

1.0 Submission of Water Works Plans

Preliminary plans and the engineer's report should be submitted for review prior to the preparation of final plans. All reports, final plans and specifications, along with a letter of transmittal, must be submitted at least 60 days prior to the date on which action by the Department is desired. Permits for construction, waste discharges, stream crossings, etc. may be required from other federal, state, or local agencies. No approval for construction can be issued until final, complete, detailed plans and specifications have been submitted to the Department and found to be satisfactory. Documents submitted for formal approval shall be accompanied by a letter of transmittal and shall include, but not be limited to:

1. Summary of the basis of design
2. Operation requirements, where applicable
3. Detailed plans
4. General layout
5. Specifications
6. Locus map
7. Deed Restriction Affidavit

1.1 Engineer's Report

The engineer's report for water works improvements shall, where pertinent, present the following information:

General Information

1. Description of the existing water works and sewerage facilities
2. Identification of the municipality or area served
3. Name and mailing address of the owner or official custodian
4. Legal authority to undertake the work proposed
5. Discussion of Massachusetts Environmental Policy Act (MEPA) regulations
6. Discussion of Wetlands Protection Act requirements
7. Discussion of water pollution control (waste disposal regulations)

Extent of Water Works System

1. Description of the nature and extent of the area to be served
2. Provisions for extending the water works system to include additional areas
3. Appraisal of the future requirements for service, including existing and potential industrial, commercial, institutional and other water supply needs

Alternate Plans

Where two or more solutions exist for providing public water supply facilities, each of which is feasible and practicable, discuss the alternate plans and give reasons for selecting the one recommended, including technical, financial and managerial considerations and analysis.

Consecutive systems must have a written agreement between the consecutive system and the supplying system. It should address the status and responsibilities of the parties for the ownership, operation and maintenance of the combined system, including but not limited to, drinking water sources, treatment facilities, distribution systems, storage and water quality sampling.

General Conditions

Soil, groundwater conditions, and foundation problems, including a description of:

1. Foundation conditions prevailing at sites of proposed structures
2. Approximate elevation of groundwater in relation to subsurface structures

Water Use Data

1. Description of population trends as indicated by available records and the estimated population that will be served by the proposed water supply system or expanded system
2. Present water consumption and the projected average maximum daily demands used as the basis of design (total and gallons per capita per day (gpcd) for both present and projected using estimated populations)
3. Present and/or estimated yield of the sources of supply
4. Compare gpcd to DEM demand projections

Fire Flow Requirements

1. Requirements of the National Board of Fire Underwriters, or other similar agency on fire flows required or recommended in the service area involved
2. Fire flows that will be made available by the proposed or enlarged system

Sewage System Available

Describe the existing sewerage system and sewage treatment works, with special reference to their relationship to existing or proposed waterworks structures which may affect the operation of the water supply system, or which may affect the quality of the supply.

Source of Water Supply

Describe the proposed source(s) of water supply to be developed, the reasons for selection, and provide information as follows, and discussed in Chapters 3 and 4:

1. Surface Water Sources
 - a. Hydrological data, stream flow, and weather records
 - b. Safe yield, including all factors that may affect it
 - c. Maximum flood flow of record, together with safety features of the spillway and dam
 - d. Description of the watershed, noting any existing or potential sources of contamination which may affect water quality
 - e. Summarized quality of the raw water with special reference to fluctuations in quality, changing meteorological conditions, etc.

2. Groundwater Sources - All of the following information, with the exception of b and f, should be depicted on U.S. Geological Survey (USGS) topographic maps.
 - a. Sites considered
 - b. Advantages of the site selected
 - c. Elevations with respect to surroundings
 - d. Probable character of formations in which the source is to be developed; this should include a delineation of the extent of the aquifer along with a minimum of two geologic cross-sections, one in the direction of groundwater flow and the other perpendicular to groundwater flow
 - e. Geologic conditions affecting the site
 - f. Summary of source exploration, test well depth, and method of construction placement of liners or screen; test pumping rates and their duration; water levels and specific yield; and water quality
 - g. Sources of possible contamination within Zones I, II, III as defined, such as sewers and sewage facilities, landfills, outcropping of consolidated water bearing formations, waste disposal wells.

Proposed Treatment Processes

Adequacy of Proposed Processes - The adequacy of proposed processes and unit parameters for the treatment of the specific water under consideration should be summarized and established. Alternative methods of water treatment and chemical use should be considered as means of reducing waste handling and disposal problems.

1. Pilot Studies - Pilot studies are required to determine the adequacy of the treatment processes to deliver water that meets the standards established by the Department. Pilot studies are also required to determine chemical dosages and other operation related parameters.

2. Normally, the duration of a pilot study covers a 12-month period. However, the Department may require a longer period of study if data obtained in the preceding months is inadequate or unsatisfactory to complete the evaluation process. Similarly, the Department may either waive the requirement of piloting or reduce the duration for a specific site provided that adequate data exists to determine the needed parameters of design and operation.

Waste Disposal

Discuss the various wastes from the water treatment plant, their volume, proposed treatment, points of discharge and/or ultimate disposal location.

Automation

Provide supporting data justifying automatic equipment, including the servicing and operator training to be provided. Manual override must be provided for any automatic controls.

Project Site

1. Discussion of the various sites considered and advantages of the recommended ones.
2. The proximity of residences, industries, and other establishments
3. Discuss potential sources of pollution, within Zones I, II, and III as defined, that may influence the operation of the water works system, such as sewage absorption systems, septic tanks, privies, cesspools, sink holes, sanitary landfill, refuse and garbage dumps.

Financing

1. Estimated cost of integral parts of the system, life expectancy and replacement cost
2. Detailed estimated annual cost of operation, maintenance, and operating personnel
3. Proposed methods to finance both capital charges and operating expenses

Future Extensions

Summarize planning for future needs and services.

1.2 Plans

Plans for water works improvements shall, where pertinent, provide the following:

General Layout

1. Suitable title
2. Name of municipality, or other entity or person responsible for the water supply
3. Area or institution to be served and locus
4. Graphic scale, in feet
5. North arrow
6. Datum used and local bench mark
7. Date plans were prepared, including all revision dates
8. Imprint of professional engineer's seal and signature of engineer showing registration in Massachusetts.
9. Legible print suitable for filing
10. Location and size of existing water mains
11. Location and nature of existing water works structures and appurtenances affecting the proposed improvements, noted on one sheet

Detailed Plans

1. Stream crossings, providing profiles with elevations of the stream bed and the normal and extreme high and low water levels
2. Profiles having a horizontal scale of not more than 100 feet to the inch and a vertical scale of not more than 10 feet to the inch, with both scales clearly indicated
3. Location and area of the property to be used for the groundwater development with respect to known references such as street intersections
4. Topography and location(s) of present or planned wells or structures with contour intervals not greater than 2 feet, plus a minimum of two geologic cross-sections, one in the direction of groundwater flow, and the other perpendicular to it.
5. Elevations of the highest known flood level, floor of the structure, upper terminal of protective casing and outside surrounding grade, using United States Coast and Geodetic Survey, United States Geological Survey or equivalent elevations, where applicable, as reference
6. Drawings of well construction, showing diameter and depth of drill holes, casing and liner diameters and depths, grouting depths, elevations and designation of geological formations, water levels and other details to describe the proposed well completely

7. Location of all existing and potential sources of pollution within 400 feet and major sources of pollution within 1/2 mile of the source and within 100 feet of underground treated water storage facilities
8. Size, length, and identity of sewers, drains, and water mains, and their locations relative to plant structures
9. Schematic flow diagrams and hydraulic profiles showing the flow through various plant units
10. Piping in sufficient detail to show flow through the plant, including waste lines
11. Locations of all chemical feeding equipment and points of chemical application (see Section 6.0, *Chemical Application*)
12. All appurtenances, specific structures, equipment, water treatment plant waste disposal units, and points of discharge having any relationship to the plans for water mains and/or water works structures
13. Locations of sanitary or other facilities, such as lavatories, showers, and toilets, where applicable or required
14. Locations, dimensions, and elevations of all proposed plant facilities
15. Locations of all sampling taps
16. Adequate description of any features not otherwise covered by the specification
17. New facilities should address all actual and potential cross-connections. (see Section 9.9)
18. Existing facilities should conduct a cross-connection survey and take appropriate corrective action where necessary. (see Section 9.9)

1.3 Specifications

Where pertinent, complete, detailed technical specifications shall be supplied for the proposed project, including:

1. A program for keeping existing water works facilities in operation during construction of additional facilities so as to minimize interruption of service
2. Laboratory facilities and equipment
3. The number of chemical feeders (see Section 6.1)

4. Materials or proprietary equipment for sanitary or other facilities including any necessary backflow or back-siphonage protection
5. A table of contents or index for easy reference

1.4 Design Criteria

A summary of complete design criteria shall be submitted for the proposed project, containing, but not limited to, the following:

1. Long-term dependable yield of the source of supply
2. Reservoir surface area, volume, and a volume-versus-depth curve, if applicable
3. Area of watershed
4. Estimated average and maximum daily water demands for the design period
5. Number of proposed services
6. Fire fighting requirements
7. Flash mix, flocculation, and settling basin capacities
8. Retention or detention
9. Unit loadings
10. Filter area and the proposed filtration rate
11. Backwash rate
12. Feeder capacities and ranges
13. Finished water storage capacity, if applicable

1.5 Revisions to Approved Plans

Any deviations from approved plans or specifications affecting the capacity, hydraulic conditions, operating units, functioning of water treatment processes, or quality of water to be delivered must be approved by the Department before initiating. Revised plans or specifications must be submitted in time to permit the review and approval of such plans or specifications before beginning any construction work that will be affected by such changes.

1.6 Deed Restriction

The owner of a transient non-community public water system or any other public water system, if deemed necessary by the Department, shall complete an affidavit containing the same information as that found in Appendix B. The person shall record a notarized copy of the same in the appropriate Registry of Deeds. Said recorded Affidavit shall be referenced in the margin of the Deed holder's deed referencing the Book and Page number of the recorded Affidavit. The public water system must provide the Department with a copy of the completed notarized and recorded deed.

2.0 General Design Considerations

The design of a water supply system or treatment process encompasses a broad area. Application of this part is dependent upon the type of system or process involved. See other relative sections in this document for specific requirements.

Facility Layout

The design shall, at a minimum, consider the following:

1. Functional aspects of the plant layout
2. Provisions for future plant expansion
3. Provisions for expansion of the plant waste treatment and disposal facilities
4. Access roads
6. Site grading
7. Site drainage
8. Driveways
9. Chemical delivery
10. Layout of sanitary waste lines to prevent contamination of water
11. For groundwater sources treating for secondary standards, bypass of the treatment units are permitted, provided that adequate safeguards are taken with regard to cross connection control between treated and untreated water. Under no circumstances shall bypasses be opened, unless the appropriate Regional Office is contacted and grants verbal approval. Disinfection of the unused section of piping between the bypass and the treated water piping may be required, along with flushing through external hydrants prior to opening.
12. For surface water and groundwater sources treating for primary standards, bypasses of the facility are prohibited. The Department will allow the installation of a bypass arrangement, provided that a physical separation is accomplished. Bypasses may be constructed to allow insertion of a spool piece during an emergency, but only after receiving verbal approval from the Department. The water supplier must follow up with written notification to the Department. Bypass arrangements shall contain appropriate valving, metering, and disinfection capabilities, with safeguards taken to prevent entry by unauthorized personnel.

