Chapter NR 811

REQUIREMENTS FOR THE OPERATION AND DESIGN OF COMMUNITY WATER SYSTEMS

NR 811.01 Applicability.
NR 811.02 Definitions.
NR 811.03 Alternative requirements.
NR 811.04 Drinking water standards.
NR 811.05 Underground placement of substances.
NR 811.06 Cross−connections and interconnections.
NR 811.07 Interconnections with other acceptable water sources.

Subchapter I — Submission of Plans
NR 811.08 General requirements.
NR 811.09 Specific requirements for waterworks, plans, specifications and engineering reports.
NR 811.10 Owner approval requirement.
NR 811.11 Resident project representative.

Subchapter II — Source Development — Groundwater
NR 811.12 Wells.
NR 811.13 Abandonment of wells.
NR 811.14 Special requirements for wells developed in unconsolidated formations.
NR 811.15 Special requirements for collector wells.
NR 811.16 Special requirements for dug wells and springs.
NR 811.17 Special requirements for infiltration lines.
NR 811.18 Special requirements for sandstone wells.
NR 811.19 Special requirements for limestone or dolomite wells.
NR 811.20 Special requirements for granite wells.

Subchapter III — Source Development — Surface Water
NR 811.21 General requirements.
NR 811.22 Intakes.
NR 811.23 Shore wells.
NR 811.231 Off−Stream raw water storage.
NR 811.232 Intake chemical treatment.

Subchapter IV — Pumping Stations, Pumphouses, and Water Treatment Plant Buildings
NR 811.24 General requirements.
NR 811.25 Buildings.
NR 811.26 Number of pumping units.
NR 811.27 Auxiliary power.
NR 811.28 Additional requirements.

Subchapter V — Pumping Equipment and Appurtenances
NR 811.29 Pumping capacity requirements.
NR 811.30 General pump, motor and wiring installation requirements.
NR 811.31 Line−shaft vertical turbine pumps.
NR 811.32 Submersible vertical turbine pumps.
NR 811.33 Motor protection.
NR 811.34 Pump variable output control devices.
NR 811.35 Pitless units.
NR 811.36 Well appurtenances.
NR 811.37 Pump discharge lines.

Subchapter VI — Chemical Addition
NR 811.38 General.
NR 811.39 Feed equipment.
NR 811.40 Storage and handling.

Subchapter VII — Treatment
NR 811.41 General treatment design.
NR 811.42 Treatment of water from surface water sources.
NR 811.43 Treatment of water from groundwater sources.
NR 811.44 Pilot testing.
NR 811.45 Aeration.
NR 811.46 Arsenic removal.
NR 811.47 Clarification.
NR 811.48 Chlorination.
NR 811.49 Filtration — gravity.
NR 811.50 Filtration — membrane.
NR 811.51 Fluoridation.
NR 811.52 Iron and manganese control.
NR 811.53 Organics removal.
NR 811.54 Ozonation.
NR 811.55 Radionuclide removal.
NR 811.56 Sequestration.
NR 811.57 Softening.
NR 811.58 Stabilization.
NR 811.59 Taste and odor control.
NR 811.60 Ultraviolet (UV) Light.

Subchapter VIII — Hydro−Pneumatic Tanks
NR 811.61 General.

Subchapter IX — Storage Facilities
NR 811.62 Volume and pressure.
NR 811.63 Location.
NR 811.64 Construction details.
NR 811.65 Plant storage.
NR 811.66 Distribution system storage.

Subchapter X — Distribution Systems
NR 811.67 Applicability.
NR 811.68 Ownership of municipal water distribution systems.
NR 811.69 Materials.
NR 811.70 Water main design.
NR 811.71 Hydrants.
NR 811.72 Air−relief facilities and valve and meter chambers.
NR 811.73 Installation of mains.
NR 811.74 Separation of water mains and sanitary or storm sewer mains.
NR 811.75 Separation of water mains and other contamination sources.
NR 811.76 Surface water crossings.
NR 811.77 Common casing crossings.
NR 811.78 Water loading stations.

Subchapter XI — Water Pressure Booster Stations
NR 811.79 General.
NR 811.80 Location.
NR 811.81 Pumps and pressures.
NR 811.82 Storage requirements.
NR 811.83 Emergency power requirements.
NR 811.84 Station requirements.

Subchapter XII — Waste Disposal
NR 811.85 General.
NR 811.851 Sanitary wastes.
NR 811.852 Floor drainage.
NR 811.853 Backwash wastewater from iron and manganese filters.
NR 811.854 Brine wastes from ion exchange plants.
NR 811.855 Wastewater from reverse osmosis plants.
NR 811.856 Water treatment plant wastewater radionuclide content compliance with the unity equation.
NR 811.857 Backwash wastewater from lime softening water treatment plants.
NR 811.858 Lime softening sludge.
NR 811.859 Spent media.
NR 811.860 Backwash wastewater from surface water treatment plants.
NR 811.861 Alum or other coagulant sludge.
NR 811.862 Recycling backwash wastewater.

Subchapter XIII — Aquifer Storage Recovery
NR 811.87 General.
NR 811.88 ASR well performance requirements.
NR 811.89 Well construction requirements for ASR wells.
NR 811.90 Equipment, appurtenances and piping for ASR wells and ASR systems.
NR 811.91 ASR system pilot studies.
NR 811.92 ASR system development testing.
NR 811.93 Operating an ASR system.

Note: Chapter NR 111 as it existed on April 30, 1992 was repealed and a new chapter NR 811 was created effective May 1, 1992. Chapter NR 811 as it existed on November 30, 2010, was repealed and a new chapter NR 811 was created effective December 1, 2010.

NR 811.01 Applicability. This chapter governs the general operation, design and construction of community water systems and the construction of any water system serving 7 or more single family homes, 10 or more duplex living units, 10 or more mobile homes, 10 or more condominium units or 10 or more apartment units. One duplex equals 2 living units. The standards for design and construction shall be considered minimum standards for new facilities and the minimum standards to which facilities in existence on December 1, 2010, shall be upgraded when improvements are undertaken at those facilities except for sys-

tems where all of the living units are owned by a single owner and the owner provides information indicating that less than 25 year−round residents will be served. These standards may be imposed on a case−by−case basis to facilities in existence on December 1, 2010, when the department determines that a health risk exists due to the water system. The owner shall be responsible for ensuring that the requirements of this chapter are met.

Note: The authority to promulgate and enforce these rules is contained in chs. 280 and 281, Stats. Pursuant to s. 299.97, Stats., any person who violates this chapter shall forfeit not less than $10 nor more than $5,000 for each violation. Each day of continued violation is a separate offense.

History: CR 09−073: cr. Register November 2010 No. 659, eff. 12−1−10.

NR 811.02 Definitions. In this chapter:

(1) "ANSI" means the American National Standards Institute.

Note: The ANSI address is 25 West 43rd St, New York, NY 10036.

(2) "API" means the American Petroleum Institute.

Note: The API address is 1220 L Street NW, Washington DC 20005−4070.

(3) "Approval" means the written approval of the department for any project requiring approval pursuant to s. 281.41, Stats., and s. NR 108.03 for community systems.

(4) "Aquifer storage recovery" or "ASR" means placement of treated drinking water underground through a well for the purpose of storing and later recovering the water through the same well for potable use.

Note: Underground placement of water for the purpose of restoring an aquifer is not included in the definition of "aquifer storage recovery" or "ASR."

(5) "ASR system" means all of the ASR wells, ASR monitoring wells and related appurtenances within a municipal water system and any interconnected public water system served by the municipal water system.

(6) "ASTM" or "ASTM International" means the organization formerly knows as the American Society for Testing and Material.

Note: The ASTM or ASTM International address is 100 Barr Harbor Drive, PO Box C700, West Conshohocken, Pennsylvania 19148−2959.

(7) "AWWA" means the American Water Works Association.

Note: The AWWA address is 6666 West Quincy Avenue, Denver, Colorado 80235.

(8) "Blackwater" means wastewater contaminated by human body waste, toilet paper and any other material intended to be deposited in a receptor designed to receive urine or feces.

(9) "Building" means a structure for support, shelter, or enclosure of persons or property.

(10) "Building drain" means horizontal piping within or under a building, installed below the lowest fixture or the lowest floor level from which fixtures can drain by gravity to the building sewer.

(11) "Building drain, storm" means a building drain which conveys storm water, clear water, or both.

(12) "Building sewer" means that part of the drain system not within or under a building which conveys its discharge to a public sewer, private interceptor main sewer, private onsite wastewater treatment system or other point of discharge or dispersal.

(13) "Building sewer, sanitary" means a building sewer which conveys wastewater consisting in part of domestic wastewater.

(14) "Building sewer, storm" means a building sewer which conveys storm water, clear water, or both.

(15) "Chlorine Institute" means the Chlorine Institute, Inc.

Note: The Chlorine Institute address is 1300 Wilson Boulevard, Arlington, VA 22209.

(16) "Community water system" means a public water system which serves at least 15 service connections used by year−round residents or regularly serves at least 25 year−round residents. Any water system serving 7 or more single family homes, 10 or more mobile homes, 10 or more apartment units, 10 or more duplex living units or 10 or more condominium units shall be considered a community water system unless information is provided by the owner indicating that 25 year−round residents will not be served.

(17) "Cross connection" means a connection or potential connection between any part of a water supply system and another environment containing substances in a manner that, under any circumstances, would allow the substances to enter the water supply system by means of back siphonage or back pressure.

(18) "CT" or "CT calc" is the product of the "residual disinfectant concentration" (C) in mg/l determined before or at the first customer, and the corresponding "disinfectant contact time" (T) in minutes, i.e., "C" x "T". If a public water system applies disinfectants at more than one point prior to the first customer, the public water system owner or operator shall determine the CT of each disinfectant sequence before or at the first customer, to determine the total percent inactivation or "total inactivation ratio." The inactivation ratio for a single disinfectant sequence is:

$$\frac{CT_{calc}}{CT_{table}}$$

where "CT_{table}" is the CT value required for the target organism and the target level of inactivation. The sum of the inactivation ratios, or total inactivation ratio for a series of disinfection sequences is:

$$\sum \frac{(CT_{calc})}{CT_{table}}$$

and is calculated by adding together the inactivation ratio for each disinfection sequence. In determining the total inactivation ratio, the public water system owner or operator shall determine the residual disinfectant concentration of each sequence and corresponding contact time before any subsequent disinfection application points. A total inactivation ratio equal to or greater than 1.0 is assumed to provide the target level of disinfection of the target organism.

(19) "Department" means the department of natural resources.

(20) "Disinfectant contact time" ("T" in CT calculations) means the time in minutes that it takes for water to move from the point of disinfectant application or the previous point of disinfectant residual measurement to a point before or at the point where residual disinfectant concentration ("C") is measured. Where only one "C" is measured, "T" is the time in minutes that it takes for water to move from the point of disinfectant application to a point before or where residual disinfectant concentration ("C") is measured. Where more than one "C" is measured, "T" is determined as follows:

(a) For the first measurement of "C", the time in minutes that it takes for water to move from the first or only point of disinfectant application to a point before or at the point where the first "C" is measured.

(b) For subsequent measurements of "C", the time in minutes that it takes for water to move from the previous "C" measurement point to the "C" measurement point for which the particular "T" is being calculated. Disinfectant contact time in pipelines shall be calculated based on "plug flow" by dividing the internal volume of the pipe by the maximum hourly flow rate through the pipe. Disinfectant contact time within mixing basins and storage reservoirs shall be determined by tracer studies or other department approved equivalent demonstration.

(21) "Disinfection profile" means a summary of daily *Giardia lamblia* inactivation through the treatment plant. The procedure for developing a disinfection profile is contained in s. NR 810.34.

(22) "Displacement zone" means the 3−dimensional subsurface region surrounding an aquifer storage recovery well into which treated drinking water is placed for storage and later recovery.

(23) "Distribution system" means all pipes or conduits by which water is delivered to consumers except piping and fixtures

inside buildings served, water services and private water mains as defined in ch. SPS 381.

(24) "Drillhole" means any of the following:

(a) Any hole that is bored, drilled or driven.

(b) Any dug hole that is deeper than it is wide.

(c) Any excavation, shaft or other opening similar to a hole described in par. (a) or (b).

(25) "Dry land access" means a vehicular access route which is above the regional flood elevation and which connects land located in the floodplain to land outside the floodplain.

(26) "Energy efficient" means that the proposed improvement will consume the minimum amount of energy to meet operational performance requirements throughout the life of the facility or system.

(27) "Entry point" means a location in the water system after treatment or chemical addition, if any, but prior to the distribution system. A sample collected in the distribution system may be considered an entry point sample if the department has determined it is more representative of the water sources.

(28) "Filtration" means a process for removing particulate matter from water by passage through porous media.

(29) "Flocculation" means a process to enhance agglomeration or collection of smaller floc particles into larger, more easily settleable or filterable particles through gentle stirring by hydraulic or mechanical means.

(30) "French drain" means a buried dry well or sump that receives building domestic or floor drain wastewater or both.

(31) "Graywater" means wastewater contaminated by waste materials, exclusive of urine, feces or industrial waste, deposited into plumbing drain systems.

(32) "Groundwater" means any of the waters of the state, as defined in s. 281.01 (18), Stats., occurring in a saturated subsurface geological formation of rock or soil.

(33) "Groundwater source" means a source of groundwater obtained from horizontal collectors, infiltration lines, springs, and dug, drilled or other types of wells.

(34) "Groundwater under the direct influence of surface water" (GWUDI) means any water beneath the surface of the ground with either of the following:

(a) Occurrence of insects or other macroorganisms, algae or large diameter pathogens such as *Giardia lamblia* or *Cryptosporidium,* in greater than or equal to 10% of representative source water samples collected over a period of 6 months, immediately prior to the first or only point of disinfectant application.

(b) Evidence of relatively rapid shifts in water characteristics such as turbidity, temperature, conductivity, or pH which closely correlate to climatological or surface water conditions where the department determines that these shifts are indications of the potential for contamination of the groundwater by the organisms identified in par. (a).

(35) "Hydrofracturing" means hydraulic fracturing of an aquifer by injecting potable chlorinated water into a bedrock formation well under pressures great enough to open the bedrock along bedding planes, joints and fractures.

(36) "Impulse generation" or "gas bursting" means the directed quick release of compressed gases and other impulse generation techniques used to develop or rehabilitate drillholes, well screens and gravel pack.

(37) "Infiltration component" means any device or method that is intended to promote the assimilation of water into in situ soil.

(38) "Living unit" means a residence, apartment unit, condominium unit, duplex unit, manufactured home, or other domicile.

(39) "Membrane filtration" means a pressure or vacuum driven separation process in which particulate matter larger than 1 micrometer is rejected by an engineered barrier, primarily through a size−exclusion mechanism, and which has a measurable removal efficiency of a target organism that can be verified through the application of a direct integrity test. It includes the common membrane technologies of microfiltration, ultrafiltration, nanofiltration, and reverse osmosis.

(40) "Monitoring well" means a well or drillhole constructed for the purpose of obtaining information on the physical, chemical, radiological or biological characteristics of the groundwater.

(41) "Municipal water system" means a community water system owned by a city, village, county, town, town sanitary district, utility district, public inland lake and rehabilitation district, municipal water district or a federal, state, county or municipal owned institution for congregate care or correction, or a privately owned water utility serving the foregoing.

(42) "Nephelometric turbidity units" or "NTUs" means the units used to describe turbidity. Nephelometric refers to the way the instrument, a nephelometer, measures how much light is scattered by suspended particles in the water.

(43) "Non−community water system" means a public water system that is not a community water system. A non−community water system may be either a non−transient non−community water system or a transient non−community water system.

(44) "NSF or NSF International" means the organization formerly known as the National Sanitation Foundation.

Note: The NSF or NSF International address is PO Box 130140, 789 N. Dixboro Road,, Ann Arbor, Michigan 48113−0140.

(45) "Other−than−municipal (OTM) water system" means a community water system that is not a municipal water system.

(46) "Owner" means any person who owns or operates a public water system.

(47) "Peak demand" means the maximum water demand in gallons per minute at any given time. The peak demand is sometimes estimated to be 2.0 times the total maximum day water use in gallons averaged over 1,440 minutes/day or the peak hour demand in gallons per minute on the maximum day of use.

(48) "Person" means an individual, corporation, company, association, cooperative, trust, institution, partnership, state, municipality or federal agency.

(49) "POWTS" means a private onsite wastewater treatment system.

(50) "POWTS component" means any subsystem, subassembly or other system designed for use in or as part of a private onsite wastewater treatment system which may include treatment, dispersal or holding, and related piping.

(51) "POWTS dispersal component" means a device or method that is intended to promote the assimilation of treated wastewater by the environment.

(52) "POWTS holding component" means any receptacle intended to collect wastewater for a period of time, including holding and dosing tanks.

(53) "POWTS treatment component" means a device or method that is intended to reduce the contaminant load of wastewater.

(54) "Professional Engineer" or "PE" means an individual licensed as a professional engineer by the Wisconsin Department of safety and professional services.

(55) "Protective casing" means the well casing providing the primary sanitary protection and that is grouted in place to a department approved depth.

(56) "Public water system" or "system" or "PWS" means a system for the provision to the public of piped water for human consumption through pipes or other constructed conveyances, if the system has at least 15 service connections or regularly serves an average of at least 25 individuals daily at least 60 days out of

the year. A public water system is either a "community water system" or a "non−community water system." A system:

(a) Includes any collection, treatment, storage and distribution facilities under control of the operator of the system and used primarily in connection with the system.

(b) Includes any collection or pretreatment storage facilities not under the system's control which are used primarily in connection with the system.

Note: The definition of public water system as regulated by this chapter is broader and includes more water systems than those governed by the public service commission under its definition of a public utility in ch. 196, Stats.

(57) "Pump installer" or "licensed pump installer" has the same meaning as "licensed pump installer," given in s. 280.01 (2e), Stats.

Note: The statutory definition of "licensed pump installer" is any individual who has paid the annual license fee under s. 280.15 (2m) (c) 2., Stats., and obtained a license under s. 280.15 (2m), Stats., as a pump installer.

(58) "Pump installing" has the meaning given in s. 280.01 (5), Stats.

Note: The statutory definition of "pump installing" means the industry and procedure employed in the placement and preparation for operation of equipment and materials utilized in withdrawing or obtaining water from a well for consumption or use, including all construction involved in making entrance to the well and establishing such seals and safeguards as are necessary to protect such water from contamination.

(59) "Recharge area" means the total land area contributing water to a well.

(60) "Regional flood" means a flood determined to be representative of large floods known to have occurred in Wisconsin or which may be expected to occur on a particular lake, river or stream once in every 100 years.

(61) "Residual disinfectant concentration" ("C" in CT calculations) means the concentration of disinfectant measured in mg/l in a representative sample of water.

(62) "Reviewable project" has the meaning given in s. NR 108.02 (13).

(63) "SCADA" means Supervisory Control and Data Acquisition, a computer system used for gathering and analyzing real time data used to monitor and control water systems and their components.

(64) "Spring" has the meaning given in s. 281.34 (1) (f), Stats.

Note: Section 281.34 (1) (f), Stats., defines "spring" to mean "an area of concentrated groundwater discharge occurring at the surface of the land that results in a flow of at least one cubic foot per second at least 80% of the time."

(65) "Supplier of water" has the same meaning as "owner" given in sub. (44).

(66) "Surface water" means all water which is open to the atmosphere and subject to surface runoff.

(67) "Surface water systems" means public water systems using surface water or groundwater under the direct influence of surface water as a source and that are subject to the requirements of 40 CFR 141, subpart H, P, and W, which contains the national primary drinking water regulations.

(68) "Treated drinking water" means potable water that has been subjected to treatment methods approved by the department to comply with the primary drinking water standards contained in ch. NR 809 and which is obtained directly from a municipal water system via piping from the municipal water distribution system to the point of underground injection.

(69) "Underground injection" means placement of any substance underground through a well, drillhole or water system.

(70) "Utility" means a public utility as defined in ch. 196, Stats.

(71) "UV" means ultraviolet light.

(72) "Variable output control device" means a physical or electronic device such as a control valve, variable speed drive unit, variable frequency drive unit or similar device to be used to control the gallon per minute pump discharge rate and/or distribution system pressure.

(73) "Virus" means a virus of fecal origin which is infectious to humans by waterborne transmission.

(74) "Waterworks" or "water system" means all facilities, structures, pipes, conduits and appurtenances by means of which water is delivered to consumers except piping and fixtures inside buildings served, water services and private water mains as defined in ch. SPS 381.

(75) "Well" has the meaning given in s. 281.34 (1) (h), Stats.

Note: Section 281.34 (1) (h), Stats., defines "well" to mean "any drillhole or other excavation or opening deeper than it is wide that extends more than 10 feet below the ground surface and is constructed for the purpose of obtaining groundwater."

(76) "Well driller" or "licensed well driller" has the same meaning as "licensed well driller," given in s. 280.01 (2m), Stats.

Note: The statutory definition of "licensed well driller" is any individual who has paid the annual license fee under s. 280.15 (2m) (c) 1., Stats., and obtained a license under s. 280.15 (2m), Stats., as a well driller.

(77) "Well drilling" has the meaning given in s. 280.01 (8), Stats.

Note: The statutory definition of "well drilling" is the industry and procedure employed in obtaining groundwater from a well by digging, boring, drilling, driving or other methods but not including the driving of points for the purpose of obtaining groundwater. It shall also include all construction work and installation of well casings in said well involved therein for the protection of such well water against pollution.

(78) "WPDES permit" means the Wisconsin pollutant discharge elimination system permit issued by the department under ch. 283, Stats., for the discharge of pollutants.

(79) "Year−round resident" means a resident who resides in the same living unit for 6 months per year or more.

(80) "Zone of influence" means the area of the cone of groundwater depression formed when the well pump is operating.

History: CR 09−073: cr. Register November 2010 No. 659, eff. 12−1−10; correction in (23), (74) made under s. 13.92 (4) (b) 7., Stats., Register December 2011 No. 672; correction in (54) made under s. 13.92 (4) (b) 6., Stats., Register February 2012 No. 674.

NR 811.03 Alternative requirements. (1) If the owner of a proposed reviewable project determines that compliance with the design requirements of this chapter is impracticable, the owner may submit in writing to the department prior to submission of final plans a request to use alternative criteria. This request shall contain the reasons that compliance with the design criteria is impracticable and alternative criteria for which department approval is sought and all pertinent facts, data, reports and studies supporting the proposed alternative.

(2) If the department determines that compliance with the design requirements of this chapter would be impracticable in any specific case, or that an alternative proposed has additional benefits with adequate safeguards, it may approve alternative criteria which are in substantial compliance with the requirements of this chapter.

History: CR 09−073: cr. Register November 2010 No. 659, eff. 12−1−10.

NR 811.04 Drinking water standards. Where practical, the quality of the raw water source shall meet the primary maximum contaminant levels of ch. NR 809 and other applicable requirements of ch. NR 809 and this chapter without treatment. In all cases, the quality of finished water supplied to consumers at the point−of−entry to the distribution system shall meet the primary drinking water standards contained in ch. NR 809. Department−approved water treatment shall be installed where necessary to meet this requirement.

History: CR 09−073: cr. Register November 2010 No. 659, eff. 12−1−10.

NR 811.05 Underground placement of substances. The use of any well, drillhole or water system for the underground placement of any substance shall be prohibited unless it is a department approved activity necessary for the construction, rehabilitation or routine operation of the well or water system.

History: CR 09−073: cr. Register November 2010 No. 659, eff. 12−1−10.

NR 811.06 Cross−connections and interconnections. Unprotected cross−connections are prohibited. Cross−connections shall be protected as required in s. SPS 382.41. Water

system interconnections are prohibited except as provided in s. NR 811.07.

History: CR 09–073: cr. Register November 2010 No. 659, eff. 12–1–10; correction made under s. 13.92 (4) (b) 7., Stats., Register December 2011 No. 672.

NR 811.07 Interconnections with other acceptable water sources. Interconnections between the public water supply system and another source of water are prohibited unless permitted by the department in individual cases. Approval of the department shall be obtained prior to making the interconnection.

History: CR 09–073: cr. Register November 2010 No. 659, eff. 12–1–10.

Subchapter I — Submission of Plans

NR 811.08 General requirements. (1) PLANS AND SPECIFICATIONS REQUIRED. The owner of a community water system shall submit plans and specifications for all reviewable projects in accordance with ch. NR 108. Plans and specifications shall comply with or incorporate the general design and operating requirements in this chapter and chs. NR 108 and 810. Worksheets shall be included with all submittals for reviewable projects for which applicable worksheets are provided by the department.

(2) APPROVALS REQUIRED. Written department approval shall be obtained prior to starting construction for all reviewable projects as defined by s. NR 108.03 (1). The department may deny approval or grant a limited approval in cases where the requirements of this chapter are not met.

(3) PROJECTS REQUIRING DEPARTMENT APPROVAL BUT NOT REQUIRING SUBMITTAL BY A PROFESSIONAL ENGINEER. The requirements for the submittal of plans and specifications for reviewable projects are in ch. NR 108. The water supply owner or the owner's representative may submit reviewable projects to the department for approval without the seal of a professional engineer registered in Wisconsin for most operation and maintenance work and for all non–subdivision, other–than–municipal water systems as provided in s. NR 108.04 (2) (c) 2. Plans shall be submitted by a registered well driller or pump installer where applicable. Examples of projects not requiring a professional engineer's seal are pump replacement with similar equipment not affecting pumping capacity; test well construction when to be pumped at a rate of 70 gallons per minute or more for a minimum duration of 72 hours, unless the well is to be converted to a municipal or subdivision well; well reconstruction work; pump base reconstruction work; pumphouse pump discharge piping and appurtenance replacement; well rehabilitation work as described in s. NR 811.12 (11) to (13); changing chemical type when the chemical feed equipment has been previously approved by the department; and painting or coating elevated water storage tank, reservoir, and hydro–pneumatic tank interiors.

History: CR 09–073: cr. Register November 2010 No. 659, eff. 12–1–10.

NR 811.09 Specific requirements for waterworks, plans, specifications and engineering reports. (1) PLANS. (a) *General.* The detailed construction plans shall contain appropriate plan and profile views, elevations, sections and supplemental views which together with the specifications provide all necessary information for construction of the improvements. The elevations shall be based on sea level datum or local datum when a conversion to sea level datum is provided. Manufacturer's drawings are not acceptable as construction plans and will not be approved. Other state and local codes, including those of the department of safety and professional services, the public service commission, and the department of health services, shall be consulted for other requirements where applicable.

(b) *Wells.* 1. A general plan shall be submitted which shows the location of the proposed well and its relation to proposed or existing water supply facilities. It shall show all features of sanitary significance which could have an effect on water quality. A separate well site plan shall be submitted which shows the property lines, contours or an appropriate number of spot elevations so that drainage can be determined, surficial features, structures, and any other relevant data. The well site plan shall also show the locations of all the observation wells, monitoring wells, test wells, treatment wells, or other wells to be constructed in relation to the well site and all permanent supply wells to be constructed on the site. A detailed well cross–section shall be submitted which shows the size and depths of drill holes and casings, depth of grout, and geological formations to be penetrated.

2. A copy of a well site investigation report shall be submitted as required in sub. (4) prior to or along with the plans submitted to the department for all final wells or applicable test wells as described in s. NR 811.12 (1) (g) 2. Based upon a review of the submitted well site investigation report, the department may perform an on–site inspection of the well site. Wellhead protection criteria conforming to s. NR 811.12 (6) shall be considered when siting wells. In addition, drawdown effects from the pumping or test pumping of test wells and final wells shall be considered during well siting and design. Information on possible drawdown effects on nearby private wells, public wells, or surface water bodies from pumping test wells or final wells and the means to be provided for measuring the effects shall be included with all submittals to the department where significant drawdown may occur or when required by the department.

3. Plans and specifications shall be submitted prior to the construction of any test well to be pumped at a rate of 70 gallons per minute or more for a duration of 72 hours or more. When it is known with reasonable certainty that any proposed test well will be converted to a final well the plans and specifications for the final well shall be submitted for department approval prior to construction of the test well.

(c) *Surface water intakes.* 1. 'Location plan.' Plans shall show the location of the intake pipeline and crib relative to the low lift pumping facility. The pipeline shall be referenced by bearing and distance, and the crib location shall be defined by latitude and longitude.

2. 'Detailed plans.' A profile of the proposed pipeline and crib shall be provided in addition to construction plans.

(d) *Treatment plants.* 1. 'Location plan.' The location plan shall show the location of the treatment plant in relation to the remainder of the water system and the water source or intake.

2. 'Layout.' The general layout plans shall include a contour map of the site, the site size, the size and location of plant structures, a schematic flow diagram indicating the various plant units, the piping layout, and a hydraulic profile at gravity plants.

3. 'Detailed plans.' The detailed construction plans shall include the location, dimensions, elevations and details of all existing and proposed plant units or equipment.

(e) *Chemical feed equipment.* The plan shall include a layout of the waterworks structure and piping. All of the following locations and details of the proposed equipment shall be included:

1. Descriptions and specifications of feed equipment, including anti–siphon devices and feed ranges.
2. Location of feeders, piping layout and points of application.
3. Storage and handling facilities.
4. Specifications for chemicals to be used.
5. Operating and control procedures.
6. Description of testing equipment and procedures.
7. Well or booster pump discharge rates and pressures.
8. Emergency eyewash and shower units.

(f) *Pumping facilities.* The plan shall show a general layout of the pumping equipment, pump bases, suction and discharge lines and related appurtenances.

(g) *Buildings.* The plans shall show the locations of all buildings and other site improvements in relation to the site property boundaries. The following details shall be included, where applicable:

1. Building dimensions, profiles, elevations, architectural details, plumbing details, HVAC details, security details, and other building appurtenances.

2. Property site contours.

3. The diameter and locations of all water mains, water service laterals, and appurtenances such as valves and hydrants.

4. The diameters and locations of all floor drains, building drain, building sewer, and POWTS components.

5. The location, elevations, construction details, and appurtenances of any on−site storm water retention or detention ponds.

6. Construction details for any non−water system related improvements to be located or constructed on the property.

(h) *Water mains.* 1. 'Location plan.' The plan shall show the proposed water main extensions in relation to existing facilities. A map, such as required by s. NR 810.26 (2), of the existing system or a portion thereof with the proposed extensions shown will satisfy this requirement.

2. 'Detailed plans.' The plans shall show the location of the proposed water main within the street right−of−way or easement; the location of other utilities, such as sanitary or storm sewers; elevations at intersections and hydrants or a profile of the proposed water main; location of proposed appurtenances; details or special features and connection to the existing system. Profiles showing the ground surface, the proposed water main, the proposed sanitary or storm sewer and rock depths are necessary when approval of a common trench is requested in high bedrock areas. The size of proposed and existing water mains shall also be shown.

3. 'Worksheet submittal.' Complete information as requested on any required worksheet shall be provided. The forms shall be completed for all water main projects including revisions to existing projects, upgrading of existing mains and resubmittals of projects previously approved by the department.

(i) *Storage facilities.* 1. 'Location plan.' The plan shall show the location of the proposed facility in relation to existing facilities.

2. 'Detailed plans.' Plans shall show contour lines at the site and complete construction details. Overflow elevations for existing and proposed facilities shall be noted.

(2) SPECIFICATIONS. Complete, detailed material and construction specifications shall be supplied for all phases of the proposed project. Specifications shall contain a program for keeping existing waterworks facilities in operation during construction of additional facilities so as to minimize interruptions of service. Specifications shall be included for controlling erosion on the construction site as a result of construction activity as specified in subch. V of ch. NR 151.

Note: Department approved Construction Site Erosion and Sediment Control Technical Standards can be found on the department's internet web site.

(3) ENGINEERING REPORT. An engineering report shall be submitted with all reviewable projects with the exception of water main extensions. The engineering report, required by s. NR 108.04 (2) (a), shall contain the controlling assumptions made and the factors used in determining the functional design of the proposed waterworks improvements as a whole and of each of the component parts or units. Where applicable, the report shall make reference to available regional, metropolitan, county or local water supply or water quality management plans and shall clearly indicate whether the proposed project is in conformance with the plans.

Note: It is recommended that the report also include an energy efficiency analysis.

(4) ENGINEERING REPORT REQUIREMENTS. The engineering report required under sub. (3) shall, in all cases, indicate the basis of design and shall include the following specific data, if applicable:

(a) *Description.* A brief description of the project and the need for improvements.

(b) *Location.* A description of the geographic location of the project, including reference to maps or exhibits and the location of existing facilities.

(c) *Topography.* A brief description of the topography of the general area and its relation to the area involved in the project.

(d) *Population.* Past census data and estimated future projection to the design year for the area involved in the project.

(e) *Design period.* The design period being used for sizing major system components, based on the population projection.

(f) *Investigations.* The results of any investigations, such as soil borings, test wells, pilot tests, water quality data, and fire flow tests.

(g) *Flooding.* Any areas of the project which are located within the floodway or floodplain as defined in ch. NR 116 shall conform to the requirements of that chapter.

(h) *Wetlands.* Any areas of the project which are to be located within a wetland, pass through a wetland or may impact a wetland shall be identified.

Note: Copies of the Wisconsin wetland inventory maps are available for inspection at the office of the department of natural resources and may be purchased through the department's internet web site. The department of natural resources is in the process of placing the wetland inventory maps on the department's internet web site.

(i) *Recommendations.* After discussion of alternatives, the recommendations for improvements shall be listed and a statement of the reasons for selection of the recommended alternative shall be provided. A discussion of estimated capital costs and estimated annual operation and maintenance costs shall be included.

(j) *Specific information.* The report shall, in addition, include specific information relevant to the type of project. The specific information required for each type of project is as follows:

1. 'Groundwater sources — Well site investigation reports.' A copy of a well site investigation report shall be submitted for department review and approval prior to the department approving the construction of a permanent well as required in sub. (1) (b) 2., or where there is reasonable certainty that the location of any test well will be the location of the permanent well. If no test well is to be constructed, site approval may be obtained simultaneously with department approval of plans for the final well. The investigation shall include a field survey of the well site and the surrounding area. The investigation shall consist, at a minimum, of a map and report indicating:

a. The well location by quarter quarter section, township, range, county, latitude, and longitude.

b. The boundaries of the site and the location of the well on the site.

c. The topography of the site.

d. The regional flood elevation.

e. The past and present use of the proposed site.

f. The potential contamination sources within 1/2 mile of the well location summarized in a table or list including distance and direction from the well site and also shown on a map surrounding the well site. The table or list shall include an assessment of the potential for the contamination sources to impact a well constructed on the site and shall include information obtained by checking the department's database of contaminated properties, established in accordance with ss. 292.12 (3), 292.31 (1), and 292.57, Stats., and the department of safety and professional services Storage Tank Database.

Note: The department's database of contaminated properties, established in accordance with ss. 292.12 (3), 292.31 (1), and 292.57, Stats., can be found on the department's Bureau for Remediation and Redevelopment internet web site. The Bureau for Remediation and Redevelopment Tracking System (BRRTS) is an on−line database that provides information on areas of known contaminated soil or groundwater and tracks the status of the cleanup actions. RR Sites Map is the program's geographic information system that provides a map−based system of contaminated properties in Wisconsin. Information that appears on the RR program's database and GIS applications can also be obtained by contacting the regional drinking water staff person responsible for the water system. The department can be contacted to obtain a copy of A Guide For Conducting Potential Contaminant Source Inventories For Wellhead Protection. The department of safety and professional services Storage Tank Database Information can be found on the department of safety and professional services internet web site.

g. The specific geologic formation or formations from which water will be pumped or withdrawn.

h. The test or final well construction details, or both, including the descending order and depths of the specific geologic formations to be penetrated.

i. The proposed test or final well pumping capacity in gallons per minute, or both, as applicable.

j. The direction of groundwater flow in the specific geologic formation or formations from which water will be pumped or withdrawn.

k. The zone of influence of the proposed well consisting of the distance to one foot of aquifer drawdown at the anticipated final pumping rate when pumpage of the well is assumed to be continuous without recharge for 30 days. The zone of influence shall be calculated using the Theis Method with or without computer modeling unless another method is approved by the department. The aquifer transmissivity (T) and storage (S) coefficients used shall be provided.

L. The recharge area for the well. The recharge area shall be calculated using the Uniform Flow Equation or a computer generated groundwater model unless another method is approved by the department.

Note: A copy of A Template For Preparing Wellhead Protection Plans For Municipal Wells, in which use of the Uniform Flow Equation is discussed, may be obtained from the department.

m. The results from any previous test wells including details of test well location and construction, water quality, pumping conditions including drawdown effects, if applicable, on other nearby wells or surface water bodies, geologic borings, and seismic, resistivity or other groundwater investigations.

n. The anticipated annual volume of water to be withdrawn and the compatibility with the existing water supply facilities.

o. The location and data from any piezometers.

p. The location of any nearby wetlands.

q. The distance and direction from the proposed well to the nearest existing well serving another water utility.

r. The distance and direction from the proposed well to the nearest neighboring private wells within 1,200 feet of the well site.

s. The location and distance to surface water and springs.

t. The locations of alternate well sites for the proposed well and other information such as test pumping or modeling as requested by the department in order to conduct a review under ch. NR 820 to justify the proposed well location if the well will be pumped at a rate equal to or greater than 70 gallons per minute and the department determines that the proposed well will be located within a groundwater protection area as defined in s. 281.34 (1) (am), Stats., or that operation of the well could result in significant adverse impacts to springs as defined in s. 281.34 (1) (f), Stats.

u. A summary evaluation of the site including advantages and disadvantages and the need for any possible water treatment.

2. 'Surface water sources.' To assess the water available at the source, the engineering report shall include a survey and study of the source, including obtaining samples from a number of locations and depths in order to select the best intake site. Sampling shall be sufficient to adequately determine the water quality characteristics. The report shall summarize information on hydrological data, such as safe yield, maximum and minimum water levels or flows, the quality of raw water with special emphasis on results of testing programs, fluctuation in water quality, including seasonal variations and effects, the presence of befouling organisms, and existing and future potential sources of contamination.

3. 'Water treatment or chemical addition processes.' The engineering report shall include a summary establishing the adequacy of the proposed processes for the treatment of the specific water under consideration. The report shall include any data from pilot or full scale plant studies and describe the method of disposal of any wastes and any possible effects on the environment.

4. 'Pumping facilities.' The engineering report shall include a description of the area to be served and the basis for design, including maximum and minimum discharge heads and flows, pump operational controls, and provisions for emergency operation.

5. 'Water storage facilities.' The engineering report shall include a description of the high to low static pressure range which the proposed facility will provide for existing and future service areas and the volume of domestic and fire storage required within the design period. The report shall explain how the proposed and existing facilities will meet these requirements. The report shall also relate the compatibility of the proposed facilities with existing facilities and any changes that will have to be made to the existing facilities.

History: CR 09–073: cr. Register November 2010 No. 659, eff. 12–1–10; correction in (1) (a), (4) (j) 1. f. made under s. 13.92 (4) (b) 6., Stats., Register December 2011 No. 672; **correction in (4) (j) 1. t. made under s. 13.92 (4) (b) 7., Stats., Register February 2017 No. 734**.

NR 811.10 Owner approval requirement. If an engineer or other agent submitting plans to the department is not an employee or otherwise retained by the owner of the water system, written acceptance of the final plans by the owner is required. A copy of the owner approval letter shall be included along with the submission of the plans to the department.

Note: As an example, if an engineer is retained by a developer to design water main extensions which will be connected to a municipal system and eventually be owned by the municipality, the plans must be accepted in writing by the municipality prior to the submission of plans to the department.

History: CR 09–073: cr. Register November 2010 No. 659, eff. 12–1–10.

NR 811.11 Resident project representative. A resident project representative shall be designated by the water supply owner or by the agent retained by the owner. The resident project representative shall be knowledgeable regarding the proposed construction, and be able to competently determine whether or not the improvements are being constructed in accordance with the department approved plans and specifications and the conditions of the approval. The project representative shall be present on the work site as needed to assure proper construction and installation of the improvements. Hiring a resident project representative does not negate the owner's responsibility to assure proper construction and installation.

History: CR 09–073: cr. Register November 2010 No. 659, eff. 12–1–10.

Subchapter II — Source Development — Groundwater

NR 811.12 Wells. (1) GENERAL REQUIREMENTS. Any proposal which would result in a diversion from the Great Lakes basin requires department approval in accordance with s. 281.346, Stats. Wells shall be constructed in conformance with the following requirements:

(a) *Termination above the ground surface.* 1. All wells shall be terminated above the ground surface.

2. The grouted protective well casing or alternatively, the top of a pitless unit, shall be terminated above grade a minimum of 12 inches above the concrete floor of a pumphouse or enclosure.

3. The portion of the pump discharge piping for permanent wells that will contain the sampling faucets, water meter, valves and other appurtenances shall be exposed above the ground surface within a pumphouse building or enclosure that is secure, weatherproof, and has a concrete floor.

(b) *Watertight construction.* Permanent wells shall have watertight construction to such depth as may be required to exclude contamination. The depth shall be below the pumping water level except where exempted by the department on a case–by–case basis.

(c) *Grout seal.* Permanent wells shall have a grout seal surrounding the protective casing. The grout seal shall be a minimum of 1.5 inches in thickness to the depths specified in ss. NR 811.14, 811.18, 811.19, and 811.20.

(d) *Outer casings.* 1. All outer casings used in the construction of permanent wells shall be removed during or after the grouting process unless grouted in place with neat cement having a minimum thickness of 1.5 inches.

2. The grout level shall be retained above the bottom of the casing during removal of the casing.

3. Starter casings 10 feet in depth or less may be left in place provided that they are incorporated into the pump base in accordance with ss. NR 811.31 (1) and 811.32 (1).

(e) *Minimum protective casing.* All permanent wells shall have a minimum of 60 feet of grouted protective casing, wherever practicable. Continuous disinfection shall be provided for wells with less than 60 feet of grouted protective casing.

(f) *Bacteriologically safe water for drilling.* All wells shall be constructed using water from a known bacteriologically safe source that will not contaminate the aquifer. Untreated surface water or untested groundwater shall not be used. A detectable free chlorine residual shall be maintained in the well during drilling operations.

(g) *Test wells.* 1. Test wells shall be drilled for permanent wells proposed in unconsolidated formations to determine geologic formation information and water quality and quantity data.

2. Test wells to be converted to permanent wells or test wells to be pumped at a rate of 70 gallons per minute or more for a period of more than 72 hours shall be approved by the department prior to their construction.

3. The department may not require test wells for replacement or additional wells drilled on the same well site unless the geology is highly variable or in locations where the formation yield, cone of depression, and water quality are not known to a high degree of certainty.

4. The department may require a test well where water quality data or geologic data for consolidated formations is not available.

(h) *Flowing wells.* 1. Flowing wells shall be provided with a valve to control the flow. The valve shall be throttled as much as practicable to prevent the erosion of the confining bed and to prevent waste of water. The control valve shall be closed if the flow ceases.

2. Flow to waste piping shall be metal pipe welded to the protective well casing or pitless unit a minimum of 6 inches above the pumphouse floor. The piping shall extend horizontally through the concrete pump base and include a check valve and a shut−off valve on the portion of the piping located inside the building. The piping shall terminate outside the pumphouse with a screened downturned pipe elbow and a minimum 2 pipe diameter free air break over the top of a storm sewer inlet structure or other department approved location.

3. Every practicable effort shall be made to install the grouted casing below the confining bed.

(i) Materials used as drilling aids, such as drilling muds and foam or other aids shall be compounds approved by the department. Such materials shall be NSF/ANSI Standard 61 approved as required in s. NR 810.09 (5).

(j) The department may require additional or more stringent well construction requirements on a case by case basis when necessary to minimize the entrance of naturally occurring or synthetic contaminants into the well.

(2) WELL DRILLER REQUIREMENTS. All wells constructed or reconstructed after December 1, 2010, shall be constructed or reconstructed by a well driller licensed or registered by the state of Wisconsin under ch. 280, Stats., and ch. NR 146. A licensed well driller or a registered drilling rig operator shall be on−site during all well drilling, as defined in s. NR 811.02 (77).

Note: Chapter NR 146 contains the registration requirements for well drillers.

(3) WELL CONSTRUCTION REPORTS. The well driller shall forward to the department, and send a copy to the owner, of a completed Wisconsin Well Construction Report within 30 days of the date of completion of a new well. The well driller shall forward to the department, and send a copy to the owner, of a revised Wisconsin Well Construction Report within 30 days of the date of completion of a reconstructed well. A well reconstruction report is required when a well is deepened, partially backfilled or when installing or removing well casings or screens.

(4) INTERFERENCE BETWEEN COMMUNITY WATER SYSTEM WELLS. When the department determines that a proposed community water system well may have a substantial effect on the water levels in one or more wells owned by a neighboring water utility, the following procedure shall be followed:

(a) The department shall provide the owner of a utility well which may be affected by the proposed well with information on its location, proposed constructional features, proposed pumping rate and the anticipated volume of water to be withdrawn.

(b) If the potentially affected utility well owner wishes to object to the proposed community water system well, the owner shall inform the department in writing of the reasons for objection within 30 days of receipt of the information in par. (a).

(c) If notice of objection is filed and good cause is shown, the department may hold a public hearing at which all interested parties may present testimony to be used by the department in determining if a restriction shall be placed on the volume of water withdrawn from the proposed well or existing wells.

(5) WELL SITES. The suitability of a site for a well is dependent on geologic, hydrogeologic, and topographic conditions and possible sources of contamination. However, the following general requirements shall be met:

(a) *Well site dimensions.* For wells to serve municipal and subdivision other−than−municipal water systems, a lot or parcel of land shall be reserved for the construction of the well which has minimum dimensions of 100 feet by 100 feet. The well shall be located near the center of the lot or parcel. For non−subdivision other−than−municipal water system wells, the well shall be located a minimum of 50 feet from any property boundary. These dimensions may be modified by the department on a case−by−case basis where they are unnecessary or inadequate to protect water quality. Larger well sites should be considered where necessary to provide adequate wellhead protection. A deeper depth of grouted protective well casing may be required by the department when necessary to compensate for a smaller well site parcel or as a condition of approving a variance to a separation distance to a potential contamination source listed in par. (d).

