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Landscape Analysis

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Acronyms and Abbreviations

ANR	Agriculture and Natural Resources
BMP	Best Management Practice
BMPs	Best Management Practices
CA	California
CAL FIRE	California Department of Forestry and Fire Protection
CBWM	Community-Based Watershed Management
CCC	California Conservation Corps
CDFW	California Department of Fish and Wildlife
CEQA	California Environmental Quality Act
CEU	Continuing Education Unit
CEUs	Continuing Education Units
CIWR	California Institute for Water Resources
CWWI	California Water Works Initiative
DCNR	Department of Conservation and Natural Resources
DEQ	Department of Environmental Quality
EPA	U.S. Environmental Protection Agency
FAO	Food and Agriculture Organization of the United Nations
GIS	Geographic Information System
HEC-HMS	Hydrologic Engineering Center–Hydrologic Modeling System
HEC-RAS	Hydrologic Engineering Center–River Analysis System
ICARP	Integrated Climate Adaptation and Resiliency Program
IPA	Institute for Public Administration
IPM	Integrated Pest Management
IRWM	Integrated Regional Water Management
IWRM	Integrated Water Resources Management
KCARE	Kansas Center for Agricultural Resources and the Environment
LMI	Labor Market Information
MCP	Master of City Planning
MOOC	Massive Open Online Course
MOOCs	Massive Open Online Courses
MWEA	Michigan Water Environment Association
NC	North Carolina
NCDWR	North Carolina Division of Water Resources
NCWSN	North Carolina Watershed Stewardship Network

NEPA	National Environmental Policy Act
NOAA	National Oceanic and Atmospheric Administration
OSFM	Office of the State Fire Marshal
QCEW	Quarterly Census of Employment and Wages
SDGs	Sustainable Development Goals
STEM	Science, Technology, Engineering, and Mathematics
TMDL	Total Maximum Daily Load
TMDLs	Total Maximum Daily Loads
TWS	Texas Watershed Steward
UC	University of California
UC ANR	University of California Agriculture and Natural Resources
UCCE	University of California Cooperative Extension
UDWRC	University of Delaware Water Resources Center
USDA	U.S. Department of Agriculture
USFS	U.S. Forest Service
USU	Utah State University
WEF	Water Environment Federation
WQA	Water Quality Association
WRM	Water Resources Management
WRRl	Water Resources Research Institute
WRRIs	Water Resources Research Institutes
WSA	Watershed Stewards Academy
WSP	Watershed Stewards Program
WREP	Water Resources Education Program
CAD	Computer-Aided Design
CPE	Continuing Professional Education
CTE	Career Technical Education
PE	Professional Engineer
RMS	Resource Management Systems
SWP	State Water Project



Executive Summary

The water industry is facing significant and on-going workforce challenges, driven by retirements of existing employees and difficulty recruiting trained water professionals in many types of positions. Workforce shortages range from water and wastewater treatment professionals to trained water resources modelers to field staff for watershed management and water quality monitoring.

To address the need, the California Institute for Water Resources (CIWR) within University of California Agriculture and Natural Resources (UC ANR) explored the opportunity to develop a California Water Works Initiative (CWWI), which would leverage UC ANR's statewide footprint across counties and develop curricula for multiple audiences in support of a next generation of water experts and stewards. This landscape analysis profiles current education and training programs in watershed and water resources management, outlining the curriculum, delivery method, administrative structure of the delivery entity, and funding sources of relevant existing examples. In addition, the analysis provides insights into workforce development issues and extension programs in watershed and water resources management.

The landscape analysis especially focuses on opportunities related to watershed management, including existing watershed land grant university extension programs and watershed-focused programs, beginning with Water Resources Research Institutes (WRRIs) that are affiliated with the National Institutes for Water Resources. To broaden the scope, the analysis included searches of university and community college degrees and offerings, nonprofit programs, and federal and global government programs that have linkages to watershed management and water resources.

We provide an introduction of our integrated conceptual approach to watershed management in order to distinguish it from water management or water resource management. Our approach recognizes that community participation is vital to watershed management, and thus, socioeconomic, institutional, and technical factors also shape watershed management. The impetus for the California Water Works Initiative is to provide an integrated, multisectoral

perspective that incorporates hydrological, environmental, social, economic, and cultural dimensions. The training curriculum will be interdisciplinary and combine scientific knowledge, technology, and human dimensions that will be accessible to the public and translatable into a holistic set of practical knowledge, skills, abilities, and behaviors to ready individuals for the challenges of watershed management jobs and careers.

The landscape analysis review indicates a baseline of watershed management knowledge and skills across multiple topics. The Landscape Summary table (see Appendix A) illustrates the topics and focus areas of the reviewed watershed management programs and separates California programs out from the other national programs. In total, the landscape includes 46 programs, of which 30 are outside of California. Of the 30 non-California programs, WRRIs, cooperative extensions, nonprofit and international organizations, or U.S. government agency offer 19 of those 30. In comparison, within California there are a total of 16 programs, and half of those (six) are part of nonprofit, state, or university non-credit programming. A total of 11 programs are at non-Californian universities or colleges, five undergraduate and 4 graduate courses, certificates or degrees (note that one university offers both graduate and undergraduate options).

The target audience for the eight non-post-secondary programs in California is the public (four) and then high schoolers, community leaders, and water professionals. The target audience for the non-Californian 19 non-post-secondary programs, 11 are for the public, and the remainder are a service to a specific water-related profession or agriculture.

The list below categorizes the program by stewardship or competency and indicates the target audience and potential for a certificate, credit, or connection to a job or career:

- Stewardship
 - leaders, stakeholders and community - 19 programs
- Competency
 - continuing education credits or certificate - 10 programs
 - university/college course, certificate, concentration, minor, major - 17 programs
 - certified crop advisors - 2 programs

The list below illustrates the focus areas of the watershed management programs:

- watershed management basics - 35 programs
- water quality - 29 programs
- non-source point pollution - 15 programs
- soil erosion and sediment impacts - 12 programs
- climate change - 15 programs
- watershed planning - 25 programs

The delivery of education and training across these programs include workshops, online/distance learning, face-to-face, hands-on projects (rain garden installations, watershed investigations, etc.).

The paper then turns to a synthesis of career and job opportunities as well as pathways for advancement. The section defines watershed jobs and identifies their common practice areas, occupational sector, jobs titles, and the compensation for these positions. To further understand job opportunities, we conducted a preliminary labor workforce analysis using the skills collected from the landscape analysis to examine California watershed management job market from May 2024 and April 2025. The following are the high-level findings.

- Most California job titles associated with watershed management are white collar STEM occupations requiring at least a bachelor's degree, with technician-level occupations accounting for approximately one-third of the watershed workforce. The data suggest that further data analysis would be beneficial to understand the correlation between the watershed management-specific jobs postings and the wider related workforce to determine: 1) if only a few workers in closely-related fields focus on watershed management; and/or (2) if watershed management practices are not characterized as such in the jobs postings, and instead the practices are carried out among this range of professionals. See Appendix B for most common job titles.
- The watershed management-related workforce in California requires a range of skills in planning, business administration, natural resources and environmental management (including specialized water management topics), data analysis, engineering and design, fire science and management, forest management and firefighting, and regulatory and policy skills. See Appendix B for most common skills.
- Top employers of California watershed management jobs include the US Forest Service, US Department of Interior, and consulting firms. Additionally, the data suggest that most watershed-related employment is scattered across dozens of employers in California; there are few watershed-related jobs in most organizations; and as noted above in the skills finding, most watershed management-related work is not designated as such and occurs as an emergent layer in existing work where job responsibilities increase beyond listed skills. See Appendix B for most common types of employers.

The insights from the landscape analysis and labor market analysis identifies watershed management program gaps and opportunities for the California Water Works Initiative and curricula. We introduce a competency framework based on the landscape analysis findings to advance thinking on the education and skills that a watershed management worker would need to know for different levels of work (public, entry, and experienced level job). The five Watershed Management competency categories include:

- Watershed Understanding: What is a Watershed?
- Watershed Planning

- Watershed Project Implementation
- Watershed Restoration and Maintenance
- Watershed Organizational Administration and Leadership

The set of analyses suggests next steps in terms of vetting the competency framework and identification of partners and collaborations that could provide opportunities for piloting various modules of the curricula and development of the California Water Works Initiative. Working within the wide educational offerings of UC ANR, watershed management education could complement this space. The effort should also look to policy windows that provide opportunities for watershed management modules to address its role in addressing the impact of climate change with drought and fires, fisheries, urban areas, agriculture, and many more.



1. Introduction

The water industry in North America is facing significant workforce challenges, driven by retirements and difficulty recruiting trained water professionals. From water agencies to consulting groups, workforce shortages range from water and wastewater treatment professionals to trained water resources modelers to field staff for watershed management and water quality monitoring.

To address this need, the California Institute for Water Resources within University of California Agriculture and Natural Resources is exploring the opportunity to develop a California Water Works Initiative, which would develop curricula for multiple audiences that support a next generation of water experts and stewards who translate education into job and career opportunities. This landscape analysis profiles current education and training programs in watershed management and water resources, outlining the curriculum, delivery method, administrative structure of the delivery entity, and funding sources of relevant existing examples. In addition, the analysis provides insights into workforce development issues and extension programs in watershed and water resources management, highlighting trends, possible career pathways, and job opportunities. The objective of this analysis is to inform CIWR's California Water Works Initiative such that its educational and training offerings could support development of a curricula that could variably support multiple audiences, including interested members of the general public on watershed management, early-career and aspiring professionals, and more experienced professionals of watershed experts and stewards, who are all capable of supporting or designing systems and policies to ensure public safety and address the challenges of ecological protection and drought-driven water shortages.

1.1. *Water Experts and Stewards Landscape*

The landscape analysis for the California Water Works Initiative especially focuses on existing watershed land grant university extension programs and watershed-focused programs, beginning with Water Resources Research Institutes (WRRIs) that are affiliated with the National Institutes for Water Resources. To broaden the scope, the analysis included searches

of university and community college degrees and offerings, nonprofit programs, and federal and global government programs that have linkages to watershed management and water resources. Water operator and technician types of certifications are not part of this analysis; however, these positions are informative to the discussion of career pathways and job opportunities for comparison.

The landscape analysis of the programs assesses the following:

- Description of the watershed education and training program, the targeted type of water expert and/or steward, the delivered skill set, and where possible the administrative organizations and structures delivering the program.
- Funding structure of the watershed education and training program.
- Assessment of the program's intent to prepare students for watershed-related job opportunities, exposure to career pathways, and potential for career advancement.
- Discussion of available data on job compensation and quality.
- Discussion of gaps and opportunities that exist to improve existing programs, including how stewardship programs could translate to more applied training and job readiness.

The synthesis of the landscape analysis begins with an introduction of our integrated conceptual approach to watershed management in order to distinguish it from water management or water resource management. Our approach recognizes that community participation is vital to watershed management, and thus, socioeconomic, institutional, and technical factors also shape watershed management. The impetus for the California Water Works Initiative is to provide an integrated, multisectoral perspective that incorporates hydrological, environmental, social, economic, and cultural dimensions. The training curriculum will be interdisciplinary and combine scientific knowledge, technology, and human dimensions that will be accessible to the public and translatable into a holistic set of practical knowledge, skills, abilities, and behaviors to ready individuals for the challenges of watershed management jobs and careers.

Following the conceptual model, the next two sections provide an overview of watershed education and training and lists the reviewed programs. The overview examines the common topics, overarching skill sets, and the content delivery structures of the reviewed watershed management programs. The subsequent section describes the different types of watershed management offerings and audience from stewardship programs to certificate programs to other institutional courses. The section also outlines of the types of funding sources for these programs, where available.

The document then turns to a synthesis of career and job opportunities as well as pathways for advancement. The section defines watershed jobs and identifies their common practice areas, occupational sector, jobs titles, and the compensation for these positions. To further

understand job opportunities, we conducted a preliminary labor workforce analysis using the skills collected from the landscape analysis to examine California watershed management job market from May 2024 and April 2025.

The summary for the landscape analysis concludes with a discussion of watershed management program gaps and opportunities for the California Water Works Initiative and curricula. This section also introduces a competency framework based on the above landscape analysis that outlines education and skills that a watershed management worker would need to know for different levels of work (public, entry, or experienced level job).

The paper concludes with a discussion and next steps in terms of vetting the competency framework and identification of partners and collaborations that could provide opportunities for piloting various modules of the curricula and development of the California Water Works Initiative.



2. Watershed Management: An Integrated Conceptual Approach

According to the U.S. Geological Survey, California Water Science Center, a watershed is defined as **“an area of land where all streams and precipitation drain to a common outlet, such as the outflow of a reservoir, the mouth of a bay, or any point along a stream channel.”** This definition encompasses both surface water and groundwater systems.

Watersheds are classified into two main types: **hydrographic and hydrologic**. The geography or geomorphology of the landscape delineates hydrographic watersheds, relying on landforms and patterns of surface water runoff. In contrast, hydrologic watersheds encompass the territory’s hydrological processes, from surface water and runoff to groundwater, aquifer recharge, evaporation, infiltration, and the dynamic interactions between rivers and aquifers.¹

Kerr (2007) describes a watershed as a unique type of “common-pool resource” based on the theory of common goods. Hydrological linkages define the area where diverse human and ecological factors intersect. Thus, watersheds embody a complex mix of economic, social, political, health, resource availability, exploitation pressures, climate change, and lifestyle dimensions—often leading to competing interests and conflicts.²

In recent years, global population growth combined with climate change has intensified conflicts over natural resources, particularly water.³ Reflecting this complexity, the concept of a watershed has evolved beyond a purely hydrological unit to become a socio-political-

¹ James Eflin and Amy L. Sheaffer, “Service-Learning in Watershed-Based Initiatives: Keys to Education for Sustainability in Geography?,” *Journal of Geography* 105, no. 1 (2006): 33–44, <https://doi.org/10.1080/00221340608978656>; Suhas P Wani and Kaushal K Garg, 1. *Watershed Management Concept and Principles*, n.d.; Demetrio Antonio Zema and Manuel Esteban Lucas-Borja, “Theoretical and Practical Approaches in Watershed Management Across Different Environmental Contexts,” *Resources* 14, no. 1 (2025): 14, <https://doi.org/10.3390/resources14010014>.

² John Kerr, “Watershed Management: Lessons from Common Property Theory,” *Watershed Management*, n.d.

³ Wani and Garg, 1. *Watershed Management Concept and Principles*.

ecological entity. It plays a critical role in ensuring food, social, and economic security, while providing vital life support services to rural communities.⁴

Emerging from these challenges is watershed management—an integrated approach focused on harmonizing the interactions between hydrological, biophysical, and socioeconomic systems to optimize water resource use for productivity, conservation, and sustainability.⁵ This interdisciplinary practice combines scientific knowledge, technology, and human dimensions to empower communities in addressing environmental, social, and economic issues.⁶

Effective watershed management is especially crucial in regions susceptible to drought and limited water availability. It enhances river flow regulation, agricultural resilience, soil fertility, and the conservation of water and soil resources, ultimately supporting the livelihoods of communities within the watershed. Moreover, it is fundamental for environmental conservation through the management of biota, land, ecosystems, and other ecologically significant resources—preserving ecological balance and ensuring the long-term viability of both land- and water-based systems⁷

Some authors argue that implementing effective watershed management practices directly contributes to achieving several of the United Nations' 2030 Sustainable Development Goals (SDGs), including Goal 6 (Clean Water and Sanitation), Goal 11 (Sustainable Cities and Communities), Goal 12 (Responsible Consumption and Production), Goal 13 (Climate Action), and Goal 15 (Life on Land).⁸

Over the past decade, the complexity of and interactions occurring in and around watersheds suggests that community involvement is increasingly vital in watershed management. In fact, the concept of Community-Based Watershed Management (CBWM) has emerged as a best practice, emphasizing active public participation and the socioeconomic, institutional, and technical factors that also influence the process.⁹

⁴ Wani and Garg, 1. *Watershed Management Concept and Principles*.

⁵ Nurani Ikhlas and Bimastyaji Surya Ramadan, "Community-Based Watershed Management (CBWM) for Climate Change Adaptation and Mitigation: Research Trends, Gaps, and Factors Assessment," *Journal of Cleaner Production* 434 (January 2024): 140031, <https://doi.org/10.1016/j.jclepro.2023.140031>; Guangyu Wang et al., "Integrated Watershed Management: Evolution, Development and Emerging Trends," *Journal of Forestry Research* 27, no. 5 (2016): 967–94, <https://doi.org/10.1007/s11676-016-0293-3>; Wani and Garg, 1. *Watershed Management Concept and Principles*; Belay Zerga, "Integrated Watershed Management: A Review," *Discover Sustainability* 6, no. 1 (2025): 657, <https://doi.org/10.1007/s43621-025-01352-0>.

⁶ A.K. Biswas, "Watershed Management," *Water Resources Development* 6, no. 4 (1990); Vikram Koundinya et al., "Core Competencies for Successful Watershed Management Practitioners," *Journal of Extension* 56, no. 1 (2018), <https://doi.org/10.34068/joe.56.01.12>; Wani and Garg, 1. *Watershed Management Concept and Principles*.

⁷ Biswas, "Watershed Management"; Ikhlas and Ramadan, "Community-Based Watershed Management (CBWM) for Climate Change Adaptation and Mitigation"; Kerr, "Watershed Management: Lessons from Common Property Theory"; Koundinya et al., "Core Competencies for Successful Watershed Management Practitioners"; Wang et al., "Integrated Watershed Management"; Wani and Garg, 1. *Watershed Management Concept and Principles*; Zema and Lucas-Borja, "Theoretical and Practical Approaches in Watershed Management Across Different Environmental Contexts"; Zerga, "Integrated Watershed Management."

⁸ Ikhlas and Ramadan, "Community-Based Watershed Management (CBWM) for Climate Change Adaptation and Mitigation."