Building Layout

The design shall provide:

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1. Adequate ventilation
2. Adequate lighting
3. Adequate heating
4. Adequate drainage
5. Dehumidification equipment, if necessary
6. Accessibility of equipment for operation, servicing, and removal
7. Flexibility of operation
8. Operator safety
9. Convenience of operation
10. Chemical storage and feed equipment in a separate room to reduce hazards and dust problems
11. Employee facilities

Location of Structures

No structures shall be located that will impede normal or flood stream flow without specific written approval of the Department. All siting shall be done in accordance with 310 CMR 22.04 (Massachusetts Drinking Water Regulations).

Electrical Controls

Main switch gear electrical controls shall be located above grade.

Standby Power

Standby power is required at all water treatment facilities unless it can be demonstrated that the community has the ability to provide the maximum daily demand for up to 24 hours by other means. This may include the combined ability of other sources to provide the maximum daily demand through existing or new emergency power generation at those sources, from storage tanks, or through a viable interconnection with another public water supplier that is part of an emergency plan approved by the Department.

Shop Space and Storage

Adequate facilities should be included for shop space and storage consistent with the designed facilities.

Laboratory Equipment

Laboratory equipment and facilities shall be compatible with the raw water source, intended use of the treatment plant and the complexity of the treatment process involved.

1. Testing equipment provided shall be adequate for the purpose intended and recognized procedures must be used.
2. Sufficient bench space, ventilation, lighting, storage room, laboratory sink, and auxiliary facilities shall be provided. Air conditioning may be necessary.

Monitoring Equipment

1. Facilities treating surface water should have the capability to monitor and record turbidity, the disinfectant residual, and pH continuously. For systems using slow sand filtration, the Department may reduce the sampling frequency to no less than once per day if it determines that less frequent monitoring is sufficient to indicate effective filtration performance.
2. For surface water treatment facilities serving more than 3,300 people, the disinfectant residual must be monitored continuously. Facilities serving 3,300 people or less, may substitute grab samples for disinfectant residual.
3. Groundwater treatment facilities that remove iron and/or manganese and serve more than 3,300 people shall have the capability to monitor and record free chlorine residual, if required, pH, and pressure. For facilities serving 3,300 people or less, grab samples may be substituted.
4. Facilities adjusting the pH of the water by chemical addition shall have the capability to monitor and record pH continuously if they serve more than 3,300 people. For facilities serving 3,300 people or less, grab samples may be substituted if approved by the Department.
5. Facilities with continuous monitoring equipment should have alarm capabilities to notify operator or appropriate staff in the event of a treatment malfunction.

Sample Taps

Sample taps shall be provided so that water samples can be obtained from each water source and from appropriate locations in each unit operation of treatment. Sample taps must be labeled. Taps shall be consistent with sampling needs and shall not be of the petcock type. Taps used for obtaining samples for bacteriological analysis shall be of the smooth-nosed type without interior or exterior threads, shall not be of the mixing type, and shall not have a screen, aerator, or other such appurtenance.

Facility Water Supply

The facility water supply service line and the plant finished water sample tap shall be supplied from a source of finished water at a point where all chemicals have been thoroughly mixed. Generally, the facility can meet this requirement if the source of finished water is located at least 100 feet downstream from the last point of chemical injection; however, in choosing this location, consideration must be given to the flow rate and the pacing equipment used for chemical injection.

Wall Castings

Consideration shall be given to providing extra wall castings built into the structure to facilitate future uses whenever pipes pass through walls of concrete structures.

Meters

All systems shall have an acceptable means of metering and totaling the finished water and calibrating meters.

Piping Color Code

To facilitate identification of piping in plants and pumping stations, it is recommended that the following color scheme be used:

Water Lines

| | |
|----------------------|-------------|
| Raw | Olive green |
| Settled or Clarified | Aqua |
| Finished or Potable | Dark blue |

Chemical Lines

| | |
|-----------------------------|------------------------------|
| Alum | Orange |
| Ammonia | White |
| Carbon Slurry | Black |
| Chlorine (Gas and Solution) | Yellow |
| Fluoride | Light blue with red band |
| Lime Slurry | Light green |
| Potassium Permanganate | Violet |
| Sulfur Dioxide | Light green with yellow band |

Waste Lines

| | |
|---------------------------|-------------|
| Backwash Waste | Light brown |
| Sludge | Dark brown |
| Sewer (sanitary or other) | Dark grey |

Other

| | |
|----------------|------------|
| Compressed Air | Dark green |
| Gas | Red |
| Other Lines | Light grey |

In situations where two colors do not have sufficient contrast to easily differentiate between them, a 6-inch band of contrasting color should be painted on one of the pipes at approximately 30-inch intervals. The name of the liquid or gas should be painted on the pipes. In some cases it may be advantageous to paint arrows indicating the direction of flow.

Disinfection

All wells, pipes, tanks, and equipment, which can convey or store potable water shall be disinfected in accordance with AWWA procedures or other procedures approved by the Department. Plans and specifications shall outline the procedure and include the disinfectant dosage, contact time, and method of testing the results of the procedure. After disinfection, one or

more water samples shall be submitted to a Massachusetts or EPA certified laboratory for bacteriological analyses. Satisfactory results shall be reported to the Department prior to placing the well, pipe, tank, and/or other facility in service.

Manual and Parts List

An operation and maintenance manual, including a parts list and parts order form, shall be supplied to the water works as part of any propriety unit installed in the facility. The operation and maintenance manual shall be submitted to the Department for approval before a water treatment facility goes on-line and should conform to *Policy 93-02, Operation and Maintenance Manuals*.

Operator Certification and Instruction

1. Provision shall be made to ensure:
 - a. that the facility or PWS is under the direct supervision of an operator who holds a valid certification equal to or greater than the classification of the treatment facility and/or the distribution system;
 - b. that the operator(s) in responsible charge must hold a valid certification equal to or greater than the classification of the PWS;
 - c. that all operating personnel making process control/system integrity decisions about water quality or quantity that affect public health be certified; and
 - d. that a designated certified operator be available for each operating shift as prescribed by 310 CMR 22.11B.
2. Provision shall be made for operator training at the start-up of a plant or pump station.

Other Considerations

Consideration must be given to the design requirements of other federal, state, and local regulatory agencies for items such as safety requirements, special designs for the handicapped, plumbing, and electrical codes.

3.0 Surface Water Supply Development

A surface water supply includes all tributary streams and drainage basins, natural lakes, and artificial reservoirs or impoundments used as sources of water by a public water system. In selecting the source to be developed, the design engineer must prove to the Department's satisfaction that an adequate quantity of water will be available and that the water delivered to consumers will meet all state drinking water standards with respect to microbiological, physical, chemical, and radiological qualities. Each water system should draw its raw water from the best available source that is economically reasonable and technically possible.

3.1 Approval of a New Surface Water Source in an Existing Water Body

Step 1: Submit Preliminary Report

The public water supplier must submit a report to the Department that includes the following:

1. Topographic map showing the exact locations of the proposed source and the proposed intake
2. Map of appropriate scale delineating the tributaries and Zones A, B, and C as described in the *Definitions* section
3. Identification of land uses in the watershed and identification of the land owned or controlled by the public water supplier
4. Estimated average daily demand and peak daily demand
5. Schedule for development of the source
6. Detailed estimated cost of operation, maintenance, and operating expenses
7. Proposed methods to finance both capital charges and operating expenses

Step 2: Conduct Site Visit

The Department will conduct a site visit after the water supplier has gathered the proper information from the property owners and obtained any necessary approvals for visiting the site. At the site exam, the Department will evaluate the proposed sampling locations and schedule to be used during the development of the source.

Step 3: Attend Coordination Meeting

The Department will arrange a coordination meeting with the programs whose approval may be needed. Meeting participants will include, but not be limited to:

- The Department Wetlands Program (including dredging program)
- The Department Water Management Act Program
- MEPA Office
- DEM (concerning the safety of existing dams or surface impoundments)
- DFWELE Natural Heritage Program
- Army Corps of Engineers

The main goal of this meeting is to establish a schedule for getting the necessary approvals from all programs involved.

Step 4: Submit Formal Documentation

The following information must be submitted to the Department before a new surface water source can be approved:

1. Safe Yield Analysis - For stream dominated sand and gravel reservoirs, the safe yield will be estimated by using the safe yield model as described in the Water Management Program document *Estimating the Firm Yield of a Surface Water Reservoir Supply System in Massachusetts, A Guidance Document*, Version 1.0, January 1996. For non-stream dominated reservoirs, a pumping test will be conducted to determine the safe yield and will comply with the following criteria:
 - a. The pumping test shall be conducted for a minimum of 30 days.
 - b. The pumping test shall be conducted at 133% of the rate at which approval is sought.
 - c. The approved pumping rate will be based on the rate at which stabilization occurs.
 - d. Reservoir water level measurements will be taken twice daily (frequency of measurements will be at least 8 hours apart).
 - e. Stabilization will have been achieved when either:
 - (1) drawdown readings do not fluctuate more than 0.5 inch in the last 24 hours of the test; or
 - (2) when using a semi-log plot extrapolation of the time-drawdown curve derived from the pumping test and projected over a 180- day period, and 10% of the water height between the top of the intake and the static water level remains above the intake.
 - f. As constant a pumping rate as possible shall be maintained for the duration of the pumping test. The pumping rate shall not fluctuate more than 10% during the final 10 days of the pumping test, excluding shutdowns.

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- g. One pump shutdown per day not to exceed 1 hour shall be allowed during the 30-day test period. If the shutdown criteria are exceeded, the Department will require the pumping test to be rerun; therefore, backup pumping equipment is recommended.
 - h. A flow-measuring device capable of providing instantaneous flow measurements accurate to within $\pm 3\%$ of the pumping rate shall be used.
 - i. The discharge from the pumping test shall be located to minimize the recirculation of water. Any groundwater discharge permits should be obtained prior to commencement of the pumping test.
 - j. Static water level measurements will commence 7 days prior to pumping test startup.
 - k. The pumping test should be conducted during low water level conditions.
 - l. Precipitation during the pumping test should be measured on site to the nearest one-hundredth (0.01) of an inch. Precipitation measurements should commence 7 days prior to pumping test startup.
 - m. Recovery reading shall be taken twice daily (frequency of measurements at least 8 hours apart) for a period of no less than 10 days following pumping test shutdown.
2. Hydrogeologic Report - Discuss the hydrogeologic system providing recharge to the reservoir and include a delineation of the drainage basin. If applicable, a fracture trace analysis of the reservoir area should be provided.
 3. Identification of Dredging Impacts
 4. Water Quality Monitoring Report - The water supplier must submit a report describing the required monitoring at this time, the water supplier may also elect to perform any additional monitoring required by *Policy 90-04, Pilot Study Requirements for Proposed Treatment*.

