Expected Range of Knowledge for Drinking Water Treatment Exam

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**Source Water**
- Clear Well Storage
- Raw Water Storage
- Surface Water/Reservoirs
- Wells/Groundwater
- Watershed Protection

**Water Treatment Processes**
- Coagulation
- Sedimentation
- Filtration
- Disinfection
- Corrosion Control
- Taste and Odor
- Iron and Manganese Removal
- Fluoridation
- Flocculation
- Best Available Technology

**Operation / Maintenance**
- Chemical Feeders
- Pumps, Motors, and Gearboxes
- Blowers and Compressors
- Water Meters
- Pressure Gauges
- Instrumentation
- Electrical Generators

**Laboratory Procedures**
- Sampling
- General Lab Practices
- Disinfectant Analysis
- Alkalinity Analysis
- pH Analysis
- Turbidity Analysis
- Specific Conductance
- Hardness
- Fluoride Analysis
- Color Analysis
- Taste and Odor Analysis
- Microbiological Analysis

**Safety / Regulations / Administrative Duties**
- Controlling
- Directing
- Implementing Regulations
- Lead and Copper Rule
- California Waterworks Standards
- Operator Certification Regulations
- Safe Drinking Water Act & Amendments
- Surface Water Treatment Rule and Amendments
- Organizing
- Planning
- Primary Contaminants
- Recordkeeping
- Safety
- Secondary Contaminants
- Total Coliform Rule
The tables below list specific objectives in each content category. The specific exam grades where these objectives are included are also provided below.

**Source Water**

- **T1 - T4** Ability to calculate flow rates and water velocity
- **T1 - T4** Ability to calculate the volume of water in a storage facility
- **T1 - T4** Ability to calculate well drawdown
- **T1 - T4** Ability to calculate detention time
- **T1 - T4** Ability to calculate well specific capacity
- **T1 - T4** Ability to calculate well head pressure
- **T1 - T4** Ability to convert common water units (e.g. gallons per minute to MGD)
- **T1 - T4** Ability to convert head pressure to water elevation
- **T1 - T4** Ability to convert units of length, volume, flow and pressure
- **T1 - T4** Ability to determine water level in a storage tank, reservoir, or well
- **T1 - T4** Ability to recognize abnormal chemical characteristics of water
- **T1 - T4** Ability to recognize abnormal odors or colors
- **T1 - T4** Ability to recognize abnormal well operations
- **T1 - T4** Ability to recognize potential security risks
- **T1 - T4** Ability to recognize potential sources of contamination in surface water
- **T1 - T4** Ability to recognize the influence of surface water on a groundwater source
- **T1 - T4** Knowledge of chemicals that contribute alkalinity and hardness to water
- **T1 - T4** Knowledge of common chemical and microbial contaminants in raw water
- **T1 - T4** Knowledge of flow measurement devices
- **T1 - T4** Knowledge of potential microbial and chemical contamination sources in groundwater and surface water
- **T1 - T4** Knowledge of problems caused by hard water
- **T1 - T4** Knowledge of storage tank disinfection procedures
- **T1 - T4** Knowledge of the characteristics of aquifers
- **T1 - T4** Knowledge of the chemical components of groundwater and surface water
- **T1 - T4** Knowledge of the hydrologic cycle
- **T1 - T4** Knowledge of visual signs of contamination in a surface water reservoir
- **T1 - T4** Knowledge of well components
- **T1 - T4** Knowledge of well depth measurement procedures
- **T1 - T4** Knowledge of well disinfection procedures
- **T1 - T4** Knowledge of well drawdown measurement techniques
- **T2 - T4** Ability to discriminate between normal and abnormal conditions of a surface water reservoir
- **T2 - T4** Ability to recognize hydrological changes
- **T2 - T4** Knowledge of how reservoir intake level effects water quality
- **T2 - T4** Knowledge of the effects of seasonal changes on water reservoirs
Expected Range of Knowledge for Drinking Water Treatment Exam

T2 - T4 Knowledge of pretreatment procedures
T3 - T4 Knowledge of surface water reservoir stratification
T3 - T4 Ability to recognize head loss across an intake screen
T3 - T4 Knowledge of groundwater treatment procedures

