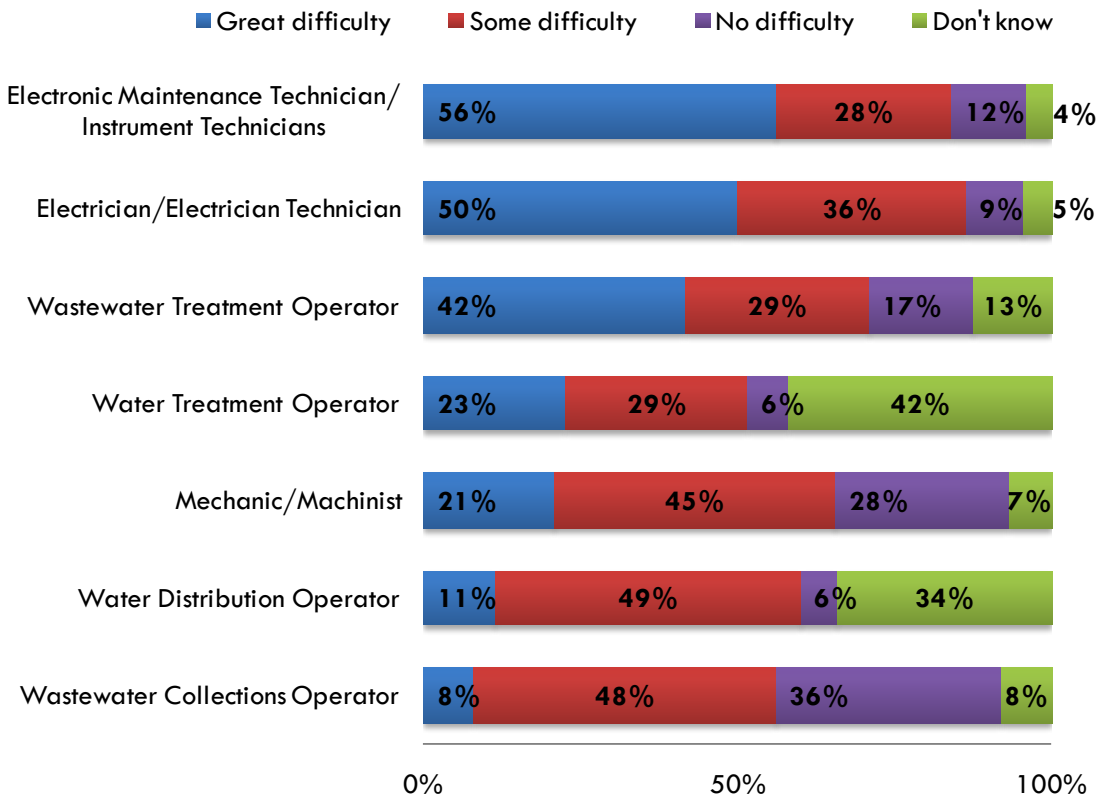
Water and wastewater agencies and utilities reported significant challenges with finding qualified employees for most of the seven occupations studied. The difficulty in finding enough experienced personnel will only become more pronounced as more workers retire over the next five years.

Hiring Difficulties

Over 60 percent of employers responding to the survey indicated difficulty in hiring for five of the seven occupations studied as shown in Figure 1. The level of difficulty finding qualified applicants for water/wastewater occupations only strengthens the overall demand for these positions.

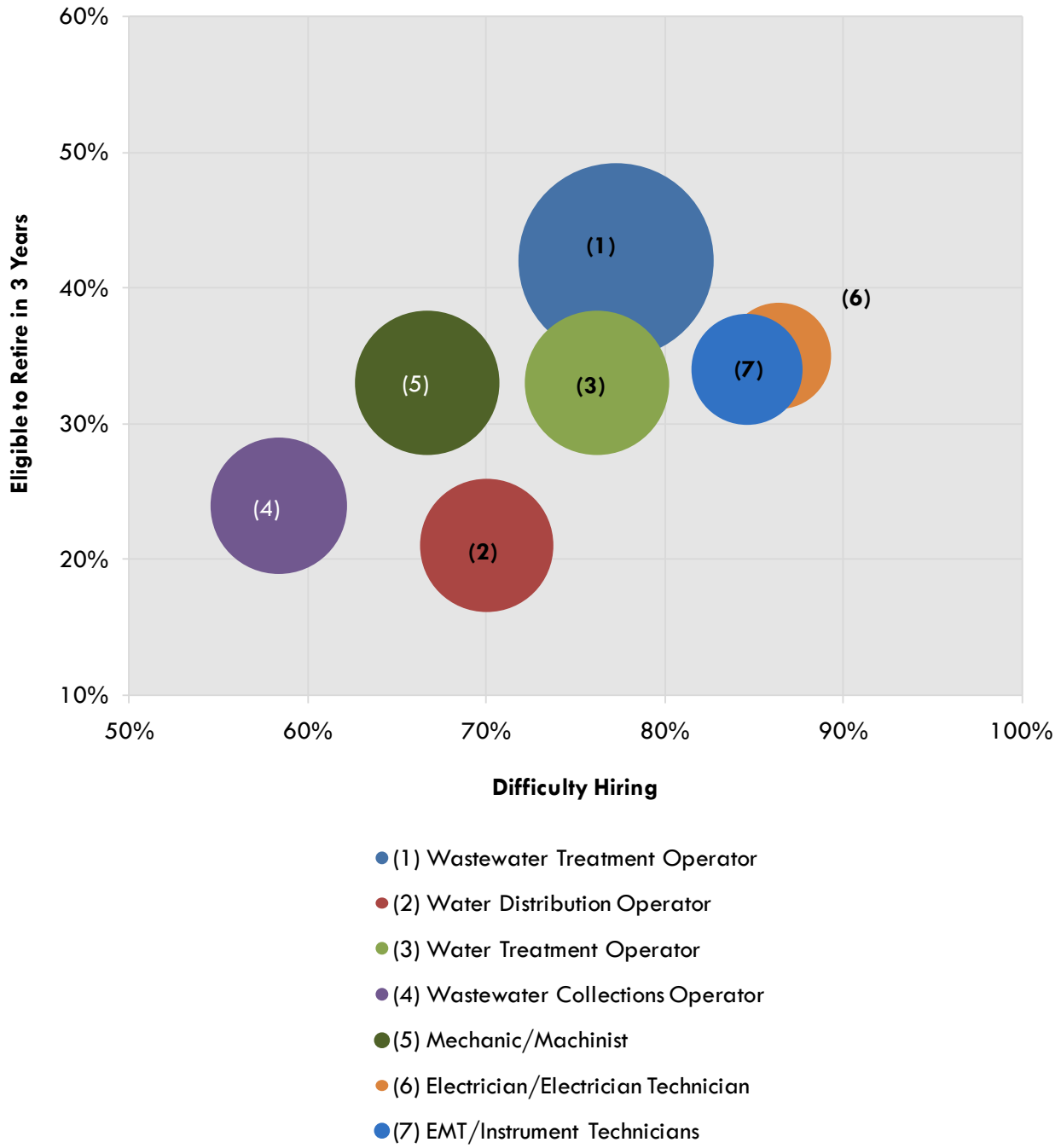
- 4 out of 5 employers experience difficulty finding qualified Electronic Maintenance Technicians and Electricians.
- 2 out of 3 employers experience difficulty finding qualified Wastewater Treatment Operators and Mechanics.
- Over 50% of employers reported difficulty in hiring for all seven of the occupations studied.

Figure 1: Difficulty in Hiring for Each Occupation



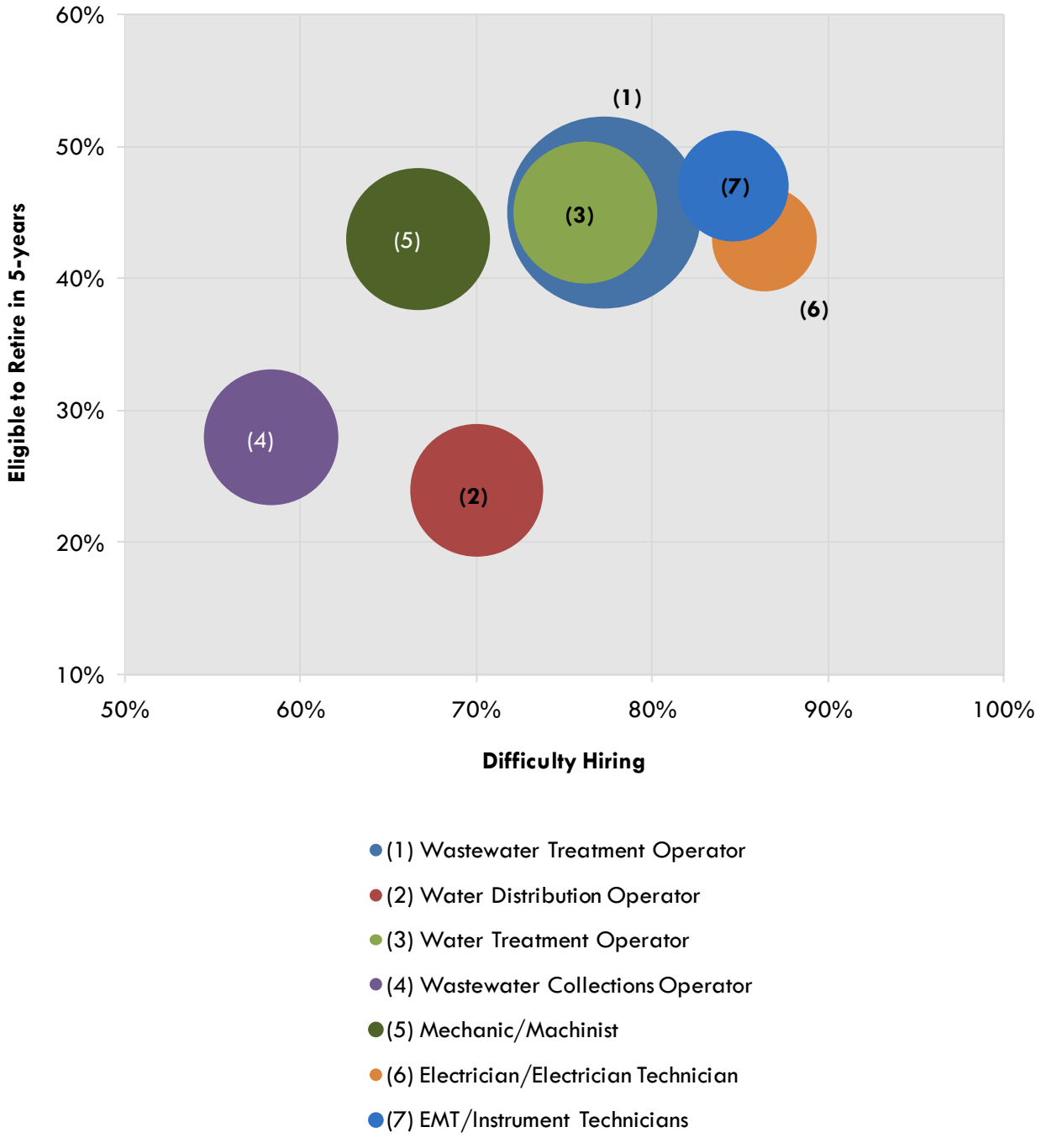
The bubble chart in Figure 2 shows the percentage of workers eligible to retire in three years (replacement rate) in relationship to the difficulty in hiring for each occupation. The area of each bubble represents the size of current employment for each occupation.