(b) *Flood protection.* Wells may be constructed or replaced on sites in the floodplain, as defined in s. NR 116.03 (16), outside of the floodway, as defined in s. NR 116.03 (22), provided that the pumphouse floor is 2 feet or more above the regional flood elevation as determined in s. NR 116.07 (4) and there is year round dry land access to the pumphouse. No new well may be constructed and no existing well may be reconstructed on a site in a floodway. Wells shall be located in an area accessible during the entire year. Where necessary, road improvements shall be installed to provide year round access. Wells shall be located on property owned by the water system owner or for which a long term easement or lease has been obtained. Access roads shall be on property owned by the water system owner or for which a long term easement or lease has been obtained.

Note: Refer to ch. NR 116 for floodplain and floodway requirements.

(c) *Well site investigation report submittal.* The owner or the owner's representative shall prepare a well site investigation report, as required by s. NR 811.09 (4) (j) 1., for each well site and submit the report to the department prior to or concurrent with the request for approval of a test well or a permanent well. The report shall be submitted on forms or in a format provided by the depart-

ment and shall contain sufficient information to evaluate compliance with the requirements of this chapter.

(d) *Minimum separation from contamination sources.* The well shall be adequately separated from potential sources of contamination. Unless a hydrogeologic investigation indicates lesser separation distances would provide adequate protection of a well from contamination or department approved treatment is installed to address the potential contamination concerns, the minimum separation distances shall be:

1. Ten feet between a well and an emergency or standby power system that is operated by the same facility which operates the well and that has a double wall above ground storage tank with continuous electronic interstitial leakage monitoring. These facilities shall meet the installation requirements of s. ATCP 93.260 and receive written approval from the department of safety and professional services or its designated Local Program Operator under s. ATCP 93.110.

2. Fifty feet between a well and a storm sewer main or a sanitary sewer main where the sanitary sewer main is constructed of water main class materials and joints. Gravity sanitary sewers shall be successfully air pressure tested in place. The air pressure test shall meet or exceed the requirements of the 4 psi low pressure air test for plastic gravity sewer lines found in the latest edition of Standard Specifications for Sewer & Water Construction in Wisconsin. Force mains shall be successfully pressure tested with water to meet the AWWA C600 pressure and leakage testing requirements for one hour at 125% of the pump shut−off head.

3. Two hundred feet between a well and any sanitary sewer main not constructed of water main class materials, sanitary sewer manhole, lift station, one or 2 family residential heating fuel oil underground storage tank or above ground storage tank or POWTS treatment tank or holding tank component and associated piping.

4. Three hundred feet between a well and any farm underground storage tank system or other underground storage tank system with double wall and with electronic interstitial monitoring for the system, which means the tank and any piping connected to it. These installations shall meet the most restrictive installation requirements of s. ATCP 93.260 and receive written approval from the department of safety and professional services or its designated Local Program Operator under s. ATCP 93.110. These requirements apply to tanks containing gasoline, diesel, bio−diesel, ethanol, other alternative fuel, fuel oil, petroleum product, motor fuel, burner fuel, lubricant, waste oil, or hazardous substances.

5. Three hundred feet between a well and any farm above ground storage tank with double wall, or single wall tank with other secondary containment and under a canopy; other above ground storage tank system with double wall, or single wall tank with secondary containment and under a canopy and with electronic interstitial monitoring for a double wall tank or electronic leakage monitoring for a single wall tank secondary containment structure. These installations shall meet the most restrictive installation requirements of s. ATCP 93.260 and receive written approval from the department of safety and professional services or its designated Local Program Operator under s. ATCP 93.110. These requirements apply to tanks containing gasoline, diesel, bio−diesel, ethanol, other alternative fuel, fuel oil, petroleum product, motor fuel, burner fuel, lubricant, waste oil, or hazardous substances.

6. Four hundred feet between a well and a POWTS dispersal component with a design capacity of less than 12,000 gallons per day, a cemetery or a storm water retention or detention pond.

7. Six hundred feet between a well and any farm underground storage tank system or other underground storage tank system with double wall and with electronic interstitial monitoring for the system, which means the tank and any piping connected to it; any farm above ground storage tank with double wall, or single wall tank with other secondary containment and under a canopy or other above ground storage tank system with double wall, or single wall tank with secondary containment and under a canopy; and with electronic interstitial monitoring for a double wall tank or electronic leakage monitoring for a single wall tank secondary containment structure. These installations shall meet the standard double wall tank or single wall tank secondary containment installation requirements of s. ATCP 93.260 and receive written approval from the department of safety and professional services or its designated Local Program Operator under s. ATCP 93.110. These requirements apply to tanks containing gasoline, diesel, bio−diesel, ethanol, other alternative fuel, fuel oil, petroleum product, motor fuel, burner fuel, lubricant, waste oil, or hazardous substances.

8. One thousand feet between a well and land application of municipal, commercial, or industrial waste; the boundaries of a landspreading facility for spreading of petroleum−contaminated soil regulated under ch. NR 718 while that facility is in operation; agricultural, industrial, commercial or municipal waste water treatment plant treatment units, lagoons, or storage structures; manure stacks or storage structures; or POWTS dispersal component with a design capacity of 12,000 gallons per day or more.

9. Twelve hundred feet between a well and any solid waste storage, transportation, transfer, incineration, air curtain destructor, processing, wood burning, one time disposal or small demolition facility; sanitary landfill; any property with residual groundwater contamination that exceeds ch. NR 140 enforcement standards; coal storage area; salt or deicing material storage area; any single wall farm underground storage tank or single wall farm above ground storage tank or other single wall underground storage tank or above ground storage tank that has or has not received written approval from the department of safety and professional services or its designated Local Program Operator under s. ATCP 93.110 for a single wall tank installation. These requirements apply to tanks containing gasoline, diesel, bio−diesel, ethanol, other alternative fuel, fuel oil, petroleum product, motor fuel, burner fuel, lubricant, waste oil, or hazardous substances; and bulk pesticide or fertilizer handling or storage facilities.

Note: The department's database of contaminated properties, established in accordance with ss. 292.12 (3), 292.31 (1), and 292.57, Stats., can be found on the department's Bureau for Remediation and Redevelopment internet web site. The Bureau for Remediation and Redevelopment Tracking System (BRRTS) is an on−line database that provides information on known contaminated soil or groundwater and tracks the status of the cleanup actions. RR Sites Map is the program's geographic information system that provides a map−based system of contaminated properties in Wisconsin. The department of safety and professional services Storage Tank Database Information can be found at the department of safety and professional services web site.

(e) *Well site inspection.* Well sites may be inspected by a representative of the department prior to approval of plans.

(f) *Ch. NR 820 compliance.* For wells with a pumping capacity of 70 gallons per minute or greater, the well location shall meet the applicable requirements of ch. NR 820.

(6) WELL HEAD PROTECTION PLAN. A well head protection plan shall be provided for all new wells for municipal water systems. The owner of the municipal water system or its agent shall develop the plan. No new municipal well may be placed into service until the department has approved the well head protection plan. The plan shall include all of the following:

(a) Identification of the groundwater flow direction.

(b) Identification of the zone of influence for the well consisting of the distance to one foot of aquifer drawdown at the anticipated final pumping rate when pumpage of the well is assumed to be continuous without recharge for 30 days. The zone of influence shall be calculated using the Theis Method with or without groundwater modeling unless another method is approved by the department.

(c) Identification of the recharge area for the well. The recharge area shall be calculated using the Uniform Flow Equation or be computer modeled unless another method is approved by the department.

Note: A copy of A Template For Preparing Well Head Protection Plans For Municipal Wells, in which use of the Uniform Flow Equation is discussed, may be obtained from the department.

(d) Identification of the potential contamination sources within 0.5 mile of the well location and an assessment of the

potential for the existing contamination sources within the recharge area of the well to negatively impact the well water quality. The potential contamination sources shall be summarized in a table or list including distance and direction from the well site and shall also be shown on a map surrounding the well site. The table or list shall include information obtained by checking the department's database of contaminated properties, established in accordance with ss. 292.12 (3), 292.31 (1), and 292.57, Stats.

Note: The department's database of contaminated properties, established in accordance with ss. 292.12 (3), 292.31 (1), and 292.57, Stats., can be found on the department's Bureau for Remediation and Redevelopment internet web site. The Bureau for Remediation and Redevelopment Tracking System (BRRTS) is an on−line database that provides information on areas of known contaminated soil or groundwater and tracks the status of the cleanup actions. RR Sites Map is the program's geographic information system that provides a map−based system of contaminated properties in Wisconsin. Information that appears on the RR program's database and GIS applications can also be obtained by contacting the regional drinking water staff person responsible for the water system. A copy of A Guide For Conducting Potential Contaminant Source Inventories For Wellhead Protection may be obtained from the department.

(e) Establishment of a well head protection area for the proposed well. The well head protection area shall encompass, at a minimum, that portion of the recharge area equivalent to a 5 year time of travel to the well. The well head protection area may be determined by a hydrogeologic investigation.

(f) A public education program for well head protection.

(g) A water conservation program.

(h) A contingency plan for providing safe water and protecting the well from contamination based on the inventory and assessment of potential contamination sources.

(i) A management plan, which assesses alternatives for addressing potential contamination sources, describes the local ordinances, zoning requirements, monitoring program, and other local initiatives proposed within the well head protection area established in par. (e), and addresses maintaining the minimum contamination source separation distances established by well siting in sub. (5) (d).

Note: A copy of Example Wellhead Protection Ordinances may be obtained from the department's Bureau of Drinking Water and Groundwater located in Madison.

(j) The well head protection plan shall be labeled with the name and signature of the person who prepared the plan, the date that the plan was signed, and the name of the company or water system which the person represents. An owner approval letter shall be submitted when required in accordance with s. NR 811.10.

(7) CASING AND LINER PIPE FOR DRILLED WELLS. (a) The protective casing shall be new prime steel pipe produced to and meeting ASTM, A 53 Grades A or B, ASTM A 106; ASTM A 589 Type I, Grade A or B, Type II, Grade A or B; or API 5L specifications. Previously used or reclaimed pipe may not be used.

(b) Each length of casing shall be legibly marked in accordance with the ASTM or API marking specification and with s. NR 812.17 (2) (d). The protective casing shall have the minimum weights and thicknesses given in Table 1.

(c) Liner pipe installed to seal off a caving zone shall be new, unused, and non−reclaimed steel pipe and shall have the minimum weights and thicknesses given in Table No. 1.

(d) Outer casings can be unmarked, used, or reclaimed pipe but shall have the minimum weights and thicknesses given in Table No. 1.

(e) All casings and liner pipe shall have additional thickness and weight if the Table No. 1 standard thickness is insufficient to assure reasonable life expectancy or to withstand the forces to which they may be subjected.

(f) Casing and liner pipe shall be equipped with a drive shoe when driven and centering guides when set. The locations of all centering guides to be installed shall be shown on the plans or noted in the specifications, or both.

(g) Casing and liner pipe shall be assembled watertight by means of joints welded in accordance with the standard welding procedure specifications of s. NR 812.18 or by threaded couplings meeting or equivalent to the specifications listed in par. (a).

(h) For wells in which the protective casing or liner pipe to be grouted is suspended, the upper terminus of the protective casing or liner pipe shall be securely attached by welding steel bands to the outer casing or by other approved methods, and the grout shall be supported on a steel ring welded to the bottom of the protective casing or liner pipe or on an approved packer attached to the bottom of the protective casing or liner pipe. The bottom of the protective casing or liner pipe may be flared out to meet this requirement.

Note: Copies of the forgoing specifications and standards are available for inspection at the central office of the department of natural resources and may be obtained for personal use from the American Society for Testing and Material (ASTM), 100 Barr Harbor Drive, PO Box C700, West Conshohocken, Pennsylvania 19148−2959, and the American Petroleum Institute (API), 1220 L Street NW, Washington, DC 20005−4070.

Table No. 1

STEEL PIPE

SIZE (inches)	DIAMETER (inches)		THICKNESS (inches)	WEIGHT PER FOOT (pounds)	
	External	Internal		Plain Ends (calculated)	With Threads and Couplings (nominal)
6 id.	6.625	6.065	0.280	18.97	19.18
8	8.625	7.981	0.322	28.55	29.35
10	10.750	10.020	0.365	40.48	41.85
12	12.750	12.000	0.375	49.56	51.15
14 od.	14.000	13.250	0.375	54.57	57.00
16	16.000	15.250	0.375	62.58	65.30
18	18.000	17.250	0.375	70.59	73.00
20	20.000	19.250	0.375	78.60	81.00
22	22.000	21.000	0.500	114.81	
24	24.000	23.000	0.500	125.49	
26	26.000	25.000	0.500	136.17	
28	28.000	27.000	0.500	146.85	
30	30.000	29.000	0.500	157.53	
32	32.000	31.000	0.500	168.21	

34	34.000	33.000	0.500	178.89
36	36.000	35.000	0.500	189.57

(8) CONCRETE WALL CASING. Concrete wall casing shall meet all of the following requirements:

(a) Be used only in dug wells and collectors.

(b) Be reinforced and at least 6 inches thick.

(c) Be poured in one operation, if possible.

(d) Not have a construction joint within 10 feet of the original ground surface.

(9) PACKERS. Packers shall be of a material that will not impart taste, odors, toxic substances or bacterial contamination to the water in the well. Lead packers may not be used.

(10) SCREENS. Screens shall meet all of the following requirements:

(a) Be constructed of stainless steel which will not be damaged by chemical action of groundwater, disinfection chemicals, or future cleaning operations.

(b) Have size of openings based on sieve analysis of the aquifer and gravel pack materials.

(c) Be designed to have an entrance velocity that does not exceed 0.1 feet per second under normal operating conditions.

(d) Be installed and have pumping equipment designed so that exposure of the screen above the pumping level will not occur during normal operation.

(e) Be provided with a bottom plate of the same material as the screen.

(11) BLASTING. Approval shall be obtained from the department prior to blasting within a well. Information regarding the procedure, number, size and location of charges shall be submitted to the department in writing.

(a) Blasting shall be conducted under the supervision of a licensed well driller and a blaster licensed by the department of safety and professional services under s. SPS 305.20.

(b) No blasting may occur within 100 feet of the grouted protective casing unless specific information is submitted for department approval that justifies the use of low strength prima−cord or charges between 50 and 100 feet of the grouted protective casing if necessary to maintain the production capacity or water quality of a well with a limited length of open drillhole.

(c) All material dislodged during the blasting shall be removed from the well.

(d) Proper safety measures shall be employed to protect the workers and surrounding structures.

(e) The department's regional drinking water staff person shall be given at least 48 hours notice prior to the date and time of the proposed blasting work.

(f) Following the completion of the blasting procedure, the well shall be thoroughly disinfected and pumped to waste, and safe bacteriological water samples shall be collected according to the requirements of s. NR 810.09 (4).

(g) The owner or an authorized representative shall submit a written report to the department within 30 days of the date of completion of the blasting and subsequent pumping of the well that includes the static and pumping water levels, gallon per minute pumping rate and specific capacity of the well both before and after the blasting, and the results of any testing for chemical or physical properties for which the well may have been blasted, if applicable.

(12) CHEMICAL CONDITIONING. Approval shall be obtained from the department prior to chemical conditioning of a well. Information regarding the method proposed, equipment, chemicals, testing for residual chemicals, disposal of waste and inhibitors to be used shall be submitted to the department in writing.

(a) The department's regional drinking water staff person shall be given at least 48 hours prior notice prior to the date and time of the proposed chemical conditioning work.

(b) Chemical conditioning, with the exception of batch chlorination, shall be performed by or under the supervision of a licensed well driller.

(c) All chemicals used in conditioning shall be NSF/ANSI Standard 60 approved for use in potable water as required per s. NR 810.09 (1) (c) unless an alternative chemical is approved by the department.

(d) Acid treatment shall include pH monitoring of nearby private or public wells, use of an inhibitor to protect the metal portions of the well and pump, complete removal of the acid from the well, neutralization of the spent acid, and proper disposal of the spent acid.

(e) The resident project representative shall closely supervise the discharge of chlorinated water. In no case may water with a measurable total chlorine residual content be discharged to a surface water. Suitable barriers, aeration or chemical dechlorination shall be provided when discharging chlorinated water to a surface water or a storm sewer connected to a surface water to ensure the water discharged does not contain a measurable chlorine residual.

(f) Following the completion of the chemical conditioning procedure, the well shall be thoroughly disinfected, pumped to waste and safe bacteriological water samples shall be collected according to the requirements of s. NR 810.09 (4).

(g) The owner or an authorized representative shall submit a written report to the department within 30 days of the date of completion of the chemical conditioning and subsequent pumping of the well that includes the static and pumping water levels, gallon per minute pumping rate and specific capacity of the well both before and after chemical conditioning, and the results of any testing for chemical or physical properties for which the well may have been chemically conditioned, if applicable.

(13) OTHER METHODS OF WELL RECONDITIONING. Approval shall be obtained from the department prior to performing any other type of reconditioning procedure, including hydrofracturing and impulse generation techniques. The requester shall submit written information regarding the procedure, the equipment, materials, chemicals and pressures to be used, and the disposal of waste to the department for approval.

(a) *Hydrofracturing*. Hydrofracturing procedures shall meet the following requirements:

1. The department's regional drinking water staff person shall be given at least 48 hours notice prior to the date and time of the proposed hydrofracturing work.

2. Hydrofracturing shall be performed by or under the supervision of a licensed well driller.

3. Clean washed inert, nontoxic material such as sand may be added to the water for the purpose of holding the joints and fractures open after the pressure is reduced.

4. When a well is to be hydrofractured within 100 feet of any existing bedrock well, the well driller shall notify the existing well owner or owners and the department's regional drinking water staff person of the forthcoming hydrofracturing operation at least 48 hours prior to the commencement of the hydrofracturing operation.

5. The upper packer may not be placed at a depth closer than 20 feet below the bottom of the casing.

6. Following the completion of the hydrofracturing procedure, the well shall be thoroughly disinfected, pumped to waste, and safe bacteriological water samples shall be collected according to the requirements of s. NR 810.09 (4).

7. The owner or an authorized representative shall submit a written report to the department within 30 days of the date of completion of the hydrofracturing and subsequent pumping of the well that includes the static and pumping water levels, gallon per minute pumping rate and specific capacity of the well both before and after the hydrofracturing, and the results of any testing for chemical or physical properties for which the well may have been hydrofractured, if applicable.

(b) *Impulse generation.* Impulse generation procedures shall meet the following requirements:

1. The department's regional drinking water staff person shall be given at least 48 hours notice prior to the date and time of the impulse generation work.

2. Impulse generation procedures shall be performed by or under the supervision of a licensed well driller.

3. A report shall be submitted to the department that identifies the impulse method to be used, the means of generating the impulse, the number of passes, the depths in the open drillhole or well screen that the procedure will be started and stopped, the psi strength of each impulse, and the number of impulses per foot. The report shall also include information on all the gases to be used and details of any chemical addition to be performed along with the impulse generation procedures, including the chemicals to be used, the reason for using the chemicals, the strength of each chemical as applied, the means to be used to inject the chemicals, and how the chemicals will be neutralized and disposed of. All chemicals used shall have NSF/ANSI Standard 60 approved for use in potable water as required per s. NR 810.09 (1) (c).

4. Impulse strength shall be maintained low enough to prevent structural damage to well casings, grout, and screens.

5. Following the completion of the impulse generation work, the well shall be thoroughly disinfected, pumped to waste, and safe bacteriological water samples shall be collected according to the requirements of s. NR 810.09 (4).

6. The owner or an authorized representative shall submit a written report to the department within 30 days of the date of completion of the impulse generation and subsequent pumping of the well that includes the static and pumping water levels, gallon per minute pumping rate and specific capacity of the well both before and after the impulse generation, and the results of any testing for chemical or physical properties for which the well may have been treated with impulse generation, if applicable.

(14) GROUTING REQUIREMENTS. (a) *Grout types and specifications.* 1. Neat cement grout shall be ASTM C150, Type I or API−10A, Class A Portland cement and water from a known bacteriologically safe and uncontaminated source with not more than 6 gallons of water per sack (94 lbs.) of cement. A mud balance shall be used to measure the grout density. Additives, including bentonite, to increase fluidity, reduce shrinkage or control time of set may be used only with prior department approval. No more than 4.7 pounds of powdered bentonite, a maximum of 5%, may be added to each 94−pound sack of cement. When bentonite is added, the volume of water shall be increased. When bentonite is added, a pressurized mud balance shall be used to measure the grout density. Bentonite mixed with neat cement grout shall comply with Table No. 2.

Table No. 2

ALLOWABLE NEAT CEMENT — BENTONITE GROUT MIXTURES

% bentonite added per 94−lb sack of cement	Maximum gal of water per 94−lb of cement	Minimum density of bentonite/grout mix in lbs/gal	Volume of bentonite/grout mix in ft^3/sack of cement
0% (0.00 lbs)	6.00	15.02	1.28
1% (0.94 lbs)	6.04	15.00	1.29
2% (1.88 lbs)	7.05	14.40	1.43
3% (2.82 lbs)	7.47	14.20	1.49
4% (3.76 lbs)	7.93	14.00	1.56
5% (4.70 lbs)	8.42	13.80	1.63

(Bentonite table information provided by the Halliburton Co.)

2. Sand cement grout may be used for annular openings greater than 3 inches. The mixture may not exceed 2 parts by weight of sand to one part of ASTM C150, Type 1 or API−10A, Class A Portland cement and not more than 6 gallons of water from a known bacteriologically safe and uncontaminated source to each 94−pound sack of cement.

3. Concrete grout may be used for annular openings greater than 6 inches. The concrete shall contain not less than 6 sacks of cement per cubic yard and not more than 6 gallons of water from a known bacteriologically safe uncontaminated source to each 94−pound sack of cement. The gravel size may not exceed 0.75 inch. The volumetric ratio of either gravel or sand to cement may not exceed 2.5 parts to one part. Wisconsin department of transportation grade A concrete is also acceptable.

(b) *Grouting procedures.* 1. All grout shall be placed from the bottom of the annular opening to the surface in one continuous operation. Grouting methods that involve forcing a measured quantity of grout down the inner casing by a plug, such as the Halliburton method, shall not be used. When a conductor pipe in the annular opening is used, the conductor pipe shall meet the material requirements of subd. 8. and shall be submerged in the grout during the entire operation. For grout depths in excess of 100 feet, a pump shall be used to inject the grout.

2. A sufficient annular opening shall be provided to permit a minimum of 1.5 inches of grout around the protective casing, grouted liner pipe, or outer casing when it is intended to grout the outer casing in place, including couplings, if used.

3. Any materials used as drilling aids shall be removed from the annular opening prior to grouting.

4. Prior to grouting through creviced formations, bentonite or similar approved materials shall be added to the annular opening in the manner indicated for grouting and circulated until the bentonite or other approved material flows to the ground surface.

5. Grout shall be allowed to overflow from the annular opening until such time as the density is the same as that of the grout being placed. The specifications shall outline the method to be used to check the grout density and equipment shall be available on site to determine grout density.

6. Standby grouting equipment for grouting annular openings, including a backup grout pump and tremie pipe meeting the material requirements of subd. 8., shall be on site during the grouting of all wells.

7. The grout level shall be maintained above the bottom of any outer casing during the withdrawal procedure.

8. Grout conductor, or tremie, pipes shall be metal pipe or a rubber−covered, fiber or steel braided, reinforced hose with a minimum pressure rating of 300 psi. Plastic pipe, including PVC pipe, shall not be used as a grout conductor pipe.

9. The conductor pipe shall be completely withdrawn from the well prior to flushing excess grout from the conductor pipe when grouting down the annular space or shall be disconnected from the grout shoe or street elbow prior to flushing excess grout when grouting within the casing.

(c) *Centering guides.* Centering guides shall be installed on the protective casing in a manner to permit unobstructed flow and uniform thickness of grout within the annular space.

(d) *Grout curing.* Drilling operations or other work in the well, including development, may not be performed within 72 hours after the grouting of casings or liners. If the department approves the use of quick−setting cement, this period may be reduced to 24 hours. Use of quick setting cement shall be clearly indicated in the specifications submitted to the department.

(15) PLUMBNESS AND ALIGNMENT REQUIREMENTS. (a) Every well constructed in rock and all screened wells greater than 100 feet in depth shall be tested for plumbness and alignment by the method outlined in AWWA Standard A100 in effect at the time of well construction or by an equivalent method. The test method shall be clearly stated in the specifications.

Note: A copy of the AWWA standard is available for inspection at the central office of the department of natural resources and may be obtained for personal use from the American Water Works Association, 6666 West Quincy Ave., Denver, Colorado 80235−3098.

(b) Variance from the vertical of two−thirds the smallest inside diameter of that part of the well being tested per 100 feet of depth to the depth of the pump setting plus 25% may not be exceeded. Also, the well shall allow free passage of a 40−foot section of pipe or a dummy to the depth of the pump setting plus 25%. The outside diameter of the pipe or dummy used may not be more than 1/2 inch smaller than the diameter being tested.

(c) The department will not approve installation of well pumps in wells with kinks and bends which prevent setting a line shaft vertical turbine pump to the desired pump setting plus 25% unless the owner accepts the installation in writing.

(d) A summary and evaluation of the test results shall be submitted to the department prior to permanent pump approval for municipal wells and prior to the department approving the well to be placed in service for other−than−municipal community public wells.

(16) YIELD AND DRAWDOWN TEST. (a) A yield and drawdown test is required. The method to be used shall be clearly indicated in the plans and specifications.

(b) The yield and drawdown test shall be performed on every municipal or subdivision well for a period of at least 12 consecutive hours. For non−subdivision other−than−municipal water system wells, the yield and drawdown test shall be performed for a period of at least 4 consecutive hours. In any case, the test shall be performed at a rate no less than the anticipated pumping capacity and for the duration necessary for the water level to stabilize at the anticipated pumping capacity.

(c) The test shall include pumping a minimum of 4 hours at a rate equal to the capacity anticipated for the permanent well pump.

(d) Water depth measurements shall be made at a frequency sufficient to evaluate the production efficiency and recovery rate of the well.

(e) All of the following data regarding the yield and drawdown test shall be submitted to the department:

1. Date and time the test was started.
2. Static water level immediately prior to starting the test.
3. Gallon per minute pumping rate.
4. Drawdown in feet during the test.
5. Date and time the pumping water level was measured.
6. Specific capacity in gpm/ft.
7. Recovery water levels including date and time measured.
8. Depth of pump setting.
9. Drawdown and recovery measurements from any observation or monitoring wells monitored during the test pumping including date and time measured.
10. Elevation of the reference point of measurement of the water level data at each monitoring point.

(f) In addition, representative samples of the well water shall be collected as required by subs. (19) and (20) and the laboratory results shall be submitted directly to the department in a department approved electronic format. The laboratory results of any exploratory or investigative water quality analyses shall be submitted to the department on paper lab forms.

(17) GEOLOGICAL DATA. (a) Formation samples shall be collected from all new test wells and final wells and from deepening of existing wells at 5−foot intervals and at each pronounced change in geologic formation. The formation samples shall be submitted to the Wisconsin State Geological and Natural History Survey, 3817 Mineral Point Road, Madison, Wisconsin 53705, in collection bags provided by the survey or in equivalent plastic bags. The formation depths sampled shall be clearly and permanently marked on each bag.

(b) Geological data shall be recorded on the completed Well Construction Report form submitted to the department.

(18) CAPPING REQUIREMENTS. (a) Wells in which no pump is installed shall be capped by welding a steel plate to the top of the casing to form a watertight and airtight seal.

(b) During construction, a temporary means of capping or covering the well shall be provided to prevent debris or any contaminants from entering the well or any annular space.

(19) BACTERIOLOGICAL QUALITY. Every new, modified, or reconditioned groundwater source shall be disinfected during or after installation of the pumping equipment. Representative samples for bacteriological analysis shall be collected as required in s. NR 810.09 (4).

(20) CHEMICAL QUALITY. Every new well shall be sampled for chemical quality. Reconditioned or reconstructed wells shall be sampled for chemical quality in cases where changes in water quality may occur. The samples shall be representative of the well water and collected and analyzed for the parameters indicated in the department's approval letter for the well construction, reconditioning or reconstruction. The samples shall be collected near the end of the test pumping period after the well construction, reconditioning, or reconstruction has been completed and where applicable, the well developed. Where not existing, a smooth end sampling faucet shall be installed on the test pump discharge piping at a location suitable for the collection of water samples for volatile parameters and a suitable throttling device shall be provided on the pump discharge piping to facilitate sample collection. The samples shall be submitted to a laboratory certified by the state of Wisconsin. Prior to collection of the samples, the department shall be provided with a detailed description of the sampling protocol for each parameter. Wells that do not meet the primary drinking water standards of ch. NR 809 may not be placed into service unless adequate treatment is provided in accordance with. s. NR 811.04.

(21) OBSERVATION WELLS AND TEST WELLS. (a) Observation wells, monitoring wells, test wells, treatment wells or other wells constructed as part of the water system shall be constructed in accordance with the requirements of this chapter for permanent community wells if they are to remain in service after completion of construction of the community well and if they are located on the well site. When taken out of service these wells shall be abandoned in accordance with s. NR 811.13. Temporary or permanent observation wells, monitoring wells, test wells, treatment wells, or other wells constructed off the well site shall meet the construction and abandonment requirements of ch. NR 141, 812, or this chapter.

(b) The wells shall be protected and secured at the upper terminal to preclude entrance of foreign material and minimize the potential for vandalism. The wells to remain in service shall be provided with locking covers.

(c) Specifications documenting the methods and materials for the temporary abandonment of test wells or test borings to be con-

verted into final wells shall be submitted to the department for review and approval.

History: CR 09–073: cr. Register November 2010 No. 659, eff. 12–1–10; correction in (5) (d) 1., 4., 5., 7., 9., (11) (a) made under s. 13.92 (4) (b) 6., 7., Stats., Register December 2011 No. 672; corrections in (5) (d) 1., 4., 5., 7., 9. made under s. 13.92 (4) (b) 7., Stats., Register October 2013 No. 694.

NR 811.13 Abandonment of wells. (1) CRITERIA FOR ABANDONMENT. The owner shall permanently abandon all unused permanent wells, test wells, and monitoring wells for permanent wells or test wells unless the department agrees to the delayed abandonment of the well as part of an extended well abandonment agreement. Wells shall be abandoned in accordance with the following criteria:

(a) Test wells and monitoring wells constructed as part of the test well or permanent well construction and test pumping evaluation processes shall be permanently abandoned prior to placing the permanent well in service unless the department approves the wells to remain in service in accordance with the requirements of s. NR 811.12 (21).

(b) Permanent wells with one or more water quality parameters exceeding a primary drinking water standard contained in ch. NR 809 shall be permanently abandoned unless department approval is obtained to continue the well in service and only if department approved water treatment is installed to provide point–of–entry water quality compliance or an extended well abandonment agreement is obtained from the department in conformance with s. NR 810.22. The department shall be contacted and written department approval shall be obtained for the abandonment of contaminated wells where the department deems it necessary to require more stringent abandonment requirements in order to protect lower aquifers from additional contamination.

(c) The department may allow existing permanent wells that are not constructed in accordance with the minimum requirements of this chapter to remain in service if the well water quality continues to meet all of the primary drinking water standards contained in ch. NR 809 or if department–approved water treatment is installed to provide point–of–entry water quality compliance. All ungrouted municipal wells shall be immediately reconstructed by grouting in a liner casing to a depth approved by the department or the well shall be taken out of service and permanently abandoned.

(2) QUALIFICATIONS OF PERSONS ABANDONING WELLS. All wells shall be permanently abandoned by persons who meet the following qualifications:

(a) For wells located within a municipal water system, the person shall be a licensed well driller, a licensed pump installer, a water system operator certified under s. 281.17 (3), Stats., working for the municipal water system, or a person under the supervision of a licensed well driller, licensed pump installer, or a water system operator certified under s. 281.17 (3), Stats., working for the municipal water system.

(b) For wells not located within a municipal water system, the person shall be a licensed well driller, a licensed pump installer or a person under the supervision of a licensed well driller or licensed pump installer.

(3) TEMPORARY ABANDONMENT. When a well is temporarily removed from service, the top of the well casing shall be sealed with a watertight threaded or welded cap. The well shall be permanently abandoned no later than 5 years after the well is temporarily abandoned. The department may enter into a written extended well abandonment agreement with the well owner in accordance with s. NR 810.22 to allow an unused or standby well to remain operational for more than 5 years after the well is temporarily abandoned.

(4) PRE–ABANDONMENT REQUIREMENTS. (a) All debris, pumps, piping, ungrouted liner pipe that can be removed, inner ungrouted casings and well screens, and any other obstruction known to be in the well shall be removed if possible before the well is permanently abandoned.

(b) Well casing pipe may be removed from a well to be abandoned if the end of the pipe remains in the well sealing material as the pipe is pulled from the well.

(c) Wells that have uncertain construction details shall be televised prior to abandonment if required by the department to allow for a proper well abandonment.

(d) All casings and liner pipes located within ungrouted annular spaces and that cannot be removed from a well prior to abandonment shall either be shot or ripped in place prior to abandonment of the well. The following minimum requirements shall be met:

1. The casing shall either be perforated using projectiles fired perpendicular and completely through the casing or liner pipe or shall be vertically ripped.

2. There shall be 4 shots or one rip per each 5 feet of casing.

3. Each shot shall be a minimum of 0.4 inches in diameter. Each rip shall have a minimum width of 0.25 inches and a minimum length of 12 inches.

4. Each successive shot or rip shall be rotated by 90 degrees.

5. The portion of the well with a casing or liner pipe to be shot or ripped shall be completely filled inside and outside by pressure grouting with neat cement from the inside out and from the bottom up in accordance with s. NR 811.12 (14).

(5) ABANDONMENT MATERIALS AND LIMITATIONS. All wells shall be abandoned using the following materials:

(a) Neat cement grout, sand–cement grout, or concrete meeting the specifications in s. NR 811.12 (14) (a). Powdered bentonite shall not be added to neat cement grout.

(b) Department approved slow–hydrating bentonite chips with the following limitations:

1. The well diameter shall be 4 inches or larger.

2. The depth of chip placement shall not exceed 500 feet.

3. The depth of standing water in the well shall not exceed 350 feet.

4. Fine particles and dust contained in the bags of bentonite chips shall be prevented from entering the well by allowing the chips to tumble under their own weight down a coarse mesh screen into the well. The chips shall be poured across the screen and into the well at a rate not to exceed emptying the bag in 3 minutes.

5. The depth of chips shall be monitored a minimum of once every calculated 50 feet to monitor for bridging of chips. Any chip bridges shall be removed.

6. Water from a clean, known bacteriologically safe source shall be poured down the well on a continuous basis as the chips are being introduced into the well in order to hydrate all of the chips. Water shall be continuously introduced until the water level rises to the top of the well casing and stays there.

(c) Pea gravel that is round, washed to be free of sand and other fine materials, disinfected and having a maximum diameter of 0.375 inches, may be poured into a well without the use of a conductor pipe if the well is sounded at 50–foot intervals to ensure that bridging of the gravel does not occur.

(6) GENERAL ABANDONMENT REQUIREMENTS. Abandonment methods shall meet the following requirements:

(a) All wells shall be filled from the bottom of the well up to the ground surface using approved materials unless it is necessary to terminate the abandonment below the ground surface to accommodate construction over the well. Well casings and abandonment materials may be terminated as much as 3 feet below the ground surface or to a depth below any future building foundation to accommodate construction over the well.

(b) The bottom end of the conductor pipe shall be submerged in the sealing material at all times.

(c) Sealing materials shall be placed by use of a conductor pipe or by means of a dump bailer except when approved bentonite chips or pea gravel are used. Bentonite chips may be poured into the well in accordance with sub. (5) (b). Pea gravel may be poured into the well in accordance with sub. (5) (c). Conductor piping used for pressure methods shall meet the requirements of s. NR 811.12 (14) (b) 8. for well grouting. Conductor piping for non−pressure methods shall be one of the following:

1. Metal pipe.

2. Rubber−covered hose reinforced with braided fiber or steel and rated at least 300 psi.

3. For use at depths less than 100 feet, thermoplastic pipe rated for at least 100 psi, including any of the following:

a. Polyvinyl chloride (PVC).

b. Chlorinated polyvinyl chloride (CPVC).

c. Polyethylene (PE).

d. Polybutylene (PB).

e. Acrylonitrile butadiene styrene (ABS).

(7) SPECIAL ABANDONMENT REQUIREMENTS. To permanently abandon a well, the owner shall have a person who meets the qualifications of sub. (2) fill and seal the well to prevent it from acting as a channel for the vertical movement of contamination or groundwater, by the following applicable method:

(a) *Monitoring wells.* Monitoring wells constructed to ch. NR 141 requirements shall be permanently abandoned in accordance with ch. NR 141 requirements.

(b) *Flowing wells.* For flowing wells, the flow shall be confined and the well shall be filled in accordance with par. (c), (d), or (e) or sealed in accordance with sub. (6) using neat cement grout applied by a pressure method.

(c) *Drift or other unconsolidated wells.* For drift or other unconsolidated wells, the well shall be completely filled from the bottom up with concrete, sand cement grout, neat cement, or approved slow−hydrating bentonite chips. Sealing materials shall meet the requirements of sub. (5). An attempt shall be made to remove any inner ungrouted well casings and screens from gravel−pack wells prior to filling. If the well casings and screens cannot be removed, an attempt shall be made to remove as much gravel pack as possible using air or water or both jetting techniques and the interior and exterior of the ungrouted casings and screens shall then be sealed from the bottom up in accordance with sub. (6) using neat cement applied by a pressure method.

(d) *Bedrock formation wells.* Wells completed in bedrock formations shall be completely filled from the bottom up with concrete, sand−cement, neat cement, or approved slow−hydrating bentonite chips. Sealing materials shall meet the requirements of sub. (5). As an alternative for uncontaminated bedrock wells deeper than 250 feet or for wells cased and grouted through the Maquoketa Shale formation, chlorinated, sand−free pea gravel may be used to fill the open drillhole from the bottom of the well up to the 250−foot depth or to a depth 20 feet below the bottom of the protective casing, whichever is deeper. Additionally, minimum 40−foot thick plugs of sealing materials meeting the requirements of sub. (5) shall be centered at the top of the uppermost Cambrian Sandstone formation and at the top of the Eau Claire formation where these formations are open in the drillhole. The department shall be contacted for specific abandonment requirements where the top or the bottom of the Maquoketa Shale formation is exposed in the open drillhole.

(e) *Dug and bored wells.* The cover and the top curbing or concrete wall shall be removed to a depth of 5 feet below grade for dug or bored wells. Concrete or rock curbing materials may be caved into the drillhole as the well is being sealed only if performed in a manner to prevent bridging.

1. If constructed in unconsolidated formations, the well shall be filled from the bottom up using clean clay or silt, clean native soil, concrete, sand−cement, neat cement, or approved slow−hydrating bentonite chips or a combination of the above. Sealing materials shall meet the requirements of sub. (5).

2. If constructed partially or completely into bedrock, the well shall be filled from the bottom up to the ground surface with concrete, sand−cement, neat cement, approved slow−hydrating bentonite chips or a combination of the above except that if bedrock is encountered below the ground surface, these materials shall be placed to a point at least 2 feet above the top of the bedrock. The remainder of the well may be abandoned with any of the materials listed in subd. 1. Sealing materials shall meet the requirements of sub. (5).

3. Dug or bored wells 18 inches in diameter and smaller shall be filled by means of a conductor pipe, or tremie pipe, except when slow−hydrating bentonite chips are used as specified in sub. (5) (b) or when clean clay or silt or clean native soil is used and the dug or bored well is 25 feet deep or less.

(8) ABANDONMENT REPORTS. The person who abandoned the well shall file an abandonment report with the department, on forms provided by the department, within 30 days after the completion of the well abandonment. The report shall be completely filled out in accordance with the information known and shall include complete information on the depths and types of sealing materials used. Well drillers and pump installers shall report to the department any unused or unabandoned wells on the property of which they have knowledge.

History: CR 09−073: cr. Register November 2010 No. 659, eff. 12−1−10.

NR 811.14 Special requirements for wells developed in unconsolidated formations. (1) CASED AND GROUTED DEPTH. The cased and grouted depth for screened wells in unconsolidated formations shall be dependent on the controlling geologic conditions. Where practical, the grouted casing shall extend to at least 5 feet below the normal pumping water level and to within 5 feet of the top of the screen unless the grout depth is at least 60 feet.

(2) TREATMENT. Additional treatment shall be provided for wells with less than 60 feet of grouted well casing.

(a) Continuous disinfection shall be provided for wells with less than 60 feet of grouted well casing.

(b) Additional detention time and treatment shall be provided when the department determines that additional protection is necessary.

(c) Wells with less than 30 feet of grouted well casing shall be provided with treatment meeting the groundwater under the direct influence of surface water requirements found in ss. NR 810.30, 810.31, 810.33, 810.34, 810.35, 810.36, 810.37, 810.38, 810.39 and 810.40.

(3) CASING AND GROUTING THROUGH CLAY OR HARDPAN. If clay or hardpan is encountered above the formation to be developed, the protective casing and grout shall extend through the materials, but any outer casing shall be withdrawn at least 5 feet above the clay or hardpan during grouting.

(4) GRAVEL PACK. If the well is gravel packed, the gravel shall be acid resistant and free of foreign material, properly sized, washed and disinfected prior to or during placement.

(5) GROUT SEAL. A sand or bentonite seal to prevent leakage of grout into the gravel pack or screen shall be provided. The seal shall be no more than 2 feet thick.

(6) GRAVEL REFILL AND OBSERVATION PIPES. Gravel refill pipes and observation pipes, when used, shall be surrounded by a minimum of 1.5 inches of grout if installed in the grouted annular opening. Observation pipes installed between the inner and the protective casing may be plastic. Pipes shall be incorporated into the concrete pump foundation to a point at least 4 inches above the

floor, and shall terminate with a threaded cap at least 12 inches above the pumphouse floor.

History: CR 09–073: cr. Register November 2010 No. 659, eff. 12–1–10.

NR 811.15 Special requirements for collector wells. **(1)** Continuous disinfection and adequate detention time shall be provided for radial collectors.

(2) Department approval of the well site shall be obtained in accordance with s. NR 811.09 (4) (j) 1. prior to conducting any intensive investigation at the well site.

(3) The area around the collector laterals shall be under the control of the supplier of water for a distance approved by the department.

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

(5) The caisson wall shall be constructed of reinforced concrete as provided in s. NR 811.12 (8). An approved water stop shall be installed between each lift. A final water stop or gasket shall be installed between the base of the pumphouse floor and the top of the caisson. All water used in the construction of the collector shall be from a known bacteriologically safe and uncontaminated source.

(6) Provisions shall be made to assure minimum vertical rise of the caisson due to potential buoyancy concerns.

(7) 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. The caisson shall be vented through a vent pipe installed through the floor in accordance with the requirements of s. NR 811.64 (8).

(8) Pump discharge pipes may not be placed through caisson walls.

(9) Pumphouses constructed on top of the caisson shall meet the construction requirements of subchs. IV and V. The floor of any pumphouse shall be supported by concrete walls that have frost footings.

History: CR 09–073: cr. Register November 2010 No. 659, eff. 12–1–10.

NR 811.16 Special requirements for dug wells and springs. **(1)** The department may approve dug wells and springs only when it is not feasible to develop a drilled well.

(2) Dug wells and springs are considered to be groundwater under the direct influence of surface water and shall be provided with treatment meeting the requirements of ss. NR 810.30, 810.31, 810.33, 810.34, 810.35, 810.36, 810.37, 810.38, 810.39 and 810.40.

(3) Dug wells and springs shall be housed in a permanent watertight concrete structure which terminates a minimum of 24 inches above the ground surface, which prevents the entry of surface water, and meets the construction requirements of s. NR 811.12 (8).

(4) Discharge piping for dug wells and springs may not be placed through the sides of the concrete casing.

(5) The supplier of water shall have control of the area around the dug well or spring for a distance approved by the department.

(6) Dug well and spring collector pumping stations shall have a watertight concrete floor. All openings in the floor shall be curbed and protected against the entrance of foreign material. The entrance hatch in the floor shall be located adjacent to the inside of the well perimeter, have a curb at least 4 inches high, have the edge of a gasketed, watertight cover extending down over the curb at least 2 inches, and be kept locked when not in use. The structure shall be vented through a vent pipe installed through the floor in accordance with the requirements of s. NR 811.64 (8).

History: CR 09–073: cr. Register November 2010 No. 659, eff. 12–1–10.

NR 811.17 Special requirements for infiltration lines. **(1)** The department may approve infiltration lines only when it is not feasible to develop a drilled well.

(2) Infiltration lines are considered to be groundwater under the direct influence of surface water and shall be provided with treatment meeting the requirements of ss. NR 810.30, 810.31, 810.33, 810.34, 810.35, 810.36, 810.37, 810.38, 810.39 and 810.40.

(3) The supplier of water shall have control of the area around the infiltration lines for a distance approved by the department.

History: CR 09–073: cr. Register November 2010 No. 659, eff. 12–1–10.

NR 811.18 Special requirements for sandstone wells. The requirements of this section apply to wells drilled in formations commonly referred to as sandstones in Wisconsin. This includes the St. Peter sandstone, the Upper Cambrian sandstones, and the Lake Superior sandstone. All of the following requirements shall be met:

(1) The minimum depth of the grouted casing shall be 60 feet. The grouted casing shall be installed to a depth of 10 feet below the anticipated pumping water level, except in cases when the department determines that this requirement is not necessary to meet the requirements of this chapter.

(2) If the sandstone is overlain by creviced limestone or shale formations, the grouted casing shall be installed a minimum of 15 feet into firm sandstone. The department shall be contacted for the required depth of grouted casing for locations where this type of construction will be required. Wells constructed to utilize aquifers beneath the Maquoketa shale shall be cased and grouted to beneath the depth of the Maquoketa shale.

(3) If the depth of unconsolidated material is more than 60 feet, the grouted casing shall be seated in firm sandstone if the sandstone is the upper rock formation.