⁹ Tena Gobena et al., "Scaling up Community Participation in Watershed Management for Food Security Improvement: The Case of Qarsa Woreda , East Haraghe Zone, Ethiopia," *F1000Research* 14 (February 2025): 244, <https://doi.org/10.12688/f1000research.153669.1>; Srishti Gupta et al., "Not Another Day Zero: Design Hackathons for Community-Based Water Quality Monitoring," arXiv:2210.16381, preprint, arXiv, October 28, 2022,

CBWM is a new paradigm in the field of watershed management due to its emphasis on active local community participation. This approach recognizes that residents and stakeholders within the watershed possess valuable knowledge and have a direct vested interest in the sustainable conservation and use of their natural resources.¹⁰

Unlike traditional watershed management methods, which are often centralized and technically driven, CBWM promotes an integrated, multisectoral perspective that incorporates hydrological, environmental, social, economic, and cultural dimensions. CBWM fosters local empowerment and strengthens community capacities through the encouragement of shared responsibilities in the management of water resources and land within the watershed. This paradigm shift aligns with broader global trends in sustainability, environmental governance, and social justice, and also supports the achievement of international sustainable development goals.

In contrast **water management**, often referred to as **Water Resources Management (WRM)** or **Integrated Water Resources Management (IWRM)**, is the coordinated planning, development, allocation, and governance of surface and groundwater to ensure their sustainable and equitable use for human, ecological, and economic purposes. It includes securing water availability and quality, safeguarding ecosystems, and enhancing resilience to hazards such as floods and droughts. Our topic, **Watershed Management**, applies a broader, systems-based approach, integrating water, land, biodiversity, and socio-economic activities within the hydrological boundaries of a watershed.¹¹ The table below illustrates the main differences between these concepts.

<https://doi.org/10.48550/arXiv.2210.16381>; Ikhlās and Ramadan, “Community-Based Watershed Management (CBWM) for Climate Change Adaptation and Mitigation”; Environmental Protection Agency, Office of Wetlands, Oceans, and Watersheds, *Community-Based Watershed Management: Lessons from the National Estuary Program*, EPA-842-B-05-003 (Environmental Protection Agency, 2005); Nur Syamsiyah et al., “Community Participation in the Development of Sustainable, Environmentally Conscious Villages in the Cirasea Sub-Watershed, Indonesia,” *Sustainability* 17, no. 11 (2025): 4871, <https://doi.org/10.3390/su17114871>; Laura S. Larsson et al., “Rural Community Leaders’ Perceptions of Environmental Health Risks: Improving Community Health,” *AAOHN Journal* 54, no. 3 (2006): 105–12, <https://doi.org/10.1177/216507990605400303>; Richard Noorgard et al., “Collectively Engaging Complex Socio-Ecological Systems: Re-Envisioning Science, Governance, and the California Delta,” *Environmental Science and Policy* 12, no. 6 (n.d.): 644–52.

¹⁰ Gobena et al., “Scaling up Community Participation in Watershed Management for Food Security Improvement”; Environmental Protection Agency, Office of Wetlands, Oceans, and Watersheds, *Community-Based Watershed Management: Lessons from the National Estuary Program*; Syamsiyah et al., “Community Participation in the Development of Sustainable, Environmentally Conscious Villages in the Cirasea Sub-Watershed, Indonesia”; Zerga, “Integrated Watershed Management.”

¹¹ Neil S. Grigg, “Framework and Function of Integrated Water Resources Management in Support of Sustainable Development,” *Sustainability* 16, no. 13 (2024): 5441, <https://doi.org/10.3390/su16135441>; Mark Lubell and Jurian Edelenbos, “Integrated Water Resources Management: A Comparative Laboratory for Water Governance,” *International Journal of Water Governance* 1, no. 3 (2013): 177–96, <https://doi.org/10.7564/13-IJWG14>; Ana Mijic et al., “Towards Adaptive Resilience for the Future of Integrated Water Systems Planning,” *Cambridge Prisms: Water* 2 (2024): e11, <https://doi.org/10.1017/wat.2024.9>; Isobel W. Heathcote, *Integrated Watershed Management: Principles and Practice*, 2nd ed. (Wiley and Sons, 2009); Rijwana Parwin, “Water Resource Assessment and Management-A Review,” *International Journal of Research in Advent Technology* 2, no. 11 (2014): 5–8.

Table 1 Main differences between “Water Management” and “Watershed Management”

Aspect	Water Management	Watershed Management
Primary Focus	Sustainable management, allocation, protection, and conservation of water resources.	Integrated management of water, land, ecosystems, and human activities within a watershed.
Resource Perspective	Water is the primary resource being managed.	Water is managed as part of an interconnected ecological and social system.
Management Unit	Administrative or hydrological boundaries (e.g., city, region, aquifer, river basin).	Watershed or drainage basin defined by natural topographic and hydrologic boundaries.
Main Objectives	Ensure reliable water supply, water quality, equitable allocation, and resilience for human and environmental needs.	Protect watershed health, improve water quality, reduce flooding and erosion, conserve ecosystems, and support sustainable communities.
Management Approach	Can be sector-specific (e.g., drinking water, irrigation, flood control) or integrated through IWRM.	Inherently integrated, recognizing the interdependence of land use, water resources, ecosystems, and upstream–downstream processes.
Typical Stakeholders	Water utilities, water agencies, irrigation districts, regulators, municipalities, and water users.	Water agencies plus land managers, conservation organizations, agricultural producers, local communities, Tribal Nations, and ecosystem managers.
Examples	Urban water supply planning, groundwater management, drought planning, wastewater management, flood protection.	Watershed restoration, riparian habitat conservation, erosion control, integrated watershed planning, forest and headwater management.

This contemporary perspective on watershed management and the conceptual framework of Community-Based Watershed Management (CBWM) indicate that capacity building among community members as watershed managers is crucial—whether they are professionals by career or community leaders actively involved in managing their own territories. In other words, these individuals may pursue watershed management as a professional lifelong career or serve as engaged community leaders. In both cases, the skills and capacities to be developed are fundamentally the same, albeit at different levels of depth and complexity.¹²

¹² Ian R. Calder, *Blue Revolution: Integrated Land and Water Resource Management*, 2nd ed (Earthscan, 2005); Gobena et al., “Scaling up Community Participation in Watershed Management for Food Security Improvement”; Ikhlas and Ramadan, “Community-Based Watershed Management (CBWM) for Climate Change Adaptation and Mitigation”; Larsson et al., “Rural Community Leaders’ Perceptions of Environmental Health Risks”; Environmental Protection Agency, Office of Wetlands, Oceans, and Watersheds, *Community-Based Watershed Management: Lessons from the National Estuary Program*; Lauren Rissman, *The*

CBWM emphasizes the empowerment of local stakeholders through the development of their technical, organizational, and leadership capacities to foster sustainable watershed governance and resilience.¹³ Several authors highlight this need for watershed managers and community members and suggest the development of a range of competencies to effectively manage watersheds and empower themselves. These competencies encompass knowledge, skills, abilities, and behaviors.¹⁴

Watershed management requires leaders who possess extensive knowledge and skills across various competencies, such as building partnerships, program design, monitoring progress, and process evaluation.¹⁵ Imperial (2005) identified that leadership, staffing and recruitment, personnel management, budgeting, contracting, and grants administration are all essential for effective watershed management.¹⁶ Bourget (2009) emphasized the need for interdisciplinary skills alongside subject matter expertise to succeed in watershed management work.¹⁷ Similarly, Lee (2005) stated that collaboration and coordination among representatives from different geographical areas are crucial for successful water resources management.¹⁸

Koundinya et al. (2018) found that watershed managers need to be skilled in a diverse range of competencies; however, a few stand out as essential components for success.¹⁹ These include the **ability to establish and maintain partnerships and collaborations, effective outreach and communication, project and organizational management, landowner interaction and interpersonal skills, as well as facilitative leadership**. Based on their survey results, the authors propose these as the “core competencies” required for successful watershed management work.

A University of Wisconsin in 2013 study identified key competencies that leaders in watershed and lake management consider crucial for their success.²⁰ The results illustrated the areas within watershed leadership training programs that needed enhancement and be beneficial to

Most Vulnerable Leaders in the Community, n.d.; Syamsiyah et al., “Community Participation in the Development of Sustainable, Environmentally Conscious Villages in the Cirasea Sub-Watershed, Indonesia.”

¹³ Calder, *Blue Revolution*; Katerina R. Gonzales et al., “Enhancing Adaptive Capacity by Engaging and Empowering Frontline Workers: A Case Study From a Water Utility,” *Community Science* 3, no. 3 (2024): e2023CSJ000036, <https://doi.org/10.1029/2023CSJ000036>.

¹⁴ Paul G. Bourget, “Integrated Water Resources Management Curriculum in the United States: Results of a Recent Survey: IWRM Curriculum in the United States,” *Journal of Contemporary Water Research & Education* 135, no. 1 (2009): 107–14, <https://doi.org/10.1111/j.1936-704X.2006.mp135001013.x>; Mark T. Imperial, “Using Collaboration as a Governance Strategy: Lessons From Six Watershed Management Programs,” *Administration & Society* 37, no. 3 (2005): 281–320, <https://doi.org/10.1177/0095399705276111>; Koundinya et al., “Core Competencies for Successful Watershed Management Practitioners”; Brian D Lee, “Pennsylvania Community Watershed Organizations as Seen by Key Informants,” *The Journal of Extension* 43, no. 5 (2005); University of Wisconsin, “Core Competencies for Watershed and Lake/Stream Leaders: Survey Results - September 2013,” 2013.

¹⁵ Koundinya et al., “Core Competencies for Successful Watershed Management Practitioners.”

¹⁶ Imperial, “Using Collaboration as a Governance Strategy.”

¹⁷ Bourget, “Integrated Water Resources Management Curriculum in the United States.”

¹⁸ Lee, “Pennsylvania Community Watershed Organizations as Seen by Key Informants.”

¹⁹ Koundinya et al., “Core Competencies for Successful Watershed Management Practitioners.”

²⁰ University of Wisconsin, “Core Competencies for Watershed and Lake/Stream Leaders: Survey Results - September 2013.”

the managers. According to the respondents, the five core areas where competency is essential include:

- ✓ **Effective communication:** Adapting messages to suit the audience during interactions.
- ✓ **Organizational and project management abilities:** Ensuring meetings are productive and participants stay engaged.
- ✓ **Facilitative leadership:** Encouraging others to contribute ideas and then provide support.
- ✓ **Vision:** Setting realistic and measurable goals that allow ongoing progress to be demonstrated to stakeholders, partners, the public, and board members.
- ✓ **Collaboration:** Building and maintaining strong, trust-based relationships with key organizations such as local authorities, conservation groups, and other stakeholders.

An integrated, multisectoral perspective of contemporary watershed management calls for a training curriculum that is interdisciplinary and combines scientific knowledge, technology, and human dimensions. In addition, research indicates that collaboration, communication, project management, and leadership skills in watershed managers are crucial for their success. Their ability to engage and mobilize both the community and political stakeholders makes the difference between taking effective action or not. This conceptual model and perspective are the basis for the subsequent review of watershed management education and training. The landscape analysis will identify similarities and differences in the current offerings and provide guidance on how California Water Works Initiative can opportunistically fill the gaps to prepare a new generation of watershed managers and community leaders.

2.1. Education and Training in Watershed Management Overview

The number of existing watershed management education and training programs are limited in comparison to that of technical training for professionals in the water operations and distribution and wastewater sectors (operations, maintenance, inspections, etc.). Potential reasons for this are that watershed management and water resources are more generalized across interdisciplinary and multidisciplinary fields, the knowledge and skill set are not well-associated with particular jobs that have an established career pathway or advancement, and watershed-related certifications are not plentiful within traditional education institutions. For these reasons, the current landscape suggests valuable improvements within education and training that builds on stewardship programs, crafts the knowledge and skill set for specific job opportunities and career pathways, and develops partnerships with existing institutions, nonprofits, and membership associations to unify existing disaggregated efforts into a cohesive program.

2.2. Landscape of Watershed Management Programs

The landscape described below is a result of a search for watershed programs, starting with programs associated with state water resources research institutes (WRRIs) that are organized as the National Institutes of Water Resources (Figure 1 to 5). The number of reviewed programs expanded with web and literature searches for “watershed management education and training” and “water resources education and training” and then searching these terms with “workforce development” and “career pathways”. The landscape includes university and college programs, with a particular focus on those in California. At present the websites of ten state WRRIs list some types of watershed management education and training, with a range of offerings including stewardship training, educational institution courses for credit or non-credit, certificate programs, and professional development courses/certificates. The WRRIs include Alabama, Colorado, Delaware, Idaho, Kansas, Michigan, Minnesota, Montana, North Carolina, and North Dakota.

Other programs identified for the California Water Works Initiative include university extension steward programs (e.g., Arkansas, Texas, Pennsylvania), university department master naturalist programs with a watershed option (e.g., Utah), undergraduate and graduate certificates, majors, and minors (e.g., Maryland, Virginia Tech, and Colorado State), university massive online courses (e.g., Colorado State), college and partnership programs (e.g., Colorado State and Community Foundation of Northern Colorado; College of the Atlantic, ME and The Union River Watershed Coalition), U.S. state programs (e.g., California Conservation Corps), cross-state programs (e.g., collaboration between Illinois-Indiana Sea Grant, University of Illinois, Purdue University, the National Oceanic and Atmospheric Administration), Canadian university offerings for professionals (e.g., McGill) and massive open online courses (MOOCs) (e.g., Queens University), and graduate programs (e.g., Masters in Engineering Leadership in Integrated Water Management), nonprofit-funded programs (e.g., Maryland Sea Grant, Watershed Management Group, Tip of the Mitt Watershed Council, Watershed Center in Trinity County, CA, and Agua University, a three month program in water education for high school students in Southern CA), community college offerings (e.g., Yuba Community College, Laramie Community College, Santa Rosa Community College, Cuyamaca College, Shasta College, and College of the Redwoods). Of note is the fact that Lane College in Oregon had a watershed science technician program that is no longer offered following the retirement of the key faculty member.

Finally, the U.S. Environmental Protection Agency and USDA Forest Service offers online learning modules or programs. Internationally, the Food and Agriculture Organization of the United Nations provides a guide to resilient watershed management planning through five lessons.

1. Agriculture and Leadership Programs

Summary of watershed education and training programs reviewed for California Water Works.

#	Location	Program	Administrator / Delivery Entity	Format	Duration / Cost	Primary Audience
1	Arkansas, USA	Arkansas Farmer Leadership in Watershed Management	University of Arkansas System Division of Agriculture	Leadership training	3 modules, up to 6 hrs; account required	Agriculture, farmers, farm advisors, crop consultants
2	Kansas, USA	KCARE Watershed Research and Implementation Partnership	Kansas State / KCARE	Applied implementation partnership	Ongoing; cost N/S	Producers, landowners
3	Colorado, USA	Water Literate Leaders of Northern Colorado	Colorado Water Center + NoCo Foundation	Leadership cohort	9 classes + 2 field trips; \$250	Leaders, board members, aspiring elected officials
4	Minnesota, USA	University of Minnesota Water Resources Center Course	University of Minnesota Water Resources Center	Online professional course	14 weeks; \$880 or tuition for credit	Professionals
5	Michigan, USA	Michigan State & MWEA Watershed Management Certification	Michigan State University + Michigan Water Environment Association	Professional certification	8 courses; \$100/course	Professionals

N/S = not specified in the draft source.

Figure 1. Training Programs based on Agriculture and Leadership in Watersheds

2. Public Stewardship and Awareness Programs

Summary of watershed education and training programs reviewed for California Water Works.

#	Location	Program	Administrator / Delivery Entity	Format	Duration / Cost	Primary Audience
6	Alabama, USA	Alabama Watershed Stewards Training, Course, and Workshop	Auburn Water Resources Center + Alabama Cooperative Extension	One-day training + self-paced online course + planning workshop	1 day or 6 months self-paced; online course free	Public, local officials, technical staff
7	Texas, USA	Texas Watershed Steward	Texas A&M AgriLife Extension + Texas State Soil & Water Conservation Board	Online + in-person workshops	Online modules and workshops; cost N/S	Public, local stakeholders, crop advisors
8	Illinois / Indiana, USA	Illinois-Indiana Master Watershed Steward	Illinois-Indiana Sea Grant + University of Illinois + Purdue + partners	Interactive stewardship program	8 sessions; cost N/S	Public, stewards
9	Arkansas, USA	Arkansas Watershed Steward	University of Arkansas Cooperative Extension + Arkansas Department of Agriculture NRD	Stewardship program	Duration N/S; cost N/S	Public
10	Maryland, USA	Maryland Watershed Stewards	Maryland Extension + Maryland Sea Grant + local groups	Stewards academy / certification	Duration N/S; cost N/S	Public, community stewards
11	Pennsylvania, USA	Penn State Extension Master Watershed Steward Program	Penn State Extension	Training + volunteer service	40 hrs training + 20 hrs service; \$125	Public, volunteers
12	Utah, USA	Utah Master Naturalist (Watershed option)	Utah State University Extension	Certification / field courses	3 field-day courses; cost N/S	Public, naturalists
13	Idaho, USA	Idaho's Bay Watchers	University of Idaho Coeur d'Alene + Coeur d'Alene Tribe + Idaho DEQ	Citizen-science monitoring	Ongoing; cost N/S	Volunteers
14	Michigan, USA	Tip of the Mitt Watershed Academy and Stewards	Tip of the Mitt Watershed Council	High-school watershed education	School-based; cost N/S	High school students
15	USA / online	U.S. EPA Online Training in Watershed Management	U.S. Environmental Protection Agency	Self-paced online modules	Minimum 15 modules for certificate; free	Public, professionals
16	Global / online	FAO Developing Resilient Watershed Management Plans	Food & Agriculture Organization of the United Nations	Self-paced online course	5 lessons, 15-40 min each; free	Global learners
17	Montana, USA	Montana Water Center's Watershed Institute Skills Self-Assessment Tool	Montana Water Center	Professional development / skills assessment	Self-paced; cost N/S	Watershed coordinators
18	North Carolina, USA	NC Watershed Stewardship Network (NCWSN)	North Carolina WRRI + NCSU + NC Sea Grant	Network / training support model	Ongoing; cost N/S	Watershed professionals, volunteers
19	USA	US Army Corps Water Resources Certified Planner (WCRP)	US Army Corps of Engineers	Professional certification	Training + experience; cost N/S	Corps planners

N/S = not specified in the draft source.

