Part 11 NON-COMMUNITY WATER SYSTEMS

11.1 Introduction and Definitions

11.1.0 General

This part provides regulation and guidance for potable water sources, storage, and distribution systems serving **Public Non-Transient Non-Community** water systems and **Public Transient Non-Community** water systems. Information to be submitted with permit applications, methodologies to be used in source evaluation, and minimum standards for construction and operation of such systems are provided.

Public Transient Non-Community water systems are administered by the Department's Drinking Water and Groundwater Protection Division.

These standards and limits represent minimum criteria. Designers should note that the use of this part requires professional judgement. The standards are minimal and the safety factors are marginal, and will not yield satisfactory designs, by themselves, in all situations.

These regulations have two principal goals:
(a) the prevention of health hazards caused by water sources of inadequate quality and quantity; and
(b) the assurance that water sources and distribution systems are adequate for the needs of a project.

11.1.1 Alternative Designs

The professional engineer may propose alternative engineering designs for water systems and justify the design based on its reliability in providing water of adequate quality and quantity for the size and nature of the project.

11.1.2 Definitions

The following definitions apply for the purposes of this Part (Appendix A Part 11); additional definitions are contained in Subchapter 21-2.

AVERAGE DAY DEMAND - The volume of water anticipated to be used by a particular building or project in a 24 hour period; expressed in gallons per day (gpd).

CONSTANT DISCHARGE PUMPING TEST - A test of a water source in which the well is pumped for a specified duration at one flow rate to determine the yield of the well, aquifer characteristics and/or well interference.

FLOOD PLAIN - Any area which is flooded with an average frequency of once or more in each 100 years as determined by the Secretary.

FLOODWAY - The channel of a river or other water course and the adjacent land areas that must be reserved in order to discharge a 100 year frequency flood without cumulatively increasing the water surface elevation more than one foot.

HYDROFRACTURING - A method of bedrock well development used to increase the yield of wells, in which high pressures are generated in the well to open fractures. Propping agents may be introduced to keep the fractures open.

HYDROGEOLOGIC CONNECTION - A situation where a water source is down- gradient of a potential source of contamination under either natural groundwater flow conditions or pumping conditions.

INSTANTANEOUS PEAK DEMAND - The instantaneous flow rate that the system must satisfy. This is determined by the number and type of plumbing fixtures on it.

LICENSED WELL DRILLER - An individual licensed under the Vermont Well Driller Licensing Rules and Standards.

LONG-TERM YIELD - The amount of water that the source is capable of providing on a daily basis over the design life of the project; expressed in gallons per minute (gpm).

MAXIMUM DAY DEMAND - For **Public Non-Transient Non-Community** water systems and **Public Transient Non-Community** water systems, the rate at which the average day demand is to be used by a particular building or project divided by not more than 720 minutes; expressed in gallons per minute (gpm).

QUALIFIED CONSULTANT - Certified Site Technician, or Vermont Registered Professional Engineer, working within the scope of his or her certification and expertise.

SHALLOW WATER SOURCE - A developed structure to collect groundwater, generally less than 20 feet deep. This includes springs, dug wells, jetted wells, drilled wells, and well points, and other water intake structures which may or may not be under the jurisdiction of the Vermont Well Driller's Rules and Construction Standards.

SOURCE INTERFERENCE - **Public** water systems and potable water supplies affected by the pumping of other proposed or existing sources.

STATE ELECTRICAL CODE - State of Vermont Electrical Safety Rule adopted by the Vermont Department of Public Safety per 26 V.S.A. §891.

STATE PLUMBING CODE - State of Vermont Plumbing Rule, adopted by the Vermont Department of Public Safety per 26 V.S.A. §2173.

TOTAL AVAILABLE HEAD - The difference in elevation between the static water level and the hydraulic base of a well.

WATER SOURCE - An existing or permitted water well or shallow water source designed to collect potable groundwater.

WATER SYSTEM - The source, pumping facility, storage, distribution system and related appurtenances used to provide potable water.

11.2 Preconstruction Requirements

11.2.0 General

For all **Public Non-Transient Non-Community** water systems and **Public Transient Non-Community** water systems, a water source site plan, basis of design statement, and design plans and specifications, along with all available information on the source, must be submitted with the permit application. In addition, a Long Range Plan, Source Protection Plan, and Engineer's Report, as required by Subchapters 4.2.2, 5.5(e), 15.1, and 16.1, must be submitted for new **Public Non-Transient Non-Community** water systems. Some of this information may be developed in pre-application work and may require review and approval by the Secretary before an application will be considered complete.

Increased demands to existing or previously approved **Public Non-Transient Non-Community** water systems and **Public Transient Non-Community** water systems will require analysis of additional maximum day demand and/or instantaneous peak demand.

11.2.1 Basis of Design

A statement of the basis of design, and supporting calculations, shall include:
(a) Average Day Demand;
(b) Maximum Day Demand;
(c) Instantaneous Peak Demand;
(d) Source Capacity;
(e) Storage Capacity;
(f) Pump Capacities;
(g) Operating Pressure Ranges; and
(h) reference to the flood plain

11.2.2 Water Source Site Plan

A water source site plan shall include:
(a) plan view at a scale of 1" = 200', or larger;
(b) surface drainage features and general topography;
(c) potential sources of contamination within the distances listed in Appendix A Part 11 Tables 11-1 and 11-2;
(d) neighboring wells as shown in the interference monitoring distance table; and
(e) minimum separation zones per Appendix A Subpart 11.4.1.

11.2.3 Design Plans and Specifications

The design plans and specifications shall include:
(a) source development, transmission, storage and distribution;
(b) system component site plan at a scale of 1" = 100', or larger;
(c) piping, valving and standard pressure; and
(d) specific construction instructions.

11.2.4 Source Development and Testing

11.2.4.1 Projects with Maximum Day Demand of 5 gpm or less

These projects will be permitted prior to water source development unless there is reason to suspect that sufficient water may not be available, in which case the Secretary may:
(a) require that the water source be developed and tested before the permit is issued; or
(b) issue a permit with a condition that the water source be developed and tested before a subdivision is created, a building is constructed or a mobile home park is established.

11.2.4.2 Projects with Maximum Day Demand of More Than 5 gpm

These projects will not normally be permitted before the source is developed and tested, unless:
(a) the applicant demonstrates a high probability of adequate yield and quality from the proposed water source. In such a case the source must be developed, tested and analyzed in accord with Subpart 11.6 prior to the creation of subdivision lots, construction of buildings or the establishment of a mobile home park.

11.2.4.3 Subdivision With Individual On-Site Sources

These projects are normally approved prior to source development. Multiple lot subdivisions may need to show evidence that adequate yields are likely to be available, and/or that proposed sources are not likely to cause unacceptable interference in nearby existing or permitted water sources.

11.3 Water System Demand

11.3.0 Average Day Demand

(a) For **Public** water systems, the average day demand shall be determined according to the design flows per Appendix A, Part 2, Table A2-1 of this rule.
(b) For residential units average day demand shall be 90% of the design flow.
(c) Installation of low flow plumbing fixtures, 3.5 gallon or less flush toilets, 3.0 gallon per minute or fewer showerheads, and faucet aerators will allow for a 10% reduction in design flows as calculated from Table A2-1.

11.3.1 Maximum Day Demand

The maximum day demand is calculated by dividing the average day demand by not more than 720 minutes. The resulting flow rate is expressed in gallons per minute.

11.3.2 Instantaneous Peak Demand

The instantaneous peak demand, expressed in gallons per minute (gpm), shall be calculated as follows:

(a) determined by the State Plumbing Code; or

(b) for residential units only, the instantaneous peak demand equals 5 gpm multiplied by the number of units.

11.4 Isolation and Separation Distances

11.4.0 General

The proposed site of the water source for the building or project shall be approved by the Secretary before the source is developed.

Adequate horizontal isolation distances between wells and potential sources of contamination are required. The required horizontal minimum distances are listed in Tables A11-1 and A11-2 below. Qualified consultants, Site Technicians, Professional Engineers or Hydrogeologists, as appropriate, are responsible for assuring that these minimums are adequate for individual cases, and should increase them as they deem appropriate in their professional judgement. The Secretary may increase the minimum horizontal isolation distances in Tables A11-1 and A11-2 or prescribe any additional safeguards it deems necessary when the depth to the aquifer or the nature of overburden material is not sufficient to protect the water source from pollution. The Secretary will consider permitting reductions of these individual cases only on the written request of the qualified consultants, which technically justifies the reduction in a particular case.

The minimum recommended horizontal isolation distances in these regulations from water systems to sewage systems are based on sewage treatment in soils, pathogen attenuation, effluent travel time in soil and dispersion, without site specific hydrogeologic information. Site specific data may be collected and justification made for reducing the distances listed in Tables A11-1 and A11-2.

Table A11-1 - REQUIRED HORIZONTAL MINIMUM SEPARATION DISTANCES

POTENTIAL SOURCE OF CONTAMINATION AND OTHER SITING LIMITATIONS	SEPARATION DISTANCE
Roadway, Parking Lot (outer edge of shoulder)	25 Feet
Driveway (Fewer than 3 residences)	15 Feet
Sewage System Disposal Fields	(See a.)

POTENTIAL SOURCE OF CONTAMINATION AND OTHER SITING LIMITATIONS	SEPARATION DISTANCE
Subsurface Wastewater Piping and Related Tanks	50 Feet
Property Line	10 Feet (See b.)
Limit of Herbicide Application on utility R O W	100 Feet (See c.)
Surface Water	10 Feet (See d.)
Flood ways	(See e.)
Buildings	10 Feet
Concentrated Livestock Holding Areas and Manure Storage Systems	200 Feet
Hazardous or Solid Waste Disposal Site	(See f.)
Non-sewage Wastewater Disposal Fields	(See f.)

a. See Table A11-2
b. Increased to 50' when adjacent to agricultural cropland.
c. Applies to rights-of-way (ROW) where herbicides have been applied in the past 12 months or may be applied in the future. This distance may be increased to 200' depending on the active ingredient in the herbicide according to Vermont Regulations for Control of Pesticides.
d. For Public water sources, see Appendix A, Part 3, Subpart 3.4.
e. Water sources shall not be located in a flood way.
f. If a water source is potentially downgradient of a source of contamination, then the Secretary shall apply the criteria in Appendix A Subpart 11.4.2.2.

