

CHAPTER III SOURCE DEVELOPMENT

III.A SURFACE WATER SOURCE

III.A.1 Supply Quantity

- *Sources of Supply, Treatment, Pumping, Transmission, and Storage Facilities of Sufficient Capacity*

PHC 19-13-B102(p)

Sources of supply shall be maintained to provide flows in excess of the maximum flows experienced in the community water system, and in individual service zones within integrated systems. Whenever peak period consumption interrupts water service to consumers under normal conditions, conservation measures that effectively reduce consumption shall be promptly instituted for the community water supply, and a program to provide sufficient supply, treatment, pumping, transmission, and storage capacity to meet existing and projected peak period consumption shall be implemented.

- *Quantity*

RSWW 3.1.1

The quantity of water at the source shall

- a. be adequate to meet the maximum projected water demand of the service area as shown by calculations based on the extreme drought of record while not significantly affecting the ecology of the water course downstream of the intake,
- b. provide a reasonable surplus for anticipated growth,
- c. be adequate to compensate for all losses such as silting, evaporation, seepage, etc.,
- d. be adequate to provide ample water for other legal users of the source.

III.A.2 Water Quality of Untreated Water Prior to Treatment

Untreated water prior to treatment shall conform with the following:

PHC 19-13-B102(c)

All parameters shall be tested for each surface source at least annually, except bacteriological and physical tests which shall be done quarterly. Groundwater sources shall be tested for these parameters when the department determines that the source is vulnerable to contamination.

Parameter	Degree of Treatment	
	Disinfection and Chemical	Filtration

PHC 19-13-B102(c)
(continued)

Treatment		
(1) Bacteriological Coliform Organisms*	Not to exceed 100/100ml monthly average, based on a running arithmetic average for the most recent twelve month period. No individual sample is to exceed 500/100ml	Not to exceed 20,000/100ml as measured by a monthly geometric mean
(2) Physical Color	Not to exceed twenty (20) standard units in more than ten percent (10%) of samples for most recent twelve (12) month period.	Not to exceed two hundred fifty (250) standard units as measured by a monthly geometric mean
Turbidity	The turbidity level as specified in 40 CFR 141.74(a)4, in a representative sample of the source water immediately prior to the first or only point of disinfection application shall not exceed (5) Nephelometric Turbidity Units (NTU).	Not to exceed two hundred fifty (250) standard units as measured by a monthly geometric mean
Parameter	Degree of Treatment	
	Disinfection and Chemical Treatment Level (mg/l)	Filtration Level (mg/l)
(3) Inorganic Chemicals		
Arsenic	.05	.05
Barium	1	1
Cadmium	.01	.01
Chloride	250	250
Chromium	.05	.05
Copper	.05	1.0
Cyanide	.01	0.2
Fluoride	2.0	2.0
Lead	.05	.05
MBAS (methylene blue active substance)	.5	.5
Mercury	.002	.005
Nitrate plus Nitrite as N	10	10
Selenium	.01	.01
Silver	.05	.05
Parameter	All Degrees of Treatment Level (mg/l)	
(4) Pesticides		
Endrin	0.002	
Lindane	0.0002	
Methoxychlor	0.04	
Toxaphene	0.003	
2,4-D	0.07	
2,4,5-TP (silvex)	0.05	

*If coliform organisms are demonstrated to be not associated with a fecal source on the basis of a sanitary survey and differential tests, exception may be made.

III.A.3 Protection and Maintenance

III.A.3.a Watershed Survey

- A water utility having an active surface water source of supply under its control shall make a sanitary survey of the watershed to the State Health Department by March 1 each year covering the preceding calendar year.

PHC 19-13-B102(b)

- *Quality*

RSWW 3.1.2

A sanitary survey and study shall be made of the factors, both natural and man made, which may affect quality. Such survey and study shall include, but not be limited to

- a. determining possible future uses of the impoundments or reservoirs,
- b. determining degree of control of watershed by owner,
- c. assessing degree of hazard to the supply by accidental spillage of materials that may be toxic, harmful or detrimental to treatment processes,
- d. assessing all waste discharges (point and non point sources) and activities that could impact the water supply. The location of each waste discharge shall be shown on a scale map,
- e. obtaining samples over a sufficient period of time to assess the microbiological, physical, chemical and radiological characteristics of the water,
- f. assessing the capability of the proposed treatment process to reduce contaminants to applicable standards,
- g. consideration of currents, wind and ice conditions, and the effect of confluencing streams

III.A.3.b Watershed Sanitation

Unless specifically limited, the following regulations apply to land and watercourses tributary to a public water supply including both surface and groundwater sources.

