CRITERIA FOR DESIGN

OF

PUBLIC WATER SUPPLY FACILITIES

IN

SOUTH DAKOTA

A Supplement to the Recommended Standards for Water Works'

July 1, 1979

Drinking Water Program

S.D. Department of Environment and Natural Resources

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FORWARD

The Recommended Standards for Water Works, often referred to as the "Ten States Standards", were first published in 1953. They were revised in 1962, 1968 and 1976. These standards are used by most state regulatory agencies in the U.S. as their policies for review and approval of plans and specifications for public water supplies.

These South Dakota Criteria are a supplement to the Ten-States Standards. By taking this approach, the extensive knowledge and experience incorporated into the Ten-States Standards over the 25-year period of its use can be retained. Also, these standards are quite familiar to engineers, equipment suppliers and others in the water-supply field. Finally, most of these standards are as appropriate in South Dakota as for any other state.

However, in some instances the Ten-States Standards are not completely applicable to South Dakota conditions of climate, water quality, treatment plant size and operator qualifications. In these situations, the Ten-States Standards are either modified or new sections added. This supplement includes only the modified or added sections.

South Dakota, by review and approval of plans and specifications, assumes no responsibility for the successful operation of the works so reviewed. The Reviewing Authority also reserves the right to waive the requirements of these Standards under special conditions.

[1]Published by: Health Education Service. P.O. Box 7126, Albany, NY 12224.

PART 1 -SUBMISSION OF PLANS

1.0 GENERAL

Delete "60 days" and insert "30 days" in lieu thereof.

Add the following:

g. Preliminary O and M manual.

1.1.9 Proposed Treatment Processes

Delete entire text and substitute the following:

Whenever the existing treatment plant has not provided the desired water quality or where no data on the effectiveness of various treatment processes for the water to be treated exists, pilot studies should be conducted to select or establish the treatment processes that will accomplish the treatment objectives at the lowest overall cost and/or with the least waste handling and disposal problems.

The use of package water treatment plants, consisting of prefabricated and substantially preassembled clarification and filtration units for small supplies, is constantly increasing in the U.S**.** It has been shown that package plants can produce water for small systems that will met the requirements of state and national regulatory agencies, but also reduce the economic impact on small communities. The use of package water treatment plants for small systems (2.0 million gallon per day capacity or less) is encouraged. The design engineer should include a package water treatment plant a**s** an alternative in the Engineer's Report, for all proposed plants of 2.0 MGD or less. This section should include the applicability of design, general layout, operational, maintenance and construction cost estimates of package treatment. A discussion of the advantages and disadvantages of the package treatment should also be included.

1.1.11 Automation

Delete entire text and substitute the following:

Encourages the design engineer to utilize systems for: automating repetitious tasks associated with plant operation, control, and protection thereby freeing the operator for more productive work. Examples of tasks that should be automated include: pumping, chemical feeding, filter rate control, filter backwashing, emergency and overflow alarms, protection of electrical equipment, and protection from extremes in temperature and humidity. Preference should be given to the selection of equipment with service representatives permanently located in South Dakota or adjacent states who will provide operator training and services for plant operation. Manual override must be provided for any automatic controls.

1.1.15 Plant Capacity

This is an added section

The nominal capacity of the water treatment plant (design capacity of the filters) should be equal to the estimated average daily demand during the last year of the design period. The maximum capacity of the plant should be equal to the estimated demand on the day of highest demand during the last year of the design period. At maximum capacity the rate of filtration should not exceed the limit established under Section 4.2.1.3.

PART 2 GENERAL DESIGN CONSIDERATIONS

2.2 d Building Drainage

Delete "adequate drainage" and add the following:

Floor drains should be provided in all rooms, hallways and pipe galleries within the treatment plant. Floors should slope toward these drains**.**

Detailed consideration should be given to the consequences of an over-flow of any treatment unit or major pipe rupture within the plant. Whenever such overflows or ruptures could result in flood damage in the plant, the design engineer should provide a drainage system to carry the water out of the plant and prevent flooding. The drainage scheme might include a system of wall or floor outlets, floor drains and sumps. Any outlets to the exterior of the building should be adequately screened and louvered to prevent entrance of objectionable materials or animals.

2.2 e Dehumidification

Delete entire text and add the following:

Adequate dehumidification equipment shall be provided to reduce corrosion within the plant when ferrous or other corrosive materials have been used in the plant.

2.2 k Sanitation Facilities

This is an added section.

The water treatment plant should be provided with a lavatory and toilet housed in a separate room. Drain pipes from lavatory or toilet shall not pass over or though any treated water basin.

2.2 1 Ladders, Stairs

This is an added section.

Stairs in place of ladders when physical space allows.

2.2m Equipment Removal, Replacement

This is an added section.

Doorways, hatches or other type openings should be provided of sufficient size to allow removal and replacement of pumps and all other equipment in the plant.

2.4 ELECTRICAL CONTROLS

Add the following:

Electrical control panels should be housed in a separate room provided with an adequate dehumidifier. Electrical switch boxes, etc., should not be placed beneath pipes that cause condensation.

2.15 MANUALS AND PARTS LISTS

Add the following:

To enhance simple operation, easier and safer operation and reduce design blunders, the preliminary O and M manual should be written by the engineer simultaneously with the plant design. Operating and maintenance instructions, as well as parts lists, for specific equipment shall be inserted into O and M manual after final selection of said equipment. This O and M manual should be revised and updated after one year of plant operation.

2.18 MATERIALS

This is an added section.

Piping, stairs, ladders, handrails, hatch covers, aerators and other similar components of the plant should be fabricated from materials that are highly resistant to corrosion in a moisture-laden atmosphere. Examples of these materials include aluminum, stainless steel, plastics and fiberglass.

2.19 PIPE AND CHANNEL SIZING

This is an added section.

Piping and channels should be sized to accommodate flows of at least 150 per cent of the maximum design flow.

2.20 NOISE CONTROL

This is an added section.

Noise levels in pump stations and treatment plants should be controlled so that they do not exceed current OSHA requirements.

PART 3 -SOURCE DEVELOPMENT

3.2 GROUNDWATER SOURCES AND DEVELOPMENT

A groundwater source includes all water obtained from dug, drilled, bored or driven wells, and adequately constructed springs and infiltration galleries.

3.2.2 Quality

3.2.2.1 Source Disinfection

a. 3. Shall be provided for standby sources, if a period greater than 6 months elapses between use.

b. Upon completion, the well shall be disinfected in accordance with current AWWA Standards for well disinfection. A recommended procedure is to add a sufficient chlorine solution to give a concentration of 50 parts per million of available chlorine when mixed with the water in the well, and allowing the chlorine to remain in the well for at least 8 hours.