Table A11-2 - REQUIRED MINIMUM HORIZONTAL SEPARATION DISTANCES TO SEWAGE SYSTEM DISPOSAL FIELDS[1,2] (Feet)

	Water Source Maximum Daily Demand (GPM)			
Design Flow of Domestic Sewage System Disposal Field (GPD)	0-1.9	2.0-4.9	5.0-7.9	>8.0
Fewer than 2,000	100	150	200	200+[a]
2,000 through 6,499	150	150	200	200+[a]
Equal to or Greater than 6,500	200++[b]	200++[b]	200++[b]	200+[a]

1 The minimum separation distance, (X), is used to determine the minimum separation zone (see Appendix A Subpart 11.4.1 and Figure 11-1).
2 For shallow water sources the minimum separation distance, X, per Subpart 11.4.1, shall not be less than 150 feet, and the minimum upslope separations distance shall be 500 feet instead of 2X regardless of the minimum separation distance, X, listed. If the bottom of

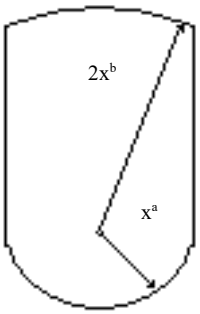
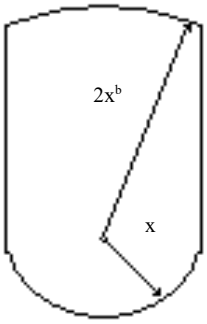
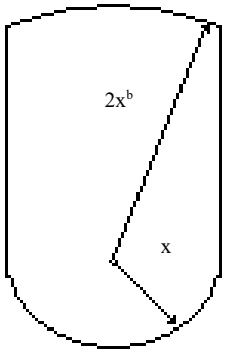
the well or spring is higher than the ground surface at the disposal field then the minimum separation distance, X, may be reduced to 50 feet.

a Hydrogeologic evaluation required to define potential recharge area of the source and two year time of travel.

b For all water sources with less than 8 gpm maximum daily demand, the minimum presumptive upslope separation distance to greater than 6,500 gpd leachfields, per Appendix A Subpart 11.4.1, shall be 1,000 feet instead of 2X.

FIGURE 11-1.

PLAN VIEW OF
REQUIRED MINIMUM SEPERATION
DISTANCES TO DOMESTIC SEWAGE DISPOSAL FIELDS[1]

Domestic Sewage System Disposal Field Design Flow (gpd)	Water Source Maximum Daily Demand, MDD (gpm)			
	MDD < 2	2 ≤ MDD	5 ≤ MOD < 8	8 ≤ MDD
< 2000	X = 100′ 			X= 200′ For water source with demands of 6 gpm or greater, the well must be located outside the 2 year time of travel of all effluent plume paths.
≥ 2000 and < 6500		X = 150′ 	X = 200′ 	
≥ 6500	X= 200′ For septic systems over 6500 gpd wells must be located outside the 2 year time of travel effluent plume path, or greater than 1000′ from the disposal fields.			

1. These shapes assume parallel ground surface contours horizontally across page with a downslope direction toward the bottom of the page.

    a. For shallow water supplies X = 150′

    b. For shallow water supplies use 500′ distance instead of 2X

11.4.1.0 Separation Distances to Sewage System Disposal Fields

Wells and sewage system disposal fields should be located to optimize the hydrogeologic separation within the project limitations. The applicant's designer must establish a separation zone around the water source which defines the probable area of groundwater recharge to the water source. The separation zone may be established by a presumptive method which uses ground surface topography and minimum distances.

The minimum separation distances for leachfields can be also estimated by using methods to define Source Protection Areas in accord with procedures defined in this rule (see Appendix A Part 3), or with other methods approved by the Secretary.

11.4.1.1 Presumptive Minimum Separation Zone Methods for a Water Well

To determine the size and shape of the required minimum separation zone between sewage disposal fields and a water well the following steps should be taken (see Figure 11-1):

(a) draw a circle with a radius equal to the required minimum separation distance, X, from Table A11-2, around the well head or water source;
(b) now either:
    (1) if the circle drawn intersects with the contour elevation of the source, then draw lines beginning at these intersections, extending upslope and perpendicular to the contours, until these lines intersect an arc with a radius equal to twice the minimum separation distance (2X) from the source. If necessary, to provide closure of the area draw an arc with radius 2X from the source; or
    (2) if the circle drawn in Step 1 is in all cases at a lower elevation than the source elevation, no further delineation may be required (resulting in the smallest possible minimum separation zone of a circle with radius X); or,
    (3) if the circle drawn in Step 1 is in all cases is above the elevation of the well, the water shed area or a circle with a radius of 2X, whichever is smaller, shall represent the minimum separation zone (resulting in the largest possible minimum separation zone of a circle with a radius 2X).

11.4.1.2 Presumptive Minimum Separation Zone Methods for a Shallow Water Source

To determine the size and shape of the required minimum separation zone between sewage disposal fields and a shallow water source, the following steps should be taken (see Figure A11-1):

(a) draw a circle with a radius equal to the required minimum separation distance, X, from Table A11-2, around the well head or water source;
(b) now either:
    (1) if the circle drawn intersects with the contour elevation of the source, then draw lines beginning at these intersections, extending upslope and perpendicular to the contours, until these lines intersect an arc with a radius equal to 500 feet from the source. If necessary, to provide closure of the area draw an arc with radius of 500 feet from the source; or

(2) if the circle drawn in Step 1 is in all cases at a lower elevation than the source elevation, no further delineation may be required (resulting in the smallest possible minimum separation zone of a circle with radius X); or

(3) if the circle drawn in Step 1 is in all cases above the elevation of the well, the water shed area or a circle with a radius of 500 feet, whichever is smaller, shall represent the minimum separation zone (resulting in the largest possible minimum separation zone of a circle with a radius of 500 feet).

11.4.2.0 Requirements for Investigation of Potential Hydrogeologic Connections Between Water Sources and Sewage Disposal Fields

This subpart applies when a hydrogeologic connection may exist between a sewage system disposal field and a potable water source.

These distances listed in Table A11-1 & A11-2 provide a minimal level of protection for water sources. These distances may be increased or reduced based on site specific data.

11.4.2.0.1 Increasing the Minimum Separation Zone

These distances may be increased up to a maximum of 500 feet if a sewage disposal field is discharging upgradient of a water source and to the same unconsolidated, unconfined aquifer from which the water source is withdrawing.

11.4.2.0.2 Reduction of the Minimum Separation Zone

These distances may be reduced with the use of site specific data under the following conditions:

(a) If there is a continuous impeding layer from the sewage system disposal field to the well head, and the well is properly sealed to prevent contaminant migration along the well casing then the minimum separation zone around the well head may be reduced to a radius of not less than 100 feet; or

(b) If the groundwater flow from beneath the sewage system disposal fields is not toward a minimum separation zone around the well head that has a radius of X; or

(c) If a detailed hydrogeologic investigation reveals that groundwater flow from beneath the sewage system disposal field does not flow toward the source under pumping conditions the minimum separation zone around the well head may be reduced to a radius of not less than 100 feet; or

(d) If a detailed hydrogeologic investigation demonstrates a time of travel exceeding two years in accordance with Appendix A Subpart 11.4.2.1, then the minimum separation zone around the well head may be reduced to a radius of not less than 100 feet.

11.4.2.1 Two Year Time of Travel

If required elsewhere in Appendix A Subpart 11.4.2, then a minimum travel time of two years must exist in the materials between a potential source of contamination that may contain pathogenic microorganisms and the drinking water source. The two year travel time is based on the reasonable assurance of pathogen attenuation. Calculations of travel time must take into

account hydraulic gradient, porosity, saturated hydraulic conductivities in the materials with the largest saturated hydraulic conductivity, the cone of influence of production wells or the recharge area of springs being considered, and mounding of the water table due to groundwater recharge by discharge of the sewage effluent.

11.4.2.2 Increased Level of Contamination

The potential source(s) of contamination may not increase the level of contamination in any drinking water source to more than the Maximum Contaminant Levels (MCL) of the Drinking Water Standards in Subchapter 21-6 of this rule. Nitrate (expressed as N) may be used as an indicator when dealing with domestic (non-industrial) wastes. Calculations must take into account the concentration of nitrate-nitrogen at the base of the leachfield, which is assumed to be 40 mg/l, dilution by precipitation and groundwater flow, dispersion, background concentrations of nitrate-nitrogen, and other existing sources of nitrate-nitrogen, including fertilizers, in the subsurface drainage basin, using the assumption that no denitrification takes place in the subsoil. Methods of calculation and evaluation must closely approximate actual conditions and should be determined in consultation with the Secretary before any work is done.

The minimum separation distances for leachfields can be also estimated by using methods to define Source Protection Areas as contained in Appendix A Part 3 or with other methods approved by the Secretary.

11.5 Well and Spring Construction Standards

11.5.0 Water Well

The requirements of this subpart presume that water wells are constructed in compliance with Appendix A, Part 12 (Construction and Isolation Standards for Wells).

11.5.1 Spring and Shallow Well Construction

11.5.1.1 Materials

Acceptable materials include:
(a) concrete tiles (grouted together);
(b) poured in place concrete;
(c) well casing; and
(d) other metallic or plastic casing as approved by the Secretary.

11.5.1.2 Site Work

Spring and shallow well site construction shall include the following:
(a) screened ventilation or overflow openings;
(b) surface water diversion berm at least 50 feet upslope when feasible;
(c) back fill material of high clay content sloping away from source;
(d) minimum of 4 inches of top soil over the clay;

(e) a watertight, rodent-proof sanitary cover; and
(f) for public water systems, an entrance access hatch and lock.