The water supplier must conduct the following monitoring at a location as close as possible to the proposed intake:

- a. Fecal and Total Coliform - Weekly for 1 year (If interested in filtration waiver, frequency of sampling is population dependent (3 - 5 times/week))
- b. Turbidity, Color, Odor, Temperature, Suspended and Total Dissolved Solids - Weekly (If interested in a filtration waiver, turbidity must be done Daily for one year)
- c. Secondary Contaminants (as listed in Appendix A) - Addressing reservoir turnover, typically spring and fall
- d. All SDWA Contaminants - Taken during spring turnover
- e. Total Organic Carbon - Seasonally
- f. *Giardia* and *Cryptosporidium* - Every other month
- g. Nitrogen Series (nitrate, nitrite, ammonia) - Monthly

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- h. THM Formation Potential - Monthly in July, August, and September
 - i. Algae - Monthly throughout the year at intake, major tributaries and at one or more locations in the reservoir.
5. Watershed Resource Protection Plan - Guidance can be found in the document *Developing a Local Surface Water Supply Protection Plan, DEP, 2000*.
 6. Proposed Treatment Plan - Every surface water supply is subject to the federal Surface Water Treatment Rule (SWTR), as written in 310 CMR 22.20A of the Massachusetts Drinking Water Regulations. The water supplier must submit a report discussing how it plans to meet the requirements of the SWTR. If planning to filter, treatment of the source must be determined through piloting according to *Policy 90-04, Pilot Study Requirements for Proposed Treatment*.

If a public water supplier is interested in a filtration waiver as specified in 310 CMR 22.20A, the water supplier must pursue development of a watershed resource protection plan. The plan must meet the criteria defined in *Policy 89-09, Preparation of a Watershed Resource Protection Plan*, and must be developed on a dual track with the treatment plant design. The water supplier must meet all criteria to avoid filtration. In addition, the water supplier must discuss how the system will provide disinfection in the interim if a waiver from filtration is pursued.

7. Operation and Maintenance Manual-for management of the source

3.2 Development of New Reservoirs

Construction and Maintenance

1. Reservoirs must be constructed to ensure that:
 - a. Water quality is protected by controlling runoff into the reservoir
 - b. Dikes are structurally sound, free of significant vegetation, and protected against wind action and erosion
 - c. The point of influent flow is separated from the point of withdrawal
 - d. Separate pipes are provided for influent to and effluent from the reservoir
 - e. The volume of water in storage can be determined at all times
2. Dams must receive appropriate safety approval from DEM.

3. Construction may require:
 - a. Approval from the Department and DEM, as necessary, of the safety features for stability and spillway design
 - b. A permit from the Department and other regulatory agencies for controlling streamflow or installing a structure on the bed of a stream or interstate waterway

Site Preparation

Site preparation for the reservoir shall include, where applicable:

1. Removal of brush and trees up to high water elevation
2. Protection from floods during construction
3. Proper abandonment and decommissioning (Section 4.14) of all wells and other structures or other facilities that will be inundated
4. Erosion minimization during development of the source

Intake Structures and Design

Intake structures and design shall include:

1. Intake screens
2. Withdrawal of water from more than one level if quality varies with depth
3. Separate facilities for release of less desirable water held in storage
4. Where ice may be a problem, holding the velocity of flow into the intake structure to a minimum, generally not to exceed 0.5 feet per second
5. Manholes every 1000 feet for pipe sizes large enough to permit visual inspection
6. Cleaning of the intake pipe and screen, as needed
7. Adequate protection against rupture by ice and other potential hazards
8. Location of the intake above the bottom of the stream, lake, or impoundment, but at sufficient depth to be kept submerged at low water level

3.3 New Feeder Reservoirs

1. The water supplier must meet all applicable requirements in Section 3.0.
2. Proposals for new feeder reservoirs must address physical and chemical changes to the terminal reservoir and any effects on existing treatment.
3. Both the terminal reservoir and the feeder reservoir must be monitored during the approval process.

4.0 Groundwater Supply Development and the Source Approval Process

Editor's note: This chapter has been revised. Please refer to the MassDEP website, <http://www.mass.gov/dep/water/laws/policies.htm#dwguid>, for the current version of Chapter 4.

5.0 Treatment

Editor's note: This chapter has been revised. Please refer to the MassDEP website, <http://www.mass.gov/dep/water/laws/policies.htm#dwguid>, for the current version of Chapter 5.

6.0 Chemical Application

Editor's note: This chapter has been revised. Please refer to the MassDEP website, <http://www.mass.gov/dep/water/laws/policies.htm#dwguid>, for the current version of Chapter 6.

7.0 Pumping Facilities

Editor's note: This chapter has been revised. Please refer to the MassDEP website, <http://www.mass.gov/dep/water/laws/policies.htm#dwguid>, for the current version of Chapter 7.

8.0 Finished Water Storage

The material and designs used for finished water storage structures shall provide stability and durability as well as protect the quality of the stored water. Steel structures shall follow the current AWWA standards concerning steel tanks, standpipes, reservoirs, and elevated tanks wherever they are applicable. Other materials of construction are acceptable when properly designed to meet the requirements of this section.

Sizing

Storage facilities should have sufficient capacity, as determined from engineering studies, to meet domestic demands, and fire flow demands where fire protection is provided.

1. Fire flow requirements established by the appropriate National Board of Fire Underwriters should be satisfied where fire protection is provided.
2. The minimum storage capacity (or equivalent capacity) for systems not providing fire protection shall be equal to the average daily consumption. This requirement may be reduced when the source and treatment facilities have sufficient capacity with standby power capability to meet peak demands of the system.

Location of Ground-Level Reservoirs

1. The bottom of reservoirs and standpipes should be placed at the normal ground surface and shall be above maximum flood level.
2. When the bottom must be below normal ground surface, it shall be placed above the water table. Sewers, drains, standing water, and similar potential sources of contamination must be kept at least 50 feet from the reservoir. Water main pipe, pressure tested in place to 50 psi without leakage, may be used for gravity sewers at distances greater than 20 feet and less than 50 feet.
3. The top of a reservoir shall not be less than 2 feet above normal ground surface. Clearwells may be excepted from this requirement when the total design gives the same protection.

Protection

All finished water storage structures shall have suitable watertight roofs that exclude birds, animals, insects, and excessive dust.

Protection from Trespassers

Fencing, locks on access manholes, and other necessary precautions shall be provided to prevent trespassing, vandalism, and sabotage.

Drains

8.0 Finished Water Storage

No drains on a water storage structure may have a direct connection to a sewer or storm drain. Drainage shall be directed to an area where flooding and erosion will not occur.

Overflow

All water storage structures shall be provided with an overflow that is brought down to an elevation between 12 and 24 inches above the ground surface, and discharges over a drainage inlet structure or a splash plate. No overflow may be connected directly to a sewer or storm drain. All overflow pipes shall be located so that any discharge is visible.

1. When an internal overflow pipe is used on elevated tanks, it should be located in the access tube. For vertical drops on other types of storage facilities, the overflow pipe should be located on the outside of the structure.
2. The overflow of a ground-level structure shall open downward and be screened with 24-mesh noncorrodible screen installed within the pipe at a location least susceptible to damage by vandalism.
3. The overflow pipe shall be of sufficient diameter to permit waste in excess of the filling rate.

Access

Finished water storage structures shall be designed with reasonably convenient access to the interior for cleaning and maintenance. Manholes above the waterline:

1. Shall be framed at least 4 inches, and preferably 6 inches, above the surface of the roof at the opening; on ground-level structures, manholes should be elevated 24 to 36 inches above the top or covering sod
2. Shall be fitted with a solid watertight cover which overlaps the framed opening and extends down around the frame at least 2 inches
3. Should be hinged at one side
4. Shall have a locking device

Valve Pit

A valve pit with necessary valves, gauges, and sampling tap to collect a representative sample shall be installed. A corporation cock between tank and valve to allow the injection of chlorine shall be installed.

Vents

Finished water storage structures shall be vented. Overflows shall not be considered as vents. Open construction between the sidewall and roof is not permissible. Vents:

1. Shall prevent the entrance of surface water and rainwater
2. Shall exclude birds and animals
3. Should exclude insects and dust, as much as this function can be made compatible with effective venting, for elevated tanks and standpipes, four-mesh non-corrodible screens may be used
4. Ground-level structures, terminate in an inverted “U” or similar type construction with the opening 24 to 36 inches above the roof or sod and covered with 24-mesh noncorrodible screen installed within the pipe at a location least susceptible to vandalism

Roof and Sidewall

The roof and sidewalls of all structures must be watertight with no openings except properly constructed vents, manholes, overflows, risers, drains, pump mountings, control ports, or piping for inflow and outflow.

1. Any pipes running through the roof or sidewall of a finished water storage structure must be welded, or properly gasketed in metal tanks. In concrete tanks, these pipes shall be connected to standard wall castings which were poured in place during the forming of the concrete. These wall castings should have seepage rings imbedded in the concrete.
2. Openings in a storage structure roof or top, designed to accommodate control apparatus or pump columns, shall be curved and sleeved with proper additional shielding to prevent the access of surface or floor drainage water into the structure.
3. Valves and controls should be located outside the storage structure so that the valve stems and similar projections will not pass through the roof or top of the reservoir.

Roof Drainage

The roof of the storage structure shall be well drained. Downspout pipes shall not enter or pass through the reservoir. Parapets, or similar construction which would tend to hold water and snow on the roof, will not be approved unless adequate waterproofing and drainage are provided.

Safety

The safety of employees must be considered in the design of the storage structure. As a minimum, such matters shall conform to pertinent laws and regulations of the area where the reservoir is constructed.

1. Ladders, ladder guards, balcony railings, and safely located entrance hatches shall be provided where applicable.
2. Elevated tanks with riser pipes over 8 inches in diameter shall have protective bars over the riser openings inside the tank.
3. Railings or handholds shall be provided on elevated tanks where persons must transfer from the access tube to the water compartment.

Freezing

All finished water storage structures and their appurtenances, especially the riser pipes, overflows, and vents, shall be designed to prevent freezing that will interfere with proper functioning.

Internal Catwalk

Every catwalk over finished water in a storage structure shall have a solid floor with raised edges and designed so that shoe scrapings and dirt will not fall into the water.

Silt Stop

The discharge pipes from all reservoirs shall be located in a manner that will prevent the flow of sediment into the distribution system. Removable silt stops should be provided where feasible.

Grading

The area surrounding a ground-level structure shall be graded in a manner that will prevent surface water from standing within 50 feet of the structure.

Painting and/or Cathodic Protection

Proper protection shall be given to metal surfaces using paints or other protective coatings and/or, by cathodic protective devices.

1. Paint systems shall meet appropriate AWWA specification. After proper curing, the coating shall not transfer any substances to the water that will be toxic or cause tastes or odors. The tank shall be flushed, disinfected, filled with water, and sampled for coliform and volatile organic compounds prior to going back into service.

2. Cathodic protection should be designed and installed by competent technical personnel.

Disinfection

Finished water storage structures shall be disinfected after construction, repair or maintenance operations in accordance with current AWWA Standards. Representative samples shall indicate microbiologically satisfactory water before the facility is placed into operation.

Maintenance

The exterior and interior of tank should be cleaned and/or inspected annually by qualified personnel. A thorough structural and coating inspection should be conducted every 5 years.

8.1 Plant Storage

The applicable design standards of Section 8.0 shall be followed for plant storage.