PHC 19-13-B32(b) - (i)

- (b) No sewage disposal system, cesspool, privy or other place for the deposit or storage of sewage shall be located within one hundred feet of the high water mark of any reservoir or within fifty feet of the high water mark of any stream, brook, or watercourse, flowing into any reservoir used for drinking purposes.
- (c) No sewage disposal system, cesspool, privy or other place for the deposit or storage of sewage shall be located on any watershed, unless such facility is so constructed that no portion of the contents can escape

PHC 19-13-B32(b) - (i)

such facility is so constructed that no portion of the contents can escape or be washed into the stream or reservoir.

(continued)

- (d) No sewage shall be discharged on the surface of the ground on any watershed.
- (e) No stable, pigpen, chicken house or other structure where the excrement of animals or fowls is allowed to accumulate shall be located within one hundred feet of the high water mark of a reservoir or within fifty feet of the high water mark of any watercourse as above mentioned, and no such structure shall be located on any watershed unless provision is made in a manner acceptable to the commissioner of health for preventing manure or other polluting materials from flowing or being washed into such waters.
- (f) No toxic metals, gasoline, oil or any pesticide shall be disposed of as a waste into any watercourse tributary to a public drinking water supply or to any ground water identified as supplying a public water supply well.
- (g) Where fertilizer is identified as a significant contributing factor to nitrate nitrogen occurring in excess of 8 mg/l in a public water supply, fertilizer application shall be made only under current guidelines established by the commissioner of health in cooperation with the state commissioner of agriculture, the college of agriculture of the University of Connecticut and the Connecticut agricultural experiment station in order to prevent exceeding the maximum allowable limit in public drinking water of 10.0 mg/l for nitrite plus nitrogen.
- (h) Where sodium occurs in excess of 15 mg/l in a public drinking water supply, no sodium chloride shall be used for maintenance of roads, driveways, or parking areas draining to that water supply except under application rates approved by the commissioner of health, designed to prevent the sodium content of the public drinking water from exceeding 20 mg/l.
- (i) The design of storm water drainage facilities shall be such as to minimize soil erosion and maximize absorption of pollutants by the soil. Storm water drain pipes, except for crossing culverts, shall terminate at least one hundred feet from the edge of an established watercourse unless such termination is impractical, the discharge arrangement is so constructed as to dissipate the flow energy in a way that will minimize the possibility of soil erosion, and the commissioner of health finds that a discharge at a lesser distance is advantageous to stream quality. Special precautions shall be taken to protect stream quality during construction.

III.A.4 Intake Facilities

Design of intake structures shall provide for:

RSWW 3.1.4.1

- a. withdrawal of water from more than one level if quality varies with depth,
- b. separate facilities for release of less desirable water held in storage,
- c. where frazil ice may be problem, holding the velocity of flow into the

- intake structure to a minimum, generally not to exceed 0.5 feet per second,
- d. inspection manholes every 1000 feet for pipe sizes large enough to permit visual inspection,
 - e. occasional cleaning of the inlet line,
 - f. adequate protection against rupture by dragging anchors, ice, etc.,
 - g. ports located above the bottom of the stream, lake or impoundment, but at sufficient depth to be kept submerged at low water levels,
 - h. where shore wells are not provided, a diversion device capable of keeping large quantities of fish or debris from entering the intake structure,
 - i. where deemed necessary, provisions shall be made in the intake structure to control the influx of zebra mussels or other aquatic nuisances. Specific method to control zebra mussels must be approved by the Department,
 - j. when buried surface water collectors are used, sufficient intake opening area must be provided to minimize inlet headloss. Particular attention should be given to the selection of backfill material in relation to the collector pipe slot size and gradation of the native material over the collector system.

RSWW 3.1.4.1
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III.A.5 Blowoffs

Blowoffs shall be required when it is determined appropriate by the Department.

III.A.6 Dams

Impoundments and reservoir construction may require:

- a. approval from the appropriate regulatory agencies of the safety features for stability and spillway design,
- b. a permit from an appropriate regulatory agency for controlling stream flow or installing a structure on the bed of a stream or interstate waterway.

RSWW 3.1.5.2

III.B GROUND WATER

III.B.1 Approvals and Reports

The following approvals, permits and reports are, at a minimum, required to allow the development and use of a source of ground water supply:

- Well Site Approval by DPH
- Well Drilling Permit from the local health agency
- Well Completion Report by driller
- Water Quality Report by approved laboratory
- Well Yield Report by driller or owner
- Well Use Approval by DPH
- DEP Diversion Permit, for sources of supply with required withdrawal rates of greater than 50,000 gpd

III.B.2 Water Quantity

DPUC 16-262m-8(c)

- The following equations are to be used when determining the design population and water demand of the community water system. Where unusual circumstances exist, the Department of Public Utility Control and Department of Health Services will determine the appropriateness of these equations.