11.6 Water Quantity Testing

11.6.0 Water Sources

11.6.0.1 Projects with a Maximum Day Demand of 5 gpm or less:

These projects:
(a) may use 50 percent of the well drillers estimated yield as long term yield; and
(b) if project maximum day demand is greater than 50 percent of the well drillers estimated yield, a constant discharge pumping test as defined in Appendix A Subpart 11.6.1 is required.

11.6.0.2 Projects with Maximum Day Demand of more than 5 gpm

These projects shall conduct a constant discharge pumping test in accord with Subpart 11.6.1 to determine the long term yield of the well.

11.6.0.3 Springs

A spring source shall require that the yield be determined by hydrogeologic flow analysis per Appendix A Subpart 11.6.1.2. Single family residences and projects classified as home occupations, shall be exempt from this requirement.

11.6.1 Long Term Yield Testing

11.6.1.1 Water Wells

When a constant discharge test is required by the provisions of Appendix A Subpart 11.6.0, the following conditions shall be met:
(a) the test shall be designed and analyzed by a qualified hydrogeologist, or a professional engineer, who is proficient in well testing and analyses;
(b) the test shall be conducted for the durations listed in Table A11-3 at a pumping rate greater than or equal to the required maximum day demand of the well;
(c) water level drawdown and rate of discharge shall be measured using accepted methods at intervals that will plot evenly on a logarithmic scale graph;
(d) the draw down measurements shall continue into the recovery period for two days or until a minimum of 90% recovery is achieved whichever occurs first.
(e) alternate testing methods may be considered by the Secretary; and
(f) monitoring for interference shall be performed as required in Appendix A Subpart 11.6.3.

Table A11-3 - CONSTANT DISCHARGE PUMPING TEST DURATION

MAXIMUM DAY DEMAND OF WELL[a]	MINIMUM TEST LENGTH, HOURS
0.0 - 1.9 gpm	24
2.0 - 4.9 gpm	36
5.0 - 7.9 gpm	48[b]
8.0 - 49.9 gpm	72
50.0 - 99.9 gpm	96
100 gpm or Greater	120

a. Rounded to nearest tenth.
b. This duration may be increased to 72 hours if interference or special studies are required.

11.6.1.2 Shallow Water Sources

11.6.1.2.1 Springs

(a) A proposal for adequately determining long term yield of springs shall be prepared by a qualified hydrogeologist or professional engineer and submitted to the Secretary for approval prior to testing; and
(b) Long term yield tests for springs shall normally include monitoring during low flow periods.

11.6.1.2.2 Shallow Water Sources Excluding Springs

These sources shall be tested in accordance with the requirements of Appendix A Subpart 11.6.1.1. and take into account seasonal fluctuations in water level.

11.6.2 Long Term Yield Analysis

The following material shall be submitted to the Secretary for approval:
(a) "as-built" water source site plans;
(b) pumping test data;
(c) predicted long-term yield and method of analysis;
(d) predicted interference; and
(e) all supporting graphs and calculations.

11.6.2.1 Water Wells

The analysis shall predict the long term yield that shall meet or exceed the following criteria:
(a) constant withdrawal at the Average Day Demand for 180 days; and
(b) drawdown shall not exceed 90 percent of the total available head.

11.6.2.2 Springs

Analysis of monitoring data shall follow accepted hydrogeologic methods such as low flow analyses or other suitable methods.

11.6.2.3 Shallow Water Sources Excluding Springs

Analyses shall be in accordance with Appendix A Subpart 11.6.2.1 and take into account seasonal low static water level.

11.6.3 Interference Testing and Analysis

(a) Any existing water source for a public or private potable water system, located within the distances specified in Table A11-4 shall be located and reported with the application. The Secretary may require interference testing to assess the impact of the project well or wells on, and/or from, other water sources.
(b) Water sources within the distances specified in Table A11-4 shall be monitored for interference during long term yield pumping tests, unless the consultant demonstrates that it is not feasible or necessary to monitor those wells.
(c) If any **Public** Community water systems exist within the distances given in Table A11-4, then the consultant shall notify the Drinking Water and Groundwater Protection Division. The Division may require additional testing or testing on additional wells to assess the impact of wells on each other.
(d) Other methods to address the potential for interference may be submitted to the Secretary by a qualified hydrogeologist, or a professional engineer, who is proficient in aquifer analysis.
(e) Water sources must not cause unacceptable interference on other water sources, unless resolved in accordance per Appendix A Subpart 11.6.3.2.

11.6.3.1 Unacceptable Interference

Public and private water systems affected by the pumping of other proposed or existing groundwater sources shall be able to meet their average day demand while the proposed water system is operated at the proposed pumping rates. If, as a result of predicted source interference, existing water systems cannot meet their design demands, then unacceptable interference exists. Unacceptable interference may also include water quality problems resulting from source testing.

11.6.3.2 Resolution of Unacceptable Interference

(a) The applicant must resolve all source interference problems prior to issuance of a Source Permit for proposed water sources. Any agreement between the applicant and the affected party will be reviewed by the Secretary. The applicant is responsible for identification of all sources in use within the monitoring radius defined in Table A11-4. The Secretary may either reduce the approved yield or require additional testing or analysis to determine the impact upon the unmonitored source. A Source Permit will not

be granted if unacceptable interference cannot be resolved or if the owner of the affected source does not accept a proposed solution.

(b) Solutions may include:
- (1) drill affected source deeper and test for water quantity;
- (2) test affected source or re-evaluate existing data;
- (3) connect affected water source onto acceptable **Public** water system;
- (4) develop an alternative water source for the affected source;
- (5) for some private water system, additional storage may be developed to offset the source interference; and
- (6) hydrofracture the well or redevelop by other methods.

Table A11-4 - MONITORING DISTANCES FROM TEST WELLS

MONITORING DISTANCE FROM TEST WELL TO A POTABLE WATER SOURCE	
MAXIMUM DAILY DEMAND OF TESTED WELL, GPM	**DISTANCE, FT.**
0 - 1.9	0 - 200
2 - 4.9	0 - 500
5 - 19.9	0 - 1000
20 - 49.9	0 - 2000
50 - 99.9	0 - 2500
100 or greater	0 - 3000

11.7 Water Quality

11.7.0 Water Quality Requirements for **Public Transient Non**-Community

Public Transient Non-Community water systems shall be designed to provide potable water. The requirements for water quality testing are as follows:

(a) All **Public Transient Non-Community** water systems shall monitor initially for contaminants as follows:
- (1) **Public Transient Non-Community** water systems shall initially monitor for all the contaminants identified in Tables A11-5 and A11-6.

Table A11-5 - SECONDARY CONTAMINANT STANDARDS FOR Public Transient Non-Community water systems	
Secondary Contaminant Standards	**Secondary Maximum Contaminant Level**
Chloride	250 mg/l
Sodium	250 mg/l
Iron	0.3 mg/l
Manganese	0.05 mg/l
Odor	3 threshold odor number
pH	6.5 to 8.5

Table A11-6 - PRIMARY CONTAMINANT STANDARDS FOR PUBLIC TRANSIENT NON-COMMUNITY WATER SYSTEMS	
Primary Contaminant Standards	**Maximum Contaminant Level**
Arsenic	0.010 mg/l
Nitrate	10 mg/l
Nitrite	1.0 mg/l
Total Coliform Bacteria	Absent
Uranium	20 ug/l

(b) The Secretary may require the monitoring and compliance with the additional contaminants not listed in Tables A11-5, A11-6, and A11-7, as well as with the contaminants listed in these tables when there is reason to suspect their presence, or suspect a public health or welfare risk.

(c) **Public Transient Non-Community** water systems shall comply with the sampling and laboratory requirements as described in Subchapter 21-6.

(d) **Public Non-Transient Non-Community** water systems and **Public Transient Non-Community** water systems shall comply with the water quality standards and monitoring requirements as specified in Subchapter 21-6 of this rule and in 40 CFR, Part 141. **Public Transient Non-Community** water systems with contaminants exceeding the primary or secondary standards may be required to treat or abandon the sources at the discretion of the Secretary.

(e) When a water system is developed before a permit is issued, the analysis shall be part of the permit application.

(f) When a water system is developed after a permit is issued, the analysis shall be submitted as a permit condition.

11.8 Design Standards for Pumping, Storage and Distribution

11.8.0 General Considerations

The Secretary has jurisdiction over water system appurtenances including pumps, pressure tanks and water storage tanks, including those located within a building.

Service water, storage facilities and all water system appurtenances shall be located to provide adequate isolation from potential sources of contamination.

11.8.0.1 Sample Taps

Sample taps shall be provided so that water samples can be obtained from each water source and from appropriate locations in each unit of distribution.

11.8.0.2 Disinfection Prior to Use

(a) All walls, pipe, tanks, and equipment which can convey or store potable water shall be disinfected in accordance with AWWA procedures; and
(b) for single family residences or public buildings with flows not exceeding 500 gallons per day, which have individual on-site water systems, shall be disinfected in accordance with Appendix A Subpart 12.

11.8.0.3 Isolation Distances

Suction water lines shall be located to comply with the isolation distances for water wells in Appendix A Subpart 11.4, Table A11-1 and be located greater than 100' from any domestic sewage disposal field.

11.8.1 Pumping Facilities

11.8.1.0 General

Pumping facilities shall be designed to maintain the sanitary quality of pumped water. Subsurface pits or pump rooms should be avoided unless there is a non-mechanical way of avoiding flooding from either groundwater, surface water, or interior pipe break. No pumping station shall be subject to flooding. Any below grade electrical installation must be provided with a ground fault interrupted electrical service. All installations shall be safely and easily accessible for monitoring, maintenance, and equipment removal.

11.8.1.1 Location

The pumping station shall be so located that the proposed site will meet the requirements for sanitary protection of water quality, hydraulics of the system and protection against interruption of service by fire, flood or any other hazard.