Washer Tanks

Washwater tanks shall be sized, in conjunction with available pump units and finished water storage, to provide the backwash water required by Section 5.2, *Chemical Feed*. Consideration must be given to the backwashing of several filters in rapid succession.

Clearwell

Clearwell storage should be sized, in conjunction with distribution system storage, to relieve the filters from following fluctuations in water use.

1. When finished water storage is used to provide the contact time for chlorine (Section 5.3.Chloramination), special attention must be given to size and baffling.
2. An overflow device should be provided.

Adjacent Compartments

Finished water shall not be stored or conveyed in a compartment adjacent to unsafe water when the two compartments are separated by a single wall.

Basins and Wet-Wells

Receiving basins and pump wet-wells for finished water shall be designed as finished water storage structures.

8.2 Pressure Tanks

Hydropneumatic (pressure) tanks, when provided as the only storage facility, are acceptable only in very small water systems. Hydropneumatic storage is considered primarily as an electrical pump control mechanism and not as true water storage. If a community public water system has a design average day flow of 7,500 gallons per day or greater, ground or elevated storage designed in accordance with Section 8.0. should be provided. Pressure tank storage is not considered for fire protection purposes. Pressure tanks shall meet ASME code requirements or an equivalent requirement of state and local laws and regulations for the construction and installation of unfired pressure vessels.

Location

The tank shall be located above normal ground or floor surface and be completely housed and heated for protection from both physical damage and freezing. Earth mounding over the tank is not recommended.

Sizing

1. The approved yield of each well in a community hydropneumatic system should be at least ten times the design average daily consumption rate. A minimum of two wells must be provided, each with the approved yield of at least ten times the design average daily consumption rate.
2. The capacity of wells and pumps in a non-community system should be sized to meet the peak instantaneous design demand in gallons per minute.
3. The gross volume of a hydropneumatic tank, in gallons, should be at least ten times the capacity of the largest pump, rated in gallons per minute. For example, a 250 gpm pump should have a 2,500 gallon pressure tank. Delivery volume in gallons of water from bladder type hydropneumatic tank(s) should be at least three times the capacity (in GPM) of the largest supplying pump (typical for non-community systems).
4. Sizing of hydropneumatic storage tanks must consider the need for chlorine detention time.

Piping

The tank shall have bypass piping to permit operation of the system while it is being repaired or painted. If more than one tank is utilized, each tank should be able to be isolated separately. Provisions should be provided to maintain system pressure while the tank is out of service.

Appurtenances

1. All pressure tanks (including bladder type) shall provide:
 - a. A drain
 - b. A pressure gauge

- c. An automatic or manual air blow-off
 - d. A means of adding air
 - e. A pressure-activated off/on switch to control the supply pump
 - f. A thermal overload or low water cut-off switch for pump protection
- 2.. Hydropneumatic tanks shall provide:
- a. An access manhole, if size of tank permits
 - b. A water sight glass
 - c. The size of the access manhole should be 24 inches in diameter, where practical

8.3 Distribution Storage

The applicable design and maintenance standards of Section 8.0 shall be followed for distribution system storage.

Pressures

The maximum variation between high and low levels in storage structures providing pressure to a distribution system should not exceed 30 feet. The minimum working pressure in the distribution system should be 35 psi and the normal working pressure should be approximately 60 psi. When static pressures exceed 100 psi, pressure reducing devices should be provided on mains in the distribution system.

Drainage

Storage structures which provide pressure directly to the distribution system shall be designed so they can be isolated from the distribution system and drained for cleaning or maintenance without necessitating loss of pressure in the distribution system. The drain shall discharge to the ground surface with no direct connection to a sewer or storm drain.

Level Controls

Adequate controls shall be provided to maintain levels in distribution system storage structures. Level indicating devices should be provided at a central location.

1. Pumps should be controlled from tank levels with the signal transmitted by telemetering equipment when any appreciable head loss occurs in the distribution system between the source and the storage structure.
2. Altitude valves or equivalent controls may be required for a second and subsequent structures on the system.
3. Overflow and low-level warnings or alarms should be located at places in the community where they will be under responsible surveillance 24 hours a day.

9.0 Distribution Systems

In determining if a water treatment, collection, storage or distribution system constitutes a public water system as defined by 310 CMR 22.00, the Department shall use the higher value generated by multiplying the:

1. Number of service connections by 1.6
2. Number of bedrooms by 2.0 (or 3.2 in areas of seasonal use)

In determining the average volume of water necessary to support a particular number of residents, the number of residents shall be multiplied by 100 gallons per day per capita. The average water volume accounts for water used for consumption, food preparation, laundering, bathing, and all other indoor sanitary uses with the exception of filling or maintaining indoor swimming pools.

9.1 Materials

1. Standards - Pipe, fittings, valves and fire hydrants shall conform to the latest standards issued by the AWWA, if such standards exist.
2. Used Materials - Water mains which have been used previously for conveying potable water may be reused provided they meet the above standards and have been thoroughly cleaned and restored practically to their original condition.
3. Joints - Packing and jointing materials used in the joints of pipe shall meet the standards of the AWWA. Pipe having mechanical joints or slip-on joints with rubber gaskets is preferred.

9.2 Water Main Design

The normal working pressure in the distribution system should be approximately 60 psi and not less than 35 psi.

1. Pressure - All water mains, including those not designed to provide fire protection, shall be sized after a hydraulic analysis based on flow demands and pressure requirements. The system shall be designed to maintain a minimum pressure of 20 psi at ground level at all points in the distribution system under all conditions of flow.
2. Diameter - The minimum size of water main for providing fire protection and serving fire hydrants shall be 8-inch diameter. Larger size mains should be provided if necessary to allow the withdrawal of the required fire flow while maintaining the minimum residual pressure specified in 9.1.1.
3. Fire Protection - When fire protection is to be provided, the system should be designed so that fire flows and facilities meet the requirements of the NBFU.

4. Small Mains - Any departure from minimum requirements should be justified by hydraulic analysis and future water use, and be considered only in special circumstances.
5. Hydrants - Water mains not designed to carry fire-flows shall not have fire hydrants connected to them.
6. Dead Ends - Dead ends shall be minimized by looping of all mains whenever practical.
7. Flushing - Where dead-end mains occur, they shall be provided with a fire hydrant if flow and pressure are sufficient, or with an approved flushing hydrant or blow-off for flushing purposes. It is recommended that all distribution systems be flushed twice each year. No flushing device shall be directly connected to any sewer.
8. Water Mains - Water mains that have been removed from service for repairs or maintenance or that continue to show the presence of coliform organisms shall be disinfected in accordance with AWWA standard C-651.
9. Annual Maintenance - The Department recommends annual system-wide flushing and a gate valve exercising program.

9.3 Valves

Sufficient valves shall be provided on water mains so that inconvenience and sanitary hazards will be minimized during repairs. Valves should be located at not more than 500-foot intervals in commercial districts and at not more than one block or 800-foot intervals in other districts.

9.4 Hydrants

1. Location and Spacing - Hydrants should be provided at each street intersection and at intermediate points between intersections as recommended by the NBFU Office. Generally, hydrant spacing may range from 350 to 600 feet depending on the area being served.
2. Valves and Nozzles - Fire hydrants should have a bottom valve size of at least 5 inches, one 4-1/2 inch pumper nozzle and two 2-1/2 inch nozzles.
3. Hydrant Leads - The hydrant lead shall be a minimum of 6 inches in diameter. Auxiliary valves shall be installed in all hydrant leads.
4. Drainage - When drains are plugged, the barrels should be pumped dry during freezing weather. Food grade glycerine may be used as antifreeze. Where hydrant drains are not plugged, a gravel pocket or dry well shall be provided unless the natural soils will provide adequate drainage. Hydrant drains shall not be connected to or located within 10 feet of sanitary sewers or storm drains.

9.5 Air Relief Valves: Valve, Meter, and Blow-off Chambers

1. Air Relief Valves - At high points in water mains where air can accumulate, provisions shall be made to remove the air by means of hydrants or air relief valves. Automatic air-relief valves shall not be used in situations where flooding of the manhole or chamber may occur.
2. Air Relief Valve Piping - The open end of an air relief pipe from automatic valves shall be extended to at least 1 foot above grade and provided with a screened, downward-facing elbow. The pipe from a manually operated valve should be extended to the top of the pit.
3. Chamber Drainage - Chambers, pits or manholes containing valves, blow-offs, meters, or other such appurtenances to a distribution system shall not be connected directly to any storm drain or sanitary sewer, nor shall blow-offs or relief valves be connected directly to any sewer.

9.6 Installation of Mains

1. Standards - Specifications shall incorporate the provisions of the AWWA standards and/or manufacturer's recommend installation procedures.
2. Bedding - A continuous and uniform bedding shall be provided in the trench for all buried pipe. Backfill material shall be tamped in layers around the pipe and to a sufficient height above the pipe to adequately support and protect the pipe. Stones found in the trench shall be removed for a depth of at least 6 inches below the bottom of the pipe.
3. Cover - All water mains shall be covered with sufficient earth or other insulation to prevent freezing.
4. Blocking - All tees, bends, plugs and hydrants shall be provided with reaction blocking, tie rods or joints designed to prevent movement.
5. Pressure and Leakage Testing - The installed pipe shall be pressure tested and leakage tested in accordance with AWWA Standard C600.
6. Disinfection - All new, cleaned or repaired water mains shall be disinfected in accordance with AWWA Standard C601. The specifications shall include detailed

procedures for the adequate flushing, disinfection, and microbiological testing of all water mains.

7. Chlorinated Discharge - In accordance with AWWA Standard C-651, thorough consideration should be given to the impact of discharge of highly chlorinated water to the environment. If there is any possibility that chlorinated discharge will cause damage to the environment, a neutralizing chemical, as listed in AWWA standard C-651, shall be applied to the water to be wasted to neutralize thoroughly the chlorine residual remaining in the water. Where necessary, federal, state, and local regulatory agencies should be contacted to determine special provisions for the disposal of heavily chlorinated water.

9.7 Separation of Water Mains and Sewers

1. General - The following factors should be considered in providing adequate separation:
 - a. Materials and type of joints for water and sewer pipes
 - b. Soil conditions
 - c. Service and branch connections into the water main and sewer line
 - d. Compensating variations in the horizontal and vertical separations
 - e. Space for repair and alterations of water and sewer pipes
 - f. Off-setting of pipes around manholes
2. Parallel Installation - Water mains shall be laid at least 10 feet horizontally from any existing or proposed sewer. The distance shall be measured edge to edge. In cases where it is not practical to maintain a 10-foot separation, it is permissible to install a water main closer to a sewer. However, the water main must be laid in a separate trench or on an undisturbed earth shelf located on one side of the sewer at such an elevation that the bottom of the water main is at least 18 inches above the top of the sewer.
3. Crossings - Water mains crossing sewers shall be laid to provide a minimum vertical distance of 18 inches between the outside of the water main and the outside of the sewer. It is preferred that the water main cross above the sewer. At crossing, one full length of water pipe shall be located so both joints will be as far from the sewer as possible. Special structural support for the water and sewer pipes may be required, as well as special materials for construction and connecting devices.
4. Sewer Manholes - No water pipe shall pass through or come in contact with any part of a sewer manhole.

