

Excerpt from: VERMONT ANR-DEC ENVIRONMENTAL PROTECTION RULES,
WATER SUPPLY RULE: CHAPTER 21, APPENDIX A, PART 12,
APRIL 12, 2005

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) unless explicitly stated otherwise. Subpart 12.4 sets forth more stringent construction standards for wells requiring permits. A well driller is expected to know whether or not a permit is required and which standards apply. The following criteria define wells which do not need a state permit:

- (a) Wells for single family residences on lots larger than 10 acres created prior to June 14, 2002 until July 1, 2007;
- (b) Wells for single family residences on lots which are exempt from state permit requirements because the lot was recorded in Town land records before the law became effective on 9-18-69 until July 1, 2007; and
- (c) Wells on exempt lots with single family houses already on them until July 1, 2007.

Note: Permits are required for changes to water systems for existing single family residences on existing lots when the lot was originally created under a subdivision permit.

12.2 Isolation Standards for Wells Not Requiring Permits

12.2.1 Well Siting

12.2.1.1 Isolation Distances

All water wells shall be located and constructed in a wise and judicious manner.

Prior to undertaking any drilling operation on a parcel, the well driller shall request of the landowner whether applicable permits are required for a well and whether they have been obtained. The well driller is responsible for knowing which construction standards apply for the different categories of wells (“permit required and no-permit required”) as defined in this rule. If a permit is required, the well driller is responsible for acquiring from the landowner the permitted well location(s) and for drilling each well in that location. For no-permit required wells, the well driller shall discuss the proposed site with the landowner and agree upon a well location which meets isolation distances or variance criteria, prior to drilling. Forms are available from the Department for use with both

permit required and no-permit required wells, and must be submitted with the Well Completion Report.

The well driller shall inform the owner of the proper isolation distances from pollution sources. The well driller shall request from the owner information on the location of existing, reserved, and permitted areas for subsurface disposal fields and other pollution sources before siting the well. Wells shall be located following minimum horizontal isolation distances from the listed potential contamination sources.

POTENTIAL SOURCE OF CONTAMINATION		MINIMUM ISOLATION DISTANCES(*)
1.	Buildings	10 ft.
2.	Edge of driveway serving fewer than 3 residences	15 ft.
3.	Property line	10 ft.(a)
4.	Roadway shoulder, parking lot edge	25 ft.
5.	Surface Water	25 ft.
6.	Subsurface wastewater piping (sewer and related tanks (septic))	25 ft.
7.	Limit of herbicide application, i.e. utility ROW	100 ft. (b)
8.	Concentrated livestock holding areas, or manure storage	200 ft.
9.	Down slope sewage system disposal facilities (fields, beds, drywells, injection wells, etc.)	100 ft.
10.	Up slope sewage system disposal facilities	100 ft.
11.	Hazardous or solid waste disposal sites	200 ft.

(a) Increase to 50 ft. when adjacent to agricultural crop land.

(b) Applies to rights-of-way (ROW) where herbicides have been applied in the past 12 months and may be applied in the future. This distance may be increased to 200 ft. depending on the active ingredient in the herbicide according to Vermont Regulations for Control of Pesticides.

(*) See Appendix A Subpart 12.2.1.2 below for variances from minimum isolation distances

12.2.1.2 Variances for Isolation Distances

When meeting the minimum isolation distances in Subpart 12.2.1.1 is physically unworkable, or the location of the subsurface disposal field can not be determined,

additional protective measures must be used. Additional protection (except as otherwise specified by the Secretary) shall be provided through the use of additional casing and grouting of any annular space. The well driller shall discuss the well location problems with the owner and the final location and use of additional protective measures shall be agreed to before construction. The variance shall be noted on the Well Completion Report.

12.2.1.3 Hazardous Locations

Where possible, the well should be located in a non-hazardous location where the well will not be subject to damage from vehicles and similar hazards.

12.2.1.4 Monitoring Wells

Monitoring wells constructed to investigate possible groundwater contamination are exempt from the isolation distances established in Appendix A Subpart 12.2.1.1, but must meet all requirements of Appendix A Subparts 12.3.3 and 12.3.4.