11.8.1.1.1 Site Protection

The station shall be:
(a) elevated to a minimum of three feet above the 100 year flood elevation, or three feet above the highest recorded flood elevation, whichever is higher, or protected to such elevations;
(b) readily accessible at all times unless permitted to be out of service for the period of inaccessibility;
(c) graded around the station so as to lead surface drainage away from the station; and
(d) protected to prevent vandalism and entrance by animals or unauthorized persons.

11.8.1.2 Pumping Stations

Both raw and finished water pumping stations shall:
(a) have adequate space for the installation of additional units if needed, and for the safe servicing of all equipment;
(b) be of durable construction, fire and weather resistant and with outward-opening doors;
(c) have floor elevation of at least six inches above finished grade;
(d) have underground structure waterproofed;
(e) have all floors drained in such a manner that the quality of the potable water will not be endangered. All floors shall slope to a suitable drain, that runs to daylight; and
(f) provide a suitable outlet for drainage from pump glands, relief valves or control valves without discharging onto the floor.

11.8.1.2.1 Equipment Servicing

Pump stations shall be provided with:
(a) crane-ways, hoist beams, eyebolts, or other adequate facilities for servicing or removal of pumps, motors or other heavy equipment that cannot be serviced or removed by other more conventional methods; and
(b) openings in floors, roofs, or wherever else needed for removal of heavy or bulky equipment.

11.8.1.2.2 Stairways and Ladders

Stairways or ladders shall:
(a) be provided between all floors, and in pits or compartments which must be entered;
(b) have handrails on both sides, and treads of non-slip material. Stairs are preferred in areas where there is frequent traffic or where supplies are transported by hand; and
(c) conform to OSHA and VOSHA regulations covering these fixtures.

11.8.1.2.3 Heating

Provisions shall be made for adequate heating for the safe and efficient operation of the equipment.

11.8.1.2.4 Ventilation

Adequate ventilation shall be provided for all areas where unsafe atmosphere may develop or where excessive heat may be built up.

11.8.1.2.5 Dehumidification

In areas where excess moisture could cause hazards to safety or damage to equipment, means for dehumidification should be provided.

11.8.1.2.6 Electrical

All electrical work shall conform to the requirements of the Vermont Code and to the relevant state and/or local codes.

11.8.1.3 Pumps

The pumping unit shall:
(a) have ample capacity to supply the instantaneous peak demand without dangerous overloading, or the required fire flow if fire demand is required from the pumping station;
(b) be driven by a prime mover able to operate against the maximum head; and
(c) be served by control equipment that has proper heater and overload protection for air temperature encountered.

11.8.1.3.1 Suction Lift

Suction lift should:
(a) be avoided, if possible; and
(b) be within allowable limits, preferably less than 15 feet.

If suction lift is necessary, provision shall be made for priming the pump.

11.8.1.3.2 Priming

Prime water must not be of lesser sanitary quality than that of the water being pumped. Means shall be provided to prevent back siphonage. 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 possible contamination, unless the air is filtered by an apparatus approved by the Secretary. Vacuum priming may be used.

11.8.1.4 Appurtenances

11.8.1.4.1 Valves

Pumps shall be adequately valved to permit satisfactory operation, maintenance and repair of the equipment. If foot valves are necessary, they shall have a net valve area of at least 1-1/2 times the area of the suction pipe and they shall be screened. Each pump shall have a positive-acting check valve on the discharge side between the pump and the shut-off valve.

11.8.1.4.2 Piping

In general, piping shall:
(a) be designed so that the friction losses will be minimized;
(b) not be subject to contamination;
(c) have watertight joints;
(d) be protected against surge or water hammer; and
(e) be such that each pump has an individual suction line or that the lines shall be so manifolded that they will insure similar hydraulic and operating conditions.

11.8.1.4.3 Gauges

Each pump shall have a standard pressure gauge in its discharge line.

11.8.1.4.4 Water Seals

Water seals shall 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 seal shall:
(a) be provided with a break tank open to atmospheric pressure; and
(b) have an air gap of at least six inches or two pipe diameters, whichever is greater, between the feeder line and the spill line of the tank.

11.8.1.4.5 Controls

Pumps, their prime movers and accessories, shall be controlled in such a manner that they will operate at rated capacity without dangerous overload. Where two or more pumps are installed, provision shall be made for alternation. Provision shall be made to prevent energizing the motor in the event of a backspin cycle.

11.8.2 Finished Water Storage

11.8.2.1 Water Storage Requirements

A water system and distribution system must be capable of satisfying both the maximum day demand of a project or building and the instantaneous peak demand of the plumbing system. Unless the combination of the water source, withdrawal system and pressurization system can

meet both these criteria, water storage shall be required. The following types of projects are exempt from this subpart of the rules, provided they are served by an individual water system:

(a) non-residential buildings with design flows of not more than 500 gallons per day with an instantaneous peak demand of less than 15 gallons per minute;
(b) a single family residence; or
(c) a single family residence with a one-bedroom apartment, where the average day demand is 540 gpd or less.

11.8.2.2 Instantaneous Peak Yield Testing

If the water source's long-term yield is less than the water system instantaneous peak demand, then an abbreviated peak demand test may be performed on the source by one of the following methods:

(a) pumping of the source at the water system instantaneous peak demand rate or greater for a duration at which the total volume pumped equals twice the average day demand. The pumping test must be supervised by a qualified hydrogeologist, professional engineer, licensed well driller or well servicer. The pump discharge rate shall be measured and recorded at 30 minute intervals with a minimum of three readings. If the pumping discharge rate during the test period is equal to, or greater than the water system instantaneous peak demand, and the source is not dewatered to the level of the pump, then no water storage is required to meet instantaneous peak demand, provided the well service pump is capable of delivering at a flow rate equal to, or greater than the peak demand;
(b) a three hour blow test with flow measurements at less than or equal to 30 minute intervals performed by a licensed well driller;
(c) licensed well driller's yields determined by methods which do not meet the requirements of Appendix A Subpart11.8.2.2(a) or (b) shall be divided by two to determine flow rate for instantaneous peak; and
(d) other methods for determining instantaneous peak yield of the water source may be used if a written proposal detailing them is approved by the Secretary prior to testing.

11.8.2.3 Storage Volume

If the water system instantaneous peak demand exceeds the water source yield and/or the source pump capacity, water storage volume computed by one of the following methods shall be provided:

(a) storage equal to average day demand if the water source long term yield equals or exceeds two-thirds of the maximum day demand;
(b) storage equal to 55 percent of average day demand if the water source long term yield equals or exceeds the maximum day demand; or
(c) storage equal to the following equation if the water source yield equals or exceeds the maximum day demand:

$S = D (1-Y/P)$

Where S= Volume of water storage (gallons)
D = Project average day demand (gallons) (See Appendix A Subpart 11.3);

P = Project water system instantaneous peak demand (gallons/minute) (See Appendix A Subpart 11.3); and

Y = Water source yield (either long term yield per Appendix A Subpart 11.6 or peak yield per Appendix A Subpart 11.8.2.2).

11.8.2.3.1 Casing Storage

A portion of the required storage may be met by using the effective storage provided by the well casing, well tile or spring box. Calculation of the effective storage shall take into account the predicted drawdown of the water level in the casing, based on the daily usage of the water source.

(a) For water wells, the effective storage shall be determined as follows:

(1) for a source where a pumping test and analysis has been performed, the effective storage shall be the volume of water between the predicted drawdown associated with Subpart 11.6.2.1(a) of this rule and the pump cut-off level.

(2) for a source where the pumping test and analysis has not been performed, the effective storage shall be the volume of water between the predicted drawdown, as calculated below, and the pump cut-off level.

The predicted drawdown shall be based on the long term yield, the maximum day demand and the total available head as follows:

$$DD = SE + (TAH (MDD / Y))$$

where DD= depth to predicted drawdown, below ground surface (ft)
SE= depth to static water level in well, below ground surface (ft)
TAH= total available head (ft)
MDD= maximum day demand (gpm)
Y= long term yield (gpm) (per 11.6)

(b) for shallow water sources, the effective storage is one half of the volume between the annual low water level and the outlet or pump cut off level.

11.8.2.4 Reservoirs General

The materials and designs used for finished water storage structures shall provide stability and durability as well as protect the quality of the stored water. Steel structures shall follow the current AWWA standards concerning steel tanks, reservoirs, and elevated tanks wherever they are applicable. Other materials of construction are acceptable when properly designed and approved by the Secretary. Design for cast-in-place and pre-cast concrete structures must be reinforced and specify the material for sealing the joints. Reservoirs should be tested for leakage.

11.8.2.4.1 Location of Reservoirs

(a) The bottom of steel reservoirs should be placed at the normal ground surface and shall be above maximum flood level.
(b) When the bottom of a steel tank must be below normal ground surface, it shall be placed above the groundwater table. Artificially lowering the groundwater table is acceptable.
(c) For all storage reservoirs, sewers, drains, standing water, and similar sources of possible contamination must be kept at least fifty feet from the reservoir Water main pipe, pressure tested in place to 50 psi without leakage, may be used for gravity sewers at distances greater than 20 feet and less than 50 feet.
(d) The top of a reservoir access shall not be less than two feet above normal ground surface.
(e) Below grade installation of precast and poured in-place concrete reservoirs are acceptable. Provisions shall be made to eliminate the tendency of the tank to float during high groundwater conditions. All joints shall be water tight.

11.8.2.4.2 Protection

(a) All finished water storage structures, shall have suitable water tight roofs which exclude birds, animals, insects, and excessive dust. If necessary, these structures shall have a perimeter drain at least 4" in diameter.
(b) Fencing, locks on access manholes, and other necessary precautions shall be provided to prevent trespassing, vandalism, and sabotage.

11.8.2.4.3 Drains

No drain on a water storage structure may have a direct connection to a sewer or storm drain. The design shall allow draining the storage facility for cleaning or maintenance.

11.8.2.4.4 Overflow

All water storage structures shall be provided with an overflow. The discharge end of the overflow should terminate at least 18 inches above the ground surface, and discharge over either a drainage inlet structure or a splash plate. No overflow may be connected directly to a sewer or storm drain. All overflow pipes shall be located so that any discharge is visible.