Figure 2: Difficulty in Hiring and Replacement Rate in 3 years for Each Occupation



The bubble chart in Figure 3 shows the percentage of workers eligible to retire (replacement rate) in **five years** in relationship to the difficulty in hiring for each occupation. The area of each bubble represents the size of current employment for each occupation.

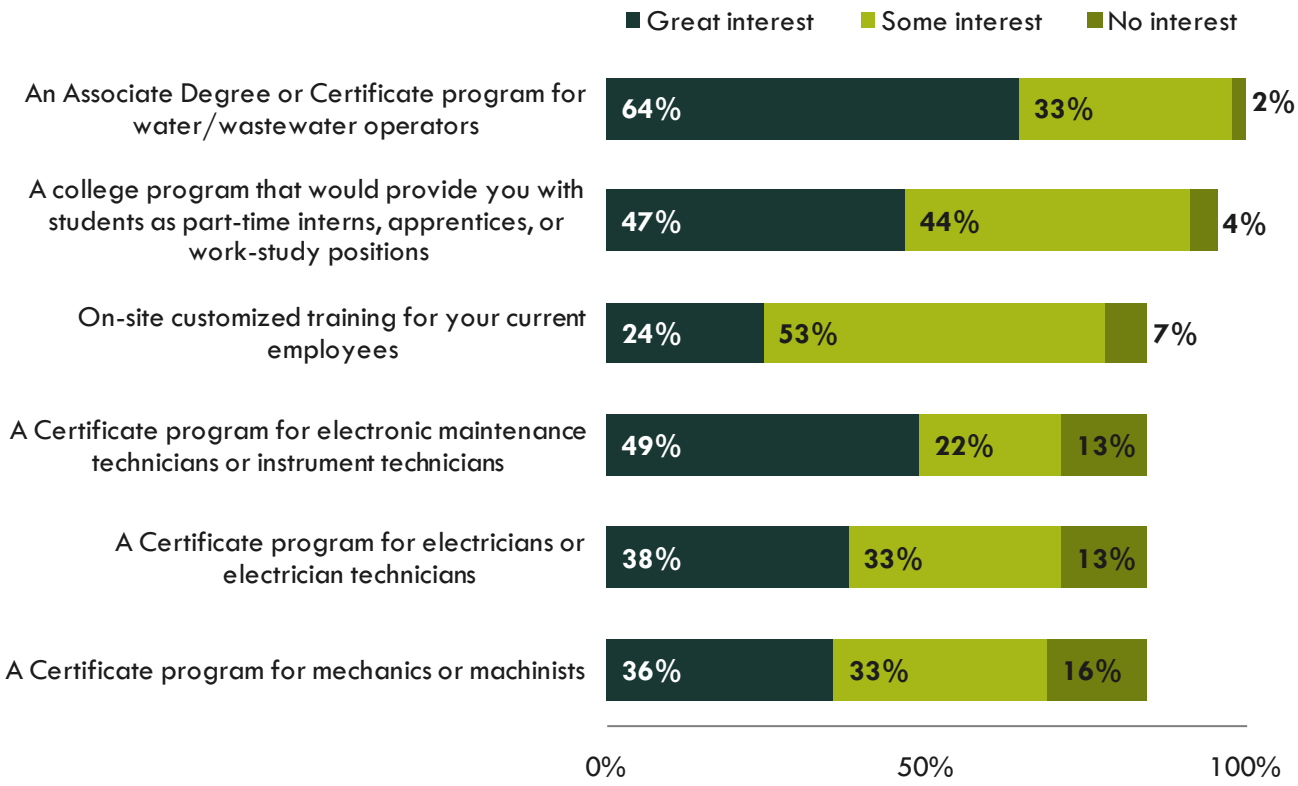
Figure 3: Difficulty in Hiring and Replacement Rate in 5 Years for Each Occupation



Workforce Development Opportunities

Employers expressed great interest in education and training programs that can be developed by community colleges. The employer responses are summarized in Figure 4 below:

Figure 4: Employer Interest in Community College Programs



- Two-thirds of employers surveyed expressed great interest in an Associate degree or certificate program for water and wastewater operators.
- Nine out of 10 employers indicated interest in an internship, apprenticeship, or work-study program through the community colleges.
- More than 70% of employers indicating interest in a certificate program for electronic maintenance technicians or instrument technicians, with 49% expressing great interest.

Employers also expressed strong interest in serving on Community College Advisory Committees to help inform course and program development for this industry. **64% of employers said they would be willing to serve in an advisory capacity, if they were asked by a community college to do so.**

College Response and Issues

The following section details the current and planned education and training programs offered by community colleges in the Bay Area, to prepare the needed workforce identified in this report. Program challenges and issues were also analyzed.

College Program Selection Criteria

Only college programs or courses related to the seven mission critical water and/or wastewater occupations studied in this scan are included in this section. Programs that prepare students for these occupations were included. The task of identifying courses and programs related to this industry that are offered at Bay Area Community Colleges was not easy, since potential courses, certificates and degrees are buried within a host of programs with differing titles.

Bay Region College Programs Related to Water and/or Wastewater Occupations

Eleven (11) community colleges out of the nineteen (19) located in the six-county region focused on in this study were identified as offering programs, certificates, or courses using the selection criteria. They were each contacted to obtain information about the following:

- Current course, certificate, or program offerings in water/wastewater related topics.
- Number of current enrollments versus capacity for the course/program.
- Future courses/programs being planned.

Current College Programs, Certificates, or Courses Related to Water/Wastewater Occupations

Water and Wastewater Operator Occupations

No community college currently provides specific preparation for the four mission critical water and wastewater operator occupations in the three sub-regions of the San Francisco Bay Area which serve as the focus of this environmental scan—San Francisco and Marin, the East Bay (Alameda and Contra Costa Counties) and the South Bay (San Mateo and Santa Clara Counties).

Solano College, located in Solano County, offers an Associate degree and certificate in Water and Wastewater Technology. This program is delivered through both an on-campus credit program as well as a regional contract education program for credit. Currently 18 employers financially support the delivery of the contract education program for credit. Solano has between 150-240 students enrolled in their program (combining both on-campus and contract education) at any one time. Over a two year period Solano offers all eight of the courses needed to complete the certificate program. Solano estimates that by spring of 2010, approximately 20 students from the contract education program will obtain the Water Utility Operations certificate and will be prepared for at least entry-level positions in the industry.

Santa Rosa Junior College, located in Sonoma County, offers courses in water treatment and distribution and wastewater operator training as well as a Water Utility Operations certificate which includes these classes. This program currently has about 40 students combined in the two courses, but could handle at least twice that number.

Los Medanos College offers an Associate Degree and Certificate program in Process Technology that prepares students to be process technicians and plant operators in refineries, chemical processing facilities and industrial plants. Some of the skills learned in these classes may be transferable to the water and/or wastewater operator occupations.

City College of San Francisco is planning a new course in Environmental Monitoring that will be offered in the Spring of 2010 that will focus on proper water sampling methods and may be applicable to some job functions of the water and/or wastewater operator occupations.

Maintenance/Operations Support Occupations
Occupations that focus on maintenance/operations support functions within water and wastewater utilities/agencies fall into two primary groups: mechanics/machinists and electricians/electronic maintenance technicians. Several community colleges located throughout the three sub-regions of the San Francisco Bay Area offer programs that prepare individuals for these occupations. For example, Laney College and Chabot College both have well developed Associate Degree and Certificate programs in Machine Technology that prepare students for the mechanic/machinist occupation.

Another example is a new certificate program in **Electrical Power Systems** developed by the College of San Mateo with input from BAYWORK members (San Francisco Public Utilities Commission and East Bay Municipal Utility District). More detailed information on this pre-apprenticeship training program for the electrical occupations in the water and wastewater industry can be found in Appendix F. Los Medanos College has Associate Degree and Certificate programs for both Electrical Technician and Instrumentation Technician that also prepare students for the electrical occupations.

The college course/program data in the tables on pages 23-26 was gathered through a survey of the 19 Bay Area community colleges in the six-county region. Information on community colleges that did not respond to the survey was supplemented with data from the State Chancellor's Office database of approved programs (those that require more than 18 units for completion). The information provided focuses on those college programs that specifically introduce mechanic/machinist and electrician/electronic maintenance technician occupations to students and prepare them for entry or advanced employment. Although information on current enrollments versus capacity for the course/program was requested from colleges, ultimately there was not enough data provided by colleges to warrant including this data element into the chart.

Many of these colleges also offer an Associate degree in Engineering that places students on a path to four-year transfer or Associate degrees and certificates in Engineering Technology that generally provide students preparation for technical support roles in engineering.