(4) If the depth of unconsolidated material is less than 60 feet and the sandstone is the upper rock formation, the department shall be contacted for the required depth of grouted casing.

History: CR 09–073: cr. Register November 2010 No. 659, eff. 12–1–10.

NR 811.19 Special requirements for limestone or dolomite wells. This section applies to wells drilled in formations commonly referred to as limestones and dolomites in Wisconsin. This includes the Niagara dolomite, the Galena–Platteville dolomite and the Prairie du Chien dolomite. When an acceptable sandstone aquifer can be utilized, construction of limestone or dolomite wells should be avoided. The following requirements apply to wells located in limestone and dolomite aquifers which are not overlain by consolidated shale or sandstone formations.

(1) At a minimum, continuous disinfection, and possibly detention, shall be provided when the department determines that additional protection is necessary.

(2) Continuous disinfection shall be provided for wells with less than 60 feet of grouted casing.

(3) If the depth of unconsolidated material overlying the limestone is 60 feet or greater for a minimum radius of one–half mile and there is no record of sinkholes, quarries, improperly constructed wells, or outcrops within that area, the minimum depth of grouted casing shall be 60 feet. The casing shall be installed to a depth of 10 feet below the anticipated pumping water level unless the department waives this requirement after finding it unnecessary in meeting the requirements of this chapter.

(4) If the depth of unconsolidated material is more than 60 feet and only 60 feet of grouted casing is required by the department, the casing shall be seated in firm limestone.

(5) If the depth of unconsolidated material is less than 60 feet at the well site or within one–half mile of the well site, the department shall be contacted to determine the required minimum depth

of grouted casing. An inner casing size of at least 12 inches in diameter shall be required to permit the installation of a grouted liner at a future date if the water from the well shows evidence of contamination. The department may waive the casing size requirement if it is demonstrated that it is unnecessary to meet the requirements of this chapter. In such cases, a minimum of 100 feet of grouted casing is usually required and, where conditions dictate, considerably more than 100 feet shall be required.

History: CR 09–073: cr. Register November 2010 No. 659, eff. 12–1–10.

NR 811.20 Special requirements for granite wells. The department shall be contacted for specific case–by–case constructional requirements for all proposed developments of wells in Precambrian igneous and metamorphic rock commonly referred to as "granite". At a minimum, continuous disinfection and possibly detention, shall be provided when the department determines that additional protection is necessary.

History: CR 09–073: cr. Register November 2010 No. 659, eff. 12–1–10.

Subchapter III — Source Development — Surface Water

NR 811.21 General requirements. Surface water sources include all lakes, rivers and streams. The source of water selected as a surface water supply shall be from the best available source which is practicable. The source shall provide the highest quality water reasonably available which, with appropriate treatment and adequate safeguards, will meet the drinking water standards in ch. NR 809. The department's office of energy should be contacted to initiate pre–application consultation regarding chapter 30 permitting. Any proposal which would result in a diversion from the Great Lakes basin requires department approval in accordance with s. 281.346, Stats.

(1) QUALITY. An investigative study shall be made of the factors, both natural and man made, which may affect water quality. The study shall include:

(a) Determining possible future uses of the water body.

(b) Determining degree of control of the watershed by the water user.

(c) Assessing degree of hazard to the water supply by agricultural, industrial, recreational, shipping and residential activities in the watershed, and by accidental spillage of materials that may be harmful or detrimental to the treatment process.

(d) Assessing all waste discharges, point source and non–point source, and activities that could impact the water supply. The location of each waste discharge shall be shown on a scale map.

(e) For lakes, an analysis of the area water currents and for streams, an analysis of streamflows, and their potential impact on water quality.

(f) Obtaining samples that are representative of the proposed intake structure based on depth and location. Parameters that may be subject to seasonal variation shall be taken for a period of up to one year or over a sufficient period of time to assess such variation. Testing shall include turbidity, pH, alkalinity, hardness, bromide, total organic carbon, color, taste and odor, ammonia, microbiological organisms, heavy metals including lead and copper, volatile organics, synthetic organics, inorganics, and radiological characteristics of the water. The microbiological testing shall satisfy the Long Term 2 Enhanced Surface Water Treatment Rule requirements found in ss. NR 809.33 to 809.335. The source water shall meet the surface water quality standards in ch. NR 102.

(2) QUANTITY. The quantity of the water at the source shall:

(a) Be adequate in conjunction with water from other existing sources to meet the maximum 20 year projected water demand of the service area as shown by calculations based on a one in 50 year drought or the extreme drought of record and should include multiple year droughts.

(b) Provide a reasonable reserve for anticipated growth.

(c) Be adequate to provide ample water for other legal users of the source in accordance with ss. 30.18, 31.02, 281.35, and 281.41, Stats., and ch. NR 142.

(3) LOCATION. The inlet for the intake shall not be located:

(a) Within 1000 feet of boat launching ramps, marinas, docks, or floating fishing piers which are accessible by the public.

(b) In areas subject to excessive siltation or in areas subject to receiving immediate runoff from wooded sloughs or swamps.

(c) Within 1000 feet of a wastewater treatment plant outfall outlet.

(4) MINIMUM TREATMENT. The design of the treatment processes, equipment, and structures shall depend on an evaluation of the nature and quality of the particular water to be treated.

(a) The design of the water treatment plant must consider the worst conditions that are projected to occur during the life of the facility.

(b) Filtration preceded by appropriate pretreatment shall be provided for all surface waters.

(c) Disinfection shall be provided for all surface waters.

(d) Additional treatment may be required by the department based on raw water sampling and other water quality factors.

History: CR 09–073: cr. Register November 2010 No. 659, eff. 12–1–10.

NR 811.22 Intakes. Intake structures shall provide for all of the following:

(1) Velocity of flow .25 to .50 feet per second through the inlet structure so that frazil ice will be held to a minimum.

(2) Withdrawal of water from the depth of the best water quality or the capability to draw from more than one level or more than one location if water quality varies with depth or location or both.

(3) Inspection manholes every 1,000 feet for pipe sizes large enough to permit visual inspection.

(4) Adequate protection against rupture by dragging anchors, ice, and other activity.

(5) Locations referenced by permanent monuments or latitude and longitude as measured by a Global Positioning System (GPS).

(6) A diversion device capable of keeping large quantities of fish or debris from entering an intake structure where shore wells are not provided.

(7) Control of nuisance organisms where necessary in accordance with s. NR 811.232.

History: CR 09–073: cr. Register November 2010 No. 659, eff. 12–1–10.

NR 811.23 Shore wells. (1) Shore well structures shall comply with all of the following:

(a) Have motors and electrical controls located above grade and above flood level.

(b) Be accessible for operation and service.

(c) Be designed to prevent flotation.

(d) Be equipped with a minimum of 2 removable or traveling screens or an equivalent means of screening before the pump suction well. Systems with only one screen shall be provided with a bypass.

(e) Provide chlorination or other chemical addition facilities for raw water transmission mains.

(f) Have the intake piping valved with provisions for backflushing and testing for leaks, where practical.

(g) Have provisions for controlling surges.

(h) Have sloped bottoms.

(2) The requirements in sub. (1) may be waived by the department on a case–by–case basis if it is demonstrated that they are not necessary to fulfill the other requirements of this chapter.

History: CR 09–073: cr. Register November 2010 No. 659, eff. 12–1–10.

NR 811.231 Off–Stream raw water storage. (1) DEFINITION. In this section, "off–stream raw water storage reservoir" is defined as a facility into which water is pumped during periods

of good quality and high stream flow for future release to the treatment facilities.

(2) CONSTRUCTION. Off−stream raw water storage reservoirs shall be constructed to assure all of the following:

(a) Water quality is protected by controlling runoff into the reservoir.

(b) Dikes are structurally sound and protected against wave action and erosion.

(c) Intake structures meet the requirements of s. NR 811.22.

(d) Point of influent flow is separated from the point of withdrawal.

(e) Water is regularly circulated to prevent stagnation.

(f) The reservoir is surrounded by a fence and unauthorized access is prevented.

(g) The reservoir is covered, where practical.

(h) The requirements of s. NR 811.47 (7) are met if the reservoir is to be used as a pre−sedimentation basin.

History: CR 09−073: cr. Register November 2010 No. 659, eff. 12−1−10.

NR 811.232 Intake chemical treatment. If the department determines that chemical treatment is warranted for taste and odor control or the control of zebra and other mussels and other nuisance organisms in an intake, the following requirements shall be met:

(1) Chemical treatment shall be installed in accordance with subch. VI and plans and specifications shall be approved by the department prior to installation.

(2) Solution piping and diffusers shall be installed within the intake pipe or in a suitable carrier pipe. Provisions shall be made to prevent dispersal of chemicals into the water environment outside the intake. Diffusers shall be located and designed to protect all intake structure components.

(3) A spare solution line shall be installed to provide redundancy and to facilitate the use of alternate chemicals, where practicable.

(4) A sample line out to the intake shall be provided which will allow for collecting raw water samples unless the chemical control system will be shut off for periods sufficient to collect raw water samples at the shore well.

History: CR 09−073: cr. Register November 2010 No. 659, eff. 12−1−10; renumbering of (1) to (4) made under s. 13.92 (4) (b) 1., Stats., Register November 2010 No. 659.

Subchapter IV — Pumping Stations, Pumphouses, and Water Treatment Plant Buildings

NR 811.24 General requirements. All water system related buildings shall be designed to maintain the sanitary quality of the water supply. Buildings subject to the requirements of this subchapter include surface water and groundwater water treatment plant buildings, structures and pumping stations, well pumphouses and enclosures, and booster pumping stations. Uses of the buildings shall be compatible with the protection of the water supply.

History: CR 09−073: cr. Register November 2010 No. 659, eff. 12−1−10.

NR 811.25 Buildings. (1) CONSTRUCTION. All water system related buildings under s. NR 811.24 shall meet all of the following requirements:

(a) Have adequate space for the installation of additional pumping units, water treatment equipment, chemical feed equipment, or controls, if needed, and for the safe servicing of all equipment.

(b) Be durable, fire and weather resistant, and constructed in a manner to maximize sanitary protection of the water supply.

(c) Be secure. Buildings shall have at least one outward opening door to the outside. All doors, windows, and hatches shall have locks. Any security alarms installed shall be connected to telemetry control and SCADA systems where such systems are used.

(d) Be landscaped to conduct surface drainage away from the station and have a floor elevation at least 6 inches above the finished grade and at least 2 feet above the regional flood elevation as determined in s. NR 116.07 (4). Buildings shall be provided with year round dry land access. Below grade installations may be permitted only if the terrain at the site is such that a gravity drain system can be provided. Subsurface pits or pumprooms and inaccessible installations intended to house well heads, pumps, pump motors, or pump controls for pumping stations are prohibited except for below grade booster pumping stations as allowed per s. NR 811.80 (3) and (4).

(e) Provide for all floors to drain so that floor runoff does not enter the treatment process or source water. Floors shall be sloped to a drain or sump.

(f) Provide a suitable outlet for drainage water from pump glands so that the disposal of any drainage water is piped to waste or otherwise disposed of in a controlled manner. Pump gland drainage piping shall not be directly connected to a hub drain or a floor drain.

(g) Be provided with concrete floors.

(h) Be provided with at least one floor drain meeting the following requirements:

1. Floor drains and hub drains shall be properly separated from a well. A floor or hub drain and associated piping accepting water from pump gland drainage, a pressure relief or control valve, a sampling faucet, or the floor shall be located no closer than 2 feet to the outer well casing. No building drain piping, except that piping leading to the aforementioned floor or hub drains, containing blackwater or graywater, may be located closer than 8 feet to the outer well casing.

2. Floor drains and hub drains shall have a discharge location that complies with all of the following requirements:

a. Floor drains and hub drains may be connected to a sanitary sewer where available if the building floor elevation is at least one foot above the rim elevation of the nearest upstream sanitary sewer manhole. If a sanitary sewer is available but a manhole is not located nearby or the manhole does not comply with the upstream location or the one foot requirement, the department may require installation of an additional manhole on the sanitary sewer main or on the sanitary building sewer.

Note: The department recommends that the floor drains from chemical feed rooms discharge to a sanitary sewer whenever practicable.

b. Floor drains and hub drains may discharge to the ground surface if the building drain and building sewer piping will only carry water from the floor or hub drain, the discharge location shall be at least 25 feet from the pumphouse, the exterior invert of the building sewer pipe shall be at least 6 inches below the building floor elevation and the exterior pipe opening shall be covered with a corrosion resistant rodent screen. A greater distance may be required for drains of pump stations serving wells constructed in sand and gravel formations. The piping shall terminate in a location that will not allow backflow of surface water into the building.

c. Floor drains and hub drains may discharge to a buried tank located a minimum of 50 feet from the well if the discharge to the building drain and building sewer piping will contain only water from pump gland drainage, a pressure relief or control valve, a sampling faucet or floor drainage. These buried tanks may not be installed unless approved by the department's bureau of watershed management wastewater section prior to installation. Floor drains and hub drains may discharge to a POWTS holding component located a minimum of 200 feet from the well if the discharge will contain toilet, sink or other sanitary or domestic waste. These POWTS holding components may not be installed unless approved by the department of safety and professional services prior to installation. In either case the rim elevation of the access manhole to the tank shall be at least one foot below the building

floor elevation and a high water alarm shall be installed for the tank in accordance with the requirements of s. SPS 383.43 (8) (e).

d. Soil infiltration components, including french drains, are prohibited.

3. The drain may be a trench drain system if the lowest elevation of any trench drain complies with subd. 2. a. Where trench drains are to be connected to a sanitary sewer and compliance with subd. 2. a. is not possible, a sump containing a sump pump shall be installed in the trench to discharge the trench water with a minimum 2 pipe diameter free air break over a hub drain. The top elevation of the hub drain shall be at least one foot above the elevation of the nearest upstream sanitary sewer manhole rim. Where trench drains will discharge to grade the exterior invert of the building sewer pipe shall be at least 6 inches below the lowest elevation of the trench drain and the exterior pipe opening shall be covered with a corrosion resistant rodent screen.

4. Floor drains shall be constructed of department of safety and professional services approved plumbing materials. The building drain piping shall be constructed of cast iron or PVC piping within 10 feet of the outer well casing.

(i) Pitless units shall be provided with a locked and vented watertight enclosure fastened watertight to a concrete floor. The enclosure shall be weather resistant, of sufficient size to accommodate all well appurtenances and electrical or auxiliary power connections and be accessible for year−round inspection, water sample collection, and water level data collection. Any enclosure vents shall be shielded from the elements and wind−blown debris and the vent openings shall be covered with 24−mesh corrosion resistant screens. Backfill material for slab−on−grade enclosures shall be compacted in lifts. Any slab−on−grade concrete floor shall have minimum dimensions of 4 feet by 4 feet by 6 inches thick and be provided with reinforcing.

(j) A small, doghouse−type, enclosure may be installed over a well and abbreviated above grade pump discharge piping where chemical addition equipment or hydro−pneumatic pressure tank storage is located remote from the well. The department may waive portions of the building installation requirements for small enclosures. The enclosure shall be secured watertight to a concrete floor and allow for convenient access to the well, piping and any appurtenances. The enclosure shall be locked as applicable. If a floor drain will not be installed, the floor shall be sloped to drain toward the access door if one is provided.

(2) EQUIPMENT SERVICING. Pumping stations shall be provided with all of the following:

(a) Crane−ways, hoist beams, eyebolts, or other facilities necessary for servicing or removal of pumps, motors, or other heavy equipment where appropriate.

(b) Openings in floors, roofs or wherever needed for removal of heavy or bulky equipment. For well pumphouses, a secured roof hatch shall be located over the well.

(3) STAIRWAYS AND LADDERS. Stairways or ladders shall be provided between all floors and in pits or compartments which are to be entered.

(4) HEATING. Adequate heating shall be provided for the safe and efficient operation of the equipment.

Note: In buildings not occupied by personnel, only enough heat need be provided to prevent freezing, unless higher temperatures are required for proper chemical addition or to allow water treatment and control equipment to function properly.

(5) VENTILATION. Ventilation for all pumping stations, pumphouses, and water treatment plant buildings is governed by applicable building codes.

(6) DEHUMIDIFICATION. A means for dehumidification shall be provided in pump rooms and in other water system related buildings where excess moisture could cause or is causing safety hazards or damage to equipment or piping.

(7) LIGHTING. All pumping stations, pumphouses, and water treatment plant buildings shall be provided with adequate interior and exterior lighting. The design of exterior lighting should promote security.

(8) SANITARY AND OTHER CONVENIENCES. All pumping stations, pumphouses, and water treatment plants shall be provided with potable water, lavatory, and toilet facilities except for unoccupied automatic stations or if such facilities are available elsewhere. All plumbing including fixtures, backflow protection, floor drains, hub drains, piping and their installation, testing, and maintenance shall conform to the requirements of chs. SPS 302, 305 and 381 to 384.

(9) MULTIPURPOSE BUILDINGS. Water supply buildings may be enclosed in or attached to buildings that serve multiple purposes such as a park building, garage, office, storage or restroom facility if the purposes for which the building are used are compatible with the protection of the water supply. In all cases the water supply facilities shall be separated by walls from the other building uses with access to the water supply facilities gained by separate locked doors and restricted to authorized water system personnel. The specific requirements for multipurpose buildings shall comply with subs. (1) to (8) where applicable.

History: CR 09−073: cr. Register November 2010 No. 659, eff. 12−1−10; correction in (1) (h) 2. c., 4., (8) made under s. 13.92 (4) (b) 6., 7., Stats., Register December 2011 No. 672.

NR 811.26 Number of pumping units. All pumping stations for systems using either groundwater or surface water shall meet the following requirements:

(1) There shall be 2 or more pumping units, with each unit capable of supplying the peak demand. The department may approve exceptions under sub. (2), if additional pumping stations which can meet the peak demand are available or if the department determines that there will be a sufficient volume of storage available between pumping periods to allow for necessary repairs. Depending on the type and size of the water system, a sufficient volume of storage may include elevated storage, ground storage fitted with high−lift pumps and auxiliary power, and pressure tank storage. If only 2 units are provided, each unit shall be capable of supplying the peak demand. If more than 2 units are installed, the total number of units shall have sufficient capacity so that if any one pump is taken out of service, the remaining pumps are capable of supplying the peak demand.

(2) If no elevated storage is available and more than 50 living units are to be served, there shall be 2 or more wells or pumping units, each of which is capable of supplying the peak demand. An approved interconnection with another water system or a ground storage reservoir with high−lift pumps may be used in lieu of this requirement for other−than−municipal water systems.

(3) Have controls for proper alternation when 2 or more pumps are installed.

History: CR 09−073: cr. Register November 2010 No. 659, eff. 12−1−10.

NR 811.27 Auxiliary power. All municipal pumping stations, pumphouses, and water treatment plants shall have a standby auxiliary power source unless the department determines that there is sufficient pumping capacity with existing auxiliary power located at other water system facilities to provide at least an average day supply of water. Sufficient power shall be provided to operate pumps, treatment systems, chemical addition, control systems, and monitoring equipment. Auxiliary power for chemical addition, treatment, and monitoring equipment is not required if the treatment, chemical addition, control, and monitoring equipment is not necessary to meet the primary drinking water standards in ch. NR 809 or the continuous disinfection requirements of chs. NR 810 and 811.

(1) POWER SOURCES. Standby power may be provided by any of the following:

(a) A dedicated on−site generator or engine. A dedicated on−site generator may be located inside or outside the building. Dedicated on−site engine−generator sets installed within the building

shall be located in a separate room. Diesel fuel tanks shall be provided with secondary containment and interstitial leakage monitoring and the installation shall receive written approval from the department of safety and professional services or its authorized agent under ch. ATCP 93 prior to installation. All fuel lines shall be exposed above grade. Water lines to water cooled units shall be provided with backflow prevention in accordance with s. SPS 382.41.

(b) A portable power source owned by the municipality and dedicated to the water supply facility operation.

(c) A portable power source not owned by the municipality but only if the water system owner obtains a written agreement with the owner of any portable power source, including tractors or trailered engine−generator sets, that requires the water system owner to have primary access to the power source in an emergency and that allows the portable power source to be brought to the water system as required for testing. The portable power source should be located in the community if possible but shall be located within 10 miles of the water system facilities at which it will be used.

Note: The department recommends the use of water system owned dedicated on−site or portable engine−generator sets in all cases. It is recommended that the equipment necessary to convert natural gas fueled engines to propane be maintained on site in case the natural gas supply has to be shut off for any significant length of time. It is recommended that exterior engine−generator set installations be installed within a locked security fence.

(2) ALTERNATE PRELUBRICATION METHODS. The pump installation shall be provided with a prelubrication line with a valved bypass around the automatic control and backflow protection, if appropriate, in order to allow temporary continuous prelubrication, whenever automatic prelubrication of pump bearings is necessary and an auxiliary power supply is provided that will not provide power to the automatic prelubrication controls.

History: CR 09−073: cr. Register November 2010 No. 659, eff. 12−1−10; correction in (1) (a) made under s. 13.92 (4) (b) 6., 7., Stats., Register December 2011 No. 672; correction in (1) (a) made under s. 13.92 (4) (b) 7., Stats., Register October 2013 No. 694.

NR 811.28 Additional requirements. (1) SUCTION OR WET WELLS. Suction or wet wells, including installations where the pumps are installed on top of a reservoir, but excluding remote booster pumping installations shall:

(a) Meet the applicable reservoir construction requirements of subch. IX.

(b) Have all below grade metal pump cans, if installed, exposed in a basement or vault.

(c) Have 2 pumping compartments or other means to allow the suction well to be taken out of service for inspection, maintenance, or repair.

(2) SUCTION LIFT. Suction lift shall be allowed only for distances of less than 15 feet and where provision is made for priming the pumps. Suction lift may not be permitted if buried piping carries the finished water.

(3) PRIMING. Prime water may not be of lesser sanitary quality than that of the water being pumped. Means shall be provided to prevent backflow. When an air−operated ejector is used, the screened intake shall draw clean air from a point at least 10 feet above the ground or other source of contamination, unless the air is filtered by apparatus approved by the department. Vacuum priming may be used.

(4) AUTOMATIC AND REMOTE CONTROLLED STATIONS. All automatic stations shall be provided with automatic signaling equipment which will report pump on−off operation and the status of other important functions, such as intrusion alarms, to the main station. Pressure monitoring shall be included if a separate pressure zone is established. All remote controlled stations shall be electrically operated and controlled and shall be provided with reliable signaling equipment.

Note: See subch. XI for booster pumping facilities in the distribution system.

(5) APPURTENANCES. (a) *Valves*. Pumps shall be adequately valved to permit satisfactory operation, maintenance and repair of the equipment. If foot valves are provided, they shall have a net valve area of at least 2.5 times the area of the suction pipe and shall be screened. Each pump shall have an automatically closing valve or check valve on the discharge side between the pump and shutoff valve. Devices such as motor controls, slow opening and closing check valves, or surge relief valves shall be installed where necessary to minimize pressure surges or water hammer.

(b) *Piping*. Piping shall be designed to minimize friction losses and shall be protected against pressure surges or water hammer. Piping shall be supported, restrained, and buttressed as necessary. Where applicable, each pump shall have an individual suction line or lines so manifolded that they insure similar hydraulic and operation conditions. Discharge piping exposed in buildings shall be ductile iron, copper, steel, stainless steel, or galvanized pipe. The use of minimum schedule 80 PVC pipe meeting the requirements of SPS Table 384.30−7 is acceptable where the water to be carried in the piping can be documented as being aggressive to metal pipe or where necessary to be compatible with water treatment equipment and processes provided that the piping is properly restrained.

(c) *Gauges and meters*. Each pump shall have a standard pressure gauge on its discharge line and have a compound pressure gauge on its suction line if suction pressures are expected to be encountered. Where suction or discharge headers are utilized, only one gauge is required on each header. In addition, the station shall have indicating, totalizing, and recording metering of the total water pumped.

Note: Discharge pressure recording devices are recommended at the larger stations.

(d) *Water seals*. Water seals may not be supplied with water of a lesser sanitary quality than that of the water being pumped. Where pumps are sealed with potable water and are pumping water of lesser sanitary quality, the water supply to the seal shall:

1. Be provided with a department of safety and professional services approved reduced principle backflow preventer or a break tank open to atmospheric pressure.

2. Where a break tank is provided, have an air gap, at least 6 inches or 2 pipe diameters, whichever is greater, between the feeder line and the spill line of the tank.

(6) PAINTING OF PIPING. In order to facilitate identification of piping in waterworks, pumping stations, pumphouses and, water treatment plants, it is recommended that the following color schemes be utilized for purposes of standardization:

(a)	*Water Lines*	*Color*
	Raw	Olive Green
	Settled or Clarified	Aqua
	Finished or Potable	Dark Blue
(b)	*Chemical Lines*	*Color*
	Alum	Orange
	Ammonia	White
	Carbon Slurry	Black
	Caustic Soda	Yellow with Green band
	Chlorine –Gas and Solution	Yellow
	Chlorine Dioxide	Yellow with Violet Band
	Fluoride	Light Blue with Red Band
	Lime Slurry	Light Green
	Ozone	Yellow with Orange Band
	Phosphate Compounds	Light Green with Red Band
	Polymers or Coagulant Aids	Orange with Green Band
	Potassium Permanganate	Violet
	Soda Ash	Light Green with Orange Band
	Sulfuric Acid	Yellow with Red Band
	Sulfur Dioxide	Lt. Green with Yellow Band
(c)	*Waste Lines*	*Color*
	Backwash Waste	Light Brown
	Sludge	Dark Brown
	Sewer – Sanitary or Other	Dark Gray
(d)	*Other Lines*	*Color*
	Compressed Air	Dark Green
	Gas	Red
	Other Lines	Light Gray

(e) For liquids or gases not listed above, a unique color scheme and labeling shall be used. In situations where 2 colors do not have sufficient contrast to easily differentiate between them, a 6 inch band of a contrasting color shall be painted on one pipe at approximately 30 inch intervals. The name of the liquid or gas should also be painted on the pipe. Arrows may be painted on the piping indicating the direction of flow.

History: CR 09–073: cr. Register November 2010 No. 659, eff. 12–1–10; correction in (5) (b), (d) 1. made under s. 13.92 (4) (b) 6., 7., Stats., Register December 2011 No. 672.

Subchapter V — Pumping Equipment and Appurtenances

NR 811.29 Pumping capacity requirements. Figure No. 1 located in the Appendix shall be used for determining minimum pump capacities for domestic service only unless specific information is submitted to the department for review and the department approves the alternate pump capacities. When using Figure No. 1, the number of homes may be reduced by one–third for apartment units, condominium units, and manufactured (mobile) homes. More detailed engineering studies are necessary for determining pump capacities in systems providing water for multiple uses, including domestic, commercial and industrial usage and fire protection.

History: CR 09–073: cr. Register November 2010 No. 659, eff. 12–1–10.

NR 811.30 General pump, motor and wiring installation requirements. (1) INSTALLATION LOCATION. All nonsubmersible pump motors and all electrical controls shall be located above grade and protected from flooding, except as allowed for below grade booster pumping stations in s. NR 811.80 (3).

(2) MOTOR, WIRING AND ELECTRICAL CONTROLS. All exposed wires shall be encased along their entire length and otherwise installed in a manner to prevent contamination of the water supply. All motors, wiring, and electrical controls shall be installed in conformance with all applicable state and local electrical code requirements.

Note: It is recommended that all pumps and motors be assessed during design to ensure that they will be energy efficient throughout their operational range and over their usable service life. It is recommended that all pump motors be provided with a recording watt meter.

History: CR 09–073: cr. Register November 2010 No. 659, eff. 12–1–10.

NR 811.31 Line–shaft vertical turbine pumps. (1) PUMP BASES. Line–shaft vertical turbine pump base installations shall meet the requirements of this subsection and as shown in Figure Nos. 2 and 3 in the Appendix:

(a) Line–shaft vertical turbine pumps shall be supported by a concrete pump base which is installed to a height at least 12 inches above the pump station floor.

(b) The protective grouted casing of wells shall extend a minimum of one inch above the concrete pump base. If there is also an inner ungrouted casing, the inner casing shall extend a minimum of one inch above the pump base and the protective grouted outer casing shall extend a minimum of 4 inches above the floor and shall be incorporated into the concrete pump base. For these installations, a steel ring shall be welded between the inner and protective casings.

(c) The metal surfaces between the pump head and base plate shall be machined or gasketed to provide a watertight seal. A gasket or sealant shall be provided between the base plate and the concrete pump foundation.

(d) For high−lift line−shaft vertical turbine pumps installed above a reservoir, a steel casing shall be installed within the concrete pump base from the reservoir roof to a height above the pump base to provide a one inch sanitary lip. The requirements of pars. (a) to (c) shall also be met if applicable.

(2) PUMP LUBRICATION. (a) Water lubricated pumps are required, except if oil lubricated pumps are necessary to provide positive lubrication. The oil used for pump lubrication shall be an NSF/ANSI Standard 61 approved mineral oil. Oil lubricated pumps may not be installed for wells in unconsolidated formations or for wells with shallow pump settings less than 250 feet.

(b) For water lubricated pumps with static water levels deeper than 50 feet, provision shall be made for prelubricating the column bearings prior to pump startup. All prelubrication water lines shall be equipped with metering or controls to monitor and limit the volume of prelubrication water. At systems where chemical addition is practiced, solenoid valve control of the prelubrication water line shall be provided. If auxiliary power is provided, additional valving of the prelubrication water line shall be provided. When pump backspin is allowed to occur after the motor shuts off, the design engineer for the water system shall determine the necessity for lubrication during this period and provide for lubrication if necessary.

History: CR 09−073: cr. Register November 2010 No. 659, eff. 12−1−10.

NR 811.32 Submersible vertical turbine pumps. **(1)** PUMP BASES. If a submersible pump is used, the top of the well casing shall be effectively sealed against entrance of water under all conditions including vibration or movement of conductors or cables. Requirements for the installation of pitless units are provided in s. NR 811.35. Submersible pump installations shall meet the requirements of this subsection and as shown in Figure Nos. 4, 5, and 6 in the Appendix:

(a) *Termination above grade.* The protective casing shall terminate above grade a minimum of 12 inches above a concrete floor. Submersible pump discharge pipes shall be extended to terminate through the top of the well casing.

(b) *Well seals.* Well seals shall consist of a sanitary surface plate bolted down with a gasketed or machined seal to a flange welded to the well casing or alternatively, a department approved well seal with one−piece top plate. All openings in the well seal shall be sealed watertight with grommets or compression fittings to prevent the entrance of contaminants.

(c) *Protective collars and pump bases.* 1. The protective casing shall terminate at least 12 inches above the floor and be surrounded by a pump base or a minimum 1.5−inch thick concrete collar. Either the pump base or the concrete collar shall be installed to a height at least 6 inches above the floor.

2. If a pump base is installed, any other outer well casing shall be terminated a minimum of 4 inches above the finished floor and incorporated into the pump base.

3. A short section of outer well casing may be installed around the protective casing and the annular space between the 2 casings filled with grout to meet the collar requirement of subd. 1.

(2) DROP PIPES. Vertical drop pipes for submersible pumps located within the well casing shall be constructed of steel, stainless steel, or galvanized steel pipe. The department shall be contacted to request approval for an alternate minimum 150 psi pressured rated plastic drop pipe material specification which shall be granted if its use can be justified due to a corrosive water condition. All vertical drop pipe material specifications shall meet or exceed the requirements of s. NR 812.28 and the Pipe and Tubing for Water Services and Private Water Mains table found in SPS Table 384.30−7.

History: CR 09−073: cr. Register November 2010 No. 659, eff. 12−1−10; correction in (2) made under s. 13.92 (4) (b) 7., Stats., Register December 2011 No. 672.

NR 811.33 Motor protection. If backspin can be expected to occur, the motor shall be provided with a time delay or non−reverse ratchet to protect the motor in case the pump controls are energized before the pump stops backspinning.

History: CR 09−073: cr. Register November 2010 No. 659, eff. 12−1−10.

NR 811.34 Pump variable output control devices. Installations where pumps and pump motors will be physically or electronically controlled by a variable output control device shall meet the following requirements:

(1) PUMPING CAPACITY TO MEET PEAK DEMAND. The gallon per minute discharge rates of the pump or pumps shall be capable of meeting the peak demand rate when there is no elevated storage and the pressure tank storage volume will be reduced due to the installation of the variable output control device or devices.

(2) HIGH PRESSURE CUT–OUT SWITCH. A high pressure cut−out switch shall be installed on the pump discharge piping to stop the pump motor when a preset maximum discharge pressure is detected if the pump shut−off head at the maximum possible speed will exceed the safe working pressures of the piping and appurtenances.

(3) PRESSURE RELIEF VALVE. A pressure relief valve shall be installed on the pump discharge piping sized to allow adequate pressure to be relieved if a malfunction that would cause the pump to discharge at the maximum possible rate would result in pressures exceeding the safe working pressures of the piping and appurtenances.

(4) BACKUP CONTROLS. All water systems supplied by one well or booster pump shall be provided with a redundant means of controlling the operation of the pump motor. Such means may include the installation of an electrical bypass of the variable output control device along with the installation of pressure switches or other department approved installation.

(5) FLOW PACING FOR CHEMICAL FEED PUMPS. Where pump discharge rates will vary after initial startup of the pump, all chemical feed pumps shall be paced from a flow proportional signal from a water meter. This requirement is in addition to any requirement for the chemical feed pump to be wired to operate in series with the pump motor starter and any required secondary chemical feed pump control mechanism.

(6) ADEQUATE STORAGE. Storage shall meet the following requirements when there is no elevated storage or the minimum pressure tank storage volume normally required by s. NR 811.61 (7) will be reduced due to the installation of one or more variable output control devices.

(a) For other−than−municipal water systems and small municipal water systems not provided with elevated storage, the gross pressure tank storage volume shall be a minimum of 2.5 times the design pump output in gallons per minute. When a vertical turbine pump requiring prelubrication or an auxiliary power source with an automatic transfer switch is employed, calculations shall be provided to the department to demonstrate that the storage volume is adequate to provide the necessary time for the prelubrication to occur or for the auxiliary power source to come on line before the system pressure drops below 20 psi as a result of a brief electrical power outage.

(b) For a control valve type of installation, the gross pressure tank storage volume shall be a minimum of 5 times the design pump output in gallons per minute to prevent the pump motor from over−heating.

(c) For booster or high−lift pump installations where the pump is discharging to a distribution system without elevated storage, the gross pressure tank storage volume shall be a minimum of 2.5 times the design pump output in gallons per minute.

(d) As an alternate to pars. (a) to (c), the department may approve other proposed pressure tank storage volumes when justified by supporting information submitted to the department.

(e) Control or piping and valve measures shall be provided to prevent water from becoming stagnant in pressure tanks where water would otherwise be forced to reside in the pressure tanks for

long periods if the pump will operate continuously to maintain system pressure.

(f) Additional storage volume shall be provided for adequate operation of water treatment equipment including storage volumes necessary to obtain required reaction or disinfection detention times in detention vessels. The storage volumes shall be calculated by the design engineer assuming the pump or pumps are discharging at the maximum possible rate.

(7) VENTILATION. Automatically controlled forced air ventilation shall be installed for any room where an electronic variable output control device will be installed and room temperatures will exceed 90 degrees F.

(8) MEASURES TO PREVENT DAMAGE FROM CORROSIVE CHEMICALS. The installation of an electronic variable output control device may not be allowed in a corrosive environment. Electronic variable output control devices may not be installed in the same room with fluoride acid chemical feed equipment. Preventive measures such as adequate sealing and ventilation of chemical containers and solution tanks shall be taken to minimize the production of corrosive fumes from other kinds of chemical feed installations, including sodium hypochlorite. The installation of a separate chemical feed room or the installation of room or chemical feed system ventilation improvements may be required by the department where significant damage from corrosive fumes has been documented.

(9) DEHUMIDIFICATION OR AIR CONDITIONING. Dehumidification or air conditioning equipment shall be installed in any room where an electronic variable output control device will be installed and excessive moisture will be a concern.

History: CR 09−073: cr. Register November 2010 No. 659, eff. 12−1−10.

NR 811.35 Pitless units. Pitless units shall be installed in a manner to provide equivalent security, sanitary protection, accessibility, and operational flexibility to an above grade pump discharge installation and in accordance with the requirements of this section and as shown in Figure No. 7 in the Appendix.

(1) TERMINATION. Pitless units shall terminate a minimum of 12 inches above a concrete floor as required by ss. NR 811.12 (1) and 811.32 (1) (a). If the vent assembly is built into the pitless unit, the portion of the pitless unit where the bottom of the vent assembly is located shall be terminated a minimum of 24 inches above the concrete floor. Pitless units shall be provided with a protective concrete collar where they pass through the concrete floor as required by s. NR 811.32 (1) (c). The exterior exposed conduit pipe for the pump wiring shall be rigid steel and the conduit pipe incorporated into the concrete collar.

(2) ENCLOSURE. The exposed portion of a pitless unit shall be surrounded by a weather resistant, watertight, locked, and vented enclosure secured to a concrete floor as required by s. NR 811.25 (1) (i). The top surface of the concrete floor shall be located a minimum of 6 inches above the finished grade.

(3) APPURTENANCES. The top of the pitless unit shall be sealed sanitarily in accordance with s. NR 811.32 (1) (b), provided with a well vent and water level measuring equipment in accordance with s. NR 811.36, and shall be provided with a frost−proof down−turned metal smooth end sampling faucet terminating above the top of the pitless unit and a minimum of 12 inches above the concrete floor of the enclosure unless the sampling faucet is installed remote from the pitless unit in accordance with sub. (6) (h).

(4) DISCHARGE PIPING. Discharge piping from a pitless unit shall meet the following requirements:

(a) The discharge piping from the pitless unit shall be directed to a separate building located above grade where all of the applicable pump discharge piping appurtenances shall be installed in accordance with s. NR 811.37 and Figure No. 7 in the Appendix.

(b) The discharge piping from the pump in the well to the above grade pump discharge piping shall remain pressurized at all times. No provisions for drain back of the discharge piping may be allowed. A shut−off valve shall not be installed in the buried portion of the pitless unit discharge piping unless approved by the department as part of a pump−to−waste installation.

(c) The buried portion of a pitless unit discharge piping along with any joints or fittings shall be ductile iron, steel, or plastic piping meeting at minimum the AWWA pressure class 150 water main standards required under s. NR 811.69. Plastic piping shall not be used in areas where soil or groundwater contamination may be present. Plastic piping shall be transitioned to metal piping within 12 inches above the floor of the building into which it will be directed, under par. (a), unless minimum schedule 80 PVC pipe is installed in the building as allowed under s. NR 811.28 (5) (b).

(5) CHECK VALVES. A check valve shall be installed in the submersible pump discharge piping in the well immediately above the pump. A check valve shall not be installed in the buried pitless unit discharge piping. A check valve may not be installed in the above grade pump discharge piping unless preceded by the pump on and off controls, or one or more pressure tanks, or unless the department approves an alternate method to maintain positive pressure in the piping under all operating conditions.

(6) SPECIFIC INSTALLATION REQUIREMENTS. (a) Pitless units shall be factory assembled and pressure tested, full length units, with the make and model number having received individual department approval for use. The inside diameter of the pitless unit shall not be smaller than the inside diameter of the well casing pipe as required by s. NR 812.31 (2) (b).

(b) The department may not approve installation of a pitless unit unless any temporary outer well casing is totally removed from the well during the well construction process. Pitless units shall be attached only to the protective grouted well casing, including wells constructed with gravel packed screens.

(c) The top surface of the remaining well grout shall be no greater than one foot below the installation depth of the pitless unit, which is the well casing cut−off depth.

(d) The pitless unit shall be installed in accordance with the requirements of s. NR 812.31 (3) (a).

(e) Pitless units shall be installed by a licensed pump installer. The installed pitless unit shall be tested and proven watertight under a pressure of not less than 14 psig. The pressure shall be maintained for a minimum of 30 minutes. Additionally, any leaks detected shall be sealed during the pressure test. The installer shall notify the department a minimum of 48 hours before performing the pressure testing so that a department employee may witness the test. A report on the results of the pressure testing, signed by a licensed pump installer, shall be submitted to the department before placing the well in service.

(f) A certification by the licensed pump installer that installed the pitless unit confirming that the well was originally grouted to the ground surface and that the requirements of pars. (b) and (c) were met, shall be submitted to the department along with the pressure testing report and a copy of the well construction report.

(g) Backfilling of the excavation shall commence as soon as practical after the installation and a successful pressure test of the pitless unit.

(h) For slab−on−grade enclosures, a below grade length of pump discharge piping from the pitless unit, sufficient to extend beyond the enclosure, shall be installed prior to backfilling of the excavation and construction of the concrete floor slab. The buried piping shall be temporarily capped in a sanitary manner unless the piping is immediately extended and connected to the remainder of the system. During the installation of the discharge piping, if the sampling faucet riser pipe is not installed within the well and pit-

less unit, a metal riser pipe shall be extended vertically from the below grade discharge piping to terminate at a height a minimum of 12 inches above the top of the future concrete floor. The riser pipe shall be fitted with a frost−proof, down−turned, metal, smooth−end sampling faucet or shall be temporarily capped.

History: CR 09−073: cr. Register November 2010 No. 659, eff. 12−1−10; correction in (6) (intro.) made under s. 13.92 (4) (b) 7., Stats., Register November 2010 No. 659.

NR 811.36 Well appurtenances. (1) WELL VENT. Each well shall be vented to the atmosphere in accordance with the following requirements:

(a) For wells without pitless units, a metal vent pipe shall be installed which terminates in a 24−mesh corrosion resistant screened "U" bend or mushroom cap at least 24 inches above the floor. The vent pipe diameter shall be a minimum of 2 inches for well casings 10 inches in diameter and larger. Vent piping shall be welded watertight to the side of the well casing a minimum of 4 inches above the floor and may extend through a concrete pump base or collar where one is present. Alternatively, vent piping may project watertight through a well seal or pump discharge head if the well seal or discharge head will facilitate the installation of the vent pipe.

(b) For wells with pitless units, a metal vent pipe shall be installed which terminates in a 24−mesh corrosion resistant screened "U" bend or mushroom cap at least 24 inches above the floor. The pitless unit vent area shall be equal to or greater than the area provided by a 2−inch diameter vent pipe for pitless units 10 inches in diameter or larger. Vent piping shall extend above or be incorporated into the top of the pitless unit or be welded watertight to the side of the pitless unit a minimum of 4 inches above the floor and may extend through a concrete pump base or collar where one is present.

Note: It is recommended that vent installations for pitless units be factory installed to prevent damage to the integrity of factory units and paint systems.

(c) If the well is flowing, the vent shall terminate above the artesian water level or a suitable automatic valve shall be provided.

(2) WATER LEVEL MEASUREMENTS. (a) Provisions shall be made for measurement of static and pumping water levels in the completed well by the use of an electric depth gauge, pressure transducer or an air line attached to the pump column and an altitude gauge.

(b) The installation shall be constructed to prevent entrance of foreign material.

(c) Air lines may not be installed through vent pipes unless justified when modifications are being made to existing installations, the minimum 2−inch diameter vent pipe area is maintained where applicable, and the specific approval of the department is obtained.

History: CR 09−073: cr. Register November 2010 No. 659, eff. 12−1−10.

NR 811.37 Pump discharge lines. Pump discharge lines shall meet the requirements of this section and as shown in Figure Nos. 8 and 9 in the Appendix.

(1) BURIED LINES. Adequate positive pressure shall be maintained on all buried piping. Pump suction and discharge lines which are to be buried shall be designed so that the line is under a continuous pressure head which is higher than the elevation of the ground surface under all operating conditions. Lines where a positive pressure head which is higher than the elevation of the ground surface cannot be maintained may be installed if the lines are encased for their entire length in watertight pipe conduit or a tunnel. Buried suction lines which, under all operating conditions, are not under a positive pressure head which is higher than the elevation of the ground surface are not permitted.

(2) ABOVE GRADE PIPING MATERIALS. Above grade pump discharge line piping materials shall meet the requirements of s. NR 811.28 (5) (b).

(3) LOCATION OF APPURTENANCES. Pump discharge piping containing appurtenances such as valves, sampling faucets, water meters, and other equipment shall be located above the ground surface.

(4) PUMP−TO−WASTE. All wells and high−lift pump stations shall be provided with a means to pump to waste. This shall be a plugged tee or blind flange or a shut−off valve followed by a hose connection installed on the pump discharge piping inside the pump station. For municipal and subdivision water systems, a valve and hydrant may be installed outside the pump station on the buried pump discharge piping.

Note: It is recommended that pump−to−waste fittings installed inside the pump station be installed as close as possible to the well or pump head in order to minimize the piping and appurtenances that water to be wasted will be pumped through.

(5) PUMP DISCHARGE PIPING APPURTENANCES. The following appurtenances shall be provided for pump discharge piping in addition to the means for pumping the well to waste required in sub. (4). Additional requirements for the installation of pump discharge piping and appurtenances for pitless unit installations are given in s. NR 811.35.

(a) *Air−vacuum relief valve.* For line−shaft vertical turbine pump discharge pipes, an air−vacuum relief valve shall be installed between the pump and the check valve. The discharge line from the relief valve shall face downward and terminate with a 24−mesh corrosion resistant screen, at least 24 inches above the floor. For well line−shaft vertical turbine pump discharge pipes that discharge directly to reservoirs, the air relief valve is not required but a vacuum relief valve and a check valve are required. The installation of an air−vacuum relief valve is not required for submersible pump installations where check valves are installed at the pump and above grade and there are no weep holes in the pump drop pipe unless entrained air in the well water or pressure surges are a concern and the installation of an air relief valve is necessary or required by the department.

(b) *Sampling faucet.* All pump discharge piping shall contain one or more sampling faucets meeting the following requirements:

1. A water sampling faucet shall be installed and located upstream of any chemical addition or water treatment equipment to allow for the collection of raw water. If possible, the faucet shall be located prior to any above grade check valve.