(a) The above grade portion of the overflow shall be open downward and be screened with 24 mesh noncorrodible screen installed within the pipe at a location least susceptible to damage by vandalism; and
(b) the overflow pipe shall be of sufficient diameter to permit discharge of water in excess of the filling rate.

11.8.2.4.5 Access

Finished water storage structures shall be designed with reasonably convenient access to the interior floor for cleaning and maintenance.

(a) On ground level structures, manholes should be elevated at least 18 inches above the top or covering sod;
(b) shall be fitted with a solid watertight cover which overlaps the framed opening and extends down around the frame at least two inches;
(c) shall have a locking device; and
(d) drainage shall be directed away from the access.

11.8.2.4.6 Vents

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

(a) prevent the entrance of surface water and rain water;
(b) exclude birds and animals;
(c) exclude insects and dust, as much as this function can be made compatible with effective venting. For elevated tanks and standpipes, four-mesh noncorrodible screen may be used; and
(d) on ground level structures, terminate in an inverted U construction with the opening 24 mesh noncorrodible screen installed within the pipe at a location least susceptible to vandalism.

11.8.2.4.7 Roof and Sidewall

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

(a) Any pipes running through the roof or sidewall of a finished water storage structure must be welded, or properly gasketed in metal tanks. In concrete tanks, these pipes shall be connected to standard wall castings which were poured in place during the forming of the concrete or wall sleeves, with flexible wall penetration sleeves;
(b) openings in a storage structure roof or top, designed to accommodate control apparatus or pump columns, shall be curbed and sleeved with proper additional shielding to prevent the access of surface or floor drainage water into the structure; and
(c) valves and controls should be located outside the storage structure so that the valve stems and similar projections will not pass through the roof or top of the reservoir.

11.8.2.4.8 Drainage of Roof

The roof of above grade storage structures shall be well drained. Roofs shall not tend to hold water.

11.8.2.4.9 Safety

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

11.8.2.4.10 Freezing

All finished water storage structures and their appurtenances, shall be designed to prevent freezing which will interfere with proper functioning.

11.8.2.4.11 Grading

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

11.8.2.4.12 Painting and/or Cathodic Protection

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

(a) Paints systems shall be acceptable to the Secretary (either EPA or NSF approved). Interior paint must be properly applied and cured. After curing, the coating shall not transfer any substances to the water which will be toxic or cause tastes or odors. Prior to placing in service, an analysis for volatile organic compounds is required to establish that the coating is properly cured; and
(b) cathodic protection should be designed and installed by competent technical personnel.A maintenance contract should be provided.

11.8.2.4.13 Disinfection

(a) Finished water storage structures shall be disinfected in accordance with correct AWWA Standard C652. Two or more successive sets of samples, taken at 24-hour intervals, shall indicate microbiologically satisfactory water before the facility is placed into operation;
(b) disposal of heavily chlorinated water from the tank disinfection process shall not be discharged to groundwater or surface water; and
(c) the disinfection procedure (AWWA chlorination method 3, section 4.3 C652) which allows use of the chlorinated water held in the storage tank for disinfection purposes is not recommended. When that procedure is used, it is required that the initial heavily chlorinated water be properly disposed in order to prevent release of water which may contain various chlorinated organic compounds into the distribution system.

11.8.2.5 Hydropneumatic Tanks

Hydropneumatic (pressure) tanks, when provided as the only storage facility, are acceptable. Pressure tank storage is not to be considered for fire protection purposes. Pressure tanks shall meet BOCA code requirements.

11.8.2.5.1 Location

The tank shall be completely housed.

11.8.2.5.2 Sizing

The capacity of the wells and pumps in a hydropneumatic storage should be such that the minimum pump on time is 2 minutes, unless the pump manufacturer certifies less is acceptable. In no case will a pump on time of less than 1 minute be acceptable. Only the available storage during the pump-on time shall be considered in meeting storage requirements.

11.8.2.5.3 Appurtenance

Each tank shall have a drain, pressure gauge, water sight glass, if applicable, automatic or manual air blow-off, means for adding air, and pressure operated start-stop controls for the pumps.

11.8.2.6 Distribution Storage

The applicable design standards of Appendix A Subpart 11.8.2 shall be followed for distribution system storage.

11.8.2.6.1 Pressures

The minimum working pressure at the hydropneumatic tank system should be set at no less than 20 psi. When static pressures exceed 100 psi, pressure reducing devices should be provided on mains in the distribution system.

11.8.2.6.2 Drainage

Storage structures which provide pressure directly to the distribution system shall be designed so they can be isolated from the distribution system and drained for cleaning or maintenance. The drain shall discharge to the ground surface with no direct connection to a sewer or storm drain.

11.8.2.6.3 Level Controls

Controls shall be provided to maintain levels in distribution system storage structures. Controls shall have the following features:
(a) low level alarm is required;
(b) pumps should be controlled from tank levels;

(c) overflow and low-level warnings or alarms shall be located at places in the community where they will be reasonably noticed by maintenance personnel;
(d) the low water level control shall be high enough so that the water system operator has time to correct the problem before a water shortage occurs.

11.8.3 Distribution Systems

11.8.3.0 Materials

11.8.3.0.1 Standards, Materials Selection

Pipe, fittings, valves and fire hydrants shall conform to the latest standards issued by AWWA. Special attention shall be given to selecting pipe materials which will protect against both internal and external pipe corrosion.

11.8.3.0.2 Used Materials

Water mains which have been used previously for conveying potable water may be reused provided they meet the above standards and have been restored practically to their original condition.

11.8.3.0.3 Joints

Packing and jointing materials used in the joints of pipe shall meet the standards of the AWWA. Pipe having mechanical joints or slip-on joints with rubber gaskets is preferred.

11.8.3.1 Service Connections

Service connection detail must be provided. Curb stops must be shown on plan drawings; they must be incapable of conveying surface loads onto the service line.

11.8.3.2 Water Main Design

11.8.3.2.1 Pressure

All water mains shall be sized after a hydraulic analysis based on flow demands and pressure requirements. The normal working pressure in the distribution system should be:
(a) 35 psi at the main;
(b) 20 psi at the ground level at the foundation wall; or
(c) 8 psi at the highest fixture.

11.8.3.2.2 Hydrants

Water mains not designed to carry fire flows shall not have fire hydrants connected to them.

11.8.3.2.3 Dead Ends

Dead ends shall be minimized by looping of all mains whenever practical.

11.8.3.2.4 Flushing

Flushing devices should be sized to provide flows which will give a velocity of at least 2.5 feet per second in the water main being flushed. No flushing device shall be directly connected to any sewer. The open end of a blow off must be capped and terminate at least 18 inches above grade.

11.8.3.3 Valves

Sufficient valves shall be provided on water mains so that inconvenience and sanitary hazards will be minimized during repairs. Valves should be located at not more than 500 foot intervals in commercial districts, at not more than one block or 800 foot intervals in other districts, and at not more than 5,000 feet on transmission lines.

11.8.3.4 Air Relief and Blow-off Chambers

11.8.3.4.1 Air Relief Valves

At high points in water mains where air can accumulate, consideration shall be made to incorporate air relief devices.

11.8.3.4.2 Chamber Drainage

Chambers, pits or manholes containing valves, blow-offs, meters, or other such appurtenances to a distribution system, shall not be connected directly to any storm drain or sanitary sewer, nor shall blow-offs or air relief valves be connected directly to any sewer. Such chambers or pits shall be drained to the surface of the ground where they are not subject of flooding by surface water, or to absorption pits underground.

11.8.3.5 Installation of Mains

11.8.3.5.1 Bedding

A continuous and uniform bedding shall be provided in the trench for all buried pipe. Back fill material shall be tamped in layers around the pipe and to a sufficient height above the pipe to adequately support and protect the pipe.

11.8.3.5.2 Cover

All water mains shall be covered with at least 5-1/2 feet of earth. Insulation may be used in lieu of cover depth.

11.8.3.5.3 Thrust Blocks

All tees, bends, plugs and hydrants shall be provided with reaction blocking, tie rods or joints designed to prevent movement. The size and shape of the blocks shall be appropriate for the site conditions and design water pressure.

11.8.3.5.4 Disinfection

All new or reconstructed water mains shall be disinfected in accordance with AWWA *Standard C651-86*. The specifications shall include detailed procedures for the adequate flushing, disinfection, and microbiological testing of all water mains. If bacteriological tests show the treatment to unsatisfactory, the disinfection procedures shall be repeated until satisfactory bacteriological sample results are obtained. The tablet method in AWWA *Standard 651* is not acceptable.

11.8.3.5.5 Pressure Testing

All types of installed pipe shall be pressure tested and leakage tested in accordance with the latest edition of AWWA *Standard C600*.

11.8.3.6 Water and Sewer Mains

11.8.3.6.1 Crossings

Water mains crossing sewers shall be laid to provide a minimum vertical distance of 18 inches between the outside of the water main and the outside of the sewer. This shall be the case where the water main is either above or below the sewer. At crossings, one full length of water pipe shall be located so both joints will be as far from the sewer as possible. If the sewer main is over the water main, then the sewer main must be encased by concrete, extending beyond the first sewer pipe joints and resting on undisturbed soil on each side of the water main, or the sewer line shall be installed to meet the Secretary's sewer line standards for Source Protection Areas. Special structural support for the water and sewer pipes may be required. Water pipes shall not pass through sewer manholes or be submerged in basins containing sewage or other grossly contaminated or hazardous material. Properly constructed and approved submerged stream crossings shall be exempted from this provision of the regulations.

11.8.3.6.2 Parallel Installation

Water mains shall be laid at least 10 feet horizontally from any existing or proposed manhole or sanitary sewer. This distance can be reduced to 5 feet for storm sewers. The distance shall be measured edge to edge. In cases where it is not practical to maintain a 10 foot separation, the Secretary may allow deviation on a case by case basis if supported by data from the design engineer. Such deviation may allow installation of the water main closer to a sewer, provided that the water main is laid in a separate trench or on an undisturbed earth shelf located on one side of the sewer at such an elevation that he bottom of the water main is at least 18 inches above the top of the sewer.