1. After the water containing chlorine is completely flushed from the well, a sample of water shall be collected on two successive days and submitted for bacteriological analysis, and both the successive samples submitted shall be free of coliform organisms prior to placing the well in service.

2. A complete chemical analysis of the water produced from a new source shall be made prior to placing the well in service. If the analysis reveals that the water from the well falls to meet the standards specified in section 3.1, appropriate treatment shall be provided, or the well shall be abandoned.

3.2.3 Location

3.2.3.1 Well Location

Groundwater sources shall be so located that there will be no danger of pollution from insanitary surroundings. such as cesspools, privies, sewage systems, 1ivestock and animal pens, dumpgrounds, or abandoned and improperly sealed wells.

a. No septic tank, aerobic system, vault privy, holding tank, sewer line of tightly jointed tile or equivalent material, shall be closer than seventy-five feat from wells less than one hundred feet deep or from springs, or fifty feet from cisterns or from wells which are more than 100 feet deep.

b. No seepage pit, absorption system, pit privy. barnyard, barn gutter, animal pens or farm silo shall be installed closer than one hundred and fifty feet from wells 1ess one hundred feet deep or from springs, or closer than one hundred feet from cisterns or from wells more than one hundred feet deep.

c. A sewer line that is constructed of materials and with joints that are equivalent to water main standards of construction and is pressure

tested to assure watertightness prior to backfilling should not be located closer than 15 feet from any well.

d. No well shall be located within a distance of 500 feet of a sewage treatment plant, sewage pumping station or sewage drainage ditch.

e. No well shall be located within a distance of 1,000 feet of a sanitary landfill, dump or wastewater stabilization ponds.

f. No well shall be located within a distance of one mile from a sewage effluent irrigation site.

g. Livestock shall not be pastured within 50 feet of water supply wells.

3.2.5 General Well Construction

3.2.5.6 Screens

g. Slotted. punctured, or perforated well pipe shall not be used as a substitute for well screens.

3.2.6.2 Gravel Pack Well Development

a. The gravel used shall be free of foreign material, shall be of selected and graded quality, not contain more than five percent calcarious material. and shall be thoroughly treated with a 50 ppm chlorine solution prior to or during placement.

b. Gravel refill pipes, when used, shall be incorporated within the pump foundation and terminated with welded or screwed caps at least 12 inches above the pumphouse floor or apron.

c. The outer casing or drill hole shall be of such diameter as to provide a minimum of 1 1/2" of grout around the gravel refill pipes when installed in the grouted annular opening.

d. Provisions for prevention of leakage of grout into the gravel pack or screen shall be provided.

3.2.6.3 Radial Collection Well Development

a. Radial collectors shall be in areas and at depths approved by the reviewing authority.

b. The location of all caisson construction joints and porthole assemblies shall be indicated on the plans.

c. Provisions shall be made to assure minimum vertical rise of the caisson.

d. The top of the caisson shall be covered with a watertight concrete floor, and all openings in the floor shall be curbed and have overlapping covers to protect against the entrance of foreign material.

e. The pump discharge piping shall not be placed through the caisson walls.

f. Continuous chlorination shall be provided with a minimum chlorine contact time of 30 minutes.

3.2.6.4 Dug or Bored Well Development

a. Dug or bored wells shall be considered only where geological conditions prevent the development of an acceptable drilled well.

b. A water tight cover shall be provided on the opening, shall be curbed and have overlapping covers to protect against the entrance of foreign material.

c. The top of the cover shall be sloped to drain to all sides and a watertight joint made where the slab rests on the well lining using cement mortar or a mastic compound.

d. A manhole, if installed, shall be provided with a curb cast in the slab and extending at least six inches above the slab. The manhole shall have a watertight overlapping cover extending down around the curb by at least two inches.

e. Adequate sized pipe sleeves shall be cast in place in the slab to accommodate the type of pump or pump piping proposed for the well. The discharge piping shall not be placed through the concrete casing.

3.2.6.5 Springs and Infiltration Gallery Development

In general, springs and infiltration galleries should be considered in the same category as surface water supplies. However, in the case of springs and infiltration galleries where the aquifer and the protective.cover are such as to insure freedom from surface contamination and the criteria listed below is complied with, these supplies may then be considered as groundwater supplies.

a. Springs and infiltration galleries shall be located as to comply with section 3.2.3.

b. An infiltration gallery shall not be located within a horizontal distance of 25 feet from the high water level of the surface water source and must be located at least 10 feet below the surface.

c. A surface drainage ditch shall be located uphill from the spring so as to intercept surface runoff and carry it away from the source.

d. A fence shall be provided at the spring box and/or infiltration gallery location and up to the surface-water drainage system uphill from the source. Such fence shall be of a construction to prevent entrance of livestock and to discourage entrance of other animals or of unauthorized persons.

e. A watertight storage reservoir as specified in section 7.0 shall be provided.

f. Continuous chlorination must be provided with a minimum contact time of 30 minutes prior to the first user of the supply.

g. The spring or infiltration gallery and all appurtenances shall be disinfected as described in Section 3.2.2.

3.2.6.7 Flowing Well Development

a. The construction of flowing wells shall be such that the flow from them can be controlled.

1. Flow control should consist of valved pipe connections, watertight pump connections or receiving reservoirs.

b. A protective casing shall be installed and the annular space grouted to form a tight seal.

3.2.6.8 Existing Wells

The reviewing authority shall be consulted for requirements concerning the construction or reconstruction of existing wells.

3.2.8 Wellhoues and Appurtenances

a. Wellhouses, when used. shall be locked to prevent vandalism. When a wellhouse is not present the well controls shall be protected from vandalism.

b. The pump room floor shall be watertight and shall slope away from the pump base. The pump room floor shall be provided with a floor drain discharging to a sump at least 25 feet from the well. Sump shall consist of a 6 ft. x 6 ft. x 6 ft. excavation backfilled with 4 ft. of gravel. The grave1 surface should be covered with a plastic sheet over-lain with topsoil to meet the existing grade.

c. The wellhouse shall be designed to permit removal of well casing, discharge pipe, turbine or submerged pump or other components of the completed well.

d. The wellhouse shall be provided with adequate heat to prevent freezing of equipment. Also adequate ventilation shall be provided to prevent overheating of equipment.

PART 4 –TREATMENT (GENERAL AND CLARIFICATION)

4.1 CLARIFICATION

4.l a Duplicate Units

Add the following:

These requirements can be waived for plants with design capacities of 250 gallons per minute or less, subject to the approval of the reviewing authority.