Figure 2. Programs based on Public Stewardship and Awareness in Watersheds

3. University and Graduate Programs Outside California

Summary of watershed education and training programs reviewed for California Water Works.

#	Location	Program	Administrator / Delivery Entity	Format	Duration / Cost	Primary Audience
20	British Columbia, Canada	UBC Master of Engineering Leadership in Integrated Water Management	University of British Columbia	Master's program	12 months; tuition	Engineers, technical leaders
21	British Columbia, Canada / online	UBC Watershed Management Distance-Learning Certificate	University of British Columbia	Graduate certificate / professional credit	5 graduate courses; tuition	Graduate students, professionals
22	Virginia, USA	Virginia Tech Watershed Management Graduate Certificate	Virginia Tech	Graduate certificate	Course-based; tuition	Graduate students
23	Canada / online	McGill Integrated Water Resources Management Course	McGill University	Online professional course	8 weeks; fee-based	Professionals, global audiences
24	Ontario, Canada / online	Queen's MOOC: Modelling Watershed Processes for Water Resource Management	Queen's University	MOOC / certificate	Course-based; certificate option	Public, online learners
25	Ontario, Canada / online	Queen's MOOC: Watershed Systems and Their Influence on Water Movement and Quality	Queen's University	MOOC / certificate	Course-based; certificate option	Public, online learners
26	Wyoming, USA	Laramie County Community College Rangeland Ecology and Watershed Management Program	Laramie County Community College	College program	Degree/program-based; tuition	Undergraduates
27	North Dakota, USA	North Dakota Water Resources Certificate	North Dakota State University / WRR	Undergraduate certificate	12 credits; tuition	Undergraduates
28	Delaware, USA	University of Delaware Regional Watershed Management Course and Internships	University of Delaware Water Resources Center + Institute for Public Administration	Course + internships	Course-based; tuition / stipend N/S	Undergraduates
29	Ontario, Canada	Queen's LEADERS-CREATE: Program for Leaders in Water and Watershed Sustainability	Queen's University	Interdisciplinary training / research program	Multi-year / program-based; funding N/S	Undergraduates, graduate students, postdocs
30	Maryland, USA / hybrid	University of Maryland Global Campus Watershed Management Certificate	University of Maryland Global Campus	Undergraduate certificate	6 courses / 18 credits; tuition	Undergraduates

N/S = not specified in the draft source.

Figure 3. University and Graduate Programs Outside California

4. California Public and Professional Programs

Summary of watershed education and training programs reviewed for California Water Works.

#	Location	Program	Administrator / Delivery Entity	Format	Duration / Cost	Primary Audience
31	California, USA	Agua University	Metabolic Studio + Los Angeles partners	Youth water education program	3 months + 2-week camping tour; grant-funded	High school students
32	California, USA	Water Education Foundation California Water Leaders	Water Education Foundation	Leadership program	1 year; cost N/S	Diverse community water leaders
33	California, USA	California Conservation Corps Watershed Stewards Program (WSP)	California Conservation Corps	Corps / service program	Corpsmember term; paid / service-based	Young adults
34	California, USA	ACWA Certificate in Water Management and Leadership	Association of California Water Agencies + CSU San Marcos	Certificate	5-course sequence; 8-week intro course; cost N/S	Public, professionals
35	USA / online	Water Environment Federation California Program	Water Environment Federation	Fee-based online watershed courses	Short online courses; fee-based	Water quality professionals
36	California, USA	Watershed and Fisheries Stewardship, Trinity County	Watershed Center	Stewardship / restoration program	Ongoing; cost N/S	Nonprofit / restoration workforce
37	California, USA	UC Climate Stewards	UC ANR + community partners	Certification	40+ hrs, classroom + online + field; cost varies	Public
38	California, USA	UC California Naturalists	UC ANR + community partners	Certification	40+ hrs, classroom + field; cost varies	Public

N/S = not specified in the draft source.

Figure 4. California Public and Professional Programs in Watersheds

5. California Colleges and Degree Pathways

Summary of watershed education and training programs reviewed for California Water Works.

#	Location	Program	Administrator / Delivery Entity	Format	Duration / Cost	Primary Audience
39	California, USA	Cal Poly SLO Watershed Management and Hydrology Concentration	Cal Poly San Luis Obispo	Degree concentration	Degree-based; tuition	Undergraduates
40	California, USA	Yuba College Field Technician – Watershed Management	Yuba College	Certificate / workforce program	Multi-course certificate; tuition	Undergraduates, technicians
41	California, USA	Yuba College Watershed Resilience and Forest Management Certificate	Yuba College	Certificate	Multi-course certificate; tuition	Undergraduates
42	California, USA	Santa Rosa Community College Forest Hydrology and Watershed Management Course	Santa Rosa Junior College	Course	Semester course; tuition	Undergraduates
43	California, USA	Shasta College Watershed Management and Ecology	Shasta College	Course / practicum	Semester course with restoration project; tuition	Undergraduates
44	California, USA	Shasta College Watershed Restoration Practicum	Shasta College	Practicum	Hands-on practicum; tuition	Undergraduates
45	California, USA	College of the Redwoods Intro Watershed Management Course	College of the Redwoods	Course	Semester course; tuition	Undergraduates
46	California, USA	Cuyamaca College Water Resources Management AS / Certificate	Cuyamaca College	Degree / certificate	Degree or certificate; tuition	Undergraduates

N/S = not specified in the draft source.

Figure 5. California Colleges and Degree Pathways

2.3. Water Experts and Skill Sets and Program Structure

Efforts in watershed education and training promote steps to attain healthy watersheds, increase understanding of water pollution, and provide knowledge and tools to approach water as a community resource. The North Central Region Water Network of 12 states offers the [North Central Region Water Network internship program](#) and provides a nuanced description of water resource management. The Network perceives education and training in this field as complex in the sense that “professionals in the field need an understanding of agriculture, natural resources, communication, social sciences and economics, public health, and planning and project management to be successful.”²¹

The referenced education and skill sets in the above definition can further be expanded to recognize that watershed management has a strong linkage with geography and the understanding of place since it involves “the comprehensive planning and coordination of activities to protect and restore the health of a geographic area's water resources, including rivers, lakes, and groundwater, to ensure sustainable use and conservation”.²² Finally, watershed management overlaps with resource conservation strategies, policies, and practices

²¹ North Central Region Water Network, “About Us,” North Central Region Water Network, 2025, <https://northcentralwater.org/about-us/>.

²² Christopher Hinojosa, “Watershed Manager,” Powerful Geography, April 21, 2020, <https://powerfulgeography.org/k-12-education/resources/geography-in-jobs-and-careers-pages/life-physical-and-social-science-job-summaries/watershed-manager/>.

aimed at efficiently allocating, preserving, and sustainably using water resources to meet societal needs while safeguarding aquatic ecosystems and the environment.

Beyond discipline education, Koundinya et al conducted a survey of three Extension watershed leadership programs offered at The Ohio State, Michigan State, and Purdue Universities and proposed the following list of skills “Core Competencies for Successful Watershed Management Practitioners”:

- establishing and maintaining partnerships/collaborating;
- outreach and communication;
- project and organizational management;
- landowner interaction/interpersonal skills;
- facilitative leadership; and
- developing and maintaining a vision for the future.²³

Gilmore et al conducted a needs assessment of the locally elected directors (board members) that served as water resources directors at Nebraska's 23 natural resources districts. The intent was to identify watershed science training requisites. Unfortunately, the respondents were not keen on training due to busyness of the position. The single most important finding was that the primary method of obtaining information was printed materials, suggesting their need for web-based information and collaborative learning opportunities using hybrid delivery (face-to-face and virtual).²⁴

The following sections profile a landscape of watershed management offerings in two categories to differentiate full programs from courses or one-off introductions:

- Watershed Planning and Stewardship Programs
- Watershed Certificates, Courses, Training, and Awareness

The review of these programs indicates a baseline of watershed management knowledge and skills across a number of topics. The Landscape Summary table (see Appendix A) illustrates the topics and focus areas of the reviewed watershed management programs and separates California programs out from the other national programs. In total, the landscape includes 46 programs, of which 30 are outside of California. Of the 30 non-California programs, WRRIs, cooperative extensions, nonprofit and international organizations, or U.S. government agency offer 19 of those 30. In comparison, within California there are a total of 16 programs, and half of those (six) are part of nonprofit, state, or university non-credit programming. A total of 11 programs are at non-Californian universities or colleges, five undergraduate and 4 graduate courses, certificates or degrees (note that one university offers both graduate and undergraduate options).

²³ Koundinya et al., “Core Competencies for Successful Watershed Management Practitioners.”

²⁴ Troy Gilmore et al., “Needs Assessment: Watershed Science for Water Resources Directors,” *Journal of Extension* 57, no. 4 (2019), <https://doi.org/10.34068/joe.57.04.10>.

The target audience for the eight non-post-secondary programs in California is the public (four) and then high schoolers, community leaders, and water professionals. The target audience for the non-Californian 19 non-post-secondary programs, 11 are for the public, and the remainder are a service to a specific water-related profession or agriculture.

The list below categorizes the program by stewardship or competency and indicates the target audience and potential for a certificate, credit, or connection to a job or career:

- Stewardship
 - leaders, stakeholders and community - 19 programs
- Competency
 - continuing education credits or certificate - 10 programs
 - university/college course, certificate, concentration, minor, major - 17 programs
 - certified crop advisors - 2 programs

The list below illustrates the focus areas of the watershed management programs:

- watershed management basics - 35 programs
- water quality - 29 programs
- non-source point pollution - 15 programs
- soil erosion and sediment impacts - 12 programs
- climate change - 15 programs
- watershed planning - 25 programs

The delivery of education and training across these programs include workshops, online/distance learning, face-to-face, and hands-on projects (rain garden installations, watershed investigations, etc.).

Within the state of California, few options exist for residents who want to immerse themselves in watershed planning. Of the four programs that target the public, three of them only offer a few modules on watersheds (UC programs and Association of California Water Agencies), and the other, California Conservation Corps program is only for young adults that want to receive experiential learning, and not all positions are focused on watersheds. Consequently, California Water Works could fill this gap while also exploring potential niches (fire, forestry, fisheries, etc.). The section below provides greater detail on each of the program's offerings and structure.



3. Watershed Management: Stewardship Programs, Certificates, and Courses

North Carolina Water Resources Research Institute at North Carolina State University supports an [NC Watershed Stewardship Network \(NCWSN\)](#). Unlike some of the stewardship programs below, NC WRRI does not offer a program and instead connects interested individuals with organizations that protect watersheds. NCWSN offers a higher-level example of watershed education since it is a collaborative partnership that seeks to empower more effective watershed stewardship. In 2013, NC watershed professionals completed a needs assessment of watershed professionals and volunteers with the intent of building local capacity to protect watersheds. The process continued with the formation of a steering committee and recruitment of the UNC-Institute for the Environment and WRRI to fund part-time Network co-coordinators. The effort developed a strategic plan and logic model, web tools, and training opportunities. In 2018 UNC's funding ceased, and NCDWR replaced it with additional support of NC Sea Grant. Currently, NCWSN coordination falls completely under WRRI with support from NCDWR. The following are the Network's guiding documents:

[An Assessment of Capacity and Resource Needs of NC Watershed Programs](#)

[Working toward a Collaborative Statewide Watershed Program May 2013 workshop summary](#)

[NCWSN Strategic Plan \(April 2015\)](#)

[NCWSN Logic Model \(April 2015\)](#): Inputs, activities, outcomes over immediate to long-term.

[NCWSN Steering Committee Charter \(April 2015\)](#)

NC WRRI's strategic plan includes the expansion of the network as a strategic goal in order to increase its impact on watersheds across North Carolina.

Auburn University Water Resources Center/WRRI and the Alabama Cooperative Extension System Water Program offer three types of training. First, the [Alabama Watershed Stewards Trainings](#) that are one-day with an overview of watershed systems, how to understand the state of a watershed, and how to improve watersheds. The training provides information about

local watersheds groups, partnerships possibilities, and project funding opportunities. A second type of training is the [Alabama Watershed Stewards Online Course](#) that is a free six month online self-paced course covering the basics of water quality, foundational knowledge about watersheds, non-point source pollution, and watershed health, and ways to get involved to protect water quality with best management practices. Participants that complete the course and quizzes can receive 0.7 CEUs from Auburn University.

The final Alabama offering is a [Watershed Management Planning Workshop](#), a one-day program that seeks to enlist citizens to become part of the process through 1) identifying and prioritizing water quality challenges in the watershed, 2) developing increased public involvement, 3) coordinating activities with other agencies, and 4) measuring success through increased and more efficient monitoring and other data gathering. The education topics include:

- Watershed planning – what it means and how it works
- The basics of watershed management
- Identify challenges and opportunities in your community
- Explore funding opportunities related to watershed planning
- Leverage water resources and community development
- Identify priorities and next steps

The workshops recruit citizens, elected officials, and technical personnel and teach a comprehensive, watershed-based and community-based approach to address watershed issues.

[Texas Watershed Steward](#) program operates as a partnership between Texas A&M Agrilife Extension in partnership with the Texas State Soil and Water Conservation Board. The program's objective is to increase support of stakeholder involvement in nonpoint sources of pollution with the provision of science-based, watershed education to help citizens identify and take action to address local water quality impairments. Stewards learn about the nature and function of watersheds, potential impairments, and strategies for watershed protection. Two one-hour [Texas Watershed Steward online training courses](#) deliver the content with two options for, the [Texas Watershed Steward for credit](#) and the [Texas Watershed Steward not for credit](#). The "not for credit" course substitutes for the face-to-face workshops that the extension offers around the state, introducing watersheds, water quality, and watershed management. The "for credit" course focuses on local stakeholders to inform them about watersheds, potential impairments, and steps that can be taken to help improve and protect water quality in a watershed. The goals of the program include:

- Promoting healthy watersheds by increasing citizen awareness, understanding, and knowledge about the nature and function of watersheds, potential impairments, and watershed protection strategies to minimize nonpoint source pollution,

- Enhancing interactive learning opportunities for watershed education across Texas and establish a larger, more well-informed citizen base,
- Empowering individuals to take leadership roles involving community and watershed-level water resource issues,
- Facilitating local efforts and activities to implement practices to improve water quality,
- Increasing stakeholder involvement in watershed protection and management efforts including development and implementation of Watershed Protection Plans (WPPs) and Total Maximum Daily Loads (TMDLs) by educating and organizing local citizens.²⁵

Other components of the course include:

- [Texas Watershed Steward curriculum description](#) and the [Texas Watershed Steward handbook](#)
- [Texas Watershed Steward workshops](#) at no cost and counting as continuing education credits, e.g., [Certified Crop Advisor workshop](#) under soil and water management
- [Watershed Protection Planning overview](#)

The TWS courses have modifications for middle schoolers, [Junior Texas Stewards](#), which is a [one and a half hours introduction](#) and students to the following topics:

- the Texas Watershed Steward (TWS) Program
- the importance of water
- the role of watersheds in the water cycle
- Texas watersheds
- impairments of water quality and quantity
- testing mechanisms and regulations surrounding Texas water
- protection programs
- and Best Management Practices (BMPs) in agricultural, urban and small-acreage, and residential settings.

The [Illinois-Indiana Master Watershed Steward Program](#) includes eight interactive sessions covering topics such as water quality science and the impacts of climate change, invasive species, and agriculture on water bodies. The Illinois-Indiana [Master Watershed Steward Program Toolkit](#) provides all materials necessary for the interactive module sessions and is only accessible after signing up for the program. The program is offered state-wide in Illinois and Indiana as a collaboration between Illinois-Indiana Sea Grant, University of Illinois, Purdue University, the National Oceanic and Atmospheric Administration, and other partners. Registration through the local county Extension offices.

²⁵ "Texas Watershed Stewardship - For Credit | Courses | AgriLife Learn," accessed July 28, 2025, <https://agrilifelearn.tamu.edu/s/product/texas-watershed-stewardship-for-credit/01t4x000002ciLPAAY>.

The University of Arkansas Cooperative Extension Service offers the [Arkansas Watershed Steward Program](#) in cooperation with the Arkansas Department of Agriculture – Natural Resources Division and other partnering agencies and organizations. The program promotes healthy watersheds, increases understanding of the potential causes of water resource degradation, and provides people the knowledge and tools they need to identify, prevent and/or resolve water quality problems. The [Arkansas Watershed Steward handbook](#) is available online, adapted partly from the Texas Watershed Steward Handbook and Arizona and Oregon Master Watershed Steward Programs in addition to a collaborative process between stakeholders from state agencies, non-governmental organizations, and university faculty from within Arkansas.

In addition, in 2022, University of Arkansas System Division of Agriculture offered a new leadership training program for farmers, farm advisors and crop consultants to learn more about how they can lead stewardship efforts. The training covers the importance of farmer-led watershed management and resources available for supporting agricultural production and local watershed management in the United States. [Tap Your Potential: A Training to Grow Farmer Leadership in Watershed Management](#) enables outreach professionals and educators who work in agricultural watersheds and seek to recruit farmers to play a more proactive role in watershed management in their communities. The curriculum, consisting of three modules and up to six hours of content, is customizable and only available after creating an account. It seeks to:

- Increase public awareness and knowledge of local watersheds, water issues, and available resources
- Increase watershed leadership in communities
- Motivate stakeholders to get involved in local watershed efforts
- Improve and protect the quality of local water resources

The [California Conservation Corps Watershed Stewards Program \(WSP\)](#) seeks to improve watershed health by actively engaging in restoration science, civic service, and community education. Corpsmembers work alongside mentor scientists around the state to assist with watershed data collection and analysis and restoration project development and maintenance; other [Corpsmembers skills](#) include invasive removal, riparian restoration, stormwater management, and data management. WSP Corpsmembers also provide watershed science curriculum to students at lower-income public schools.

Maryland's Extension watershed restoration specialists partner with watershed restoration groups to advise and help organize the [Maryland Watershed Stewards'](#) six academies across the state. The stewards meet weekly for 5 months to obtain certification, and each academy provides region specific curriculum that includes the following guidelines:

- Installation of projects to improve the water quality (rain gardens, rain barrels, and conservation landscaping);

- Resources for funding green design projects;
- A “capstone” project to be completed after graduating from the academy; and
- Become trainers of other stewards (i.e., “train-the-trainer”).