Water Treatment Processes

Coagulation/Flocculation/Sedimentation
T3 - T4 Ability to calculate a coagulant dose from a jar test
T3 - T4 Ability to perform a jar test
T3 - T4 Ability to recognize and correct abnormal conditions in a sedimentation basin
T3 - T4 Ability to recognize normal and abnormal floc formation
T3 - T4 Knowledge of flocculation tanks
T3 - T4 Knowledge of chemical coagulants and coagulant aids
T3 - T4 Knowledge of coagulation/flocculation start-up/shutdown and adjustment procedures
T3 - T4 Knowledge of enhanced coagulation
T3 - T4 Knowledge of sedimentation basins
T3 - T4 Knowledge of the coagulation/flocculation process
T3 - T4 Knowledge of the effects of temperature, alkalinity, and pH on flocculation
T3 - T4 Knowledge of the flash mixing process
T3 - T4 Knowledge of the jar testing procedure
T3 - T4 Knowledge of the sedimentation process
T3 - T4 Knowledge of tube settlers
T4 Knowledge of water gradient velocities
T4 Knowledge of the zeta potential
T4 Knowledge of Van Der Waals forces
T4 Knowledge of ballasted flocculation procedures

Filtration
T1 - T4 Ability to interpret turbidity information
T1 - T4 Knowledge of turbidity causing matter
T2 - T4 Ability to calculate daily filter production
T2 - T4 Ability to calculate filter backwash rate
T2 - T4 Knowledge of head loss effects on filters
T2 - T4 Knowledge of filter surface washing methods
T2 - T4 Knowledge of filtration mechanisms (absorption, adsorption)
T3 - T4 Ability to calculate a filter-aid dosage
T3 - T4 Ability to calculate a filtration rate
T3 - T4 Ability to calculate filter loading rate
T3 - T4 Ability to recognize and correct problems in gravity filters
Expected Range of Knowledge for Drinking Water Treatment Exam

T3 - T4  Ability to recognize and correct problems in multimedia filters
T3 - T4  Knowledge of backwash sequencing
T3 - T4  Knowledge of filter media types and uses
T3 - T4  Knowledge of maximum filtration rates
T3 - T4  Knowledge of normal and abnormal filter media conditions
T3 - T4  Ability to calculate filter media volume and capacity
T4    Ability to conduct a comprehensive performance evaluation of a filter
T4    Ability to operate an air scour system
T4    Ability to perform a filter assessment surveillance program
T4    Ability to perform a filter profile analysis
T4    Ability to recognize and correct problems in granular activated carbon filters
T4    Knowledge of air scouring systems
T4    Knowledge of filter media replacement requirements and techniques
T4    Knowledge of filter porosity

Disinfection
T1 - T4  Ability to calculate a chemical dosage
T1 - T4  Ability to calculate a chemical solution concentration
T1 - T4  Ability to calculate chlorine demand and chlorine residual
T1 - T4  Knowledge of acceptable chlorine residual levels
T1 - T4  Knowledge of breakpoint chlorination chemistry
T1 - T4  Knowledge of chlorine chemistry
T1 - T4  Knowledge of common chlorine compounds used for disinfection
T1 - T4  Knowledge of disinfectant byproduct formation
T1 - T4  Knowledge of disinfectant properties and uses
T1 - T4  Knowledge of disinfection residual requirements
T1 - T4  Knowledge of MCLs and MRDLs of disinfectants
T2 - T4  Ability to calculate a CT value
T2 - T4  Ability to choose an appropriate disinfectant for a specific microbial problem
T2 - T4  Knowledge of chloramine chemistry
T2 - T4  Knowledge of disinfectant byproduct reduction procedures
T2 - T4  Knowledge of TOC/Disinfection byproduct correlation

Corrosion Control
T1 - T4  Ability to recognize corrosion problems
T1 - T4  Knowledge of pH adjustment procedures
T1 - T4  Knowledge of corrosion causes
T2 - T4  Knowledge of corrosion reduction methods
T3 - T4  Knowledge of C-factor
T3 - T4  Knowledge of the cathodic protection process
Expected Range of Knowledge for Drinking Water Treatment Exam

T3 - T4 Knowledge of corrosion control inhibitors
T3 - T4 Knowledge of the Langelier Index
T3 - T4 Knowledge of corrosion control chemical reactions
   T4 Ability to choose the proper corrosion control chemical for a specific problem

Taste and Odor
T1 - T4 Knowledge of abnormal taste and odors
T1 - T4 Knowledge of chemicals that contribute taste and odor
T1 - T4 Knowledge of taste and odor treatment processes