4.1.1 Presedimentation

a. Basin Design

Insert "and" in lieu of "or"

4.1.2 Rapid Mix

Delete "b" and add the following:

b. Design Parameters

Mixing time and velocity gradient for optimum mixing are dependent upon raw water quality, chemical coagulant or softening chemical used, and jar test data. These data and the rationale for selecting values for mixing time and velocity gradient should be submitted to the reviewing authority for approval prior to design of rapid mix units.

4.1.3 Flocculation

4.1.3f Superstructure

Insert "shall" in lieu of "may".

4.1.4 Sedimentation

4.1.4g Superstructure

Delete entire section and add the following:

A superstructure over the sedimentation basins shall be required.

4.1.4h Sludge Collection

Insert "shall" in lieu of "should".

4.1.4i Drainage

Because mechanical sludge collection equipment is required, the last sentence of this section may be deleted.

4.1.5 Solids Contact Unit

Add the following:

Upon written approval of the reviewing authority, a single solids contact unit may be used in small plants employing presedimentation.

4.1.6 Tube Settlers

Delete existing paragraph and add the following:

4.1.6.1 General Design Considerations

a. Stilling zone should be provided between influent zone and tube zone of settling basin.
b. Tubes should be submerged between two and four feet below water surface.
c. Provisions should be made to prevent floc build-up on tube openings.

d. Overflow rate should be selected on the basis of water temperature, turbidity, clarifier configuration and overflow rate, and effectiveness of coagulation/flocculation. Usual range is 2-4 gpm/ft^2 based a portion of basin covered by tubes; however, lower rates may be required for cold waters with low turbidity.

4.2 FILTRATION

4.2.1 Rapid Rate Gravity Filters

4.2.1.2 Number of Filters

Delete from the last sentence:
"...with one filter removed from service."
Add the following:
A "unit" is defined as a filter compartment that can be taken out of service independent of other units and can be backwashed separately.

4.2.1.4c Housing for Filters

Delete this section and add the following:

"Filters shall be housed and protected from freezing temperatures."

4.2.1.6 Filter Material

Add the following:
The use of dual (anthracite coal and sand) or mixed (anthracite coal, sand and garnet) media is recommended.

4.2.1.6a Material Depth

Change 30 inches to 48 inches.

4.2.1.6e (5) Torpedo Sand

In first sentence substitute "may" in lieu of "should".
Add the following:
A layer of high-density material (specific gravity greater than 3.5) with an effective size of 1.0 to 2 mm may be used instead of torpedo sand.

4.2.1.8 Surface Wash, Subsurface Wash or Air Scour

Add the following:
The use of surface wash, subsurface wash or air scour is encouraged.

d. Air Scour Systems

Air scour systems to minimize loss of filter media and eliminate potential movement of support gravels. The use of support gravels is not recommended where the simultaneous flow of scour air and backwash water can pass through the gravel. A water-only cycle should be provided to restratify the filter media following an air-water wash.

4.2.1.10 Backwash

a. Add the following:
Backwash rates for dual and mixed-media filters utilizing air-water wash shall be a minimum of 9 to 15 gpm/ft^2 to provide for proper operation of the air scour system.
b. Add the following after "pump":
"a common underdrain system"

4.2.2 Rapid Rate Pressure Filters

Add the following:

These filters should not be used when undesirable entrapped gases are present in the raw water unless degasification can be successfully employed ahead of the pressure filters.

4.2.3 Diatomaceous Earth Filtration

Delete entire section and add the following:

Use of these filters may be considered for swimming pools but shall not be used for public water supplies.

4.3 DISINFECTION

4.3.2 Contact Time and Point of Application

Add the following:

For waters containing organic substances, chlorination of the raw water is discouraged and processes such as ozonation, chlorine dioxide, chloramination, coagulation/sedimentation, or granular activated carbon adsorption should be used to remove the organics before applying chlorine.

4.3.3 Residual Chlorine

Delete "0.2" and add "0.3" in lieu thereof.

4.3.4 Testing Equipment

Delete 0.5 million gallons per day and substitute 1.5 million gallons per day.

4.4 SOFTENING

4.4.2 Cation Exchange Process

Add the following:

Cation exchange softening should not be used for softening water for public water supplies.

4.6 IRON AND MANGANESE CQNTROL

4.6.1 Removal by Oxidation. Detention and Filtration

4.6.1.1 Oxidation

Add the following:

Dissolved oxygen should be controlled so that it does not enter the water distribution system.

4.7 FLUORIDATION

Add the following:

In the selection of fluoride compound it should be noted that the use of hydrofluorosilicic acid presents a greater safety hazard than the other compounds.

4.9 TASTE AND ODOR CONTROL

4.9.2 Chlorination

Add the following:

Chlorination shall not be used for removal of odors from surface supplies.

4.9.8 Potassium Permanganate

Delete "may be considered" and substitute "is recommended" in lieu there- of.

4.11 WASTE HANDLING AND DISPOSAL

4-11.2 Brine Waste

Delete entire paragraph and add the following:

The waste from ion exchange plants, demineralization plants, etc. shall be disposed of by discharge to the sanitary sewer. A holding tank may be required to prevent the overloading of the sewer and/or interference with the waste treatment processes. The effect of brine discharge to sewage lagoons may depend on the rate of evaporation from the lagoons.

4.11.3a Lagoons (for lime softening)

2. Delete and add the following:
   Provide at least two permanent lagoons, each having about five years of sludge storage volume.

3d Delete and add the following:
Minimum freeboard shall be 3 feet.

3g Add the following:
Lagoons shall be fenced to prevent public access. Signs should be attached to the fence on each side of the pond and every 500 feet along the fence to warn public of hazardous area.

3h Add the following:
Embankment should have a minimum of 8-foot top width. Minimum inner slope should be 3:l (horizontal to vertical). Outer slope should not be steeper than 3:l. Embankments should be protected from erosion.

3i Add the following:
Lagoon width should be narrow enough to allow removal of waste solids by dragline, clamshell or scraper.

4.11.k Delete

4.11.3f Delete

4.11.4 Alum Sludge

Delete the entire section and add the following:

Lagooning is the preferred method of alum sludge handling. Sludge production can be calculated using total chemicals used plus a factor for turbidity. Sludge lagoons should be designed in accordance with Section 4.11.3a as modified.

4.11.5.3 Discharge to Community Sanitary Sewer

Add the following:

Minimum velocity in receiving sewer should be 2.5 feet per second to prevent solids deposition. Hydraulic capacity of all sewers and pumping stations along the flow path to the wastewater treatment facilities should be checked for adequacy. If necessary, a holding tank shall be provided to prevent over-load of sewer wastewater treatment systems.