San Francisco/Marin Counties			
	Electronic Maintenance Technicians/Electricians	**Mechanics/Machinists**	**Comments**
City College of San Francisco	▪ Associate Degree – Electronic Engineering Technology ▪ Certificates – Basic, Intermediate Electronics ▪ Apprenticeship Program – Electrician	▪ Associate Degree – Mechanical Engineering Technology ▪ Certificate – Manufacturing & Metal Fabrication ▪ Course in Machine Shop	▪ Programs currently at 25-30% of capacity ▪ Also offer an Associate Degree in Engineering ▪ For more information, visit: www.ccsf.edu/Departments/Engineering_and_Technology/program.html
College of Marin	▪ Course in Electronics Technology ▪ Associate Degree – Engineering (emphasis on Electrical Engineering)	▪ Certificate – Machine & Metals Technology ▪ Associate Degree – Engineering (emphasis on Mechanical Engineering)	▪ Also offer an Associate Degree in Engineering Technology ▪ For more information, visit: www.marin.edu/ProgramDirectory/ProgramProfile.aspx?AcadProgramID=55 and www.marin.edu/ProgramDirectory/ProgramProfile.aspx?AcadProgramID=62 and www.marin.edu/ProgramDirectory/ProgramProfile.aspx?AcadProgramID=64

Alameda & Contra Costa Counties (East Bay)			
	Electronic Maintenance Technicians/Electricians	**Mechanics/Machinists**	**Comments**
Berkeley City College	N/A	N/A	
College of Alameda	N/A	N/A	
Laney College	▪ Courses in Electrical Technology with industrial applications	▪ Associate Degree & Certificate in Machine Technology	▪ Also offer a Transfer Program in Engineering and a Certificate in Engineering Technology ▪ For more information, visit: www.laney.peralta.edu/apps/comm.asp?$1=30150 and http://laney.peralta.edu/apps/comm.asp?$1=31312 and www.laney.peralta.edu/apps/comm.asp?$1=30154 ▪ Planning for Associate Degree and Certificate in Electrical Technology ▪ Planning for Certificate in Industrial Maintenance Technology (Basic and Advanced)
Merritt College	N/A	N/A	

Alameda & Contra Costa Counties (East Bay)			
Chabot College	▪ Courses in Electronic Systems Technology ▪ Apprenticeship Program – Electrical, Plant Engineering	▪ Associate Degrees & Certificates – Machine Technology: o Machine Tool Technology & Numerical Control (Degrees) o Machinist, Numerical Control Programmer, Tool Maker (Certificates) ▪ Associate Degree – Welding Technology ▪ Certificate – Inspection & Pipe Welding	▪ Also offer an Associate Degree – Engineering
Las Positas College	▪ Associate Degree – Electronics Technology	▪ Associate Degree – Industrial Technology	For more information, visit: www.laspositascollege.edu/INDT/INDTprogram.php and www.laspositascollege.edu/ELEC/ELECprogram.php
Contra Costa College	N/A	N/A	▪ Offer a Transfer Program in Engineering
Diablo Valley College	▪ Associate Degree & Certificate – Electrical/Electronics Technology	N/A	▪ For more information, visit: www.dvc.edu/org/departments/electronics/degrees-and-certificates/certificate-of-achievement-electronics-technology.htm
Los Medanos College	▪ Associate Degree & Certificate – Electrical Technician ▪ Associate Degree & Certificate – Instrumentation Technician ▪ Associate Degree – Industrial Electronics		▪ For more information, visit: www.losmedanos.edu/EETEC/degrees.asp and www.losmedanos.edu/departments/ptech/default.asp
Ohlone College	N/A	N/A	▪ Offer an Associate Degree – Engineering (transfer) and Courses in Engineering Technology ▪ For more information, visit: www.ohlone.edu/instr/engineeringtech/ and www.ohlone.edu/instr/engineering/

San Mateo & Santa Clara Counties (South Bay)			
	Electronic Maintenance Technicians/Electricians	**Mechanics/Machinists**	**Comments**
Canada College	N/A	N/A	▪ Offer an Associate Degree – Engineering ▪ For more information, visit: http://canadacollege.net/academics/degrees/engineering.html
College of San Mateo	▪ Associate Degree & Certificate – Electronics Technology ▪ Associate Degree – Engineering Technology (Electronics) ▪ Electrical Power Systems Certificate - 2 semesters. (State approval for 16 unit certificate. 24 credits will be approved by fall 2010. (See Appendix F for more information on this certificate program.)		▪ Also offer Associate Degrees in Engineering & Engineering Technology (General) ▪ For more information, visit: http://collegeofsanmateo.edu/electronics/degrees.asp and http://collegeofsanmateo.edu/engineering/degrees_engineering_as.asp and http://collegeofsanmateo.edu/engineering/degrees_electronics_as.asp and http://collegeofsanmateo.edu/engineering/degrees_general_as.asp and http://www.collegeofsanmateo.edu/webpages/studytracks_details.asp?MajorID=84 and http://collegeofsanmateo.edu/apprenticeship/electricalapprenticeship.asp
Skyline College	▪ Basic Electronics Course	N/A	
DeAnza College	N/A	▪ Skills Certificate – Computer Numerical Control (CNC) Machine Operator ▪ Certificate – Manufacturing Systems Technicians ▪ Associate Degree & Certificate – CNC Machinist ▪ Associate Degree & Certificate – CNC/Research & Development Machinist	▪ For more information, visit: http://www.deanza.edu/manufacturing/Degree.html
Foothill College	▪ Apprenticeship Program, Associate Degree & Certificate in General Electrician	N/A	▪ Also offer an Associate Degree – Engineering (transfer) ▪ For more information, visit: www.foothill.fhda.edu/engineering/index.php and www.foothill.fhda.edu/programs/programs.php?rec_id=549

San Mateo & Santa Clara Counties (South Bay)			
Mission College	N/A	N/A	▪ Offer Associate Degree – Engineering; Transfer Program – Industrial Technology; and Associate Degree & Certificate – Semiconductor Manufacturing Technician ▪ For more information, visit: www.missioncollege.org/catalog/engr.pdf and www.missioncollege.org/depts/smt/semicontech.html and www.missioncollege.org/depts/industrial_tech/documents/CurricGuide_IT.pdf
West Valley College	N/A	N/A	▪ Offer Associate Degree – Engineering (transfer) ▪ For more information, visit: www.westvalley.edu/engr/index.html
Evergreen Valley College	N/A	N/A	▪ Offer Associate Degree – Engineering (transfer) and courses in Civil Engineering Technology, Engineering Technology ▪ For more information, visit: www.evc.edu/degrees/09-10/engineering.pdf and www.evc.edu/mse/
San Jose City College	▪ Apprenticeship Program – Electrician	▪ Associate Degree & Certificate – Facilities Maintenance ▪ Associate Degree & Certificates – Machine Technology 0 Entry-Level Machinist 0 CNC Machine Operator 0 Machine Tool Technology	▪ For more information, visit: www.sjcc.edu/Acad/Divisions/applied/facilities.html and www.sjcc.edu/Acad/Divisions/applied/machine.html and www.sjcc.edu/Acad/Divisions/applied/electrician.html ▪ New CNC/Laser program opened ▪ Master CAM course planned for fall 2010

Difficulty Finding Faculty

Colleges indicate they have some difficulty finding qualified faculty to teach courses, especially attracting qualified instructors with industry experience. For those colleges who have no problem finding qualified faculty, they cite good connections with industry.

Internships, Outreach to High Schools, Industry Partnerships and Advisory Boards

Most colleges who were surveyed do not offer internships for their students, but would like to work with employers to do so. All colleges engage in some form of outreach activities to their local high schools. All colleges have advisory boards comprised of a variety of industry and business entities that guide program development. Most colleges currently do not have water and/or wastewater agency representatives on their advisory boards.

Community Support and Resources

There are excellent opportunities for Bay Area community colleges to partner with BAYWORK and Workforce Investment Boards to meet the workforce needs of the region's water and wastewater utilities/agencies. It will take well-developed partnerships to prepare skilled workers in the water and wastewater operator occupations as well as the maintenance/ operations support occupations that these employers will need in the coming years. The chart below summarizes existing and potential partnerships that can be leveraged:

Organization	Type of Organization	Contribution to Partnership
BAYWORK (Bay Area Water/Wastewater Workforce Development Collaborative) ckd@sfwater.org	Industry Association	▪ Access to employers ▪ Information on industry standards, trends ▪ Access to job descriptions ▪ Support for partnership development
California Water Environment Association http://www.cwea.org/	Industry Association/ Certifying Agency	▪ Certification for wastewater collections occupations ▪ Information on industry standards, regulations ▪ Professional development, training ▪ Access to job descriptions
California Environmental Protection Agency – State Water Resources Control Board (Office of Operator Certification) http://www.waterboards.ca.gov/water_issues/programs/operator_certification/	Certifying Agency	▪ Certification for wastewater treatment occupations ▪ Information on industry standards, regulations
California Department of Public Health http://www.cdph.ca.gov/certlic/occupations/Pages/DWopcert.aspx	Certifying Agency	▪ Certification for water treatment/distribution occupations
American Water Works Association http://www.awwa.org/	Industry Association	▪ Information on industry standards, trends ▪ Professional development, training ▪ Access to job descriptions ▪ Access to employers?
Water Research Foundation http://www.waterresearchfoundation.org/	Research organization	▪ Information on industry standards, trends
Liquid Assets http://liquidassets.psu.edu/	Public Media/Outreach Initiative	▪ Information on industry research, trends
Water Reuse Association http://www.watereuse.org/	Industry Association	▪ Information on industry standards, trends ▪ Professional development, training
Bay Area Clean Water Agencies http://www.bacwa.org/	Industry Association	▪ Connections with employers ▪ Information on industry trends, issues