2. If chemical addition, water treatment, or water storage is installed, a second entry point sampling faucet shall be installed as far downstream of the chemical injection, water treatment, or water storage as practical. If necessary to obtain a water sample representing finished water quality, a water service lateral shall be brought back into the building and fitted with a sampling faucet after being connected to the finished water main outside the building.

3. All sampling faucets shall be installed to terminate a minimum of 12 inches above the floor, have a down−turned smooth end spout, be constructed of metal, have a minimum spout diameter of 0.25 inches, be installed directly on the piping conveying the water whenever possible, and be located in an area accessible for sampling.

(c) *Check valve or other type of automatically closing valve.* A check valve shall be provided except if prohibited at pitless unit installations under s. NR 811.35 (5). Where extreme surge pressures occur, slow opening valves, voltage ramped motors, or other means of surge protection shall be provided.

(d) *Meters.* All municipal well pump discharge pipes, all other−than−municipal well pump discharge pipes with pumps discharging at a rate greater than or equal to 70 gallons per minute or if chemical addition is practiced, all groundwater reservoir high−lift pumps if chemical addition is practiced, and all surface water low−lift and high−lift combined pump discharge pipes shall be provided with water meters to determine the quantity of water discharged.

Note: It is recommended that an hour meter be installed for any pump motor where the pump discharge piping will not be provided with a water meter.

(e) *Shut−off valve.* A shut−off valve shall be provided.

(f) *Pressure gauge.* A pressure gauge shall be provided.

(g) *Chemical injection tap.* A chemical injection tap allowing chemical injection, shall be provided and installed in accordance with s. NR 811.39 (2) (f).

History: CR 09−073: cr. Register November 2010 No. 659, eff. 12−1−10.

Subchapter VI — Chemical Addition

NR 811.38 General. This subchapter contains general requirements for the design and construction for chemical storage, handling, and addition facilities. Specific treatment design requirements are contained in subch. VII. Specific operating requirements are contained in subch. I of ch. NR 810. No chemicals may be applied to treat drinking water unless approved by the department. This requirement applies to first time application, temporary application, or when it is proposed to replace one chemical with another. The department shall be contacted prior to discontinuing the use of any chemical.

History: CR 09−073: cr. Register November 2010 No. 659, eff. 12−1−10.

NR 811.39 Feed equipment. (1) NUMBER OF FEEDERS. If chemical feed, such as chlorination, coagulation or other essential processes, is necessary to produce a water quality meeting the primary maximum contaminant levels, a minimum of 2 feeders shall be provided so that a standby unit or combination of units will be available to replace the largest unit during shut−downs. Spare parts shall be available for all feeders to replace parts which are subject to wear and damage.

(2) DESIGN AND CAPACITY. The design and capacity of chemical feed equipment shall meet all of the following requirements:

(a) *Separate chemical feed systems.* Separate chemical feed systems shall be provided in accordance with the following requirements:

1. A separate feed system shall be provided for each chemical.

2. Separate disinfection chemical feed systems shall be provided if pre− and post− water treatment disinfection application points are installed.

3. Each chemical feed pump or gas feeder shall take suction from its own dedicated chemical solution tank or gas cylinders. The department may approve multiple chemical feed pumps or gas feeders for the same process application point taking suction from the same chemical solution tank or gas cylinders in the following situations:

a. Where multiple water sources are discharging to the same location. In this case, a means shall be provided for determining the flow from each individual water source.

b. Where multiple pumps are pumping from the same water source and discharging to the same location through a combined header pipe. In this case, a means shall be provided for measuring total flow.

c. For the situations in subd. 3. a. and b., a single chemical feeder with a single feed point or multiple chemical feeders with multiple feed points may be used, provided the installation meets the other requirements of this subchapter.

Note: An example of subd. 3. a. would be multiple wells discharging to a single reservoir or water treatment plant. An example of subd. 3. b. would be multiple high−lift pumps taking suction from a single reservoir and discharging to a combined pump discharge pipe.

(b) *Acceptable chemical feed pumps.* Positive displacement diaphragm metering pumps, peristaltic chemical feed pumps or other pumps, as approved by the department, shall be used to feed liquid chemicals. Pumps shall be sized to match or exceed maximum head conditions found at the point of injection.

(c) *Chemical feeder settings.* Feeders shall be able to supply, at all times, the necessary amounts of chemical at an accurate rate, throughout the range of feed. All positive displacement diaphragm metering pumps shall be operated at a minimum speed setting of 12 strokes per minute. For positive displacement diaphragm metering pumps with an adjustable stroke length the pumps shall be operated at a minimum of 20 percent of the maximum stroke length. Peristaltic chemical feed pumps shall be operated at a minimum of 10 percent of the maximum feeder output for the given interior diameter of the feed tube installed. If these operating requirements cannot be met using stock chemical solution, dilution of the chemical shall be required.

(d) *Flow paced chemical feed.* Automatic proportioning of chemical feed to rate of water flow shall be provided when water flow rates will vary. Chemical feed pumps shall be proportionally flow paced by a signal from a water meter when discharge rates from a well or service pump will be variable over the pump cycle. When applicable, this includes variable output control devices as required by s. NR 811.34 (5).

(e) *Anti−siphon devices.* Chemical feed pumps shall be provided with anti−siphon devices meeting the following requirements:

1. All electronic positive displacement diaphragm metering pumps shall be provided with a spring−opposed diaphragm type anti−siphon device or a spring opposed diaphragm type anti−siphon and back pressure valve device installed in the discharge piping of the chemical feed pump. The anti−siphon and back pressure functions may be part of a common device or separate devices. Any back pressure valve shall be set to open at a pressure greater than the maximum pressure in the piping or facilities into which the chemical feed pump will discharge. When a back pressure valve is installed on the discharge piping of a chemical feed pump, it shall be preceded by a pressure relief valve and a pressure gauge or other department approved means to verify that the back pressure valve is operating satisfactory.

2. Digitally controlled diaphragm metering pumps shall be provided with a spring opposed diaphragm type anti−siphon and back pressure valve device installed in the discharge piping of the chemical feed pump in accordance with the requirements of subd. 1.

3. Peristaltic chemical feed pumps shall be provided with a back pressure valve device installed in the discharge piping of the chemical feed pump in accordance with the requirements of subd. 1.

4. The department may be contacted to request approval of an equivalent anti−siphon device or equivalent means of providing anti−siphon protection if the installation of the anti−siphon devices as required in subds. 1. to 3. is not practical given the properties of the chemical to be fed. Adequate justification shall be provided to the department for the request.

(f) *Location of chemical injection.* 1. Chemical solutions shall be prevented from being siphoned into the water supply. Anti siphon protection shall be provided by discharging chemicals at points of positive pressure and by providing anti−siphon devices in accordance with par. (e), or through a suitable air gap or other effective means approved by the department. A point of continuous positive pressure shall be assured on the system side of the last shut−off valve. If a second shut−off valve is provided downstream of the primary shut−off valve, the point of injection may be between the 2 shut−off valves.

2. All chemicals shall be fed downstream of the check valve. Strong acids and bases such as fluorosilicic acid and sodium hydroxide shall be fed downstream of both the check valve and the shut−off valve.

Note: It is recommended that all chemicals be fed downstream of both the check valve and the shutoff valve.

3. If chemical feeding is at a location without continuous positive pressure, one of the following installation requirements shall be met to prevent siphoning of chemical solutions:

a. A suitable air gap shall be provided which is at a higher elevation than the chemical solution tank.

b. A dual head feeder with a small break tank located higher than the chemical solution tank shall be provided.

c. A chemical feed pump discharging without any air gap or break box may be approved by the department on a case−by−case basis if the installation is provided with a spring opposed diaphragm type anti−siphon and back pressure valve device. The back pressure valve shall be installed as close as possible to the point of chemical addition. The spring opposed diaphragm type anti−siphon and back pressure valve device shall be installed in accordance with the requirements of par. (e) 1.

(g) *Makeup water lines.* The makeup water supply lines to chemical feed tanks shall be protected from contamination by chemical solutions either by equipping the supply line with backflow or backsiphonage prevention devices, or by providing an air gap between the supply line and the top of the solution tank.

(h) *Chemical resistance.* Materials and surfaces coming in contact with chemicals shall be resistant to the aggressiveness of the chemical solution.

(i) *Dry chemical feeders.* Dry chemical feeders shall meet the following requirements:

1. Measure chemicals volumetrically or gravimetrically.

2. Provide effective dissolving and mixing of the chemical in the solution pot and provide gravity feed from solution pots, if possible.

3. Completely enclose chemicals to prevent emission of dust to the operating room.

(j) *Direct sewer connections prohibited.* No direct connection shall be made between any sanitary or storm sewer and a drain or overflow from any feeder or solution chamber or tank.

(3) LOCATION. Chemical feed equipment shall meet the following requirements:

(a) Be located near points of application to minimize length of feed lines.

(b) Be readily accessible for servicing or repair and observation of operation.

(c) Be located and have protective containment curbs so that chemicals from equipment failure, spillage, or accidental drainage may not enter the water in conduits, treatment, or storage basins.

(d) Be located within a containment basin capable of receiving accidental spills, drainage, or overflows without an uncontrolled discharge outside of the containment basin. A common containment basin may be provided for each group of compatible chemicals. At minimum, the containment basin shall be sized to contain the volume of the largest tank that could fail. Chemical containment basins shall not be provided with floor drains. Trapped and vented floor drains discharging to sanitary sewers, holding tanks or the ground surface in accordance with s. NR 811.25 (1) (h) may be installed for chemical rooms outside of containment basins. Chemical feed pumps shall be located within the containment basin. Piping shall be designed to minimize or contain chemical spills in the event of pipe ruptures.

(e) Be located above grade, except if this requirement is waived by the department.

(f) Be located in accordance with s. NR 811.48 (5) if gas chlorine feeders are used.

(g) Be located in accordance with s. NR 811.51 (2) if fluorosilicic acid is used.

(4) CONTROL. Chemical feeders shall be controlled in accordance with the following requirements:

(a) Feeders may be manually or automatically controlled if the water supply pumps are manually controlled. Where pumps are automatically controlled, the feeders shall be automatically controlled. In all cases, automatic control shall be capable of reverting to manual control when necessary.

(b) The operation of the chemical feed pumps shall be interlocked with the operation of the appropriate well or service pump. Any controlled electrical outlet used for any chemical feed pump shall be clearly marked.

(c) Secondary control of chemical feed equipment shall be provided for fluoride chemical feed equipment in accordance with s. NR 811.51 (4) or when required by the department.

(d) Feeders shall be designed and controlled to provide chemical feed rates proportional to flow and for variable flow rates shall be paced by a water meter.

(e) Automatic chemical feed rate control in combination with residual analyzers which have alarms for critical values and SCADA system reporting or recording charts may be used.

(5) SOLUTION TANKS. The requirements for solution tanks, in s. NR 811.40 on storage and handling apply.

(6) WEIGHING SCALES. Weighing scales shall meet the following requirements:

(a) Be provided for weighing cylinders at all plants utilizing chlorine gas.

Note: It is recommended that indicating and recording type scales be used.

(b) Be required for other solution feed unless comparable means for determining usage is approved by the department.

(c) Be required for volumetric dry chemical feeders.

(d) Be accurate enough to measure increments of 0.5% of load.

(7) FEED LINES. Feed lines shall meet the following requirements:

(a) Be as short as possible in length of run, of durable, corrosion resistant material, easily accessible throughout the entire length, protected against freezing, and readily cleanable.

(b) Slope upward from chemical source to feeder when conveying gases.

(c) Introduce corrosive chemicals in a manner to minimize potential for corrosion.

(d) Be designed consistent with scale−forming or solids−depositing properties of the water, chemical, solution, or mixture conveyed.

(e) Not carry chlorine gas under pressure beyond the chlorine feeder room.

(f) Include corporation stops and removable injection nozzles when application is into a pipe line of adequate diameter. Injection nozzles installed in a horizontal section of pipe shall be installed up into the bottom half of the pipe.

(g) Be color coded in accordance with s. NR 811.28 (6).

(8) SERVICE AND CARRIER WATER SUPPLY. Water used for dissolving dry chemicals, diluting liquid chemicals, operating chemical feeders or as carrier water to deliver chemicals to injection locations shall be from a safe, approved source with appropriate backflow prevention provided. The department may grant an exception in cases where the finished water quality will not be affected by addition of the chemical mixed with untreated water.

History: CR 09−073: cr. Register November 2010 No. 659, eff. 12−1−10.

NR 811.40 Storage and handling. Specific requirements regarding storage and handling are provided in the sections covering the particular chemical. Storage and handling installations shall meet the following general requirements:

(1) STORAGE FACILITIES. Storage facilities shall meet the following requirements:

(a) Space shall be provided for at least 30 days of chemical supply, convenient and efficient handling, dry storage conditions, and a minimum of 1.5 truck loads storage volume where purchase is by truck load.

(b) Covered or unopened shipping containers shall be provided for storage unless the chemical is transferred into an approved covered storage unit. Solution tanks shall have overlapping or threaded covers that provide sanitary protection for the

chemical being stored. Large tanks shall be covered and those with top access openings shall have either threaded covers or the openings shall be curbed and fitted with overlapping covers. Grommets, pipe seals, or other sanitary means shall be provided to create a sanitary seal where tubes, hoses, and pipes pass through the walls or covers of chemical storage tanks.

(c) Solution storage or day tanks supplying chemical feeders directly shall have at a minimum sufficient capacity for one day of operation. If the chemical solution is prepared from a powder or slurry, 2 solution tanks shall be required if necessary to assure continuity of feed.

(d) Solution storage or day tanks supplying feeders directly shall have a maximum capacity such that daily chemical solution usage is a minimum of 5% of the tank capacity. The department may approve chemical container storage volumes that will allow daily chemical solution usage less than 5% of the tank capacity if supporting information is provided to the department and the chemical storage container is placed on a scale, or another department approved method is installed, to accurately determine daily chemical usage. Graduated lines shall not be used to determine daily chemical usage in cases where the daily use is less than 5% of the tank capacity. In any case, the maximum storage volume shall not exceed 45 days for sodium hypochlorite and 60 days for all other chemicals.

(e) Storage facilities shall be constructed of, or lined with, materials compatible with the chemical being handled.

(f) Mixing equipment shall be provided where necessary to assure a uniform chemical solution strength. Continuous mixing shall be provided to maintain slurries in suspension.

(g) Means shall be provided to accurately determine the amount of chemical applied either by measurement of the solution level in the tank or by weighing scales. Graduation lines shall be in increments of approximately 2% to 3% of tank capacity. A meter shall be provided on the water fill line to a fluoride saturator.

(h) For non−bulk tanks, suction lines shall extend into the tank through the tank cover. Chemical feed pumps shall be installed at a height above the maximum liquid level in the chemical storage tank. Flooded suctions, for bulk tanks and if necessary to prevent loss of prime, may be approved by the department on a case−by−case basis.

(i) Adequate means of draining tanks shall be provided, but there may be no direct connection between any drain piping and a sanitary sewer. Chemicals shall not be discharged directly to a storm sewer. Drain piping shall terminate at least 2 pipe diameters, but not less than 3 inches, above the overflow rim of a receiving sump, conduit or waste receptacle.

(j) Overflow pipes, if provided, shall be turned downward, be appropriately screened, have a free air break discharge and be located in a conspicuous location.

(k) If subsurface locations for solution or storage tanks are approved by the department, the tanks shall be free from sources of possible contamination and located to assure positive drainage for groundwater, accumulated water, chemical spills, and overflows.

(L) The design shall insure that incompatible chemicals are not stored or handled in common areas.

(m) All buried chemical solution lines and gas lines shall be installed within protective conduit piping. Each chemical solution line shall be placed in its own protective conduit piping.

Note: When the chemical feed equipment will not be installed near the point of chemical application it is recommended that chemical solution piping be installed within protective conduit from the chemical feed equipment to the point of chemical application.

(n) Gases from feeders, storage, and equipment exhausts shall be conveyed to the outside atmosphere above grade and remote from air intakes. Liquid storage tanks shall be vented to the outside but not through vents in common with day tanks.

(o) Permanent signs identifying the chemical for each fill tube shall be posted at chemical offloading areas. Permanent signs identifying the tank contents shall be posted adjacent to or on chemical storage tanks.

(p) Compliance with local, state, and federal safety codes, including department of safety and professional services and OSHA codes, for other applicable chemical safety and handling requirements is required.

(2) HANDLING FACILITIES. Handling facilities shall meet the following requirements:

(a) Equipment shall be provided for measuring quantities of chemicals used to prepare feed solutions.

(b) Piping for chemicals shall be compatible with the chemical being conveyed.

(c) The following equipment shall be provided for each installation where chemicals are handled:

1. Where the eyes or body of any person may be exposed to injurious corrosive materials, suitable facilities for quick drenching or flushing of the eyes and body shall be provided as required in s. SPS 332.15.

2. Rubber gloves, protective clothing, and safety goggles that form a tight seal with the face shall be provided for each operator who prepares chemical solutions.

3. A dust respirator of the prescribed type shall be provided for handling dry chemicals if required in the respective material safety data sheet or s. SPS 332.15.

(d) Provision shall be made for the transfer of dry chemicals from shipping containers to storage bins or hoppers in such a way as to minimize the quantity of dust generated. Control shall be provided by use of one of the following:

1. Vacuum pneumatic equipment or closed conveyor systems.

2. Facilities for emptying shipping containers in special containers.

3. Exhaust fans and dust filters which place the hoppers or bins under negative pressure.

(e) Carts, elevators, or other appropriate means shall be provided for lifting chemical containers to minimize lifting by operators.

(f) Electrical equipment shall be used which will prevent explosions, particularly when using sodium chlorite and activated carbon. Equipment shall comply with ch. SPS 316.

(g) Procedures for disposing of empty bags, drums, carboys, or barrels shall minimize exposure to dusts or chemicals.

(h) Acids shall be kept in closed, acid−resistant shipping containers, or storage units. Transfer from shipping containers to solution or day tanks shall be through acid resistant hose or pipe by means of a transfer pump.

(3) CHEMICALS. All chemicals used to treat or produce potable water shall meet the following requirements:

(a) Shipping containers shall be fully labeled to include chemical name, purity, applicable NSF/ANSI standard approval in conformance with par. (b), concentration and supplier name and address.

(b) Chemicals shall meet the requirements of s. NR 810.09 (1).

History: CR 09−073: cr. Register November 2010 No. 659, eff. 12−1−10; correction in (1) (p), (2) (c) 1., 3., (f) made under s. 13.92 (4) (b) 6., 7., Stats., Register December 2011 No. 672.

Subchapter VII — Treatment

NR 811.41 General treatment design. The design of treatment processes and devices shall depend on evaluation of the nature and quality of the particular water to be treated and the desired quality of the finished water. Treatment shall be provided by each supplier of water if necessary in order to ensure that the finished water supplied to consumers meets the primary maxi-

mum contaminant levels contained in ch. NR 809 and is not objectionable to an appreciable number of consumers. The requirements of specific treatment processes are provided in ss. NR 811.42 to 811.60.

History: CR 09–073: cr. Register November 2010 No. 659, eff. 12–1–10.

NR 811.42 Treatment of water from surface water sources. Treatment of water from surface water sources shall meet the following requirements:

(1) GENERAL REQUIREMENTS. All public water supply systems drawing water from lakes, rivers, streams, or other surface water sources shall, after the water is drawn, treat the water as provided in this chapter. In general and at a minimum, this treatment shall include coagulation, sedimentation, and filtration plus disinfection or membrane filtration plus disinfection. Filtration is required in all cases. Total plant removal and inactivation shall provide a minimum 99.9 percent (3–log) inactivation of *Cryptosporidium* and *Giardia Lamblia* plus 99.99 percent (4–log) inactivation of viruses.

(2) TREATMENT REQUIREMENTS. The following treatment requirements shall be met:

(a) Conventional plants consisting of coagulation, sedimentation, and filtration that meet the turbidity requirements in s. NR 810.29 (1) are granted the following removal credits: 99.7 percent (2.5–log) *Giardia Lamblia*, 99.9 percent (3.0–log) *Cryptosporidium* and 99 percent (2–log) virus. The remaining 68 percent (0.5–log) *Giardia Lamblia* inactivation and 99 percent (2.0–log) virus inactivation shall be provided by CT disinfection. For conventional plants, a minimum of one–half of the required CT shall be provided after filtration.

(b) Log removal credit for membrane filtration shall be site specific as approved by the department.

(c) Additional treatment may be required by the department as provided in s. NR 810.35.

(d) The department may approve any request for a deviation from required treatment methods based on data which shows that the requirements of this chapter are unnecessary in the specific case.

(3) REDUNDANCY. All critical treatment components shall be provided with redundancy.

(4) CT VALUES. CT values for the inactivation of *Giardia Lamblia*, *Cryptosporidium,* and viruses can be found in ss. NR 810.47 to 810.62.

(5) CHLORINE RESIDUAL REQUIREMENTS. The free chlorine concentration in the water entering the distribution system shall be at least 0.2 mg/l at the entry point to the distribution system and detectable throughout the distribution system or the total combined chlorine concentration shall be at least 1.0 mg/l at the entry point to the distribution system and detectable throughout the distribution system. Continuous chlorine residual monitoring of the water entering the distribution system shall be provided as required in ss. NR 809.74 (2) and 810.38 (2) (c).

History: CR 09–073: cr. Register November 2010 No. 659, eff. 12–1–10.

NR 811.43 Treatment of water from groundwater sources. Treatment of water from groundwater sources shall meet the following requirements:

(1) DISINFECTION CAPABILITY REQUIRED. All existing and new municipal water systems and all other–than–municipal water systems constructed or modified after December 1, 2010, shall be provided with equipment and the necessary appurtenances which can continuously disinfect the water. The department may require the installation of disinfection equipment at existing other–than–municipal water systems if necessary to ensure a safe water supply.

(2) DISINFECTANT RESIDUAL REQUIREMENTS. Disinfection of water drawn from groundwater sources is to supplement and not replace proper well location, construction, and source protection. When disinfection of water drawn from a groundwater source is required to maintain bacteriologically safe water, the residual maintained in the distribution system and the residual monitoring is the same as that required for surface water in s. NR 811.42 (5).

(3) DISINFECTION REQUIREMENTS FOR WELLS. Specific disinfection requirements for wells are provided in subch. II. Any additional disinfection requirements for wells will be developed by the department if necessary on a case by case basis.

(4) DISINFECTION OF GROUNDWATER EXPOSED TO THE ATMOSPHERE. Disinfection of water drawn from groundwater sources shall be required in facilities which expose the water to the atmosphere, such as open basins, open filters, air stripping towers, or gravity aerators.

(5) REQUIRED ACTIONS FOR WELLS WITH NON–COMPLYING WATER QUALITY. One of the following actions shall be taken after consulting with the department if untreated water drawn from a groundwater source exceeds one or more of the primary maximum contaminant levels in ch. NR 809 or a department health advisory:

(a) The well shall be removed from service and permanently abandoned.

(b) The well shall be removed from service and either reconstructed or provided with permanent treatment to provide complying water quality. Wells may temporarily continue in service without reconstruction or providing permanent treatment only as approved by the department. Department approval is required prior to reconstructing the well or providing water treatment. Under emergency conditions, the department may allow temporary use of a well from which bacteriologically contaminated groundwater is drawn if disinfection adequate to ensure safe water is provided. In such cases, disinfection measures meeting the requirements of sub. (3) shall be provided. A continuous boil water notice may be required by the department during all or part of this interim period if deemed necessary by the department to protect public health.

(6) GROUNDWATER UNDER THE DIRECT INFLUENCE OF SURFACE WATER. The department may allow the use of water drawn from a groundwater source that has been determined by the department to be under the direct influence of surface water provided that treatment facilities meeting the requirements of subch. II of ch. NR 810 are provided as approved by the department. The total plant removal and inactivation shall provide a minimum 3–log inactivation of *Cryptosporidium* and *Giardia Lamblia* plus 4–log inactivation of viruses. The disinfectant residual maintained in the distribution system and residual monitoring shall be the same as required for treatment of water drawn from a surface water source in s. NR 811.42 (5). The department may approve modified treatment requirements for other–than–municipal public water systems if surface water treatment is impractical and if sufficient treatment can be provided. The supplier of water shall contact the department to determine what modified treatment will be approved.

(7) REDUNDANCY. All critical treatment components shall be provided with redundancy.

(8) CT VALUES. CT values for the inactivation of *Giardia Lamblia*, *Cryptosporidium*, and viruses can be found in ss. NR 810.47 to 810.62.

History: CR 09–073: cr. Register November 2010 No. 659, eff. 12–1–10.

NR 811.44 Pilot testing. Pilot testing is required to establish effective treatment and operation requirements for new treatment methods, if revisions are proposed to existing treatment methods, if the water quality poses significant treatment issues, and if design parameters need to be determined for the first time or for the specific site conditions. The department may waive the pilot testing requirement if information on other locations where the proposed treatment methods using similar water quality are already in place and operating successfully is available or if other justification necessary to support the proposed treatment pro-

cesses is submitted to the department. Pilot testing shall address the following requirements:

(1) Plans, specifications, and an engineering report detailing the proposed pilot plant design, operation, sampling, lab analyses, and any waste disposal shall be submitted to the department and the written approval of the department shall be obtained prior to constructing or operating the pilot plant. At minimum, the pilot plant proposal shall address the following issues, where they apply:

(a) Pilot plant treatment design including all operating parameters.

(b) Length of pilot plant operation. The pilot plant shall operate long enough to establish the treatment effectiveness, media run lengths, wastewater volumes and characteristics, and any other necessary operating parameters. The pilot plant shall operate through a minimum of 2 treatment cycles or as determined by the department.

(c) Chemicals and chemical feed equipment to be used along with chemical addition rates.

(d) Waste disposal.

(e) Operator safety.

(f) Backflow or back−siphon protection for any water system facilities that the pilot plant may be connected to.

(g) Pilot plant security.

(2) A report summarizing the results of the pilot plant testing and making recommendations for any full scale water system improvements shall be submitted to the department for review and comment by the owner or the owner's representative prior to or along with the submittal of plans and specifications for any permanent installations.

History: CR 09−073: cr. Register November 2010 No. 659, eff. 12−1−10.

NR 811.45 Aeration. Aeration treatment devices described in this section may be used for oxidation, separation of gases, or for taste and odor control. Air stripping towers shall meet the requirements of s. NR 811.53 (2), which can be used for the removal or reduction of some volatile organic compounds. The following requirements shall be met:

(1) NATURAL DRAFT AERATION. The design for natural draft aeration shall provide that:

(a) Water is distributed uniformly over the top tray.

(b) Water is discharged through a series of 3 or more trays with separation of trays not less than 6 inches.

(c) Trays are loaded at a rate of one to 5 gallons per minute for each square foot of total tray area.

(d) Trays have slotted, heavy woven wire mesh with 0.5−inch openings or perforated bottoms.

(e) Perforations are $^{3}/_{16}$ to $^{1}/_{2}$ inches in diameter, spaced one to 3 inches on centers, when perforations are used.

(f) Construction is of durable material resistant to the aggressiveness of the water and dissolved gasses.

(g) Contamination from sources such as those listed is sub. (7) is minimized by providing down−turned, louvered or hooded, screened air inlet or outlet openings. Screens shall be constructed of 24−mesh corrosion resistant material.

(h) Exhaust air is discharged directly to the outside atmosphere and in a location that will be protective of public health.

(2) FORCED OR INDUCED DRAFT AERATION. The design for forced or induced draft aeration shall provide that:

(a) Water is distributed uniformly over the top tray.

(b) The blower and blower motor are weatherproof and are installed in a weather−tight, screened enclosure.

(c) There is an adequate countercurrent flow of air through the enclosed aeration column.

(d) Aerator trays are loaded at a rate of one to 5 gallons per minute for each square foot of total tray area.

(e) Water will discharge through a series of 5 or more trays with separation of trays not less than 6 inches or as approved by the department.

(f) Construction is of durable material resistant to the aggressiveness of the water and dissolved gasses.

(g) The aerator is insect−proof, watertight, and light−proof.

(h) The air intake is located above grade and the air introduced into the column is as free as possible from contamination sources such as those listed in sub. (7).

(i) The water outlet is adequately sealed to prevent unwanted loss of air.

(j) Interior and exterior sections of the aerator can be easily reached or removed for maintenance.

(k) Contamination from sources such as those listed in sub. (7) is minimized by providing down−turned, louvered or hooded, screened air inlet or outlet openings. Screens shall be constructed of 24−mesh corrosion resistant material.

(L) Exhaust air is discharged directly to the outside atmosphere and in a location that will be protective of public health.

(3) PRESSURE AERATION. Pressure aeration installations shall meet the following requirements:

(a) Pressure aeration may be used for oxidation purposes. Pressure aeration will not be approved for removal of dissolved gases.

(b) Filters following pressure aeration shall be provided with adequate exhaust devices for release of air.

(c) Pressure aeration devices shall be designed to cause a thorough mixing of compressed air with the water being treated.

(d) Pressure aeration devices shall provide screened and filtered air that is free of obnoxious fumes, dust, dirt, and other contaminants.

(e) Air compressors supplying pressure aerators shall be oil−less.

(4) OTHER METHODS OF AERATION. Other methods of aeration may be approved by the department only if a pilot plant study conducted in accordance with s. NR 811.44 demonstrates the method's effectiveness. Methods include spraying, diffused air, and mechanical aeration. The treatment processes shall be designed to meet the particular needs of the water to be treated.

(5) DISINFECTION. Aerated water other than from pressure aeration shall receive continuous disinfection treatment. A corporation stop shall be provided on the inlet piping to all non−pressure aerators to allow disinfection for emergency or maintenance purposes.

(6) PROTECTION FROM WIND. Aerators that discharge through the atmosphere shall be protected by being placed in a louvered enclosure designed to provide easy access to the interior.

(7) PROTECTION FROM CONTAMINATION. Aerators that are used for oxidation or removal of dissolved gases from waters that will be given no further treatment other than chlorination shall be protected from contamination from insects and birds, obnoxious fumes, all types of precipitation and condensation, and windborne debris or dust.

(8) BYPASS PIPING. Bypass piping and any associated valves or other appurtenances shall be installed to allow water to be bypassed around a non−pressure aerator unless the aerator is necessary to comply with primary maximum contaminant levels or the requirement is waived by the department because the water system has access to other water sources that can provide at least an average day supply of water.

(9) REDUNDANCY. Redundant aeration systems shall be provided for units installed to comply with primary maximum contaminant levels unless the requirement is waived by the department because the water system has access to other water sources that can provide at least an average day supply of water.

(10) WATER QUALITY. A metal smooth−end sampling faucet installed on the aerator outlet piping and test equipment shall be

provided to test for appropriate water quality parameters following aeration such as dissolved oxygen, pH, iron, manganese, radon gas, and carbon dioxide when required by the department to insure proper operation of the aeration equipment.

History: CR 09−073: cr. Register November 2010 No. 659, eff. 12−1−10.

NR 811.46 Arsenic removal. The following minimum requirements shall be met when the following treatment methods are employed for arsenic removal:

(1) PILOT TESTING. All process designs shall be based on information from a pilot study unless waived by the department based upon previous demonstration that the process design will effectively remove arsenic based upon the water quality to be treated. Documentation shall be submitted to the department to support any pilot test waiver.

(2) OXIDATION AND FILTRATION. Arsenic III shall be oxidized by chemical or physical processes or both to arsenic V and then filtered out.

(a) Adequate detention time shall be provided if necessary to complete the conversion to arsenic V before filtration.

(b) Ferric chloride or ferric sulfate shall be added to the water supply for water with less than a 20 to 1 ratio of iron to arsenic if necessary in order to provide adequate arsenic removal efficiency.

(3) ADSORPTIVE MEDIA. Metal oxide coated adsorptive media may be used as the sole means of removing arsenic or in cooperation with or as a polishing unit after oxidation and filtration of arsenic.

(a) The adsorptive media shall be NSF/ANSI Standard 61 approved in accordance with s. NR 810.09 (5).

(b) The pilot study and final design shall address the following issues:

1. Pre− and post−filtration adjustment of pH to enhance the arsenic removal rate and reduce water corrosivity.

2. Conversion of the arsenic III to arsenic V prior to filtration.

3. Oxidation and filtration of iron and manganese to prevent fouling of the media.

4. Concentrations of sulfate and dissolved solids in the source water and the need to remove or reduce the concentrations in order to maintain treatment efficiency and minimize media fouling.

(4) OTHER ACCEPTABLE TREATMENT METHODS. Coagulation and filtration, anion exchange, electrodialysis, membrane filtration, and lime softening are treatment methods that may also be used to remove arsenic. The pilot study and final design shall address the following issues, if applicable:

(a) Pre− and post−treatment adjustment of pH to enhance the arsenic removal rate, prevent scaling, or fouling of the treatment equipment, and reduce water corrosivity.

(b) Conversion of the arsenic III to arsenic V prior to removal.

(c) Oxidation and filtration of iron and manganese to prevent fouling of the treatment equipment.

(d) The use of ferric chloride, ferric sulfate, alum, or a polymer as coagulant aids.

(e) Concentrations of sulfate and dissolved solids in the source water and the need to remove or reduce the concentrations in order to maintain treatment efficiency and minimize treatment equipment fouling.

History: CR 09−073: cr. Register November 2010 No. 659, eff. 12−1−10.

NR 811.47 Clarification. Plants designed to reduce suspended solids concentrations prior to filtration shall:

(1) Provide a minimum of 2 units each for rapid mix, flocculation and sedimentation.

(2) Permit operation of the units either in series or parallel.

(3) Be constructed to permit units to be taken out of service without disrupting operation with drains or pumps sized to allow dewatering in a reasonable period of time.

(4) Provide multiple−stage treatment facilities if required by the department.

(5) Be started manually following shutdown.

(6) Minimize hydraulic head losses between units to allow future changes in processes without the need for repumping.

(7) Meet the following specific requirements:

(a) *Presedimentation.* Waters containing high turbidity or having unusual treatment requirements may require pretreatment, usually sedimentation or detention either with or without the addition of coagulation chemicals.

1. 'Basin design.' Presedimentation basins shall have the following:

a. Hopper bottoms or be equipped with continuous mechanical sludge removal apparatus, and provide arrangements for dewatering.

b. Cover or superstructure.

2. 'Inlet.' Incoming water shall be dispersed across the full width of the line of travel as quickly as possible. Short circuiting shall be prevented.

3. 'Bypass.' Provisions for bypassing presedimentation basins shall be included.

4. 'Detention time.' Three hours detention is the minimum period required for presedimentation. Greater detention may be required in individual cases of chemical pretreatment.

5. 'Raw water samples.' A means for collecting raw water samples prior to any chemical addition shall be provided.

(b) *Rapid mix.* Mixing shall mean the rapid dispersion of chemicals throughout the water to be treated, usually by violent agitation. For surface water plants using direct or conventional filtration, the use of a primary coagulant is required at all times.

1. 'Mixing.' The detention period shall not be more than thirty seconds with mixing equipment capable of imparting a minimum velocity gradient (G) of at least 750 feet per second per foot. The appropriate G value and detention time shall be determined through jar testing.

2. 'Equipment.' Basins shall be equipped with mechanical mixing devices unless other methods, such as baffling, or injection of chemicals at a point of high velocity, are approved by the department after determining that the other requirements of this chapter will be met. Variable speed drive equipment is recommended.

3. 'Location.' The rapid mix and flocculation basin shall be as close together as possible.

(c) *Flocculation — slow mixing.* Flocculation installations shall meet all of the following requirements:

1. 'Basin design.' Inlet and outlet design shall prevent short circuiting and destruction of floc. Series compartments shall be provided to minimize short−circuiting and to provide decreasing mixing energy with time. Basins shall be designed so that individual basins may be isolated without disrupting plant operation. A drain or pumps or both shall be provided to allow dewatering and sludge removal.

2. 'Detention.' Flow−through velocity may be not less than 0.5 nor greater than 1.5 feet per minute with a detention time for floc formation of at least 30 minutes. Tapered energy with diminishing velocity gradient shall be considered in the design of the flocculation basin.

3. 'Equipment.' Agitators shall be driven by variable speed drives or other means which vary the peripheral speed of paddles in the range of 0.5 to 3.0 feet per second and the tip speed of vertical shaft impellors in the range of 6 to 10 feet per second. Uniform mixing shall be provided to prevent settling in the flocculation basin.

4. 'Piping.' Flocculation and sedimentation basins shall be as close together as possible. The velocity of flocculated water through pipes or conduits to settling basins may not be less than

0.5 nor greater than 1.5 feet per second. Allowances shall be made to minimize turbulence at bends and changes in direction.

5. 'Other designs.' Baffling may be used to provide flocculation only after approval by the department. The design shall be such that the velocities and flows in this section shall be maintained.

6. 'Superstructure.' A superstructure shall be provided over the flocculation basins.

(d) *Sedimentation.* Sedimentation shall follow flocculation. The detention time for effective clarification is dependent upon factors related to basin design as well as the nature of the raw water, such as turbidity, color and colloidal matter, and taste and odor causing compounds.

1. 'Detention time.' Plants with conventional sedimentation shall provide a minimum of 4 hours of settling time. This may be reduced to 2 hours for lime−soda softening facilities treating only groundwater. Also, reduced sedimentation time may be approved when equivalent effective settling is demonstrated or when overflow rate is not more than 0.5 gallons per minute per square foot.

2. 'Inlet devices.' Inlets shall be designed to distribute the water equally and at uniform velocities. Open ports, submerged ports, and similar entrance arrangements are required. A baffle shall be constructed across the basin, close to the inlet end, and project several feet below the water surface to dissipate inlet velocities and provide uniform flows across the basin.

3. 'Outlet devices.' Outlet devices shall be designed to maintain velocities suitable for settling in the basin and to minimize short circuiting. The use of submerged orifices is recommended in order to provide volume above the orifices for storage when there are fluctuations in flow.

4. 'Weir overflow rate.' The rate of flow over the outlet weir may not exceed 20,000 gallons per day per foot of weir length. If submerged ports or orifices are used as an alternate for overflow weirs, they may not be lower than 3 feet below the flow line with flow rates equivalent to weir loadings. The entrance velocity through the submerged orifices shall not exceed 0.5 feet per second.

5. 'Drainage.' Basins shall be provided with a means for dewatering. Basin bottoms shall slope toward the drain not less than one foot in 12 feet where mechanical sludge collection is not provided.

6. 'Covers.' Covers or superstructures are required at all plants. Where covers are used, access hatches shall be provided as well as drop light connections so that observation of the floc can take place at the inlet, midpoint and outlet of the basin.

7. 'Velocity.' The velocity through settling basins may not exceed 0.5 feet per minute. The basins shall be designed to minimize short circuiting. Fixed or adjustable baffles shall be provided as necessary to achieve the maximum potential for clarification.

8. 'Overflow.' An overflow weir or pipe shall be installed, which will establish the maximum water level desired on top of the filters. It shall discharge by gravity with a downturned pipe elbow a minimum of one foot above a concrete splash pad and shall be covered with 4−mesh corrosion resistant screen at a location where the discharge is visible and where the water can be appropriately drained.

9. 'Safety.' Guard rails shall be installed around openings which may be hazardous to maintenance personnel. Permanent holders or handholds shall be provided on the inside walls of basins above the water level.

10. 'Sludge collection.' Mechanical sludge collection equipment may be provided.

11. 'Sludge removal.' Facilities for disposal of sludge are required by the department. Sludge removal design shall provide:

a. Sludge pipes not less than 3 inches in diameter and so arranged as to facilitate cleaning.

b. Entrance to sludge withdrawal piping to prevent clogging.

c. Valves located outside the tank for accessibility.

d. Provisions for the operator to observe and sample sludge being withdrawn from the unit.

12. 'Sludge disposal.' Sections NR 811.858 and 811.861 contain additional specific requirements for sludge disposal. Flushing lines or hydrants shall be provided to backflush sludge lines and basins or for other purposes. Protection shall be provided for all potable water lines used if potable water could become contaminated by nonpotable water.

(e) *Solids contact unit.* Units designed for combined softening and clarification, if water characteristics, especially temperature, do not fluctuate rapidly and flow rates are uniform and operation is continuous, may be used if specifically approved by the department. Units shall be designed for the maximum uniform rate and be adjustable to changes in flow, which are less than the design rate and for changes in water characteristics. A minimum of 2 units are required unless the department waives this requirement. For plants with multiple units, the rated capacity of the plant shall be available with one unit out of service.

1. 'Installation of equipment.' Supervision by a representative of the manufacturer shall be provided whenever mechanical equipment is installed and at the time of initial operation.

2. 'Operating equipment.' A complete outfit of tools and accessories shall be provided. Laboratory equipment to control the treatment process shall be provided at all waterworks. In addition, sampling taps with adequate piping located to permit the collection of samples of water from critical portions of the units shall be provided.

3. 'Chemical feed.' Chemicals shall be applied at points and by means as to ensure satisfactory mixing of the chemicals with the water.

4. 'Mixing.' Mixing devices employed shall be constructed to provide adequate mixing of the raw water with previously formed sludge particles and to prevent deposition of solids in the mixing zone. A rapid mix device or chamber ahead of the solids contact unit may be required by the department.

5. 'Flocculation.' Flocculation equipment shall be adjustable by speed, or pitch or both, provide for coagulation to occur in a separate chamber or baffled zone within the unit, and provide a flocculation and mixing period of not less than 30 minutes.

6. 'Sludge concentrators.' Sludge concentrators shall provide either internal or external concentrators in order to obtain a concentrated sludge with a minimum of wastewater.

7. 'Sludge removal.' Sludge removal design shall provide all of the following:

a. Sludge pipes not less than 3 inches in diameter, arranged to facilitate cleaning.

b. Entrance to sludge withdrawal piping to prevent clogging.

c. Valves located outside the tank for accessibility.

d. Facilities for an operator to observe or sample sludge being withdrawn from the unit.

8. 'Cross−connections.' Sludge blow−off outlets and drains shall terminate and discharge at places approved by the department. Cross−connection control shall be included for all potable water lines such as those used to backflush sludge lines or flush basins if potable water could become contaminated by nonpotable water.

9. 'Detention period.' The detention time shall be established on the basis of the raw water characteristics and local conditions that affect the operation of the unit. Based on design flow rates, the minimum detention time shall be 2 to 4 hours for suspended solids contact clarifiers and softeners treating surface waters, and

one to 2 hours for the suspended solids contact softeners treating only groundwater.

10. 'Suspended slurry concentrate.' Softening units shall be designed so that continuous slurry concentrates of 1% or more, by weight, can be effectively maintained.

11. 'Water losses.' a. Units shall be provided with suitable controls for sludge withdrawal.

b. Total water loss may not exceed 5% for clarifiers or 3% for softening units.

c. Solids concentration of sludge discharged to waste shall be at least 3% by weight for clarifiers and 5% by weight for softeners.

12. 'Weir or orifices.' The units shall be equipped with either overflow weirs or orifices. Weirs shall be adjustable, at least equivalent in length to the perimeter of the tank, and constructed so that surface water does not travel over 10 feet horizontally to the collection trough.

13. 'Weir or orifice loading.' Weir loading may not exceed 20 gallons per minute per foot of weir length for units used for softeners, or 10 gallons per minute per foot of weir length for units used for clarifiers. Where orifices are used, the loading rate per foot shall be equivalent to weir loadings. Orifices or weirs shall produce uniform rising rates over the entire area of the tank.

14. 'Upflow rates.' Unless supporting data is submitted to the department and the department grants an exception, the following rates may not be exceeded:

a. 1.75 gallons per minute per square foot of area at the slurry separation line if units are used for softeners.

b. 1.0 gallon per minute per square foot of area at the sludge separation line if units are used for clarifiers.

(f) *Tube or plate settlers.* Proposals for settler unit clarification shall include pilot plant or a full scale demonstration or both satisfactory to the department prior to the preparation of final plans and specifications for approval. Settler units consisting of variously shaped tubes or plates which are installed in multiple layers and at an angle to the flow, may be used for sedimentation, following flocculation. Tube or plate settler installations shall meet the following:

1. 'Inlet and outlet considerations.' Design the inlets and outlets to maintain velocities suitable for settling in the basin and to minimize short−circuiting.

2. 'Drainage.' Drain piping from the settler units shall be sized to facilitate a quick flush of the settler units and to prevent flooding other portions of the plant.

3. 'Protection from freezing.' Units shall be located within a plant or within a covered basin.

4. 'Application rate for tubes.' A maximum application rate of 2 gallons per minute per square foot of cross−sectional area, unless higher rates are successfully shown through pilot plant or in−plant demonstration studies and are approved by the department.

5. 'Application rate for plates.' A maximum plate loading rate of 0.5 gallons per minute per square foot, based on 80 percent of the projected horizontal plate area.

6. 'Flushing lines.' Flushing lines shall be provided to facilitate maintenance and shall be properly protected against backflow or back siphonage.

7. 'Placement.' Modules shall be placed in zones of stable hydraulic conditions and in areas nearest effluent launders for basins not completely covered by the modules.

8. 'Inlets and outlets.' Inlets and outlets shall conform with par. (d) 2. and 3.

History: CR 09−073: cr. Register November 2010 No. 659, eff. 12−1−10.

NR 811.48 Chlorination. Chlorine installations shall meet the following requirements:

(1) CHLORINATION EQUIPMENT. (a) *Type.* The following types of chemical feed equipment may be used to feed chlorine:

1. Solution−feed−gas−type chlorinators.

2. Hypochlorite feeders of the positive displacement type.

3. Digitally controlled constant stroke length positive displacement type.

4. Peristaltic type.

5. Tablet chlorinator type.

(b) *Capacity.* The chlorinator capacity shall be such that a free chlorine residual of at least 2 mg/1 can be attained in the water after a contact time of at least 30 minutes when maximum flow rates coincide with anticipated maximum chlorine demands. Liquid chemical feed equipment shall be designed to operate in accordance with the requirements of s. NR 811.39 (2) (c). Solution−feed−gas−type chlorination chemical feed equipment shall be designed to operate between 30% and 70% of the rotameter capacity. This may require that 2 rotameters be provided, one for normal feed rates and one for emergency feed rates. For all chemical feed systems, the emergency feeder setting shall be designed to provide a minimum of 2 mg/l of chlorine.