9.8 Surface Water Crossings

Surface water crossings, whether over or under water, present special problems.

1. Above-Water Crossings - The pipe shall be adequately supported and anchored, protected from damage and freezing, and accessible for repair or replacement.
2. Underwater Crossings - A minimum cover of 2 feet shall be provided over the pipe. When crossing water courses which are greater than 15 feet in width, the following shall be provided:
 - a. The pipe shall be constructed with flexible watertight joints.
 - b. Valves shall be provided at both ends of water crossings so that the section can be isolated for testing or repair; the valves shall be easily accessible, and not subject to flooding; the valve closest to the supply source shall be in a manhole.
 - c. Permanent taps shall be made on each side of the valve within the manhole to allow insertion of a small meter gauge for testing to determine leakage and for sampling purposes.

9.9 Cross Connections

A cross connection is an interconnection between the potable drinking water line and any connection with non-potable water, gases, or chemicals.

Cross-connection Control Program Plan

Every public water system shall have a cross-connection control program approved by the DEP. A community PWS cross-connection control program must include a program description, staff profile, strategies for testing, surveying, compliance and enforcement, fees structure, all forms required by the state, and a registration and tracking system. Small community PWS, with a population less than 3,300 people, must complete the questionnaire, *Cross-connection Control Program Plan for Small Community Public Water Systems*. Non-community PWS must complete the *Cross-connection Program Plan Questionnaire for Non-community Public Water Systems*.

Cross-Connection Survey

All commercial, industrial and institutional facilities must be surveyed for cross-connections by a public water system. All cross connection surveys must be conducted by a Massachusetts Certified Cross-Connection Surveyor.

Backflow Preventer Devices

1. Backflow prevention devices must be installed by a Massachusetts Certified Plumber, with the exception of devices located on fire protection systems. A Massachusetts Certified Fire Sprinkler Installer must install these particular devices.
2. A Massachusetts Certified Backflow Prevention Device Tester shall do all tests performed on backflow prevention devices.
3. Backflow prevention devices must meet the following installation specifications:
 - a. Reduce pressure backflow preventer (RPBP) and double check valve assembly (DCVA) with shut-off;
 - b. Backflow prevention devices must be installed in a horizontal alignment between 36 and 48 inches from the floor to the bottom of the device and a minimum of 12 inches from any wall; and
 - c. Installation of RPBP and DCVA in a vertical position must be determined by the PWS, considering adequate distances for the testing and maintenance of the devices.

Fire Protection Systems

1. All existing cross-connections between public water systems and fire protection systems, (310 CMR 22.22), installed prior to March 21, 1997, shall be equipped with an UL listed alarm check valve with the standard alarm pressure switch trim package. The device shall comply with regulatory requirements of 310 CMR 22.22(9)(d)6.
2. Fire protection systems installed on or after March 21, 1997, shall be equipped with a protection device as specified at 310 CMR 22.22(9)(d)l. Generally, a backflow prevention device should be installed when the cost (device and installation) is equal to or less than 5% of the total cost of the fire protection system modification; or when the total cost of the system modification (excluding installation costs) equals or exceeds \$100,000.
3. A PWS may not approve the installation of a backflow prevention device until a building permit is issued in accordance with 780 CMR, and approved by the local fire department.

Cross-Connection Certification and Renewal

1. Backflow Prevention Device Testers and/or a Cross-Connection Surveyor must pass the respective certification examinations approved by the Department.

2. Cross-connection surveyors must be certified annually. If a surveyor does not apply for a cross-connection certification for more than one year from the original exam date, they must retake the exam.
3. Cross-connection surveyors or testers that have expired certifications (more than one year from the expiration date), must retake the exam, or attend a certification renewal class as approved by the DEP.

Cross-Connection Surveyor Responsibilities

1. Surveys
 - a. Inspect all the distribution systems beginning at meter or source until the last tap.
 - b. Keep records of findings by using the Cross-connection Survey Report form and Violation Notice available through the Department.
 - c. Submit a cross-connection survey report to the facility owner. If the town subcontract the services of a surveyor, the cross-connection survey report must be routed through the PWS before going to the facility owner.
 - d. Facility owner is responsible for eliminating or protecting all existing and potential cross-connections within the facility.
 - e. The facility owner must submit plans and design data sheet for the installation of backflow prevention devices to the PWS.
2. Plans and Design Data Sheet
 - a. Review and approve or deny the plans for the installation of air gap separation.
 - b. Letters of approval or denial must be signed the person responsible for the cross connection program at the PWS.
 - c. Submit approval letters to the local plumbing inspector; or to the local building inspector and fire marshal for devices on fire protection systems.

Steps

New Facilities -To avoid creating cross connections in new facilities, have the PWS, plumbing inspector, building inspector and fire marshal review the plumbing plans.

Existing Facilities - The facility owner is responsible for the elimination or proper protection of all cross-connections found as a result of a cross-connection survey. All plans for corrective actions of cross-connections that require the installation of a reduced pressure backflow preventer (RPBP) or double check valve assembly (DCVA) must be submitted to the PWS for review and approval. A plumbing permit must be issued for all the other backflow preventer devices. The installation must be done by a license plumber and inspected by the local plumbing inspector. In some cases, other local officials should be involved, such as the fire marshal and/or building inspector.

10.0 Water Management Act Requirements

Editor's note: This chapter is presented separately on the MassDEP website, <http://www.mass.gov/dep/water/laws/policies.htm#dwguid>.

11.0 Capacity Development and Standard Operation Procedures

This guidance is designed to provide public waters systems with methodologies to establish and maintain the “technical, managerial and financial capacity” to sustain operations as required by the Federal Safe Drinking Water Act. The guidance is intended as a voluntary tool for systems to use as appropriate. Nevertheless, in accordance with MGL Chapter 111 Section 160 the Department may require certain systems in noncompliance to follow particular aspects of this guidance in order to achieve or return to compliance. Not all parts of Chapter 11 are applicable to all systems.

11.1 Synopsis of Capacity Development Process

In accordance with the U.S.EPA guidance on capacity, public water system capacity is the ability of a public water system to plan for, and maintain compliance with applicable federal and state drinking water standards. Capacity has three components: technical, managerial, and financial. Adequate capability in all three areas is necessary for a system to have “capacity”. In evaluating system Capacity, the Department requires the demonstration of effective controls in all three areas of Capacity.

In accordance with the U.S.EPA guidance on capacity, public water system capacity Development is the process of a water system acquiring and maintaining adequate technical, managerial, and financial capabilities to enable it to consistently provide safe drinking water.

As part of the Safe Drinking Water Act Amendments of 1996 (SDWA), each state had to submit a Capacity Development Strategy to EPA. The Department’s Strategy was submitted and accepted. The Strategy outlined ways in which The Department would work together with water systems to ensure that the PWS acquire and maintain the technical, financial and managerial capacity needed to meet the SDWA public health objectives. The preceding chapters of these guidelines primarily discuss the minimum criteria used by the Department to demonstrate adequate technical capacity. Therefore, this chapter will address the minimum guidelines that demonstrate financial and managerial capacity and delineate the processes that are necessary to plan for, achieve and maintain capacity.

The Department will use the following three processes to assist public water systems to achieve capacity:

1. Education and Technical Assistance– In addition to information on technical issues the Department will provide PWS with financial and managerial reference material, training and technical assistance.
2. Prevention – The Department will provide PWS with capacity guidelines that PWS can use to forestall a technical, financial or managerial breakdown that could result in violation of a drinking water standard, in poor drinking water quality and/or in a public health emergency.

3. Corrective Action – Drinking water records indicate and the Department recognizes the fact that some violations of the Department’s “technical” requirements are often

the result of a “financial” or “managerial” breakdown. When the Department makes such a determination, it will use these guidelines in conjunction with its Enforcement Strategy to improve the financial and managerial health of the system.

The following managerial and financial capacity guidelines can be used by PWS to enhance its system capacity. Please note that many of these guidelines may not be applicable to all systems, as much of the language is geared to larger systems. However, they may be used by small systems to develop simplified documentation appropriate to their system size.

11.2 Management Capacity

Management capacity is the ability of a water system to operate in compliance with SDWA requirements. It refers to the system’s institutional and administrative capabilities - including ownership, accountability, staffing, organization, documentation, and planning. The following items in Section 11.2 are generally used to demonstrate that a PWS has adequate managerial capacity.

11.2.1 Statement of Purpose

Every water system should have a written document that states its primary mission and provides guidance on decision making. It should define: the mission, the customer, and the product standards for safe drinking water, for delivery and for payment process. This written statement of purpose document provides a common basis for management and employees to work together within the organizational structure to meet objectives. Management and employees should be familiar with this document, and it should be reviewed periodically.

11.2.2 Legal Components

11.2.2.1 The Entity

Every public water system should understand what type of legal entity it is; and how that type of entity is required to operate on delivering water. It should keep a copy of its Articles of Incorporation, enabling legislation, or the State Law under which it operates in a safe, permanent file. Each new manager (responsible party, owner, selectmen, board member, supervisor, etc.) should receive a copy of this document. Refer to the *Model Water and Sewer Commission Reorganization Act, Chapter 40N of the Massachusetts General Laws* for guidance on developing an appropriate legal authority for a new or existing water system.

11.2.2.2 Documents and Filings

All court orders, deeds, easements, long term contracts or leases, bylaws, inter-municipal agreements, official maps of the service area, and similar documents should be stored in a permanent file in a safe location that is known to system managers.

11.2.2.3 Authority and Responsibilities

Each manager (responsible party, owner, selectmen, board member, supervisor, etc.) should review the documents that outline the power, authority, duties and responsibilities of management (board of water commissioners, selectmen, supervisors, etc.). PWS should develop an informational package for new management that includes key documents, a map of the system, an organization chart, a rate chart and other information. Managers (responsible party, owner, selectmen, board member, supervisor, etc.) should receive basic training on the duties and responsibilities of managing a PWS.

11.2.2.4 Meeting Records and Minutes

Official actions should be recorded in writing and saved in a record book. Minutes should include votes, any changes to bylaws, and other legal actions of the PWS. This ensures an historical and documented record of actions.

11.2.2.5 Bylaws, Rules and Regulations

Bylaws, rules and regulations of the PWS should be written, and changed only by a recorded vote. These documents should be updated periodically to include amendments and deletions. The cover page should include the effective date and a note on revisions, such as *contains all revisions through 31 October 2001*. Copies of bylaws, rules and regulations should be available to qualified parties upon request. Standard operating procedures (SOPs, as noted below) may be considered as bylaws and/or regulations.

11.2.2.6 Organizational Structure

Each PWS should have a formal Organization Chart that clearly shows the chain of command within that PWS. The chart should start at the highest level (mayor, selectmen, and water commissioners) and include all employees, contract help, and part time staff including primary and secondary operators.

The ownership of the PWS should be clear to the service population, the local community and local, state and federal agencies. Adequate personnel policies should be in place to retain and compensate personnel and to provide appropriate training as needed or recommended.

11.2.2.7 Duties and Responsibilities

A job description should be created for each position on the organization chart. Job descriptions are an important part of organizing the work within the water system. A job description should define a person's duties and responsibilities, supervisor, and staff supervised. These may serve as a basis for the person's salary and duties. In the process of developing job descriptions, gray areas may be defined, and areas of conflict identified.