- (1) Design Population* Served = number of service connections x number of people per service;
- (2) Average Daily Demand = population served x 75 gallons per person per day;
- (3) Peak Hour Demand = average daily demand x 1/3.

* Design Population shall mean the estimated number of people per service connection, calculated as follows, unless specific circumstances dictate otherwise:

<u>Type of Service</u>	<u>Design Population Per Service Connection</u>
Single family dwelling (Over 3 bedrooms add 1 person per additional bedroom)	4
Multi-dwelling (i.e. apartments, elderly housing, duplexes, townhouses and residential condominiums)	
One bedroom unit	2
Two bedroom unit	3
Three bedroom unit (Over 3 bedrooms add 1 person per additional bedroom)	4
Mobile Homes or Trailers	2.5
Convalescent Homes	Use number beds
All other components described in 16-262m-1(a)	Use estimated population

- Water Supply requirements

DPUC 16-262m-8(d)

- (1) Each community water system shall be designed to furnish and maintain sufficient facilities to provide a continuous and adequate supply of water; and there shall be at least a 15% margin of safety maintained between the system's safe daily yield and anticipated average daily demand. Unless other acceptable provisions are made to assure continuous service, the community water system should be able to meet the anticipated average daily demand with its largest well and/or pump out of service;
- (2) For a system utilizing only groundwater supplies, a minimum of 2 well sources shall be provided;
- (4) All wells, especially deep drilled rock wells, are subject to diminution of their yields after a period of time. Therefore, they should be periodically monitored for possible loss of yield, and scheduled for an appropriate maintenance program when conditions dictate. When new

wells are added at a future date, especially in the vicinity of existing wells, suitable measures shall be taken to ascertain potential loss of yield from the adjacent wells simultaneously with the yield testing of the new wells;

- (5) Reserve well site property is required and must be shown on the final map;
- (6) There shall be a safe yield capacity sufficient to supply 75 gallons per person per day and at least 15% additional supply to maintain an adequate margin of safety and be able to accommodate adjacent growth in the future.

III.B.3 General Construction

III.B.3.a Wells Under Construction

A well under construction shall be protected so that there can be no drainage or surface wash into the well. Workmen employed in such construction shall exercise sanitary precautions in disposal of wastes and handling of construction materials so as to avoid contamination of the well and aquifer. All water used in constructing a well shall be disinfected with fifty milligrams per liter (parts per million) of chlorine in order to protect the well from contamination. No polluted water shall be used in connection with the construction of a well.

PHC 19-13-B51e

III.B.3.b Well Development Considerations

- (1) Wells shall be constructed in accordance with PHC Regulation 19-13-B51 and the Regulations of Connecticut State Agencies Sections 25-128-1 through 25-128-64, inclusive (Regulations of the Well Drilling Industry);
- (2) The bacterial, physical, inorganic chemical, organic chemical and radiological quality of the source must satisfy the requirements of PHC Regulation 19-13-B102 and the Connecticut Department of Health Services action levels for organic compounds. Suitable treatment may be required by the Department of Health Services;
- (3) Each well shall be equipped with a water level probe for periodic drawdown measurement; and there shall be provided suitable low water level well pump shut-off and lightning protection devices in accordance with Section 19-13-B102(n) of the Regulations of Connecticut State Agencies.

DPUC 16-262m-8(f)

III.B.3.c Drilling

- (a) The well shall be so constructed that a pump of capacity equal to the desired yield can be installed and operated for different yields.
- (b) Any water used shall be disinfected or of drinking water quality.
- (c) Any chemicals or other additives used in drilling shall be cleaned out from the well.
- (d) Rock cuttings shall be cleaned out of the well.
- (e) The well shall be tested as provided by Section 19-13-B51 of the Public

WDC 25-128-42

Health Code.

- (f) The well driller shall prepare and maintain a log on forms supplied by the Board, and shall submit copies of the log to the Board and to the owner or owners of the well, respectively. The log shall clearly identify the location of the well upon the premises.
- (g) Well development shall be performed only by properly registered persons.
- (h) Subcontracted work shall be performed only by properly registered persons.
- (i) No solder containing more than 0.2 per cent lead shall be used in making joints and fittings in any public or private potable water supply system or any water user's pipelines.

WDC 25-128-42
(continued)

III.B.3.d *Development*

- a. Every well shall be developed to remove the native silts and clays, drilling mud or finer fraction of the gravel pack.
- b. Development should continue until the maximum specific capacity is obtained from the completed well.
- c. Where chemical conditioning is required, the specifications shall include provisions for the method, equipment, chemicals, testing for residual chemicals, and disposal of waste and inhibitors.
- d. Where blasting procedures may be used, the specifications shall include the provisions for blasting and cleaning. Special attention shall be given to assure that the grouting and casing are not damaged by blasting.