Iron and Manganese
T1 - T4 Ability to recognize an iron and manganese problem
T3 - T4 Knowledge of iron and manganese oxidation chemistry
T3 - T4 Knowledge of iron and manganese removal techniques

Fluoridation
T4 Knowledge fluoridation chemicals
T4 Knowledge of fluoride chemistry
T4 Knowledge of optimal fluoride level range
T4 Knowledge of the health effects of fluoride

Best Available Technology (BAT)
T1 - T4 Knowledge of health effects of lead and copper
T1 - T4 Knowledge of adverse health effects caused by common contaminants
T2 - T4 Knowledge of Best Available Technology (BAT) for common water contaminants
T2 - T4 Knowledge of effective removal techniques for common contaminants
T3 - T4 Ability to perform blending calculations
T3 - T4 Knowledge of the aeration process
   T4 Knowledge of chemical oxidation techniques and uses
   T4 Knowledge of granular activated carbon (GAC)
   T4 Knowledge of nitrate removal processes

Operation / Maintenance

Chemical Feeders
T1 - T4 Ability to calculate a dosage for a chemical feeder
T1 - T4 Ability to calibrate and adjust a chemical feeder pump
T1 - T4 Ability to operate a chemical feeder system
T1 - T4 Ability to replace components of a chemical feeder system
T1 - T4 Ability to set proper chemical feed rate
T1 - T4 Knowledge of chemical feeder calibration and adjustment
Expected Range of Knowledge for Drinking Water Treatment Exam

T1 - T4  Knowledge of the components of chemical feeder systems
T1 - T4  Knowledge of the operation of chemical feeder systems

Pumps, Motors, and Gearboxes
T1 - T4  Ability to discriminate between normal and abnormal operation of a water pump
T1 - T4  Knowledge of pump types and uses
T1 - T4  Knowledge of the components of a water pump
T1 - T4  Knowledge of the operation of a water pump
T1 - T4  Knowledge of valve types and uses
T1 - T4  Ability to replace components of a water pump
T2 - T4  Knowledge of pump installation procedures

Blowers and Compressors
T3 - T4  Knowledge of the operation of blowers and compressors
T3 - T4  Ability to discriminate between normal and abnormal operation of blowers and compressors
T4  Ability to replace components of blowers and compressors
T4  Knowledge of the components of blowers and compressors

Water Meters
T1 - T4  Ability to read and interpret water meter readings
T1 - T4  Knowledge of the components of water meters
T1 - T4  Knowledge of the operation of water meters
T1 - T4  Knowledge of water meter types and uses
T2 - T4  Ability to calibrate a water meter

Pressure Gauges
T1 - T4  Knowledge of head pressure
T1 - T4  Knowledge of the operation of pressure gauges
T2 - T4  Ability to replace pressure gauges
T3 - T4  Knowledge of the components of pressure gauges

Instrumentation
T1 - T4  Knowledge of basic SCADA system components
T2 - T4  Ability to determine normal operation of a SCADA system
T2 - T4  Knowledge of the components of on-line analyzers
T3 - T4  Ability to recognize analytical interferences in on-line analyzers
T3 - T4  Ability to repair or replace defective parts of on-line analyzers
T3 - T4  Knowledge of the operation of on-line analyzers
Expected Range of Knowledge for Drinking Water Treatment Exam

Electrical Generators
T3 - T4 Knowledge of the operation of an electrical generator
T3 - T4 Knowledge of the components of an electrical generator

Laboratory Procedures
Sampling
T1 - T4 Ability to collect a water sample
T1 - T4 Ability to determine a proper sampling site
T1 - T4 Ability to follow chain of custody
T1 - T4 Knowledge of appropriate sample containers and sample sizes
T1 - T4 Knowledge of maximum holding times
T1 - T4 Knowledge of proper sampling and preservation techniques
T1 - T4 Knowledge of well sampling techniques

General Laboratory Practices
T1 - T4 Ability to calculate a chemical solution concentration
T1 - T4 Knowledge of chemical hazards
T2 - T4 Ability to calculate a dilution factor
T2 - T4 Ability to mix chemicals and prepare reagents
T2 - T4 Ability to perform dilutions

Disinfectant Analysis
T1 - T4 Ability to analyze a water sample for free and total chlorine
T1 - T4 Ability to read and interpret a colorimeter
T1 - T4 Knowledge of approved analytical procedures for chlorine analysis
T1 - T4 Knowledge of chlorine chemistry