For example, completion of the [Calvert County Stewards program](#) certification course, the candidate will have learned about:

- Stormwater management principles and practices.
- Best management practices (BMPs) for controlling stormwater in a residential setting.
- Native plants and their role in protecting the environment.
- The stormwater professionals from the region.
- Designing and installing stormwater management practices through hands-on techniques.
- How to explain stormwater issues to interested citizens.
- Presenting the concept of stormwater management to neighbors and small groups.
- Local Geographic Information System (GIS) and the UMD Sea Grant Extension SMART Tool.
- Identifying and obtaining funding sources to pay for projects.

The Candidate will graduate with:

- A toolkit with supplies and materials to assist with restoration and outreach activities.
- A certificate stating the candidate has graduated to a Master Watershed Steward.

Requirements for Initial Certification:

- Complete the WSA coursework, consistent with the attendance policy, below.
 - Complete the class and team capstone projects to the satisfaction of WSA Coordinators
- Maintain with 1st year having 15 hrs. service and 5 hrs. continuing education, after 1st year 20 hours combined.

The [Penn State Extension Master Watershed Steward Program](#) requires the completion of a minimum of 40 hours of training and 20 hours of volunteer service. After initial certification, the program expects Master Watershed Stewards to log at least 20 hours of volunteer service and attend at least 10 hours of annual training. The program costs \$125 for registration. There is also a [Future Master Watershed Steward program](#) (a collaborative effort between Penn State Extension and the Pennsylvania Department of Conservation and Natural Resources (DCNR) - Bureau of State Parks) for youth, typically ages 11 to 18 and led by an adult and interested in the local community, environment, and/or water resources. The [Bureau of State Parks Watershed Education \(WE\) Program](#) serves as part of the curriculum.

Utah State University’s Department of Watershed Sciences and USU’s extension offer a [Utah Master Naturalist certification program](#) which includes watershed investigations as part of its three field day courses. The program also serves as an opportunity for continuing education

credits and partners with the Extension's [Utah Water Watch](#), a public water quality monitoring program open to volunteers of all ages.

California State Monterey Bay's Department of Applied Environmental Science has an affiliated [Watershed Institute](#) as well as several labs ([Watershed Geology Lab](#), [Watershed Environments and Ecology Lab](#)) to support courses and research. The Institute consists of a direct action, community-based coalition of researchers, restoration ecologists, educators, planners, students, and volunteers and use a systems approach to the management of watersheds to support the Environmental Protection Agency and the California State Water Resources Control Board.

Nonprofit-led stewardship programs with university and other partnerships include Idaho's [Bay Watchers](#)' partnership with University of Idaho Coeur d'Alene, Coeur d'Alene Tribe, Idaho Department of Environmental Quality (DEQ), and lake and bay communities seeks to empower citizen scientist volunteers with watershed education for the purpose of monitoring long-term water quality trends in Coeur d'Alene Lake bays to augment data collected by the Coeur d'Alene Tribe and Idaho DEQ.

[Watershed Center](#) is a nonprofit in Trinity County, CA that offers the [Watershed and Fisheries Stewardship program](#) for the purpose of regional restoration work, on-the-ground monitoring, public outreach, grow support and funding for watershed treatments, and implementation of on-the-ground restoration projects. However, much of the program's work seeks to restore and conserve fish populations.

The Watershed Management Group in Tucson, AZ is a community-based power building nonprofit that offers a range of professional training, from [Design Planning: Water Budgeting Scenarios](#) to optimize on-site water sources to [Water Harvesting Design Certification: October 2025](#) that is an in-person, one week, 45 hour course.

Tip of the Mitt Watershed Council in Northern Michigan has a [Tip of the Mitt Watershed Academy and Stewards](#) program since 2015 that engages high school science students and provides them an opportunity to become experts in their local watershed. The [Tip of the Mitt 2022 brochure](#) refers to the topics included:

- Local watershed basics
- Nonpoint source pollution
- Water chemistry basics
- Macroinvertebrates
- Water quality monitoring

The Academy is under the 2017-developed Water Resources Education Program (WREP), a program that engages students in introductory, foundation-laying, watershed experiences that enhance the local curriculum, increase water resources literacy and foster stewardship ethic in a team structure.

Collaborative Watershed Curriculum

In the early 2000s, the College of the Atlantic created a collaborative watershed-based curriculum and educational partnership that involved community organizations and leaders demonstrates another model. The College of the Atlantic is located on Mt. Desert Island on the coast of Maine and at the Acadia National Park entry. It received U.S. Department of education received grant funding to co-develop the watershed curriculum with community organizations and leaders. The curriculum included hands-on learning, service learning, and had a human ecological focus, and the college's teacher education program worked with local elementary and secondary teachers to integrate the curriculum into applicable courses. This effort further led to the creation of the Union River Watershed Coalition (URWC) for watershed regional planning, and college faculty offered GIS courses and workshops for interested students, community, and faculty to facilitate regional planning.²⁶

3.1. Watershed Certificates and Courses

Programs Focused on Professionals

Certificate programs vary for the intended audience—professionals in various fields in addition to water and students. [Montana Water Center Watershed Institute](#) provides for systematic outreach and professional development for watershed coordinators. The certificate involves a first step of using the [Skills Self-Assessment Tool](#), which helps identify tailored learning opportunities. The skill areas currently assessed include: Project Planning, Volunteer Recruitment and Retention, Conflict Management, Fundraising, Watershed Sciences, Technical Writing, Data Analysis, and Marketing and Promotion, Outreach. Participants earn certificates of completion for each skill area.

Water Literate Leaders of Northern Colorado is a leadership-oriented program that recruits individuals who hold or aspire to political office or service on boards and commissions and can impact regional water policy in Colorado. The cohort program requires face-to-face participation for nine classes with homework and two field trips for a cost of \$250. [Water Literate Leaders of Northern Colorado curriculum](#) topics include historical context, water law and policy, supply and demand, economic growth and development, agriculture, municipalities, and environmental & recreational issues. The leadership program is a partnership of Colorado State's Colorado Water Center and [NoCo Foundation](#), which used to be called the Community Foundation of Northern Colorado.

Extension courses often focus on professionals and cover watersheds with a primer on the water cycle, hydrologic features of a watershed, and land use impacts to lake water quality. The [University of Minnesota Water Resources Center](#) designed an online, interactive, 14-week-long course, costing \$880 for continuing education or tuition for credit. The seven-module curriculum includes: Institutions and Policy, Watershed Science, Civic Engagement,

²⁶ Richard J Borden et al., "A River Runs Through It: A College-Community Collaboration for Watershed-Based Regional Planning and Education," *Human Ecology Review* 14, no. 1 (2007): 90-100.

Communications Assessment, Evaluation and Monitoring, Implementation Activities, Project and Program Implementation

University partnerships with organizations that provide certifications (e.g., Michigan State and Michigan Water Environment Association) for professionals with responsibilities or interest in watershed management. Michigan State's and MWEA's [Watershed Management Certification](#) program has an interdisciplinary approach using a [recruiting flyer](#) that targets individuals with responsibilities or an interest in watershed management, including:

Consultants	Instructors and Researchers at Universities
Policy Makers	and Research Institutions
Civil and Environmental Engineers	Professionals from Municipal and
Landscape Engineers and Architects	Government Engineering
Regulatory Staff	Public Works Personne
Scientists	

In the beginning, it cost of \$30 for each of the 8 courses below but now is \$100 per course. To receive the certification of completion, the student must achieve 80% on each courses' test, which include:

- Course 1: Basics of Hydrology
- Course 2: Addressing Water Quality
- Course 3: Socioeconomic Considerations, Institutions & Management Issues
- Course 4: Developing & Implement Watershed Management Plans
- Course 5: Tools & Modeling for Watershed Management
- Course 6: Understanding Soil Erosion & Sediment and Pollution
- Course 7: Historical & Legal Issues of Watershed Management
- Course 8: Best Management Practices (BMP) – Drain and Water Resources Maintenance

In 2019, the [Association of California Water Agencies offered a Certificate in Water Management and Leadership](#) as a five-course sequence. The first was an eight-week course that was open to the public and served as an introduction to the water management industry. The course was affiliated with California State University San Marcos.

Since 1997, the [Water Education Foundation](#) has hosted California's year-long water leadership program, the *William R. Gianelli Water Leaders Class* with the aim of reaching diverse community leaders, otherwise known as California Water Leader. In 2022, the Foundation launched the inaugural and biennial Colorado River Water Leaders program on the 100th anniversary year of the Colorado River Compact. The program seeks to increase knowledge on water along with individual leadership skills to participate in active and cooperative water resource decision-making. A unique element of the program is that cohort members have individual mentors from the Foundation's stakeholder groups or a policymaker.

The [UC Environmental Stewards](#) also offers a professional program to inspire and empower individuals to create more sustainable and resilient communities and ecosystems. The statewide program is the result of the integration of two separate UC Agriculture and Natural Resources certification courses in 2023—the [California Naturalist](#) that started in 2012 and the [Climate Stewards](#) that started in 2020. UC Environmental Stewards collaborates with local community partner organizations to deliver both certifications, which offer interdisciplinary science material suitable to a community college level individual, requiring 40 hours of classroom, hybrid online, and field learning. Water stewardship is a component of the Climate Stewards course, but both certifications encourage certified participants to volunteer for water stewardship activities.

The Water Environment Federation, a membership organization representing water quality professionals, offers two fee-based online watershed courses: [Watershed Planning: Focus on Nutrients and Bacteria](#) and [Watershed Strategies: Beyond Permitting Integrated Planning and Trading](#).

The [Water Quality Association \(WQA\)](#), a membership association for the residential, commercial, and industrial water treatment industry, also offers training and certifications around water treatment.

The U.S. Environmental Protection Agency offers an [Online Training in Watershed Management](#) via learning modules that are self-paced (see [flyer](#)). To obtain the [Watershed Academy Web Training Certificate](#) trainees must complete a minimum of 15 modules, a minimum of 12 of which must be from the core modules list. These include:

[Watershed Ecology](#)

[Watershed Change](#)

[Analysis and Planning](#)

[Management Practices](#)

[Community and Social Practices](#)

[Clean Water Act Foundations](#)

The Food & Agriculture Organization of the United Nations provide [A guide to developing a resilient watershed management plan](#) via 5 lessons that take 15-40 minutes each to complete. The [online course](#) includes:

- Learning step 1 – Introduction to resilient watershed management
- Learning step 2 – Ensure an enabling environment and engaging stakeholders
- Learning step 3 – Perform risk assessment
- Learning step 4 – Identifying measures for resilient watershed management
- Learning step 5 – Develop and implement the resilient watershed management plan

The US Army Corps of Engineers offers a [Water Resources Certified Planner](#) (WCRP) program as part of its workforce development efforts for Corps planners. The program focuses on the knowledge, skills, and abilities (KSAs) to frame this program, and define each:

- Knowledge focuses on understanding of concepts from a theoretical perspective.
- Skills are the practical application of theoretical knowledge as expressed via capabilities or proficiencies that come from training or hands-on experience.
- Abilities are talents that a person can use for a task or situation.

The certification requires candidates to have taken certain training, but also to demonstrate experience, knowledge, and leadership. The curriculum is not shared and resides in a member-only portal.

Finally, Kansas Center for Agricultural Resources and the Environment (KCARE) offers an agriculture sector focused assistance program on watershed issues. The [Watershed Research and Implementation Partnership](#) focuses on restoring and protecting Kansas' impaired agricultural watersheds through science-based and stakeholder-driven sustainable environmental stewardship and best management practices (BMPs). The program is interdisciplinary and provides producers and landowners with outreach, financial assistance, and the most current research on watershed modeling, economic analysis, GIS mapping, and agricultural technologies.

Related to watershed management with some common elements, some universities support programs in water resources management with more of a technical focus for professionals. For instance, McGill University offers an 8-Week Online [Integrated Water Resources Management Course](#) that is available globally to engineers, biologists, development workers, communication and advocacy specialists, government workers, and policy analysts, as well as people looking to change career direction or explore their interest in water resources management. Topics include principles of integrated water resources management; water resources planning; developing a watershed management plan; history and principles of adaptive management; adaptive capacity and governance; social learning; water law, policy and ethics; and water risks for business. The course consists of modules and chapters from an e-textbook written specifically for the course. Following course completion, attendees receive a certificate of completion from the Department of Bioresource Engineering, McGill University.

[University and Graduate Courses, Certificates, Concentrations, Minors, Majors](#)

University of Maryland Global Campus [Watershed Management](#) is a hybrid delivery undergraduate certificate for six courses/18 credits. The certificate is advertised for its insights, tools, and knowledge about watershed management, including protecting water quality and aquatic ecosystems, preventing water pollution, decreasing flood risk, and minimizing other human and environmental health impacts related to polluted runoff.

The curriculum design focuses on management of watersheds to reduce the impact of land development, industrial processes, and everyday human activities. It includes geospatial analyses and the biophysical and social impacts of human activities on watersheds, with applied learning via collaborative and community-based approaches to reduce stormwater impacts on watersheds. The six courses include:

- Environmental Systems (3 Credits, ENHS 300)
- Environmental Health and Safety Regulations (3 Credits, ENHS 305)
- Environmental Technology and Control (3 Credits, ENHS 340)
- Introduction to Geographic Information Systems (3 Credits, ENHS 350)
- Introduction to Watershed Management (3 Credits, ENHS 360)
- Pollution Prevention Strategies (3 Credits, ENHS 405)

The intent is that graduates would be prepared for careers with local, state, and federal government; industry; consulting; and nongovernmental organizations implementing watershed and stormwater management programs.

[North Dakota Water Resources Research Institute](#) at North Dakota State University offers an interdisciplinary [Water Resources Certificate Program](#) that is a 12-credit program for undergraduates in their junior and senior years. The curriculum includes courses from three categories: hydrology fundamentals, soil and water contaminants management, and technological advances in water management. The certificate prepares students to enter careers in hydrology and water resources management.

Colorado State University offers a [Watershed Science and Sustainability major](#) that provides the foundational and specialized knowledge and experience to address modern water issues with careers in state/federal service, municipal and utility water resource management, conservation, and environmental consulting.

Two state polytechnic institutes offer watershed management options. Virginia Tech offers a [Watershed Management Graduate Certificate](#) that integrates existing programs and courses from five colleges and ten departments at Virginia Tech to provide an interdisciplinary and substantive understanding of watershed science, policy, and decision-making. An oversight committee of the faculty from participating colleges and departments administers this program while the Graduate School will have responsibility for issuing certificates to the students. The selection of [courses](#) depend on whether degree or non-degree seeking, but in general, degree conferral requires:

- Watershed Management with a planning emphasis (UAP 5134G Land Use and Environment: Planning and Policy or UAP/NR 5414 Natural Resources Planning), which is an interdisciplinary course in applied environmental science, planning, and policy, focusing on the use of the land, its effects on water and ecological resources, and methods of land analysis and management to mitigate those impacts. This core course emphasizes the major areas of watershed management with special emphasis on planning and policy.
- A course from the Watershed Science concentration area
- Two courses from the Watershed Analysis concentration area.

Cal Poly San Luis Obispo's [Watershed Management and Hydrology Concentration - Environmental Management and Protection](#) provides a [broad variety of hydrologic sub-disciplines](#) including vadose zone hydrology, groundwater hydrology, soil erosion control,

water quality and watershed management. The concentration enables students to apply for water-related positions at federal and state agencies, private companies and environmental consulting firms.

The University of Delaware Water Resources Center (WRRI) offers a Regional Watershed Management course that explores public policies and practices of watershed management by examining case studies in water supply, water quality, drought, floodplain, and stormwater management. The UDWRC also offers graduate assistantships and undergraduate internships. The Institute for Public Administration (IPA) in the Biden School of Public Policy & Administration administer the undergraduate internships and these are open to undergraduates enrolled at University of Delaware, Delaware State University, or Delaware Technical and Community College.

[Community College Programs](#)

[California](#)

Across California's community colleges, some watershed management options exist for students. The [Yuba Community College Field Technician – Watershed Management](#) program that provides students with the concepts, methods, and applications of field work in watershed management and hydrology (e.g., the conservation of floodplains, invasive species, river restoration/bank stabilization and limiting nonpoint source pollutants). Skills include quality sample collection, data retrieval from stream gages, and surveying, by using standard fieldwork methods, and GIS field applications to collect, store and interpret data. Of note is that Yuba College's offerings are a result of a Community Impact Grant of \$700,000 from the [Yuba Water Agency](#) in 2021. The five-year funding enabled the development of a Watershed Management Program needed for the workforce in the greater Sacramento region related to watershed resilience and economic development. As of the third year of the grant collaboration, Yuba College has implemented summer internships for students, and all classes required to complete the watershed management certificates were in place as of the fall 2024 semester.

Yuba College added a fourth certificate was recently approved by the regional career-technical organization, the North Far North regional consortium, for a [Watershed Resilience and Forest Management certificate](#). The certificate at Yuba College provides students with a blend of environmental science, GIS technology, and public safety skills to prepare for careers in natural resource management and conservation, such as developing strategies to reduce risks of wildfires and watershed degradation. The proximity of Yuba College may suggest a potential avenue for CIWR via collaboration and or/partnerships, particularly in relation to tying the degree to career pathways as Cuyamaca College has done.

In terms of courses, [Santa Rosa Community College Forest Hydrology and Watershed Management course](#) provides an introduction to forest and wildland hydrology, and the management of resources on a watershed scale (e.g., fundamental concepts of the hydrologic cycle: precipitation, interception, evaporation, evapotranspiration and runoff, infiltration, and

groundwater; and fundamentals of protection, management, and monitoring watersheds in California). Shasta College offers technician-level training in [Natural Resources](#) that includes two watershed courses: Watershed Management and Ecology and Watershed Restoration Practicum. The first emphasizes issues in California, including the hydrologic cycle, water quality, water use and conservation, and watershed health and function that requires a watershed restoration project with planning and implementation. The second course, the practicum provides a hands-on approach to ecosystem management, erosion control, sediment control, and stream restoration. Finally, the [College of the Redwoods Intro Watershed Management](#) course provides an introduction to hydrology and the science of managing watersheds, including atmospheric inputs, run-off and erosion, storm-flow components, evapotranspiration impacts and groundwater use. The course also includes field exercises that focus on evaluation and measurement of water resources.