(c) *Standby equipment.* Where chlorination is necessary for protection of the water supply, standby equipment of sufficient capacity shall be available to replace the largest unit during shutdowns. Spare parts shall be made available to replace parts subject to scaling, wear, and breakage.

(d) *Automatic proportioning.* Automatic proportioning chlorinators shall be required where the rate of flow of the water is not reasonably constant or where the rate of flow of the water is not manually controlled.

(2) POINT OF APPLICATION. Chlorine application points shall meet the following requirements:

(a) Chlorine shall be applied at a point which will provide the maximum contact time. Provisions shall be made to minimize short−circuiting.

(b) At plants treating surface water, piping provisions shall be made for applying chlorine to the raw water, settled or clarified water, filtered water, and the plant effluent.

(c) At plants treating groundwater, provision shall be made for applying chlorine to the raw water, the clearwell inlet, and the discharge piping as applicable.

(d) At plants treating groundwater where CT is required by the department, provision shall be made for applying chlorine to the raw water, at the inlet to all CT reservoir detention basins, and the high−lift pump discharge piping as required by the department.

(3) RESIDUAL TESTING EQUIPMENT. Chlorine residual testing equipment shall meet the following requirements:

(a) Chlorine residual testing methodology shall be as specified in s. NR 809.563 (2), Table R. The equipment shall enable measurement of residuals to the nearest 0.1 mg/1 in the range below 0.5 mg/1 and to the nearest 0.2 mg/1 between 0.5 mg/1 to 2.0 mg/1.

Note: It is recommended that all systems, at a minimum, use an instrument using the DPD colorimetric method with a digital readout and a self contained light source. Automatic chlorine residual pacers and recorders are recommended where the chlorine demand varies appreciably over a short period of time.

(b) Water systems that rely on chlorination for inactivation of bacteria or other microorganisms present in the source water shall have continuous chlorine residual analyzers and other equipment that automatically shut down the facility when the chlorine residuals required by the department are not met. The department may approve less than continuous monitoring for municipal water systems serving 3,300 or fewer people and other−than−municipal water systems on a case−by−case basis provided that replacement measures or practices are implemented to provide comparable public health protection.

(4) CHLORINATOR PIPING. The water supply piping shall be designed to prevent contamination of the treated water supply by

sources of impure or unknown quality. Pipes carrying elemental liquid or dry gaseous chlorine under pressure shall be Schedule 80 seamless steel tubing or other materials recommended by the Chlorine Institute. PVC pipe may not be used. Chlorine solution piping and fittings shall be rubber, PVC, polyethylene, or other materials recommended by the Chlorine Institute.

(5) HOUSING. Chlorine gas feed and storage installations shall meet the following requirements:

(a) Chlorine gas feed and storage installations shall be separated from other operating areas by gas−tight rooms or enclosures in order to prevent injury to personnel and damage to equipment.

(b) Chlorine gas rooms shall be provided with a safety glass inspection window installed in an interior wall or exterior door to permit viewing of the interior of the room and the equipment.

(c) Chlorine gas rooms shall be provided with a minimum of one door having emergency or panic hardware opening outward to the building exterior. Rooms may have additional doors to the building exterior.

(d) Chlorine gas rooms shall be heated to prevent freezing and insure proper operation of the equipment.

(e) Chlorine gas cylinders shall be provided with restraints to prevent movement of the cylinders.

(f) Full and empty cylinders of chlorine gas shall be:

1. Isolated from operating areas.

2. Restrained in position to prevent movement of the cylinders.

3. Stored in rooms separate from ammonia storage.

4. Stored in areas not in direct sunlight or exposed to excessive heat.

(g) Pressurized chlorine feed lines may not carry chlorine gas beyond the chlorine room. Vacuum chlorine feed lines may carry gas beyond the chlorine room if the chlorine lines are either schedule 40 polyethylene tubing or schedule 80 PVC pipe. Polyethylene tubing shall be enclosed in a protective conduit running from the chlorine room to a point near the ejector. The end of the conduit in the chlorine room shall be sealed. Polyethylene tubing connections shall be made using tube adaptors especially designed for this purpose. PVC pipe joints may be socket welded using PVC cement or threaded using polytetrafluoroethylene pipe joint tape.

(h) Premanufactured chlorine cabinets may be used for retrofit situations only. These cabinets shall have an observation window, fan, air intake, and light as required in par. (b) and sub. (6) for normal chlorine gas rooms.

Note: It is recommended that these cabinets not be placed on the sunny side of the building.

(6) VENTILATION OF CHLORINE GAS ROOMS. Ventilation of chlorine gas rooms shall meet the following requirements:

(a) One complete air change per minute shall be provided when the room is occupied.

(b) The exhaust fan suction shall be near the floor as far as practical from the door and air inlet, with the point of discharge located to avoid contamination of air inlets to other rooms and structures, and to avoid being blocked by snow or other obstructions.

(c) Air inlets shall be located near the ceiling and controlled to prevent adverse temperature variations.

(d) Louvers for the chlorine room air intake and exhaust shall be corrosion resistant and shall facilitate airtight closure.

(e) The exhaust fan switch shall be located outside the entrance to the chlorine room with a signal light indicating fan operation when the fan can be controlled from more than one point. Outside switches shall be protected from vandalism. As an alternative, the fan may be controlled by an automatic door switch with manual shut−off.

Note: It is recommended that switches for fans and lights be interlocked for simultaneous operation.

(f) Vent lines from feeders and storage shall discharge to the outside atmosphere, above grade, in a downward direction, be screened, and be located as required in par. (b). In addition, vent lines shall conform with the manufacturer's installation recommendations.

(7) SAFETY EQUIPMENT. The following safety equipment shall be provided when chlorine gas is used:

(a) Respiratory protection equipment, known as gas masks, meeting the requirements of the National Institute for Occupational Safety and Health (NIOSH) shall be available where chlorine gas is handled, and shall be stored at a convenient heated location, but not inside any room where chlorine is used or stored. The gas masks shall use compressed air, have at least a 30 minute capacity, and be compatible with or exactly the same as the gas masks used by the fire department responsible for the plant. The gas masks shall be available at all installations where chlorine gas is handled and shall be placed outside every room where chlorine gas is used or stored. At installations utilizing 100− or 150−pound cylinders, an agreement with the local fire department which has an approved type of gas mask for the fire department to handle water system chlorine gas leaks may be approved by the department. Instructions for using, testing and replacing gas mask parts shall be posted. Other protective clothing shall be provided as necessary.

(b) A bottle of concentrated ammonium hydroxide, 56 percent ammonia solution, shall be available for chlorine leak detection.

(c) If pressurized chlorine gas is present, continuous chlorine leak detection equipment shall be installed and equipped with both an audible alarm and a warning light. Automatic emergency chlorine cylinder shutdown valves shall also be provided.

(d) If ton cylinders are used, leak repair kits, approved by the Chlorine Institute, shall be available at the waterworks or a nearby fire department.

(8) AMMONIATION. Housing and ventilation for ammoniation shall meet the requirements in subs. (5) and (6) for chlorine. However, the fan inlet shall be near the ceiling and the fresh air inlet shall be near the floor. Ammonia storage and feed facilities shall be separate from chlorine facilities because of the combustion hazard. A plastic bottle of hydrochloric acid shall be available and used for leak detection.

(9) CALCIUM HYPOCHLORITE TABLET CHLORINATORS. Calcium hypochlorite tablet chlorinators shall meet the following design requirements:

(a) *Calcium hypochlorite solution formation.* The calcium hypochlorite solution shall be produced by dissolving tablets with a department approved feed water source using an erosion chamber or an upward directed spray system. The department may approve other methods or technology for producing calcium hypochlorite solution after the submittal of data from a department−approved pilot program.

(b) *Tablets.* The calcium hypochlorite tablets used in the chlorinator shall be supplied by the manufacturer of the tablet chlorinator equipment. The supplier of the calcium hypochlorite tablets shall have obtained NSF/ANSI Standard 60 certification for the tablets in accordance with s. NR 810.09.

(c) *Tablet hoppers.* 1. The tablet hopper shall be sized to provide a minimum of 2 days of supply assuming average day consumption of the tablets.

2. Load cells shall be provided on the hopper so that the weight of the tablets consumed in a 24−hour period can be determined. The design shall allow for collection of the data necessary to determine the theoretical daily chlorine usage. The design shall allow any solution to be drained out of the hopper before weighing the tablets. The load cell equipment shall be capable of providing an alarm when the weight of the tablets approaches a one day supply based upon an average day use. The alarm signal shall be automatically annunciated by the water system controls. A local alarm

shall be sounded or signaled by an exterior red light at the pump station if the operation of the pump station is not remotely controlled.

3. The tablet hopper shall include a screened air−vacuum relief device if the possibility of a vacuum condition could develop during the operation of the tablet chlorinator.

(d) *Solution tank.* 1. The open area for any pipe penetration through the walls of the solution tank shall be sealed sanitarily so that insects and foreign material cannot contaminate the chlorine solution.

2. The on and off operation of the process to produce chlorine solution from the tablets shall be controlled by float switches or sensors located in the solution tank.

3. Float switches or sensors shall be installed and wired to provide automatic shut−off and operator alarms for low and high solution level conditions. The shut−off and alarm signals shall be automatically annunciated by the water system controls. A local alarm shall be sounded or signaled by an exterior red light at the pump station if the operation of the pump station is not remotely controlled.

4. The tank shall be capable of being drained for maintenance purposes.

5. The solution tank shall be sized to keep an adequate supply of calcium hypochlorite in the tank at all times based upon the capabilities of the tablet chlorinator to produce solution and the chemical feed pump withdrawal rates necessary to achieve the required dosages.

(e) *Feed water piping requirements.* 1. The flow rate and pressure of the feed water piping shall be regulated so as to meet the design flow requirements provided by the supplier of the equipment. A shut−off valve, flow meter, and pressure gauge shall be installed on the feed water piping.

2. Pre−treatment devices shall be installed as necessary if the feed water does not meet the water quality requirements designated for the tablet chlorinator. Any pre−treatment device shall be compatible for use in a potable water system and shall not be used unless approved by the department. A strainer−filter shall be installed on the feed water piping, if necessary.

3. A check valve shall be installed on the feed water piping upstream of any treatment equipment, control valve, or solenoid valve.

4. A solenoid valve shall be installed on the feed water piping to control the flow of water into the tablet chlorinator. The operation of the solenoid valve shall be controlled based upon float switches or sensors located in the solution tank.

5. Erosion type tablet chlorinators shall be provided with a control valve capable of regulating the flow of water through the erosion cell. The submittal for review to the department for an erosion−type tablet chlorinator shall include the chlorine delivery rate versus flow rate curve for the specified model.

(f) *Chemical feed pumps.* 1. The chemical feed pump shall be wired to operate in association with the well or service pump as required by s. NR 811.39 (4).

2. A tablet chlorinator producing calcium hypochlorite solution shall use a chemical feed pump installed in compliance with s. NR 811.39 (2), or a centrifugal pump.

3. Centrifugal pumps shall be sized to match or exceed the maximum head condition at the point of injection.

4. Flow paced chemical feed pumps installed in compliance with s. NR 811.39 (2) or centrifugal pumps with variable speed motors shall be incorporated into the design if the flow rate of the water being treated may vary based upon automatic control of the well or service pump. The requirements of s. NR 811.39 (2) (d) shall be met.

(g) *Chemical injection location.* 1. Tablet chlorinator chemical feed pumps shall discharge at locations and in a manner that complies with the installation requirements of s. NR 811.39 (2) (f).

2. When a centrifugal pump will discharge at a point not under continuous positive pressure, the outlet piping between the centrifugal pump and the point of chemical injection shall be installed with a vertical pipe loop that will extend to a height that is a minimum of 12 inches above the top of the solution tank and the location of the chemical addition pipe connection with the water system piping. A vacuum relief valve shall be installed on the top of the pipe loop. As an alternative to the installation of a vertical pipe loop, an electrically operated shut−off valve on the outlet piping, wired to operate in series with the operation of the well or service pump motor and the chemical feed pump, may be installed.

(h) *Centrifugal pump discharge piping.* The outlet piping of a centrifugal pump shall also be provided with a check valve and a manually operated shut−off valve. These valves shall be installed upstream of any pipe loop or electrically operated shut−off valve as required by par. (g) 2.

(10) SODIUM CHLORITE FOR CHLORINE DIOXIDE GENERATION. Proposals for the storage and use of sodium chlorite shall be submitted to the department for approval. Department approval shall be obtained prior to the preparation of final plans and specifications. Provision shall be made for proper storage and handling of sodium chlorite to eliminate any danger of fire or explosion.

(a) *Storage.* 1. Sodium chlorite shall be stored by itself in a separate room and preferably shall be stored in an outside building detached from the water treatment facility. Sodium chlorite shall be stored away from organic materials with which it could react violently.

2. Storage structures shall be constructed of noncombustible materials.

3. If the storage structure is located in an area where a fire may occur, water shall be available to keep the sodium chlorite area cool enough to prevent heat induced explosive decomposition of the sodium chlorite.

(b) *Handling.* 1. Care shall be taken to prevent spillage of sodium chlorite.

2. An emergency plan of operation shall be available for the clean up of any spillage.

3. Storage drums containing sodium chlorite shall be thoroughly flushed and the waste shall be discharged to an acceptable location prior to recycling or disposal.

(c) *Feeders.* 1. Chemical feed pumps shall meet the requirements of s. NR 811.39 (2).

2. Tubing for conveying sodium chlorite or chlorine dioxide solutions shall be Type 1 PVC, polyethylene or materials recommended by the manufacturer.

3. Chemical feeders may be installed in chlorine gas rooms if sufficient space is provided or in separate rooms meeting the requirements of subs. (5) and (6).

4. Feed lines shall be installed in a manner to prevent formation of gas pockets and shall terminate at a point of positive pressure.

5. Check valves shall be provided to prevent the backflow of chlorine into the sodium chlorite line.

History: CR 09−073: cr. Register November 2010 No. 659, eff. 12−1−10.

NR 811.49 Filtration — gravity. The application of any type of gravity filter and media shall be supported by water quality data representing a period of use sufficient to characterize any variations in water quality. Experimental or pilot plant treatment studies may be required to demonstrate the applicability of the method or rate of filtration proposed. Pressure filters will not be approved for surface water applications. The following specific requirements shall be met:

(1) RAPID RATE GRAVITY FILTERS. (a) *Pretreatment.* Rapid rate gravity filters may only be utilized after coagulation, flocculation and sedimentation.

(b) *Number.* At least 2 filter units shall be provided. Provisions shall be made to meet the plant design capacity at the approved filtration rate with one filter out of service. If only 2 units are pro-

vided, each shall be capable of meeting the plant design capacity, normally the projected maximum daily demand.

(c) *Rate of filtration.* The permissible rate of filtration shall be determined after consideration of factors such as raw water quality, degree of pretreatment provided, filter media, water quality control parameters, competency of operating personnel and other factors required by the department. If effective coagulation, flocculation, sedimentation and filtration processes are to be utilized with relatively clean water sources, the following filtration rates may be approved:

Filtration Rate	Filter Media Type
2 gpm/ft^2	Single Media
3 gpm/ft^2	Dual Media
4 gpm/ft^2	Tri Media

In all cases, the filtration rate shall be proposed and justified by the design engineer and shall be approved by the department prior to the preparation of final plans and specifications. Higher rates than indicated in this paragraph may be approved with sufficient justification by the design engineer.

(d) *Structural details and hydraulics.* The filter structure shall be designed to provide:

1. Vertical walls within the filter.

2. No protrusion of the filter walls or other structures into the filter media or the area between the top of the media and the high water line during backwashing.

3. Cover by superstructure.

4. Head room to permit normal inspection and operation.

5. Minimum filter box depth of 8.5 feet.

6. Minimum water depth over the surface of the media of 3 feet.

7. Trapped effluent pipe to prevent backflow of air to the bottom of the filters.

8. Prevention of floor drainage to the filter with a minimum 4−inch curb around the filters.

9. Prevention of flooding by providing an overflow if this is not provided in a pretreatment unit.

10. Maximum velocity of treated water in the pipe and conduits to the filter of 2 feet per second.

11. Cleanouts and straight alignment for influent pipes or conduits where solids loading is heavy or following lime−soda softening.

12. Washwater drain capacity to carry maximum backwash flow.

13. Walkways around filters not less than 24 inches wide.

14. Safety handrails or walls around the filter areas adjacent to walkways.

15. Construction to prevent cross connections and common walls between potable and nonpotable water.

16. Washwater troughs.

(e) *Washwater troughs.* Washwater troughs shall be designed to provide:

1. A bottom elevation above the maximum level of expanded media during washing.

2. A 2−inch freeboard at the maximum rate of wash.

3. A top or edge which is all at the same elevation.

4. Spacing so that each trough serves the same number of square feet of filter area.

5. A maximum horizontal travel of suspended particles not exceeding 3 feet in reaching the trough.

(f) *Filter material.* The media shall be clean silica sand or other natural or synthetic media approved by the department and shall meet the following general requirements: a depth of not less than 24 inches; an effective size of the smallest material no greater than 0.45 mm to 0.55 mm, depending upon the quality of the raw water; a uniformity coefficient of the smallest material not greater than 1.65; a minimum of 12 inches of media with an effective size range no greater than 0.45 mm to 0.55 mm; and a specific gravity greater than other filtering materials within the filter. The following specific requirements shall be met:

1. 'Sand.' Sand shall have an effective size of 0.45 mm to 0.55 mm, a uniformity coefficient of not greater than 1.65, specific gravity greater than 2.5 and an acid solubility less than 5 percent.

2. 'Anthracite.' Filter anthracite shall consist of clean, hard, and durable anthracite coal particles of various sizes. Non−anthracite material may not be blended. Anthracite used as the only media shall have an effective size from 0.45 mm to 0.55 mm and a uniformity coefficient not greater than 1.65. Anthracite used to cap sand filters shall have an effective size from 0.8 mm to 1.2 mm and a uniformity coefficient not greater than 1.7. Effective size of anthracite for iron and manganese removal from potable groundwater shall be a maximum of 0.8 mm. Effective sizes greater than 0.8 mm may be approved by the department based upon onsite pilot plant studies. Anthracite shall have a specific gravity greater than 1.4 and an acid solubility less than 5%.

3. 'Granular activated carbon (GAC).' a. Granular activated carbon as a single media may be considered only after pilot or full scale testing and with prior approval of the department.

b. The media shall meet the basic specifications for filter media as provided in this paragraph except that larger size media may be allowed by the department where full scale tests have demonstrated that treatment goals can be met under all conditions.

c. There shall be provisions for a free chlorine residual and adequate contact time in the water following the filters and prior to distribution.

d. There shall be means for periodic treatment of filter material for control of bacterial and other growth.

e. Provisions shall be made for frequent replacement or regeneration of granular activated carbon if used for filtration.

4. 'High density sand.' High density sand shall consist of hard durable, and dense grain garnet, ilmenite, hematite, magnetite, or associated minerals of those ores that will resist degradation during handling and use and shall meet all of the following:

a. Contain at least 95% of the associated material with a specific gravity of 3.8 or higher.

b. Have an effective size of 0.2 to 0.3 mm.

c. Have a uniformity coefficient of not greater than 1.65.

d. Have an acid solubility less than 5%.

5. 'Other media.' Other media may be approved, but only on the basis of pilot tests and experience which demonstrate that the requirements of this chapter will be met.

6. 'Supporting media.' Torpedo sand and gravel shall be provided as supporting media except when proprietary filter bottoms are used. In that case, the department, on the basis of substantiating information provided by the owner, may allow elimination of certain layers of supporting media or a reduction in the depth of the layers. Otherwise, the following apply:

a. A 3−inch layer of torpedo sand shall be used as a supporting media for the filter sand. The torpedo sand shall have an effective size of 0.8 mm to 2.0 mm, and a uniformity coefficient not greater than 1.7.

b. Gravel, when used as the supporting media, shall consist of hard, rounded silica particles and may not include flat or elongated particles. The coarsest gravel shall be 2.5 inches in size when the gravel rests directly on the strainer system, and shall extend above the top of the perforated laterals or strainer nozzles. Not less than 4 layers of gravel shall be provided in accordance with the following size and depth distribution when used with per-

forated laterals or strainer nozzles. Reduction of gravel depths may be considered upon justification to the department when proprietary filter bottoms are specified.

Gravel Size	Gravel Depth
2 1/2 to 1 1/2 inches	5 to 8 inches
1 1/2 to 3/4 inches	3 to 5 inches
3/4 to 1/2 inches	3 to 5 inches
1/2 to 3/16 inches	2 to 3 inches
3/16 to 3/32 inches	2 to 3 inches

(g) *Filter bottoms and strainer systems.* Departures from these standards by using proprietary bottoms may be approved by the department on a case−by−case basis if the effectiveness of the method is demonstrated. Porous plate bottoms may not be used where iron or manganese may clog them or with waters softened by lime. The design of manifold type collection systems shall:

1. Minimize loss of head in the manifold and laterals.

2. Assure even distribution of washwater and even rate of filtration over the entire area of the filter.

3. Provide a ratio of the area of the final openings of the strainer systems to the area of the filter of about 0.003.

4. Provide a total cross−sectional area of the laterals about twice the total area of the final openings of the strainer system.

5. Provide a cross−sectional area of the manifold at 1.5 to 2 times the total cross−sectional area of the laterals.

6. Lateral perforations without strainers shall be directed upwards.

(h) *Surface wash.* Surface wash facilities consisting of either fixed nozzles or a revolving mechanism are required unless air scour equipment is provided. All surface wash devices shall be designed with:

1. Water pressures of at least 45 psi.

2. Volume of flow of 2.0 gallons per minute per square foot of filter area with fixed nozzles and 0.5 gallons per minute per square foot with revolving arms.

3. A vacuum breaker installed above the high water elevation in the filter or other approved device to prevent back siphonage.

(i) *Air scouring.* Air scouring may be provided in place of surface wash. The following requirements apply:

1. Air flow for air scouring the filter shall be 2 to 5 standard cubic feet per minute per square foot of filter area when the air is introduced in the underdrain. Air scour distribution systems placed above the underdrains shall use the lower end of the range.

2. A method for avoiding excessive loss of the filter media during backwashing shall be provided.

3. Air scouring shall be followed by a fluidization wash sufficient to restratify the media.

4. Air shall be free from contamination.

5. Air scour distribution systems shall normally be placed below the media and supporting bed interface; if placed at the interface the air scour nozzles shall be designed to prevent media from clogging the nozzles or entering the air distribution system.

6. Piping for the air distribution system may not be flexible hose which will collapse when not under air pressure and may not be a relatively soft material which may erode at the orifice opening with the passage of air at high velocity.

7. Air delivery piping may not pass down through the filter media nor may there be any arrangement in the filter design which would allow short circuiting between the applied unfiltered water and the filtered water except if all of the following criteria are met:

a. The vertical piping is double wall, welded at top and bottom, schedule 40 stainless steel for the internal pipe and schedule 5 stainless steel for the external pipe.

b. The annulus between the double−wall is pressurized on−site to 80 psi.

c. An air connection to the double−wall annulus shall be provided including piping with a pressure gauge, regulator, flow switch and ball valve along with an air reservoir and compressor.

d. The flow switch shall alarm and trigger filter shutdown if a pressure drop of over 10 psi is detected.

8. The backwash delivery system shall be capable of 15 gallons per minute per square foot of filter surface area; however, when air scour is provided, the backwash rate shall be variable and may not exceed 8 gallons per minute per square foot unless operating experience shows that a higher rate is necessary to remove scoured particles from filter surfaces.

9. The filter underdrains shall be designed to accommodate air scour piping when the piping is installed in the underdrain.

10. Backwash facilities shall meet the requirements of par. (k).

(j) *Appurtenances.* The following shall be provided for every filter:

1. Sampling faucets on the influent and effluent lines.

2. Indicating loss−of−head gauge with appropriate cross−connection protection.

3. Indicating flow rate controls. A modified rate controller which limits the rate of filtration to a maximum rate may be used. However, equipment that simply maintains a constant water level on the filters will not be approved unless the rate of flow onto the filter is properly controlled. A pump in each filter effluent line may be used as the limiting factor for the rate of filtration only with approval from the department.

4. For surface water and groundwater under the direct influence of surface water, provisions for filtering to waste with appropriate measures for backflow prevention.

5. For surface water and groundwater under the direct influence of surface water, on−line continuous turbidimeters shall be installed on the effluent from each filter. All turbidimeters shall consistently determine and indicate the turbidity of the water in nephelometric turbidity units (NTUs). Each turbidimeter shall report to a recorder that is designed and operated to allow the operator to accurately determine the turbidity at least every 15 minutes. Turbidimeters on individual filters shall be designed to accurately measure low−range turbidities and trigger an alarm when the effluent level exceeds 0.3 NTU. Access to the filter interior through wall sleeves shall be provided in several locations to allow the installation of sampling lines, pressure sensors and other devices, at different depths in the filter media.

6. A 1 to 1.5−inch pressure hose and rack at the operating floor for washing the filter walls.

(k) *Backwash.* Backwashing facilities shall be designed to provide:

1. A minimum rate of 15 gallons per minute per square foot, consistent with water temperatures and specific gravity of the filter media. The department may approve a reduced rate of 10 gallons per minute per square foot for full depth anthracite or granular activated carbon filters, if justification is provided. A reduced rate of backwashing is acceptable when air scouring is provided that meets the requirements of par. (i).

Note: A rate of 20 gallons per minute per square foot or a rate necessary to provide for a 50% expansion of the filter bed is recommended.

2. Backwashing by filtered water at the required rate from washwater tanks, a washwater pump from a reservoir or a high service main, or a combination of these.

3. Washwater pumps in duplicate unless an alternate means of obtaining washwater is available.

4. Backwashing of not less than 15 minutes wash of one filter at the design rate of wash.

5. A washwater regulator or valve on the washwater line to obtain the desired rate of filter wash with the washwater valves on the individual filters open wide.

6. A rate−of−flow indicator and totalizer on the main wash-water line, located for convenient reading by the operator during the washing process.

7. Backwashing by a method which prevents rapid changes in the backwash water flow.

8. Backwash shall be operator initiated. Backwash systems with automated sequencing shall be operator adjustable.

(L) *Miscellaneous*. Roof drains may not discharge into the filters and basins or the conduits preceding the filters.

(2) SLOW RATE GRAVITY FILTERS. The use of slow rate gravity filters is not allowed without prior engineering studies to demonstrate the adequacy and suitability of this method of filtration for the specific raw water supply. The following standards shall be applied:

(a) *Quality of raw water.* Slow rate gravity filtration shall be limited to waters having maximum turbidities of 50 nephelometric turbidity units (NTUs) and maximum color of 30 units; turbidity may not be attributable to colloidal clay. Raw water quality data shall include examinations for algae.

(b) *Structural details and hydraulics*. Slow rate gravity filters shall be designed to provide:

1. Not less than 2 filter units. If only 2 units are provided, each shall be capable of meeting the plant design capacity, normally the projected maximum daily demand, at the approved filtration rate. If more than 2 filter units are provided, the filters shall be capable of meeting the plant design capacity at the approved filtration rate with one filter removed from service.

2. A cover or superstructure.

3. Headroom to permit normal movement by operating personnel for scraping and sand removal operations.

4. Adequate manholes and access ports for handling of sand.

5. Filtration to waste and overflow at the maximum filter water level.

(c) *Rates of filtration.* The permissible rates of filtration shall be based on the quality of the raw water as determined from experimental data. Proposed rates shall be submitted to the department for approval. The design rate shall be 45 to 150 gallons per day per square foot of sand area. However, the department may approve design rates of 150 to 230 gallons per day per square foot if effectiveness is demonstrated to the satisfaction of the department.

(d) *Underdrains*. Each filter unit shall be equipped with a main drain and an adequate number of lateral underdrains to collect the filtered water. The underdrains shall be so spaced that the maximum velocity of the water flow in the lateral underdrain will not exceed 0.75 feet per second. The maximum spacing of the laterals may not exceed 3 feet if pipe laterals are used.

(e) *Filtering material.* A minimum depth of 30 inches of filter sand, clean and free of foreign matter, shall be placed on graded gravel layers. The effective size shall be between 0.30 and 0.45 mm, and the uniformity coefficient may not exceed 2.5.

(f) *Filter gravel.* The supporting gravel shall conform to the size and depth distribution requirements in sub. (1) provided for rapid rate gravity filters.

(g) *Depth of water on filter beds*. The design shall provide a depth of at least 3 feet of water over the sand. Influent water shall be distributed in a manner which will not scour the sand surfaces.

(h) *Control appurtenances*. Each filter shall be equipped with:

1. A loss−of−head gauge.

2. An orifice, Venturi meter or other suitable metering device installed on each filter to enable measurement of the rate of filtration.

3. An effluent pipe located at an elevation which will maintain the water level in the filter above the top of the sand.

History: CR 09−073: cr. Register November 2010 No. 659, eff. 12−1−10; renumbering of (1) (e) made under s. 13.92 (4) (b) 1., Stats., Register November 2010 No. 659.

NR 811.50 Filtration — membrane. Membrane technologies have a wide range of applications from the use of lower pressure membranes for removal of surface water contaminants such as *Giardia Lamblia* and *Cryptosporidium* to the use of reverse osmosis for desalination, inorganic compound removal, and radionuclide removal. The following specific requirements shall be met:

(1) TREATMENT OBJECTIVES. The selection of the specific membrane process shall be matched to the desired treatment objectives. The department shall be contacted to determine inactivation/removal credits for the specific membrane and treatment objective membranes to be used in treatment of surface water or groundwater under the direct influence of surface water.

(2) WATER QUALITY CONSIDERATIONS. A review of historical source raw water quality data, including turbidity or particle counts or both, seasonal changes, organic loading, microbial activity, and temperature differentials as well as other inorganic and physical parameters shall be conducted. The data shall be used to determine feasibility and cost of the system and the degree of pre−treatment. Design considerations and membrane selection at this phase shall also address the issue of target removal efficiencies and system recovery versus acceptable transmembrane pressure differentials. On surface water supplies, pre−screening or cartridge filtration may be required. The source water temperature shall be considered when establishing the design flux of the membrane under consideration and the number of treatment units to be installed. Seasonal variation of design flow rates may be based on documented lower demand during colder weather.

(3) PILOT TESTING. Prior to initiating the design of a membrane treatment facility, pilot testing shall be conducted. The pilot plant study shall be designed to identify the best membrane to use, need for pre− treatment, type of post− treatment, cold and warm water flux, backwash optimization, chemical cleaning optimization, fouling potential, operating and transmembrane pressure, integrity testing procedures, bypass ratio, amount of reject water, system recovery, process efficiency, particulate or organism removal efficiencies, and other design and monitoring considerations, each where applicable. The duration of the pilot testing shall be 9 to 12 months for microfiltration and ultrafiltration on surface water supplies and 2 to 7 months for reverse osmosis and nanofiltration on groundwaters. The general protocol and sampling schedule shall follow the US EPA Membrane Filtration Guidance Manual, EPA 815−R−06−009, November 2005.

(4) CHALLENGE TESTING. Membranes treating surface waters or groundwater under the direct influence of a surface water shall be challenge tested to establish a product specific maximum *Cryptosporidium* and *Giardia Lamblia* log removal credit. Challenge testing shall meet the requirements of s. NR 810.45 (2).

(5) PRETREATMENT. Pretreatment shall be as follows:

(a) *Microfiltration and ultrafiltration.* Pretreatment shall be designed to remove suspended solids and large particulate matter. The pretreatment may consist of a screen or strainer with a 200 to 500 micron rating. Chemicals used for pretreatment shall be certified for compliance with ANSI/NSF Standard 60.

(b) *Reverse osmosis and nanofiltration*. Pretreatment shall be provided where appropriate for turbidity reduction, iron or manganese removal, stabilization of the water to prevent scale formation, microbial control, chlorine removal for certain membrane types, and pH adjustment. At a minimum, cartridge filters shall

be provided for the protection of the reverse osmosis or nanofiltration membranes against particulate matter.

(6) MEMBRANE MATERIALS. Two types of membranes may be used for reverse osmosis and nanofiltration. These are cellulose acetate based and polyamide composites. Microfiltration and ultrafiltration membranes may be organic polymers such as: cellulose acetate, polysulfones, polyamides, polypropylene, polycarbonates or polyvinylidene. The physical configurations may include: hollow fiber, spiral wound or tubular. Membrane materials shall be compatible with any pre−oxidants.

(7) USEFUL LIFE OF MEMBRANES. The life expectancy of a particular membrane under consideration shall be evaluated during the pilot study or from other relevant available data.

(8) BACKWASHING. Automated periodic backwashing shall be provided for microfiltration and ultrafiltration on a timed basis or once a target transmembrane pressure differential or a high resistance have been reached. Back flushing volumes may range from 5% to 15% of the permeate flow depending upon the frequency of flushing or cleaning and the degree of fouling. The back flushing volumes shall be considered in the treatment system sizing and the capacity of the raw water source. For systems using pressurized air, the compressors shall utilize food grade oil and filters shall be provided to prevent oil from reaching the membranes. Chemically enhanced backwash systems shall be protected from cross connections and shall be followed by a regular backwash. Backwash wastes shall be disposed of in accordance with subch. XII.

(9) MEMBRANE CLEANING. A means shall be provided to allow for periodically cleaning the membrane. Cleaning shall include a soak type cleaning and may also include more frequent maintenance cleans. The cleaning process shall protect the raw and finished water from contamination. Cleaning chemicals, frequency and procedure should follow membrane manufacturer's guidelines. Some cleaning solutions require heated water. Cleaning chemicals shall be NSF/ANSI Standard 60 certified. Membrane cleaning shall be initiated by the operator. Waste streams from chemical cleaning shall be discharged to the sanitary sewer. Adequate space shall be provided for different or additional chemicals which may be required to adequately clean the membranes in the future.

(10) MEMBRANE INTEGRITY TESTING. A means shall be provided to conduct direct and indirect integrity testing to routinely evaluate membrane and housing integrity and overall filtration performance. Direct integrity testing may include pressure and vacuum decay tests for microfiltration and ultrafiltration and marker−based tests for nanofiltration and reverse osmosis. The direct testing method shall allow for conducting tests at least once per day and may be required 3 times per day. Indirect monitoring options may include particle counters or turbidity monitors or both and shall allow for testing continuously. The testing methodology shall be approved by the department during startup procedures.

(11) MONITORING. Equipment shall be provided to monitor water quality, flow rates, and water pressure.

(a) *Water quality.* Sampling taps shall be provided to allow monitoring of water quality from the source water, from the water after any pretreatment, from the filtrate of each membrane unit, from the combined filtrate of all membranes, from the backwash, and prior to the entry to any clearwell.

(b) *Flow monitoring*. Water meters shall be provided to allow flow measurement from the source water, from the filtrate of each unit, from the combined filtrate of all units, from the backwash source, from any recirculation line, and from any waste line.

(c) *Pressure monitoring*. Pressure gauges shall be provided prior to the membrane units, after each membrane unit, and on the combined effluent of all membrane units.

(d) *Additional monitoring*. Additional monitoring points shall be provided as necessary to satisfy integrity testing requirements and operational reporting requirements of sub. (10) and s. NR 810.07.

(12) CROSS CONNECTION CONTROL. Cross connection control considerations shall be incorporated into the system design, particularly with regard to chemical feeds and waste piping used for membrane cleaning, waste stream and concentrate. Protection may include block and bleed valves on the chemical cleaning lines and air gaps on the drain lines.

(13) REDUNDANCY OF CRITICAL COMPONENTS. Redundancy of critical control components including but not limited to pumps, valves, air supply, chemical feed equipment and computers shall be provided.

(14) POST TREATMENT. Post treatment of water treated using reverse osmosis or nanofiltration shall be provided. Post treatment may consist of degasification for carbon dioxide, if excessive, and hydrogen sulfide removal, if present, pH and hardness adjustment for corrosion control, and disinfection as a secondary pathogen control and for distribution system protection.

(15) BYPASS WATER. The design shall provide for a portion of the raw water to bypass the unit to maintain stable water within the distribution system and to improve process economics as long as the raw water does not contain unacceptable contaminants. Alternative filtration shall be provided for bypassed surface water or groundwater under the direct influence of surface water.

(16) REJECT WATER. Reject volumes shall be evaluated in terms of the source availability and from the waste treatment availabilities. The amount of reject water from a unit may be reduced to a limited extent by increasing the feed pressure to the unit. Waste disposal from reverse osmosis or nanofiltration reject water shall discharge to a municipal sewer system, to waste treatment facilities, or to an evaporation pond.

(17) TREATMENT EFFICIENCY. The design treatment efficiency shall be determined by pilot testing.

(18) POWER CONSUMPTION. The power consumption of a particular membrane under consideration shall be evaluated during the pilot study or from other relevant data.

(19) CONTROL SYSTEMS. (a) *Back−up systems*. Automated monitoring and control systems shall be provided with back−up power and operational control systems consisting of the following:

1. Dual running programmable logic controllers (PLCs) with synchronized programs and memory, or spare PLCs loaded with the most current program.
2. Spare input/output (I/O) cards of each type.
3. A minimum of 2 human machine interfaces (HMI).
4. Backup power supply including uninterruptible power supply (UPS).

(b) *Remote or unmanned operational control.* Systems designed for remote or unmanned control shall be provided alarms, communication systems, and automatic shutdown processes. The department shall be contacted to determine the extent of operational control required. At a minimum the following alarms shall be provided:

1. High raw or filtrate turbidity.
2. Pump failure.
3. High pressure decay test.
4. High transmembrane pressure.
5. PLC failure.
6. Membrane unit shutdown.
7. Clearwell level high or low.
8. Equipment failure.
9. High or low chlorine residual.
10. Low chemical level.
11. Power failure.
12. Building intrusion
13. Building low temperature.

History: CR 09−073: cr. Register November 2010 No. 659, eff. 12−1−10.

NR 811.51 Fluoridation. Sodium fluoride, sodium fluorosilicate and fluorosilicic acid shall conform to the applicable NSF/ANSI Standard 60 and AWWA standards B701, B702, and B703 in effect at the time of use. Other fluoride compounds which may be available shall be approved by the department. The following specific requirements shall be met:

(1) FLUORIDE CHEMICAL STORAGE. Fluoride chemicals shall be stored in accordance with the following requirements:

(a) Fluoride chemicals shall be isolated from other chemicals to prevent contamination.

(b) Fluoride chemicals shall be stored in covered or unopened shipping containers and stored inside a building.

(c) Unsealed storage units for fluorosilicic acid shall be vented to the atmosphere at a point outside the building. The vent piping shall terminate with a down−turned U−bend. The vent pipe opening shall be covered with a 24−mesh corrosion resistant screen.

(2) FLUORIDE ACID HOUSING. Equipment for feeding fluoride in the acid form and unsealed acid storage containers shall be housed in accordance with the following requirements:

(a) All chemical feed equipment, solution tanks, and acid containers shall be housed in a separate room within the pumphouse away from controls, electrical contacts and other equipment subject to damage.

(b) Unsealed acid storage units or solution tanks shall be vented to the outside in accordance with sub. (1).

(c) Ventilation shall be provided for the room.

(d) Entrance may be from inside the pumphouse but shall include a gasketed, sealed door to minimize the transfer of fumes outside the fluoride room.

(3) CHEMICAL FEED INSTALLATIONS. Chemical feed installations shall:

(a) Conform to the requirements of ss. NR 811.38 to 811.40.

(b) Provide scales, loss−of−weight recorders, liquid level indicators, or graduated feed drums for determining the amount of chemical applied. The method shall be accurate to within 5% of the average daily change in reading. A meter shall be provided on the water fill line to a fluoride saturator.

(c) Not allow fluoride addition before lime−soda softening or ion exchange softening.

(d) Provide feeders accurate to within 5% of any desired feed rate.

(e) Be such that the point of application of fluorosilicic acid, if into a horizontal pipe, shall be in the lower half of the pipe with the chemical injection nozzle projecting upward into the pipe as required by s. NR 811.39 (7) (f).

(f) Provide chemical feeder settings in accordance with s. NR 811.39 (2) (c).

(g) Provide adequate anti−siphon devices for all fluoride feed pumps or lines as required in s. NR 811.39 (2) (e).

(h) Provide soft water for fluoride saturator makeup water.

(4) SECONDARY CONTROLS. Secondary control systems for automatically controlled fluoride chemical feed devices shall be provided as a means of reducing the possibility for overfeed; these may include flow or pressure switches or other equivalent devices.

(5) DUST CONTROL. Dust control shall meet the following requirements:

(a) Provision shall be made for the transfer of dry fluoride compounds from shipping containers to storage bins or hoppers in such a way as to minimize the quantity of fluoride dust which may enter the room in which the equipment is installed. The enclosure shall be provided with an exhaust fan and dust filter which place the hopper under a negative pressure. Air exhausted from fluoride handling equipment shall discharge through a dust filter to the atmosphere outside of the building.

(b) Provision shall be made for disposing of empty bags, drums, or barrels in a manner which will minimize exposure to fluoride dust. A floor drain shall be provided to facilitate the hosing of floors.

(6) PROTECTIVE EQUIPMENT. Protective clothing, gloves, goggles or face shields and aspirator shall be provided.

(7) TESTING EQUIPMENT. Equipment shall be provided for measuring the quantity of fluoride in the water using the analytical methods as specified in s. NR 809.113 (1), Table A. When also feeding phosphates, the electrode method is required. The Alizarin Visual method may be approved only in special cases where the owner can allocate the extra time needed for testing.

(8) DILUTION EQUIPMENT. Where dilution of the chemical solution is necessary, a graduated container and transfer pump shall be provided.

History: CR 09−073: cr. Register November 2010 No. 659, eff. 12−1−10.

NR 811.52 Iron and manganese control. Iron and manganese control refers solely to treatment processes designed specifically for this purpose. The treatment process used will depend upon the character of the raw water. The selection of treatment processes shall meet specific local conditions as determined by engineering investigations, including chemical analyses of representative samples of water to be treated. The department may require the operation of a pilot plant in accordance with s. NR 811.44 in order to gather all information pertinent to the design. Consideration shall be given to adjusting the pH of the raw water to optimize the chemical reaction. The following requirements for specified treatment processes shall be met:

(1) REMOVAL BY OXIDATION–DETENTION–FILTRATION OR OXIDATION–FILTRATION. (a) *Oxidation.* Oxidation may be by aeration, as indicated in s. NR 811.45, or by chemical oxidation with chlorine, potassium permanganate, sodium permanganate, hydrous manganese oxides, ozone or chlorine dioxide.

(b) *Detention or reaction.* 1. A detention period of 0.5 to 3 hours, as determined by pilot studies, shall be provided following oxidation by aeration in order to insure that the oxidation reactions are as complete as possible. The detention period may be omitted or reduced where a pilot plant study indicates no need for detention or that a detention period less than 30 minutes will be adequate and department approval is obtained.

2. The detention basin shall be designed as a holding tank with sufficient baffling to prevent short circuits. Sludge collection equipment is not required. The floor shall be sloped to facilitate cleaning. Detention basins shall meet all potable water reservoir standards as required by subch. IX.

(c) *Sedimentation.* Sedimentation basins shall be provided when treating water with high iron or manganese content or both and a significant volume of oxidized material will be created or where chemical coagulation is used to reduce the load on the filters. Provisions for sludge removal shall be made. Sedimentation basins shall meet all potable water reservoir standards as required by subch. IX.

(d) *Rapid rate pressure filters.* Use of rapid rate pressure filters as well as gravity filters may be considered for iron and manganese removal. Use, however, is subject to the following conditions:

1. Minimum criteria relative to number, rate of filtration, structural details and hydraulics, filter media, etc., provided for rapid rate gravity filters in s. NR 811.49 also apply to pressure filters, where appropriate.

2. Generally, the design filtration rate shall be 3 gallons per minute per square foot of filter area. Higher or lower rates may be justified based on in−plant or pilot plant studies.

3. Filter design shall provide for:

a. Loss of head gauges with a suitable range in head on the inlet and outlet pipes of each filter.

b. An easily readable meter or flow indicator on each battery of filters.

Note: A flow indicator is recommended for each filtering unit.

c. Piping and shut−off valves so that each filter can be operated and backwashed individually.

d. Minimum side wall shell height of 5 feet. A corresponding reduction in side wall height may be approved where proprietary bottoms permit reduction of the gravel depth.

e. Wastewater collection a minimum of 18 inches above the surface of the media.

f. An underdrain system to efficiently collect the filtered water and distribute the backwash water.

g. Backwash and air relief valve discharge piping terminating with a free air break a minimum of 24 inches above the floor or wastewater collection pipe or sump.

h. Inlet and outlet sampling faucets for each filter.

(2) REMOVAL BY LIME PROCESSES. The removal of iron and manganese by lime processes shall meet the requirements in s. NR 811.57.

(3) REMOVAL BY MANGANESE GREENSAND TYPE FILTRATION. The removal of iron and manganese by greensand type filtration consisting of a continuous feed of potassium or sodium permanganate to the influent of a manganese greensand filter, is more applicable to the removal of iron plus manganese than to the removal of iron only because of economic considerations. As an alternate method, application of the potassium permanganate to the greensand on a "batch" basis may be installed when the department determines "batch" application is as effective as continuous feed. The following requirements apply:

(a) The permanganate shall be applied as far ahead of the filter as practical.

(b) Other oxidizing agents or processes, such as chlorination or aeration, may be used prior to the permanganate feed to reduce the cost of the chemical.

(c) The normal filtration rate shall be 3 gallons per minute per square foot.

(d) The normal backwash rate shall be 8 to 10 gallons per minute per square foot for manganese greensand media and 15 to 20 gallons per minute per square foot for manganese coated media.

(e) Air washing may be provided.

(f) Sampling faucets shall be provided prior to application of permanganate, immediately ahead of filtration and at the filter outlet.

(4) REMOVAL BY ION EXCHANGE. The removal of iron and manganese by ion exchange may not be used unless pilot plant studies have demonstrated that satisfactory removal efficiencies can be continuously provided. There may be no oxidation of the iron or manganese prior to the process.