Alkalinity Analysis
T2 - T4 Knowledge of chemicals that contribute alkalinity to water
T3 - T4 Ability to use a titrator
T3 - T4 Ability to recognize a titration endpoint
T3 - T4 Knowledge of abnormal alkalinity levels

pH Analysis
T1 - T4 Ability to read and interpret a pH meter
T1 - T4 Knowledge of acids and bases
T1 - T4 Knowledge of acceptable water pH range
T1 - T4 Knowledge of chemicals that affect the pH of water
T1 - T4 Knowledge of the effects of pH on water quality
T1 - T4 Knowledge of the pH scale
Expected Range of Knowledge for Drinking Water Treatment Exam

T1 - T4  Ability to analyze a water sample for pH
T2 - T4  Ability to calibrate a pH meter

Turbidity Analysis
T1 - T4  Ability to analyze a water sample for turbidity
T1 - T4  Ability to read and interpret a turbidimeter
T1 - T4  Knowledge of the Nephelometric Turbidity Unit (NTU) scale
T1 - T4  Knowledge of turbidimeter instrumentation
T1 - T4  Knowledge of turbidity causing matter
T1 - T4  Knowledge of turbidity level requirements
T2 - T4  Ability to prepare and calibrate turbidimeter with Primary Standard (Formazin)

Specific Conductance
T3 - T4  Ability to analyze a water sample for specific conductance
T3 - T4  Ability to read and interpret a specific conductance meter
T4  Ability to calculate a TDS value from a specific conductance reading
T4  Knowledge of EC/TDS ratio
T4  Ability to calibrate a specific conductance meter

Hardness
T1 - T4  Knowledge of chemicals that contribute hardness to water
T2 - T4  Ability to analyze a water sample for water hardness
T2 - T4  Knowledge of hardness removal processes

Fluoride Analysis
T4  Ability to operate an Ion Specific Electrode (ISE)
T4  Knowledge of optimal fluoride level range

Color Analysis
T2 - T4  Ability to recognize abnormal colors in water
T3 - T4  Knowledge of abnormal color levels
T4  Knowledge of color analysis scale
T4  Knowledge of true and apparent color

Taste and Odor Analysis
T1 - T4  Ability to identify an objectionable taste or odor in water
T1 - T4  Knowledge of chemicals that contribute taste and odor to water
T4  Knowledge of odor analysis protocol
Expected Range of Knowledge for Drinking Water Treatment Exam

Microbiological Analysis

T1 - T4  Knowledge of the presence/absence test method
T1 - T4  Knowledge of approved analytical procedures for coliform analysis
T1 - T4  Knowledge of common microbial contaminants in raw water
T2 - T4  Knowledge of Heterotrophic Plate Count (HPC)
T3 - T4  Ability to distinguish between presumptive and confirmed coliform results
T3 - T4  Knowledge of the multiple tube fermentation method
T3 - T4  Knowledge of the membrane filtration method

Safety / Regulations / Administrative Duties

Safety

T1 - T4  Ability to demonstrate safe work habits
T1 - T4  Ability to identify potential safety hazards
T1 - T4  Ability to recognize unsafe working conditions
T1 - T4  Ability to select and utilize safety equipment
T1 - T4  Knowledge of chemical hazards
T1 - T4  Knowledge of compressed gas safety procedures
T1 - T4  Knowledge of confined space safety procedures
T1 - T4  Knowledge of electrical safety
T1 - T4  Knowledge of hazardous chemical handling
T1 - T4  Knowledge of incompatible chemicals
T1 - T4  Knowledge of lock-out/tag-out procedures
T1 - T4  Knowledge of Material Safety Data (MSD) sheets
T1 - T4  Knowledge of personal protective equipment (PPE)
T1 - T4  Knowledge of proper chemical handling techniques
T1 - T4  Knowledge of safe working practices
T1 - T4  Knowledge of the use of safety equipment
T2 - T4  Knowledge of HAZWOPER guidelines
T3 - T4  Ability to administer a safety plan
T3 - T4  Ability to generate a written safety plan