11.8.3.6.3 Exception

The Secretary must specifically approve any variance from the requirements of Appendix A Subparts 11.8.3.6.1 and 11.8.3.6.2 when it is impossible to obtain the specified separation distances. Where sewers are being installed and Appendix A Subparts 11.8.3.6.1 and 11.8.3.6.2 cannot be met, the sewer materials shall be water main pipe or equivalent and shall be pressure tested to ensure water tightness.

11.8.3.7 Surface Water Crossings

Surface water crossings, whether over or under water, present special problems. The reviewing authority should be consulted before final plans are prepared.

11.8.3.7.1 Above-water Crossings

The pipe shall be adequately supported and anchored, protected from damage including flood waters, floating debris, ice and freezing, and shall be accessible for repair or replacement.

11.8.3.7.2 Underwater Crossings

A minimum cover of two feet measured from the lowest point of the stream bed, shall be provided over the pipe. When crossing water courses, the pipe shall be of special construction, having flexible water tight joints.

11.8.3.8 Cross-connections and Interconnections

11.8.3.8.1 Cross-connections

There shall be no connection between the distribution system and any pipes, pumps, hydrants, or tanks whereby unsafe water or other contaminating materials may be discharged or drawn into the system. This does not preclude approved cross connection control devices.

11.8.3.8.2 Cooling Water; Heating Water

(a) Neither steam condensate nor cooling water from engine jackets or other heat exchange devices shall be returned to a **Public** water system.
(b) Notwithstanding subsection (a) of this section, standing column geothermal systems are allowed provided that:
    (1) No additive is added to the re-circulated groundwater;
    (2) The heat exchange medium in the system is R-410A or a different heat exchange medium approved by the Secretary;
    (3) The system has a low pressure safety cutout circuit that will turn off the system when there is a pressure leak in the heat exchange medium containment vessel;
    (4) All electrical components of the system are properly grounded to prevent potential electrolysis of metals: and

(5) In the event that the heat exchange unit is disconnected as a heating or cooling source, all piping associated with the unit shall either be capped and labeled or removed.

(c) For the purposes of this section, a standing column geothermal system is one where groundwater is taken from a **Public** water system well for heating and/or cooling purposes and re-circulated back into the same well below the estimated low water elevation of the well

11.8.3.8.3 Interconnections

Drains from the fire hydrants, air relief pits and blow off valve pits shall not connect directly to sewer lines or discharge at a points which will permit possible back-siphonage conditions.

11.8.3.9 Water Services and Plumbing

11.8.3.9.1 Plumbing

Water services and plumbing shall conform to the state plumbing code.

11.8.3.10 Water Loading Stations

Water loading stations present special problems since the fill line may be used for filling both potable water vessels and other tanks or contaminated vessels. To prevent contamination of both the water system and potable water vessels being filled, the following principles shall be met in the design of water loading stations:

(a) there shall be no backflow to the water system;

(b) the piping arrangement shall prevent contaminant being transferred from a hauling vessel to others subsequently using the station;

(c) hoses shall not be contaminated by contact with the ground.

Part 12 CONSTRUCTION AND ISOLATION STANDARDS FOR WELLS

12.1 General

12.1.1 Pursuant to 10 V.S.A. Section 1395a(b), this subpart sets forth certain minimum construction standards, which apply to any person engaged in the business of well drilling ("well driller" as used in this part) for **Public** water systems unless explicitly stated otherwise.

12.2 Construction Standards for Monitoring Wells, Public Non-Transient Non-Community water systems and Public Transient Non-Community water systems

12.2.1 Drilling - General

12.2.1.1 Damage to Site

The well driller shall not cause undue soil erosion or water pollution; or pollute the site with fuels, lubricants, solvents, or other contaminants used in the construction or repair of the well. The well driller must obtain approval from the Secretary before allowing or causing the discharge of water or other substances to waters of the State. The well driller should make preparations in advance to contain and promptly remove any contaminants which are accidentally spilled.

12.2.1.2 Drilling fluids and cuttings

The well driller shall not use materials and procedures which may adversely affect the public health, the drill site, or groundwater. The use of drilling fluids, additives, cements or other materials that may adversely affect the public health or the environment is prohibited. All drilling fluids shall be disposed of properly upon completion of their use. Contaminated drill cuttings, samples or liquids shall be disposed of as approved by the Secretary.

All water used in drilling or servicing water wells shall be potable water (see definition in Subchapter 21-2).

All wells shall be sufficiently developed to remove all additives and well development fluids (such as hydrofracturing water) and provide reasonably clear water.

12.2.1.3 Contaminated Equipment

When constructing or repairing a well for potable water, the well driller shall not use or reuse casing, tools, or drilling fluids which may have become contaminated. All drilling equipment which may have become contaminated during a drilling operation shall be thoroughly cleaned and decontaminated before reuse.

12.2.1.4 Disinfection

All potable water wells shall be adequately chlorinated promptly upon completion of well construction, servicing, or repair or installation of pumps, and may include circulation of the chlorinated solution as necessary to ensure adequate disinfection of the entire well.

12.2.1.5 Heat Pump Wells

Only non toxic fluids shall be used in closed loop heat pump well installations.

12.2.2 Casing and Liner

12.2.2.1 The casing and liner material used on all wells shall be of such strength and composition as to prevent the movement of water or contaminants into or out of the well in the interval cased. The casing or liner shall not distort, collapse, crack, or disintegrate during placement or under normal conditions. The casing and liner shall be adequate to provide for the installation, removal, and maintenance as appropriate of caps, pitless adapters, screens, pumps, pipes, wires or other devices which may be used. Any casing which is driven shall be protected with a firmly attached drive shoe or equivalent. All steel casing shall have full circumferential welds or threaded coupling joints.

12.2.2.2 The well driller shall perform the following, unless the Department grants an exemption:

(a) Bedrock Wells
All bedrock wells shall be constructed with not fewer than 20 feet of water tight casing. The casing shall be securely set into competent bedrock. The casing shall prevent sediment or fluids from above the bottom of the casing from entering the well.

(b) Gravel Wells
All gravel wells shall be constructed with not less than 20 feet of water tight casing.

(c) Lining Wells
When a liner is set to control hole stability within the uncased hole it shall be terminated with a packer or otherwise secured to the bore hole. It may be slotted, screened or perforated to permit the movement or storage of water. When a liner is set to control water movement or contamination, it shall be adequately grouted and water tight.

(d) Monitoring Wells
Monitoring wells are exempt from minimum casing length requirements, however, they shall be designed and constructed to prevent any migration of contaminants into uncontaminated zones.

(e) Closed Loop Heat Pump Wells
Heat pump wells in which a closed loop is to be installed shall be exempt from the casing length requirements of this subpart. A temporary casing may be used but shall be adequately set to prevent contamination. The full depth of the loop shall be grouted in place. The temporary casing may be removed at the time of grouting. Closed loop heat pump wells may require an underground injection control (UIC) permit (contact the UIC program for more information).

12.2.3 Annular Space

12.2.3.1 Annular space shall be grouted unless the native materials such as drill cuttings can achieve the following:
(a) when placed are at least as impervious, competent and compact as the surrounding materials;
(b) completely fill the annular space from the bottom of the casing to land surface;
(c) do not allow the accumulation of water around the well or artesian flow in the annular space; and
(d) securely support the casing so that it cannot be moved by manual means.

12.2.3.2 In cases where contamination occurs and impermeable natural materials cannot be adequately placed and compacted as required in Appendix A Subpart 12.3.3.1 or where geologic conditions or the isolation distance may not be adequate as required in Appendix A Subpart 12.2.2, the annular space shall be grouted for the full length of the unscreened portion of the casing, or the portion thereof below the frost line or pitless adaptor, so that no fluids may move in the zone needing to be grouted. Grouting procedures and materials set forth in Appendix A Subpart 12.3.4 shall be followed.

12.2.3.3 Under most conditions, driven steel casing shall be considered to have no annular space provided no pilot hole larger than the casing has been drilled below the depth of the pitless adaptor or the frost line.

12.2.4 Grouting

12.2.4.1 Grouting or the use of a grout mixture is recommended or required under the following conditions:
(a) Filling the annular space as required in Appendix A Subpart 12.3.3;
(b) Providing additional protection when isolation distances are less than that required in Appendix A Subpart 12.2.1.1;
(c) Plugging abandoned wells, and closed loop heat pump wells; and
(d) As needed in the construction or closure of monitoring wells.

12.2.4.2 A grouting material or mixture shall:
(a) Allow negligible movement of all fluids in the annular space;
(b) Support and secure the casing; and
(c) Provide negligible shrinkage, breakage, or deterioration of the grout after placement.

12.2.4.3 The grout shall be placed in a continuous operation to ensure against any voids, mixing with or diluting contaminated fluids, or damaging the casing or borehole. Fluid based grouts shall be placed from the bottom to the top of the annular space under positive pressure. The amount of water utilized in mixing any grout shall be carefully limited to only the amount needed to properly hydrate and place the grout mixture.

12.2.4.4 The full depth of all closed loop heat pump installations shall be grouted in place.

12.2.5 Closure of Abandoned Wells

12.2.5.1 All abandoned wells shall be closed to prevent the contamination of ground or surface water resources, the migration of fluids, and risks to the health and safety of the public.

12.2.5.2 Prior to closing, all wells or holes shall be cleared of any pumps, wires, piping, or other materials which may interfere with effective closing.

12.2.5.3 An abandoned well or hole shall be completely filled with a grout or other material to render the bore hole at least as impervious as the surrounding native material. Contaminated wells shall be closed with grout material for the full depth of the well or at least the zone shown to be contaminated. If a flowing well is to be abandoned, it shall be closed to prevent fluids from flowing out of the well.