11.3 Standard Operation Procedures (SOPs) and Policies

Generally, SOPs and policies are included with the bylaws and regulations of the organization. These should all be **written** documents.

11.3 Standard Operating Procedures

11.3.1 Operational Policy

Management should define the operation and maintenance of the PWS. For example, *Policy Describing the Flushing Program Required by the Department*. If a board oversees the PWS, one board member should be designated as the link between the board and the certified operator in charge of the PWS. The certified operator should file monthly written reports with the board or its designee. The monthly reports should include at a minimum, water quality test results, maintenance performed, and recommendations for improvements.

Manuals for every piece of equipment should be kept in a central location in a bound book or file, and logs should be kept of all repairs and maintenance. There should be a policy that sets the maximum amount of money that the operator may spend without obtaining the board's permission.

11.3.2 Personnel/ Professional Improvement/ Hiring Policy

Each PWS should have a written personnel policy. It should state the holidays and vacation policy, limitations or approvals required for time off and overtime, and operation during emergencies and off-duty time. The process for handling employee grievances should be clearly stated. A written personnel policy is needed to protect the rights of the individual employee and the PWS.

The amount of money involved in sick and vacation time accrued should be recorded and reported to the employee at regular intervals. A dedicated account is recommended for deposit of wages for accrued sick and vacation time.

The PWS commitment to continuing education should be defined in this policy. It should include requirements for professional memberships and training. It should clearly state criteria for training, approval of training requests, payment of fees and mileage, and use of PWS vehicles. All staff should be adequately trained prior to starting their jobs.

For PWS that have a board of water commissioners or a similar structure, the policy should specify the method for filling board vacancies, attendance requirements for commissioners, and training of board members. It should address completing tasks in a timely manner. Policy should include provisions for removing a commissioner from office (e.g., continued absence at meetings). Positions such as the treasurer and superintendent should not be part of the control structure (e.g., board of commissioners) wherever feasible to avoid conflict of interest.

11.3.3 Conflict of Interest Policy

Preventing conflict of interest is an important consideration when organizing work within the water system. Although the state law covers what constitutes a conflict of interest for municipal and district employees, the PWS should have a written policy that defines acceptable and unacceptable activities.

11.3.4 Water Rates Policy

11.3 Standard Operating Procedures

Every PWS should have a written policy on water rates and other charges. At a minimum it should address the following:

- What the rates cover. Does the rate cover capital and operating expenses? Does the PWS receive subsidies or other income sources?
- Rate classifications and how rates are changed.
- An explanation on fees and charges such as seasonal connections, shut-off/ turn-on fees, impact and connection fees, emergency water ban violation fines, and fees for various size services or meters.

The policy should state the rationale for the rate, fee structures, and the procedures for establishing rates. Rate procedures outlined in the enabling legislation for the PWS may be repeated in this policy.

The PWS should have a printed rate card available to all customers and potential customers. It should include all water rates. Often this is printed on the back of the water bill.

Every PWS user should be metered. Each user should receive a water bill based on actual readings (quarterly or more frequent bills are suggested). Parks, public buildings and other community facilities may be exceptions to this quarterly billing rule, but they should be metered and monitored.

The Massachusetts water conservation standards require PWS to develop a 100 % metering program for all public and private users. The PWS operations plan should include regular meter reading of all users.

The PWS should keep an inventory of all its meters and should systematically check meters for accuracy. There should be an active and ongoing program to replace aged and broken meters. Refer to Section 11.5.2.6 for typical useful life of fixed assets. The normal life expectancy of water meters ranges from 7 to 15 years.

11.3.5 Connections and Main Extensions Policy

There should be a written policy outlining conditions for new connections to the water system. The connection policy should include the following:

- The responsibility of the PWS
- The responsibility of the potential customer
- Conditions for the denial of a connection to the system
- The materials and methods to be used when installing the service line
- Method for establishing the fee for connection to the system
- Who owns (and is responsible for repair to) what component of the connection to the main.

In some cases, the PWS will install the service connection and bill the customer for the cost of the installation from the curb cock to the building. In other cases, the potential customer is

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responsible for installing the service connection. It is important to state the responsibility of the customer in regard to the connection. The PWS should not allow any connections that would result in the system exceeding the safe yield of its sources or the hydraulic capacity of its distribution system.

There should be a written policy regarding the extension of water mains to serve new areas both inside and outside the current service area. Often (if the water main extension is to serve a new housing or industrial development), the developer is required to pay the costs of installing the pipe to the specifications of the water system. If it is desirable to install a larger main than required by the development, the policy should clearly state who pays the difference for the larger sized pipe. The type of pipe, depth, bedding material, and other related specifications should be noted in the policy. The Department also requires a Cross-Connection Control Program Plan (See Chapter 9, *Distribution Systems*).

11.3.6 Water Conservation and Drought Emergency Policy

Each PWS should work with local officials to adopt a drought emergency bylaw or health regulation that authorizes increasingly stringent mandatory water conservation measures with escalating penalties for failure to comply. A *Model Water Use Restriction Bylaw/Ordinance* is available on the Department's web site.

The drought emergency bylaw is only one part of a water conservation policy. The policy should also include the following components:

- “Increasing block rate” pricing or conservation pricing
- Education of users to reduce water use
- A series of increasingly stringent voluntary measures to reduce water use
- Assistance to the largest water users on how to save money by reducing water use
- Reducing the amount of “unaccounted-for” water
- Methods to monitor the success of the program

For more information on water conservation standards, drought and emergency planning, review the following resources:

Water Conservation Standards for the Commonwealth of Massachusetts, the Department's Policy 87-05, Declaration of a Water Supply Emergency, the provisions of MGL Chapter 40, section 41 A, Water Emergency, Chapter 10 of these Guidelines and the Web sites of AWWA, NEWWA, and the MWRA.

A PWS may impose voluntary water use restrictions at any time without the Department's approval. However, a PWS may not impose a mandatory ban without the Department's approval. A PWS may impose a mandatory ban only if it has a Water Use Restriction Bylaw/Ordinance approved by the Department. The Department can declare a *Declaration of Water Supply Emergency* only after the water system petitions the Department. The Department can attach conditions to the Declaration as required. A Declaration remains in effect for 6 months unless revoked by the Department.

11.3.7 Leak Detection and Unaccounted for Water

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Each PWS should adopt a policy for leak detection and tracing of “unaccounted-for” water. All connections, including public buildings, should be metered, (See Section 11.3.4, *Water Rate Policy*). A full leak detection survey of the distribution system should be completed every two years; identified leaks should be repaired within a year. The PWS should calibrate its master meters annually, (at a minimum), to ensure water meter accuracy. There should be a program to replace or rebuild water meters for each connection on a 10-year cycle. The policy should include a requirement that all large quantity water users calibrate their meters each year at their expense.

For a well-run PWS, the amount of unaccounted water should be below 10% of total water consumption, and should remain under 15% at all times. Water systems should monitor tanks and lines for leaks, and implement a leak detection program.

PWS should encourage their customers to conduct on-site leak detection. By reducing the amount of “unaccounted-for” water, the system may:

- Reduce costs of operation by reducing electricity and pumping cost
- Reduce impacts on ground water wells by pumping less
- Delay the need to add another source, add storage, increase pipe sizes, or increase treatment capacity
- Increase the life span of equipment

Note: If a new withdrawal or source over 100,000 gallons per day is being considered, the Water Management Act requires careful attention to water conservation with special attention directed at reducing the amount of unaccounted for water. (See Chapter 10, *Water Management Act Requirements*). If a water supply source requires an Interbasin Transfer Act approval, the water conservation plan must meet the *Interbasin Transfer Act Performance Standards* adopted by the Water Resource Commission in 1999.

11.3.8 Service Shut Off and Restoration Policy

Each PWS should have and enforce a delinquent account policy which specifies how past due accounts of water customers will be handled. It is important that this policy be uniformly applied. Many water systems experience cash shortages because customers do not pay their bills. The delinquent account policy sets forth the steps the system will take, and the customer’s options. Often the procedure includes a second billing with interest and perhaps a penalty; a third billing with interest and a shut off warning; a final shut off warning; and an onsite visit with a doorknob hanger explaining the shutoff (often the shutoff will leave trickle running for public health purposes); and then shutoff. Some water systems use other methods, such as small claims court. For a district or municipality, a lien may be placed on the property as specified in the MGL Chapter 40 Sections 42A through 42F.

The policy should state in a clear, step-by-step process:

- what constitutes a delinquent (or past due) account
- how the shut-off/turn-on is accomplished
- conditions for restoration of service
- exceptions to the policy

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Additional guidance may be found at *MGL Chapter 40N, Section 9(d)*. The provisions of *MGL Chapter 165 Sections 11A through 11E* explain the procedure to be used by a private water company for shutting off water.

Note: Privately owned PWS are required to follow the billing and termination policy as listed in the Department of Telecommunications and Energy's (DTE) regulation 320 CMR 25.00. This policy can be used as a model for publicly owned water systems.

11.3.9 Billing Policy

Each PWS should have a written billing policy.

The water billing policy is often included in the rules and regulations or bylaws. The written policy should state:

- Frequency of billing
- Dates when water bills should go out
- Provision for estimating the bill when the meter can not be read
- Provision for handling absentee and seasonal customers
- Procedure a customer follows in contesting the amount billed
- Provisions for deferral of charges as allowed by MGL Chapter 40 Section 42J
- Special policies on the elderly, handicapped, veterans, or other groups
- Procedures for abatements or refunds

Billing should follow shortly after the filing of the meter readers' report. More frequent billing such as quarterly and monthly may make payments easier for customers.

Every water system user should be metered and receive a water bill based on readings. There should be a plan developed to install meters for all non-metered connections. Install outside-meter readers wherever possible.

Note: Privately owned PWS are required to follow the billing and termination policy as listed in the Department of Telecommunications and Energy's (DTE) regulation 320 CMR 25.00. This policy can be used as a model for publicly owned water systems.

11.3.10 Customer Comment Policy

Each PWS should have a written policy regarding complaints, comments and compliments. It should contain:

- A complaint/comment/compliment logbook
- Procedures for PWS to follow up complaints/comments
- Procedures to inform customers of complaints/comments investigation results
- Filing system for information collected and record of resolution

Note: Tracking complaints may seem arduous; however, gathering and reviewing this data may uncover seasonal or intermittent problems with the system that would not have been discovered.

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Tracking comments may result in system improvements. Tracking compliments will improve staff morale and encourage positive attitudes.

11.3.11 Bidding and Purchasing Policy

Each PWS should develop its own written Bidding and Purchasing Policy so that the steps and procedures are clear and understood by all parties. The policy should cite the contracting agency, and the method of recording and filing quotes and bids. Refer to the *Guide for Local Government Procurement of Supplies, Services and Real Property* that is available from the state bookstore.

District and municipal water systems (and in certain cases, privately owned water systems receiving public grant or loan money) are required to comply with the MGL Chapter 30B *Massachusetts Uniform Procurement Act*; or MGL Chapter 30 *Public Bidding Laws*, especially Section 39M. These laws are fairly complex and in certain circumstances allow several alternative courses of action.