4.12 OZONATION

This is a new section.

Ozone may be used for disinfection, organics removal, taste and odor removal, iron and manganese oxidation and color removal. When used for disinfection, subsequent addition of chlorine, chlorine dioxide or chloramine is required to maintain a residual within the water distribution system.

4.12.1 Ozonation Equipment

The ozonation system should include the following components: gas preparation, electrical power supply, ozone generator, contactor, off-gas handling/treatment and ancillary system including instruments, controls, safety equipment and housing.

4.12.1.1 Gas Preparation

The gas preparation system shall provide dry, dust-free, oil-free oxygen-bearing gas to the ozonator.

4.12.1.2 Electrical Power Supply

The ozone generator may be controlled. by varying voltage and/or frequency of electrical power supply.

4.12.1.3 Ozone Generator

An efficient means of cooling the ozonator shall be provided. Generator shall be capable of providing the required amount of ozone for the established contact time at maximum flow rates.

4.12.1.4 Contactor

Contactor should be selected to provide efficient diffusion of ozone into the water based on application dependency as outlined as follows:

TREATMENT OBJECTIVE	APPLICATION DEPENDENT UPON
Disinfection	Mass transfer of ozone
Iron and Manganese Oxidation	Mass transfer of ozone
Organics Removal.	Either mass transfer of ozone or
Taste and Odor Removal	reaction rate of chemicals present.
Color Removal	(Depends on chemicals present)

Performance of contactor should not be affected by deposition of iron and manganese.

4.12.1.5 Off-Gas Handling/Treatment

Ozone levels of contactor off-gases shall not exceed 0.1 mg/l before discharge to atmosphere.

4.12.1.6 Ancillary Systems

The ozonation system should be provided with systems to measure the following:

a. temperature, pressure and moisture content of feed gas
b. flow rate, temperature, pressure and ozone concentration of ozone of off-gas from ozone generator
c. amperage, voltage, power and frequency (if a controllable variable of electrical power supply)
d. flow rate and temperature of cooling water for water-cooled ozone generators
e. residual ozone level in ozonized water

4.12.1.7 Safety Equipment

The ozonation system should be provided with:

a. an alarm to indicate excessive moisture in feed gas

b. automatic shut down ozone generator if flow rate and/or temperature of cooling water fall below levels required to provide adequate cooling
c. an alarm to indicate ambient ozone levels exceeding 0.1 mg/l (by volume)
d. automatic shut down of ozone generation equipment if ambient ozone levels exceed 0.3 mg/l (by volume)
e. self-contained breathing apparatus located outside of the entrance to ozonation facilities

4.12.1.8 Housing

a. Ozonation system shall be enclosed and separated from the other areas.
b. Ozonation room shall be:
    1. provided with shatter-resistant inspection window installed in an interior wall,
    2. constructed in such a manner that all openings between ozonation room and remainder of plant are sealed,
    3. provided with doors assuring ready means of exit and opening only to the building exterior,
    4. ventilated at the rate of one complete air change every three minutes when the room is occupied. (Ventilating fan shall take suction near the floor as far as practical from the door and air inlet, with the point of discharge so located as not to contaminate air inlets to any rooms or structures.)
    5. provided with louvered air inlets near the ceiling,
    6. heated to 60.F and protected from excessive heat.
c. Switches for fans and lights shall be outside of the room, at the entrance. A signal light indicating fan operation should be provided at each entrance when the fan can be controlled from more than one point.

4.12.1.9 Maintenance

Regular maintenance service should be provided through a service contract with the ozone equipment supplier.

4.12.1.10 Construction Materials

Stainless steel shall be used for "dry" and "wet" ozonized gas service unless documentation of long-term, reliable service using plastic materials is submitted to the reviewing authority and the use of plastic materials subsequently authorized.

4.12.2 Contact Time and Ozone Dosage

Contact time and ozone dosage required to accomplish the desired treatment objective shall be determined on the basis of pilot studies using the selected contactor. For disinfection, an ozone residual of 0.4 mg/l shall be maintained for a minimum of four minutes.

4.12.3 Points of Application

Application points for introducing ozone into the water should be established through pilot studies. Generally for disinfection, ozone is introduced near the end of the water treatment process. For organics removal, iron and manganese removal, and pre-disinfection, ozone is usually introduced early in the treatment process. In any case, for organics removal ozonation shall be carried out prior to chlorination.

4.13 REVERSE OSMOSIS

This is a new section.

4.13.1 General

The primary role of the design engineer in the application of reverse osmosis includes:

a. defining the quantity and quality of the raw water
b. designing the pretreatment and post-treatment systems
c. site planning
d. treated water stabilization
e. concentrate disposal

The reverse osmosis process should not be used to treat waters having a total dissolved solids concentration exceeding 12,000 mg/l for low pressure (400 psig) membranes or 30,000 mg/l for high pressure (1000 psig) membranes without justification.

4.13.2 Raw Water Pretreatment

4.13.2.1 Raw Water Quality

The following information shall be provided concerning the raw water: source identification (well or surface supply)

Temperature	manganese
color	strontium
Turbidity	barium
suspended solids	ammonia
specific conductance	carbonate
PH	bicarbonate
plugging factor	sulfate
bacterial analysis	chloride
calcium	fluoride
magnesium	nitrate
sodium	silica
potassium	hydrogen sulfide
iron	ortho phosphate

Also any other data that might affect performance of reverse osmosis such as oil, heavy metals, etc.

4.13.2.2 Pretreatment System

Pretreatment system shall be capable of producing feed water of a quality recommended by the manufacturer of the reverse osmosis process. Detailed information, including manufacturer's feedwater requirements, proposed pretreatment system and documented evidence (such as pilot data) that this pretreatment system is clearly capable of producing the desired feedwater quality, shall be submitted to the reviewing authority.

4.13.3 Reverse Osmosis Process

Reverse osmosis units shall utilize either spiral wound or hollow fine fiber membranes. Detailed information shall be submitted to the reviewing authority concerning required feedwater quality and anticipated performance capabilities of the reverse osmosis process.

4.13.4 Post Treatment

Treated effluents from the reverse osmosis process are usually low in pH and solids, high in carbon dioxide content and are normally corrosive. Detailed information shall be submitted to the reviewing authority concerning the anticipated corrosiveness of the product water and the method or methods proposed for stabilizing this water. The effluent corrosiveness and the capability of the method(s) proposed for controlling effluent stability should be verified by pilot-study and/or other reliable data.

Disinfection of the effluent shall be required and shall be in accordance with the provisions of Section 4.3.