In contrast, several colleges in the state focus more on water resources and are not as germane to the watershed management perspective of California Water Works. For example, Cuyamaca College' offers both a [Water Resources Management Associate in Science degree and a Certificate of Achievement](#). The major focuses on the design, implementation, and evaluation of water conservation/water resources management program, emerging technologies, and methods for long-term sustainability of water and wastewater resources. Consequently, Cuyamaca College is more interested in tracking students to jobs and career pathways that are wastewater related. The curriculum's core major requirements qualify the student to take the American Water Works Association's Water Use Efficiency Practitioner certification examination, the Landscape Water Management certification offered by the California Landscape Contractor's Association, and the Certified Landscape Water Manager certification offered by the Irrigation Association. Beyond preparing students for entry level jobs in the water and wastewater field, courses in this major prepare students to transfer to a four-year college or university degree programs, including Water Resources, Environmental Sciences, and Natural Resources Management. The learning outcomes include:

- Describe the essential uses of water, the infrastructure that has been developed to meet demand, and the problems the water industry faces.
- Identify a specified number of legal and financial constraints which complicate efficient and effective water resource management.
- Explain the concept and importance of water portfolio diversification.
- Describe the political/organizational structures and list the major agencies involved in providing water in the greater San Diego region.
- Compare and contrast the sources of wastewater, the major collection/transportation networks, and the major wastewater treatment/reclamation facilities operating in San Diego County.
- Identify the major regulatory agencies that monitor and regulate the water/wastewater industry.
- Explain how the current carbon footprint of the water and wastewater infrastructure significantly impacts California's energy and power demands.

- Compare and contrast a specified number of resource recovery/alternative treatment methods.

Finally, a prior yet unique high school water education program in California was “Agua University.” It is interactive and accessible to teens with a limited science education. The program prides itself on not using the terms “watershed and watershed management” and instead creates ways that graduates understand what a watershed is and how the stress on it needs to be reduced through efforts that the program covers. In addition to the regular program, students attend a two-week camping tour of urban California’s water sources: Yosemite, Owens Valley, the California Delta. Agua University was Miguel Luna’s idea. He continued to build the program using a \$65,000 grant from Metabolic Studios, a philanthropic organization devoted to science-based restoration. The funds helped launch the Urban Stream Corps in partnership with the Los Angeles Conservation Corps, which trains water analysts and connects to work positions with the state and county.²⁷

Outside of California

A Wyoming community college, Laramie County Community College, offers a [Rangeland Ecology and Watershed Management Program](#) that equips students with skills in plant/crop, soil and livestock management as well as preservation and use of natural resources.

Queens University, Ontario, Canada offered MOOCS in the past: [Watershed Systems and Their Influence on Water Movement and Quality](#) and [Modelling Watershed Processes for Water Resource Management](#). Both offered a fee-based certificate. Queens also has an multi-tiered education program, [LEADERS-CREATE: Program for Leaders in Water and Watershed Sustainability](#), that is interdisciplinary and funded by Natural Sciences and Engineering Research Council of Canada (NSERC), Canada's federal funding agency for university-based research and student training. In addition to training courses, workshops, and conferences, the program integrates faculty, graduate students, and post-docs who work on single-discipline projects with undergraduate students serving as research assistants.

The University of British Columbia, Canada has offered watershed education for over 25 years and provides lessons to the development of watershed programs, particularly given its relative distance from California. In the late 1990s, UBC began delivering graduate level courses in Watershed Management via distance learning course for a certificate. The curriculum consisted of five graduate level courses that could be taken for professional credit or for graduate credit, including Integrated Watershed Management, Urban Watershed Management, Agricultural Watershed Management, Water in International Development, and Groundwater Hydrology.²⁸

In 2016, UBC grew the program into a 12-month Masters in Engineering Leadership in Integrated Water Management aimed at water management sectors engineers and technical leaders, and thus less related to California Water Works perspective of watershed

²⁷ Judith Lewis Mernit, “A Bucket, a Beaker and a Job,” *High Country News* January 21 (2013): 6–7.

²⁸ Hans Schreier et al., *Distance Education in Watershed Management: Linking Graduate Students with Professionals*, 4, no. 5 (2025): 24–27.

management. The program blended advanced technical courses and strategic business education—water treatment technologies, regulatory frameworks, water and wastewater management strategies, environmental fluid mechanics, and engineering hydrology, business strategy, innovation, operations, project management, leadership, and a final capstone project. The program reports that 71% of the graduates were promoted, and 78% successfully transitioned into new career paths within engineering, architecture, and urban planning. However, as January 2025, the program is paused and not accepting applications to evaluate its future direction and relevance in the evolving field of water management.

This suggests that the needs of the water management industries are changing and may be lever that is an option for CIWR to pull as it designs its watershed management offerings. For example:

- There are trends suggesting that decentralized water and wastewater treatment are growing, where providers define their business model as “water treatment as a service” (or service-centric) versus asset-centric commodification. Service-centric management uses water systems levels to guide strategic business planning.²⁹
- The current water landscape likely needs to focus on equitable access and sustainability.
- Climate change is making sensors for water efficiency and mathematical modeling for demand more important, and new additional services like efficient energy consumption tools will likely be growing a line of business in this era.
- The separation of customer management, network and infrastructure management, and ownership are leading to the implementation of technology to connect to customers.³⁰

3.2. *Watershed Management Program Funding*

Funding for watershed programs differs for across programs. The above listed programs are offerings of extensions, universities, and non-profit water-related organizations. These entities receive funding from federal and state government agencies, university and extension programs, water-related partnerships, and non-profits and foundations interested in water issues. For example, in the review of the above programs, these were the most common:

- federal funding from the Clean Water Act Section 319(h) for nonpoint source pollution program, National Oceanic and Atmospheric Administration;
- state funding from a related practice area agency, like agriculture, soil and water conservation districts, pollution, water resources, natural resources, California Volunteers;
- extension and university and university to university partnerships, like University of Illinois and Purdue University;

²⁹ Martin Jones et al., “The Evolution of Asset Management in the Water Industry,” *Journal AWWA* 106, no. 8 (2014): 140–48, <https://doi.org/10.5942/jawwa.2014.106.0114>.

³⁰ Jaime Barba Sevillano, “A Look into the Future of the Water Industry,” Text, *Smart Water Magazine*, Smart Water Magazine, December 28, 2021, <https://smartwatermagazine.com/blogs/jaime-barba-sevillano/a-look-future-water-industry>.

- non-profit and foundation grants, like Sea Grant in many states, water-related member associations, rotary, Kiwanis, community foundations, fisheries, and AmeriCorp.

Auburn University Water Resources Center/WRRI, Alabama Cooperative Extension System Water Program in partnership with Alabama Water Watch and various local partners are responsible for the activities for the [Alabama Watershed Stewards](#). The program is funded by the Alabama Department of Environmental Management through a Clean Water Act Section 319(h) nonpoint source grant provided by the U.S. Environmental Protection Agency – Region 4.

Michigan WRRI receives funding for its [Michigan Watershed Management Certificate](#) for professionals from the Michigan Water Environment Association.

Minnesota WRRI supports the [Michigan Watershed Specialist Training Program](#) with funding is from participant fees and in-kind support from partners including: University of Minnesota faculty and staff, Minnesota Pollution Control Agency, Minnesota Department of Agriculture, Minnesota Board of Soil and Water Resources, Minnesota Department of Natural Resources, Minnesota Association of Soil and Water Conservation Districts and member SWCDs, Minnesota Association of Watershed Districts and member WDs. Finally, the development and delivery of the first two sessions were funded primarily by the Clean Water Act Section 319 Nonpoint Program.

North Carolina's stewardship network, [NC Watershed Stewardship Network \(NCWSN\)](#), resides at the WRRI with support from NC Sea Grant, NC Division of Water Resources (NCDWR) and volunteers who step up to provide support to water stewards through team projects. The WRRI and NCDWR collaborate to coordinate the NCWSN efforts.

[Texas Watershed Steward](#) program is a partnership between Texas A&M Agrilife Extension in partnership with the Texas State Soil and Water Conservation Board (TSSWCB), and the funding comes from the Clean Water Act §319(h) nonpoint source grant from the TSSWCB and the U.S. Environmental Protection Agency (EPA).

The [Illinois-Indiana Master Watershed Steward Program](#) is available state-wide in Illinois and Indiana as a collaboration between Illinois-Indiana Sea Grant, University of Illinois, Purdue University, the National Oceanic and Atmospheric Administration, and other partners.

The [Maryland Watershed Stewards Academies](#) receive support from the Maryland Sea Grant.

Tip of the Mitt Watershed Council in Northern Michigan has a [Watershed Academy and Stewards](#) program and the [Water Resources Education Program \(WREP\)](#) that receives support from:

- Petoskey-Harbor Springs Area Community Foundation
- Ian and Sally Bund
- Ham Schirmer
- Lake Charlevoix Association

- Kiwanis Club of Charlevoix
- Rotary Club of Charlevoix
- Great Lakes Fisheries Trust
- Tip of the Mitt Watershed Council

University of Arkansas's stewardship, [Arkansas Watershed Steward Program](#), and leadership training program for farmers ([Tap Your Potential: A Training to Grow Farmer Leadership in Watershed Management](#)) receive funding from the United States Environmental Protection Agency and Arkansas Natural Resources Division.

The [California Conservation Corps Watershed Stewards Program \(WSP\)](#) funding comes from the CCC, CDFW Fisheries Restoration Grant Program, AmeriCorps, and California Volunteers grants, Placement Site Partner Match (the location for the primary activities).



4. Links to Career Pathways, Advancement, and Job Opportunities

College and graduate programs as well as nonprofit and professional organizations provide information on career pathways and job opportunities. Related research indicates that more could be done; a 2009 survey of Missouri Master Naturalist Program graduates serving as volunteers found that preparation for a new career was a strong motivation to complete the program.³¹

A career pathway is a workforce development model that is a structured plan or roadmap that outlines the education, training, and experience required to progress through a series of jobs or roles within a specific field or industry. “Pathways are intended to link high school, post-secondary education, and employers into a seamless system that will enable young people to develop the skills they need to gain valuable experience and move into productive careers.”³² Unlike water and wastewater operations, watershed management careers seem to have less educational presence, whether at the primary, secondary, or technical college levels or in undergraduate and graduate settings. Although partially due to the complexity of water resource management and its interdisciplinary/multi-disciplinary skill set, the need for water savvy individuals is key to the climate-change and water-scarce future.

4.1. *Where are watershed jobs? Definitions and Practice Areas*

Just like preparation for watershed management and water resource jobs entails the need for multidisciplinary training to understand the nuance, the practice areas for these jobs are also diverse, falling within the fields of agriculture, natural resources, communication, social sciences and economics, public health, and planning and project management. For example, Kane et al of the Brookings Institution examined the water workforce using a methodology and

³¹ Caroline N Broun et al., “An Evaluation of the Missouri Master Naturalist Program and Implications for Program Expansion,” *The Journal of Extension* 47, no. 3 (2009): Article 5.

³² Sunil K. Sinha et al., “Smart One Water: An Integrated Approach for the Next Generation of Sustainable and Resilient Water Systems,” in *Oxford Research Encyclopedia of Environmental Science*, by Sunil K. Sinha et al. (Oxford University Press, 2023), <https://doi.org/10.1093/acrefore/9780199389414.013.835>.

data definition that combined watershed management with water operations. Their working definition stated that water jobs were:

Jobs directly involved in the construction, operation, design, and governance of water infrastructure systems nationally, including drinking water, wastewater, stormwater, and green infrastructure. These positions span the public and private sector and involve oversight, maintenance, and financial and administrative support, including involvement in managing several closely-related physical assets, such as pipes and septic systems.³³

In 2015 Canada's Environmental Careers Organization (ECO) Canada conducted a survey focused on *Careers in Water Quality*. The result indicated that the "water quality job market is shifting to higher educational requirements. Nearly 75% of new job openings in water quality require a bachelor's degree. However, only 25% of the water quality labour force has one."³⁴ It also examined future trends and found that demand for water quality professionals is increasing, particularly for chemists, hydrogeologists, green building professionals, water utility engineers and environmental engineers.

Their analysis showed that water quality jobs involve eight broad practice areas:

- Integrated water resources and watershed management.
- Protection of groundwater from contamination.
- Protection of surface water.
- Marine water quality.
- Aquaculture and food processing.
- Municipal water systems, including water treatment, water distribution, wastewater treatment and wastewater collection.
- Green building.
- Water quality education, communication, policy and planning.

Focusing on watershed education within the career pathways model, a helpful resource is the [Wisconsin Department of Public Education's Career Clusters and Pathways](#) documentation of the knowledge and skills for the Agriculture, Food, and Natural Resources cluster's associated pathway of [Environmental Service Systems](#). The Knowledge and Skill statements for environmental service systems drill down the essential topics and mention watershed management.³⁵ For example:

- Apply scientific principles to the study of environmental service systems in order to facilitate development of solutions to environmental issues, problems and applications.
- Discuss properties, classifications, functions and principles for managing watersheds.

³³ Joseph Kane and Adie Tomer, *Renewing the Water Workforce: Improving Water Infrastructure and Creating a Pipeline to Opportunity* (Metropolitan Policy Program, Brookings Institution, 2018), 60–61.

³⁴ Jennifer Schultz, "Water Career Trends and Growth Very Promising," *Environmental Science and Engineering Magazine*, April 24, 2015, <https://esemag.com/water/water-career/>.

³⁵ States' Career Clusters Initiative, "Agriculture, Food and Natural Resources Cluster Environmental Service Systems Pathway Knowledge and Skill Statements," 2008, 24, https://dpi.wi.gov/sites/default/files/imce/pathways-wisconsin/2023_03_KS-CareerPathway-AG-EnvironmentalService-2008.pdf.

- Sample Indicators: Identify properties of watersheds. Explain watershed management. Delineate watersheds.³⁶

4.2. Career Options

The Water Replenishment District (WRD), one of the largest water management agencies (by population) in the state of California with a mission focused on managing and recharging groundwater resources, highlights [water career pathways](#) alongside salaries for water treatment operators. In addition, WRD identifies eight mission critical water and wastewater careers pathways, which include general maintenance to technical positions, such as calibration, electrical, machinists, mechanics, and engineers. Another highlighted pathway is for water use efficiency practitioners. WRD suggests high school class curricula and area community college courses for each of these water career pathways and provides videos of individuals in positions such as operator analysts, managers, hydrogeologists, GIS analysts, water resources engineers, and government affairs. Finally, WRD provides a range of [water and resource recovery career salaries](#).

In addition to water districts with operator careers, other common employers associated with watershed management education and training are positions in government agencies, consulting firms, and non-profit organizations (e.g., watershed coordinators for [Central Santa Monica Bay Watershed Area](#)). General jobs and careers mentioned are watershed managers, hydrologists, and environmental scientists. More specifically, the Bureau of Labor Statistics associates watershed knowledge and skills with environmental scientist/specialists, conservation scientist/forester, urban/regional planners, hydrologist.

A few of the colleges and universities with programs discussed above lay out career lists that are similar, with the addition of:

- | | |
|--|--|
| • Hydrologic Technician | • Environmental Compliance Inspectors |
| • Water Quality Analyst | • Forest and Conservation Technicians |
| • Watershed Biologist/Scientist | • Outreach and public information |
| • Aquatic Ecologist | • Community education |
| • Environmental Consultant | • Landscape design |
| • Watershed Resource Specialist, Manager, or Coordinator | • Landscape and facilities maintenance |
| • Water Conservation Technician | • Irrigation system design |
| • Soil and Plant Scientists | • Urban water management |
| • Conservation Scientists | |

³⁶ States' Career Clusters Initiative, "Agriculture, Food and Natural Resources Cluster Environmental Service Systems Pathway Knowledge and Skill Statements," 24.

Watershed Job Quality and Compensation

The above profiles and discussion of job opportunities and career pathways for workforce development mirror the lack of robust watershed management education and training in comparison to that for technical training of professionals in the water and wastewater sectors. Consequently, data on job quality and compensation are also limited when trying to profile the interdisciplinary, multi-sector and field watershed job and career.

A 2015 survey from Canada's Environmental Careers Organization (ECO) Canada on *Careers in Water Quality* reported on career pathways and salaries.³⁷ In terms of pathways, water resources engineers, water quality scientists, and professionals in water quality communications, education, policy and planning often require a bachelor's degree compared to water quality technicians that may only be a three-year diploma. Job changes are often lateral moves to different types of employers. In comparison, engineers, water systems operators, and green building professionals tend to be able to experience a more vertical career pathway from entry level to senior level positions, including progressive management roles.

The Canadian survey's now-dated salary data indicated that earnings for water quality workers have significant variation due to different types of employers and practice areas. For example, workers in mining, oil and gas, and environmental consulting obtain higher salaries while those working for governments, conservation organizations, watershed management organizations and other NGOs receive less. The practice area also influenced salary. Although

OCCUPATION CATEGORY	STARTING SALARY RANGES			AVERAGE EARNINGS WITH 5 YEARS EXPERIENCE		
	LOW	MEAN	MAX	LOW	MEAN	MAX
Watershed Officer	40,000	63,485	90,000	60,000	81,729	120,000
Biologist, Ecologist	29,000	48,365	75,000	35,000	83,163	115,000
Agronomist, Soil Scientists, and Forester	26,000	53,154	90,000	64,800	89,542	150,000
Chemist (Water Quality)	27,000	46,333	65,000	40,000	70,833	100,000
Hydrogeologist	40,000	74,100	120,000	80,000	114,800	160,000
Communication, Education, Policy, Planning Occupations	20,000	53,019	95,000	35,000	68,575	150,000
Environmental Health and Safety Professional (Water Quality Focus)	40,000	65,111	90,000	60,000	86,000	105,000
Water Quality Technicians (Monitoring, Sampling, Lab Analysis)	26,000	42,095	69,000	37,000	63,588	120,000
Water Quality Modeller	n.a.	50,000	n.a.	n.a.	85,000	n.a.
GIS Analyst	49,000	55,333	65,000	74,000	87,667	104,000
Green Building Professional	35,000	46,000	55,000	50,000	85,286	180,000
Water Quality / Environmental Engineer (in Resource Development)	29,000	55,606	n.a.	35,000	88,000	150,000
Water Resources Engineer	42,500	55,551	80,000	48,000	69,273	96,000
Utility Engineer	42,500	57,583	100,000	55,000	86,813	127,000
Municipal Water Systems Operators	40,000	56,327	70,000	50,000	78,895	105,000
Water Well Driller & Pump Installer	54,944	62,486	70,000	64,640	108,660	145,000
All Core WQ Occupations	10,000	57,030	150,000	20,000	88,785	400,000

the average starting salary for water quality jobs was \$55,284, the average for a hydrogeologist was \$74,100, and a watershed officer was not only less at \$63,485 but also with much less salary growth potential with five years of experience (28% versus 55%). The table from the article below provides occupation categories for comparison.

