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Details:

(FORM UPDATED: 08/11/2010)

**WISCONSIN STATE LEGISLATURE ...
PUBLIC HEARING - COMMITTEE RECORDS**

2009-10

(session year)

Joint

(Assembly, Senate or Joint)

**Committee for Review of Administrative Rules
(JCR-AR)**

COMMITTEE NOTICES ...

- Committee Reports ... **CR**
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INFORMATION COLLECTED BY COMMITTEE FOR AND AGAINST PROPOSAL

- Appointments ... **Appt** (w/Record of Comm. Proceedings)
- Clearinghouse Rules ... **CRule** (w/Record of Comm. Proceedings)
- Hearing Records ... bills and resolutions (w/Record of Comm. Proceedings)
(**ab** = Assembly Bill) (**ar** = Assembly Resolution) (**ajr** = Assembly Joint Resolution)
(**sb** = Senate Bill) (**sr** = Senate Resolution) (**sjr** = Senate Joint Resolution)
- Miscellaneous ... **Misc**

CT Values for Inactivation of *Giardia lamblia* Cysts by Free Chlorine
25°C (77°F)

Chlorine Concentration (mg/L)	pH ≤ 6					pH = 6.5					pH = 7.0					pH = 7.5								
	0.5	1	1.5	2	2.5	3	0.5	1	1.5	2	2.5	3	0.5	1	1.5	2	2.5	3	0.5	1	1.5	2	2.5	3
≤0.4	4	8	12	16	20	24	5	10	15	19	24	29	6	12	18	23	29	35	7	14	21	28	35	42
0.6	4	8	13	17	21	25	5	10	15	20	25	30	6	12	18	24	30	36	7	14	22	29	36	43
0.8	4	9	13	17	22	26	5	10	16	21	26	31	6	12	19	25	31	37	7	15	22	29	37	44
1	4	9	13	17	22	26	5	10	16	21	26	31	6	12	19	25	31	37	8	15	23	30	38	45
1.2	5	9	14	18	23	27	5	11	16	21	27	32	6	13	19	25	32	38	8	15	23	31	38	46
1.4	5	9	14	18	23	27	6	11	17	22	28	33	7	13	20	26	33	39	8	16	24	31	39	47
1.6	5	9	14	19	23	28	6	11	17	22	28	33	7	13	20	27	33	40	8	16	24	32	40	48
1.8	5	10	15	19	24	29	6	11	17	23	28	34	7	14	21	27	34	41	8	16	25	33	41	49
2	5	10	15	19	24	29	6	12	18	23	29	35	7	14	21	27	34	41	8	17	25	33	42	50
2.2	5	10	15	20	25	30	6	12	18	23	29	35	7	14	21	28	35	42	9	17	26	34	43	51
2.4	5	10	15	20	25	30	6	12	18	24	30	36	7	14	22	29	36	43	9	17	26	35	43	52
2.6	5	10	16	21	26	31	6	12	19	25	31	37	7	15	22	29	37	44	9	18	27	35	44	53
2.8	5	10	16	21	26	31	6	12	19	25	31	37	8	15	23	30	38	45	9	18	27	36	45	54
3	5	11	16	21	27	32	6	13	19	25	32	38	8	15	23	31	38	46	9	18	28	37	46	55

Chlorine Concentration (mg/L)	pH = 8.0					pH = 8.5					pH ≤ 9.0							
	0.5	1	1.5	2	2.5	3	0.5	1	1.5	2	2.5	3	0.5	1	1.5	2	2.5	3
≤0.4	8	17	25	33	42	50	10	20	30	39	49	59	12	23	35	47	58	70
0.6	9	17	26	34	43	51	10	20	31	41	51	61	12	24	37	49	61	73
0.8	9	18	27	35	44	53	11	21	32	42	53	63	13	25	38	50	63	75
1	9	18	27	36	45	54	11	22	33	43	54	65	13	26	39	52	65	78
1.2	9	18	28	37	46	55	11	22	34	45	56	67	13	27	40	53	67	80
1.4	10	19	29	38	48	57	12	23	35	46	58	69	14	27	41	55	68	82
1.6	10	19	29	39	48	58	12	23	35	47	58	70	14	28	42	56	70	84
1.8	10	20	30	40	50	60	12	24	36	48	60	72	14	29	43	57	72	86
2	10	20	31	41	51	61	12	25	37	49	62	74	15	29	44	59	73	88
2.2	10	21	31	41	52	62	13	25	38	50	63	75	15	30	45	60	75	90
2.4	11	21	32	42	53	63	13	26	39	51	64	77	15	31	46	61	77	92
2.6	11	22	33	43	54	65	13	26	39	52	65	78	16	31	47	63	78	94
2.8	11	22	33	44	55	66	13	27	40	53	67	80	16	32	48	64	80	96
3	11	22	34	45	56	67	14	27	41	54	68	81	16	32	49	65	81	97

Note:

CT values between the indicated pH values may be determined by linear interpolation.

CT values between the indicated temperatures of different tables may be determined by linear interpolation.

If no interpolation is used, use the CT value at the lower temperature and at the higher pH.