4.13.5 Brine Disposal

Detailed description of the method of brine disposal shall be submitted to the reviewing authority along with data justifying the method selected. Normally accepted methods include discharge to the municipal sewers or to evaporation ponds.

4.14 ELECTRODIALYSIS

This is a new section.

4.14.1 General

The primary role of the design engineer in the application of electrodialysis is essentially the same as outlined in Section 4.13.1 except that the electrodialysis should not be used to treat waters that have total dissolved solids concentrations exceeding 5,000 mg/l without justification.

4.14.2 Raw Water Pretreatment

4.14.2.1 Raw Water Quality

Provide the same information as outlined in Section 4.13.2.1.

4.14.2.2 Pretreatment System

Comply with the same requirements as outlined in Section 4.13.1.1.

4.14.3 Electrodialysis Process

Detailed information shall be submitted to the reviewing authority concerning the required feed water quality and anticipated performance capabilities of the electrodialysis process.

4.14.4 Post Treatment

Detailed information shall be submitted to the reviewing authority concerning the anticipated corrosiveness of the product water and the method or methods proposed for stabilizing this water. The effluent corrosiveness and the capability of the method(s) proposed for controlling effluent stability should be verified by pilot-study and/or other reliable data.

Disinfection of the effluent shall be required and shall be in accordance with the provisions of Section 4.3

4.14.5 Brine Disposal

Comply with the same requirements as outlined in Section 4.13.5

PART 5 -CHEMICAL APPLICATION

5.1 FACILITY DESIGN

5.1 1 Number of feeders

a. (1) Delete and add the following:

Back up feeders for gases, liquids and solids should be provided, and...

5.4 SPECIFIC CHEMICALS

5.4.1 Chlorine gas

5.4.1c Chlorinator room

Add the following:

The exhaust fan and the lights shall be operated with the same switch so they are turned off and on simultaneously.

PART 6 -PUMPING FACILITIES

6.2 PUMPING STATIONS

6.2.3 Stairways and Ladders

Add the following:

c. Be constructed of non-corrosive materials that do not require paint or other non-permanent protective coatings for prevention of corrosion.

6.3 PUMPS

6.3.2 Priming (for pumps)

Delete entire section and add the following:

Pumping facilities shall be designed so that there is no need for pumps requiring priming.

6.5 AUTOMATIC AND REMOTE CONTROLLED STATIONS

Add the following:

All pumping stations shall be provided with automatic control systems with manual override.

6.6 APPURTENANCES

6.6.2 Piping

Add the following:

f. be constructed of non-corrosive materials that do not require paint or other non-permanent protective coatings.

6.6.6 Power

Change "shall" to "should".

7.0 Potable Water Storage Facilities

7.1. General

7.1.1 These standards shall be applicable for all elevated tanks, ground reservoirs, standpipes, clear wells and pressure tanks.

7.1.2 Plans and Specifications shall be submitted for review and approval by this Department for all proposed construction of new and existing storage facilities.

7.1.3 Water storage facilities are recommended for all public water supplies, i.e. any system with at least 15 service connections. Pressure tanks will be allowed where adequate fire protection is otherwise provided.

7.2 Storage Standards

7.2.1 Location

a. The design for any given water supply should be integrated with the distribution system, ground elevation, effective pressures, economics of pumping and general terrain. A design may provide for below or above ground storage or elevated storage depending on the nature of the design.
b. For below ground reservoirs the bottom of the reservoir shall be at least two feet above the top of the water table.
c. For gravity-feed mains a minimum pressure of 20 p.s.i. shall be supplied to all mains.
d. For ground reservoirs subject to flooding the overflow opening shall be at least 2 feet above the highest record flood level.
e. No sewer shall pass within 25 ft. of a ground storage reservoir, unless it is constructed of cast-iron, mechanical joint, pressure test pipe.

7.2.2 Capacity

a. Reservoirs shall be sized on the basis of preliminary engineering studies to determine domestic need plus fire protection, where fire protection is supplied.

7.2.3 Materials

a. Materials for reservoirs shall comply with current American Water Works Association and American Society for Testing & Materials Standards.

7.2.4 Construction

a. All reservoirs shall be equipped with an air vent terminating in an inverted U with the opening 24 to 36 inches above the roof or sod and be covered with a 24 inch mesh non-corrodible screen. It shall have an air flow greater than the maximum flow of water into and out of the tank. See Appendix A.

b. All reservoirs shall be equipped with an overflow which terminates 12 to 24 inches above the ground level. Directly below the overflow orifice a concrete splash pad, to prevent erosion, and proper drainage away from the reservoir shall be provided. The overflow shall be covered with a 24 inch mesh non-corrodible screen and be of sufficient size to permit wasting of water in excess of the maximum possible filling rate.
c. The discharge piping shall be designed in a manner that will prevent the flow of sediments into the distribution system. Removable silt stops are recommended.
d. The roof and sidewalls of reservoir shall be watertight except for vents, overflows, manholes, and piping. Any pipes running thru the.wal1 or reservoir roof shall be welded or properly gasketed.
e. Manholes of sufficient size to permit easy access shall be supplied. They should be framed at least 4 inches, and preferably 6 inches, above the surface of the roof and should be fitted with a hinged, locked, watertight and two inch overlapping cover. See Appendix A.
f. The roof of all reservoirs shall be watertight and sloped to provide adequate drainage.
g. Altitude-Control valves or telemeter equipment should be used where appreciable head loss occurs in the system.
h. All manhole steps subject to stored water contact should be cast aluminum or protected cast iron.
i. All reservoirs shall have the necessary valving to bypass the reservoir to allow for repairs.
j. Alarms for overflow and low-level warning are recommended.
k. The design of a reservoir should minimize the effect of freezing on riser pipes, vents, and overflows.
1. Clear well construction shall be such that a double-wall exists between potable and non-potable water.
m. No non-potable piping shall pass thru the clear well.

7.3 Pressure (Hydropneumatic) Tanks

7.3.1 Design

a. Each tank shall be quipped with a pressure gage, water site glass, automatic or manual air blowoff, means for adding air, pressure operated start-up controls for the pumps, and a bypass valve to permit operation while tank is being repaired.
b. All connections to the tank shall be welded or threaded.
c. The capacity of the tank shall provide at least 30 minutes contact time for chlorine based on the rated capacity of the pumps.
d. Pressure tanks shall meat American Society for Mechanical Engineers and American Society for Testing and Materials Standards.
e. Pressure tanks shall not be considered for fire protection.
f. Buried pressure tanks shall be constructed of material at least 3/16 inch thick, with a protective outside coating.