12.2.5.4 All abandoned monitoring wells shall be closed. Wells located where contaminants are present shall be completely filled with grout material to prevent migration of fluids in the bore hole. Contaminated materials shall be transported and disposed of in accordance with the Secretary's requirements.

12.2.6 Well Finish

12.2.6.1 Each well shall be finished to prevent damage to the well and minimize the potential for contamination.

12.2.6.2 The well casing shall extend not less than 18 inches above existing grade, or at least 12 inches above the pump house floor or concrete apron surface, except as permitted in Appendix A Subpart 12.3.6.4.

The well shall be covered with a temporary or permanent tight fitting cap or protective structure which cannot be removed or opened without the use of tools, a key, or a combination.

12.2.6.3 Any well located in the 100 year frequency floodplain or floodway shall be floodproofed to prevent flood water from entering the well.

12.2.6.4 No well shall be located in a well pit, underground enclosure, or in a hazardous location unless specifically requested by the owner. If an underground enclosure is used it shall prevent intrusion by persons or animals and shall be passively drained to prevent any ponding of water in the enclosure. The well shall be capped with a water tight cap meeting the Standard for Watertight Well Caps (PAS-97) adopted by the Water Systems Council, Chicago, IL. A sanitary seal shall not be used. Any well which is buried in a well pit, or underground enclosure shall be separately vented. The wiring for the pump shall either be sealed for water tightness where it enters the cap or be contained in a watertight conduit system.

Wells permitted under Appendix A Subparts 12.4.2(c) and (d) may only be buried when approved by the Secretary.

12.2.6.5 No well shall be finished, vented or capped in a manner which has any similarity to any oil or gas filling pipe unless specifically and permanently labeled to prevent confusion.

12.2.7 Pump Installation for Water Wells

12.2.7.1 If a pump house is placed over a well, it shall be passively drained. The casing shall extend at least 12 inches above the floor. The well shall be capped as required in Appendix A Subpart 12.3.6.2 or shall otherwise be suitably covered to prevent foreign material from entering the well.

12.2.7.2 If a pitless unit is used it shall be constructed of durable water tight materials. The pitless unit shall be at least the same size as the well casing and securely attached by welding, cementing or threading.

12.2.7.3 If a pitless adapter is used it shall be of durable construction and of sufficient strength and size for the pump and pipe to be attached to it. The attachment hole through the well casing must be properly sized, smooth and without burrs. The pitless adapter must be securely connected to the well casing and must be watertight.

12.2.7.4 All wells should be properly vented at the well head or by adequate size pipe into a protected structure. The vent opening shall be covered with a very fine mesh screen. Wells which have special construction (e.g., flowing wells) need not be vented.

12.2.7.5 All wells shall be finished as required in 12.3.6 and shall be disinfected upon completion of work as required in Appendix A Subpart 12.3.1(e).

12.2.7.6 All wiring in the well shall conform to all applicable standards and shall be done under the license of a licensed electrician where appropriate and required.

12.2.7.7 All wiring outside of the casing shall be contained in a suitable conduit or pipe from the well cap to at least 2 feet below land surface. Connection to the well cap assembly shall be tight fitting.

12.2.7.8 All pumps, piping, and fittings shall be of durable construction suitable for use in water systems and shall not contain any hazardous materials. All in-well pumps should have a check valve to prevent backflow. Torque arresters, taping of electrical lines, and piping and other appropriate means shall be used to properly support and prevent excessive movement of the pumping system in the well or damage to the well.

12.2.7.9 Due to the inherent health risks associated with inadequate pump installations, the Department recommends that all final pump installations be performed by a licensed water well driller or a licensed plumber.

12.2.8 Flowing Wells

12.2.8.1 Flowing wells should be constructed and finished in a manner to prevent unreasonable depletion of the aquifer, loss of artesian pressure, and erosion of the aquifer confining materials or the land surface.

12.2.9 Well Tag Identification

12.2.9.1 Each new water well or untagged water well which is deepened or serviced shall be identified with a permanently attached identification tag. The tag shall identify the well driller's license number and a unique number which shall be used on the Well Completion Report. When deepening or servicing a previously tagged well, the complete previous tag number shall be recorded on the Well Completion Report. Identification tags will be supplied by the Secretary. Each driller will be provided with a supply of tags upon request. Each water well shall be tagged within 30 days of completion.

12.2.9.2 Each monitoring well shall be adequately and permanently identified with a unique identification (usually supplied by the owner's consultant) and noted on the Monitoring Well Report and on any site plan. This identification shall not be subsequently removed but may be added to. Where feasible, the same tag used by water well drillers shall be used on monitoring wells. All monitoring wells shall be tagged or permanently identified within 30 days of construction.

12.2.10 Inspection of Wells

12.2.10.1 The Secretary may observe the construction of wells to assure compliance with this chapter. Upon request of the Secretary, the well driller shall provide details of material, equipment, and methods used and other information that the Secretary may require.

12.2.10.2 The Secretary may inspect, with permission of the well owner, any well as it deems necessary or desirable. The Secretary may inspect any well which is the subject of any formal complaint filed with the Secretary.

12.2.10.3 The Secretary shall notify the well owner, and other parties if appropriate, of the time and date of the inspection.

12.3 Construction and Isolation Standards for Wells Requiring Permits

12.3.1 Purpose and Scope

12.3.1.1 Vermont's Water Supply Rule (Chapter 21) require permits for wells drilled under these jurisdictions. The well driller shall request of the landowner whether a state permit is required or not for the construction of the proposed well. If a state permit is required, the well driller shall construct the well in accordance with these Construction and Isolation Standards.

12.3.2 Wells Serving **Public Non-Transient Non-Community** water systems and **Public Transient Non-Community** water systems

A well for a **Public Non-Transient Non-Community** water systems or **Public Transient Non-Community** water systems requiring permits means any well which requires a permit from the Wastewater Management Division. These permits are required by 10 V.S.A. Section1973, and cover water sources for:

(a) **Public Transient Non-Community** water systems (TNC), which serve 25 or more people more than 60 days per year.

(b) **Public Non-Transient Non-Community** water systems (NTNC), which are **Public** water systems that are not **Public Community** water systems and that regularly serve at least 25 of the same persons over six months per year.

12.3.3 Construction Standards For **Public Non-Transient Non-Community** water systems and **Public Transient Non-Community** water systems

12.3.3.1 Well construction for **Public Non-Transient Non-Community** water systems and **Public Transient Non-Community** water systems must at minimum follow those standards outlined in Subpart 12.3 unless stated otherwise.

12.3.4 Isolation Distances

12.3.4.1 The proposed site of the water source for the building or project shall be approved by the Secretary before the source is developed. Adequate isolation distances between wells and potential sources of contamination are required. The distances are listed in Subpart 11.4 of this Appendix.

12.3.5 (Reserved)

12.3.6 Wells Requiring Source Permits under the Water Supply Rule

12.3.6.1 Public Community water system wells require a permit from the Secretary as do wells for bulk and bottled water. They are as follows:

(a) Wells for Public Community water systems are those which serve at least fifteen (15) service connections used by year-round residents or regularly serve at least 25 year round residents.

(b) Wells for bulk water facilities (bulk water is water delivered to consumers or water surveyors by means other than pipeline or bottled water); and

(c) Wells for Bottled Water Facilities (bottled water is non-carbonated, non-flavored water placed in a sealed container for sale or distribution to the public with the express or implied intent of providing water for human consumption).

12.3.7 Construction Standards from the Water Supply Rule

12.3.7.1 The following standards are in addition to those in Appendix A Subpart 12.3. Water used in drilling must be potable and all fluids, muds, additives must be National Sanitation Foundation (NSF) approved and listed. Every well shall be tested for plumbness and alignment in accordance with American Water Works Association (AWWA) Standards.

12.3.8 Minimum Protected Depths

12.3.8.1 Drilled wells shall provide watertight construction to such depths as may be required by the Secretary, to:

(a) exclude surface contamination, and
(b) seal off formations that are contaminated or yield undesirable water.

12.3.8.2 Drilled bedrock wells shall have casing installed a minimum of 10 feet into unweathered competent bedrock. A minimum of 20 feet of casing shall be installed in all bedrock wells.

12.3.9 Temporary Steel Casing

12.3.9.1 Temporary steel casing used for construction shall be capable of withstanding the structural load imposed during its installation and removal.

12.3.10 Permanent Steel Casing Pipe

12.3.10.1 Steel pipe used for permanent casing in permitted water wells shall be new pipe meeting AWWA, ASTM, or API specifications for water well construction,

12.3.10.2 Have minimum weights and thickness as indicated in the table below.

STEEL PIPE					
SIZE	**DIAMETER (inches)**		**THICKNESS (inches)**	**WEIGHT per FOOT (pounds)**	
	EXTERNAL	**INTERNAL**		**PLAIN ENDS (calculated)**	**W/THREADS & 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	
18	18.000	17.250	0.375	70.59	
20	20.000	19.250	0.375	78.60	
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	

12.3.10.3 When additional thickness and weight is necessary to assure reasonable life expectancy of a well, the casing shall:

(a) be capable of withstanding forces to which it is subjected,

(b) be equipped with a drive shoe when driven, and

(c) have full circumferential welds or threaded coupling joints.

12.3.11 Nonferrous Casing Materials

12.3.11.1 The use of any nonferrous material as well casing shall be approved by the Secretary prior to submission of plans and specifications; and

12.3.11.2 Nonferrous material proposed as a well casing shall be resistant to the corrosiveness of the water and to the stresses to which it will be subjected during installation, grouting and operation.

12.3.12 Packers

12.3.12.1 Packers shall be of material that will not impart taste, odor, toxic substance or bacterial contamination to the well water.

12.3.13 Screens

12.3.13.1 Screens shall be constructed of materials capable of withstanding the structural loads imposed and resistant to damage by chemical action of groundwater or cleaning operations, and shall

(a) have size of openings based on sieve analysis of formation and/or gravel pack materials;
(b) have sufficient diameter to provide adequate specific capacity and low aperture entrance velocity. The entrance velocity should not exceed 0.1 feet per second;
(c) be installed so that the pumping water level remains above the screen under all operating conditions;
(d) where applicable, be designed and installed to permit removal or replacement without adversely affecting watertight construction of the well;
(e) be provided with a bottom plate or washdown bottom fitting of the same material as the screen; and
(f) be reviewed and approved by the Secretary before installation.