Organization	Type of Organization	Contribution to Partnership
Centers of Excellence (SF Bay Area and Greater Silicon Valley) California Community Colleges http://www.coeccc.net/water	Economic and Workforce Development	▪ Labor Market Information ▪ Support for partnership development
San Mateo County Workforce Investment Board http://www.co.sanmateo.ca.us/portal/site/wib	Workforce Development (San Mateo County)	▪ Support for partnership development ▪ Access to employers ▪ Access to job descriptions and employment opportunities ▪ Access to skilled workers seeking employment
NOVA Workforce Board http://www.novawb.org/	Workforce Development (North Santa Clara County)	▪ Support for partnership development ▪ Access to employers ▪ Access to job descriptions and employment opportunities ▪ Access to skilled workers seeking employment
Marin Workforce Investment Board http://www.marinemployment.org/about-mcwib.htm	Workforce Development (Marin County)	▪ Support for partnership development ▪ Access to employers ▪ Access to job descriptions and employment opportunities ▪ Access to skilled workers seeking employment
Alameda County Workforce Investment Board http://www.acwib.org/	Workforce Development (Alameda County)	▪ Support for partnership development ▪ Access to employers ▪ Access to job descriptions and employment opportunities ▪ Access to skilled workers seeking employment
Contra Costa Workforce Development Board http://www.wdbccc.com/about.htm	Workforce Development (Contra Costa County)	▪ Support for partnership development ▪ Access to employers ▪ Access to job descriptions and employment opportunities ▪ Access to skilled workers seeking employment
San Francisco Workforce Investment Board http://www.oewd.org/WISF-Board.aspx	Workforce Development (San Francisco City/County)	▪ Support for partnership development ▪ Access to employers ▪ Access to job descriptions and employment opportunities ▪ Access to skilled workers seeking employment
Santa Clara County Workforce Investment Network (Work 2 Future) http://www.work2future.biz/index.html	Workforce Development (Santa Clara County/San Jose)	▪ Support for partnership development ▪ Access to employers ▪ Access to job descriptions and employment opportunities ▪ Access to skilled workers seeking employment

Conclusion

BAYWORK selected seven mission critical occupations for this workforce study because these occupations are essential to reliable water and wastewater operations and because of industry concerns about whether sufficient numbers of qualified candidates would be available to fill upcoming vacancies.

Bay Area Community Colleges and Workforce Investment Boards, now armed with relevant labor market data are poised to respond to the workforce needs of water and wastewater utilities/agencies in the six Bay Area counties outlined in this report. The need may be somewhat modest in size, but there will be employment opportunities for students in the short term due to retiring workers from this industry. Regional colleges should respond to documented employer workforce needs in a coordinated and flexible manner.

The survey results indicate that over 50% of employers are having difficulty hiring qualified candidates for all seven occupations, and over 80% of employers indicate difficulty in hiring Electricians/Electrician Technicians and Electronic Maintenance Technicians/Instrument Technicians. Many of the college courses and programs that will be needed for the three maintenance/operations support occupations are in place. However, there appears to be some need for course and/or program development to more fully meet the water/wastewater operator workforce needs of employers, particularly in the South Bay. Partnerships must be built between community colleges and utilities/agencies to prepare students for these specific occupations in this industry.

Workforce Investment Boards have access to a large pool of unemployed workers, many of whom could be excellent candidates for this industry, if they are provided with the proper education and work experience. Perhaps the hardest challenge to address going forward will be the creation of internship and apprenticeship opportunities, so that classroom learning can be supplemented by the on-the job experience needed. Right now utilities don't have the funding to create new positions for people who aren't at journey level and ready to provide full value. Grant funding from sources like the Department of Labor would need to cover not only community college coursework but also funding for these internship and apprenticeship opportunities. A combination of community college efforts, union apprenticeships and utility internships/apprenticeships may all be needed to give prospective workers the "in-plant" experience needed to be qualified to fill open positions.

Students or workers looking for an industry with good paying jobs that offers career advancement opportunities should consider this sector. It is an industry the public depends on because of its importance to the basic infrastructure of our communities. In addition, one can make the case that these occupations should be considered environmental jobs and/or green jobs because they contribute directly to the stewardship of one of our most vital natural resources.

Recommendations

1. Develop a measured, flexible and coordinated response to the workforce development needs of regional water and wastewater utilities/agencies.

Water/Wastewater Operator Occupations

- Build on the contract education model provided through Solano Community College to offer ongoing training.
- Establish an additional community college credit program, focusing on the South Bay counties, in order to meet the projected need for workers.
- Develop outreach programs and partnerships with high schools and related career academies to develop a pipeline of new, younger workers.
- Focus on raising students', educators' and parents' awareness about the current role of water and wastewater operators as "green collar knowledge workers" with access to excellent career advancement opportunities.

Maintenance/Operations Support Occupations

- Raise awareness of career opportunities in water and wastewater utilities/agencies for individuals enrolled in programs related to the electrician/electronic maintenance technician and mechanic/machinist positions.
- Add elective or required coursework to these programs to expose students to the specific tools, technology, practices and regulations related to the water and wastewater industry.
- Promote maintenance and operations support occupations courses/programs to unemployed/underemployed returning students who have experience in construction trades, engineering or utilities.

2. Create and expand industry partnerships.

- Collaborate regionally on grants to fund program development, partnerships with industry and resources needed to expand courses/programs and internships.
- Establish regional advisory boards to assist multiple, adjacent colleges, to identify in an on-going way, the employment skills and education requirements of employers.
- Build off of the industry partnerships developed by the Centers of Excellence for this study, to expand outreach to employers and identify potential adjunct faculty.
- Identify employers who want to partner with colleges to develop student internship and apprenticeship programs. 3 out of 4 employers surveyed indicated interest in developing such programs.

3. Provide on-going professional development for college faculty.

- Expand the existing *Community College Energy Faculty Forum* (sponsored by the Bay Area Community College Consortium) to include faculty with an interest in water and wastewater related curriculum and programs.
- Work with the Environmental Training Centers of the California Community Colleges Economic and Workforce Development Program to access technical assistance and training resources for faculty.
- Identify employers who can develop "faculty internship" programs.

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Appendix A: How to Utilize this Report

This report is designed to provide current industry data to:

- Define potential strategic opportunities relative to an industry's emerging trends and workforce needs;
- Influence and inform local college program planning and resource development;
- Promote a future-oriented and market responsive way of thinking among stakeholders; and,
- Assist faculty, Economic Development and CTE administrators, and Community and Contract Education programs in connecting with industry partners.

The information in this report has been validated by employers and also includes a listing of what programs are already being offered by colleges to address those workforce needs. In some instances, the labor market information and industry validation will suggest that colleges might not want to begin or add programs, thereby avoiding needless replication and low enrollments.

About the Centers of Excellence

The Centers of Excellence (COE), in partnership with business and industry, deliver regional workforce research customized for community college decision making and resource development. This information has proven valuable to colleges in beginning, revising, or updating economic development and Career Technical Education (CTE) programs, strengthening grant applications, assisting in the accreditation process, and in supporting strategic planning efforts.

The Centers of Excellence Initiative is funded in part by the Chancellor's Office, California Community Colleges, Economic and Workforce Development Program. The total grant amount (grant number 08-305-021 for $205,000) represents funding for multiple projects and written reports through the Center of Excellence. The Centers aspire to be the premier source of regional economic and workforce information and insight for California's community colleges.

More information about the Centers of Excellence is available at **www.coeccc.net**.

Important Disclaimer

All representations included in this report have been produced from primary research and/or secondary review of publicly and/or privately available data and/or research reports. Efforts have been made to qualify and validate the accuracy of the data and the reported findings; however, neither the Centers of Excellence, COE host District, nor California Community Colleges Chancellor's Office are responsible for applications or decisions made by recipient community colleges or their representatives based upon components or recommendations contained in this study.

Appendix B: Below Journey-Level and Vacancies Sample Data

SAMPLE DATA	Current full-time budgeted positions	Number of full-time budgeted positions BELOW journey-level	% BELOW journey-level within occupation	Current vacancies (budgeted for but currently vacant)	% of vacancies within occupation
Water Treatment Operator	238	36	15.1%	7	2.9%
Water Distribution Operator	202	56	27.7%	9	4.5%
Wastewater Treatment Operator	433	79	18.2%	20	4.6%
Wastewater Collections Operator	212	43	20.3%	2	1.0%
Mechanic/Machinist	229	27	11.8%	7	3.1%
Electrician/Electrician Technician	126	8	6.3%	10	7.9%
Electronic Maintenance Technician/Instrument Technician	134	1	0.7%	9	6.7%
TOTAL (all occupations)	**1,575**	**250**	**15.9%**	**64**	**4.1%**

Appendix C: Study Methodology and Universe Data

About the Survey
The Centers of Excellence, in partnership with BAYWORK, collected workforce data on water occupations through an in-depth survey. The survey was conducted online and by e-mail during the months of July, August, and September of 2009. For the participating agencies, 53 percent of the survey responses were submitted via e-mail; 47 percent were submitted through an online survey tool.

About the Respondents
Forty-five (45) employers, representing a combined workforce of more than 5,400 employees in water and/or wastewater departments or sections, responded to the survey. These respondents came from carefully selected water and/or wastewater utilities or agencies identified through BAYWORK as employing one or more of the seven target occupations. The respondent's size of firm and regional location were recorded where possible. **Caution should be used in generalizing results to the entire population of employers to the degree that the sample may differ from the universe.**

Study Methodology: Universe of Firms
To estimate the total number of water and/or wastewater utilities and agencies in the region, the following inputs were considered.

- A comprehensive database of utilities and agencies in the six target counties was developed by BAYWORK.
- A post-survey review of the database compared the original list to the responding agencies (sample) for duplications and other errors.
- Large, identifiable agencies, such as SFPUC and EBMUD, were tagged as outliers and removed as they would unduly influence the universe calculations.

These inputs were analyzed and the total number for the database was then combined into the universe of employers estimate (77).

Universe Data: Occupational Employment
Seven water and wastewater occupations were identified as high-demand and aligned with community college education programs. The combined employment for the seven occupations totals at least 1,575 jobs (known employment from survey respondents) and could be as high as **2,580** jobs. The latter figure is an extrapolated estimate of employment, based on survey responses and an estimate of the total number of water and wastewater utilities and agencies in the six target counties. Margin of error for the 45 survey respondents (out of the universe of 77) is $\pm$ 9.48 percent.