7.4 Corrosion Protection

7.4.1 Linings

a. All metal water storage facility should have an approved painting, lining, coating or conditioner to protect the interior of the tank from aggressive water. Suitable finishes will be those tested and approved by the New York State Department of Health, Engineering and Sanitation Manual. Division of Sanitary Engineering, latest edition.

7.4.2 Cathodic Protection

a. Cathodic Protection has proven to be a viable alternative to linings if installed by competent technical personnel. It may be used alone or in conjunction with linings.
b. No cathodic protection devices shall be installed whereby the anodes hang from the ceiling of the reservoir. They should be installed below the low water level of the reservoir. This will protect against damage due to floating ice caps.

7.5 Disinfection

7.5.1 After construction or repairs have been effected and painting has been completed the tank shall be disinfected before it is placed or replaced in service as per AWWA D102. Either of two methods will be approved. Two bacteriological samples collected on consecutive days shall be submitted to the State Health Laboratories in Pierre for bacteriological analysis. If the results are positive the procedure shall be repeated until negative samples are obtained.

a. Water containing the selected chlorine dosage (See Appendix B) shall be added to the dry tank to completely fill the tank. After the required time has elapsed the water should be flushed to waste. Care should be taken in discharging the waste water into streams rivers, etc. All appurtenances shall be operated during the disinfection period.
b. Water containing 50 ppm of chlorine shall be added to the tank to such a depth that when the tank is filled a chlorine residual of at least 2 ppm remains. The water containing 50 ppm of chlorine shall be held in the tank for a 24 hour period before the tank is filled. The full tank, in turn, shall be allowed to stand for 24 hours, after which time the tank may be put into service without draining the water used to disinfect it.

7.6 Safety

7.6.1 The safety of the employees must be considered in the design of the storage structure.

a. Ladders, ladder guards, balcony railing, and safely located entrance hatches shall be provided where applicable.
b. Elevated tanks with riser pipes over eight inches in diameter shall have protective bars over the riser opening inside the tank
c. Railing or handholds shall be provided on elevated tanks where persons must transfer from the access tube to the water compartment

8.0 Potable Water Distribution System

8.1 General

8.1.1 The distribution system of a public water supply includes the main, valves, hydrants, consumer service pipes, meters, and related appurtenances.

8.1.2 A hydraulic analysis of the distribution system, including future water use, shall be included when plans and specifications are submitted to SDDWNR for review.

8.2 Pipe Standards

8.2.1 Pipe selected shall have been manufactured and shall be installed in conformity with the latest standard specifications issued by the American Water Works Association (AWWA) or the American Standards Association. Plastic pipe will be accepted provided that it has been approved by and bears the seal of the National Sanitation Foundation. All pipe shall be at least Schedule 40 or be rated for at least 150 psi working pressure. Used water mains that meet the American Water Works Association specifications may be used again after the pipe has been thoroughly cleaned and has been restored practically to its original condition.

8.2.2 Water main joints - packing and jointing materials used in the joints of pipe shall meet the standard of the AWWA. Pipe having mechanical joints or slip-on joints with rubber gaskets is preferred.

8.3 Sizes of Mains

8.3.1 To comply with the State Insurance Services Office a minimum main size of six inches in residential areas and eight inches in high-value districts is required where cross-connecting mains are not more than 600 feet apart. The standard grading schedules and flow requirements of the Insurance Services Office should be followed in other instances.

8.3.2 Municipal supply mains not intended for fire-fighting should not be connected to fire hydrants and the supply runs should not exceed 300 feet for 2-inch pipe, 600 feet for 3-inch pipe and 1.200 feet for 4-inch pipe.

8.4 System Design

8.4.1 Dead ends shall be minimized by looping all mains.

a. Where dead-end mains occur they shall be provided with a fire hydrant, flushing hydrant. or blow-off for flushing purposes.
b. No flushing device shall be directly connected to any sewer.

8.4.2 Water pressure in system.

a. A water distribution system shall be designed so as to provide at all times a minimum residual pressure of 20 pounds per square inch at each service outlet or connection under any or all conditions or demands that can be placed on the system. Under normal operation conditions, minimum pressures should be approximately 60 psi and not less than 35 psi.
b. Where the topography of the area to be served is such that air locks in the lines may occur, air release devices shall be installed. The

installation of such shall preclude the possibility of submergence or possible entrance of contamination. Automatic air-relief valves shall not be used in situations where flooding of the manhole or chamber may occur.

c. Where distribution system conditions are such that it is necessary to provide more than one pressure plane or where distribution system conditions and demands are such that low pressures develop, the method of providing increased pressure shall preferably be by means of booster pumps taking suction from storage reservoirs. Where booster pumps must be installed to take suction directly from the distribution system, a minimum intake pressure of 20 pounds per square inch must be maintained when the pump is in normal operation. Such installations must be equipped with automatic pressure cut-off devices so the pumping units become inoperative at a suction pressure of less than 10 psi. The piping arrangement shall include a by-pass of the booster pump.

8.4:3 Valve locations

a. In municipalities, gate valves should be located so that a single break in the line will require no more than 500 feet of pipe to be disconnected from service in high value areas, nor more than 800 feet in other sections.
b. Valves should be located at street intersections in a position so that they can be readily operated in case of main failure.

8.4.4 Hydrants

a. Hydrants should be located at street intersections and at intermediate points between intersections as recommended by the State Insurance Services Office. Generally, hydrant spacing may range from 350 to 600 feet depending on the area being served. In high-value districts, hydrants may be spaced as close as 150 feet.
b. Fire hydrants should have a 4 1/2 inch pumper outlet, not less than two 2 1/2 inch hose cutlets, and be connected to the main with pipe not smaller than six inches.
c. A gravel pocket or dry well shall be provided for the hydrant drain unless the natural soils will provide adequate drainage. Hydrant drains shall not be connected to or located within 10 feet of sanitary sewers and storm drains, nor within 25 feet of septic tanks or absorption fields.

8.4.5 Metering

a. Accurate metering devices shall be provided at each service connection for the accumulation of water usage data of each service outlet.

8.4.6 Cross-Connection Protection

a. There shall be no physical connection permitted between a line carrying a public drinking water supply and a line carrying water of unknown or questionable quality. No water connection shall be made from any public drinking water supply to any water-using mechanical device unless it is protected against backflow and back-siphonage by a

device approved by the SDDWNR.

8.4.7 Water Services and Plumbing

a. Water services and plumbing shall conform to the South Dakota State Plumbing Code and relevant local codes.

8.5 Installation of Water Distribution Mains

8.5.1 Actual installation procedures shall comply with AWWA standards and manufacturer's recommended installation procedures.