Table 2. Table 2 Canada on Careers in Water Quality Salaries. Source: Schultz, "Water Career Trends and Growth Very Promising."

In older data from the U.S. Bureau of Labor Statistics, Hamilton identified five primary water career categories:

³⁷ Schultz, "Water Career Trends and Growth Very Promising."

- Engineering occupations, such as agricultural engineers, civil engineers, environmental engineers, industrial engineers, and mining and geological engineers.
- Planning and outreach occupations, such as urban and regional planners, operations research analysts, landscape architects and public relations specialists.
- Construction occupations, such as construction managers, laborers, equipment operators, pipelayers, plumbers, pipefitters, steamfitters, septic tank servicers and sewer pipe cleaners.
- Agriculture and grounds maintenance positions, such as farmers, ranchers, agriculture equipment operators, farm and nursery workers, landscaping and grounds keeping workers.
- Water operations occupations, such as water and wastewater treatment plant and system operators, and pump operators.³⁸

The research on salaries is also consistent with the more recent Canadian study referenced above and similarly notes that salaries highly variable and based on location and job function. For example, across all types of water resource-related positions and sectors, the U.S. median salary is around \$35,000, yet the median pay range for Microbiologists, Conservation Scientists, Chemists, Environmental Scientists, and Hydrologists is \$61,100 to \$75,530. Engineering Specialists earn salaries in a higher range of \$74,000-\$84,320.

To provide context to the older data from Canada, the University of Wisconsin-Green Bay reported [salary estimates for water science careers](#). According to the U.S. Department of Labor, through 2030, national job growth for environmental protection technicians will be 6%. Michigan State University Online watershed management certificate also suggests possible pathways and salaries to recruit students.

Table 3. Career Pathways and Potential Earnings for Watershed Management Students

Target Occupation	National Median Salary (USD)
Zoologists and Wildlife Biologists	\$70,595
Conservation Scientists	\$67,667
Fish and Game Wardens	\$60,731
Project Management Specialists	\$98,571
Natural Sciences Managers	\$157,747
Environmental Engineers	\$100,090
Civil Engineers	\$95,888
Architectural and Engineering Managers	\$165,360

In 2021, as part of Valley Vision's support of the Strong Workforce Program (SWP), they convened the Agriculture, Water, and Environmental Technologies (AgWET) industry Regional Advisory meeting on the topic of water conservation. The advisories seek to build relationships

³⁸ James Hamilton, *Careers in Water Conservation*, Green Jobs (Bureau of Labor Statistics, 2013), https://www.bls.gov/green/water_conservation/water_conservation.pdf.

among employers, educators, and the workforce, and this effort is in partnership with the Los Rios Community College District, Lake Tahoe Community College, Sierra College, and Yuba Community College District. The Los Rios Center of Excellence for Labor Market Research profiled a series of workforce data on watershed management occupations, indicating occupations and associated education, experience, and training.

Table 4. Watershed Management Occupations, Education, Experience, and Training

OCCUPATION	TYPICAL ENTRY-LEVEL EDUCATION	WORK EXPERIENCE REQUIRED	TYPICAL ON-THE-JOB TRAINING
Natural Science Managers*	Bachelor's degree	Five years +	None
Environmental Engineering Technologists and Technicians	Associate's degree	None	None
Conservation Scientists	Bachelor's degree	None	None
Environmental Scientists and Specialists, Including Health**	Bachelor's degree	None	None
Hydrologists	Bachelor's degree	None	None
Environmental Science and Protection Technicians, Including Health	Associate's degree	None	None
Hydrologic Technicians	Associate's degree	None	Moderate-term
* Natural Science Managers includes environmental science managers. ** Includes professionals focused on environmental health.			

Source: Adapted from Valley Vision, Agriculture & Natural Resources Regional Advisory Meeting Proceeding (2021), based on Emsi 2021.1; QCEW Employees, Non-QCEW Employees, and Self-Employed; North (Greater Sacramento) region--El Dorado, Nevada, Placer, Sacramento, Sutter, Yolo, and Yuba.

For the Greater Sacramento area, the following figure showed 3% forecasted growth in these occupations from 2019 – 2024, and associated wages for these occupations were all above the living wage and higher for those requiring bachelor's degrees (natural science managers including water resource specialists, conservation scientists, environmental scientists and specialists including health and restoration planners, and hydrologists).

Table 5. Watershed Management Occupations, Greater Sacramento, 2019 – 2024

Occupation	2019 Jobs	2024 Jobs	2019–2024 Projected Change	2019–2024 Projected % Change	2019–2024 Average Annual Job Openings
Natural Science Managers*	537	558	21	4%	38
Environmental Engineering Technologists and Technicians	159	172	13	8%	16
Conservation Scientists	285	296	11	4%	27
Environmental Scientists and Specialists, Including Health**	2,957	3,036	79	3%	276
Hydrologists	179	182	3	2%	17
Environmental Science and Protection Technicians, Including Health	587	612	25	4%	71
Hydrologic Technicians	104	109	5	5%	10
North (Greater Sacramento)	4,808	4,965	157	3%	455

Notes: * includes water resource specialists; ** includes environmental restoration planners

Source: Adapted from Valley Vision, Agriculture & Natural Resources Regional Advisory Meeting Proceeding (2021), based on Emsi 2021.1; QCEW Employees, Non-QCEW Employees, and Self-Employed; North (Greater Sacramento) region--El Dorado, Nevada, Placer, Sacramento, Sutter, Yolo, and Yuba.

Hourly Wage Ranges by Occupation

Low, median, and high hourly wages in the Greater Sacramento region

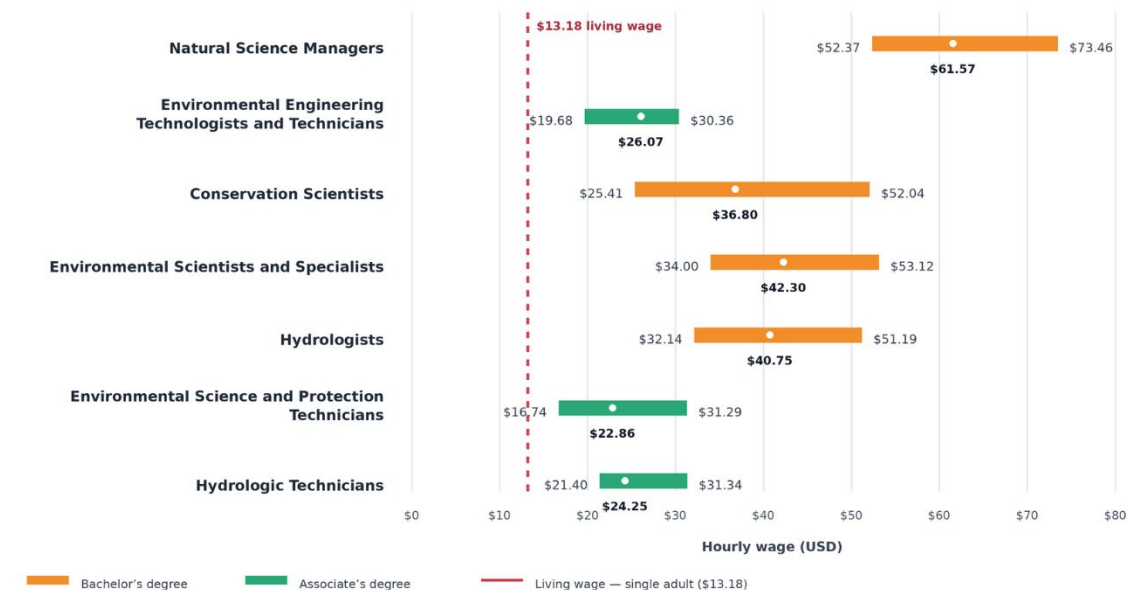
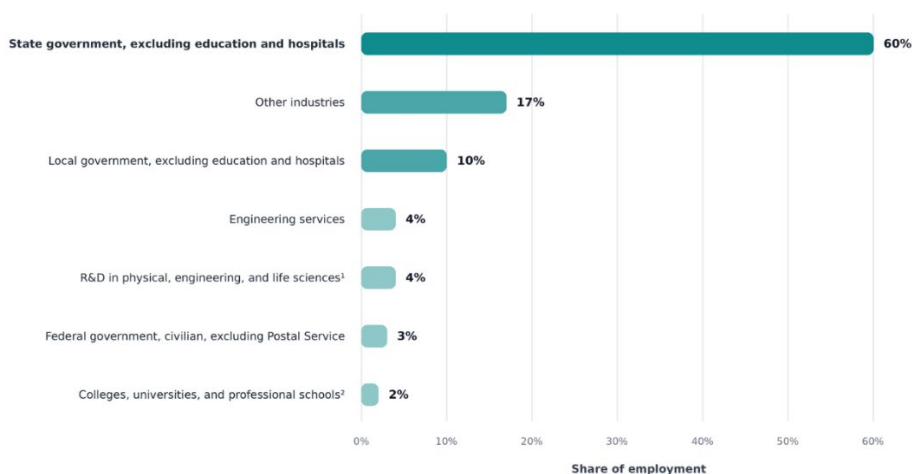


Figure 6. Watershed Management Occupational Wages, Greater Sacramento, 2019. Source: Adapted from Valley Vision, Agriculture & Natural Resources Regional Advisory Meeting Proceeding (2021), based on Emsi 2021.1; QCEW Employees, Non-QCEW Employees, and Self-Employed; North (Greater Sacramento) region--El Dorado, Nevada, Placer, Sacramento, Sutter, Yolo, and Yuba.

Finally, the data on 2020 staffing patterns for bachelor's level and middle skill occupations in Greater Sacramento show the distribution of a specific occupation across different industries. State government accounts for 60% of both of these skill levels.

Where Bachelor's-Level Watershed Management Jobs Are Concentrated

Greater Sacramento region, 2020

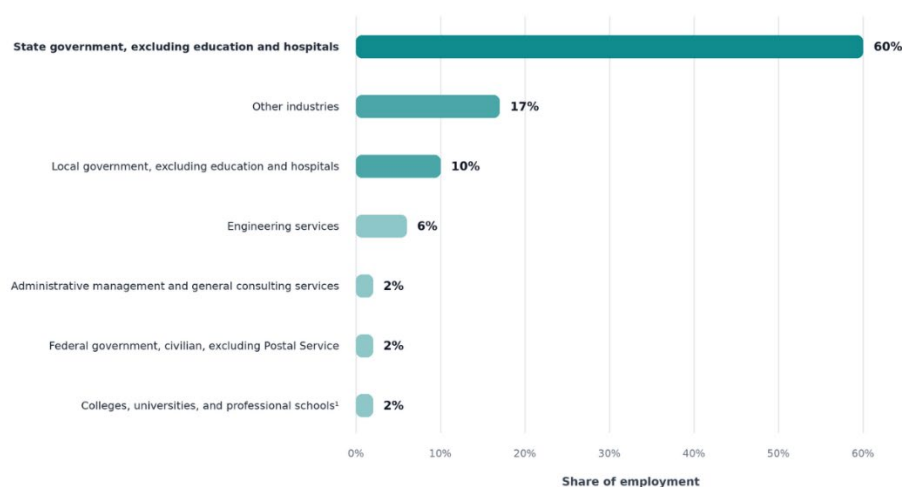


¹ Excludes nanotechnology and biotechnology. ² State government.
Source: Emsi 2021.3; QCEW Employees, Non-QCEW Employees, and Self-Employed.

Figure 7. Watershed Management Staffing Patterns for Bachelor's Level Occupations, Greater Sacramento, 2020. Source: Adapted from Valley Vision, Agriculture & Natural Resources Regional Advisory Meeting Proceeding (2021), based on Emsi 2021.3; QCEW Employees, Non-QCEW Employees, and Self-Employed; North (Greater Sacramento) region--El Dorado, Nevada, Placer, Sacramento, Sutter, Yolo, and Yuba.

Where Middle-Skill Watershed Management Jobs Are Concentrated

Greater Sacramento region, 2020



¹ State government. Percentages may not total 100% because of rounding.
Source: Emsi 2021.3; QCEW Employees, Non-QCEW Employees, and Self-Employed.

Figure 8. Watershed Management Staffing Patterns for Middle Skill Occupations, Greater Sacramento, 2020. Source: Adapted from Valley Vision, Agriculture & Natural Resources Regional Advisory Meeting Proceeding (2021), based on Emsi 2021.3; QCEW Employees, Non-QCEW Employees, and Self-Employed; North (Greater Sacramento) region--El Dorado, Nevada, Placer, Sacramento, Sutter, Yolo, and Yuba.

An additional search for positions in California provides a few recent comparisons and illustrates the range found in the above workforce data. [Contra Costa County's job descriptions for a Watershed Management Planning Specialist](#) reports that the salary band ranges from \$90,328.52 - \$109,794.86 but requires 3 years of experience or a Masters degree. A non-profit, Yuba River Citizens League, recently advertised for a full-time, non-exempt, and temporary [Forest Restoration Field Technician - Nevada City](#) at \$21 per hour.

To directly examine the watershed labor market, we conducted a more comprehensive workforce analysis using jobs postings from Lightcast between May 2024 and April 2025. A preliminary real time LMI (jobs postings) analysis suggests that for positions that use "Watershed Management" as a skill criterion in the last 12 months in California indicated that there were 198 unique jobs postings, which was a +91% increase from the previous year. The top job titles were Forestry Technicians; Water Resource Engineers; Stormwater Engineers; Watershed Specialists; Wildland Firefighters, Civil Engineers, Foresters, Environmental Scientists. For these 198 postings, the median advertised salary was \$35.82 per hour, and the salary at the 90th percentile of \$73.72 per hour.

To broaden the scope, a similar analysis searched for jobs postings that included additional skill criteria, including Watershed Management, Stormwater Management, Hydrology, Water Quality, Water Resource Management, Erosions, Water Chemistry Analysis, Soil Contamination, Soil Management. This subsequent analysis generated 12,138 unique jobs postings in 9 skill categories, with a +4% increase in postings between May 2024 and April 2025. The top job titles were Civil Engineers, Environmental Health and Safety Managers and Specialists, Land Developers, Water Resource Engineers, Environmental Scientists and Specialists, Irrigation Technicians, Environmental Compliance Specialists. For these 12,138 postings, the median advertised salary was \$42.49 per hour, and the salary at the 90th percentile of \$72.22 per hour.

Using this preliminary analysis, we qualitatively ranked jobs postings data for job titles and skills as having "High," "Moderate," or "Potential" relevance to watershed management based on the results of the landscape program and literature reviews. The ranking process resulted in 40 Job titles and 128 Skills scoring "High" or "Moderate". We further reduced the skills to a subset of skills most specific to watershed management (n=87). With this reduced set of job titles and skills, we utilized jobs postings from Lightcast between May 2024 and April 2025 in California to find correlations that suggest the types of job titles and skills involved in the work (see Appendix B for full methodology). Appendix B includes tables illustrating the most common job titles and skills in the watershed management workforce jobs postings and top employers in California. A summary of the findings is below, with Appendix B providing more nuance.

- Most California job titles associated with watershed management are white collar STEM occupations requiring at least a bachelor's degree, with technician-level occupations accounting for approximately one-third of the watershed workforce. The data suggest that further data analysis would be beneficial to understand the

correlation between the watershed management-specific jobs postings and the wider related workforce to determine: 1) if only a few workers in closely-related fields focus on watershed management; and/or (2) if watershed management practices are not characterized as such in the jobs postings, and instead the practices are carried out among this range of professionals. See Appendix B for most common job titles.

- The watershed management-related workforce in California requires a range of skills in planning, business administration, natural resources and environmental management (including specialized water management topics), data analysis, engineering and design, fire science and management, forest management and firefighting, and regulatory and policy skills. See Appendix B for most common skills.
- Top employers of California watershed management jobs include the US Forest Service, US Department of Interior, and consulting firms. Additionally, the data suggest that most watershed-related employment is scattered across dozens of employers in California; there are few watershed-related jobs in most organizations; and as noted above in the skills finding, most watershed management-related work is not designated as such and occurs as an emergent layer in existing work where job responsibilities increase beyond listed skills. See Appendix B for most common types of employers.

Our preliminary job postings analysis and landscape analysis of existing programs provide a baseline to address two issues found in the landscape analysis. First, there is a lack of current published research analysis on watershed management jobs and career pathways for an individual interested in watershed development. Second, the lack of analysis parallels the dearth of watershed focused degree programs and certificates at community colleges and universities and even for the general public even in California. These two issues are interrelated. Community colleges are the primary medium for workforce development, and community colleges must vet new degree and certificate programs with labor market analysis to determine the expected student population for revenue generation purposes. The above analysis for Greater Sacramento serves as an example, as does the watershed workforce analysis in the Appendix B. For community colleges to invest in the development of new degree programs, there must be well-defined jobs and careers that graduates can obtain and/or transfer to a similar four-year program. Consequently, in the current climate, watershed management is more likely to be embedded within environmental science, land management, and or natural resource management programs, with those graduates working in a variety of fields like forestry and fisheries industries. There is also a limitation to the development of community college watershed non-degree programming because the degree-based career education reimbursement rate from state to college is greater when there is a clear labor market and students are more likely to transfer to four-year institutions than for non-degree credentials (credentials, microcredentials, certificates, badges, etc.).