11.3.12 Accounts /Receivable/Payable/Segregation Policy

Each PWS should have a written policy on handling of accounts payable, accounts receivable, and the segregation of duties. This policy should spell out the approval process for routine bills, special provisions for approval of large bills, required paper trail, person responsible for the tasks, filing system, and documentation needed for the bill payment. Note the importance of separating duties to ensure accuracy and honesty. Policy should require bonding of staff responsible for the money.

11.3.13 Bonding and Insurance Policy

Each PWS should have a written policy that sets out the amount of bonding required for officers and employees that handle money and the amount of property damage and liability insurance needed. The water commissioners might wish to have an insurance policy for oversight and omissions. This policy is usually not needed for municipalities that already have such coverage.

11.3.14 Management Information Systems Policy

A management information systems policy outlines procedures for informing managers of the financial and operational status of the system. The management informational system should have a standard periodic report that includes:

- Summary of expenditures by category
- Revenues received by category
- Cash available for paying bills
- Status of delinquent rate payers by age of account
- Status of actual versus budgeted expenses and revenues
- Deviation of year-to-date budget from year-to-date expenses by line item
- Brief outlook for the future

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The report should also include an operational summary of accomplishments, complaints and resolution, a summary of short-term, midterm and long-term operational plans, and other matters of interest to management. Develop a standard format for these reports.

11.3.15 Land Management Policy

Each PWS should have a written land management policy that states the public water system's commitment to land management, including:

- Activities that are allowed
- Management philosophy/future plans
- Specific requirements such as forest management plans and maps, wildlife management plans, and watershed management plans
- Management conditions such as sign postings and marking of boundaries every 10 years
- Closure conditions
- Patrolling of streams and boundaries
- Enforcement
- Plan to work with local Conservation Commissions
- Providing maps to customers identifying Zone II's and land ownership

11.4 Water System Planning

Any system experiencing problems related to planning, operation, and/or management as determined by the Department should submit a water system master plan (Master Plan) for its review and approval upon request. The Department should work with the PWS and other parties to establish the level of details for this plan.

Planning is critical for all water systems. All water systems should have written long and short-term plans. The goal of planning activities is to identify present and future needs and set forth a means for addressing those needs. The results of proper planning will help ensure the efficient use of available resources and the orderly growth of the water system, while maintaining reliable and safe delivery of high quality water. Many of the items described in Chapter 11 are components of a Master Plan.

The Master Plan is a dynamic document that has to be both realistic, forward looking, and captures the vision of the PWS's needs over 5, 10, or 20 years. At a minimum a master plan should have the following sections:

1. Strategic Plan
2. Background Information
3. Capital Improvements Plan
4. Financial Plan

Note: Visit our Web site for a detailed master plan checklist: www.state.ma.us/dep.

11.4.1 Strategic Plan

A strategic plan is a long-range plan that documents a mission statement and outlines the goals and objectives to achieve the mission. Objectives are specific, achievable and measurable means to reach the goals. Together the goals and objectives provide guidance and a baseline to develop the work breakdown structures.

11.4.2 Background Information

Customer Profile

- Age, income levels, employment status, major employers and predominant activities that affect water quality and quantity. *This information is critical if a system plans to apply for federal/state low-income loans and subsidies.*
- Average water usage and peak demand periods
- Existing and future service area
- Current and projected population, growth and other changes that affect water demand

Water System Description and Analysis

- System design standards and descriptions
- Age of wells, plants, and facilities
- Extent of distribution lines
- Capacities of system; hydraulic model of system

- Vehicles and equipment owned by the system
- Major changes or challenges in treating or delivering water in the future
- Physical deficiencies in the system such as inadequate production capacity or significant amount of unaccounted for water

Water Sources

- Ground water source or surface water source or groundwater under the influence of surface water.
- Nature of watershed or wellhead area such as agricultural, residential, livestock, golf courses and factories etc.
- Water quality analysis including any reoccurring violations of drinking water standards
- Adequacy of water supplies given the projected demand
- Trends or threats to the water supply
- Location of alternate sources and use of interconnection(s)
- Wellhead protection plan, watershed control program and conservation plan
- Source Water Assessment report if available

Personnel and Management

- Organizational structure
- Staffing levels and qualifications, operator certification
- Record keeping and reporting
- Existence of operating policies, procedures or other reference manuals, (operations and maintenance, consultants and contractors)
- General responsibilities of personnel at all level
- Existence of emergency response plans, cross connection control program, drought contingency plans or water conservation plans
- Major policies and bylaw provisions of the governing board
- Customer service policies
- System operation and control
- Safety procedures

11.4.3 Capital Improvement Plan

A Capital Improvement Plan (CIP) is a document that thoroughly outlines, for a specified period, all necessary capital projects, the reasons for each project, and their costs. It should consider expanding service, upgrading water treatment, replacing worn-out equipment, adequacy of storage/ pressure and compliance with the SDWA and amendments. A CIP should contain a financial estimate for each year of the specified period and possible sources of financing for these improvements.

1. Capital asset inventory (Refer to *Fixed Asset Review* in this chapter.) identifies the capital resources owned by a community or water department, (e.g. buildings, machinery, vehicles, equipment and land). The inventory lists should include the following:
 - Capital items and their acquisition date and cost
 - Condition of equipment, replacement date and estimated replacement cost

Note: Visit our Web site for a Capital Assets Inventory Table: www.state.ma.us/dep.

2. System needs identification, cost estimation and prioritization identifies the following:
 - Current and future drinking water standards, compliance, and water demand
 - Current needs to maintain customer service (e.g., water meters and line replacement)
 - Future needs to improve customer service (e.g., new vehicles and remote sensors), and other items (e.g., new office, landscape equipment, or new hydrants)
 - Cost of each project organized into low cost projects to be paid from current or future budgets, and high cost items that will require external financing
 - Lead time needed for achieving each item
 - Prioritizing projects to be completed or started each year

Note: Most water systems under-spend on system improvements, pipe replacement, and upgrades. This leads to deterioration of the water system's infrastructure. Systems that are facing rapid changes may need to update their plan every five year. Others facing no changes may have a valid plan for 15 years.

11.4.4 Financial Plan

The financial planning process is an effective management tool designed to answer both short and long term questions regarding money or funding. Financial planning can be broken down into the following two elements:

- Annual operating plan or budget
- Capital plan

11.4.4.1 Annual Operating Plan or Budget

An annual operating plan or budget is a plan to estimate income and expenses for a future time period. Typical expense categories are annual debt service, salaries or personnel costs, office utilities, operations / maintenance and office supplies, chemicals, equipment leases, insurance, contract and professional services, telephone and travel.

Operating revenue is derived from the sale of water, connection fees, late payments, penalties, and reconnection fees. Non-operating revenue is derived from meter deposits or interest on checking or reserve accounts.

Rate increase, drought, uncollected bills, and new and lost customers affect revenue. Gains occur when revenues exceed expenses; losses occur when revenues are lower than expenses.

11.4.4.2 Capital Plan

A capital plan identifies the possible financing alternatives for the projects prioritized in the CIP. Funding sources include loans and grants from federal and state agencies, banks, foundations, cash, reserve funds, general obligation bonds, special assessments, promissory or short term notes, joint financing, privatization, and rate revenues. The capital plan, financial plan, and CIP are interrelated and should be prepared and reviewed together.

11.5 Financial Capacity

Financial capacity is the water system's ability to acquire and manage sufficient financial resources to achieve and maintain compliance with SDWA requirements. Financial capacity refers to the financial resources of the water system, including but not limited to the revenue sufficiency, credit worthiness, and adequacy of fiscal controls. The following items in Section 11.5 –11.7 are generally used to demonstrate that a PWS has adequate financial capacity.

11.5.1 Revenue Sources

11.5.1.2 Rates

In order to be successful, a water system should operate in accordance with sound business principles. It is generally recommended that a PWS charge a fair price for the services it provides. The rate should support the operational and maintenance cost of treating and delivering water to the customers, the system's debt service and meet future needs. The Department may require the PWS to do a "cost-of-service" review and/or a "rate study".

PWS should review and adjust their water rates based on the projected revenue needed the following year. The system should provide upon request a copy of their water rate structure and fee schedule for drinking water services. Rate adjustment in small yearly increments creates less resistance than large rate increases every few years.

Note: Systems regulated by DTE require that agency's approval prior to any rate changes, as required by M.G.L, Chapter 164, section 94 and M.G.L, Chapter 165, section 2.

11.5.1.3 Rate Structures - There are four basic rate structures:

- Unmetered or flat rates
- Uniform rates

- Ascending/increasing block rate
- Descending/declining block rates

Note: Although commonly used throughout the United States, descending/declining block rates are illegal for municipalities and water supply districts in Massachusetts. Ascending/increasing block rates and flat rates are the preferred rate structures because they provide a reliable source of income, promote conservation and are more equitable to residential users if structured properly.

11.5.1.4 Charges

Service Charge - Service charges recover the costs associated with the daily operation of the water system, regardless of a customer's usage. They include meter reading and service, billing, and administrative expenses. Usually, the service charges are based on meter size.

Hydrant and Fire Protection Charge - Water systems are designed to provide water at peak hourly flows, and to provide sufficient fire protection to extinguish a fire over a minimum two-hour period. The costs associated with fire protection should be charged to the customer who will benefit from the protection. This includes public and private fire hydrants, and sprinklers.

11.5.1.5 Fees

Connection Fee - Connection fees, usually based on service line size, are charged for connecting new users to the PWS. The fee should equal or exceed the actual cost of materials, labor and equipment required for the connection.

Backflow Prevention Device Testing Fee - All backflow devices should be tested annually by the water system. The fee charged to the customer should represent the full cost to test each device, including the cost of labor, vehicle, equipment and related administrative costs. The fee is usually per device, although discounts may be given for multiple devices.

Other Fees - The system may establish fees, based on actual cost, for duties performed at the request of the customer. These include fees for a final meter reading, meter test, and turn-on or turn-off service. Hourly fees should be set for service calls, including equipment. Fees should be reviewed annually. The PWS may impose late payment charges. Generally (see note below), a late payment charge is a penalty plus interest for a payment that is over 30 days late.

11.5.1.6 Other Revenue Sources - Water systems should seek income from other sources when appropriate and when it does not interfere with the primary function of delivering safe water. These income sources may include: rental of unused buildings or land for compatible farming or other uses; forest management activities such as timber harvesting, firewood cutting, and collection of nuts, berries, other products and user fees.

Note: The Massachusetts Department of Telecommunications and Energy (DTE) does not permit the water companies that it regulates to charge residential customers interest on late payments.

11.5.2 Accounting

Note: Systems regulated by DTE must adhere to DTE's accounting requirements.

11.5.2.1 Billing - Billing frequency should be reviewed annually and adjusted annually if necessary. PWS should consider computerizing the billing process via a software program so that the process is more accurate and efficient. Quarterly or monthly billing is recommended.

11.5.2.2 Accounts Receivable – PWS should consider computerizing the process of recording accounts receivable, as these should be recorded and tracked. Customers that are 30 or more days late should be sent dunning letters, and in some cases, termination notices for continued failure to pay water bills.