8.5.2 A minimum cover of 6 feet above the top of the pipe shall be provided for all water main installations.

8.5.3 Separation of water mains and sewers.

a. Parallel installations - water mains shall be laid at least 10 feet horizontally from any existing or proposed sanitary sewer, storm sewer or sewer manhole; the distance shall be measured edge-to-edge. When conditions prevent a horizontal separation of 10 feet, specific approval from SDDWNR shall be obtained. Approval may be granted when the following is provided:

1. The water main is laid in a separate trench or on an undisturbed earth shelf located on one side of the sewer line and at such an elevation that the bottom of the water main is at least 18 inches above the top of the sewer line.

2. When it is impossible to obtain this horizontal (10 feet) or vertical (the water main 18 inches above the sewer main) separation, the sewer line must be relaid and constructed with cast iron pipe with mechanical compression or lead joints and/or other pipe equivalent to water main standards of construction and should be pressure-tested to assure water tightness before back-filling.

3. Water mains shall be laid to provide a horizontal distance of at least 25 feet from any existing or proposed septic tank, seepage pit, absorption field, stabilization pond or lagoon. When conditions prevent this separation, specific approval from SDDWNR shall be obtained. Approval may be granted when the following is provided:

a. The water line must be encased in PVC. cast iron or 6 inches of concrete for whatever distance necessary to obtain the 25' separation. If PVC or cast iron is used as encasement material, the ends shall be adequately sealed with concrete.

b. Vertical Separation at Crossings - water mains crossing house sewers, storm sewers or sanitary sewers shall be laid to provide a separation of at least.18 inches between the bottom of the water main and the top of the sewer and one full length of water pipe must be located so both joints will be as far from the sewer as possible. When conditions prevent such a vertical separation, specific approval from SDDWNR shall be obtained. Approval may be granted when the following is provided.

1. A non-perforated sewer main may cross above a water main if minimum vertical separation of 18 inches is provided, the sewer main material is of acceptable water main pipe quality and is a continuous piece at least 20 feet in length, and the length of water pipe is located so both joints are as far as possible from the sewer main. Adequate structural support must be provided for the sewers to prevent excessive deflection of joints and settling on and breaking the water mains.
2. A water main may cross either above or below a non-perforated sewer line with a vertical separation of less than 18 inches if either the water or sewer line is encased as 8.5.3a.3.a. for at least 10 feet each side of the crossing. Adequate structural support must be provided for the sewers to prevent excessive deflection of joints and settling on and breaking the water mains.
3. Specific approval fm SDDWNR shall be obtained if a water main must cross a perforated sewer line, absorption field or sewage ditch. Approval may be granted if the water line is encased as described in 8.5.3a.3.a. a minimum of 25 feet each side of the crossing.
4. There shall be at least a 10 foot horizontal separation between water mains and sanitary sewer force-mains. There shall be an 18 inch vertical separation at crossings as required in 8.5.3b.

8.5.4 Surface Water Crossings

a. Under water crossings

1. Where water mains are laid under any flowing stream or semipermanent body of water, the water main shall be of special construction, having flexible water tight joints, or shall be encased in a separate water-tight pipe encasement extending at least 10 feet beyond the banks of the normal water flow.
2. Valves must be provided on each side of the crossing to allow the underwater portion to be isolated and pressure tested, with the valve closest to the supply source located in a manhole.

b. Above water crossings.

1. The water main shall be adequately supported and anchored, protection from damage and freezing, and accessible for repair and replacement.

8.6 Sanitary Precautions and Disinfection

8.6.1 Pipe shall not be laid in water or placed where it can be flooded with water or sewage during its storage or installation.

8.6.2 Pressure and leakage tests for new installations shall be performed in accordance to AWWA Standard C600.

8.6.3 Disinfection – all new, cleaned or repaired water mains shall be thoroughly disinfected in accordance with AWWA C601-68, preferably by the following method:

a. By filling the. water mains with at least a 50 ppm chlorine solution and allowing it to stand at least 24 hours with a minimum remaining chlorine residual of 25 ppm. All valves and hydrants should be operated during the disinfection process. If a 25 ppm residual is not present after 24 hours, the entire process must be reaccomplished.

b. After the disinfection process, the lines shall be flushed and two consecutive samples of water from the end of the line disinfected must be collected at 1east 24 hours apart and submitted to the. State Health Laboratory in Pierre, or other laboratory acceptable to SDDWNR, and shall be found free of coliform bacteria, before the system is placed into service.

8.7 Water Loading Stations

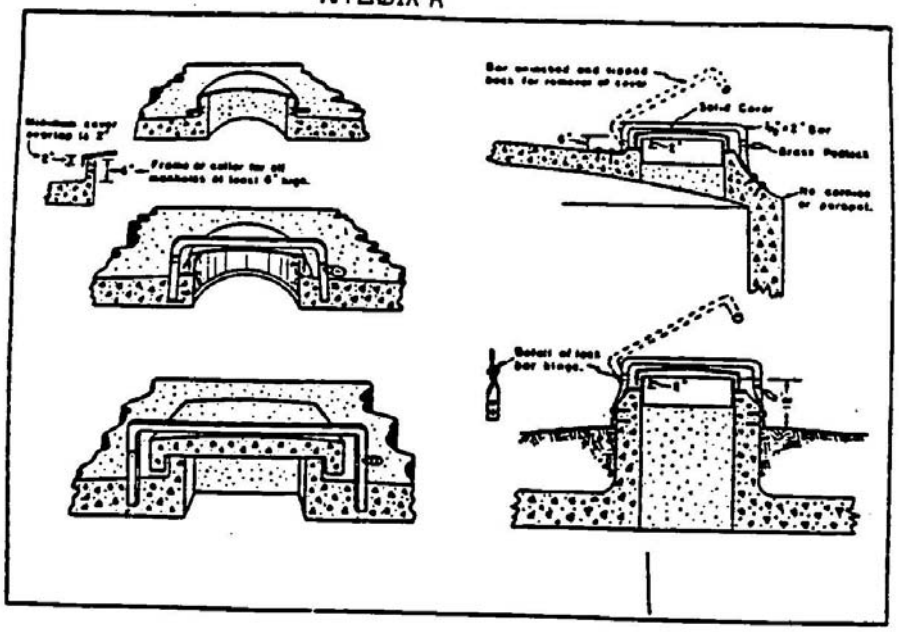
8.7.1 Water dispensing units present special problems when the fill line may be used for filling both potable water vessels and other tanks or contaminated vessels. To prevent contamination of public supply, the following criteria. shall be met:

a. A device shall be installed on the fill line to provide an air break and prevent a submerged discharge line. (See Figure**.** 1)