NR 810.53 CT table for viruses when using free chlorine

CT Values for Inactivation of Viruses by Free Chlorine								
Temperature (C)	Log Inactivation							
	1.0 pH		2.0 pH		3.0 pH		4.0 pH	
	6 - 9	10	6 - 9	10	6 - 9	10	6 - 9	10
0.5	3	23	6	45	9	66	12	90
5	2	15	4	30	6	44	8	60
10	2	11	3	22	4	33	6	45
15	1	8	2	15	3	22	4	30
20	1	6	1	11	2	16	3	22
25	1	3	1	7	1	11	2	15

NR 810.54 CT table for *Giardia lamblia* when using chlorine dioxide

CT Values for Inactivation of <i>Giardia lamblia</i> Cysts by Chlorine Dioxide						
Inactivation	Temperature (C)					
	≤1	5	10	15	20	25
0.5-log	10	4.3	4	3.2	2.5	2
1-log	21	8.7	7.7	6.3	5	3.7
1.5-log	32	13	12	10	7.5	5.5
2-log	42	17	15	13	10	7.3
2.5-log	52	22	19	16	13	9
3-log	63	26	23	19	15	11

NR 810.55 CT table for viruses when using chlorine dioxide

CT Values for Inactivation of Viruses by Chlorine Dioxide pH 6-9						
Inactivation	Temperature (C)					
	≤1	5	10	15	20	25
2-log	8.4	5.6	4.2	2.8	2.1	1.4
3-log	25.6	17.1	12.8	8.6	6.4	4.3
4-log	50.1	33.4	25.1	16.7	12.5	8.4

NR 810.56 CT table for *Cryptosporidium* when using chlorine dioxide¹

Log credit	Water Temperature, °C										
	≤0.5	1	2	3	5	7	10	15	20	25	30
0.25	159	153	140	128	107	90	69	45	29	19	12
0.5	319	305	279	256	214	180	138	89	58	38	24
1.0	637	610	558	511	429	360	277	179	116	75	49
1.5	956	915	838	767	643	539	415	268	174	113	73
2.0	1275	1220	1117	1023	858	719	553	357	232	150	98
2.5	1594	1525	1396	1278	1072	899	691	447	289	188	122
3.0	1912	1830	1675	1534	1286	1079	830	536	347	226	147

¹Systems may use this equation to determine log credit between the indicated values: $\text{Log credit} = (0.001506 \times (1.09116)^{\text{Temp}}) \times \text{CT}$.

NR 810.57 CT table for *Giardia lamblia* when using chloramines

CT Values for Inactivation of <i>Giardia lamblia</i> Cysts by Chloramine pH 6-9						
Inactivation	Temperature (C)					
	≤1	5	10	15	20	25
0.5-log	635	365	310	250	185	125
1-log	1,270	736	615	500	370	250
1.5-log	1,900	1,100	930	750	550	375
2-log	2,535	1,470	1,230	1,000	735	500
2.5-log	3,170	1,830	1,540	1,250	915	625
3-log	3,800	2,200	1,850	1,500	1,100	750

NR 810.58 CT table for viruses when using chloramines

CT Values for Inactivation of Viruses by Chloramine						
Inactivation	Temperature (C)					
	≤1	5	10	15	20	25
2-log	1,243	857	643	428	321	214
3-log	2,063	1,423	1,067	712	534	356
4-log	2,883	1,988	1,491	994	746	497

NR 810.59 CT table for *Giardia lamblia* when using ozone

CT Values for Inactivation of <i>Giardia lamblia</i> Cysts by Ozone						
Inactivation	Temperature (C)					
	≤1	5	10	15	20	25
0.5-log	0.48	0.32	0.23	0.16	0.12	0.08
1-log	0.97	0.63	0.48	0.32	0.24	0.16
1.5-log	1.5	0.95	0.72	0.48	0.36	0.24
2-log	1.9	1.3	0.95	0.63	0.48	0.32
2.5-log	2.4	1.6	1.2	0.79	0.60	0.40
3-log	2.9	1.9	1.43	0.95	0.72	0.48

NR 810.60 CT table for viruses when using ozone

CT Values for Inactivation of Viruses by Ozone						
Inactivation	Temperature (C)					
	≤1	5	10	15	20	25
2-log	0.9	0.6	0.5	0.3	0.25	0.15
3-log	1.4	0.9	0.8	0.5	0.4	0.25
4-log	1.8	1.2	1.0	0.6	0.5	0.3

NR 810.61 CT table for *Cryptosporidium* when using ozone¹

Log credit	Water Temperature, °C										
	≤0.5	1	2	3	5	7	10	15	20	25	30
0.25	6.0	5.8	5.2	4.8	4.0	3.3	2.5	1.6	1.0	0.6	0.39
0.5	12	12	10	9.5	7.9	6.5	4.9	3.1	2.0	1.2	0.78
1.0	24	23	21	19	16	13	9.9	6.2	3.9	2.5	1.6
1.5	36	35	31	29	24	20	15	9.3	5.9	3.7	2.4
2.0	48	46	42	38	32	26	20	12	7.8	4.9	3.1
2.5	60	58	52	48	40	33	25	16	9.8	6.2	3.9
3.0	72	69	63	57	47	39	30	19	12	7.4	4.7

¹Systems may use this equation to determine log credit between the indicated values: $\text{Log credit} = (0.0397 \times (1.09757)^{\text{Temp}}) \times \text{CT}$.