PWS should have a written accounts receivable aging policy. A list of aged accounts receivable should be prepared periodically. Past due notices should be sent to delinquent customers with outstanding bills past certain days and shut-off notices should follow if a customer fails to respond to the past-due notices.

11.5.2.3 Accounts Payable- The payment process should require valid documents (invoices) to pay bills and avoid duplicate payments. Each payment invoice should be approved and signed by the designated responsible party (e.g. superintendent/commissioners). Any contract-related invoice should be verified against the contract document before payment.

11.5.2.4 Financial Accounting and Record Keeping - General Accepted Accounting Principles (GAAP) should be adopted in preparing financial statements. For good management practices, trial balance and treasurer's report should be prepared on a monthly basis for review and operations evaluation. Balance sheet, income and expenditure statement, cash flow statement and a management letter should be prepared annually as part of the audit report. The annual report should be prepared no later than three months after the end of fiscal year. Deficiencies and/ or recommendations from the annual audit should be reviewed and addressed in a timely manner.

All municipal systems are encouraged to use an enterprise account for the PWS to ensure adequate capacity. The system should maintain financial books and records for auditing and financial planning purposes.

11.5.2.5 Enterprise Account - All municipal public water systems are encouraged to use an enterprise account. MGL, Chapter 44, S. 53F1/2 allows municipalities to establish a separate account for a drinking water system. Enterprise accounting gives the PWS the ability to demonstrate which drinking water costs are recovered through user charges.

Enterprise accounting also allows the surplus or retained earnings generated by the PWS to remain within the fund rather than closing out at year's end and becoming part of free cash in the general fund. A community can establish an enterprise fund by adopting Chapter 44 Section 53F1/2, or by enacting special legislation.

No later than March 1 each year, the appropriate enterprise officer or board should submit to the mayor or board of selectmen the estimated costs and revenues for the next fiscal year. Revenue

estimates should be prepared for user charges, investment income, and any other enterprise revenues. Enterprise available funds should also be considered. This information is recorded on the tax recapitulation sheet.

The water department can appropriate reserve funds or retained earnings for operating costs to:

- Offset the need to increase user charges
- Fund capital improvements
- Reimburse the general fund for previous water department funding
- For enterprise revenue deficits (operating loss)

Accounting for enterprise funds is similar to accounting for the private sector. Revenues are recognized when earned and expenses are recognized when incurred (“full accrual basis of accounting”). Enterprise accounting also requires the establishment of fixed assets. No separate bank account is needed; however, enterprise fund monies should be listed separately in the general ledger.

11.5.2.6 Fixed Assets Review - Fixed asset accounting (Capital Asset Inventory) is required of all enterprise funds. Any new fixed asset should be recorded upon acquisition and depreciated over its useful life. A fixed asset can be defined as a specific piece of property that has a tangible nature, a life longer than the current fiscal year, and a significant value. Generally fixed assets are land, buildings, improvements, machinery and equipment. (Visit our Web site for Asset Inventory).

The PWS should do a complete physical inventory of each fixed asset to establish the initial database. Fixed assets should be recorded at their original cost. When historical cost records are incomplete, best available estimates should be completed by an independent reviewer/company.

The useful life of every asset should be determined so that depreciation expense can be calculated and recorded. Because enterprise accounting is based on the objective of income determination, it is necessary to allocate the cost of any fixed asset over the life of the asset.

Typical values of useful life attributed to the various fixed assets found in water systems are given below:

| Description | Useful Life/years |
|--|--------------------------|
| <i>Emergency Power</i> | 15 |
| <i>Field Equipment</i> | 10 |
| <i>Furniture and Fixtures</i> | 5 |
| <i>Hydrants</i> | 50 |
| <i>Instrumentation</i> | 10 |
| <i>Meters</i> | 7-15 |
| <i>Pumping Equipment</i> | 15-20 |
| <i>Pump Stations</i> | 20-30 |
| <i>Reservoirs and Tanks</i> | 100 |
| <i>Service Connections</i> | 50 |
| <i>Structures and Improvement</i> | 50 |
| <i>Transmission / Distribution Mains</i> | 50-100 |
| <i>Transportation Equipment</i> | 6-10 |

11.5 Financial Capacity

| | |
|---------------|----|
| <i>Valves</i> | 50 |
| <i>Wells</i> | 30 |

11.5.2.7 Budgeting - A formal budget system should be in place and should be updated annually. Periodically compare budget estimates with expenditures and determine balances. Reports should be presented to the higher management for review and approval. Budgets for the following fiscal year should be started in the spring to allow sufficient time for management and public review.

Generally, expenditures for a public water system can be grouped into seven main categories:

1. Personnel - salaries, over-time, payroll taxes, employee health insurance premiums, worker's compensation and training.
2. Supplies - includes the cost of small tools, chemicals if needed, and office supplies.
3. Operating Expenses - cost of electricity, utility expenses, water quality testing, vehicle and equipment expenses, all insurance costs, including liability insurance, physical damage insurance, vehicle insurance, board liability insurance and bonding of employees.
4. Contracting Services - costs of contracting with engineers and utility consultants, lawyers, accountants, and financial advisors.
5. Repairs- Includes the cost of pipe and repair parts required.
6. Debt Service- Include annual payments on bonds and annual payments on loans (principal and interest)
7. Direct/Indirect Costs - Systems with enterprise funds should identify both direct and indirect costs. Direct costs are associated to the water department; indirect costs are prorated among departments, and cannot be assigned directly to the water department.

Note: A healthy PWS generally has a positive cash flow for the next 5 years, adequate capital to finance equipment replacement, an operating cash reserve, and an emergency cash reserve greater than or equal to the cost of replacing the most expensive piece of equipment.

11.6 Internal Controls

11.6.1 Collection Policies

Specific rules on dates of billing, deadlines for payments without interest, deadlines before disconnection and reconnection charge should be part of the bylaws and should be strictly enforced.

11.6.2 Bidding and Purchasing

Cities, towns and districts in Massachusetts should adhere to the public procurement process, M.G.L. Chapter 30B, when contracting for services or supplies. It includes procedures for choosing contractors, purchasing and disposing of property. The PWS should have a *Bidding and Purchasing Policy* that adheres to Chapter 30B requirements. A list of pre-qualified bidders for common type of services and suppliers should be maintained.

11.6.3 Contracting and Work Projects

Policies should be established for bidding procedures that insure the system gets quality work at the best price. Standard operations procedures should include proper procedures to assure that only valid and authorized invoices are submitted for payment. Any increase beyond the contract amount should be subject to review and approval by higher management.

11.6.4 Insurance Coverage

The PWS should have sufficient insurance coverage for structures, vehicles, boiler and machinery, and worker compensation.

11.6.5 Cash Receipts

Standard operating procedures should be in place for cash transactions, from date stamping to recording of bills, receipts, and payments. Whenever possible, no single person should be responsible for processing payments and posting accounts.

11.6.6 Payroll

Standard accounting procedures for payroll should be used in payroll operations such as signing time cards and calculating gross wages. Payroll functions should be computerized.

11.6.7 Abatements

Abatements are issued when an incorrect charge results in an over charge to the customer. The treasurer should use a formal abatement policy when handling abatement requests from customers. Any abatement request should be subject to review and

approval by the commissioners. Official records should be kept for all abatement decisions.

11.7 General Financial Indicators

11.7.1 Financial Ratios

Financial ratios are used to gauge the financial health of water systems. There are two simple ratios to help determine the financial stability of the system: 1) the operating ratio and 2) the debt service coverage ratio:

- Operating Ratio = Total Operating Revenue / Total O & M Expenses

Generally, an operating ratio below 1.176, or 1.15 including debt is considered to be an indicator of weak financial health, and ratios above 1.5, not including debt, are preferable.

- Debt Service Coverage Ratio = Net Available Revenues/ Debt Service Expenses

Debt Service Coverage Ratio measures the ability of water systems to cover their debt service (principal and interest on loans and bonds) after all operating expenses is paid. *This ratio should exceed 1.0 and analysts consider a range of 1.0- 1.5 as acceptable.*

11.8 Capacity Assessment

The Department's Drinking Water Program (DWP) evaluates the technical, managerial and financial capacity of all public water systems with priority given to systems with significant violations or public health problems, systems with a history of non-compliance, systems experiencing major changes in operations and systems requesting DWSRF loans. As a result of these evaluations, The DWP provides technical assistance and education, prevention measures and corrective action plans to PWS systems in accordance with the PWS' compliance with federal and state drinking water requirements and the Department's compliance and enforcement strategy.

11.8.1 Drinking Water State Revolving Fund (DWSRF)

In accordance with the SDWA any public water system receiving DWSRF loans must demonstrate capacity.

11.8.2 Sanitary Surveys

The Department generally uses its' sanitary survey program to evaluate each PWS capacity. The capacity ranking of each PWS is based on information gathered through sanitary surveys and a review of the system's historical file.

11.8.3 Capacity Assessment Language

The Capacity of a PWS is assessed by its' degree of compliance with the SDWA and DWP requirements including the capacity indicators that were discussed in these guidelines. Systems are categorized as having "adequate", "conditional" or "inadequate" capacity. These categories generally have the following meaning:

11.8.3.1 Adequate Capacity

- Complies with all major Department's drinking water regulations and is expected to comply well into the future.
- Demonstrates a willingness and ability to plan for the future, including capital improvement plans, emergency funds, enterprise accounting, employee training, and updated master plans.

11.8.3.2 Conditional Capacity

- Currently complies with all the Department's drinking water regulations; but has issues that are being monitored and rectified; or
- Currently complies but may not have addressed a foreseeable major need that will have to be addressed within the next five years; or
- Is not in compliance with drinking water regulations; but has demonstrated good faith in remedying issues through an enforceable agreements such as an Administrative Consent Order (ACO) and remains in compliance with the enforcement order; or
- Is not in compliance; but the deficiencies can and will be corrected within 12 months.

11.8.3.3 Inadequate Capacity

- Is not in compliance with drinking water regulations or cannot be expected to meet them in the future;
- Does not plan ahead for future impacts (e.g. growth and aging infrastructure) which could greatly impair their ability to provide water that meets state and federal standards.
- Substantial technical assistance is required in order to improve system performance.

Note: Systems with inadequate capacity are not generally eligible to receive DWSRF loans.

11.8.4 New Public Water Systems - Water Supply Business Plan

An applicant to develop a new public water system (community or NTNC) must demonstrate managerial, technical and financial abilities to comply with the SDWA and other drinking water requirements pursuant to 310 CMR 22.00. The applicant must submit a business plan in a format approved by the Department. The documents must demonstrate the systems proficiency in all three capacity areas: technical, managerial and financial. The plan must be submitted during initial stages of the new source approval process. (See Chapter 1, *Submission of Water Works Plans*) If a water system is part of a larger enterprise, only the water supply portion of the enterprise needs to be included in the business plan. Visit our Web site for a detailed water supply business plan.

Note: This does not apply to existing systems that are developing a new source.

11.8.5 Public Water Systems Applying for Variances and Exemptions

An applicant for a variance or exemption must demonstrate managerial, technical and financial abilities to comply with the SDWA and other drinking water requirements pursuant to 310 CMR 22.00. The applicant must demonstrate the system's proficiency in all three capacity areas: technical, managerial and financial.