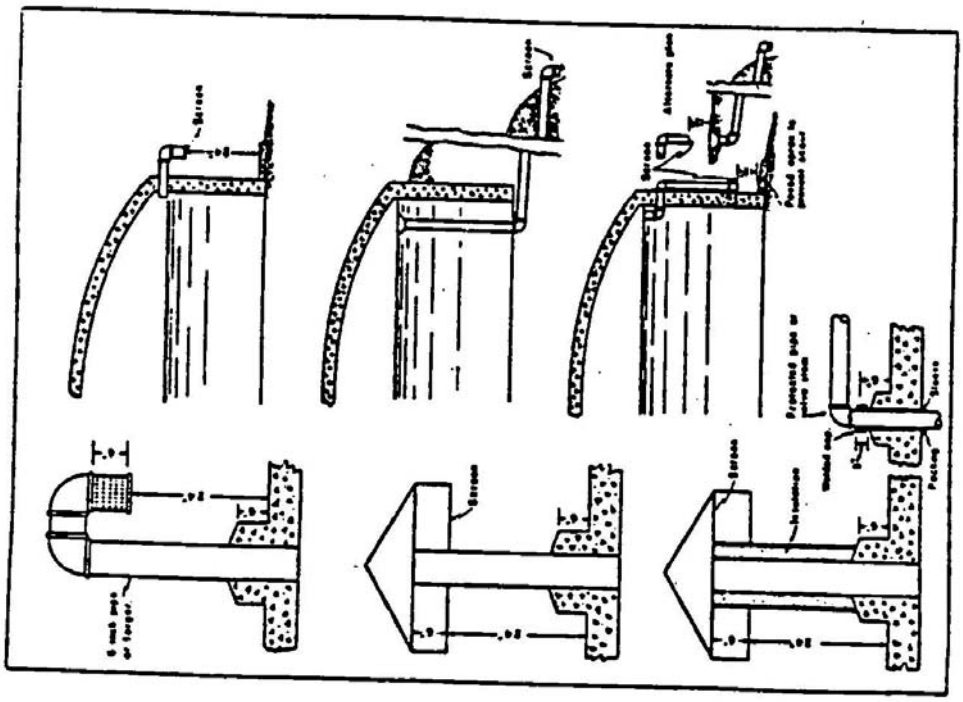
b. The fill hose and cross connection control device must be constructed so that when hanging freely it will terminate at least two feet above the ground surface.

c. The discharge end of the fill line must be unthreaded and constructed to prevent the attachment of additional hose, piping or other appurtenances.

APPENDIX A



TYPES OF MANHOLE COVERS AND LOCKING DEVICES



SUGGESTED SANITARY DETAILS OF VENTS, OVERFLOWS AND PIPE CONNECTION ON ROOF OF RESERVOIRS.

South Dakota Department of Environment and Natural Resources
Office of Drinking Water
523 E. Capitol Ave., Foss Bldg.
Pierre, South Dakota 57501-3181

RECOMMENDED PROCEDURE FOR CHLORINE DISINFECTION OF SPRING BOX, ELEVATED STORAGE, GROUND RESERVOIR, CISTERN, WATER TREATMENT PLAN BASIN

Introduction

A ground reservoir, elevated tank, spring box, cistern, or water treatment plant basin should be thoroughly cleaned and then disinfected with a strong chlorine solution after:

1. ORIGINAL CONSTRUCTION
2. ANY REPAIR OR MAINTENANCE
3. FLOODING
4. A PERIOD OF NON-USE
5. TWO OR MORE "UNSAFE" BACTERIOLOGICAL WATER SAMPLES ARE TRACED TO THE WELL

Adequate chlorine requires a certain chlorine dosage for a minimum contact time - 100 parts per million for 2 hours, or 50 parts per million for 8 hours, or 25 parts per million for 24 hours.

Chlorine for disinfection for these water systems can be either 5.25% sodium hypochlorite solution or 65% calcium hypochlorite powder. A 5.25% hypochlorite solution is common house-hold bleach such "Hilex", "Clorox", or "Purex" available at grocery stores and supermarkets. The 65% calcium hypochlorite powder is available from chemical supply houses and is known commercially as "HTH", Perchloron", or "Pittchlor".

Recommended Procedures

1. The unit to be disinfected should be full of water.
2. Determine recommended chlorine disinfection dosage for the desired contact time from the following table:

AMOUNT OF CHLORINE NECESSARY FOR DOSAGE AND TIME COMBINATIONS

Volume of Box, Basin, Reservoir or Cistern		5.25% Sodium Hypochorite (Bleach) 100 ppm* for 2 hrs		50 ppm* for 8 hrs		25 ppm* for 24 hrs		65% Calcium Hypochorite 100 ppm* for 2 hrs		50 ppm* for 8 hrs		25 ppm* for 24 hours	
50	gal	1½	cups	3/4	cup	3/8	cup	- - -	- -	- - -	- -	- - -	- -
100	gal	3	cups	1½	cups	3/4	cup	- - -	- -	- - -	- -	- - -	- -
200	gal	6	cups	3	cups	1½	cups	- - -	- -	- - -	- -	- - -	- -
500	gal	1	gal	7½	cups	3 3/4	cups	9½	oz	- - -	- -	- - -	- -
1,000	gal	2	gals	1	gal	7½	cups	1 lb 3 oz	oz	9½	oz	- - -	- -
2,000	gal	4	gals	2	gals	1	gal	2 lb 6 oz	lbs	1 lb 3 oz	oz	9½	oz
5,000	gal	- -	- -	5	gals	2½	gals	6	lbs	3	lbs	1 lb 8 oz	oz
10,000	gal	- -	- -	- - -	- -	5	gals	12	lbs	6	lbs	3	lbs
20,000	gal	- -	- -	- - -	- -	- - -	- -	24	lbs	12	lbs	6	lbs
50,000	gal	- -	- -	- - -	- -	- - -	- -	60	lbs	30	lbs	15	lbs
100,000	gal	- -	- -	- - -	- -	- - -	- -	120	lbs	60	lbs	30	lbs

* ppm = parts per million

3. Completely mix the chorine dosage throughout the unit to be disinfected.
4. Leave the chorine solution in the unit for the recommended contact time.
5. Do not use the heavily chlorinated water.
6. At the end of the contact time, remove the water from the unit and discharge to waste. DO NOT ALLOW THE WATER TO ENTER A RIVER, LAKE, OR STREAM.
7. Fill the unit with clean water and collect a water sample for bacteriological testing after one or two days of use.