NR 810.62 UV dose table for *Cryptosporidium*, *Giardia lamblia*, and viruses

Log credit	<i>Cryptosporidium</i> UV dose (mJ/cm ²)	<i>Giardia lamblia</i> UV dose (mJ/cm ²)	Virus UV dose (mJ/cm ²)
0.5	1.6	1.5	39
1.0	2.5	2.1	58
1.5	3.9	3.0	79
2.0	5.8	5.2	100
2.5	8.5	7.7	121
3.0	12	11	143
3.5	15	15	163
4.0	22	22	186

SECTION 3. NR 811 is repealed and recreated to read:

Chapter NR 811
DESIGN REQUIREMENTS FOR
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 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.

APPENDIX

- Figure No. 1 Pump capacities for domestic water service.
- Figure No. 2 Line-shaft vertical turbine pump base installation. (No outer well casing)
- Figure No. 3 Line-shaft vertical turbine pump base installation. (With an inner ungrouted well casing)
- Figure No. 4 Submersible vertical turbine pump base installation. (Without an outer casing)
- Figure No. 5 Submersible vertical turbine pump base installation. (With an inner ungrouted well casing)
- Figure No. 6 Submersible vertical turbine pump base installation. (With an outer well casing installed to provide a protective collar.)
- Figure No. 7 Pitless unit installations.
- Figure No. 8 Example line-shaft vertical turbine pump and discharge piping installation.
- Figure No. 9 Example submersible vertical turbine pump and discharge piping installation.
- Figure No. 10 Common trench installation requirements for water main and sanitary or storm sewers.
- Figure No. 11 Acceptable water loading station devices.

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.

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 two 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 the effective date of this section...[LRB inserts date] shall be upgraded when improvements are undertaken at those facilities except for systems 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 the effective date of this section...[LRB inserts date] 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.

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 known 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 owners 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:

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

$$CT_{table}$$

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. Comm 81.

(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:
- 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.
 - 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 regulation and licensing.

(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: s. 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. Comm 81.

(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. and obtained a license under s. 280.15 (2m) 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 six 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.

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.

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.

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.

NR 811.06 Cross-connections and interconnections. Unprotected cross-connections are prohibited. Cross-connections shall be protected as required in s. comm. 82.41. Water system interconnections are prohibited except as provided in s. NR 811.07.

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.

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 chs. NR 108, NR 810, and this chapter. 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 ss. 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.

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 commerce, 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 commerce 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 commerce Storage Tank Database Information can be found on the department of commerce 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) (a), 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.

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.

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.

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 two 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 the effective date of this section...[LRB inserts date] 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 (73).

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 department 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. Comm 10.260 and receive written approval from the department of commerce or its designated Local Program Operator under s. Comm 10.110.

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 two 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. Comm 10.260 and receive written approval from the department of commerce or its designated Local Program Operator under s. Comm 10.110. 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. Comm 10.260 and receive written approval from the department of commerce or its designated Local Program Operator under s. Comm 10.110. 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. Comm 10.260 and receive written approval from the department of commerce or its designated Local Program Operator under s. Comm 10.110. 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 commerce or its designated Local Program Operator under s. Comm 10.110 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), 292.3T (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 commerce Storage Tank Database Information can be found at the department of commerce 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 casing 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 commerce under s. Comm 5.20.
 - (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 ss. 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 I 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 chs. NR 141, NR 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 converted into final wells shall be submitted to the department for review and approval.

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 four 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.

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.

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.

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).

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.

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.

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.

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.

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.

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 organism where necessary in accordance with s. NR 811.232.

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.

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.

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:

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

(b) 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.

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

(d) 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.

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.

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 ss. 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 commerce 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. Comm 83.43 (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 two 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 commerce 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. Comm 2, 5 and 81 to 84.

(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.

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 two 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.

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 NR 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 commerce or its authorized agent under ch. Comm 10 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. Comm 82.41.

(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.

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 two 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 Comm table 84.30-7 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 commerce 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) <i>Water Lines</i>	<i>Color</i>
Raw	Olive Green
Settled or Clarified	Aqua
Finished or Potable	Dark Blue
(b) <i>Chemical Lines</i>	<i>Color</i>
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) <i>Waste Lines</i>	<i>Color</i>
Backwash Waste	Light Brown
Sludge	Dark Brown
Sewer - Sanitary or Other	Dark Gray
(d) <i>Other Lines</i>	<i>Color</i>
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 two 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.

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.

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.

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.

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 two 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 Comm table 84.30-7.

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.

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.

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 812.34 (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 pitless 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.

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.

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).

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.

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 two 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 subs. 3. a. and 3. 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 per cent of the maximum stroke length. Peristaltic chemical feed pumps shall be operated at a minimum of 10 per cent 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 two 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.