To arrive at the estimates of occupational employment for the universe of employers currently (77 utilities or agencies), in 3 and 5 years, and the rate of replacements (eligibility to retire in 3 and 5 years), survey data for the sample was extrapolated to approximate the employment levels for the larger group. From the sample, the following components were referenced:

- In the survey, respondents were asked how many individuals in each occupation were currently employed in full-time budgeted positions. This resulted in estimates for the distribution of employment across the sample, mean employment, and sample total employment.
- Responses were then analyzed to identify those that employed individuals in each of the 7 study occupations. These responses informed the percent of the sample firms employing each occupation.
- Employers were asked to detail projected budgeted position increases or decreases in 3 and 5 years. These responses resulted in occupational growth rates for both periods of time.
- Employers were asked to detail eligibility to retire without penalty in 3 and 5 years. These responses resulted in replacement (eligibility to retire) rates for both periods of time.

Using the percent of firms employing each occupation, mean employment from the sample, and the universe of firms estimate (see above), the current employment was estimated for each occupation. A similar method was used to calculate the approximate growth in the next 3 and 5 years and to estimate potential replacement needs in 3 and 5 years.

Mean (average) Employment
Mean employment calculations from the sample were used to extrapolate the estimated current universe employment for an occupation. However, the distribution of employment as reported in the sample is an important component in determining how appropriate the Mean is to the universe. That is, if the Mean is overly influenced by a few large employers, then it is not necessarily indicative of the universe of employers. For extrapolation purposes, removing these outliers from the calculation of the Mean results in a better representation of average employment.

In the Water and Wastewater study, each occupation's sample responses were examined to see if the Mean was being similarly influenced by one or more employer responses (outliers). When outliers were removed, a new Mean was calculated for use in the employment extrapolation calculations. Employment totals shown in the table below were calculating using the new Mean.[10]

Universe Data: Occupational Employment[11]

Occupation	Estimated 2009 Employment	New and Replacement Jobs (in 3 years)	New and Replacement Jobs (in 5 years)
Water Treatment Operators	370	150	200
Water Distribution Operator	330	60	80
Wastewater Treatment Operator	750	300	360
Wastewater Collections Operator	370	120	170
Mechanic/Machinist	360	120	170
Electrician/Electrician Technician	180	60	90
Electronic Maintenance Technician/Instrument Technician	230	80	110
Total	**2,580**	**890**	**1,190**

[10] The outlier employment that was removed from the calculation of the mean and subsequent extrapolation calculations is added back in (post-calculation) to the employment totals.
[11] Totals may not add due to rounding.

Appendix D: Occupational Profiles

Water Treatment or Distribution Plant Operator
Water Treatment Plant Operators perform water treatment functions through the operation of an entire process or system of machines.

Water Distribution Operators run water transmission and distribution systems (e.g., pumps and valves), often using a Supervisory Control and Data Acquisition (SCADA) control system. Operators in these positions generally do not perform construction, maintenance or plumbing work. These occupations are related to SOC Code 51-8031 Water and Liquid Waste Treatment Plant and Systems Operators as classified by the U.S. Department of Labor, Bureau of Labor Statistics. The following list describes in more detail some of the tasks that may be required of Water Treatment and Distribution Plant Operators:[12]

- Add chemicals to disinfect and deodorize water.
- Operate and adjust controls on equipment to purify and clarify water.
- Inspect equipment or monitor operating conditions, meters and gauges to determine load requirements and detect malfunctions.
- Collect and test water samples using test equipment and color analysis standards.
- Record operational data, meter and gauge readings on specified forms.
- Monitor, maintain, repair and lubricate equipment and clean and maintain tanks and filter beds using hand and power tools.
- Coordinate and direct plant workers engaged in routine operations and maintenance activities.

Occupational Outlook: Due to an anticipated wave of retirements of water treatment and distribution plant operators and a shortage of workers prepared for these positions, the U.D. Department of Labor predicts a strong national outlook for job opportunities in these positions. At the local level, employers surveyed indicated the following demand over a five year period:

Water and Wastewater Occupations	2009 Employment	5-year Growth Rate (total new job growth)	Eligible to Retire in 5 years (total replacement rate)	New & Replacement Jobs (5 year total)
Water Treatment Operator	238	1%	45%	106
Water Distribution Operator	202	1%	24%	49

[12] Occupational Profile: California Labor Market Information, Water and Liquid Waste Treatment Plant Workers (SOC Code 51-8031)

Training and Education: Training and education requirements vary for entry to executive operator positions. "Trainee-level" workers require basic training while "journey-level" and "supervisory-level" operators need more advanced preparation and experience. Generic job descriptions developed by BAYWORK outline the skills, knowledge and abilities for trainee- versus journey-level positions found in the table below. Training generally takes three to five years before operators reach journey level. The chart at the end of this occupational profile compares Skills, Knowledge & Abilities required for the trainee level vs. the journey level for this occupation.

The California State Department of Health Services (DHS) dictates five levels or "grades" of preparation for treatment and distribution operators and administers examinations and certifications that require progressive education and experience. Treatment plant operators require "T 1-5" licensure while distribution plant operators call for "D 1-5" certification. In some cases, community college coursework can substitute for experience requirements.

Career Pathways: In alignment with the training and education requirements, career paths for water treatment and distribution operators tend to be relatively linear—progressing from entry-level positions to supervisory- or executive-level operator roles. In some cases, education and experience in one role (treatment or distribution) may be supplemented for the other which can allow for movement between these two types of operator occupations. Job titles can vary by agency and levels of certification required for each job title can also differ by the size and complexity of the agency. For example, a small plant may only require operators to have achieved lower-level certification while a larger, more complex operation likely requires supervisors and manager to have the most advanced levels of preparation.

Occupational Wages: In the Bay Region, water agencies and utilities surveyed identified the following **monthly wages** for Water Treatment and Distribution Plant Operators (wage ranges averaged across respondents):

	Trainee- Level	Journey-Level	Supervisory-Level
Water Treatment Operator	$4,405- $5,609	$5,649- $7,042	$7,144- $9,000
Water Distribution Operator	$3,929- $4,973	$5,052- $6,364	$6,448- $8,473

The U.S. Bureau of Labor Statistics specifically highlights Oakland-Fremont-Hayward as *the* top-paying metropolitan area when compared to others across the nation for the "Water and Liquid Waste Treatment Plant and System Operators" occupation.

Water Treatment & Distribution Operator
Skills, Knowledge & Abilities (trainee vs. journey level)

	Trainee	Journey
Skills in…	Routinely maintenance/clean machinery, structures, equipment, piping	Safely applying large doses of chemicals Operating equipment, small hand tools Reading/interpreting/implementing Federal, state, local laws, regulations for water treatment for public consumption Identifying needs for adjustment, maintenance, repair of equipment, machinery, related facilities Performing dose calculations
Knowledge of…	Basic arithmetic Common hand, power tools Safe work practices Elementary mechanical, electrical, hydraulic principles	Operation/maintenance of water treatment plants, distribution systems, equipment including valves, pumps, motors, automatic control devices Servicing/repairing/calibrating plant equipment Chemistry, mathematics used in the operation of a water treatment facility including properties of related chemical compounds, water treatment testing laboratory procedures Mechanical, electrical, hydraulic principles Current water treatment safety rules, codes, recycling regulations Current technological developments in water treatment, distribution, quality Uses and principles of computerized electronic equipment in the collection, storage, and interpretation of operational data related to water treatment and supply; Repairing/calibrating water plant, distribution system equipment Routine operating report generation Standardized water quality tests Computer inventory control for water treatment chemicals, fuel, supplies Federal Regulations related to water treatment, distribution systems National Pollutant Discharge Elimination System (NPDES) permit requirements Basic computer skills

Ability to…	Understand/follow written, verbal instructions Learn practices, procedures, techniques, regulations, laws pertaining to water treatment plant, distribution system Learn to operate/clean/ perform minor maintenance on water treatment plant, distribution equipment, facilities Learn to read/interpret mechanical systems, piping diagrams Learn to observe/record operating conditions, make verbal, written reports Learn to recognize unusual, inefficient, dangerous operating conditions, exercise independent judgment within established guidelines Learn the operations, routine servicing of computerized instrumentation, plant operating equipment Read/interpret variety of meters, gauges, recording equipment Work with decreasing supervision while accepting increasing responsibility	Operate and maintain treatment plant machinery and equipment; Collect samples and perform routine laboratory tests; Read and interpret gauges, recording devices and related monitors; Communicate clearly and concisely, both orally and in writing; Establish and maintain effective working relationships with those contracted in the course of work; Work in confined spaces and with potentially hazardous chemicals in inclement weather conditions; Perform moderate to heavy lifting in addition to standing and/or walking for extended amount of time; Work without immediate or limited supervision.

Wastewater Treatment or Collections Plant Operator
Wastewater treatment operators perform wastewater treatment functions to remove harmful pollutants from domestic and industrial liquid waste to make it safe to return to the environment.[13]

Wastewater collections operators maintain systems that deliver this liquid waste from homes and businesses to treatment plants. These occupations are related to SOC Code 51-8031 Water and Liquid Waste Treatment Plant and Systems Operators as classified by the U.S. Department of Labor, Bureau of Labor Statistics. The following lists describe in more detail some of the tasks that may be required of Wastewater Treatment and Collections Plant Operators:

Wastewater Treatment Operator[14]

- Operate sewage treatment, sludge processing and disposal equipment
- Add chemicals to disinfect and deodorize water
- Inspect equipment or monitor operating conditions, meters and gauges to determine load requirements and detect malfunctions
- Collect and test water samples using test equipment and color analysis standards
- Record operational data, meter and gauge readings on specified forms
- Start and stop pumps, engines and generators to control flow of raw sewage through filtering, settling, aeration and sludge
- Monitor, maintain, repair and lubricate equipment and clean and maintain tanks and filter beds using hand and power tools
- Coordinate and direct plant workers engaged in routine operations and maintenance activities

Wastewater Collections Operator[15]*:*

- Inspect, clean, maintain, construct and repair collections systems
- Perform pump stations inspections, record instrument readings and make adjustments to keep flow consistent
- Excavate, shore and repair collections systems including damaged pipes, manholes and casting adjustments; maintain and repair lift stations and components
- Maintain traffic safety controls at work sites
- Contain and clean up wastewater spills
- Read and interpret collections systems maps to determine flow characteristics and construction details
- Communicate work performed through written reports
- Monitor, coordinate and/or supervise crews performing systems maintenance