12.2.1.5 Contaminated wells that cannot be corrected shall be closed according to Appendix A Subpart 12.3.5.

12.3 Construction Standards for Wells Not Requiring Permits and for Public Non-Transient Non-Community water systems, Public Transient Non-Community water systems, and Non-Public water systems requiring permits

12.3.1 Drilling - General

12.3.1.1 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.

12.3.1.2 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.

12.3.1.3 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.

12.3.1.4 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.

12.3.1.5 Heat Pump Wells

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

12.3.2 Casing and Liner

12.3.2.1 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.

12.3.2.2 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).

12.3.3 Annular Space

- 12.3.3.1 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.
- 12.3.3.2 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.

12.3.3.3 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.

12.3.4 Grouting

12.3.4.1 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.

12.3.4.2 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.

12.3.4.3 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.

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

12.3.5 Closure of Abandoned Wells

12.3.5.1 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.

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

12.3.5.3 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.

12.3.5.4 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.

12.3.6 Well Finish

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

12.3.6.2 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.

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

12.3.6.4 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-2) 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.

12.3.6.5 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.

12.3.7 Pump Installation for Water Wells

12.3.7.1 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.

- 12.3.7.2 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.
- 12.3.7.3 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.
- 12.3.7.4 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.
- 12.3.7.5 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).
- 12.3.7.6 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.
- 12.3.7.7 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.
- 12.3.7.8 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.
- 12.3.7.9 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.

12.3.8 Flowing Wells

- 12.3.8.1 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.

12.3.9 Well Tag Identification

12.3.9.1 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.

12.3.9.2 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.

12.3.10 Inspection of Wells

12.3.10.1 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.

12.3.10.2 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.

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

12.4 Construction and Isolation Standards for Wells Requiring Permits

12.4.1 Purpose and Scope

12.4.1.1 Vermont's Water Supply Rule (Chapter 21) and the Environmental Protection Rules (Chapter 1) 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.

12.4.2 Wells Serving **Public Non-Transient Non-Community** water systems, **Public Transient Non-Community** water systems, and **Non-Public** water systems requiring permits

A well for a **Public Non-Transient Non-Community** water systems, **Public Transient Non-Community** water systems, and **Non-Public** 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. Section 1973, and cover water sources for:

- (a) Any building other than a single family residence (examples include churches, schools, restaurants, stores, offices, shops, factories, condominiums, etc).
- (b) Residences in subdivisions which require subdivision permits.
- (c) **Public Transient Non-Community** water systems (TNC), which serve 25 or more people more than 60 days per year.
- (d) **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.
- (e) Any well created after July 1, 2007.

12.4.3 Construction Standards For **Public Non-Transient Non-Community** water systems, **Public Transient Non-Community** water systems, and **Non-Public** water systems requiring permits

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

12.4.4 Isolation Distances

12.4.4.1 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.

12.4.5 (Reserved)

12.4.6 Wells Requiring Source Permits under the Water Supply Rule

12.4.6.1 **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).

12.4.7 Construction Standards from the Water Supply Rule

12.4.7.1 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.

12.4.8 Minimum Protected Depths

12.4.8.1 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.

12.4.8.2 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.

12.4.9 Temporary Steel Casing

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

12.4.10 Permanent Steel Casing Pipe

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

12.4.10.2 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	

12.4.10.3 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.

12.4.11 Nonferrous Casing Materials

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

12.4.11.2 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.

12.4.12 Packers

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

12.4.13 Screens

12.4.13.1 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.

12.4.14 Grouting Requirements

12.4.14.1 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.

12.4.14.2 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.

12.4.14.3. 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.

12.4.14.4. 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.

12.4.14.5 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.

12.4.14.6 Guides

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

12.4.15 Well Construction

12.4.15.1 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.

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

12.4.15.3 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.

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

12.4.16 Development

12.4.16.1 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.

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

12.4.16.3 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.

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

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

12.4.17 Capping Requirements

12.4.17.1 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.

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

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

12.4.18 Closure of Abandoned Wells

12.4.18.1 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.

12.4.18.2 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.

12.4.18.3 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.

12.4.19 Aquifer Types and Construction Methods - Special Conditions

12.4.19.1 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.

12.4.19.2 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.

12.4.20 Well Pumps, Discharge Piping and Appurtenances

12.4.20.1 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.

12.4.20.2 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.

12.4.20.3 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.

12.4.20.4 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.

12.4.20.5 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.