5. Watershed Management Programs: Gaps and Opportunities

5.1. *Stewardship, University, Professional and Programs*

Steward programs are often short, one day, or online programs with easily consumable modules for self-learning (e.g., Alabama). Field work and hands-on learning are often part of short as well as longer programs. The topics typically include an overview of watershed systems, understanding the state of the watershed and impairments, and how to improve the watershed with best management practices (BMPs). Field work involves participants in actual watershed planning activities and testing. Stewardship programs are more likely to be for personal enhancement than tied to career development. The goals and objectives of stewardship programs tilt toward activism and volunteerism in the community.

In comparison, university courses are found in environmental science, natural resources, and/or land management and may or may not be interdisciplinary, and programs do attempt to attract students based on the translation of the knowledge gained through the above discussed courses, minors, majors and certificates to careers and job opportunities. However, these are often careers that demand degrees.

The North Central Water Collaborative purposefully created the [North Central Watershed Management Research and Outreach Undergraduate Internship Program](#) due to the lack of training for undergraduates and to address the complexity of water resource management and provide exposure to the multiple disciplines and skills for success (agriculture, natural resources, communication, social sciences and economics, public health, and planning and project management).

The reviewed professional-focused programs stress some of the basics, but content is germane to those that address policy and politics of water policy issues and delivers skills that help professionals, such as county board of supervisors or water resources directors, understand how to collaborate within the decision-making process. Koundinya's et al research survey of three Extension watershed leadership programs offered at The Ohio State, Michigan State, and Purdue Universities indicates this. They actually proposed the following list of skills "Core Competencies for Successful Watershed Management Practitioners":

- establishing and maintaining partnerships/collaborating;
- outreach and communication;
- project and organizational management;
- landowner interaction/interpersonal skills;
- facilitative leadership; and
- developing and maintaining a vision for the future.³⁹

5.2. Competency Framework Models

The opportunity to develop the California Water Works program would be to design the curriculum around fundamental competencies delivered via education and skills in traditional in-class and online courses with a focus on applied, field work. Models in related fields exist for such development.

As a first example, the F3 (Farms Food Future) Initiative supports California’s Central Valley agriculture industry through the development of new ag technology, regenerative farming practices, and training for quality jobs in the world’s food production capital. The effort to develop a pipeline of workers starts at community college, but rather than the traditional approach of an Associate of Arts degree followed by entering a 4-year engineering school, the effort focuses on competencies since many non-traditional students may find the traditional path’s pre-recommended courses challenging to complete. The following slide illustrates the Ag Systems Certificate Program and Core Competency and Performance Indicators. These were developed in partnership with a dozen local industries.

Table 6. The Ag Systems Certificate Competency and Performance Indicators

Core Competency	Performance Indicators	Core Competency	Performance Indicators
Digital Literacy	Identify/utilize technology (hardware and software) used in agriculture	Interpersonal Skills	
Basic Equipment Operation	Safely operate electronic and mechanical equipment used in agriculture	Animal Production Systems	Explain the fundamentals of animal systems
Basic Equipment Configuration	Safely set up electrical and mechanical equipment in agricultural tasks	Food Safety	Implement best practices to meet manufacturing, food safety, and sanitation requirements

³⁹ Koundinya et al., “Core Competencies for Successful Watershed Management Practitioners.”

Basic Equipment Troubleshooting	Troubleshoot basic electrical, mechanical, and software systems and communicate identified issues effectively	Basic Safety	Follow workplace safety protocols using Occupational Safety & Health Administration (OSHA) standards
General Agricultural Systems Fundamentals	Explain agriculture industry fundamentals	Industry Communication	Communicate effectively using industry methods within an organizational structure
Crop Production Systems	<i>Explain the fundamentals of plant science and crop production systems</i>	Applied Technical Writing	Write effective agricultural technical reports
Tool Operation	Safely use basic hand and power tools	Applied Technical Reading	Read and interpret agricultural industry documents.

Source: California CTE Regional Consortium, Design Team Faculty, "Agricultural Systems Certificate: Curriculum Information," August 2023, <https://regionalcte.org/lmi/1087-4909-20231117112921678746.pdf>.

Another applicable example of the development of competencies and a supporting network is the [Trail Skills Project](#), which is a shared community of practice website that serves as a workforce hub for the trail management community providing connections to trails education, trail expertise, professional development, and job opportunities. The goals of the Trail Skills Project align well with the inspiration behind the California Water Works initiative:

Promote workforce development of current and future trail professionals.

Advance [trails training opportunities](#) and development.

Provide increased opportunities to connect trail volunteers, stewards, agency staff, and professionals.

Define a pathway to a [career in trails](#) and inspire the next generation of trail professionals

Bolster the capacity of volunteers to meet stewardship needs.

The Projects effort started with the creation of [Trail Competency Framework](#), which serves as its foundation and provides:

Individual profiles use the [trail competencies](#) and skill level descriptions to self-identify individual expertise and gaps.

[Trails trainings](#) identify which elements of the [Trail Competency Framework](#) align with learning objectives.

Job descriptions can be generated and aligned with the [trail competencies](#)

Trail Competency Framework

47 competencies organized into six competency groups



Figure 9. Trail Skill Project Competency Framework. Source: Passo, M., Freeman, J., & Anderson, K. (2022, March 29). Developing a data-driven trail competency framework [Conference presentation]. 2022 Sustainable Trails Conference.

The framework outlines competencies for trail maintenance for different levels of trail workers—entry, full, and expert. Each level has a definition of KSAs, and performance for each level aligns with an identified competency. The framework can then guide the development of job descriptions for trail workers. For example, one trail competency is trail construction and addressing water management and drainage features, the framework provides the following:

Skill Definition: Construct drainage features that decrease erosion and increase sheet flow, including grade reversals, rolling grade dips, berms, ditches, and sheet drains.

Entry Level Performance:

- Demonstrate understanding of basic natural and stormwater induced drainage effects on trails.
- Construct all types of drainage features with supervision.

Full Performance Level:

- Understand the application of different drainage features for managing water volumes and velocities.

- Identify locations and the appropriate drainage feature.
- Construct the full suite of drainage features independently and/or with a team across multiple types of terrain, soil and ground conditions.

Expert Level Performance

- Implement a comprehensive drainage plan for a trail and/or trail system across numerous types of terrain, soil and ground conditions including difficult and challenging types.

An interested individual would then also find addition “Resources for Water Management/Drainage Features” such as documents and media, video trainings, and training programs. To fulfill its workforce development goal, it also lists how to find Trainers as well as workers.

The development of the framework utilized research and a subsequent survey of the individuals from BLM, NPS, USFS, state parks, private and nonprofit organizations, and local, county, higher education institutions to obtain [feedback on measures for each competency](#).

5.3. Developing a Competency Framework Under the California Water Works Initiative

The California Water Works Initiative has an opportunity to provide education and training that is lacking in accessibility across the state with delivery of well-sequenced content in modules that are purposefully tied to and focused on preparing participants for jobs and careers at different levels of expertise and abilities, e.g. public, entry, and experienced job levels. The goals and objectives of a Watershed Management Competency Framework would be to:

- Develop a common language
- Identify training gaps
- Design Training
- Describe job opportunities and evaluate applicants
- Identify Career Pathways in Watershed Management
- Professional Development Tool for Watershed Management workforce

The California Water Works Competency Framework represents a set of watershed management competencies that the landscape analysis and reviewed research indicate as the set of knowledge and expertise to work in the interdisciplinary and multidisciplinary field of watershed management. The Framework reflects the primary goals of watershed management, which is to support the science-based, sustainable, and equitable management of water, land, and ecosystems within a watershed. It also recognizes that this work is collaborative and engages local communities, agencies, and stakeholders. These technical and facilitative functions of watershed management integrate ecological knowledge, community engagement, policy frameworks, and monitoring tools to protect watershed health and ensure water security.

Of note is the [California Water Plan Update 2023 Resource Management Strategy](#) (RMS) that focused on three intersecting themes: addressing climate urgency, strengthening watershed resilience, and achieving equity in water management. [The Watershed Management topic](#) was one of the 11 updated RMSes and addresses competencies stating that:

Successful watershed management is reliant on a complex supply chain of interdependent social, scientific, economic, and capacity factors. Adding further complexity, each of these factors may present unique challenges based on the socio-ecological aspects of the place they are being implemented....Two specific factors stood out as being centrally important to building a sound foundation to tackle the many challenges to implementing a successful watershed effort: First, a watershed effort needs to have strong administration, led by an entity with baseline capacity to coordinate, organize, and deploy a comprehensive watershed management strategy (e.g., coordinating, planning, implementation). Second, that entity must have trust and tangible partnership with its critical agencies, organizations, and Tribal governments. While not exhaustive, the following are some of the challenges to implementation that determine whether a watershed effort has the administrative capacity and can sustain trusted partnerships that contribute to shared goals.⁴⁰

The California Water Works Competency Framework outlines the necessary knowledge and expertise in social, economic, environmental, institutional, and personal dimensions across the Framework's five competencies. As a first step, most of the five competencies have sub-categories that depict the associated skills for that competency and differ for the public versus an entry level or experienced level job, such that a worker's knowledge, expertise, and associated skills increase and diversify from entry level to advanced level jobs. The intent of the Framework and its five competencies and associated skill sub-categories is to standardize learning and inform job descriptions and duties.

The five Watershed Management competency categories include:

- Watershed Understanding: What is a Watershed?
- Watershed Planning
- Watershed Project Implementation
- Watershed Restoration and Maintenance
- Watershed Organizational Administration and Leadership

The competencies and skill sub-categories outlined below synthesize the above landscape and discussed workforce development analyses. The full competency framework (see Appendix B) endeavors to be inclusive of the wide range of skills that can also translate to differ job levels. The section below provides an overview of the framework with a general description of the activities for each of the five competency areas. Appendix B describes a full list of skills, and

⁴⁰ California Department of Water Resources, *Resource Management Strategy Introduction*, California Water Plan Update 2023 (California Department of Water Resources, 2024), 25, <https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/California-Water-Plan/Docs/RMS/2025/Introduction-RMS---2025.pdf>.

when feasible breaks the skills into what a public participant should know how to do versus a worker in an entry or experienced level job.

Competency Framework and Skills by Worker

Watershed Understanding: What is a Watershed?

The first competency involves an understanding the watershed system and components, including the hydrologic cycle, surface water, groundwater, and recycled water. This would be in respect to the uses of water and users across various geographies and economic sectors. Particular topics would be environmental water and aquatic habitat water, watershed resource analysis, water quality, alongside an overview of watershed history, law, and policy that has impacts on watersheds.

Watershed Planning

The second competency turns to the activities and skills needed to develop watershed plans using Best Management Practices (BPM). This includes an understanding of the laws that impact the process, how to conduct a watershed assessment to determine planning elements (e.g., pollution, restoration, regeneration), and how to develop community-based monitoring systems to track the implementation and impact of watershed projects.

Watershed Project Implementation

The third competency stresses that community is a central element of watershed management planning, and that the engagement process is inclusive and sensitive to water equity. The implementation process also requires skills such as watershed mapping, watershed investigations, project management, budgeting, scheduling, data management and collection.

Watershed Restoration and Maintenance

The fourth competency addresses the necessary skills that are the backbone for watershed restoration and the maintenance necessary for it. This would include an understanding of hydrology, hydrogeology, water quality assessment and monitoring, the diverse types of restoration (e.g., riparian, upland restoration, and reforestation and soil conservation), drainage and stormwater management and principles, and fire and flood risk mitigation strategies. The knowledge of water quality database resources, tools, and modeling and simulations (water rights and allocation systems, optimization modeling, risk analysis and expected monetary value, cost benefit analysis, etc.) are essential to maintain watersheds.

Watershed Organizational Administration and Leadership

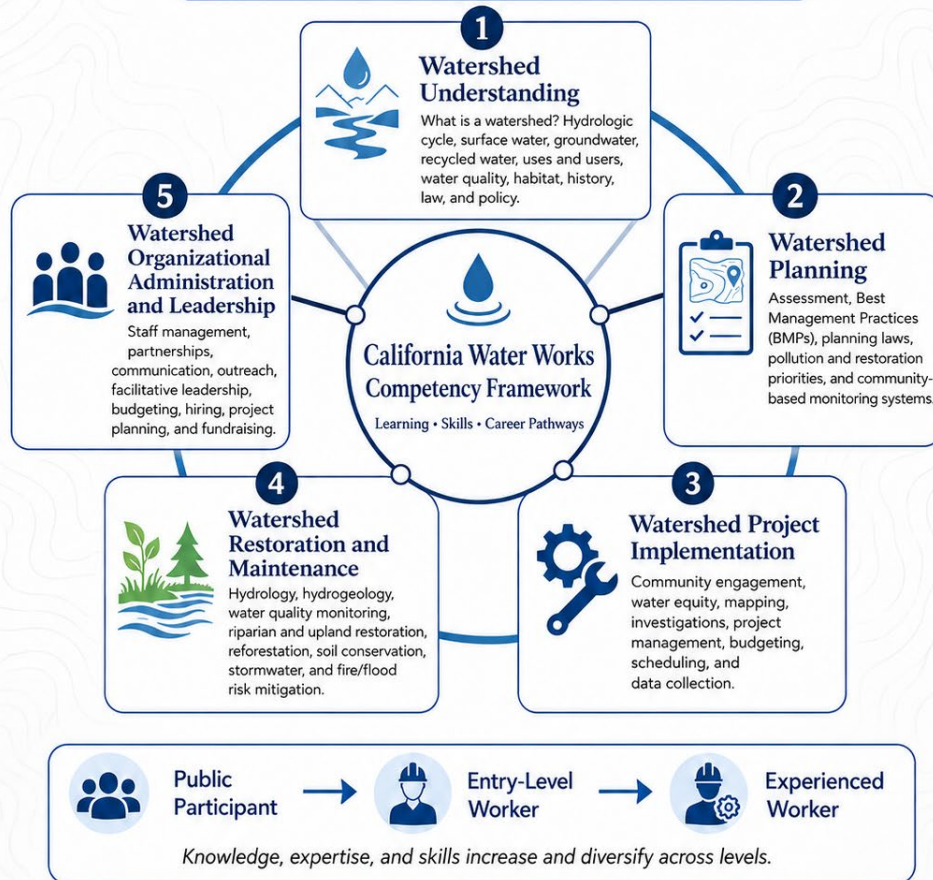
The fifth and final watershed management competency emphasizes the internal and external management of a watershed organization's resources as well as the soft skills important to leading it. Internally, these include staff management and how to establish and maintain partnerships and collaborations through effective outreach and communication strategies. External to the organization, facilitative leadership is vital to developing a vision for the future while understanding program and project budgeting, project planning and implementation, hiring, and fundraising.

California Water Works Competency Framework

Five core watershed management competencies for learning, workforce development, and job standardization.



Cross-cutting dimensions: social, economic, environmental, institutional, and personal.



Appendix B provides detailed skill sub-categories for public, entry-level, and experienced workers.

Figure 10. California Water Works Competency Framework

Competency Framework Next Steps

The framework discussed above is a starting point and to evolve it further requires additional refinement of the five competencies and additional defining of skills for each that are appropriate for a member of the public versus a worker in an entry and experienced job position. These steps are consequential to the Identification and/or development of curriculum for each competency and job level. The vetting the framework and curriculum via employers of watershed management positions is also an important step to further define target audiences and appropriate venues to pilot it.



6. California Water Works Next Steps

6.1. UC ANR Program Collaboration

UC ANR offers statewide programs with education and applied training components that result in certifications that could provide collaborative opportunities. UC Environmental Stewards offers both the [Climate Stewards](#) with its own [Climate Stewards handbook](#) and [California Naturalists program](#) through [college and community partners able to offer the curriculums](#) across the state. Participants desiring certification must enroll in a 40+ hour course with one of the partner organizations. The curriculum combines classroom and field experience in science, problem-solving, communication training and community service. In addition, for the California Naturalist courses, if upon completion of the certification requirements, participants enrolled in non-community college courses are eligible for four academic units through [UC Davis Extension](#) for an additional nominal fee and is offered under Continuing and Professional Education (CPE). Within the California Naturalists courses, a few compatible courses, arranged around the handbook, could include: Chapter 3: Water; Chapter 4: Plants; and Chapter 5: Forest, Woodland, and Range Resources and Management.

Other programs that could present opportunities for collaboration would be the UC Statewide programs, such as:

- [UC Integrative Pest Management](#) (IPM), online courses via the [extension foundation virtual campus](#) are free, but fee-based for Continuing Education Units (possible compatible courses include How Pest Management Professionals Can Protect Water Quality (no CEUs); Runoff and Surface Water Protection);
- [UC Master Gardener Program](#) (MGP), offered via local-county [UC Cooperative Extension](#); and
- [UC Master Food Preserver](#) (MFP), also offered via local-county [UC Cooperative Extension](#).

Collaboration with any of the programs offered via partners and local-county UC Cooperative Extension would create greater breadth. In addition, if there are modules in these programs with a water focus, there could be opportunities to share California Water Works curriculum

modules as a pilot or to attract another audience who would like to gain more watershed management knowledge.

The future of California Water Works Initiative will also need to consider the following issues associated with the design, structure, and administration of the curriculum:

- audience and branding (30 under 30; Well Camp, Water/Agua University/College/School/Bootcamp);
- budget expense versus the actual number participants/students;
- format (hybrid, multiple modalities);
- how many modules/courses;
- length of time to complete any module/course;
- institutional delivery (University Extension has benefits of revenue generation, and often UC Extension is nimbler than community colleges);
- type of course (professional course or linked something that it would be Continuing Education credit, Ag something, water something, irrigation, etc.);
- additional partnerships and collaborations necessary for curriculum delivery; and
- partnerships with agencies and entities for contracted curriculum delivery.

This list is not exhaustive, yet indicates the level of outreach and budgetary considerations that will be necessary for future success.

6.2. Identify Policy Window Opportunity

Finally, watershed management, unlike water distribution and wastewater operators and technicians, is a career path that is not as well identified. Those industries and associated careers have recently been characterized as homeland security and critical infrastructure priorities. However, the impact of climate change with drought and fires, there may be a policy window that suggests a greater need for watershed management. The identification of key entry points in the policy process. For example, within fire and forestry, CAL FIRE-Office of the State Fire Marshal (OSFM) has a [State-Certified Prescribed-Fire Burn Boss](#) that performs prescribed-fire planning, obtains state or local approval and permits, may enter into the necessary contracts with the Department of Forestry and Fire Protection, develops and implements a burn plan, monitors fire effects, maintains prescriptive requirements, and conducts an After-Action Review. To become certified, a person must take a curriculum that provides the initial Certification training as well as the required annual Continuing Education and will be able to access liability insurance. However, there are few that can deliver the curriculum even though the State desires burn bosses.