[13] Occupational Profile: California Labor Market Information, Water and Liquid Waste Treatment Plant Workers (SOC Code 51-8031)
[14] ibid; Catherine Curtis, Stationary Engineer/Wastewater Treatment Plant Operator
[15] California Water Environment Association. (2009) *Collection Systems Maintenance Certification 2009 Candidate Handbook* Retrieved June 30, 2009 from,. http://cwea.org/pdf/tcp/hb_cs07.pdf

Occupational Outlook: Due to an anticipated wave of retirements of wastewater treatment and collections plant operators and a shortage of workers prepared for these positions, the U.S. Department of Labor predicts a strong national outlook for job opportunities in these positions. At the local level, employers surveyed indicated the following demand over a five year period:

Water and Wastewater Occupations	2009 Employment	5-year Growth Rate (total new job growth)	Eligible to Retire in 5 years (total replacement rate)	New & Replacement Jobs (5 year total)
Wastewater Treatment Operator	433	6%	45%	214
Wastewater Collections Operator	212	15%	28%	90

Training and Education: For both Wastewater Treatment and Collections Operators, training and education requirements vary for entry to supervisory operator positions. "Trainee-level" or workers require basic training while "journey-level" and "executive-level" operators need more advanced preparation and experience. Wastewater Treatment and Collections Operators require approximately four to five years of preparation before reaching journey level. Generic job descriptions developed by BAYWORK outline the skills, knowledge and abilities for trainee- versus journey-level wastewater treatment and collections positions found in the chart at the end of this occupational profile.

Wastewater Treatment Operators. The State Water Resources Control Board (SWRCB) dictates five levels or "grades" of preparation for Wastewater Treatment Operators and administers examinations and certifications that require progressive education and experience. In some cases, community college coursework can substitute for experience requirements.

Because certification is required for any job within this occupation at the same time that certification requires some level of experience on the job, the Water Resources Control Board administers "Operator in Training" (OIT) certificates for each grade which provide temporary permissions for workers to get experience at that level. According to the SWRCB, state regulations define an OIT as "any person who operates a wastewater treatment plant under the direct supervision of a certified operator while gaining experience to qualify for an operator certificate." OIT certificates are particularly useful for those starting at the trainee level.

In some Bay Area localities, training takes place through union-based apprenticeship programs whereby on-the-job training is paired with technical instruction. Apprentices maintain OIT certificates, are "indentured" by the labor union during their training and receive payment for their work. After completing classroom and on-the-job requirements and achieving a Grade II certificate from the SWRCB and a Mechanical Technical One certificate, trainees become journey-level operators.

Wastewater Collections Operators. The California Water Environment Association (CWEA) oversees certification of Wastewater Operators—a nonprofit organization dedicated to keeping California's water clean.[16] CWEA also dictates four grades of preparation and administers examinations and certifications that require progressive education and experience. Possession of a related associate's degree can reduce experience requirements for different grade certifications.

Career Pathways: In alignment with the training and education requirements, career paths for Wastewater Treatment and Collections Operators tend to be relatively linear—progressing from pre-apprentice or entry-level positions to journey- and supervisory-level operator roles. In some cases, education and experience in one role (treatment or collections) may be supplemented for the other which can allow for movement between these two types of operator occupations. Job titles can vary by agency and levels of certification required for each job title can also differ by the size and complexity of the plant. For example, *Wastewater Operator Occupational Information* (2005)[17] notes that an operator working at a small plant that consists only of a pond simply requires Grade I certification while the largest and most complex plants call for shift supervisors to have at least Grade III certification.

Occupational Wages: In the Bay Region, water agencies and utilities surveyed identified the following **monthly wages** for Wastewater Treatment and Collections Plant Operators (wage ranges averaged across respondents):

	Trainee-Level	Journey-Level	Supervisory-Level
Wastewater Treatment Operator	$4,171- $5,222	$5,432- $6,627	$6,429- $8,389
Wastewater Collections Operator	$3,982- $4,859	$4,654- $6,004	$5,972- $7,852

The U.S. Bureau of Labor Statistics specifically highlights Oakland-Fremont-Hayward as *the* top-paying metropolitan area when compared to others across the nation for the "Water and Liquid Waste Treatment Plant and System Operators" occupation.

[16] http://www.cwea.org/index.shtml
[17] http://www.waterboards.ca.gov/water_issues/programs/operator_certification/docs/infoflyer2005.pdf

Wastewater Treatment & Collections Operators

Skills, Knowledge & Abilities (trainee vs. journey level)

	Trainee	Journey
Skills in…	Performing routine maintenance/cleaning of machinery, structures, equipment, piping Operating a motor vehicle, common hand and power tools	Operating wastewater treatment plant equipment, including automatic control devices performing routine maintenance, making operating adjustments Cleaning/painting/maintaining facilities, equipment Operating assigned plant equipment without immediate supervision
Knowledge of…	Elementary mechanical, electrical, hydraulic principles Arithmetic Basic computer skills Common safe work practices Common hand, power tools Basic wastewater treatment principles, practices, equipment	Standard tools, equipment, materials used in maintenance, repair, installation, construction of wastewater systems Wastewater treatment principles, methods, practices Elementary biology and chemistry Related safety rules, codes, regulations Methods used/precautions taken in storing/handling of chemicals, other hazardous substances Basic first aid Wastewater sampling, routine process control tests
Ability to…	Learn the practices, procedures, techniques, regulations, laws of wastewater treatment plants including inspecting, testing plant machinery; adjusting valves, controls; reading gauges; making repairs to wastewater equipment including pumps, grit collectors, conveyors, washers, chlorinators, evaporators, sludge collectors, drive units, deodorizing equipment Learn to assist in/perform preventive sewer maintenance by use of various electrical, hydraulic, mechanical, hand-operated devices Learn, assist with/operate heavy, special equipment Learn to maintain, install, reconstruct collection systems Learn to perform television inspection of sewer lines to evaluate condition Learn to perform data entry, retrieval, such as electronic mail/calendar, time card/portal, Underground Service Alert (USA) marking information, TV database input, etc. Understand and follow written and verbal instructions Operate/read/interpret meters, gauges, record charts Learn to shut down pumping, treatment stations, facilities Maintain facilities in neat, clean, sanitary condition Learn to operate forklift, other machinery to transport equipment, materials throughout plant Learn to interpret mechanical systems, piping diagrams Learn to observe/record operating conditions, make written reports Make arithmetic calculations Learn to recognize unusual, inefficient, dangerous operating conditions Report any failures of equipment, operating difficulties Learn to exercise independent judgment within guidelines Work with decreasing supervision while accepting increasing responsibility Learn to read/interpret maps of the wastewater system Perform heavy manual labor	Recognize unusual, inefficient, or dangerous operating conditions, take appropriate action Perform preventive sewer maintenance with electrical, hydraulic, mechanical, hand-operated cleaning devices Perform maintenance, repairs, installation, reconstruction of wastewater collection systems, including excavation to required grade, depth; preparation of bedding; removal of damaged section of sewer line; laying/installing of pipe; backfilling/ compacting proper backfill material; paving trenches around structures, manholes Perform television inspection of sewer lines to determine cleaning, repair, replacement needs Accurately read/record data from gauges, meters Collect samples properly Perform basic laboratory tests related to process control Instruct/direct work of lower level employees Interpret plant, piping, distribution diagrams Perform routine control tests, adjust plant equipment Keep records, make oral, written reports of work performed Perform heavy manual labor Operate heavy, special equipment, including forklifts, backhoes, crane trucks, dump trucks, and hydrojet sewer Operate a motor vehicle, common hand, power tools Operate a personal computer

Electrician Technician

Water and wastewater utilities employ Electrician Technicians to repair, test, install, modify, calibrate, and trouble-shoot electrical equipment used in their facilities and systems. This occupation relates to SOC Code 47-2111 Electricians as classified by the U.S. Department of Labor, Bureau of Labor Statistics. The following list describes in more detail some of the tasks that may be required of Electricians with an emphasis on those performed specifically for water and wastewater agencies:[18]

- Inspect, maintain, repair, alter, clean, calibrate, measure and test electrical components and equipment used in power transfer and industrial process control for water treatment, distribution, wastewater treatment and hydroelectronic power plant operation
- Apply standards and safety regulations to ensure equipment and systems compliance with codes and ordinances enforced by regulatory agencies
- Assist in the development and design of new electrical services
- Read and interpret wiring diagrams
- Estimate labor, material and supply costs and interface with vendors
- Maintain records and provide oral reports on work performed
- Supervise trainees

Occupational Outlook: Electrician Technicians can work in a variety of environments including but not limited to water and wastewater utilities. The California Employment Development Department labor market data for the Bay Area region predicts a modest increase in demand for this occupation between 2006-2016 due to both growth and separations (retirements). Water and wastewater agencies surveyed expressed the following demand for Electrician Technicians over the next five years:

Water and Wastewater Occupations	2009 Employment	5-year Growth Rate (total new job growth)	Eligible to Retire in 5 years (total replacement rate)	New & Replacement Jobs (5 year total)
Electrician/Electrician Technician	126	2%	43%	52

Training and Education: Training and education requirements vary for entry to supervisory level positions. "Trainee-level" workers require minimal prior preparation while "journey-level" Electrician Technicians need significant advanced training and experience. A generic job description developed by BAYWORK for Electrician Technicians outlines the skills, knowledge and abilities for trainee- versus journey-level positions which can be found in the chart at the end of this occupational profile.