(5) TESTING EQUIPMENT. Testing equipment shall be provided for all plants. The equipment shall have the capacity to accurately measure the iron content to a minimum of 0.1 mg/l and the manganese content to a minimum of 0.05 mg/l.

History: CR 09−073: cr. Register November 2010 No. 659, eff. 12−1−10.

NR 811.53 Organics removal. (1) GENERAL REQUIREMENTS. Organic compounds may be removed by a variety of processes. All process designs shall be based on information from a pilot study conducted in accordance with s. NR 811.44 with the compounds to be removed unless the pilot study is waived by the department. Unless the department approves other requirements, the processes shall be designed to remove a minimum of 99% of the contaminant in question.

(2) PACKED TOWER AERATION. Packed tower aeration units shall meet the following requirements:

(a) *General.* Packed tower aeration, which is also known as air stripping, may be used for the removal of volatile organic chemicals, trihalomethanes, carbon dioxide, and radon.

(b) *Process design.* The process design shall include determination of the Henry's Constant for each contaminant, the mass transfer coefficient, air pressure drop, and stripping factor. Justification shall be provided for the selected design parameters including the height and other dimensions of the unit, air to water ratio, packing specifications, packing depth, and surface loading rate.

1. Pilot testing considerations:

a. The pilot study shall evaluate a variety of loading rates and air to water ratios at the peak contaminant concentration. Special consideration shall be given to removal efficiencies when multiple contaminants occur.

b. If there is adequate past performance data on the contaminant to be treated, including at the peak contaminant concentration, the department may approve the process design based on the appropriate calculations without pilot testing.

2. The installation shall be designed to reduce contaminants to below the maximum contaminant level and to the lowest practical level.

3. The packing material shall be NSF/ANSI Standard 61 approved for use in potable water in accordance with s. NR 810.09 (5). The packing material shall be resistant to the aggressiveness of the water, dissolved gasses, any chemicals added to the water supply, and any cleaning materials.

4. The packing tower shall be constructed of materials compatible with potable water including stainless steel, reinforced concrete, aluminum, reinforced fiberglass, or plastic. The tower construction materials shall be resistant to the aggressiveness of the water, dissolved gasses, any chemicals added to the water supply, and any cleaning materials. Towers constructed of light weight materials shall be provided with adequate support to prevent damage from wind.

5. The ratio of the column diameter to the packing diameter shall be at least 7:1 for the pilot unit and at least 10:1 for the full scale tower. The type and size of the packing used in the full scale unit shall be the same as that used in the pilot unit.

6. The blower shall be adequately sized to provide sufficient air to achieve the desired removal rates. The minimum volumetric air to water ratio at the maximum water flow rate shall be 25:1. The maximum air to water ratio shall not exceed 80:1.

7. The design shall give consideration to potential fouling problems from calcium carbonate, iron and manganese precipitation, and from bacterial growth. Pretreatment shall be provided where necessary to prevent significant fouling. Disinfection capability shall be provided immediately before and after packed tower aeration.

8. The effects of temperature shall be considered in the process design as a drop in water temperature can result in a drop in contaminant removal efficiency.

(c) *Water flow system.* 1. Water shall be distributed uniformly at the top of the tower using spray nozzles or orifice−type distributor trays that prevent short circuiting. For multi−point injection, a minimum of one injection point for every 30 square inches of tower cross−sectional area shall be installed.

2. A mist eliminator shall be provided above the water distributor system.

3. A side wiper redistribution ring shall be provided at least every 10 feet in order to prevent water channeling along the tower wall and short circuiting.

4. Sample faucets shall be provided on the tower inlet and outlet piping.

5. An outlet sump, if provided, shall be accessible for cleaning purposes and be equipped with a drain valve. The drain shall not be directly connected to a storm or sanitary sewer.

6. A drain fitting shall be installed in the outlet piping to allow for the discharge of water and any chemicals used to clean the

tower. The drain shall not be directly connected to a storm or sanitary sewer.

7. The design shall prevent freezing of the inlet riser, tower, and the outlet piping when the unit is not operating.

8. All buried piping shall be maintained under a positive pressure greater than the elevation of the ground surface.

9. The water flow to each tower shall be metered.

10. Consideration shall be given to installing a butterfly valve in the inlet piping to control the water flow rate and to minimize air entrainment.

11. A means shall be provided to prevent flooding of the air blower.

12. The inlet piping shall be supported separately from the tower's main structural support.

(d) *Air flow system.* 1. The air inlet shall be installed in a protected location.

2. The air inlet to the blower and the tower discharge vent shall be screened and provided with a downturned, hooded or mushroom cap that protects the screen from the entrance of extraneous matter including insects and birds, obnoxious fumes, all types of precipitation and condensation, and windborne debris or dust. The screens shall be constructed of 24−mesh corrosion resistant material and installed at a location least susceptible to vandalism or damage. The air inlet shall also be provided with a dust filter.

Note: It is recommended that a 4−mesh corrosion resistant screen be installed in front of the 24−mesh screen on the air inlet system.

3. The blower shall be provided with a weather−proof motor, a tight housing, and an adequate foundation.

4. An air flow meter or department approved alternative method for determining the air flow shall be installed on the air inlet piping.

5. A positive air flow sensing device and a pressure gauge shall be installed on the air inlet line to the tower. If positive air flow is not detected, the device shall automatically shut down the water flow.

6. A backup motor for the blower shall be readily available where the tower is used to maintain primary drinking water standards.

(e) *Other requirements.* 1. The tower shall be provided with a sufficient number of access ports with a minimum diameter of 24 inches to facilitate inspection, media replacement, media cleaning, and maintenance of the interior.

2. A means shall be provided for cleaning the packing material should it become fouled.

3. Any clearwell or reservoir constructed to receive water from a tower shall be constructed to meet the potable water reservoir requirements of s. NR 811.64.

4. The tower shall be designed and constructed so that it can be extended without major reconstruction.

5. A means of bypassing the tower shall be provided unless the requirement is waived by the department because the water system has access to other water sources that can provide an average day supply of water at minimum.

6. Disinfection application points shall be provided on the tower inlet and outlet piping.

7. Any water passed through the tower shall be continuously disinfected and provided with a minimum of 30 minutes of post aeration contact time.

8. The water supply pump or pumps, blower motor, disinfection equipment, and the positive air flow sensing device shall be electrically interconnected to operate in series.

9. Adequate packing support shall be provided to allow the free flow of water and to prevent packing deformation.

10. Adequate auxiliary power shall be provided to operate the air blower and disinfection equipment during power failures unless the requirement is waived by the department because the water system has access to other water sources that can provide an average day supply of water at minimum or operation of the tower is not mandatory to meet primary drinking water standards.

11. The tower shall be provided with an adequate foundation and lateral support to prevent overturning due to wind loading.

12. The equipment shall be located within a secure building or within a locked security fence to prevent vandalism.

13. An access ladder with safety cage shall be provided to allow access and inspection of all areas of the tower.

14. Exhaust air shall be discharged directly to the outside atmosphere and in a location that will be protective of public health. Air emissions controls shall be provided if necessary to meet air quality standards.

15. Noise control equipment shall be provided where systems are located in residential areas.

(3) GRANULAR ACTIVATED CARBON FILTERS. Granular activated carbon filter installations shall meet the following requirements:

(a) The maximum filtration rate for pressure filters shall be 6 gallons per minute per square foot of filter area. The maximum filtration rate for gravity filters shall be 3 gallons per minute per square foot of filter area. Higher rates may be justified based on pilot studies for removal of the contaminant in question.

(b) The water from the carbon filter shall be continuously disinfected.

(c) The filter design shall provide for:

1. Loss of head gauges on the inlet and outlet pipes of each filter.

2. A meter or flow indicator.

3. Adequate freeboard for backwashing based on the specific gravity of the media.

4. An underdrain system to effectively collect the filtered water and distribute the backwash water.

5. Backwash and air relief valves having discharges that terminate in a free air break at least 24 inches above the floor.

6. Smooth end sampling faucets on the inlet and outlet pipes of each filter.

7. The ability to conveniently inspect, replace, or regenerate the media.

(d) The carbon used shall be virgin carbon.

(e) Information supporting selection of the carbon for removal of the contaminants in question shall be provided to the department.

(f) A plan for the disposal of the spent carbon shall be included in the specifications. Disposal of spent granular activated carbon shall comply with s. NR 811.859.

(g) An assessment of the impacts of radon and its decay products on operation, operator safety, and waste disposal shall be provided to the department.

History: CR 09−073: cr. Register November 2010 No. 659, eff. 12−1−10.

NR 811.54 Ozonation. Ozonation can be used for a variety of purposes including disinfection, oxidation, and microflocculation. When applied, all of these reactions may occur but typically only one is the primary purpose for its use. Ozonation can be used for the removal of color, taste and odors, organics, algae, cyanide, hydrogen sulfide, iron, manganese, and heavy metals. In addition to these treatment processes, ozone is an acceptable alternative to chlorine disinfectants. Given the sophisticated nature of the ozone process, consideration shall be given to the need for maintaining qualified operators to operate and maintain the equipment. The following requirements shall be met:

(1) GENERAL. The following general requirements shall be met:

(a) All process designs shall be based on bench or pilot scale studies of dosage requirements, application points, and detention times conducted in accordance with s. NR 811.44.

(b) When ozone is used as a disinfectant, ozonation and detention shall provide the required disinfection CT value. Additionally, application of a disinfectant which maintains a measurable residual in the distribution system shall be required.

(c) Where ozonation is approved by the department to be used for disinfection of a bacteriologically unsafe water supply, duplicate process streams shall be provided. This includes air supply, air preparation equipment, ozone generators, ozone contact chambers, ozone diffusers, power supply, and post disinfection equipment. This requirement may be waived by the department where other acceptable water sources having sufficient capacity are available.

(2) FEED GAS PREPARATION. Feed gas can be air, oxygen enriched air, or high purity oxygen. Sources of high purity oxygen include purchased liquid oxygen; on site generation using cryogenic air separation; or temperature, pressure or vacuum swing, adsorptive separation, technology. For high purity oxygen−feed systems, dryers typically are not required. Feed gas preparation shall meet the following requirements:

(a) *Air handling equipment.* Air handling equipment on conventional low pressure air−feed systems shall consist of an air compressor unless drawn by vacuum, water or air separator, refrigerant and desiccant dryers and particulate filters. For oxygen−feed systems, compressors, separators, and dryers may not be required by the department depending on the purity of the oxygen. In all cases the design shall ensure that the maximum dew point of −60°C (−76°F) will not be exceeded at any time.

(b) *Air compression.* 1. Air compressors shall be of the liquid−ring or rotary lobe, oil−less, positive displacement type for smaller systems or dry rotary screw compressors for larger systems.

2. The air compressors shall have the capacity to simultaneously provide for maximum ozone demand, provide the air flow required for purging the desiccant dryers, where required, and allow for standby capacity.

3. Air feed for the compressor shall be drawn from a point protected from rain, snow, condensation, mist, and fog to minimize moisture content of the air supply. The air feed shall be protected from contaminated air sources. Outside air intakes shall consist of a downturned pipe elbow installed at a location least susceptible to vandalism and covered with a 24−mesh corrosion resistant screen.

4. A compressed air after−cooler or entrainment separator or both with automatic drain shall be provided prior to the dryers to reduce the water vapor.

(c) *Air drying.* 1. Dry, dust−free, and oil−free feed gas shall be provided to the ozone generator. Sufficient drying to a maximum dew point of −60°C (−76°F) shall be provided at the end of the drying cycle.

2. Drying for high pressure systems shall be accomplished using desiccant dryers. For low pressure systems, a refrigeration air dryer in series with desiccant dryers shall be used.

3. A refrigeration dryer capable of reducing the inlet air temperature to 4°C (40°F) shall be provided for low pressure air preparation systems. The dryer may be of the compressed refrigerant type or chilled water type.

4. The desiccant dryers shall be of the external heated or heatless type.

5. For heat−reactivated desiccant dryers, the unit shall contain 2 desiccant filled towers complete with pressure relief valves, 2 4−way valves and a heater. In addition, external type dryers shall have a cooler unit and blowers. The size of the unit shall be such that the specified dew point will be achieved during a minimum absorption cycle time of 16 hours while operating at the maximum expected moisture loading conditions.

6. Each dryer shall be capable of venting dry gas to the atmosphere, prior to the ozone generator, to allow start−up when other dryers are on−line.

(d) *Air filters.* 1. Air filters shall be provided on the suction side of the air compressors, between the air compressors and the dryers and between the dryers and the ozone generators.

2. The filter before the compressor shall be of the coalescing type and be capable of removing all particles larger than 10 microns in diameter. The filter before the dryer shall be of the coalescing type and be capable of removing all particles larger than 5 microns in diameter. The filter after the dryer shall be of the particulate type and be capable of removing all particles larger than 0.5 microns in diameter or a size specified by the generator manufacturer.

(e) *Air preparation piping.* Piping in a compressed air preparation system shall be common grade steel, seamless copper, stainless steel, or galvanized steel. The piping shall be designed to withstand the maximum pressures in the air preparation system. PVC piping may be used in a vacuum air preparation system when located and supported to be protected from physical damage including from heat.

(3) OZONE GENERATORS. Ozone generators shall meet the following requirements:

(a) *Capacity.* The production rating of the ozone generators shall be provided in pounds per day and pounds per kilowatt−hour. The capacity of any ozone generators shall be determined by ozone demand tests including tests under critical conditions. Where ozone is approved for use by the department as a disinfectant, the generators shall be sized in conjunction with the detention basins to provide the required inactivation CT values for viruses, *Giardia lamblia*, and *Cryptosporidium* contained in ss. NR 810.59, 810.60, and 810.61.

1. The design shall ensure that the minimum concentration of ozone in the generator exit gas will be 1.0% by weight.

2. Generators shall be sized to have sufficient reserve capacity so that the system does not operate at peak capacity for extended periods of time. Low, medium, and high frequency systems which operate at lower peak voltages require less reserve capacity.

3. Generators with individual dielectrics shall have the capability of operating satisfactorily while individual dielectrics are out−of−service. This shall be accomplished through the use of individually fused dielectrics.

4. At least 2 generators, each with a capacity of supplying the normal ozone demand, shall be provided. If determined by the department to be not critical to maintaining production capacity, smaller installations employing ozone generators with multiple individually fused dielectrics may be able to employ a fewer number of generators each having excess ozone production capacity.

5. If there is to be a variation in the supply temperature of the generator cooling water throughout the year, then curves or other data shall be furnished to the department to show ozone production changes due to the varying temperature of the supplied cooling water. The design shall ensure that the generators can produce the required ozone at the maximum coolant temperature.

(b) *Electrical.* The generators may be low, medium, or high frequency type. The specifications shall require that the transformers and other electrical hardware be proven, high quality components designed for ozone service.

(c) *Cooling.* Adequate cooling shall be provided. Cooling water supplied to the ozone generators may not be corrosive or scale forming and shall be sufficiently free of microbiological and inorganic contaminants to prevent fouling of the water side of the tubes. If natural water quality does not meet this requirement, treatment shall be required. A closed loop cooling water system shall be used if proper cooling water conditions cannot be assured.

(d) *Materials.* To prevent corrosion, the ozone generator shell and tubes shall be constructed of type 304L or 316L stainless steel.

(4) OZONE CONTACTORS. The selection or design of the contactor and method of ozone application depends on the purpose for which the ozone is being used. Contactors can be of the diffused bubble, venturi, or aspirating turbine mixer type as approved by the department. Ozone contactors shall meet the following requirements:

(a) Where ozone is used as a disinfectant, a minimum of 2 contact chambers shall be provided with the chambers designed to prevent short−circuiting. Contactors shall be closed vessels.

(b) Contactors shall be separate vessels having no common walls with the remainder of the facility, unless common walls are approved by the department on a case−by−case basis. If common walls are used, the contactor shall be kept under negative pressure and sufficient ozone monitors shall be provided to protect worker safety. No normally inhabited structure may be constructed over an ozone contactor or reservoir containing ozone.

(c) Contact vessels shall be made of reinforced poured concrete. All reinforcement bars shall be covered with a minimum of 1.5 inches of concrete. Ozone resistant interior coatings shall be approved by the department in accordance with s. NR 810.09 (5). Smaller contact vessels may be made of stainless steel, fiberglass, or other material which will be stable in the presence of residual ozone and ozone in the gas phase above the water level.

(d) Contact chambers shall be of sufficient depth and size to allow for adequate contact time and freeboard for foaming where applicable. The depth of water in bubble diffuser contactors shall normally be a minimum of 18 feet unless a shallower depth can be justified to the department. A minimum freeboard of 3 feet shall be provided where foaming will be an issue.

(e) The contact time for disinfection shall be determined based on the required inactivation CT values for viruses, *Giardia lamblia,* and *Cryptosporidium* contained in ss. NR 810.59, 810.60, and 810.61. The minimum contact time shall be 10 minutes. A shorter contact time may be approved by the department if justified by appropriate design and CT considerations. Sufficient ozone capacity and contact chamber size shall be provided to achieve the desired CT value when injecting ozone into only one of the 2 contact chambers. The diffusion system shall normally work on a countercurrent basis such that the ozone shall enter through porous diffusers at the bottom of the vessel and water shall enter from the top of the vessel. Countercurrent flow shall be provided in all chambers of the vessels. Co−current diffusion systems shall only be approved by the department where adequate justification can be supplied.

(f) For ozone applications in which precipitates are formed, such as with iron and manganese removal, porous diffusers may not be used.

(g) Where taste and odor control is of concern, multiple application points and contactors shall be considered.

(h) A system shall be provided between the contactor and the off−gas destruct unit to remove foam from the air and return the froth to the contactor or other location acceptable to the department when foam will be an issue. A potable water spray system shall be placed in the contactor head space if foaming is expected to be excessive.

(i) All openings into the contactor for pipe connections, hatchways, etc., shall be properly sealed to prevent the escape of ozone using welds or ozone resistant gaskets such as Teflon or Hypalon.

(j) A pressure or vacuum relief valve shall be provided in the contactor as appropriate. Pressure or vacuum relief valve discharge piping shall be piped to a location where there will be no damage to the ozone destruction unit or an uncontrolled release of ozone.

(k) Sampling faucets and monitors shall be provided on the inlet and outlet of each contact chamber to monitor water quality and the ozone residual. If allowed by the department, a portable monitor or a comparable testing method may be used to analyze water collected from sample taps provided on the inlet and outlet of each contact chamber.

(L) A water meter shall be provided on the inlet to the contact chambers to measure water flow.

(m) If required by the department, contactors or reservoirs used as contactors shall be fitted with the improvements necessary to allow sampling of water from intermediate points for ozone residual.

(n) All contactors shall have provisions for cleaning, maintenance, and drainage. Each contactor compartment shall also be equipped with an access hatchway.

(5) OZONE DESTRUCTION. Ozone destruction shall meet the following requirements:

(a) A method or combination of methods for destroying or recirculating the final off gas from the ozone contactors shall be provided to meet safety and air quality standards. Acceptable methods include:

1. Thermal destruction.
2. Catalytic destruction.
3. Thermal and catalytic destruction.
4. Recycling to some point in the treatment system in addition to the installation of destruction equipment.

(b) A detectable ozone residual may not carry over into the distribution system.

(c) The maximum allowable air ozone concentration in the destruction unit discharge is 0.1 ppm by volume.

(d) At least 2 units shall be provided which are each capable of handling the entire gas flow unless the second unit is deemed unnecessary by the department.

(e) Exhaust blowers shall be provided in order to draw ozone off−gas from the contactors into the destruct unit.

(f) Catalysts shall be protected from foam, moisture and other impurities that may harm the catalyst.

(g) The catalyst and heating elements shall be located where they can be easily reached for maintenance.

Note: In order to reduce the risk of fires, the use of units that operate at lower temperatures is encouraged, especially where high purity oxygen is the feed gas.

(6) PIPING MATERIALS. Piping materials used in ozone service shall meet the following requirements:

(a) Only low carbon 304L and 316L stainless steel piping shall be used for ozone service. Alternative piping materials may be approved by the department on a case−by−case basis.

(b) Gasket materials shall be Teflon or Hypalon.

(c) Rubber components may not be used in contact with ozone.

(7) JOINTS AND CONNECTIONS. (a) Connections on stainless steel piping used for ozone service are to be welded where possible.

(b) Connections with meters, valves, or other equipment are to be made with flanged joints with ozone resistant gaskets, such as Teflon or Hypalon. Screwed fittings and field−cut threaded connections may not be used.

(c) A positive closing plug or butterfly valve and a leak−proof backflow prevention check valve system shall be provided in the piping between the generator and the contactor for pressurized ozone generation systems.

(8) INSTRUMENTATION. Instrumentation shall meet the following requirements:

(a) Pressure gauges shall be provided at the discharge from the air compressor, at the inlet to the refrigerator dryers, at the inlet and outlet of the desiccant dryers, at the inlet to the ozone generators and contactors, and at the inlet to the ozone destruction unit.

(b) Each generator shall have a trip which shuts down the generator when the wattage exceeds a preset level. It is recommended

that electric power meters be provided for measuring the electric power supplied to the ozone generators.

(c) Dew point monitors shall be provided for measuring the moisture of the feed gas from each desiccant dryer. Where there is potential for moisture entering the ozone generator from downstream of the unit or where moisture accumulation can occur in the generator during shutdown, post−generator dew point monitors shall be used.

(d) Air flow meters shall be provided for measuring the air flow from the desiccant dryers to each of the ozone generators, the air flow to each contactor, and the purge air flow to the desiccant dryers.

(e) Temperature gauges shall be provided for the inlet and outlet of the ozone cooling water and the inlet and outlet of the ozone generator feed gas, and, if applicable, for the inlet and outlet of the ozone power supply cooling water.

(f) Water flow meters shall be installed to monitor the flow of cooling water to the ozone generators and, if applicable, to the ozone power supply.

(g) At a minimum, ozone monitors shall be installed and maintained to measure ozone concentrations in both the feed−gas and the off−gas from the contactor and the off−gas from the destruct unit. Monitors or a comparable testing method shall also be provided for measuring ozone residuals in water in accordance with subs. (4) and (5) (b). The number and location of ozone residual monitors shall be such that the amount of time that the water is in contact with the ozone residual can be determined.

(h) Ambient air ozone monitors shall be installed in rooms where exposure to ozone is possible.

(9) ALARMS. The installation of alarm and shutdown systems shall meet the following requirements:

(a) A dew point alarm and shutdown shall shut down the generator in the event the system dew point exceeds −60°C (−76°F).

(b) An ozone generator cooling water flow alarm and shutdown shall shut down the generator in the event that cooling water flows decrease to the point that generator damage could occur.

(c) An ozone power supply cooling water flow alarm and shutdown shall shut down the power supply in the event that cooling water flow decreases to the point that power supply damage could occur.

(d) An ozone generator cooling water temperature alarm and shutdown shall shut down the generator if either the inlet or outlet cooling water exceeds the designated preset temperature.

(e) An ozone power supply cooling water temperature alarm and shutdown shall shut down the power supply if either the inlet or outlet cooling water exceeds the designated preset temperature.

(f) An ozone generator inlet feed−gas temperature alarm and shutdown shall shut down the generator if the feed−gas temperature exceeds the designated preset value.

(g) An ambient air ozone concentration alarm and shutdown shall sound when the ozone level in the building ambient air exceeds 0.1 ppm or a lower value chosen by the water supplier. Ozone generator shutdown shall automatically occur when the building ambient air ozone level exceeds 0.3 ppm or a lower value chosen by the water supplier.

(h) An ozone destruct temperature alarm shall sound when the temperature exceeds the designated preset value.

(i) Audible alarms and warning lights shall be installed and maintained to insure operators are alerted to improper operating or hazardous conditions.

(10) SAFETY. (a) The maximum allowable ozone concentration in the air to which workers may be exposed may not exceed 0.1 ppm by volume.

(b) Noise levels resulting from the operation of the ozonation system shall be controlled to within acceptable limits by special room construction and equipment isolation.

(c) High voltage and high frequency electrical equipment shall meet current electrical and fire codes.

(d) An exhaust fan shall be provided in the ozone generation and contactor rooms to remove ozone gas if a leak occurs and shall meet all of the following requirements:

1. One complete air change per minute shall be provided when the room is occupied.

2. The exhaust fan suction shall be located near the floor with the point of discharge located to avoid contamination of air inlets to other rooms and structures, to outside breathable air, or being blocked by snow or other obstructions.

3. Air inlets shall be located near the ceiling and controlled to prevent adverse temperature variations.

4. An exhaust fan switch shall be located outside of the entrance to the room with a signal light indicating fan operation when the fan can be controlled from more than one point.

(e) A portable purge air blower that will remove residual ozone in the contactor prior to entry for repair or maintenance shall be provided.

(f) A sign shall be posted indicating "No smoking, oxygen in use" at all entrances to the treatment plant. In addition, no flammable or combustible materials shall be stored within the oxygen generator areas.

History: CR 09−073: cr. Register November 2010 No. 659, eff. 12−1−10.

NR 811.55 Radionuclide removal. (1) RADIUM REMOVAL. Water treatment to remove radium shall meet the following requirements:

(a) *General.* Radium may be removed by using the water treatment processes of zeolite softening, lime−soda softening, reverse osmosis, hydrous manganese oxides, and adsorptive resins. Other processes may also be used to remove radium as approved by the department on a case−by−case basis. The process design shall address the fate of radium in the treatment process including waste disposal. Where applicable, disposal of treatment plant wastes containing radium shall normally be to a sanitary sewer or wastewater treatment plant.

Note: It is recommended that measures be taken to protect workers from gamma radiation exposure and radon gas inhalation where applicable.

(b) *Finished water quality.* Radium removal processes shall be designed to provide a finished water with a radium content as close to 0 picocuries per liter as practical while maintaining a finished water that is not corrosive. The department shall determine allowable plant outlet water quality, including radium concentrations, based on the raw water quality and the treatment process proposed. If corrosive water is produced during the radium removal process, a department approved method of corrosion control shall be provided.

(c) *Finished water sampling and reporting.* For the radium removal processes listed in par. (a), a minimum of 4 consecutive quarters of finished water sampling for radium shall be required after the plant becomes operational to demonstrate treatment effectiveness. For other proposed radium removal treatment methods, the required radium monitoring program shall be established by the department. The sampling shall be conducted under worst case conditions. Radium analyses shall be performed by a U.S. environmental protection agency approved laboratory. The laboratory shall forward a copy of the radiological analyses to the department in an electronic format. Water hardness monitoring equipment shall be provided to monitor for hardness breakthrough when softening is used for radium removal. Daily water hardness measurements shall be reported on the monthly operating report submitted to the department. Use of hardness monitoring to substitute for radium analyses shall only be allowed if demonstrated effective by simultaneous radium and hardness sampling conducted for one year.

(d) *Water softening*. Treatment for radium removal using standard water softening processes shall comply with the requirements of s. NR 811.57.

(e) *Hydrous manganese oxides*. Water treatment using hydrous manganese oxides for radium removal shall meet the following requirements:

1. Each installation shall be individually pilot tested on−site under a department approval unless the pilot testing requirement is waived by the department based upon documentation of successful similar treatment performance at wells with similar water quality.

2. Pre−mixed or on−site mixed hydrous manganese oxide chemicals shall conform to the applicable NSF/ANSI Standard 60 and AWWA standards as required by s. NR 810.09 (1) (c).

(f) *Adsorptive resins*. Water treatment using adsorptive resins for radium removal that will continuously accumulate radium on the resin shall meet the following requirements.

1. Each installation shall be individually pilot tested on−site under a department approval unless the pilot testing requirement is waived by the department based upon documentation of successful similar treatment performance at wells with similar water quality.

2. The radiation protection section of the department of health services shall be contacted to obtain a radioactive material license to operate pilot and full scale installations prior to constructing or operating the systems.

(g) *Other treatment*. Other radium removal treatment processes may be approved by the department on a case−by−case basis using information obtained from department approved on−site pilot studies conducted on the water to be treated.

(h) *Waste disposal*. Disposal of radium removal treatment plant waste shall comply with subch. XII.

(2) RADON GAS REMOVAL. Water treatment to remove radon gas shall meet the following requirements:

(a) Radon may be removed using aeration or pressurized granular activated carbon filters. The process design shall address the gamma radiation and disposal concerns associated with the use of granular activated carbon filters.

(b) The design of radon removal equipment shall be based on a department approved on−site pilot study conducted on the water to be treated. The department may approve manufactured radon removal equipment without pilot study on a case−by−case basis if adequate treatment effectiveness is demonstrated to the department.

(c) Aerators used for radon removal shall comply with ss. NR 811.45 and 811.53.

(d) Radon gas shall be vented to the atmosphere at an elevation and location to prevent elevated radon gas air concentrations in inhabitable areas.

(e) Granular activated carbon filters for radon removal shall comply with s. NR 811.53. Disposal of carbon filters used for radon removal shall comply with s. NR 811.859.

(f) A minimum of 4 consecutive quarters of finished water sampling for radon gas shall be required after the plant becomes operational to demonstrate treatment effectiveness. The sampling shall be conducted under worst case conditions. Radon gas analyses shall be performed by a U.S. environmental protection agency approved laboratory. The laboratory shall forward a copy of the radiological analyses to the department in an electronic format.

(3) URANIUM REMOVAL. Water treatment to remove uranium shall meet the following requirements:

(a) The designer of any proposed uranium removal equipment shall contact the department prior to the final design of the equipment to allow for department input on design requirements. The design shall be based on information obtained from department approved on−site pilot studies conducted on the water to be treated. The process design shall address the fate of uranium in the treatment process. Disposal of water treatment plant wastes containing uranium shall be in accordance with written department guidance. If applicable, disposal of treatment plant wastes containing uranium shall be to a sanitary sewer or wastewater treatment plant as approved by the department. The discharged water treatment plant wastes and spent media shall be analyzed for radionuclide content as required by the department. The disposal of spent media containing residual radionuclides shall be as approved by the department.

(b) A minimum of 4 consecutive quarters of finished water sampling for uranium shall be required after the plant becomes operational to demonstrate treatment effectiveness. The sampling shall be conducted under worst case conditions. Uranium analyses shall be performed by a U.S. environmental protection agency approved laboratory. The laboratory shall forward a copy of the radiological analyses to the department in an electronic format.

(c) Prior to constructing or operating the systems, the radiation protection section of the department of health services shall be contacted to obtain a radioactive material license to operate pilot and full scale installations when uranium will be concentrated on the resin or media to a level greater than 170 picocuries per gram at any time during use, including just prior to backwashing, regeneration, or disposal.

(d) Disposal of uranium removal treatment plant waste shall comply with subch. XII.

History: CR 09−073: cr. Register November 2010 No. 659, eff. 12−1−10.

NR 811.56 Sequestration. (1) SEQUESTRATION BY POLYPHOSPHATES. Sequestration by polyphosphates is suitable when concentrations of iron, manganese, or a combination of both, are 1.0 mg/1, or less. Polyphosphate treatment may be less effective for sequestering manganese than for iron. The following requirements shall be met:

(a) Where phosphate treatment is used, chlorine residuals shall be maintained in the distribution system. In addition:

(b) Polyphosphates may not be applied ahead of iron and manganese removal treatment. The point of application shall be prior to any aeration or oxidation and as far upstream as practical from the chlorine or other oxidant application.

(c) Chemical feed installations shall conform to the requirements of subch. VI.

(d) Chemicals for new or existing installations shall meet the applicable NSF/ANSI Standard 60 requirements of s. NR 810.09 (1) (c).

(e) Stock phosphate solution shall be kept covered and disinfected by carrying an approximate 10 mg/1 free chlorine residual unless the phosphate is not able to support bacterial growth, has a pH of 2 or less, and has not been diluted.

(f) The total phosphate applied may not exceed 10 mg/l as PO_4.

(g) If polyphosphate sequestration is practiced, appropriate orthophosphate testing equipment shall be provided.

(h) Possible adverse affects on corrosion shall be considered and addressed if necessary when phosphate addition is proposed for iron or manganese sequestering.

(2) SEQUESTRATION BY SODIUM SILICATES. Sodium silicate sequestration of iron and manganese is appropriate only for groundwater supplies prior to air contact. Sodium silicate addition is applicable to waters containing up to 2 mg/l of iron, manganese, or a combination of both. The following requirements shall be met:

(a) On−site pilot tests are required to determine the suitability of sodium silicate for the particular water and the minimum chemical feed rate needed.

(b) Chlorine residuals shall be maintained throughout the distribution system to prevent biological breakdown of the sequestered iron.

(c) Rapid oxidation of the metal ions such as by chlorine or chlorine dioxide shall accompany or closely precede the sodium

silicate addition. Injection of sodium silicate more than 15 seconds after oxidation may cause detectable loss of chemical efficiency. Dilution of feed solutions much below 5% silica as SiO_2 shall also be avoided for the same reason.

(d) The amount of silicate added shall be limited to 20 mg/l as SiO_2. The combined amount of added and naturally occurring silicate may not exceed 60 mg/l as SiO_2.

(e) Chemical feed installations shall conform to the requirements of subch. VI.

(f) Sodium silicate may not be applied ahead of iron or manganese removal treatment.

(g) Liquid sodium silicate shall meet the applicable NSF/ANSI Standard 60 requirements of s. NR 810.09 (1) (c).

History: CR 09–073: cr. Register November 2010 No. 659, eff. 12–1–10.

NR 811.57 Softening. The softening process selected shall be based upon the chemical qualities of the raw water, the desired finished water quality, the requirements for disposal of sludge or brine waste, the cost of plant and chemicals, and plant location. The applicability of the process chosen shall be demonstrated and discussed in detail in an engineering report. For very hard water, the sodium levels in cation exchange softened water shall be considered in selecting the treatment process. Following are requirements for specific processes:

(1) LIME–SODA PROCESS. The applicable design standards for lime–soda softening of groundwater are the same as those for conventional clarification–filtration surface water treatment plants, except that the minimum settling time may be reduced to 2 hours. Where softening is included in the surface water treatment process, the clarification criteria shall govern. In addition:

Note: See s. NR 811.47 for criteria pertaining to softening with solids contact units and s. NR 811.49 for filtration requirements.

(a) Mechanical sludge removal equipment shall be provided in the sedimentation basin.

(b) Determinations shall be made for the carbon dioxide content of the raw water.

Note: When concentrations exceed 10 mg/l, the economics of removal by aeration as opposed to removal with lime should be considered. See s. NR 811.45 for aeration requirements.

(c) Equipment for stabilization of water softened by the lime–soda process is required.

Note: See s. NR 811.58 for stabilization requirements.

(d) Provisions shall be included for proper disposal of softening sludges.

Note: See s. NR 811.858 for design requirements.

(e) The use of excess lime may not be substituted for chlorination or any other approved method of disinfection.

Note: See s. NR 811.48.

(2) ION EXCHANGE PROCESS. Iron, manganese or a combination of both in the oxidized state or unoxidized state may cause resin fouling in the ion exchange process. Pretreatment shall be required whenever the content of iron, manganese, or a combination of both is one milligram per liter or more. In specific instances, the department may also require pretreatment where lesser amounts exist. In addition:

(a) The units shall be of pressure or gravity type, of either an upflow or downflow design, using automatic or manual regeneration. Automatic regeneration is suggested for small plants. A manual override shall be provided for all automatic controls.

(b) The design capacity for hardness removal may not exceed 20,000 grains per cubic foot when resin is regenerated with 0.3 pounds of salt per kilograin of hardness removed.

(c) The depth of the exchange material may not be less than 3 feet.

(d) The rate of softening may not exceed 7 gallons per square foot per minute, and the backwash rate shall be 6 to 8 gallons per square foot per minute.

(e) The freeboard design shall be based upon the specific gravity of the media and the direction of water flow.

(f) The bottoms, strainer systems, and support for the exchange materials shall conform to criteria provided for rapid rate gravity filters in s. NR 811.49.

(g) Facilities shall be included for even distribution of the brine over the entire surface of both upflow or downflow units. Backwash, rinse, and air relief discharge pipes shall be installed in such a manner as to prevent back–siphonage.

(h) A bypass shall be provided around softening units to produce a blended water of desirable hardness. Meters shall be installed on the bypass line and on each softener unit. An automatic proportioning or regulating device and shut–off valve shall be provided on the bypass line. The department may require treatment of the bypassed water to obtain acceptable levels of iron or manganese in the finished water.

(i) Waters having 5 units or more of turbidity may not be applied directly to the cation exchange softener. Silica gel materials may not be used for waters having a pH above 8.4 or when iron is present. When the applied water contains a chlorine residual, the cation exchange material shall be a type that is not damaged by residual chlorine. Phenolic resin may not be used.

(j) Brine storage tanks shall conform to the following requirements:

1. The wet storage tank shall be designed to hold at least 1.5 times the volume of salt delivered to permit refill before the tank is completely empty. The volume of both salt and brine storage to be provided depends upon the size of the plant, the proximity and assuredness of the salt source, and the method of delivery.

2. It shall be isolated from possible sources of contamination.

3. It shall be properly covered and equipped with manholes having overlapping watertight covers to prevent entry of surface runoff.

4. Overflows and vents shall be designed in accordance with s. NR 811.64 (4) and (8), respectively.

5. The water for filling the tank shall be distributed over the entire surface of the tank by pipes at least 2 pipe diameters above the maximum liquid level in the tank or be protected from back–siphonage.

6. The underdrain collection system shall be covered with a screen or perforated plate to allow brine but not salt to pass through.

7. A sampling tap shall be provided on the brine discharge line in order that the concentration of brine can be determined. A suitable means for measuring the volume of brine used for regeneration shall be provided.

Note: It is recommended that the interior concrete surfaces of brine storage tanks be painted with a salt–resistant sealing compound or paint meeting NSF/ANSI Standard 61 requirements, to prevent deterioration.

(k) The requirements for brine wastes are found in s. NR 811.854.

(L) Smooth–end sampling taps shall be provided for control purposes. Taps shall be located on each raw water source, each treatment unit influent and each treatment unit effluent. Testing equipment shall be provided to adequately control the treatment process at all plants.

(m) Water from ion exchange treatment plants shall be stabilized as required in s. NR 811.58 (4), except where it can be shown that the treated water will be non–corrosive.

History: CR 09–073: cr. Register November 2010 No. 659, eff. 12–1–10.

NR 811.58 Stabilization. Water that is unstable to the extent of causing corrosion or deposition problems in the distribution system, whether a result of natural causes or water treatment processes, shall be stabilized. The following standards shall apply:

(1) CARBON DIOXIDE ADDITION. (a) Recarbonation chamber design shall provide:

1. A total detention time of 20 minutes or as approved by the department.

2. Two compartments, with a depth that will provide a diffuser submergence not less than 7.5 feet nor greater than recommended by the manufacturer and as follows:

a. A mixing compartment having a detention time of at least 3 minutes.

b. A reaction compartment.

(b) The design shall prevent carbon dioxide from entering the plant from the recarbonation and reaction chamber.

(c) Plants generating carbon dioxide from combustion shall have open top recarbonation tanks in order to dissipate carbon monoxide gas.

(d) Provisions shall be made for draining the recarbonation basin and removing sludge.

(e) Recarbonation tanks shall be located outside or sealed and vented to the outside.

(2) PHOSPHATES. Phosphates may be used for sequestering calcium in lime softened water, corrosion control and in conjunction with alkali feed following ion exchange softening. When used:

(a) Feed equipment shall conform to requirements in ss. NR 811.38 to 811.40.

(b) Phosphate chemicals shall meet the NSF/ANSI Standard 60 requirements.

(c) Stock phosphate solution shall be kept covered and disinfected by carrying an approximate 10 mg/1 chlorine residual. The department may exempt phosphate solutions having a pH of 2.0 or less from this requirement.

(d) Facilities shall be designed to maintain satisfactory chlorine residuals as indicated in s. NR 810.09 (2) and (3).

(e) The total phosphate applied may not exceed 10 mg/1 as PO_4.

(3) SPLIT TREATMENT. If approved by the department, a lime−soda water treatment plant may be designed using 'split treatment' in which raw water is blended with lime−treated water to partially stabilize the water. Treatment plants designed to utilize 'split treatment' shall contain facilities for further stabilization by other methods.

(4) ALKALI FEED. An alkali feeder shall be provided for all ion exchange water softening plants to provide stable water unless the effluent water is shown to be non−corrosive. Other waters may also be corrosive and require pH adjustment. The chemical shall be adequately mixed and the point of application located such that any deposition in the piping is minimized. The piping shall be accessible for cleaning or replacement. Equipment for monitoring pH shall be provided.

(5) CARBON DIOXIDE REDUCTION BY AERATION. The carbon dioxide content of an aggressive water may be reduced by aeration. Aeration devices shall conform to s. NR 811.45.

(6) OTHER TREATMENT. Other treatment for controlling corrosive waters by the use of sodium silicate and sodium bicarbonate may be used where necessary. Any proprietary compound shall receive the specific approval of the department before use. Chemical feeders shall comply with the requirements in subch. VI.

(7) CONTROL. Laboratory equipment shall be provided for determining the effectiveness of stabilization treatment.

History: CR 09−073: cr. Register November 2010 No. 659, eff. 12−1−10.

NR 811.59 Taste and odor control. Waterworks which are designed and constructed to provide taste and odor control shall comply with any requirements provided for the following applicable methods:

(1) CHLORINATION. Chlorination is effective for the removal of some objectionable odors. Adequate concentration and contact time shall be provided to complete the chemical reactions involved. Excessive potential trihalomethane or other disinfection by−product production through this process shall be investigated by bench−scale testing prior to design.

(2) CHLORINE DIOXIDE. Chlorine dioxide may be used in the treatment of any taste or odor which is treatable by an oxidizing compound. Provision shall be made for proper storage and handling of sodium chlorite to eliminate any danger of explosion.

(3) POWDERED ACTIVATED CARBON. (a) Powdered activated carbon may be added prior to coagulation to provide maximum contact time. Although facilities to allow the addition at several alternate points is recommended, in no case may carbon be added near the point of chlorine application.

(b) The carbon shall be added as a premixed slurry or by means of a dry−feed machine if the carbon is properly 'wetted'.

(c) Continuous agitation or resuspension equipment shall be provided to keep the carbon from depositing in the mixing chamber/slurry storage tank.

(d) Dust control shall be provided.

(e) The required dosage of carbon in a water treatment plant depends upon the tastes and odors involved. Provisions shall be made for adding sufficient amounts to meet peak demands.

(f) Powdered activated carbon shall be handled as a potentially combustible material. It shall be stored in a building or compartment as nearly fireproof as possible. Other chemicals may not be stored in the same compartment. A separate room shall be provided for carbon feed installations. Carbon feeder rooms shall be equipped with explosion−proof electrical outlets, lights, and motors.

(4) GRANULAR ACTIVATED CARBON. The requirements for granulated activated carbon are in s. NR 811.49.

(5) COPPER SULPHATE AND OTHER COPPER COMPOUNDS. Continuous or periodic treatment of water with copper compounds to kill algae or other growths shall be controlled to prevent a level in excess of 1.0 mg/l as copper in the plant effluent or distribution system. Provisions shall be made for uniform distribution of the chemical.

(6) AERATION. The requirements for aeration are in s. NR 811.45.

(7) POTASSIUM PERMANGANATE. The department may approve application of potassium permanganate if the treatment will be controlled to insure that no residual color will be present in the finished water.

(8) OZONE. Ozonation may be used as a means of taste and odor control. Adequate contact time shall be provided to complete the chemical reactions involved. Ozone is generally more desirable for treating water with high threshold odors. Requirements for ozonation are contained in s. NR 811.54.

(9) OTHER METHODS. Any other methods of taste and odor control may be allowed by the department only after laboratory or pilot plant tests or both.

(10) FLEXIBILITY. Plants treating water known to have taste and odor problems shall be provided with equipment and multiple chemical addition points to provide several alternative control processes.

Note: Refer to subch. VI, for requirements for the storage, handling and application of chemicals in treating surface waters.

History: CR 09−073: cr. Register November 2010 No. 659, eff. 12−1−10.

NR 811.60 Ultraviolet (UV) Light. Ultraviolet (UV) light technology is a primary disinfectant typically used for *Cryptosporidium* and *Giardia lamblia* inactivation of both surface water and groundwater supplies. The USEPA Ultraviolet Light Disinfection Guidance Manual (USEPA UVDGM) shall be used as the basis for the validation, design and operation of all UV systems. Water systems which are designed to provide ultraviolet light disinfection shall comply with the following:

(1) TREATMENT OBJECTIVES. The target pathogen and the target log inactivation shall be used to identify the corresponding required UV dose.

(2) WATER QUALITY CONSIDERATIONS AND PRETREATMENT. In order to provide adequate disinfection treatment, some water

sources may need treatment prior to ultraviolet light disinfection. UV disinfection of surface water sources shall follow filtration. Department approval for specific pretreatment requirements is required if any of the parameters in Table No. 3 are exceeded in the water to be treated by ultraviolet light.

Table No. 3	
Inlet Water Quality Parameters	
Parameter	Maximum or Range
UV 254 mm Absorption	0.155 cm^{-1}
Dissolved Iron	0.3 mg/l
Dissolved Manganese	0.05 mg/l
Hardness	120 mg/l
Hydrogen Sulfide	Non−detectable odor
Fouling Microorganisms	None
pH	6.5 to 9.5
Suspended Solids	10 mg/l
Turbidity	1.0 NTU
Total Coliform	1,000/100 ML

(3) VALIDATION. Ultraviolet light treatment devices shall be validated by a third party entity in accordance with the USEPA Ultraviolet Light Disinfection Guidance Manual (USEPA UVDGM) or another validation standard as approved by the department.

(4) MATERIALS. The ultraviolet light housing shall be type 304 or type 316L stainless steel.

(5) DESIGN. (a) The ultraviolet treatment device shall be designed to provide a UV light dose of a minimum of 40 millijoules per square centimeter (mJ/cm^2) and shall also deliver the target dose as prescribed by s. NR 810.62 by operating within the validated operating conditions for that particular unit.

(b) The ultraviolet treatment assemblies shall be designed to allow visual observation, cleaning, and replacement of the lamp, lamp sleeves, and sensor window or lens.

(c) All ultraviolet lamps shall be housed in quartz sleeves.