The identification of state programs that prioritize watershed management could be a target for the California Water Works pilot and curriculum development for certification. For example, the state investments in the Watershed Coordinator program at the California Department of Conservation and long-standing investments in the Integrated Regional Water Management (IRWM) may present an opportunity. Wildfires also present an opportunity. The [California Wildfire and Forest Resilience Task Force](#) with the Regional Forest and Fire Capacity program

at the California Department of Conservation helps watershed-based groups build institutional capacity, interconnect with each other, and lead wildfire resilience. Interviews for this research identified that individuals engaged in ecological restoration work around fisheries want prescribed fire training due to it being a holistic approach for watershed health. Prescribed fires and long term management increases water flow, wood habitat, macroinvertebrate communities. Identifying prescribed fire-watershed connections and joining together with fisheries organizations, e.g. [Salmonid Restoration Federation](#) (SRF), may provide another opportunity.

Many watershed groups across the state face their own particular watershed needs due to geography (less water, warmer water but lots of water, etc.) while also struggling to hire trained watershed individuals. These groups (e.g., [Watershed Research and Training Center](#)) express a desire for the design of modules from the curriculum that could address specific geographical issues and prepare their professional employees for their entry level jobs.

In addition, seeking partnerships with organizations that received awards for resilience planning and Jobs First like that California's Regional Resilience Grant, which is part of the Integrated Climate Adaptation and Resiliency Program (ICARP). The [County of Humboldt North Coast Partnership Regional Climate Resilience Plan](#) laid out their [regional resilience planning and assessment](#) and [regional resilience planning statement](#) around watersheds: "The NCRP planning and project implementation framework is focused on a **set of integrated, multi-benefit objectives that protect and enhance watersheds**, develop and maintain built infrastructure (water, wastewater, energy, communications and transportation), and sustain human communities through the lens of public health, economic development, jobs and local revenue."

The plan [Healthy Watersheds, Vital Communities, Thriving Economies: Actionable Strategies for California's North Coast Region](#) outlines a set of actionable, multi-benefit strategies that together support conservation of functional ecosystems and working landscapes, enhancement of built infrastructure, and enrichment of community health and economic vitality. Priorities to be reflected in NCRP plans and implementation project selection are presented with respect to natural infrastructure, built infrastructure, human capital, financing and investment. The report then drills down into regional focus area strategies, presenting current conditions, limiting factors and focused policy and strategy recommendations for the built environment (communications, transportation, energy, flood protection, water, and wastewater infrastructure), natural environment (aquatic ecosystems, native habitat, nearshore marine, forests, and agriculture/working lands), and local socioeconomic capacity.

Other grants in this program went to Santa Ana River Watershed Climate Adaptation and Resilience Plan and Coachella Valley Regional Water Resilience Plan would be similar venues to seek partners for the pilot.

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Appendix A Landscape Summary

	Appendix A Landscape Summary		Topics and Focus Areas of Watershed Management Programs (NOTE: Sorted on Audience for Grouping)									
	Program	Target Audience	Watershed Management Basics	Water Quality Monitoring	Non-source Point Pollution	Soil Erosion and Sediment Impacts	Climate Change	Watershed Planning	Leadership, Stakeholder, and Community Involvement	Continuing Education Credits Offered or Certificate	University/College Course, Certificate, Concentration, Minor, Major	Supports Certified Crop Advisors
1	Arkansas Farmer Leadership in Watershed Management	Agriculture, Farmers, Farm Advisors, Crop Consultants	X	X					X			X
2	Kansas Center for Agricultural Resources and the Environment Watershed Research and Implementation Partnership	Agriculture Farmers and Landowners	X					X	X			
3	Water Literate Leaders of Northern Colorado	Politicians, Water Boards, Water Commissions	X						X			
4	University of Minnesota	Professionals	X	X	X	X		X	X	X		
5	Michigan State and Michigan Water Environment Association Watershed Management Certification	Professionals	X	X	X			X	X	X		
6	Alabama Watershed Stewards Training, Course, and Workshop	Public	X	X				X	X	X		
7	Texas Watershed Steward	Public	X	X	X	X		X	X		X	X
8	Illinois-Indiana Master Watershed Steward	Public		X			X		X			
9	Arkansas Watershed Steward	Public		X	X				X			
10	Maryland Watershed Stewards	Public		X			X					
11	Penn State Extension's Master Watershed Steward Program	Public	X	X								
12	Utah Master Naturalist	Public		X								
13	Idaho's Bay Watchers	Public	X	X					X	X		
14	Tip of the Mitt Watershed Academy and Stewards	Public	X	X	X							
15	U.S. Environmental Protection Agency Online Training in Watershed Management	Public	X				X	X	X			
16	Food & Agriculture Organization of the United Nations Developing Resilient Watershed Management Plans	Public	X					X	X			
17	Montana Water Center's Watershed Institute Skills Self-Assessment Tool	Watershed Coordinators						X	X	X		
18	NC Watershed Stewardship Network (NCWSN)	Watershed Professionals Network							X			
19	US Army Corps of Engineers Water Resources Certified Planner	US Army Corps Planners						X	X			
University Certificate and Degree Programs												
20	University of British Columbia, Canada Masters in Engineering Leadership in Integrated Water Management	Graduate	X					X			X	
21	University of British Columbia, Canada Watershed Management Distance-Learning Certificate	Graduate	X					X		X	X	
22	Virginia Tech Watershed Management Graduate Certificate	Graduate	X	X				X			X	
23	McGill University Integrated Water Resources Management Course	Professionals Globally	X				X	X	X			

	Appendix A Landscape Summary		Topics and Focus Areas of Watershed Management Programs (NOTE: Sorted on Audience for Grouping)									
	Program	Target Audience	Watershed Management Basics	Water Quality Monitoring	Non-source Point Pollution	Soil Erosion and Sediment Impacts	Climate Change	Watershed Planning	Leadership, Stakeholder, and Community Involvement	Continuing Education Credits Offered or Certificate	University/College Course, Certificate, Concentration, Minor, Major	Supports Certified Crop Advisors
24	Queens University, Ontario, Canada MOOCS Modelling Watershed Processes for Water Resource Management	Public	X	X	X	X		X			X	
25	Queens University, Ontario, Canada MOOCS Watershed Systems and Their Influence on Water Movement and Quality	Public	X	X							X	
26	Laramie County Community College Rangeland Ecology and Watershed Management Program	Undergraduate										
27	North Dakota Water Resources Research Institute Water Resources Certificate	Undergraduate	X			X	X				X	
28	University of Delaware Water Resources Center Water Resources Management Associate in Science and Certificate of Achievement	Undergraduate	X	X		X	X	X			X	
29	University of Maryland Global Campus Watershed Management Course	Undergraduate	X	X	X						X	
30	Queens University, Ontario, Canada LEADERS-CREATE: Program for Leaders in Water and Watershed Sustainability	Undergraduate Graduate	X	X	X	X	X	X			X	
California Programs												
31	Agua University	High School	X									
32	Water Education Foundation California Water Leader	Diverse Community Leaders	X					X	X			
33	California Conservation Corps Watershed Stewards Program (WSP)	Public	X	X			X	X	X			
34	Association of California Water Agencies Certificate in Water Management and Leadership	Public	X						X			
35	Water Environment Federation California Program	Water Quality Professionals		X				X		X		
36	Watershed and Fisheries Stewardship Trinity County California	Watershed Nonprofit		X				X				
37	UC Climate Stewards	Public	X				X			X		
38	UC California Naturalists	Public	X				X			X		
California Colleges and University Degree Programs												
39	Cal Poly San Luis Obispo Watershed Management and Hydrology Concentration - Environmental Management and Protection	Undergraduate	X	X	X	X		X			X	
40	Yuba Community College Field Technician – Watershed Management	Undergraduate	X	X	X		X				X	
41	Yuba Community College Watershed Resilience and Forest Management certificate	Undergraduate	X	X	X	X	X	X			X	
42	Santa Rosa Community College Forest Hydrology and Watershed Management Course	Undergraduate	X	X	X	X	X	X			X	
43	Shasta College Watershed Management and Ecology and Watershed Restoration Practicum	Undergraduate	X	X	X	X	X	X			X	
44	Shasta College Watershed Restoration Practicum	Undergraduate	X	X	X	X	X	X			X	

[illegible]

Appendix B Watershed Management Jobs Postings Analysis

Aaron Wilcher, Community Economic Development Advisor, Eastern Sierra region, UCCE

Introduction

I conducted a jobs postings analysis to support a landscape scan for the California Water Works program, an effort to support training and education to advance watershed management practices.

The jobs postings research consisted of focused analysis of those jobs postings in California during a 12-month period from May 2024 through April 2025. The number of results (n=198) suggests watershed management is an emerging set of methods and practices. The data analysis included looking at a wider related labor market and performing simple tests to find correlations that suggest the types of job titles and skills involved in the work, and potentially affected by changes in policy, management practices, or market forces.

Methodology

Created a baseline set of reports for the 1-year period between May 2024 and April 2025 in California based on the Skill keyword “Watershed management.” The scan resulted in 198 jobs postings.

The author team qualitatively assessed the results of the report indicating level of relevance (“High,” “Moderate,” “Potential”) based on the results of the environmental scan, literature and program review.

The data reports produced several key reports for further analysis: top employers, job titles, skills, occupations. The author team selected job titles and skills to test the results.

The ranking process resulted in 40 Job titles and 128 Skills scoring “High” or “Moderate” The analysis used the 40 job titles and a subset of skills most specific to watershed management (n=87) to test significance in relationship to a wider labor market than the original data runs.

Using the 40 Job Titles, I ran a Skills report and then combined the results with the original report (skill criteria “watershed management”) to look for areas of significant overlap—significant overlap in this case meant skills that occurred with at least 5 jobs postings in the previous year in both reports. I eliminated generalized skills (e.g. communication skills, mathematics) to focus on the most specific technical skills. The process yielded 229 skills, the results of which are described below.

I reproduced a similar process to test Job Titles. Using the 87 skills (not using “watershed management” as a criteria), I ran a Job Title report. Using the same process, we compared the original Job Title report to this new report, which yielded 42 job titles that most significantly appeared in both reports. The findings are included below.

Findings

The comparison of job titles suggests a few key observations that should be further tested in the research.

Most jobs associated with watershed management are white collar STEM occupations requiring at least a bachelor's degree. These include professional jobs in engineering, planning, and environmental and management fields. The job titles Environmental Scientists, Stormwater Engineers, Wastewater Engineers, and Water Resources Engineers have the highest correlation (the largest number of jobs postings in each of the sample datasets).

There are a significant number of technician-level occupations in water quality, planning, program coordination, forestry, permitting and compliance, and environmental and conservation. These occupations represent perhaps a third or less of the watershed management workforce.

There are a focused set of job titles (n=42) representing the focused set of professions where most watershed management-related work occurs. However, the correlation between the watershed management-specific jobs postings and the wider related workforce is generally not strong, suggesting at least two possibilities: (1) that only a few workers in closely-related fields focus on watershed management; (2) that watershed management is not characterized as such in the jobs postings; instead, the practices are carried out among this range of professionals. These observations should be further tested.

Table B1 Job titles most common in California watershed management workforce jobs postings May 2024 - April 2025 (n=42)

Category	Job title
Compliance and Regulatory	Compliance Specialists, Environmental Permitting Specialists
Engineering (Including Water-related)	Civil Engineers, Drainage Engineers, Engineering Geologists, Environmental Engineers, Stormwater Engineers, Water Resource Control Engineers, Water Resources Engineers
Forest management and Fire-related	Foresters, Forestry aides, Forestry technicians
Natural Resources and Environmental Management	Conservation Technicians, Environmental Resources Specialists, Environmental Scientists, Environmental Specialists, Fish and Wildlife Technicians, Natural

	Resources Managers, Natural Resources Project Managers, Sustainability Specialists, Sustainability Analysts
Planning and Community	Community Educators, Community Planning, Environmental Planning, Planners
Water Management	Stormwater Managers, Wastewater Project Managers, Water Quality Technicians, Water Resources Managers, Water Resource Specialists

Source: Analysis of Lightcast Jobs Postings 2025.3

Observations of the data suggest that skill requirements for watershed management-related workforce in California require a range of skills in planning, business administration, natural resources and environmental management (including specialized water management topics), data analysis, engineering and design, fire science and management, forest management and firefighting, and regulatory and policy skills. A sample of these findings is included in the tables below.

Table B2 Skills most common in California watershed management workforce jobs postings May 2024 - April 2025 (n=87)

Category	Skill
Business and Management	Business Development, Budgeting, Business Strategies, Decision-Making, Grant Applications Grant Management, Influencing Skills, Innovation, Marketing, Mentorship, Operations, Program Management and Development, Project Management, Public Relations, Quality Control, Sales, Scheduling, Strategic Planning
Data Analysis	Cost Benefit Analysis, Data Analysis, Data Management, Field Research, MS Office Suite, R (Programming Language), Report Writing, Sampling (Statistics), Site Assessment
Engineering and Design	ArcGIS, AutoCAD, AutoCAD Civil 3D, Civil Design, Civil Engineering, Construction Engineering, Engineering Plans, Engineering Geology, MicroStation (CAD), Professional Engineer (PE) License

Forest management and Fire-related	Fire Management, Fire Prevention, Fire Science, Fire Suppression, Firefighting, Forest Engineering, Forest Management, Forest Ecology, Incident Management, Timber Management, Wildfire Suppression
Natural Resources and Environmental Management	Agriculture, Air Quality, Biology, Ecological Restoration, Environmental Resource Management, Environmental Science, Invasive Species Management, Natural Resource Management, Pesticides, Pollution Prevention, Public Works, Rangeland Management, Resilience
Planning	Community Development, Community Planning, Facilities Planning, Governance, Land Management / Land Tenure, Planning, Project Planning, Regional Planning, Strategic Planning, Urban Planning
Regulatory and Policy	Auditing, CA Environmental Quality Act (CEQA), Environmental Compliance, Environmental Permitting, National Environmental Policy Act (NEPA), Ordinances, Regulatory Compliance
Specialized Water Management	Certified Professional in Erosion Control / Storm Water Quality, Erosion Control, Flood Controls, Ground Water, HEC-HMS (Hydrologic Modeling Systems), HEC-RAS, Hydrogeology, Hydrology, Hydraulic Engineering, Irrigation (Landscaping & Architecture), Levees, Pump Stations, Sediment Controls, Soil Sampling, Soil Science, Storm Drains, Wastewater, Water Conservation, Water/Wastewater Engineering, Watershed Management, Wildlife Biology / Management
Technician Skills	Construction, Hand Tools, Machinery, Power Tool Operation

Source: Analysis of Lightcast Jobs Postings 2025.3

Summary findings of employers come from the original analysis of jobs postings where Watershed Management is listed as a skill criterion. The data indicates that the US Forest Service, US Department of Interior, and consulting firms are among the employers with the

most concentration of Watershed Management-related employment. However, the data suggests at least a few possibilities for these results: (1) that most watershed-related employment is scattered across dozens of employers in California; (2) there are few watershed-related jobs in most organizations; (3) as noted above, most watershed management-related work is not designated as such and occurs as an emergent layer in existing work (job enlarging). Watershed management jobs are found in private consulting, federal land management agencies, local government, water utilities, state government, advocacy and technical assistance groups.

Table B3 Top employers in California watershed management workforce jobs postings May 2024 - April 2025 (n=72)

Watershed Management Job Types	Top California Employers
Conservation & advocacy	American Rivers, Nature Conservancy, San Francisco Estuary Institute
Federal agencies	National Park Service, US Forest Service, US Department of Interior, US Department of Agriculture
Local Government	City of Oceanside, City of Malibu, City and County of San Francisco, County of Contra Costa, County of Ventura, Port of San Diego, Sacramento County
Private technical consulting services	Black & Veatch, HDR, Stantec, Tetra Tech, Terraphase Engineering
State agencies	State of California, University of California, Merced
Utilities	East Bay Municipal Utility District, LA Department of Water & Power, Santa Clara Valley Water District, Valley Water

Source: Analysis of Lightcast Jobs Postings 2025.3

Appendix C Watershed Management Competency Framework

The Watershed Management Competency Framework identifies five broad competency areas and associated skills relevant to watershed education, planning, project implementation, restoration and maintenance, and organizational leadership. The framework is intended to provide a high-level overview of the knowledge and skills that can support California's watershed workforce.

Competency Area	Associated Competency Skills
1. Watershed Understanding: What is a Watershed?	Watershed system definitions and components; Surface water; Groundwater; Recycled water; Water uses and people; Environmental water use and aquatic habitat; Watersheds in California; History, law and policy; Hydrologic cycle; Water quality; Watershed resource analysis
2. Watershed Planning	Watershed management plan development; Watershed needs assessment; Community-based monitoring systems; Integrated watershed management planning in California; Pollution prevention plans; Best management practices; Watershed restoration and regenerative plans
3. Watershed Project Implementation	Participatory and inclusive community stakeholder engagement; Project management; Budgeting; Scheduling; Water equity and socioeconomic considerations; Institutions and management issues; Data management; Data collection; Watershed mapping; Watershed investigations
4. Watershed Restoration and Maintenance	Water quality assessment and database resources; Water quality testing and monitoring; Riparian and upland restoration; Reforestation and soil conservation; Fire and flood risk mitigation; Soil erosion, sediment and pollution; BMPs for drains and water resources maintenance; Modeling and simulation tools; Environmental and natural resources science; Stormwater management; Native plants and rain gardens; Green design and infrastructure; Hydrology; Hydrogeology
5. Watershed Organizational Administration and Leadership	Staff management; Partnerships and collaboration; Outreach and communication; Facilitative leadership; Developing and maintaining a vision; Program and project budgeting; Contracts; Funding and grants; Communications; Education and public outreach; Inspections and monitoring