12.3.14 Grouting Requirements

12.3.14.1 All permanent well casing, including the couplings, (except driven Schedule 40 steel casing with the approval of the Secretary), shall be surrounded by a minimum of 1½ inches of grout to the required depth. All temporary construction casings should be removed, but shall be withdrawn at least ten feet to insure grout contact with the native formation.

Deviation from the grouting standards contained herein may be allowed after review under the provisions of Section 3.7 in Subchapter 21-3.

12.3.14.2. Neat cement grout

(a) Cement conforming to ASTM standard C150, with not more than 5 gallons of water per 94 pound sack of cement, shall be used for 1½ inch or larger annular openings.
(b) Additives may be used to increase fluidity subject to approval by the Secretary.

12.3.14.3. Concrete grout

(a) Equal parts of cement conforming to ASTM Standard C150, and sand, with not more than 5 gallons of water per 94 pound sack of cement may be used for annular openings larger than 1½ inches.
(b) Where an annular opening larger than 4 inches is available, gravel not larger than ½ inch in size may be added.

12.3.14.4. Clay Seal/Bentonite

Where an annular opening greater than 6 inches is available, a clay seal of clean local clay mixed with at least 10 percent swelling bentonite may be used when approved by the Secretary.

12.3.14.5 Application

(a) Sufficient annular opening shall be provided to permit a minimum of 1½ inches of grout around permanent casings, including couplings.
(b) When the annular opening is less than 4", grout shall be installed under pressure by means of a grout pump from the bottom of the annular opening upward in one continuous operation until the annular opening is filled.
(c) When the annular opening is four or more inches and less than 100' in depth, and concrete grout is used, it may be placed by gravity through a grout pipe installed to the bottom of the annular opening in one continuous operation until the annular opening is filled.
(d) When the annular opening exceeds six inches, is less than 100' in depth, and a clay seal is used, it may be placed by gravity.
(e) After cement grouting is applied, work on the well shall be discontinued until the cement or concrete grout has properly set.
(f) If clay or hard pan is encountered above the water bearing formation, the permanent casing and grout shall extend through such materials, or
(g) If a sand or gravel aquifer is overlain only by permeable soils, the permanent casing and grout shall extend to at least 18.5 feet below original or final ground elevation, whichever is lower.
(h) If a temporary outer casing is used, it shall be completely withdrawn as grout is applied.
(i) Alternate methods of installing grout in rock wells follow. All examples include drilling a hole 3" in diameter greater than the casing (including couplings) at least 10' into unweathered bedrock. A minimum of 20 feet of casing is required.
    (1) Place grout in open hole and insert plugged casing to displace grout upward and into the natural materials.
    (2) Fill hole with grout, set open casing, let grout set, drill grout out; note that grout may be removed before the cement is set as long as the wet cement seal is not broken. Regrouting may be required in the event of a failure of the grout.
    (3) Set casing near bottom of hole with tremie pipe fitting on end of casing, pump grout into bottom of pipe until it rises to the surface outside of the casing, set casing, remove tremie pipe, and drill out fittings.
    (4) Other methods may be approved after review by the Secretary.

12.3.14.6 Guides

The casing shall be provided with sufficient guides welded to the casing to permit unobstructed flow and uniform thickness of grout.

12.3.15 Well Construction

12.3.15.1 Permanent casing for all groundwater sources shall project at least 12 inches above the pump house floor or concrete apron surface and at least 18 inches above final ground surface.

12.3.15.2 Where a well house is constructed, the floor surface shall be at least 6 inches above the final ground elevation.

12.3.15.3 Sites subject to flooding shall be provided with an earth mound surrounding the casing and terminating at an elevation at least 2 feet above the 100 year flood elevation, or other suitable protection as determined by the Secretary.

12.3.15.4 The top of the well casing at sites subject to flooding shall terminate at least 3 feet above the 100 year flood elevation.

12.3.16 Development

12.3.16.1 Every well shall be developed to remove the native silts and clays, drilling mud and/or finer fraction of the gravel pack or rock fracture.

12.3.16.2 Development shall continue until the maximum specific capacity is documented from the completed well.

12.3.16.3 Where chemical conditioning is required, the specification shall include provisions for the method, equipment, chemicals, testing for residual chemicals, and disposal of waste and inhibitors.

12.3.16.4 Where blasting procedures may be used, the specifications shall include the provisions for blasting and cleaning.

12.3.16.5 Other development procedures including hydrofracturing may be approved by the Secretary.

12.3.17 Capping Requirements

12.3.17.1 A water-tight, non-corrodible vented cap must be installed on each well. Each cap must have a screened 40 mesh vent designed to shed water and snow.

12.3.17.2 At all times during the progress of work, the contractor shall provide protection to prevent tampering with the well or entrance of foreign materials.

12.3.17.3 Caps for testing flowing wells shall include a pressure gauge sensitive enough to calculate static water level to the nearest tenth of a foot.

12.3.18 Closure of Abandoned Wells

12.3.18.1 Test wells and groundwater sources which are not in use or planned for use shall be sealed by such methods as necessary to restore the controlling geological conditions which existed prior to construction, or as directed by the Secretary.

12.3.18.2 Wells to be abandoned shall:

(a) be sealed to prevent undesirable exchange of water from one aquifer to another;
(b) preferably be filled with neat cement grout;
(c) have fill materials other than cement grout or concrete approved by the Secretary;
(d) when filled with cement grout or concrete, these materials shall be applied to the well hole through a pipe, tremie, or bailer; and
(e) be disinfected and free from foreign materials.

12.3.18.3 Well abandonment shall be performed only by a Vermont licensed water well driller or monitoring well driller for her or his respective class and in conformance with all Department regulations.

12.3.19 Aquifer Types and Construction Methods - Special Conditions

12.3.19.1 Gravel Pack Wells

(a) Gravel pack shall be well rounded particles, 95% siliceous material, that are smooth and uniform, free of foreign material, properly sized, washed and then disinfected immediately prior to or during placement.
(b) Gravel pack shall be placed in one uniform continuous operation.
(c) Gravel refill pipes, when used, shall be Schedule 40 steel pipe incorporated within the pump foundation and terminated with screwed or welded caps at least 12 inches above the pump house floor or concrete apron.
(d) Gravel refill pipes located in the grouted annular opening shall be surrounded by a minimum of 1 ½ inches of grout.
(e) Protection from leakage of grout or fine grained formation materials into the gravel pack or screen shall be provided for.
(f) Permanent casings shall meet requirements of Subpart 12.4.10.
(g) Minimum casing and grouted depth shall be acceptable to the Secretary.

12.3.19.2 Naturally Flowing Wells

(a) Flow shall be controlled.
(b) Permanent casing and grout shall be provided.
(c) If erosion of the confining bed appears likely, special protective construction may be required by the Secretary.
(d) Capping shall be in accordance with Subpart 12.3.6.2.

12.3.20 Well Pumps, Discharge Piping and Appurtenances

12.3.20.1 Line Shaft Pumps

Wells equipped with line shaft pumps shall:

(a) have the casing firmly connected to the pump structure or have the casing inserted into a recess extending at least one half inch into the pump base, and

(b) have the pump foundation and base designed to prevent water from coming into contact with the joint.

12.3.20.2 Submersible Pumps

Where a submersible pump is used:

(a) the top of the casing shall be effectively sealed against the entrance of water under all conditions of vibration or movement of conductors or cables, and

(b) the electrical cable shall be firmly attached to the riser pipe at 20 foot intervals or less.

12.3.20.3 Discharge Piping

(a) The discharge piping shall:
  (1) be designed so that the friction loss will be low,
  (2) have control valves and appurtenances located above the pump house floor when an above ground discharge is provided,
  (3) be protected against the entrance of contamination,
  (4) be equipped with a check valve, a shut off valve, a pressure gauge, a means of measuring flow, and a smooth nosed sampling tap located at a point where positive pressure is maintained,
  (5) where applicable, be equipped with an air release vacuum relief valve located upstream from the check valve, with exhaust/relief piping terminating in a down-turned position at least 18 inches above the floor and covered with a 24 mesh corrosion resistant screen,
  (6) be valved to permit test pumping and control of each well,
  (7) have all exposed piping, valves and appurtenances protected against physical damage and freezing,
  (8) be properly anchored to prevent movement, and
  (9) be protected against surge or water hammer.

(b) The discharge piping should be provided with a means of pumping to waste, but shall not be directly connected to a sewer.

12.3.20.4 Pitless Well Units

(a) The Secretary must be contacted for approval of specific applications of pitless units.

(b) Pitless units shall:
  (1) be threaded or welded to the well casing,
  (2) be of watertight construction throughout,

(3) be of materials and weight at least equivalent and compatible to the casing,
(4) have field connection to the lateral discharge from the pitless unit of threaded, flanged or mechanical joint connection, and
(5) have the wellhead terminate at least 18 inches above final ground elevation or 3 feet above highest known flood elevation or as the Secretary directs.

(c) The design of the pitless unit shall make provision for:
(1) access to disinfect the well,
(2) facilities to measure water levels in the well
(3) a cover at the upper terminal of the well that will prevent the entrance of contamination,
(4) a contamination-proof entrance connection for electrical cable,
(5) an inside diameter as great as that of the well casing, up to and including casing diameters of 12 inches, to facilitate work and repair on the well, pump, or well screen, and
(6) at least 1 check valve within the well casing or in compliance with requirements of the Secretary.

12.3.20.5 Casing Vent

Provisions shall be made for venting the well casing to atmosphere. The vent shall terminate in a downturned position, at or above the top of the casing or pitless unit in a minimum 1½ inch diameter opening covered with a 24 mesh, corrosion resistant screen. The pipe connecting the casing to the vent shall be of adequate size to provide rapid venting of the casing.