(d) Where in−situ cleaning of the lamp sleeves is proposed, the design shall protect the potable water from cleaning solutions.

1. When off−line chemical cleaning systems are used, the UV enclosure shall be removed from service, drained, flushed with an NSF/ANSI Standard 60 certified solution, drained, and rinsed before being placed back in service.

2. On−line systems that use wipers or brushes may use chemical solutions provided they are NSF/ANSI Standard 60 certified.

(e) An automatic shutdown valve shall be installed in the water supply line prior to the ultraviolet treatment device. When power is not provided the valve shall be in the closed position.

(f) The inlet and outlet piping to the reactors shall assure that the UV dose delivery is equal to or greater than the UV dose delivered during validation.

(g) The flow to each reactor shall be equally distributed and metered.

(h) Valves shall be provided to allow isolating and removing from service each UV reactor.

(i) Reactors shall be provided with air relief and pressure control valves per manufacturer requirements.

(j) UV transmittance (UVT) analyzers shall be provided if UVT is part of the dose monitoring strategy.

(k) Sample taps shall be provided downstream of each reactor.

(6) CONTROLS. (a) A delay mechanism shall be installed to provide sufficient lamp warm−up prior to allowing water to flow from the ultraviolet treatment unit.

(b) An automatic shutdown shall be designed to activate the shutdown valve in cases where the ultraviolet light dose falls below the approved design dose or outside of the validated specifications.

(c) Where the UV is necessary to provide adequate disinfection, 99.9 percent of the volume of water passing through the reactors shall receive UV light treatment within the validated specifications. This may require the use of a bleed line from the reactors during lamp warm up and cool down periods.

(7) BACK−UP. A sufficient number of parallel ultraviolet treatment devices shall be installed to insure that adequate disinfection is provided when one unit is out of service. The department may approve an alternate method that provides adequate disinfection.

(8) TREATMENT BYPASS. No bypass of the ultraviolet treatment process may be installed unless an alternate method of providing adequate disinfection is provided.

(9) MONITORING. Continuous monitoring of UV intensity as measured by a UV sensor, flow rate, and lamp status shall be provided for each ultraviolet treatment device to demonstrate that the device is operating within the range of conditions for which it was validated for the required UV dose. Each monitoring device shall be connected to the control system for the shutdown valve for the respective ultraviolet treatment device. The department may require additional monitoring devices and control systems if any of the water quality characteristics listed in Table No. 3 are representative of the water to be treated and may impair the effectiveness of the ultraviolet light treatment.

(10) CHLORINE ADDITION. Unless waived by the department, chlorine shall be added after UV for virus inactivation and to provide a residual in the distribution system.

(11) PILOT TESTING. Pilot testing is generally not required unless factors such as fouling or aging cannot be predicted by bench−scale testing.

History: CR 09−073: cr. Register November 2010 No. 659, eff. 12−1−10.

Subchapter VIII — Hydro−Pneumatic Tanks

NR 811.61 General. The department may approve the use of hydro−pneumatic, or pressure, tanks, as provided in s. NR 811.62 (2). All of the following requirements shall be met:

(1) The tanks shall be completely housed, or earth−mounded with one end projecting into an operating house, to prevent freezing. A tank may be installed below grade if one end is exposed in a basement, vault or manhole. If the tank is installed below grade, all electrical controls and air release valves and any other appurtenances which may permit contamination of the water supply shall be extended to at least 24 inches above grade. Air release piping extended above grade shall be terminated in a down−turned U−bend screened with a 24−mesh corrosion resistant screen. The basement, vault or manhole shall be constructed to prevent surface water from entering including sealing any annular spaces where pipes and appurtenances pass through a wall, floor or ceiling. The basement, vault or manhole shall be equipped with heating, ventilation and dehumidification equipment if necessary to prevent excessive corrosion of the pressure tank and associated piping or to prevent water from freezing. Access manholes shall terminate a minimum of 24 inches above grade with an overlapping, locking cover. Vent pipes shall be metal and terminate a minimum of 24 inches above grade in a downward facing U−bend screened with a 24−mesh corrosion resistant screen. Doors shall open outward and be provided with a lock.

(2) Each tank shall be provided with bypass piping and the necessary shut−off valves to permit operation of the system while the tank is being repaired or painted. For galvanized or bladder type pressure tanks, the individual connecting pipe to each tank shall be provided with a shut−off valve, pipe union and drain fitting. Threaded drain fittings shall be provided with a vacuum breaker.

(3) Each tank not equipped with a bladder or diaphragm to separate the air and water and with a gross volume of 500 gallons or more shall have a drain fitting with shut−off valve and control

equipment consisting of a pressure gauge, a pressure relief valve, a water sight glass, an automatic air blow−off, and pressure or probe operated start−stop controls for the pumps.

(4) Each tank not equipped with a bladder or diaphragm to separate the air and water and with a gross volume of 500 gallons or more or that will be painted inside shall be provided with an access manhole. If the tank interior is to be painted it shall be painted with NSF/ANSI approved paints in accordance with s. NR 810.09 (5).

(5) Each tank not equipped with a bladder or diaphragm to separate the air and water and with a gross volume of 500 gallons or more shall be provided with an automatically controlled air compressor to add air to the tank. All compressors used to routinely add air to tanks shall be oil−less. Larger capacity compressors that are not oil−less may be used temporarily to fill a tank upon startup, repair or service but shall be fitted with one or more filters and any other appurtenances necessary to remove particulates and oil from the air prior to injection.

(6) Each tank equipped with a diaphragm or bladder shall be equipped with an air inlet for adding air manually, a pressure relief valve for each tank or bank of tanks sized to handle the maximum flow rate, and pressure−operated start up and shut down controls for the well pump.

(7) The gross volume, in gallons, of any tank or combination of tanks, shall be at least 10 times the capacity of the largest pump, rated in gallons per minute, unless the proposed pump motor or motors will be controlled by a variable output control device in a manner intended to reduce the volume of required pressure tank storage in accordance with s. NR 811.34 (6). For a standard installation, the required storage volume is intended to provide a minimum pump run time of 2 to 3 minutes.

(8) Each tank shall be identified by stamping or labeling showing the manufacturer's name, a serial number, the tank volume, the allowable working pressure, and the year fabricated.

(9) Each tank not equipped with a bladder or diaphragm to separate the air and water and with a gross volume of 500 gallons or more shall be constructed of steel and have a 0.25 inch minimum side wall and head wall thickness.

History: CR 09−073: cr. Register November 2010 No. 659, eff. 12−1−10.

Subchapter IX — Storage Facilities

NR 811.62 Volume and pressure. **(1)** VOLUME REQUIREMENTS. A sufficient quantity of water, as determined from engineering studies, shall be maintained in elevated storage when only one pumping unit to the distribution system is available to serve the water system. This shall be at least an average−day supply under normal operating conditions. When more than one distribution pump is available, the storage shall be in accordance with standard engineering practice. Standard engineering practice is based upon an engineering review of existing and future water supply needs including: type of service and population served; average day, maximum day, peak hour and fire flow demands and durations; water source quality, availability and treatment, pump capacities, auxiliary power, storage capacity, water distribution and costs.

(2) PRESSURE REQUIREMENTS. Storage facilities shall be designed to meet all the following requirements:

(a) *Minimum and maximum pressures.* The storage facilities shall be designed to meet the minimum and maximum pressure requirements specified in s. NR 811.66 (1).

(b) *Fire flows and residual pressures.* When fire protection is to be provided, the storage facilities shall be designed in conjunction with distribution system design to provide the minimum fire flows and residual pressures specified in s. NR 811.70 (6).

(c) *Alternative means for maintaining pressure.* A hydro−pneumatic tank, booster pumping facilities, or other reliable means shall be provided to maintain system pressure when a gravity storage reservoir or tank is not available.

(3) ELEVATED STORAGE REQUIREMENT WAIVED. The department may waive the requirement for elevated storage if the system is designed to serve less than 50 homes, if it is not economically feasible to provide elevated storage, if elevated storage facilities are proposed for a later development phase, or if service is proposed for domestic use only.

History: CR 09−073: cr. Register November 2010 No. 659, eff. 12−1−10.

NR 811.63 Location. Storage facilities shall be located in accordance with all the following requirements:

(1) FLOODWAY AND FLOODPLAIN. (a) *Floodway.* Storage facilities may not be located within a floodway, as defined in s. NR 116.03 (22).

(b) *Floodplain.* If it is necessary to locate a reservoir in a floodplain, as defined in s. NR 116.03 (16), outside of the floodway, the lowest elevation of the bottom floor, including sumps, shall be a minimum of 2 feet above the regional flood elevation as determined in s. NR 116.07 (4). All projects shall conform to the requirements of that chapter.

Note: Refer to ch. NR 116 for floodplain and floodway requirements.

(2) GRADING. The area surrounding structures shall be graded in a manner that will prevent surface water from standing within 50 feet of the structure.

(3) YEAR−ROUND ACCESS. Storage facilities shall be located in an area accessible during the entire year. If necessary, road improvements shall be installed to provide year−round dry land access. Storage facilities and access roads shall be located on property owned by the water supply owner or for which the owner has obtained easements.

(4) FLOOR ELEVATIONS. The department recommends that the lowest elevations of floors and sump floors of ground level reservoirs and standpipes should be placed at or above the normal ground surface. If the department allows the floor or sump to be below the normal ground surface, it shall be placed a minimum of 2 feet above the groundwater table. Borings shall be made to determine groundwater elevations if that information is not available.

(5) CONTAMINATION SOURCES. (a) Sewers, drains, fuel storage tanks, standing water, and similar sources of contamination shall be kept a minimum of 50 feet from the reservoir.

(b) The department may approve gravity or force main sewers within 50 feet of a reservoir if the sewer or force main is constructed of water main class pipe meeting the requirements of s. NR 811.69 and is pressure tested in place to meet the requirements of s. NR 811.12 (5) (d) 2.

(6) ROOF SURFACE ABOVE GRADE. (a) The top roof surface of a ground level reservoir may not be less than 2 feet above normal ground surface.

(b) The department shall require a higher exposed elevation if high groundwater, poor surface drainage, or tight soils are encountered that will deter subsurface drainage or if necessary to provide positive pressures for pump intake or discharge lines in accordance with s. NR 811.37.

Note: It is recommended that no more than one−half of the reservoir depth be constructed below grade.

(c) The department may except clearwells constructed under filters from the 2 foot requirement when the total design gives the same protection.

History: CR 09−073: cr. Register November 2010 No. 659, eff. 12−1−10.

NR 811.64 Construction details. **(1)** MATERIALS. Materials used in the construction of storage facilities shall meet all the following requirements:

(a) *General requirements.* The materials and designs used for finished water storage structures shall provide stability and durability as well as protect the quality of the stored water. Unless the design engineer can justify the use of other materials, the depart-

ment will approve only steel or concrete for use in a water storage facility. Porous materials, including wood and concrete block, may not be used.

(b) *AWWA standards.* Structures shall be constructed in accordance with the AWWA standards D100, D102, D103, D104, D110, D115, D120, and D130 concerning steel; concrete or fiberglass tanks, standpipes, reservoirs, and elevated tanks in effect at the time of construction wherever they are applicable.

(2) PROTECTION. Storage facilities shall be constructed and maintained to protect the water supply in accordance with the following requirements:

(a) *General requirements.* All water storage structures shall have watertight roofs or covers which exclude surface water, rain, snow, birds, animals, insects and dust.

(b) *Installation of ancillary equipment.* The installation of ancillary equipment, such as antennas, shall be done in a manner that ensures no damage to the tank, coatings, or water quality. Any damage that occurs to the tank during installation shall be corrected.

(c) *Adjacent compartments.* Finished water may not be stored or conveyed in a compartment adjacent to nonpotable water when the 2 compartments are only separated by a single wall. The department may waive this requirement for backwash water holding compartments meeting potable water reservoir construction on a case−by−case basis.

(d) *Security.* Locks on access manholes, fences and ladder cage bottoms and any other necessary measures shall be provided to prevent trespassing, vandalism and sabotage.

Note: The department recommends that intrusion alarms and/or motion sensors be installed as applicable and where feasible for elevated tank pedestal access doors and reservoir access hatches. The department recommends that high strength, cut resistant locks or lock covers be installed to prevent direct cutting of a lock.

(3) DRAINS. Drains for storage structures shall meet all the following requirements:

(a) *General drain discharge requirements.* 1. Piping used to drain water from a water storage structure shall discharge to the ground surface. The drain piping shall be brought down to within 12 to 24 inches of the ground surface and discharged with a free air break over a drainage inlet structure, splash pad or riprap.

2. Drains may not be directly connected to a storm sewer. The department may approve discharge with a free air break over a storm sewer manhole or through a valved connection to the overflow piping on a case−by−case basis.

3. Drains may not be directly connected to a sanitary sewer. Clear water from drains may not be discharged to a sanitary sewer. The department may approve the temporary discharge of drain wastewater containing sediment and/or chemicals used for cleaning or temporary treatment of a water storage structure to a sanitary sewer on a case−by−case basis.

(b) *Impacts to the environment prohibited.* Negative impacts to the environment from the discharge of drainage water shall be prevented.

(4) OVERFLOW. Each reservoir shall be provided with overflow piping meeting all the following requirements:

(a) *General overflow discharge requirements.* 1. 'Discharge.' The overflow pipe of a water storage structure shall be brought down to within 12 to 24 inches of the ground surface and shall discharge with a downward opening and a free air break over a drainage inlet structure, splash pad or riprap. The department may approve discharge with a 12 to 24 inch free air break over a storm sewer manhole on a case−by−case basis. Overflows may not discharge to a sanitary sewer.

2. 'Pipe diameter.' The overflow pipe shall be of sufficient diameter to permit wasting water in excess of the maximum filling rate.

3. 'Pipe material.' The over flow pipe shall be constructed of ductile iron, steel or stainless steel.

4. 'Visibility.' All overflow pipes shall be located so that any discharge is visible.

5. 'Flapper or rubber duck bill valve.' If a metal flapper valve or a rubber duck bill valve is used, a screen shall be provided in accordance with pars. (c) and (d).

(b) *Impacts to the environment prohibited.* Negative impacts to the environment from the discharge of overflow water shall be prohibited.

(c) *Elevated tanks and standpipes.* 1. When an internal overflow pipe is used on elevated tanks, it shall be located in the access tube.

2. The overflow pipe shall be provided with a 4−mesh corrosion resistant screen installed within the pipe at a location least susceptible to damage by vandalism.

(d) *Ground level structures.* 1. Overflow pipes shall terminate a minimum of 12 to 24 inches above the final graded ground surface in a manner to prevent the backflow of water into the reservoir.

2. The overflow shall be screened with 24−mesh corrosion resistant screen installed within the pipe at a location least susceptible to damage by vandalism.

3. Each reservoir chamber that can be isolated from the rest of the reservoir so that it can remain in service while other chambers are out of service shall be provided with its own overflow pipe terminating outside the reservoir in accordance with the requirements of subds. 1. and 2.

(5) INLET–OUTLET PIPING. Inlet and outlet piping to a storage structure shall meet all the following requirements:

(a) *Pressure requirements.* Inlet and outlet piping from a storage structure shall be under positive pressure at all times wherever practical and in conformance with s. NR 811.37 (1). The department may approve inlet piping that is not under positive pressure at all times on a case−by−case basis where the piping is exposed and located above grade.

(b) *Pipe sizing.* Piping shall be sized to accommodate design fill and removal rates including considerations for future improvements.

(6) BYPASS PIPING. (a) *Groundwater facilities.* If the water system design is such that all water passes through one ground reservoir, there shall be bypass piping from the well pumps to the high lift pumps to allow the reservoir to be taken out of service for cleaning and maintenance. The department may waive this requirement if the well pumps can provide sufficient volume and pressure directly to the distribution system, if the well pumps and high lift pumps are greatly different in capacity, or if the reservoir is divided into multiple cells which can be independently removed from service. If CT is required, the department will approve bypass piping around reservoirs only if the required minimum CT can be met with the reservoir chamber or chambers out of service.

(b) *Surface water facilities.* If the water treatment plant design is such that all water passes through one ground reservoir, bypass piping or multiple cells shall be installed to allow the reservoir to be totally or partially taken out of service for cleaning and maintenance. The design shall provide for maintaining the required minimum CT while the reservoir is totally or partially out of service.

(7) ACCESS. Water storage structures shall be designed with reasonably convenient access for cleaning and maintenance. Manholes installed above the waterline shall meet the following requirements:

(a) *Elevated storage structures and reservoirs covered by inhabitable structures.* Manholes on elevated tanks, standpipes and reservoirs covered by inhabitable structures shall be framed a minimum of 4 inches above the surface of the roof. Manhole openings shall be fitted with a solid watertight cover which overlaps the framed opening and extends down around the frame a minimum of 2 inches. A compressible gasket shall be attached to

the bottom side of the cover so that when the cover is closed it will provide a water tight seal around the manhole opening.

(b) *Ground storage structures.* On ground level structures, manholes shall be elevated no less than 24 inches above the top or covering sod. Manhole openings shall be fitted with a solid watertight cover which overlaps the framed opening and extends down around the frame a minimum of 2 inches. A compressible gasket shall be attached to the bottom side of the cover so that when the cover is closed it will provide a water tight seal around the manhole opening.

(c) *Locks.* Overlapping interior and exterior manhole covers shall be locked at all times except when being used by authorized personnel.

(d) *Other openings.* All other manholes, openings, or access ways shall be provided with watertight, bolted, and gasketed covers.

(8) VENTS. Water storage structures shall be vented to the atmosphere. Vent installations shall meet the following requirements:

(a) *General requirements.* 1. The overflow pipe shall not be considered a vent.

2. Open construction between the sidewalls and the roof to act as a vent is not allowed.

(b) *Exclude contamination.* Vents shall be constructed to:

1. Prevent the entrance of surface water, rain and snow as applicable.

2. Exclude birds and animals.

3. Exclude insects and dust to the extent this can be done while providing effective venting.

(c) *Elevated tanks and standpipes.* Vents installed on elevated tanks and standpipes shall terminate in a U−bend or mushroom cap constructed with the opening at least 4 inches above the roof and covered with 4− to 24−mesh corrosion resistant screen installed within the pipe or cap at a location protected from the environment. Mushroom caps shall be provided with an automatically resetting pressure−vacuum relief "frost−proof" mechanism. The skirted sides of mushroom caps shall totally cover any screens when viewing the cap from the side.

(d) *Ground level structures.* Vents installed on ground level structures shall terminate in a U−bend or mushroom cap constructed with the opening 24 to 36 inches above the roof or sod and covered with 24−mesh corrosion resistant screen installed within the pipe or cap at a location least susceptible to vandalism. The skirted sides of mushroom caps shall totally cover any screens when viewing the cap from the side.

(e) *Size.* Vents shall be sized to allow an air flow consistent with maximum water inflow and outflow rates.

(f) *Materials of construction.* 1. Vent pipes shall be constructed of ductile iron, steel, or stainless steel pipe.

2. Mushroom caps shall be constructed of steel, stainless steel, or aluminum.

3. Screens shall be constructed of stainless steel or aluminum.

(9) SILT STOP. The discharge pipes from all water storage structures shall be located in a manner that will prevent the flow of sediment into the distribution system. Removable silt stops shall be required where feasible.

(10) ROOF AND SIDEWALLS. The roof and sidewalls of all storage structures shall be constructed to meet the following requirements:

(a) *Watertight construction.* The roof and sidewalls of all structures shall be watertight with no openings except properly constructed vents, manholes, overflows, risers, drains, pump mountings, control ports, or piping for inflow and outflow.

(b) *Sealed openings.* Any pipes running through the roof, floor or sidewall of a finished water storage structure shall be sealed watertight. Openings for metal tanks shall be welded or properly gasketed. Pipes running through openings in a concrete structure shall be connected to a standard wall pipe or run through a wall sleeve which were poured in place during the formation of the structure. These wall pipes and wall sleeves shall be metal and have seepage rings embedded in the concrete. Pipes running through a wall sleeve shall be provided with a department approved watertight seal installed between the pipe and the wall sleeve.

(c) *Roof curbing.* Openings in a storage structure roof or top, designed to accommodate control apparatus, pump columns and other equipment, shall be provided with minimum 4−inch high curbing and sleeved with proper additional flashing to prevent the access of surface or floor drainage water to the structure.

(d) *Installation of appurtenances.* Valves and controls shall be located outside the storage structure so that valve stems and similar projections do not pass through the roof or top of the reservoir unless the department determines that this requirement need not be met to fulfill the other requirements of this chapter. The department may allow floor drain piping carrying graywater or a trench drain carrying graywater, electrical conduits, water service piping, and chemical feed piping to be encased in a concrete reservoir roof. Other appurtenances, including drain piping carrying blackwater, shall not be encased in a concrete reservoir roof. Toilets shall not be located above the reservoir roof.

(e) *Earth cover over reservoirs.* 1. In addition to meeting the requirements of s. NR 811.63 (6), the top of any earth covered reservoir shall be covered with a flexible waterproof membrane. The minimum membrane thickness shall be 0.060 inches. Department approval of the specific membrane proposed is required. Protective boards shall be placed over the membrane before applying the earth cover when recommended by the membrane manufacturer.

2. Bentonite panel membranes may not be used to meet the waterproof membrane requirement.

3. Earth covering of reservoirs shall be avoided where possible.

(f) *Roof slope.* The top of any storage structure shall have a minimum slope of 0.015 feet per foot to facilitate drainage.

(g) *Drainage for roof or cover.* The roof or cover of the storage structure shall be well drained, but downspout pipes may not enter or pass through the reservoir. Where parapets or similar construction which would hold water and snow on the roof are constructed, adequate waterproofing and drainage shall be provided.

(h) *Exposed grouted precast concrete planked roofs.* Grouted precast concrete planked roofs exposed to the environment shall meet the following requirements:

1. A minimum 2 inch thick reinforced concrete topping shall be installed over the top surface of the grouted plank roof. Fiber mesh may be used to provide reinforcing.

2. A minimum 0.060 inch thick flexible waterproofing membrane shall be installed over the concrete topping. Department approval of the specific membrane proposed is required. The installation of stone ballast over the membrane is optional.

3. The roof planks, concrete topping, or any insulation boards installed over the topping shall be installed to provide the minimum slope of 0.015 feet per foot required in par. (f).

(i) *Exposed reinforced poured−in−place flat concrete roofs.* Reinforced poured−in−place flat concrete roofs exposed to the environment shall be provided with a minimum 0.060 inch thick flexible waterproofing membrane installed over the roof. Department approval of the specific membrane proposed is required. The installation of stone ballast over the membrane is optional.

Note: For this section flat does not mean level.

(11) SAFETY. Worker safety shall be considered in the design of the storage structure. The following shall apply:

(a) Ladders, ladder cages or safety climbing devices, balcony railings, landing platforms, guardrails, and safe locations of entrance hatches shall be provided where applicable.

(b) On elevated tanks where persons transfer from the access tube to the water compartment railings, handholds and landing platforms shall be provided, where applicable.

(c) On elevated tanks with riser pipes over 8 inches in diameter, protective bars shall be installed over the riser openings inside the tank.

(d) A handrail system shall be installed on the roof of any elevated tank.

(e) Storage structures shall be constructed to meet applicable local, state, including applicable portions of ch. SPS 332, and federal OSHA codes for specific safety requirements.

(f) Confined space entry should be in accordance with the requirements of s. SPS 332.29 and federal OSHA codes.

(12) FREEZING. All of the following actions shall be taken to minimize the potential for freezing:

(a) All water storage structures and their appurtenances, especially riser pipes, overflows, and vents shall be designed to minimize freezing that would interfere with proper operation.

(b) Riser pipes shall be insulated where possible.

(c) Recirculation pumps and air bubbler systems may be used to minimize freezing.

(d) Equipment used for freeze protection that will come into contact with the potable water shall meet ANSI/NSF Standard 61 or be approved by the department.

(13) TURNOVER. Storage facilities shall be designed to facilitate turnover of water in order to prevent freezing and stagnant water conditions. Consideration shall be given to installing separate inlet and outlet pipes, diffusers, baffle walls, adjusting controls to temporarily reduce storage capacities, or other department approved means where necessary.

(14) INTERNAL CATWALK. Every catwalk over a storage structure containing finished water or water to become finished water shall have a solid floor with sealed raised edges to prevent shoe scrapings, dirt, and other contaminants from falling into the water.

(15) PAINTING AND CATHODIC PROTECTION. Interior paints, coatings, and cathodic protection systems shall be installed in accordance with all of the following requirements:

(a) Metal surfaces shall be protected by paints or other protective coatings. The paints or coatings may be accompanied by cathodic protection devices.

(b) Interior paint and coating systems and application procedures shall be consistent with AWWA standard D102 in effect at the time of application, have ANSI/NSF Standard 61 approval for use in potable water, and be approved by the department in accordance with s. NR 810.09 (5). Paint and coating systems shall be applied, cured, and used in a manner consistent with the ANSI/NSF approval. After curing, the paint or coating shall not transfer any substance to the water that will be toxic or cause taste or odor problems.

(c) Cathodic protection shall be designed and installed by competent technical personnel.

Note: A copy of the cited AWWA standards is available from the American Water Works Association, 6666 West Quincy Ave., Denver, Colorado 80235.

(16) MISCELLANEOUS APPURTENANCES. The following miscellaneous appurtenances shall be installed where feasible or applicable and in accordance with the following requirements:

(a) *Smooth end sampling faucet.* A smooth end sampling faucet shall be installed in the connecting main or riser pipes of elevated tanks, standpipes, and reservoirs, if design permits. The sampling faucet shall be installed in accordance with the requirements of s. NR 811.37 (5) (b) 3.

(b) *Chlorination tap.* A threaded tap for chlorination purposes shall be installed in the connecting main or riser pipes of elevated tanks, standpipes, and reservoirs.

(c) *Valve vaults and above grade enclosures.* Valve vaults and above grade enclosures installed at the base of storage facilities shall be protected against freezing and provided with floor drainage facilities discharging to the ground surface by gravity, if possible, or else by a floor sump with a sump pump permanently installed. If constructed outside of the storage facility, the entrance to the vault or enclosure shall be locked to prevent unauthorized access.

(17) DISINFECTION. Water storage structures shall be disinfected in accordance with all the following requirements:

(a) *Disinfection required.* Water storage structures shall be disinfected before being put into service or before being returned to service following maintenance or repair work to the water storage structure. Detailed procedures for disinfection, equivalent to those outlined in AWWA standard C652 in effect at the time of disinfection, shall be written into the specifications by the design engineer or contractor as applicable.

(b) *Bacteriological sampling.* Disinfection and bacteriological sampling requirements shall meet the requirements of s. NR 810.09 (4). Detailed procedures for bacteriological sampling shall be written into the specifications by the design engineer or contractor as applicable.

(c) *Allowable chlorine in wasted water.* The amount of chlorine in any water wasted from a storage structure to the environment shall be assessed to prevent harmful impacts. Dechlorination prior to discharge may be necessary in some cases to prevent harmful impacts. Water wasted to surface water may not contain any substances in concentrations that adversely affect the water as determined under chs. NR 105 and 106. For chlorine, no total residual chlorine may be measured in water being discharged to a surface water.

Note: A copy of the AWWA standards is available for inspection at the central office of the department of natural resources and may be obtained for personal use from the American Water Works Association, 6666 West Quincy Avenue, Denver, Colorado 80235.

History: CR 09–073: cr. Register November 2010 No. 659, eff. 12–1–10; correction in (11) (e), (f) made under s. 13.92 (4) (b) 7., Stats., Register December 2011 No. 672.

NR 811.65 Plant storage. The applicable design standards of ss. NR 811.63 and 811.64 shall be followed for plant storage. In addition:

(1) FILTER WASHWATER TANKS. Filter washwater tanks shall be sized, in conjunction with available pump units and finished water storage, to provide the backwash water required by s. NR 811.49. The design shall address the possibility of having to backwash more than one filter at a time, or several filters in succession.

(2) CLEARWELL. (a) Clearwell storage shall be sized, in conjunction with distribution system storage, to relieve the filters from the strain of fluctuations in water use or peak demands.

(b) When water storage is used to provide proper contact time for disinfection, documentation, including tracer testing, shall be provided to assure adequate detention time under all operating conditions. The department may require the installation of baffle walls or additional reservoir capacity if necessary to prevent short circuiting and to obtain adequate contact times.

(3) BASINS AND WET–WELLS. Receiving basins, pump cans, and pump wet–wells for finished water or water to become finished water shall be designed as finished water storage structures.

History: CR 09–073: cr. Register November 2010 No. 659, eff. 12–1–10.

NR 811.66 Distribution system storage. The applicable design standards of ss. NR 811.63 and 811.64 shall be followed for distribution storage. In addition:

(1) PRESSURE VARIATION. Distribution system storage facilities shall meet all the following requirements:

(a) *Allowable head range.* The maximum variation between high and low levels in storage structures which float on a distribution system may not exceed 30 feet during normal usage.

(b) *Minimum and maximum pressures.* The minimum and maximum pressure in service areas shall be 35 and 100 psi respectively at ground level.

1. In areas where a minimum of 35 psi cannot be maintained, a high pressure zone shall be established in the distribution system by means of booster pumps and related facilities or pressure boosting systems on individual service lines as required in subch. XI. The use of individual service line booster pumps shall be limited to the extent possible.

2. In situations where static pressures exceed 100 psi, pressure reducing devices may be required on mains in distribution systems having documented system deficiencies or problems due to high pressure such as main breaks and service line breaks.

Note: Section SPS 382.40 (7) (d) 2. a. requires a pressure reducing device to be installed to protect individual services when the incoming pressure exceeds 80 psig.

(2) DRAINAGE. The design shall allow draining of storage facilities for cleaning or maintenance while maintaining adequate positive pressure in the distribution system. The drains shall discharge to the ground surface as required in s. NR 811.64 (3).

(3) LEVEL CONTROLS. Adequate controls shall be provided to maintain required levels in distribution system storage structures. Level indicating devices shall be provided at a central location. Combination indicating and recording devices are recommended.

History: CR 09−073: cr. Register November 2010 No. 659, eff. 12−1−10.

Subchapter X — Distribution Systems

NR 811.67 Applicability. This subchapter covers water distribution systems for community water systems which are to be located in street rights−of−way or easements. Other piping systems shall be constructed in accordance with the requirements of ch. SPS 382.

History: CR 09−073: cr. Register November 2010 No. 659, eff. 12−1−10; correction made under s. 13.92 (4) (b) 7., Stats., Register December 2011 No. 672.

NR 811.68 Ownership of municipal water distribution systems. (1) MUNICIPAL OWNERSHIP. The distribution system of a municipal water system shall be owned and maintained by the waterworks owner.

(2) MUNICIPALLY OWNED MAINS ON PRIVATE PROPERTY. All water mains owned by a municipal water system on private property shall be installed in permanent easements.

Note: To assure the use of approved materials and proper installation and maintenance, the department recommends that fire hydrants and water mains to be constructed on private property be installed in permanent easements and owned and maintained by the waterworks owner.

(3) PRIVATELY OWNED LOOPED MAINS REQUIRING CHECK VALVES. Water mains to be connected to the publicly owned distribution system at more than one point may be privately owned and maintained provided that a check valve is installed on the water main at each point of connection to the distribution system to prevent water from flowing back into the distribution system. Each check valve shall be located in a manhole or vault and shall be immediately preceded and followed by a buried or exposed shut−off valve on the main. The water supplier shall have access to the manholes and valves for inspection purposes.

Note: A drain fitting may be added on the piping between the check valve and the gate valve on the public water system side of the check valve. The gate valve may be closed and the drain fitting opened to periodically check for leakage through the check valve. Refer to s. SPS 382.40 for standards for the construction of private water mains.

History: CR 09−073: cr. Register November 2010 No. 659, eff. 12−1−10.

NR 811.69 Materials. Water main materials shall meet the following requirements:

(1) ACCEPTABLE MATERIALS. All pipe used for water main installations shall be cast iron, ductile iron, steel, reinforced concrete, polyvinyl chloride, high density polyethylene, copper or materials specially approved by the department for restricted or experimental use. If a restricted or experimental use approval is issued, the department may require special precautions until a satisfactory use record has been established. For polyvinyl chloride pipe, only joints with elastomeric gaskets or butt fusion welds shall be used.

(2) STANDARDS. Pipes, joints, fittings, valves, and fire hydrants shall have been manufactured in conformity with the latest standards issued by the AWWA and may not be used unless approved by the department. All pipe shall be minimum AWWA pressure class 150 and shall be designed for a minimum 100 psi working pressure except as approved by the department for special low pressure applications. Specifications for water main pipe and joints for water mains having a diameter less than those contained in AWWA standards shall meet the requirements of s. SPS 382.40.

Note: A copy of the AWWA standards is available for inspection at the central office of the department of natural resources and may be obtained for personal use from the American Water Works Association, 6666 West Quincy Avenue, Denver, Colorado 80235.

(3) LEAD FREE. Any pipe, pipe fittings, solder, or flux used in the installation or repair of any public water system shall be lead free. Lead free is defined, with respect to solders and flux, as containing not more than 0.2% lead and, with respect to pipes and pipe fittings, as containing not more than 8.0% lead. Repairs to lead joints shall be made using alternative methods, if possible. For ductile iron pipe, the use of lead tipped gaskets is prohibited.

(4) PROTECTION AGAINST CORROSION. Special attention shall be given to selecting pipe materials which will protect against internal and external corrosion. If soils, groundwater, or both, are aggressive, ductile iron water mains shall be provided with polyethylene encasement installed in conformity with the latest AWWA standards.

(5) PROTECTION AGAINST CONTAMINATION FROM ORGANIC COMPOUNDS IN SOIL AND GROUNDWATER. If possible, construction of water mains through or near areas of soil or groundwater contamination shall be avoided. Special attention shall be given to selecting pipe and gasket materials for construction in contaminated soil or groundwater which will protect against external corrosion and penetration of the pipe and gaskets by the contaminants. Water mains designed to pass through or near areas of contaminated soil or groundwater shall meet the following requirements:

(a) The department shall be contacted to obtain approval of the water main design requirements prior to the submittal to the department of the plans and specifications.

(b) Installations shall meet the following design criteria:

1. Minimum class 52 ductile iron water main piping with polyethylene encasement shall be used.

2. Hydrant drain ports shall be permanently plugged or hydrant barrels installed without drain ports.

3. Nitrile gaskets shall normally be used, except as provided in subd. 4.

4. The use of fluorocarbon gaskets shall be required if:

a. Nitrile gaskets will not be compatible with the contaminants present.

b. The soil or groundwater contamination exceeds primary drinking water standards.

c. The contamination concentrations and locations are uncertain.

5. Pipe bedding shall meet the requirements of s. NR 811.73 (2) (a).

(6) REHABILITATION. All materials used for the interior rehabilitation of water mains shall meet ANSI/NSF standards and may not be used until specifically approved by the department.

History: CR 09−073: cr. Register November 2010 No. 659, eff. 12−1−10; correction in (2) made under s. 13.92 (4) (b) 7., Stats., Register December 2011 No. 672.

NR 811.70 Water main design. The design of water mains and distribution systems shall meet the following requirements:

(1) GENERAL. Water mains and water distribution systems shall be designed to maintain point−of−entry water quality. Special consideration shall be given to distribution main sizing, providing multidirectional flow where possible, providing an adequate number of shut−off valves for distribution system control, providing an adequate number of fire hydrants where fire protec-

tion will be provided, and providing for adequate flushing throughout the system. Systems shall be designed to maximize turnover, to minimize the number of dead ends and to minimize residence times while delivering code complying pressures and flows.

(2) FLOODING. Any areas of the project which are located within the floodway, as defined in s. NR 116.03 (22), or floodplain as defined in s. NR 116.03 (16), shall be identified on the plans and shall conform to the requirements of that chapter.

Note: Refer to ch. NR 116 for floodway and floodplain requirements.

(3) WETLANDS. Any areas of the project which are to be located within a wetland, pass through a wetland or may impact a wetland shall be identified.

Note: Copies of the Wisconsin wetland inventory maps are available for inspection at the office of the department of natural resources and may be purchased through the department's internet web site.

(4) 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 minimum and maximum normal static pressure in the distribution system shall be 35 psi and 100 psi, respectively, at ground level. The system shall be designed and operated to maintain a minimum residual pressure of 20 psi at ground level at all points in the distribution system under all conditions of flow.

(5) DIAMETER. The minimum diameter of water mains to provide water for fire protection and to serve fire hydrants is 6 inches. Larger mains are required if necessary to allow the required fire flow while maintaining a minimum residual pressure of 20 psi at ground level at all points in the distribution system.

(6) FIRE PROTECTION. The minimum flow requirement for water mains serving fire hydrants is 500 gpm at 20 psi residual pressure at ground level at all points in the distribution system.

Note: It is recommended that the actual fire flow design be based on the capacity of any fire pumper which may be connected to the water main and the type of services or buildings to be protected. It is also recommended that the local fire department be consulted to discuss needed fire flows before constructing water system improvements.

(7) SMALL DIAMETER MAINS. Any departure from minimum requirements shall be justified by hydraulic analysis and future water use, and will be considered for approval by the department only in special circumstances. The main sizing for small diameter mains may be calculated based upon a fixture unit determination.

Note: See the requirements of ch. SPS 382 for guidance in sizing mains according to fixture units to be served.

(8) DEAD ENDS. Dead ends shall be minimized by looping mains whenever possible. Where dead end mains occur, they shall terminate with a fire hydrant, if flow and pressure are sufficient, or with an approved flushing hydrant or blow−off for flushing purposes. Flushing devices shall be installed on the dead end of all water main stubs 20 feet or more in length unless a shut−off valve is installed near the point of connection and closed until the stub is placed in service in the future. Flushing devices shall be sized to provide a minimum velocity of 2.5 feet per second in the water main being flushed. Flushing devices on dead end mains shall be installed downstream of all services. No flushing device shall be directly connected to any sewer.

Note: Refer to AWWA standard C651 for required flows and openings to flush pipelines.

(9) VALVING. Sufficient valves shall be provided on water mains so that inconvenience or sanitary hazard to water users will be minimized during maintenance and construction. Valves shall 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.

(10) FRICTION COEFFICIENTS. Unless other values are specially approved by the department, the following maximum "C" values, using the Hazen−Williams formula, shall be used for checking the hydraulic characteristics of new water mains shown on plans and specifications submitted for review:

Non−cement lined iron	C = 100
Cement lined iron	C = 140
PVC	C = 140
HDPE	C = 150

The "C" value of existing water mains and for all water mains with a pipe diameter of 12 inches or less may be less than the maximum "C" value for new pipe and shall be considered in distribution system analysis. The actual interior diameter of the pipe being modeled shall also be considered in the distribution system analysis.

History: CR 09−073: cr. Register November 2010 No. 659, eff. 12−1−10.

NR 811.71 Hydrants. (1) LOCATION. Fire hydrants shall be provided at each street intersection and at intermediate points between intersections. Generally, fire hydrant spacing may range from 350 to 600 feet depending on the type of area being served and the individual fire hose length and fire fighting practices utilized by each system.

(2) SIZE. Fire hydrants shall have a bottom valve size of at least 5 inches, one 4.5−inch pumper nozzle, and 2 2.5−inch nozzles unless the waterworks has established other hydrant criteria which are in accordance with AWWA standards C502 and C503 in effect at the time of design and are approved by the department. The connecting main between the supply main and the hydrants shall be a minimum of 6 inches in diameter.

(3) RESTRICTIONS. Fire hydrants may not be installed on proposed water mains which will not have minimum flow and pressure as required in s. NR 811.70 (6). The department may approve the installation of hydrants if system improvements which will make at least 500 gpm available at 20 psi are planned for construction within one year following construction of the proposed improvements. If the department approves the installation of hydrants which do not meet the minimum flow and pressure requirements of s. NR 811.70 (6), the hydrants shall be color coded or tagged and the fire chief shall be notified in writing that fire department pumpers may not be connected to the hydrants until the necessary additional improvements are made and fire flow tests have shown that greater than the minimum required flow and pressure are available.

(4) DRAINS. Hydrant drains may not be connected to, or located within 8 feet of sanitary sewers, storm sewers, or storm sewer inlets. If groundwater rises above the drain port, hydrant drain ports shall be permanently plugged prior to installation or hydrants with no drain ports installed and hydrant barrels shall be pumped dry during freezing weather. If hydrant drain ports are not plugged, a gravel pocket or dry well shall be provided unless the department finds that the natural earth will provide adequate drainage.

(5) AUXILIARY VALVES ON HYDRANT LEADS. Auxiliary valves shall be installed in hydrant leads off transmission water mains, off water mains in commercial and industrial districts and off all water mains 12 inches and larger.

Note: The department recommends that auxiliary valves be installed in all hydrant leads. Also, hydrants of the type that remain closed when the barrels are broken off are recommended.

(6) SERVICE LATERALS ON HYDRANT LEADS PROHIBITED. Service laterals may not be installed on hydrant leads.

(7) FLUSHING HYDRANTS. Flushing hydrants or blow−off installations shall be installed at all dead ends and at intermediate locations as necessary in order to remove sediment and optimize water quality for all water systems that do not provide fire protection. Flushing hydrants shall be sized to provide a minimum velocity of 2.5 feet per second in the water main being flushed. Flushing hydrants shall allow frost−proof operation. If necessary, flushing hydrants shall be pumped out prior to freezing weather.

(8) SAMPLING HYDRANTS AND FAUCETS. All water systems shall be provided with a sufficient number of sampling faucets, hydrants, or stations to provide representative water quality sampling sites throughout the water distribution system including extremities and dead ends. An adequate number of sampling sites shall be provided as required under the department's monitoring plan requirements contained in ch. NR 809 to meet all of the department's water quality sampling requirements. Sampling faucets, hydrants, and stations shall be protected from contamination and vandalism to the extent possible. Locks shall be provided for sampling station enclosures. Fire hydrants may not be considered as sampling hydrants. All sampling locations shall be pumped out prior to freezing weather if necessary. Sampling installations may not have drain–to–soil weep ports and shall not drain to any sanitary or storm sewer.

History: CR 09–073: cr. Register November 2010 No. 659, eff. 12–1–10.

NR 811.72 Air–relief facilities and valve and meter chambers. (1) AIR–RELIEF FACILITIES. If possible, water mains shall be constructed to avoid high points at which air can accumulate. Permanent provisions shall be installed to remove the air by means of air relief valves, hydrants, or blow–offs when high points cannot be avoided. Automatic air–relief valves may not be used in situations where flooding of the manhole or chamber may occur. The open end of an air–relief pipe shall be extended to the top of a manhole or chamber and have a screened, downward facing elbow.

(2) CHAMBERS. Chambers, pits, and manholes containing valves, blow–offs, meters, or other such appurtenances constructed for use in the distribution system shall meet the following requirements:

(a) *Location not subject to flooding or high groundwater.* If possible, chambers, pits, and manholes containing valves, blow–offs, meters, or other such appurtenances to a distribution system shall not be located in areas subject to flooding or in areas of high groundwater. If location in areas not subject to flooding or in areas of high groundwater is not possible, any valve discharge or structure vent pipes shall terminate a minimum of 24 inches above the ground surface or the high water level, whichever is the higher elevation.

(b) *Means to allow drainage.* Chambers, pits, and manholes containing valves, blow–offs, meters, or other such appurtenances to a distribution system may not be connected directly to any storm drain or sanitary sewer, nor may any blow–offs or air–relief valves be connected directly to any sewer. Chambers shall be drained to absorption pits underground or to the ground surface where they are not subject to flooding by surface water or high groundwater. If electrical power is available, sumps with sump pumps discharging above grade with a down–turned metal pipe and a free air break over grade or over a storm sewer receptacle may also be approved by the department.

(c) *Installation requirements.* If not installed in the road right–of–way or if installed in the road right–of–way in areas with minimal risk from damage due to traffic and maintenance equipment, larger below grade facilities or below grade facilities housing pumps and other electrical equipment shall meet the applicable booster pumping station requirements of s. NR 811.84. In addition, if installed in vulnerable areas of the road right–of–way, the facilities may be constructed with a gasketed, watertight, bolt–down cover at grade if approved by the department. All structures shall be vented to the atmosphere.

History: CR 09–073: cr. Register November 2010 No. 659, eff. 12–1–10.

NR 811.73 Installation of mains. (1) GENERAL REQUIREMENTS. Installation of mains shall be in accordance with AWWA standards in effect at the time of design, manufacturer's recommended installation procedures, and the requirements of this section.

Note: A copy of the AWWA standards is available for inspection at the central office of the department of natural resources and may be obtained for personal use from the American Water Works Association, 6666 West Quincy Avenue, Denver, Colorado 80235.

(2) INSTALLATION SPECIFICATIONS. The specifications for installation of mains shall include provisions for all of the following:

(a) *Bedding.* 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. Grossly contaminated soil shall be removed, properly disposed of according to chs. NR 500 to 520 requirements, and replaced with clean material. Clean clay cut–off walls shall be installed to minimize the movement of contaminants along the trench if required by the department.

(b) *Stone removal.* Stones found in the trench shall be removed for a depth of at least 6 inches below the bottom of the pipe.

(c) *Testing.* Pressure testing of the installed pipe, including measurement of leakage and testing for electrical conductivity shall be conducted, if appropriate. Pressure and leakage testing shall be in accordance with AWWA Standard C600 in effect at the time of testing.

(d) *Disinfection and sampling.* All new, cleaned or repaired water mains shall be disinfected and sampled in accordance with the following requirements:

1. 'Disinfection required.' Water mains shall be disinfected before being put into service or before being returned to service following maintenance or repair work. Detailed procedures for disinfection, equivalent to those outlined in AWWA Standard C651 in effect at the time of disinfection, shall be written into the specifications by the design engineer.

2. 'Bacteriological sampling.' Disinfection and bacteriological sampling requirements shall meet the requirements of s. NR 810.09 (4). The design engineer shall include detailed procedures for bacteriological sampling in the specifications.

3. 'Allowable chlorine in wasted water.' Consideration shall be given to the amount of chlorine in any water wasted from a water main to the environment to prevent harmful impacts. Dechlorination prior to discharge may be necessary in some cases to prevent harmful impacts. Water wasted to surface water may not contain any substances in concentrations that adversely affect the water as determined under chs. NR 105 and 106. For chlorine, no total residual chlorine may be measured in water being discharged to surface water.