The preparation period for an Electrician Technician trainee lasts three to five years on average and a few agencies offer on-the-job training options in the electrical maintenance of their plants. Electrician Technician trainees must only demonstrate completion of 12th grade or

[18] Occupational Profile: California Labor Market Information, Electricians (SOC Code 47-2111); Workforce Development Task Force Generic Electrician Technician Preview

the equivalent and hold a valid California driver's license in order to begin training. To work toward journey-level status as a general electrician, individuals must complete 8,000 hours of on-the-job training and enroll with a state-approved training provider which includes several community colleges across California. Bay Area community colleges such as Los Medanos and College of San Mateo (CSM) offer coursework that fulfills the state requirements for Trainees. Sample coursework at CSM includes D.C. Electronics, A.C. Electronics, Applied Electronic Mathematics, Digital Devices and Electrical Inspection I.[19]

Electrician Technicians can achieve journey-level status usually after this period by demonstrating achievement of trainee-level requirements, in addition to 18 to 24 months experience as a utility electrical worker and completion of job requirements. Alternatively, individuals can attain of journey-level status in general electrical installation and repair work as demonstrated by licensure obtained through the California Department of Industrial Relations.[20]

Career Pathways: Career pathways for Electrician Technicians tend to be linear, moving from entry-level positions to advanced opportunities including supervisory and management positions. Journey-level preparation also allows Electrician Technicians to move between positions in water and wastewater utilities and agencies and other industries.

Occupational Wages: In the Bay Region, water agencies and utilities surveyed identified the following **monthly wages** for Electrician Technician positions (wage ranges averaged across respondents):

	Trainee-Level	Journey-Level	Supervisory-Level
Electrician Technician	$3,497- $4,435	$5,812- $7,033	$7,455- $9,349

[19] http://www.collegeofsanmateo.edu/etc/
[20] http://www.dir.ca.gov/DAS/ElectricalTrainee.htm

Electrician Technician

Skills, Knowledge & Abilities (trainee- vs. journey-level)

	Trainee	Journey
Skills in…	Demonstrating manual dexterity	Demonstrating manual dexterity Operating a motor vehicle safely
Knowledge of…	Basic arithmetic Hand and power tools commonly used in the electrician trade Safe work practices Elementary electrical and mechanical principles	Standard terms, practices, procedures and modern methods common to the electrical trade as practiced in utility plan processes Shop mathematics The use and operation of measuring and testing devices Hand tools and equipment of the trade National Electrical Code and the industry standards electrical safety requirements specified by the National Fire Protection Association and other applicable codes and ordinances enforced by governmental agencies and the company. Basic supervisory principles
Ability to…	Learn the practices, procedures, techniques, regulations, and laws pertaining to the electrician trade Learn the proper maintenance, installation, repair, alteration, cleaning, calibrating, measuring, and testing of a variety of electrical components Learn to interpret and work from shop drawings and electrical diagrams Learn to perform work requiring considerable manipulative skills, mechanical comprehension, mathematical calculations and logical reasoning Acquire increased job knowledge and skills Understand and follow written and verbal instructions Make written/verbal reports of work completed Use independent judgment and initiative Establish and maintain effective working relationships Learn and apply safe work practices Successful pass an entry-level electrical test	Perform duties required of the trainee-level electrician technician Inspect, maintain, troubleshoot, repair, install, operate and test a wide variety of electrical and solid state electronic equipment used in power transfer and industrial process control for water treatment, distribution, wastewater treatment, and hydroelectric power plant operation Plan, lay out, and execute journey level electrical work Assist in the development and design of new and redesigned electrical services Keep records and make reports including preparing as built and shop drawings Establish and maintain effective working relationships Read and interpret wiring diagrams Communicate orally and in writing Coordinate the work of assigned team members as required on larger projects Direct the work of sub-journey level employees Make rough estimates of labor, material, and supply cost Obtain quotes from vendors Use initiative and independent judgment with established guidelines Apply safe work practices and identify and report safety hazards

Electronic Maintenance and Instrument Technicians
Water and wastewater utilities employ Electronic Maintenance and Instrument Technicians to maintain, repair, test, install, modify, calibrate, and trouble-shoot electronic, pneumatic, and control equipment associated with the facilities and systems of water and wastewater utilities. This occupation relates to SOC Code 17-3023 Electrical and Electronic Engineering Technicians as classified by the U.S. Department of Labor, Bureau of Labor Statistics. The following list describes in more detail some of the tasks that may be required of Electricians with an emphasis on those performed specifically for water and wastewater agencies:[21]

- Apply electrical and electronic theory to maintain, repair, test, install, modify, calibrate, and trouble-shoot electronic, pneumatic, and control equipment associated with the facilities and systems of water and wastewater utilities; these include communication systems, digital and/or analog computers, printed circuits, etc.
- Conduct preventative maintenance inspections of equipment
- Read and interpret wiring diagrams, mechanical drawings, and specifications in making installations or performing major repair
- Apply federal, state and local laws, codes and regulations
- Estimate labor, materials and supplies necessary for performance of work
- Maintain records and provide oral reports on work performed
- Supervise trainees

Occupational Outlook: Electronic Maintenance and Instrument Technicians can work in a variety of environments including but not limited to water and wastewater utilities. The California Employment Development Department labor market data for the Bay Area region predicts a modest increase in demand for this occupation between 2006-2016 due to both growth and separations (retirements). Water and wastewater agencies surveyed expressed the following demand for Electronic Maintenance and Instrument Technicians over the next five years:

Water and Wastewater Occupations	2009 Employment	5-year Growth Rate (total new job growth)	Eligible to Retire in 5 years (total replacement rate)	New & Replacement Jobs (5 year total)
Electronic Maintenance Technician/ Instrument Technician	134	4%	47%	65

Training and Education: Training and education requirements vary for entry to supervisory level positions. "Trainee-level" workers require minimal prior preparation while "journey-level" Electronic Maintenance and Instrument Technicians need significant advanced training and experience. A generic job description developed by the BAYWORK for this occupation outlines the skills, knowledge and abilities for trainee- versus journey-level positions which can be found in the chart at the end of this occupational profile.

[21] Occupational Profile: California Labor Market Information, Electricians (SOC Code 17-3023); Workforce Development Task Force Generic Instrument and Control Technician Preview

The preparation period for an Electronic Maintenance and Instrument Technician trainee lasts three to five years on average and a few agencies offer on-the-job training options in the instrumental maintenance of their plants. Entry-level technicians must demonstrate minimal qualifications including education ranging from completion of 12th grade or the equivalent to one year of community college preparation and possession of a valid California driver's license. In a few cases, specific entry-level positions may require additional certification (e.g., Federal Communications Commission Rad Telephone First or Second Class Licensure).

In order to access journey-level positions, Electronic Maintenance and Instrument Technicians must demonstrate advanced education and experience credentials. In addition to completion of the 12th grade, journey-level technicians typically require a two-year trade or associate's degree in related sciences and up to two years of experience as a district electrical worker. Alternatively, those showing up to four years experience in the field or attainment of journey-level status in general electrical installation and repair work (see *Occupational Profile – Electrician Technician, Training and Education*) also qualify for these positions.

Career Pathways: Career pathways for Electronic Maintenance and Instrumentation Technicians tend to be linear, moving from entry-level positions to advanced opportunities including supervisory and management positions. Journey-level preparation also allows Electronic Maintenance and Instrumentation Technicians to move between positions in water and wastewater utilities and agencies and other industries.

Occupational Wages: In the Bay Region, water agencies and utilities surveyed identified the following **monthly wages** for Electronic Maintenance and Instrumentation Technicians positions (wage ranges averaged across respondents):

	Trainee-Level	Journey-Level	Supervisory-Level
Electronic Maintenance and Instrumentation Technicians	$3,959- $4,833	$6,006- $7,417	$7,279- $9,034

Electronic Maintenance and Instrument Technician

Skills, Knowledge & Abilities (trainee- vs. journey-level)

	Trainee	Journey
Skills in…	Mechanical dexterity	Mechanical dexterity
Knowledge of…	Standard hand, power tools Materials, terms, practices, equipment used in the electrical, instrument repair fields Arithmetic related to shop, field work Mechanical principles related to shop, field work Occupational hazards, standard safety practices	Operations, services, activities, operational methods, operational practices, operational characteristics of equipment related to the field Principles, procedures of confined space entries Principles of mathematics Electrical, electronic circuits Methods, practices, tools used in maintaining, repairing, testing, adjusting pneumatic, electromechanical recording, metering instruments Mechanical linkage, telemetering systems Occupational hazards, safety practices, precautions Hydraulics related to operation of recording, metering instruments Principles of operation, maintenance of pneumatic, electronic instruments, controls Pertinent federal, state local laws, codes, regulations
Ability to…	Learn to assist higher-level technicians in inspection, trouble-shooting, diagnosis, repair, installation, overhauling, maintenance, calibration, fabrication, design modification, removal of systems, equipment relevant to trade Learn to complete tasks requiring considerable manipulative skills, mechanical comprehension, mathematical calculations, logical reasoning Learn to interpret/work from shop drawings, electrical diagrams Use some independent knowledge, judgment Acquire increased job knowledge, skills Understand/carry out verbal, written instructions Keep standard records, make simple verbal or written reports of work performance Communicate clearly, concisely orally, in writing Learn/perform shop mathematics with accuracy Learn/apply safe work practices Establish/maintain effective working relationships Perform job functions in a customer-oriented environment when assigned to work teams Learn pertinent federal, state, local laws, codes, regulations related to field	Install, maintain, repair, overhaul, inspect, trouble-shoot, diagnose, maintain, calibrate, fabricate, modify, remove systems, equipment relevant to trade, including communication systems, digital/analog computers, printed circuits, etc. Use some independent knowledge, judgment Operate hand/power tools relevant to the field Conduct preventive maintenance inspections of all equipment related to the field Read/interpret wiring diagrams, mechanical drawings, specifications in making installations, performing major repair work Estimate labor, materials, supplies necessary for performance of specific assignments Direct the work of sub-journey level employees as required Ensure observation of proper safety precautions Direct work of sub-journey level employees Keep records/make written, verbal reports of work Collaborate with other departments to solve problems, determine needs Establish/maintain effective working relationships

Mechanic/Machinist
Water and wastewater agencies employ Mechanics and Machinists to maintain mechanical equipment associated with water and wastewater transmission, distribution, storage, and treatment. Mechanics and Machinists may do many of the same tasks. However, BAYWORK notes that Machinists spend more time fabricating parts and working in the shop while Mechanics tend to dedicate a majority of time to working in the field and conducting maintenance in the water/wastewater industry.

