

**Small Water System Operation and Maintenance**  
**Office of Water Programs**  
**California State University, Sacramento**  
(9.0 Continuing Education Units)

## **Objective**

This course is designed to train operators to safely and effectively operate and maintain small water systems and treatment plants.

## **Scope**

This course introduces operators to the practical aspects of operating and maintaining small drinking water supply systems and treatment plants, with an emphasis on safe practices and procedures.

Topics covered include the duties of small system operators, water sources, and treatment processes. Detailed descriptions and illustrations of drinking water well components are presented. Operators will learn how to set up a wellhead protection program; operate, maintain, and rehabilitate wells; disinfect wells and pumps; and troubleshoot operating problems. Other topics in this training course include operation and maintenance procedures for small water treatment plants, disinfection, safety, laboratory procedures, setting water rates, and an introduction to basic math for operators. The Chapter Review section at the end of each chapter gives you the opportunity to self-assess your understanding of the material by answering fill-in, matching, and multiple-choice questions.

## **Learning Objectives**

### Chapter 1, Introduction to Small Water Systems

1. Discuss the need for, uses of, and regulations governing the production of safe, pleasant drinking water.
2. Explain the flow pattern of a typical small water supply system.
3. Use a sanitary survey to evaluate the suitability of an identified water source for drinking purposes and as a general water supply.

### Chapter 2, Wells

1. Identify, operate, maintain, and inspect the parts of wells, pump systems, and hydropneumatic pressure tanks.
2. Protect wells from contamination, disinfect wells and pumps, and rehabilitate wells.
3. Troubleshoot wells and pumping systems, including removing sand from water and mains.
4. Describe factors involved in selecting a well site and the types of wells and drilling methods.

5. Test and evaluate wells and pumps.
6. Keep accurate records of wells and pumping systems.
7. Abandon and plug wells that are no longer productive or needed.

### Chapter 3, Small Water Treatment Plants

1. Explain the importance of small water treatment plants.
2. Operate and maintain treatment processes for:
  - a. Coagulation and flocculation
  - b. Settling
  - c. Filtration (including slow sand filtration)
  - d. Disinfection
  - e. Corrosion control
  - f. Solids contact units
  - g. Iron and manganese control
  - h. Softening
3. Safely perform the duties of an operator.

### Chapter 4, Disinfection

1. Explain the disinfection processing using chlorine, hypochlorite, chlorine dioxide, and chloramines, as well as ultraviolet (UV) and ozone systems.
2. Describe the breakpoint chlorination process.
3. Identify the points of disinfectant application and select the proper dosage.
4. Start up, shut down, troubleshoot, and maintain disinfection equipment and systems.
5. Handle disinfectants safely, and develop and conduct a chlorine safety program.

### Chapter 5, Safety

1. Develop a safety program for a water utility agency, including delivering safety information and practices to other operators.
2. Operate and maintain pumps, wells, and other facilities safely, with attention to the safety of operators and consumers.
3. Work safely in streets while protecting road users and pedestrians from work areas in streets and sidewalks.
4. Conduct a safety inspection of waterworks facilities.

### Chapter 6, Laboratory Procedures

1. Safely operate laboratory equipment.
2. Collect representative samples, and preserve and transport the samples.
3. Prepare samples for analysis.
4. Describe lab test limitations, recognize precautions for those tests, and record lab test results.
5. Perform the following field or laboratory tests: alkalinity, chlorine residual, chlorine demand, coliform, hardness, jar test, pH, temperature, and turbidity.

## Chapter 7, Introduction to Small System Management

1. Develop water rates and determine revenue needs for a small water utility: itemize system expenses, identify funding sources for capital improvements, relate costs to level of service, distribute costs to customers.
2. Prepare a consumer confidence report (CCR) for the utility's customers, describing the financial strength of the utility.
3. Plan for financial stability and keep accurate records of costs and sources of revenues.
4. Prepare a contingency plan for emergencies and prepare a plan to strengthen the security of your utility's facilities.

## Other Sections

Appendix A, Introduction to Basic Math for Operators  
Answer Key  
Glossary  
Index

## Time Assignment

This course time assignment outlines the components of a distance learning (correspondence) training course offered by OWP for continuing education units (CEUs) or contact hours.

**Title of course and training manual:** Small Water System Operation and Maintenance, Sixth Edition

**Number of text pages:** 778

**Average word count:** 513 words per page

**Average reading speed:** 130 words per minute; 4 minutes per page

The training manual used for this course contains text, tables, graphs, illustrations, math example problems, section questions, and chapter review questions to enhance the presentation of information and the student learning experience. The course is designed for students to spend the same amount of time reading the tables, graphs, and illustrations as they spend reading the equivalent amount of related chapter text.

**Number of math example problems:** The course contains 184 math example problems. The math examples support and expand the concepts presented in the chapter text.

**Average math example problem solution speed:** 3 minutes per example problem

**Number of section questions:** The course contains 436 section questions, located in the “Check Your Understanding” sections integrated throughout the chapter text. These questions enable students to self-assess their understanding of a section of material before proceeding to the next section.

**Average section question/answer speed:** 2 minutes per question

**Number of chapter review questions:** The course contains 260 review questions, located in the “Chapter Review” at the end of each chapter. Question types include fill-in, multiple choice, and matching.

**Average chapter review question/answer speed:** 2 minutes per question

**Objective test questions:** The course contains 350 test questions. There is one objective test per chapter. Question types include true/false; best answer (one correct answer); multiple choice (one or more correct answers); and math (requiring students to work through equations to find solutions).

**Average objective test question/answer speed:** 2 minutes per question

The table summarizes the course components outlined above and shows the calculations for the total time assignment values in minutes and hours.

Course component	Number of component units	Minutes required to complete component unit	Total time assignment for component
Text pages	778 ×	4 =	3,112
Math example problems	184 ×	3 =	552
Section questions	436 ×	2 =	872

Chapter review questions	260 ×	2 =	520
Objective test questions	350 ×	2 =	700
			<b>5,756 minutes</b>
			<b>96 hours</b>