Note: A copy of the AWWA standards is available for inspection at the central office of the department of natural resources and may be obtained for personal use from the American Water Works Association, 6666 West Quincy Avenue, Denver, Colorado 80235.

(e) *Cover.* Sufficient earth or other suitable cover shall be provided over mains to prevent freezing. A minimum cover of 5 to 7 feet is required unless determined by the department to be unnecessary in specific cases. Insulation may be required at some installations to prevent freezing.

(f) *Thrust restraint.* All tees, bends, plugs and hydrants shall be provided with thrust blocking, tie rods, or a joint restraint system designed to prevent movement.

(g) *Locating wire.* All underground components of public water mains, including mains, hydrant leads, and water services to be constructed of nonconductive material, shall be provided with a locating wire or other department approved equally effective means that can be used to locate the components.

(h) *Erosion control.* Construction site erosion control shall be provided in accordance with s. NR 811.09 (2).

(3) PIPE BURSTING. Department approval is required prior to installing any replacement water mains using the pipe bursting method. Replacement water mains installed through the pipe bursting method shall meet the following requirements in addition to the applicable requirements of sub. (2).

(a) The interior of the water mains shall be thoroughly cleaned of any debris and thoroughly disinfected prior to installation. Water samples shall be collected from the newly installed replacement water mains and sampled for bacteriological quality in accordance with s. NR 810.09 (4).

(b) The installed water mains shall be tested to meet at minimum the applicable AWWA pressure and leakage test requirements in effect at the time of testing prior to being placed in service.

(c) Unless department approval is obtained for the use of other pipe materials, only butt fused DR 9 or 11 HDPE pipe, butt fused DR 14 or 18 PVC pipe or properly restrained ductile iron pipe shall be used for installation as part of the pipe bursting process.

History: CR 09−073: cr. Register November 2010 No. 659, eff. 12−1−10.

NR 811.74 Separation of water mains and sanitary or storm sewer mains. (1) GENERAL. The following factors shall be considered in planning separation of water and sewer mains: materials and type of joints for water and sewer pipes, soil conditions, service and branch connections into the water main and sewer line, compensating variations in the horizontal and vertical separations, space for repair, and alterations of water and sewer pipes.

(2) HORIZONTAL SEPARATION. The following horizontal separation requirements shall be met:

(a) Water mains shall be laid at least 8 feet horizontally from any existing or proposed sanitary sewer main, storm sewer main, or sanitary or storm sewer manhole. The distance shall be measured center to center.

(b) In cases where it is not practical to maintain an 8−foot horizontal separation distance, the department may allow exceptions to that requirement on a case−by−case basis, if supported by data from the design engineer. The following requirements shall be met in order for the department to approve a center to center horizontal separation distance of less than 5 feet:

1. The bottom of the water main shall be at least 18 inches above the top of the sewer main and the minimum horizontal separation distance shall be 3 feet measured edge to edge.

2. A profile of the rock surface as determined from exploration shall be shown on the plan when high bedrock is the reason for the exception to the 8−foot separation distance.

Note: See Figure No. 10 in the Appendix.

(3) VERTICAL SEPARATION. If water mains cross over sanitary or storm sewer mains, the water main shall be laid at such an elevation that the bottom of the water main is at least 6 inches above the top of the sewer main. If water mains cross under sanitary or storm sewer mains, a minimum vertical separation distance of 18 inches shall be maintained between the top of the water main and the bottom of the sewer main. At crossings, one full length of water pipe shall be centered above or below the sewer so that both joints will be as far from the sewer as possible. Special structural support for the water and sewer pipes may be required by the department after a determination that added support is necessary to meet the requirements of this chapter.

(4) EXCEPTION. If it is not possible to obtain the proper horizontal and vertical separation as specified in subs. (2) and (3), a gravity sanitary or storm sewer main shall be constructed of materials and with joints that are equivalent to water main standards of construction from manhole to manhole and air pressure tested to assure water tightness in accordance with the 4 psi pressure testing requirements given in s. NR 811.12 (5) (d) 2. Department approval is required for any exception to the requirements in subs. (2) and (3).

(5) FORCE MAINS. No exception to the 8−foot separation distance may be granted for sanitary sewer force main installations unless the requirement in sub. (2) (b) is met.

(6) SEWER MANHOLES. No water pipe may pass through or come into contact with any part of a sanitary or storm sewer manhole.

History: CR 09−073: cr. Register November 2010 No. 659, eff. 12−1−10.

NR 811.75 Separation of water mains and other contamination sources. (1) Proposed water mains shall be adequately separated from any potential source of contamination. The following minimum horizontal separation distances shall be maintained:

(a) Eight feet between a water main and a POWTS holding, treatment or dispersal component, sanitary sewer lift−station or grave site.

(b) Twenty−five feet between a water main and a buried main or tank containing gasoline, diesel, bio−diesel, ethanol, other alternative fuel, fuel oil, petroleum product, motor fuel, burner fuel, lubricant, waste oil, or hazardous substance.

(c) Fifty feet between a water main and a sanitary landfill.

(2) Water mains may not pass through landfills.

History: CR 09−073: cr. Register November 2010 No. 659, eff. 12−1−10.

NR 811.76 Surface water crossings. Surface water crossings, whether over or under water, present special problems. For this reason, the department shall be consulted before final plans are prepared. The design shall meet the following requirements:

(1) ABOVE−WATER CROSSINGS. (a) The pipe shall be adequately supported and anchored, protected from damage and freezing, and accessible for repair or replacement.

(b) A means to accommodate bridge expansion such as an expansion joint shall be provided to the water main if the corresponding bridge has expansion joints.

(c) Shut−off valves shall be provided at both ends of a bridge crossing if the bridge has expansion joints so that the section can be isolated for testing or repair. The valves shall be easily accessible and not subject to flooding.

(2) UNDERWATER CROSSINGS. (a) A minimum cover of 2 feet shall be provided over the pipe.

(b) When crossing water courses which are greater than 15 feet in width, the following shall be provided:

1. The pipe shall be of special construction, having flexible, watertight joints. Butt fused DR 9 or 11 HDPE pipe or butt fused DR 14 or 18 PVC pipe are an acceptable alternative.

2. Shut−off 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, and the valve closest to the supply source shall be in a manhole. Unless the department approves an equivalent method, permanent taps shall be made on the pipe within the manhole on either side of the valve to allow insertion of a small water meter to determine leakage during system pressure testing.

History: CR 09−073: cr. Register November 2010 No. 659, eff. 12−1−10.

NR 811.77 Common casing crossings. In some cases, such as highway crossings, it becomes desirable due to extremely high construction costs to install water mains, sanitary sewers, force mains or storm sewers within a common casing. The following requirements apply:

(1) Any sewers shall be constructed of water main class pipe and joints and pressure and leakage tested in accordance with the requirements in s. NR 811.12 (5) (d) 2.

(2) The water main shall be located above the sewer main and be adequately supported.

(3) A vertical separation distance of 6 inches shall be maintained between the bottom of the water main and the top of the sewer main.

(4) Normal separation distances shall be provided as close as possible to the ends of the casing.

(5) Force mains shall be installed within an intermediate casing within the larger casing. The intermediate casing shall extend a minimum of 5 feet beyond each end of the larger casing.

(6) The remaining space in the casing may be filled if desired.

History: CR 09−073: cr. Register November 2010 No. 659, eff. 12−1−10.

NR 811.78 Water loading stations. Water loading stations shall comply with the requirements of this section to prevent contamination of both the public water supply and potable water vessels being filled.

(1) There may be no backflow or backsiphonage to the public water supply. Either a free air break shall be provided as shown in Figure No. 11 in the Appendix or alternatively, a reduced pressure principle backflow preventer shall be installed on the water loading piping. Cross connection control shall be provided to meet the requirements of s. SPS 382.41.

(2) The piping arrangement shall prevent contaminants from being transferred from a hauling vessel to others subsequently using the station.

(3) Hoses may not be contaminated by contact with the ground.

Note: It is recommended that a water meter be installed on the piping at all water loading stations to record water usage. It is also recommended that a free air break be installed in place of installing a reduced pressure principle backflow preventer.

History: CR 09−073: cr. Register November 2010 No. 659, eff. 12−1−10; correction in (1) made under s. 13.92 (4) (b) 7., Stats., Register December 2011 No. 672.

Subchapter XI — Water Pressure Booster Stations

NR 811.79 General. If the storage or primary pumping facilities cannot provide a minimum static pressure of 35 psi throughout the distribution system at street elevation, it shall be necessary to create a boosted pressure zone to serve those portions of the system. The use of pressure boosting systems on individual service lines shall be limited to a maximum of 10 individual systems in any given service area. The minimum static water pressure at street elevation shall be 20 psi in order for individual pressure boosting systems to be installed. Individual pressure boosting systems shall be owned and maintained by the water system owner. Booster station design shall be in accordance with this subchapter.

History: CR 09−073: cr. Register November 2010 No. 659, eff. 12−1−10.

NR 811.80 Location. (1) Pumps shall take suction from a reservoir, a water main adjacent to a reservoir, or elevated tank, where possible. If necessary, pumps can take suction from a distribution system water main if the installation complies with the requirements of this subchapter.

(2) For pumps not directly supplied by a reservoir or elevated tank, the suction pressure shall be at least 35 psi when the pumps are supplying design flow rates.

(3) Underground installations shall be permitted only if gravity drainage to the ground surface of large volumes of water from the vault can be provided or if the pumps and drivers are protected from damage by water or can be readily replaced. The department may waive the gravity drainage requirement if a minimum of 20 psi can be maintained at street elevation in the boosted zone by the main zone when the station is out of service or if sufficient elevated storage or alternate supply exists within the booster zone. The drain line may not discharge to a storm or sanitary sewer.

(4) In−line submersible pumps may be installed below the ground surface in a watertight installation. Provision shall be made for operational monitoring, pressure monitoring, flow metering, water sampling, and isolation valves. The pumps shall be accessible for servicing and repairs.

(5) Electrical equipment shall be installed above ground except if determined unnecessary by the department to meet the other requirements in this chapter.

(6) Buried stations may not be installed beneath roadways or in a floodplain.

Note: Refer to ch. NR 116 for floodplain definitions.

History: CR 09−073: cr. Register November 2010 No. 659, eff. 12−1−10.

NR 811.81 Pumps and pressures. (1) The booster pumps shall maintain static pressures in the area served within the range of 35 to 100 psi under normal operating conditions.

(2) The pump capacities for domestic service only shall be as established in Figure No. 1 in the Appendix, or as justified by additional engineering studies. Fire protection shall be provided if feasible and will require additional engineering studies.

(3) Pumping stations which serve more than 50 living units shall be designed such that the peak demand can be met with the largest pump out of service.

(4) For pumps not directly supplied by an adjacent reservoir or elevated tank, the suction pressure shall be at least 35 psi when the pumps are supplying design flow rates. An automatic cutoff control shall be provided that will stop the pumps when the suction pressure falls below 20 psi.

(5) For pumps supplied by an adjacent but not physically connected reservoir or elevated tank, the suction pressure shall be at least 3 psi under all pumping conditions. An automatic cutoff control shall be provided that will stop the pumps when the suction pressure falls below 3 psi.

(6) For those stations servicing a boosted zone without elevated storage, one of the following shall be provided:

(a) A continuously running pump to maintain pressure in the boosted zone. A small feed back line or other means shall be provided to prevent the pump from overheating.

(b) A single speed pump and one or more hydro−pneumatic tanks with a total gross volume at least ten times the rated gallon per minute capacity of the pump.

(c) A pump fitted with a 2 to 3 minute minimum run timer and one or more hydro−pneumatic tanks to prevent frequent pump cycling.

(d) A pump controlled by a variable output control device along with one or more hydro−pneumatic tanks having a total gross volume meeting the requirements of s. NR 811.34 (6).

History: CR 09−073: cr. Register November 2010 No. 659, eff. 12−1−10.

NR 811.82 Storage requirements. Elevated storage is not required for a boosted pressure zone where the primary pressure zone can provide minimum pressures of 35 psi at street elevation in all areas of the boosted zone. Elevated storage facilities shall be provided for a boosted pressure zone serving more than 50 living units in any of the following situations:

(1) If the primary pressure zone cannot maintain pressures of 3 psi or greater at street elevation in all areas served by the booster pumps including situations where emergency power is provided.

(2) If the primary pressure zone provides pressures of 3 to 35 psi at street elevation in all areas served by the booster pumps and an emergency power source is not provided for the booster station.

History: CR 09−073: cr. Register November 2010 No. 659, eff. 12−1−10.

NR 811.83 Emergency power requirements. Boosted pressure zone emergency power installations shall meet the following requirements:

(1) Emergency power shall be provided if 50 or fewer living units are being served and the primary pressure zone cannot maintain positive pressures of 3 psi or greater at street elevation in all areas served by the booster pumps, and sufficient elevated storage is not provided.

(2) Emergency power shall be provided if more than 50 living units are being served and the primary pressure zone cannot maintain pressures of 20 psi or greater at street elevation in all areas served by the booster pumps, and sufficient elevated storage is not provided.

(3) Emergency power shall consist of a dedicated on−site engine−generator set with an automatic transfer switch capable of powering at minimum the domestic service pumps and station building demands.

History: CR 09−073: cr. Register November 2010 No. 659, eff. 12−1−10.

NR 811.84 Station requirements. (1) The on−off operation of the pumps and the system pressure at the booster station shall be monitored at one of the main waterworks pumping stations, other waterworks facility, or wherever the master control panel is located. At stations serving 50 or fewer living units, monitoring may be provided by a light or an audible alarm placed in a conspicuous location outside the station to indicate pump failure. A continuous recording pressure device may be provided.

(2) Pressure gauges shall be provided on the booster pump suction and discharge lines.

(3) A flow meter shall be provided, if practical, in the booster pump discharge line. Booster pump motors shall be provided with hour meters if a flow meter will not be installed.

(4) A metal smooth end sampling faucet shall be installed on the combined booster pump discharge piping.

(5) The design shall provide for automatically bypassing the pumping units when the pumps are not operating.

(6) The design shall include piping and shut−off valves for manually bypassing the station when the station is out of service.

(7) If chemical addition is necessary, the station shall be provided with a separate chemical room meeting the requirements of subchs. VI and VII.

(8) General requirements for above grade stations are listed in subch. IV.

(9) Underground stations shall be equipped with heating, ventilation, and dehumidification equipment. Sump and sump pump equipment shall be provided unless a discharge to the ground surface can be provided. Access manways shall terminate a minimum of 24 inches above grade with an overlapping, locking cover. Sump pump discharge and vent pipes shall be metal and terminate a minimum of 24 inches above grade in a downward facing U−bend with a 24−mesh corrosion resistant screen. Chemical addition equipment may not be installed in underground stations.

History: CR 09−073: cr. Register November 2010 No. 659, eff. 12−1−10.

Subchapter XII — Waste Disposal

NR 811.85 General. The discharge of pollutants from a waterworks facility into the waters of the state or into a publicly owned treatment works, as those terms are defined in s. 283.01, Stats., shall conform to all the applicable requirements of ch. 283, Stats., and the rules adopted under ch. 283, Stats. Provisions shall be made for proper disposal of all wastes from waterworks facilities. Wastes may be from sanitary facilities, laboratories, or treatment plants. If new methods are proposed or the treatment results are uncertain, the department may require laboratory, pilot, or full−scale testing to establish design parameters. Sections NR 811.853 to 811.862 contain general standards to be utilized in meeting the requirements of ch. 283, Stats. System owners proposing discharges other than to already permitted wastewater treatment plants shall obtain a WPDES permit.

History: CR 09−073: cr. Register November 2010 No. 659, eff. 12−1−10.

NR 811.851 Sanitary wastes. Wastes from toilet facilities shall be discharged to a sanitary sewer system. The floor elevation to a building from which there is a discharge shall be constructed at least one foot above the rim of the nearest sanitary sewer manhole in accordance with s. NR 811.25 (1) (h) to prevent contamination from sewer backup. Where a sanitary sewer system is not available, the installation of an individual POWTS may be approved by the department if the installation meets ch. SPS 383 requirements and if the POWTS separation distances to a community water system well shall comply with the requirements of s. NR 811.12 (5) (d).

History: CR 09−073: cr. Register November 2010 No. 659, eff. 12−1−10; correction made under s. 13.92 (4) (b) 7., Stats., Register December 2011 No. 672.

NR 811.852 Floor drainage. Floor drains in pump stations and treatment plants shall comply with the requirements of s. NR 811.25 (1) (h).

History: CR 09−073: cr. Register November 2010 No. 659, eff. 12−1−10.

NR 811.853 Backwash wastewater from iron and manganese filters. (1) DISCHARGE TO SANITARY SEWER. Backwash wastewater from iron and manganese removal filters may be discharged to a sanitary sewer if the discharge will not overload the facilities or adversely affect the wastewater treatment process. The radionuclide content of the wastewater shall comply with s. NR 811.856. An equalization tank shall be provided when it is necessary to prevent overloading the sewers or wastewater treatment plant.

(2) DISCHARGE TO SAND FILTERS. All of the following requirements apply when sand filters are used to treat backwash wastewater from iron and manganese removal filters:

(a) Filters shall be designed for a maximum rate of 35 gallons per square foot per day except if testing indicates that higher rates will not cause excessive plugging of the media and a quality effluent can be maintained. Sufficient surface area shall be provided so that during any filtration cycle the wastewater depth over the media does not exceed 2 feet. The filters shall be sized to handle the entire backwash volume from all of the filters at the treatment plant unless the filters are washed on a rotating schedule.

(b) No filter, regardless of the volume of water to be handled, may be smaller than 100 square feet in area. Multiple units may be necessary to facilitate cleaning.

(c) The filter media shall consist of a minimum of 12 inches of sand, 3 to 4 inches of supporting small gravel or torpedo sand, and 9 inches of gravel in graded layers. All fines shall be removed from the media by washing. The filter sand shall have an effective size of 0.3 to 0.5 mm and a uniformity coefficient not exceeding 3.5.

(d) An adequate underdrainage collection system shall be provided. Provision shall be made for sampling the filter effluent.

(e) A cover shall be provided which prevents freezing during the winter months.

(f) The filter shall be located in an area not subject to flooding, and the site shall be graded to prevent ponding of surface runoff. Finished grade elevation shall be designed to facilitate maintenance, cleaning, and removal or replacement of surface sand. An overflow may not be provided.

(g) The radionuclide content of the wastewater shall comply with s. NR 811.856.

(3) DISCHARGE TO LAGOONS. Lagoons used to settle backwash wastewater from iron and manganese removal filters shall meet all of the following design requirements:

(a) Lagoons shall be designed with a volume which is 10 times the total quantity of wastewater discharged during any 24−hour period.

(b) Lagoon length shall be 4 times the width, and the width shall be at least 3 times the depth.

(c) Adequate inlet and outlet devices shall be provided so that velocity currents are minimized.

(d) The radionuclide content of the wastewater shall comply with s. NR 811.856.

(4) DISCHARGE TO DETENTION TANKS. Detention tanks used to settle backwash wastewater from iron and manganese removal filters shall meet all of the following design requirements:

(a) Detention tanks shall be designed to maximize settling by means of inlet piping and baffling configurations. Tanks shall be of sufficient capacity to hold at least 2 complete backwash cycles.

The floor shall be sloped to a sump and access manholes provided to facilitate cleaning. A cover shall be provided to prevent freezing.

(b) Pumps shall be provided to discharge the decant water to a storm sewer or receiving watercourse over approximately a 24−hour period. A convenient means of sampling the effluent shall be provided. Any discharge requires a WPDES permit. The radionuclide content of the wastewater shall comply with s. NR 811.856.

(c) Decant water to be returned to the water treatment plant shall meet the requirements of s. NR 811.862.

(d) Settled sludge removed from detention tanks shall be disposed of at a wastewater treatment plant unless the department approves an alternate disposal location on a case−by−case basis.

History: CR 09−073: cr. Register November 2010 No. 659, eff. 12−1−10.

NR 811.854 Brine wastes from ion exchange plants. The department may allow brine wastes to be discharged to a sanitary sewer system or to a watercourse if sufficient flow is available to provide adequate dilution to meet water quality or effluent standards. Dilution in streams shall be based on the 7−day low flow for the previous 10−year period. Except if discharging to large waterways or sewerage systems that will not be overloaded by the discharge, the minimum requirement shall be an equalization tank of sufficient size to allow brine discharge over a 24−hour period. The radionuclide content of the wastewater shall comply with s. NR 811.856.

History: CR 09−073: cr. Register November 2010 No. 659, eff. 12−1−10.

NR 811.855 Wastewater from reverse osmosis plants. The department may allow reject wastewater from reverse osmosis membranes to be discharged to a sanitary sewer system or to a watercourse if sufficient flow is available to provide adequate dilution to meet water quality or effluent standards. Dilution in streams shall be based on the 7−day low flow for the previous 10−year period. Except if discharging to large waterways or sewerage systems that will not be overloaded by the discharge, the minimum requirement shall be an equalization tank of sufficient size to allow reject wastewater discharge over a 24−hour period. The radionuclide content of the wastewater shall comply with s. NR 811.856.

History: CR 09−073: cr. Register November 2010 No. 659, eff. 12−1−10.

NR 811.856 Water treatment plant wastewater radionuclide content compliance with the unity equation. Levels of radium and uranium in water treatment plant wastewater to be discharged to a sanitary sewer or to surface water shall meet all of the following requirements:

(1) UNITY EQUATION. The levels of radium and uranium in the wastewater shall meet the limits of the Unity Equation as calculated based upon the requirements of the department of health services under s. DHS 157.30 (3) and Appendix E of ch. DHS 157.

(2) CALCULATIONS. (a) Unity Equation calculations shall be performed for water treatment plants treating wells with combined radium−226 and radium−228, uranium, or both exceeding the maximum contaminant level unless required by the department in individual cases or if other less common radionuclide elements may be of concern.

(b) The water system owner or its consultant shall submit the Unity Equation assumptions and calculations to the department for review and approval before, or along with, the submission of plans and specifications to the department for the radionuclide removal water treatment equipment or plant.

(3) CORRECTIVE ACTIONS. Corrective action as approved by the department shall be taken, if necessary, to maintain the result of the Unity Equation calculations as less than one.

Note: The department's Public Water Supply Section located in Madison may be contacted to obtain a copy of DNR Application of DHS Radionuclide Wastewater Disposal Criteria for help in addressing Unity Equation issues.

History: CR 09−073: cr. Register November 2010 No. 659, eff. 12−1−10; correction in (1) made under s. 13.92 (4) (b) 7., Stats., Register November 2010 No. 659.

NR 811.857 Backwash wastewater from lime softening water treatment plants. Filter backwash wastewater from lime softening water treatment plants shall be disposed of by any of the following methods:

(1) Returned to the inlet end of the plant in accordance with the requirements of s. NR 811.862.

(2) Direct or controlled discharge to a sanitary sewer system may be allowed by the department if the discharge will not overload the facilities or adversely affect the wastewater treatment process.

(3) Discharge to surface water. Suspended solids shall be removed from the filter backwash wastewater before the filter backwash wastewater is discharged to surface water. This will require settling and possibly coagulation. Any discharge requires a WPDES Permit.

History: CR 09−073: cr. Register November 2010 No. 659, eff. 12−1−10.

NR 811.858 Lime softening sludge. Sludge from plants using lime to soften water will vary in quantity and in chemical characteristics depending on the softening process and the chemical characteristics of the water being softened. The department shall determine special disposal requirements for sludge from plants treating water containing radium−226, radium−228, or uranium. These special requirements shall modify the requirements for specific disposal methods. The requirements for specific disposal methods are as follows:

(1) LAGOONS. The design shall meet the following minimum requirements:

(a) Locations free from flooding, with grading or ditching to divert surface runoff.

(b) Minimum lagoon depth of 4 to 5 feet with interior and exterior slopes of 3:1.

(c) Two years solids storage volume for temporary lagoons and 8− to 10−years storage volume for permanent lagoons.

(d) Multiple cells to provide flexibility in operation.

(e) Adjustable decanting devices.

(f) Means of convenient cleaning where appropriate.

(2) APPLICATION TO AGRICULTURAL LAND. The department may allow liquid sludge to be applied to agricultural land by tank truck if the solids do not exceed 10 to 12% by weight. This method requires proper handling facilities, vehicles, and equipment to allow hauling and spreading which does not create a nuisance. Adequate sludge holding facilities are required for use during times that trucks cannot operate. Higher solids content sludges may also be spread. However, prior to increasing the solids content the local department sludge management specialist shall be contacted to evaluate the acceptability of spreading the high solids sludge. Land application of sludge, including the radium−226 content, shall comply with the applicable requirements of s. NR 204.07.

(3) DISCHARGE TO SANITARY SEWER. Discharge to sanitary sewer may be utilized if a study or experience has shown that problems will not occur in the sewage collection system or at the wastewater treatment plant. An equalization tank may be necessary to even out flows to the sewer system. The radionuclide content of the sludge shall comply with s. NR 811.856.

(4) MECHANICAL DEWATERING. Pilot testing of mechanical dewatering is necessary to show the results that may be obtained. The department shall review and approve proposals on a case−by−

case basis to insure that water quality and effluent requirements will be met.

History: CR 09−073: cr. Register November 2010 No. 659, eff. 12−1−10.

NR 811.859 Spent media. (1) GENERAL. Spent media from water treatment plants may require special handling and disposal. The department shall evaluate on a case−by−case basis the proper handling and disposal techniques for spent media under any of the following circumstances:

(a) Granular activated carbon shall be evaluated when treating water with volatile organic compounds or radium, uranium, or radon gas.

(b) Filter sand, green sand, ion exchange media, membranes, support media, and other media that may retain radionuclide material shall be evaluated when treating water with radium−226, radium−228, or uranium.

(2) DISPOSAL APPROVAL. The department shall be contacted for approval prior to disposal of the medias listed in sub. (1). A written request indicating the type of media, the volume of media, the contaminants of concern and their concentration in the influent water and the media, the proposed method of transportation, and the proposed method of disposal shall be submitted to the department.

History: CR 09−073: cr. Register November 2010 No. 659, eff. 12−1−10.

NR 811.860 Backwash wastewater from surface water treatment plants. Filter backwash wastewater from surface water treatment plants shall be disposed of by any of the following methods:

(1) RECYCLING. Filter backwash wastewater may be returned to the inlet end of the plant in accordance with the requirements of s. NR 811.862. Membrane filtration plants may not recycle backwash wastewater unless the waste goes through coagulation and settling processes prior to being applied to the membranes. Membrane manufacturers may have specific feed water quality parameter requirements that could limit recycling. Chemical cleaning waste from membrane plants may not be recycled unless specifically approved by the department. All plants recycling filter wastewater shall have an alternative means of disposing of wastewater available during challenging raw water quality periods.

(2) DISCHARGE TO SANITARY SEWER. The wastewater program of the department may approve direct or controlled discharge to a sanitary sewer system if the discharge will not overload the facilities or adversely affect the wastewater treatment process.

(3) DISCHARGE TO SURFACE WATER. Suspended solids shall be removed from the filter backwash wastewater before the filter backwash wastewater is discharged to surface water. This will require settling and possibly coagulation. Any discharge requires a WPDES Permit. Chemical cleaning waste from membrane plants may not be discharged to surface water.

(4) TREATED BY SECONDARY MEMBRANE. The filter backwash water may be treated by a dedicated membrane system and sent to the clearwell if approved by the department in accordance with all of the following requirements:

(a) The membrane, as can be demonstrated by integrity testing conducted every 8 hours, shall provide a minimum 99.9997 percent (5.5−log) removal of *Cryptosporidium*.

(b) If the membrane cannot be demonstrated to provide a 99.9997 percent (5.5−log) removal of *Cryptosporidium*, UV shall be provided following the membrane. The membrane and UV together shall provide a minimum of 99.9997 percent (5.5−logs) of removal or inactivation of *Cryptosporidium*, or a combination of both.

(c) A target removal of less than 99.9997 percent (5.5−logs) of *Cryptosporidium* may be considered by the department if testing of the backwash water in accordance with s. NR 809.334 and bin classification in accordance with s. NR 810.34 would result in a bin classification less than Bin 4.

History: CR 09−073: cr. Register November 2010 No. 659, eff. 12−1−10.

NR 811.861 Alum or other coagulant sludge. Alum or other coagulant sludge shall be disposed of by the following methods:

(1) LAGOONS. The general design criteria for lagoons is in s. NR 811.858 (1).

(2) DISCHARGE TO SANITARY SEWERS. Discharge to sanitary sewers may be utilized if a study or experience has shown that problems will not occur in the sewage collection system or at the sewage treatment plant. A holding tank may be necessary to even out flows to the sewer system. The radionuclide content of the sludge shall comply with s. NR 811.856.

(3) MECHANICAL DEWATERING. Mechanical dewatering may be utilized if approved by the department after review of the results of testing.

(4) SUPERNATENT WATER. Any thickener supernatant or liquids from dewatering processes to be recycled shall meet the requirements of s. NR 811.862.

History: CR 09−073: cr. Register November 2010 No. 659, eff. 12−1−10.

NR 811.862 Recycling backwash wastewater. Filter and contactor backwash wastewater may be recycled if approved by the department in accordance with all of the following requirements:

(1) The filter and contactor backwash wastewater shall be settled in a settling tank or equalization basin prior to being returned to the inlet end of the plant. For surface water systems, a coagulant or polymer may be required to enhance settling to prevent protozoans such as *Giardia lamblia* and *Cryptosporidium* from concentrating. Tanks and basins shall meet all of the following minimum requirements:

(a) The tanks shall contain the anticipated volume of backwash wastewater produced by the plant when operating at design capacity.

(b) The tanks shall be of adequate size to contain the total waste washwater from 2 consecutive backwashes to provide operation flexibility.

(2) The settled filtered backwash wastewater shall be returned to the head end of the plant at a maximum rate of 10% of the instantaneous flow rate at which raw water is entering the plant. All of the following requirements shall be met:

(a) The point of recycle shall be prior to all treatment and chemical addition except chemical treatment for zebra mussel control at the intake.

(b) A meter shall be provided on the recycle line.

(c) A means shall be provided for controlling the rate at which the settled backwash wastewater is returned.

(3) For systems treating groundwater, the settled filtered backwash wastewater shall be disinfected prior to or at the time that it is returned to the head end of the plant.

(4) Reservoirs to be used to settle backwash wastewater for plants treating potable-groundwater shall be constructed to potable reservoir construction standards as required by subch. IX. The discharge of any wastewater or sludge, or both, from such a reservoir to a sanitary or storm sewer main, manhole, or other collection structure, whether by pump or by gravity, shall not be made through a direct connection. The discharge piping shall terminate downward with a one−foot free air break over the receiving structure as required in s. NR 811.64 (4).

(5) For surface water systems that recycle their backwash wastewater, all of the following reporting and record keeping requirements apply:

(a) A current plant schematic showing the origin of all recycle streams, how any recycle streams are transported, and where the

recycle streams enter the treatment process shall be maintained on file with the department.

(b) Information on the typical recycle flow rate, the highest observed plant flow rate each year, and the design flow rate of the plant shall be available to the department upon request.

(c) The information in pars. (a) and (b) along with all of the following information shall be maintained on file for a minimum of 10 years: dates when recycle flow rate has exceeded 10 percent of raw water flow rate entering the plant; how recycle flow rate is controlled; dimension and volume of backwash equalization basin; typical detention time in equalization basin; type of coagulant fed prior to equalization basin; and means of sludge removal from the equalization basin.

History: CR 09−073: cr. Register November 2010 No. 659, eff. 12−1−10.

Subchapter XIII — Aquifer Storage Recovery

NR 811.87 General. (1) Approval of the department is required prior to the construction of any aquifer storage recovery well or the conversion of any previously constructed well for use as an aquifer storage recovery well.

Note: Approval to construct or develop an aquifer storage recovery well is not an approval to operate an ASR system.

(2) Approval of the department is required prior to the operation of any aquifer storage recovery system.

Note: The department will not issue an approval to operate an ASR system until after it has reviewed and evaluated the results of an approved ASR pilot study.

(3) Only treated drinking water may be placed underground through an ASR system well.

(4) Only a municipal water system may construct an aquifer storage recovery well or operate an ASR system.

(5) The displacement zone around an ASR well may extend no further than 1,200 feet from that ASR well.

History: CR 09−073: cr. Register November 2010 No. 659, eff. 12−1−10.

NR 811.88 ASR well performance requirements. (1) Unless the department determines that it is not technically or economically feasible, the quality of the treated drinking water to be placed underground through an aquifer storage recovery well shall comply with the preventive action limits contained in ch. NR 140 prior to underground injection. In all cases, the quality of the treated drinking water to be placed underground through an aquifer storage recovery well shall meet the primary drinking water standards contained in ch. NR 809 and may not contain any substance at a concentration that exceeds a state or federal health advisory prior to underground injection.

Note: Pursuant to s. 160.19 (2) (b), Stats., the department finds that treated drinking water in a municipal water system may at times exceed preventive action limits established for iron, manganese, nitrate, nitrite, copper, lead, fluoride, asbestos, chloroform, bromoform, bromodichloromethane, and dibromochloromethane. Such exceedances may occur at the point of underground injection and within the displacement zone surrounding an aquifer storage recovery well even though the treated water being injected would remain in compliance with federal and state water quality standards for drinking water. The maximum allowable concentration of a primary drinking water contaminant in treated drinking water has been set by the United States Environmental Protection Agency at the lowest level that is considered to be technically and economically achievable at this time. The department also finds that it is not technically or economically feasible to require that residual concentrations of chloroform, bromoform, bromodichloromethane, and dibromochloromethane be removed from the injected water when a disinfection residual is desired at the wellhead to provide additional protection to the water system from potential biological contamination.

(2) All water that is retrieved through an aquifer storage recovery well shall comply with the primary drinking water standards contained in ch. NR 809 and shall be treated to provide a disinfectant residual prior to recovery into any municipal water distribution system.

(3) The quality of treated drinking water stored in a displacement zone shall at all times comply with the primary drinking water standards contained in ch. NR 809. ASR systems shall be designed and operated to maintain compliance with the groundwater standards contained in ch. NR 140, as required by s. NR 140.22. Therefore, treated drinking water stored underground in an ASR system shall comply with the applicable enforcement standards established in ch. NR 140 prior to movement beyond the property boundary of the ASR well site.

Note: An ASR well site is considered to include lands adjacent to the ASR wellhead that are directly owned by the municipal water system and any contiguous properties that are directly owned by the local unit of government of which the water system is a subunit.

(4) At the completion of each aquifer storage recovery cycle, the subsurface water in any portion of a displacement zone may not attain or exceed ch. NR 140 enforcement standards for iron, manganese, nitrate, nitrite, copper, lead, fluoride, asbestos, chloroform, bromoform, bromodichloromethane or dibromochloromethane or ch. NR 140 preventive action limits established for any other substance. The department may grant an exemption from this requirement, in accordance with s. NR 140.28, when an ASR well or ASR system is located in an area where the background concentration of a substance attains or exceeds the groundwater preventive action limit or enforcement standard established for that substance.

Note: Pursuant to s. 160.19 (2) (b), Stats., the department finds that routine operation of an ASR system may result in an exceedance of the preventive action limits established for iron, manganese, nitrate, nitrite, copper, lead, fluoride, asbestos chloroform, bromoform, bromodichloromethane, and dibromochloromethane in a displacement zone. An ASR cycle is normally completed when the volume of water recovered equals the volume of water that was originally injected; however, the department recognizes that some of the treated drinking water injected during an aquifer storage recovery cycle may remain in an aquifer at the completion of the cycle and that substances present in this residual treated drinking water may result in ch. NR 140 preventive action limits being exceeded in an aquifer at the completion of an aquifer storage recovery cycle.

History: CR 09−073: cr. Register November 2010 No. 659, eff. 12−1−10.

NR 811.89 Well construction requirements for ASR wells. (1) Each well constructed or converted for use as an aquifer storage recovery well shall be completed in a manner that complies with the well construction requirements established in ss. NR 811.12 to 811.20.

(2) Any monitoring well constructed on an ASR well site shall comply with the well construction requirements established in ss. NR 811.12 to 811.20. For the purpose of this subsection, an ASR well site is considered to include only those lands adjacent to the ASR wellhead that are directly owned by the municipal water system.

(3) Each monitoring well that is located beyond the property boundary of an ASR well site and that is constructed as part of an ASR system pilot study, ASR system development study, or for ASR operational monitoring shall comply with the monitoring well construction requirements established in ch. NR 141. For the purpose of this subsection, an ASR well site is considered to include only those lands adjacent to the ASR wellhead that are directly owned by the municipal water system.

(4) Each aquifer storage recovery well shall be enclosed within a lockable protective structure that is secured from tampering or unauthorized entry in a manner that is approved by the department.

(5) Each monitoring well shall be enclosed within a lockable protective covering and secured from tampering or unauthorized entry in a manner that is approved by the department.

History: CR 09−073: cr. Register November 2010 No. 659, eff. 12−1−10.

NR 811.90 Equipment, appurtenances and piping for ASR wells and ASR systems. (1) Pumping equipment, appurtenances and piping that are to be installed as part of an ASR system shall comply with the requirements of ss. NR 811.30 to 811.37.

(2) Department approval shall be obtained prior to installation or modification of any well, pumping equipment, appurtenances or piping for the purpose of aquifer storage recovery.

(3) Security shall be provided for each ASR well site in a manner that is approved by the department.

History: CR 09−073: cr. Register November 2010 No. 659, eff. 12−1−10.

NR 811.91 ASR system pilot studies. (1) Department approval is required prior to conducting any ASR system pilot study.

(2) Only a municipal water system may perform an ASR system pilot study.

(3) A request to conduct an ASR system pilot study shall be submitted to the department in writing. The request shall identify the location of each existing well that is being considered for use as an ASR well within the proposed ASR system, the location of any new well that is anticipated to be constructed for use as an ASR well within the proposed ASR system and any additional wells that are to be used or constructed as part of the ASR system pilot study.

(4) Each request to conduct an ASR system pilot study shall contain all of the following:

(a) A preliminary hydrogeologic report that describes the methods and results of any hydrologic investigation, aquifer testing, hydrogeologic modeling or geochemical modeling performed to identify the location of the proposed ASR system well sites. The preliminary hydrogeologic report shall identify the location of each existing public or private water well and each potential source of groundwater contamination that is located within 1200 feet of the outer perimeter of the displacement zone that is calculated to be established around each of the proposed ASR wells within the proposed ASR system. The report shall also identify the well selected for further evaluation during the ASR well pilot test, identify the dimensions of the displacement zone that will be created around the designated test well, and describe the current and anticipated groundwater flow patterns found in the vicinity of the designated test well.

(b) A preliminary engineering report that provides an analysis of the technical feasibility for developing each of the potential ASR wells identified for the proposed ASR system and estimates the probable percentage of treated drinking water that would be recovered from each of the potential ASR wells during an ASR cycle.

(c) Plans and specifications for any well equipment, pumping equipment, appurtenances or piping that is to be constructed or altered in order to complete the proposed ASR system pilot study.

(d) A description of all operating procedures to be followed during the ASR well pilot study. This description shall contain details including the maximum volume of water to be placed underground, the flow rate and pressure of underground injection, the expected water storage period, anticipated water retrieval rates, and methods proposed for disposing of the water recovered during the ASR system pilot study.

(e) A description of all performance and compliance monitoring procedures to be followed during the ASR system pilot study. This description shall include a listing of the sampling locations, methods and schedules that will be used to ensure that the aquifer storage recovery well remains in compliance with the performance requirements set forth in s. NR 811.88.

(f) Plans and specifications for each monitoring well proposed as part of the ASR system pilot study. A minimum of one monitoring well is required as part of the ASR system pilot study. The department may require additional monitoring wells should the proposed ASR system encompass multiple or otherwise unique geologic formations. The department may also waive the monitoring well requirement if water quality data from other ASR system pilot studies conducted in similar geologic conditions is submitted as part of the ASR system pilot study request and is determined to be applicable by the department.

(5) The department may require modification of plans and specifications, operating procedures or compliance and monitoring procedures required in sub. (4) to ensure that compliance with the performance requirements in s. NR 811.88 can be determined.

(6) Within 180 days after completing an approved ASR system pilot study or prior to recovering any water retrieved through an ASR well into a water distribution system, a municipal water system shall submit a final report on the ASR system pilot study to the department.

History: CR 09−073: cr. Register November 2010 No. 659, eff. 12−1−10.

NR 811.92 ASR system development testing. (1) Department approval shall be obtained prior to any ASR system development testing.

(2) Following the completion of an approved ASR system pilot study, each additional ASR well that is to be developed within an ASR system shall be subject to ASR system development testing.

(3) The department may require monitoring wells to be installed as part of an ASR system development test if it finds any of the following:

(a) Geologic conditions in the vicinity of the proposed ASR well are not consistent with the conditions examined during the municipal water system's ASR system pilot study.

(b) Geologic conditions in the vicinity of the proposed ASR well are not consistent with the conditions reported in other ASR system pilot studies or ASR system development tests performed by other municipal water systems.

(c) Results obtained during the municipal water system's ASR system pilot study or other aquifer tests indicate that additional monitoring is warranted to ensure compliance with the water quality standards established in chs. NR 140 and 809.

(4) Each request for an ASR system development test shall include a report or testing plan that contains the following:

(a) A comparison of the hydrogeologic conditions and formations found at the ASR system pilot study well site and any well site that is to be evaluated as part of the ASR system development testing request.

(b) An evaluation of the municipal water system's ASR system pilot test results and the transferability of those results to any well that is to be included as part of the ASR system development test.

(c) Plans and specifications for any well equipment, pumping equipment, appurtenances or piping that is to be constructed or altered as part of the ASR system development test.

(d) A description of all operating procedures to be followed during the ASR system development test. This description shall contain details such as, but not limited to, the volume of water to be placed underground, the flow rate and pressure of underground injection, backflushing schedules, the expected water storage period, anticipated water retrieval rates and methods for disposing of water recovered during the ASR system development test.

(e) A description of all performance and compliance monitoring procedures to be followed during the ASR system development test.

(f) A description of any monitoring wells proposed to be constructed or utilized during the ASR system development test.

(5) The department may require modification of plans and specifications, operating procedures or compliance and monitoring procedures required under sub. (4) to ensure that compliance with the performance requirements in s. NR 811.88 can be determined.

(6) Within 180 days after completing an approved ASR system development test or prior to recovering any water retrieved through any newly developed aquifer storage recovery well into a water distribution system, the municipal water system conducting the test shall submit a final report containing the final results of the investigation to the department.

(7) The department may deny a request to perform an ASR system development test if it determines that the test cannot be conducted in a manner that is protective of human health or the

environment. Whenever a request to perform an ASR system development test is denied, the department shall provide the person who submitted the request for an ASR development test with a written explanation of the reasons for denying the request.

History: CR 09−073: cr. Register November 2010 No. 659, eff. 12−1−10.

NR 811.93 Operating an ASR system. (1) Department approval to operate an ASR system shall be obtained prior to recovery of any water retrieved through an aquifer storage recovery well into a municipal water system.

(2) Only the owner of a municipal water system may submit a request to operate an ASR system.

(3) Completion of an ASR pilot study is required before a municipal water system may submit a request to operate an ASR system.

(4) Completion of an ASR system development test and approval of the department is required before any additional aquifer storage recovery well that was not approved as part of an original request to operate an ASR system is connected to the existing ASR system.

(5) A request to operate an ASR system shall be submitted to the department in writing and shall contain the following:

(a) A copy of the final report of the approved ASR system pilot study and copies of any approved ASR system development studies conducted by the municipal water system.

(b) A final plans and specifications report that describes the components of the ASR system. The final plans and specifications report shall include as built drawings for each aquifer storage recovery well and each monitoring well that was constructed as part of the ASR system pilot study or ASR system development study. The report shall also include descriptions of pumping equipment, piping and other appurtenances that are installed or required for ASR system operation.

(c) A proposed final operating plan that describes the entire ASR cycle and shows how the ASR system will be integrated into municipal water system operations. The proposed final operating plan shall contain details including the total volume of water to be injected, rate of injection, pressure of injection, length of the water storage period, rate of recovery, post−recovery water treatment techniques necessary to maintain a distribution system disinfectant residual, and methods for disposing of any water that cannot be recovered into the water distribution system.

(d) A proposed demand management and water accountability plan that describes actions which the municipal water system is currently conducting or will be initiating to ensure that groundwater and surface water resources are conserved and used as efficiently as possible.

(e) A proposed compliance and monitoring plan that lists all sampling parameters and provides details on monitoring schedules, monitoring locations, sampling methods and quality assurance techniques that will be followed to ensure that compliance with the requirements set forth in s. NR 811.88 is maintained. The compliance and monitoring plan shall provide for testing of the water that is to be injected, stored and recovered through each aquifer storage recovery well and for the groundwater present in any monitoring well that is installed as part of the ASR system. Parameters to be analyzed for each water quality sample collected, the locations for sample collection and the frequency at which water quality samples are to be collected shall be determined by the department following a review of the final ASR system pilot study report or ASR system development study report, the proposed operating plan, the proposed monitoring plan and the drinking water quality monitoring schedule currently followed by the municipal water system. Unless otherwise specified by the department, all water quality results obtained from ASR system compliance monitoring activities shall be compiled and submitted to the department on an annual basis and at least 45 days prior to the start of each new ASR cycle.

(6) The department may require modification of any plans and specifications, operating plans, demand management and water accountability plans or compliance and monitoring plans required in sub. (5) in any manner necessary to ensure compliance with the performance standards set forth in s. NR 811.88.

(7) If requested, the department may consider and approve the modification of plans and specifications, operating plans, demand management and water accountability plans or compliance and monitoring plans required in sub. (5) if information submitted in support of a requested modification demonstrates to the satisfaction of the department that the proposed modifications will continue to ensure compliance with the standards set forth in s. NR 811.88 and any other applicable requirements contained in ch. NR 811.

History: CR 09−073: cr. Register November 2010 No. 659, eff. 12−1−10.