These occupations relate to SOC Code 49-9041 Industrial Machinery Mechanics and SOC Code 51-4041 Machinists as classified by the U.S. Department of Labor – Bureau of Labor Statistics. The following list describes in more detail some of the **tasks** that may be required of Mechanics and Machinists with an emphasis on those performed specifically for water and wastewater agencies:[22]

- Repair, maintain, install, adjust, clean and test a variety of water/wastewater plant facilities including chemical feed and processing equipment; belt, chain and screw conveyors; sluice gates, compressors and scrapers; air conditioning, heating and ventilation equipment; oxygen production and distribution equipment; electric oil-hydraulic elevators; mechanical, structural and plumbing apparatus; and diesel engines and related co-generation equipment
- Fabric parts and fittings
- Select and use appropriate hand and power tools for maintenance and repair
- Operate arc welding and gas cutting and welding equipment
- Set controls to regulate machining or enter commands to retrieve, input or edit computerized machine control media
- Record repairs and maintenance performed

Occupational Outlook: Mechanics and Machinists can work in a variety of environments including but not limited to water and wastewater agencies. The California Employment Development Department labor market data for the Bay Area region predicts a modest increase in demand for these occupations between 2006-2016 due to both growth and separations (retirements). Water and wastewater agencies surveyed expressed the following demand for mechanics and machinists over the next five years:

Water and Wastewater Occupations	2009 Employment	5-year Growth Rate (total new job growth)	Eligible to Retire in 5 years (total replacement rate)	New & Replacement Jobs (5 year total)
Mechanic/Machinist	229	2%	43%	101

Training and Education: Training and education requirements vary for entry to executive operator positions. "Trainee-level" workers require minimal prior preparation while "journey-level" mechanics/machinists need more advanced training and experience. Generic job descriptions developed by BAYWORK outline the skills, knowledge and abilities for trainee- versus journey-level positions found in the chart at the end of this occupational profile.

[22] Occupational Profile: California Labor Market Information, Industrial Machinery Mechanics (SOC Code 49-9041) and Machinists (SOC Code 51-4041); Bay Area Forum – Workforce Development Task Force Generic Mechanic/Machinist Job Preview.

The training period for Mechanics/Machinists lasts three years on average and generally occurs on the job. Trainees must only demonstrate completion of 12th grade or the equivalent and hold a valid California driver's license in order to begin training. Mechanics/machinists can achieve journey-level status usually after three years by demonstrating achievement of trainee-level requirements in addition to 18-months experience as an upper-level trainee and completion of job requirements. Alternatively, attainment of a recognized journey-level apprenticeship with work experience primarily in maintenance repair and/or machine production also qualifies individuals for journey-level status.

Career Pathways: Career pathways for Mechanics/Machinists tend to be linear, moving from entry-level positions to advanced opportunities including supervisory and management positions. Journey-level preparation also allows Mechanics/Machinists to move between positions in water and wastewater utilities and agencies and other industries.

Occupational Wages: In the Bay Region, water agencies and utilities surveyed identified the following **monthly wages** for Mechanic/Machinists positions (wage ranges averaged across respondents):

	Trainee-Level	Journey-Level	Supervisory-Level
Mechanic/Machinists	$4058- $5,034	$5327- $6,457	$6,523- $8,190

Mechanic/Machinist
Skills, Knowledge & Abilities (trainee vs. journey level)

	Trainee	Journey
Skills in…	Record keeping/verbal reporting of work performed Manual dexterity	Reading/interpreting mechanical drawings, plans, specifications Making rough sketches Estimating labor, materials for proposed work Diagnosing defects in mechanical equipment common to water/wastewater utilities
Knowledge of…	Arithmetic, mechanical principles related to shop work Standard safety practices Use of standard stationary, hand, power tools, materials; terms, practices, equipment common to mechanical/machinist trades	Standard methods, practices, materials, tools, equipment used in installation, adjustment, maintenance, repair of mechanical equipment common to a wastewater treatment plant Safety regulations & practices pertaining to the work, including precautions in handling and storing liquid chlorine and oxygen Functions, capabilities of common machine tools Metal fabrication techniques, working properties of common metals, alloys Uses, operation of arc welding, gas cutting, welding equipment Rigging principles, techniques Shop mathematics Diesel engines, related co-generation equipment Methods, procedures of carpentry, painting trades

Ability to…	Understand/carry out oral, written instructions Learn to read/interpret mechanical blueprints, shop drawings, specification, diagrams Learn to use equipment, tools common to mechanical maintenance, machining including lathes, welding equipment, mills, drill presses, grinders, measuring tools Learn practices, procedures, methods, equipment used in construction maintenance repair of water/wastewater plants, flood control facilities; includes mechanical inspection, preventive maintenance, repair of pumps, valves, conveyors, cranes, meters, water heaters, fixtures, related mechanical equipment including pump alignments/in-shop balancing, threading, soldering, installing plumbing fittings, connections Learn to perform work requiring considerable manipulative skills, mechanical comprehension, accurate use of shop mathematics, logical reasoning Learn to perform electrical repairs Learn to operate light construction equipment Haul equipment to, from job sites Keep simple shop or field records Make oral, written reports of supplies, materials, or equipment used, work performed Work in sumps or deep pits while assisting in the maintenance of pumps, screening equipment Use some independent judgment, initiative Acquire increased job knowledge, skills Understand/carry out verbal, written instructions Learn/apply safe work practices Respond to public inquiries in a courteous manner Establish and maintain effective working relationships	Repair, maintain, install, adjust water/wastewater plant facilities including chemical feed, processing equipment; belt, chain, screw conveyors; sluice gates, compressors, scrapers; air conditioning, heating, ventilating equipment; oxygen-production, distribution equipment; electric oil-hydraulic elevators; mechanical, structural, plumbing apparatus; diesel engines, related co-generation equipment Fabricate parts, fittings Use hand, power tools such as drills, hydraulic presses, jacks, grinders, power saws, pipe threaders, bending machines Use precision measuring instruments Use gas and arc welding Keep records and make reports of work progress

Appendix E: Career Pathway Example

Wastewater Treatment Plant Operator
Career Ladder

Entry Level

You need:

- SS#
- Employment Authorization
- CA Drivers License, current
- HSD/GED
- 18 years or older
- Read and Write English
- Aptitudes in Math, English, Mechanical and Electrical
- Ability to identify hand tools
- Soft skills such as dependable, responsible, ability to follow instructions, team player, communicate effectively, flexibility, and leave personal issues at door.

Typical Jobs

9910 Pre-apprentice Program Worker

7375 – Apprentice Waste Water Treatment Operator

Mid Level

You need:

- All of entry level criteria plus…
- At least 4 years of experience
- Grade 2 or higher Waste Water Treatment Certificate
- Journeyman level
- Demonstrated knowledge of plant processes, policies and procedures, basic biology and chemistry, and safety practices at the plant.
- Ability to work with hand tools, power tools, troubleshoots problems, understand mathematics, mechanical and electrical applications, and monitor & assess system performance.

Typical Jobs

7372 – Wastewater Treatment Operator

7373- Senior Stationary Engineer

Executive Level

You need:

- All of mid-level criteria plus…
- At least 6 years of experience
- Management and supervisory skills
- Grade Five Four Waste Water Operator Certificate or higher
- Administrative aptitude
- Ability to exercise exceptional judgment on matters of utility management
- Ability to plan and direct the activities of organization, to analyze problems and recommend solutions.
- To be liaison to other departments

Typical Jobs

7252 – Stationary Engineer Plant Chief

5130 – Sewage Treatment Plant Superintendent

0941 – Division Manager

5166- Assistant General Manager of Wastewater Enterprise

Wastewater Enterprise, San Francisco Public Utilities Commission

Catherine Curtis, Workforce Development (Version 1.1)
April 2008, Career Plan

Appendix F: Electrical Power Systems Certificate, College of San Mateo

College of San Mateo with assistance from East Bay Municipal Utility District, Pacific Gas and Electric, the San Francisco Public Utilities Commission and *BAYWORK,* is offering a one-year certificate program in Power & Electrical Systems training. The purpose of this certificate program is to increase potential job candidates' technical skills so companies can hire local talent in the communities where they provide power, water, wastewater and other services. Technical jobs available in the utility industry include:

- Electrical technician
- Instrument and control technician
- Apprentice system operator
- Electrical workers I, II, and III
- Maintenance technician

Certificate of Specialization: Electrical Power Systems and Instrumentation

16 semester units. A grade of "C" or "P" or higher is required for each course

ELEC 110	Introduction to Fundamentals of Electronics	3.0 units
ELEC 231	Basic Applied Electronic Mathematics	2.0 units
ELEC 232	Advanced Electronics Mathematics	1.0 unit
ELEC 680MF	Transformers and Rotating Machinery	2.0 units
ELEC 421	Fundamentals of Electric Motor Control	4.0 units
ELEC 441	Sensors and Data Transmission Systems	4.0 units

Program Information
The education and skills students learn in the Electrical Power Systems and Instrumentation Program improve their qualifications for employment in the utilities companies as well as their success once they are employed.

For more information contact:
Kathleen Ross, Dean, Business/Technology
College of San Mateo
rossk@smccd.edu
(650) 574-6532

Employer Survey: Water-Wastewater Occupations in the South Central Coast Region
Spring/Summer 2015

Research Objectives:

1. Establish current employment levels, 3-yr projected growth (new job creation), and anticipated retirement needs (3-year outlook) for key occupations
2. Gain an understanding of the difficulty finding qualified applicants for positions
3. Solicit employer input on the necessary/required industry certifications for each position
4. Assess employer value of varying levels of CC program awards
5. Determine employer willingness to be involved directly with college programs in region
6. Assess supply (training and education) and capacity

Key Occupations:

BAYWORK (2009)	**ATEEC (2014)**	**SCC Survey (2015)**
water treatment operator	water treatment operator	Yes
water distribution operator		Yes
wastewater treatment operator	wastewater plant operator	Yes
wastewater collections operator		Yes
mechanic/machinist	mechanical maintenance technician	Yes
electrician/electrician technician	electrical maintenance technician	Yes
electronic maintenance technician/instrument technicians	instrument technician	Yes
	water conservation technician	Yes
	SCADA programmer	Yes
	environmental compliance technician/inspector	modified; determine if on staff only