Regulations / Administrative Duties

T1 - T4  Ability to interpret water quality characteristics (hardness, turbidity, pH)
T1 - T4  Knowledge of basic unit processes used in treating drinking water
T1 - T4  Knowledge of corrective actions to take when regulations are violated
T1 - T4  Knowledge of drinking water monitoring and reporting requirements
T1 - T4  Knowledge of drinking water regulations
T1 - T4  Knowledge of notification protocol and procedures
T1 - T4  Knowledge of NSF Standards
Expected Range of Knowledge for Drinking Water Treatment Exam

T1 - T4 Knowledge of operator certification requirements
T1 - T4 Knowledge of Primary and Secondary Drinking Water Standards
T1 - T4 Knowledge of public notification procedures
T1 - T4 Knowledge of record keeping requirements
T1 - T4 Knowledge of California Waterworks Standards
T1 - T4 Knowledge of the Consumer Confidence Report (CCR)
T1 - T4 Knowledge of the Disinfectants and Disinfection Byproduct Rule and amendments
T1 - T4 Knowledge of the Groundwater Rule
T1 - T4 Knowledge of the Lead and Copper Rule
T1 - T4 Knowledge of the Surface Water Treatment Rule and amendments
T1 - T4 Knowledge of the Total Coliform Rule and amendments
T1 - T4 Knowledge of waterborne pathogens
T1 - T4 Ability to interpret water quality reports
T1 - T4 Ability to research and interpret Maximum Contaminant Levels (MCLs)
T2 - T4 Ability to administer a maintenance program
T2 - T4 Knowledge of cryptosporidium action plan
T2 - T4 Knowledge of pending regulations
T2 - T4 Knowledge of performance standards and removal requirements for surface water treatment
T2 - T4 Knowledge of the Filter Backwash Rule
T2 - T4 Knowledge of routine sampling requirements
T3 - T4 Ability to administer a regulatory compliance program
T3 - T4 Ability to calculate percent or log removal of contaminants from water
T3 - T4 Ability to calculate the cost of water treatment operations
T3 - T4 Ability to develop an operational site sampling plan
T3 - T4 Ability to develop an operations plan
T3 - T4 Ability to evaluate treatment facility performance
T3 - T4 Knowledge of facility operation and maintenance
T3 - T4 Knowledge of management principles
T3 - T4 Knowledge of permit requirements for water operations
T3 - T4 Knowledge of principles of supervision
T3 - T4 Knowledge of public relations principles
T3 - T4 Knowledge of pump to waste discharge environmental regulations
T3 - T4 Knowledge of regulatory primacy issues
T3 - T4 Knowledge of source water replenishment processes
T3 - T4 Knowledge of the Sanitary Survey process
T4 Ability to interpret historical water use data
T4 Knowledge of the role of Regional Boards in managing contamination sources
T4 Knowledge of the Source Water Assessment Program
T4 Knowledge of the Watershed Survey process
Expected Range of Knowledge for Drinking Water Treatment Exam

T4 Knowledge of the vulnerability assessment process

Water Treatment Exam Math

T1 - T4 Ability to calculate flow rates and water velocity
T1 - T4 Ability to calculate the volume of water in a storage facility
T1 - T4 Ability to calculate well drawdown
T1 - T4 Ability to calculate detention time
T1 - T4 Ability to calculate well specific capacity
T1 - T4 Ability to calculate well head pressure
T1 - T4 Ability to convert common water units, (gallons per minute to MGD, etc…)
T1 - T4 Ability to convert head pressure to water elevation
T1 - T4 Ability to convert units of length, volume, flow and pressure
T1 - T4 Ability to determine water level in a storage tank, reservoir or well
T1 - T4 Ability to calculate a chemical dosage
T1 - T4 Ability to calculate a chemical solution concentration
T1 - T4 Ability to calculate chlorine demand and chlorine residual
T1 - T4 Ability to calculate a dosage for a chemical feeder
T1 - T4 Ability to calculate a chemical solution concentration
T2 - T4 Ability to calculate daily filter production
T2 - T4 Ability to calculate filter backwash rate
T2 - T4 Ability to calculate a CT value
T2 - T4 Ability to calculate a dilution factor
T2 - T4 Ability to perform dilutions
T3 - T4 Ability to calculate a coagulant dose from a jar test
T3 - T4 Ability to calculate a filter-aid dosage
T3 - T4 Ability to calculate a filtration rate
T3 - T4 Ability to calculate filter loading rate
T3 - T4 Ability to calculate percent or log removal of contaminants from water
T3 - T4 Ability to calculate the cost of water treatment operations