RSWW 3.2.5.10

- *Manner of Construction*

The construction of any well shall be planned and carried out in a manner to guard against waste and contamination of ground water resources.

WDC 25-128-37

III.B.3.e *Drilling Fluids and Additives*

Drilling fluids and additives shall

RSWW 3.2.5.1

- a. not impart any toxic substances to the water or promote bacterial contamination,
- b. be acceptable to the Department.

III.B.4 *Location and Protection*

III.B.4.a *Separating Distances*

All separating distances are to be measured horizontally.

PHC 19-13-B51d

- (a) Wells with required withdrawal rate of under ten gallons per minute.

- (1) Each such well shall be located at a relatively high point on the premises consistent with the general layout and surroundings; be protected against surface wash; be as far removed from any known

protected against surface wash; be as far removed from any known or probable source of pollution as the general layout of the premises and the surroundings will permit; and, so far as possible, be in a direction away from ground water flow from any existing or probable source of pollution.

- (2) No such well shall be located within seventy-five feet of a system for disposal of sewage or other source of pollution. Greater separating distances shall be required for certain industrial wastes or certain rock formations. If a sewer is constructed of extra heavy cast iron pipe with leaded joints or equal approved type of tight joint, a minimum separating distance of twenty-five feet shall be maintained.
 - (3) No such well shall be located within twenty-five feet of the high water mark of any surface water body, nor within twenty-five feet of a drain carrying surface water or of a foundation drain.
- (b) Wells with required withdrawal rate of from ten to fifty gallons per minute.
- (1) Each such well shall be located at a relatively high point on the premises consistent with the general layout and surroundings; be protected against surface wash; be as far removed from any known or probable source of pollution as the general layout of the premises and the surroundings will permit; and, so far as possible, be in a direction away from ground water flow from any existing or probable source of pollution.
 - (2) No such well shall be located within one hundred fifty feet of a system for disposal of sewage or other source of pollution . Greater separating distance shall be required for certain industrial wastes or certain rock formations. If a sewer is constructed of extra heavy cast iron pipe with leaded joints or equal approved type of tight joint, a minimum separating distance of seventy-five feet shall be maintained.
 - (3) No such well shall be located within fifty feet of high water mark of any surface water body, nor within fifty feet of a drain carrying surface water or of a foundation drain.
- (c) Wells with a required withdrawal rate of more than fifty gallons per minute.
- (1) Location of such well shall be approved by the state department of health in accordance with the provisions of section 25-33 of the 1969 supplement to the general statutes and section 19-13-B39 of the PHC.
 - (2) Each such well shall be located at a relatively high point on the premises consistent with the general layout and surroundings; be protected against surface wash; be as far removed from any known or probable source of pollution as the general layout of the premises and the surroundings will permit; and, so far as possible, be in a direction away from ground water flow from any existing or probable source of pollution.

- (3) No such well shall be located within two hundred feet of a system for disposal of sewage or other source of pollution. If conditions warrant, greater distance shall be required. Sanitary conditions in the area within the radial distance required shall be under control of the well owner by ownership, easement, or other arrangement approved by the commissioner of health. If a sewer is constructed of extra heavy cast iron pipe with leaded joints or equal approved type of tight joint, a minimum separating distance of one hundred feet shall be maintained.
- (4) No such well shall be located within fifty feet of the high water mark of any surface water body nor within fifty feet of a drain carrying surface water or of a foundation drain.

PHC 19-13-B51d
(continued)

- Refer to *Water Supplies Section, Regulation Clarification, "Sources of Pollution"* in Appendix C.
- *Source protection.*

WSS, RC

- (1) The following minimum separating distances are required by PHC Regulation 19-13-B51 and 19-13-B103 (Technical Standards). All separating distances shown should be measured horizontally:

DPUC 16-262m-8(e)

Minimum Distances*			
	Under 10 gpm	10 to 50 gpm	Over 50 gpm
(A) Septic system, buried oil tanks or other source of pollution	75'	150'	200'
(B) Cast iron sewer pipe with leaded joints or equivalent	25'	75'	100'
(C) Surface water body or drain	25'	50'	50'

*Greater separating distances are required for gravel wells with pumping capacities greater than 50 gpm, where ledge is found at less than 10 feet and/or the soil percolation rate is faster than 1 inch per minute at the surrounding septic systems.

- (D) Sanitary conditions within the radial separating distance required shall be under the control of the water supply owner by direct ownership, easement, or other arrangement approved by the Department of Health Services and detailed on the as-built map.

- *Continued Sanitary Protection*

Continued sanitary protection of the well site from potential sources of contamination shall be provided either through ownership, zoning, easements, leasing or other means acceptable to the Department. Fencing of the site may be required by the Department.

RSWW 3.2.3.2

III.B.4.b 100 Year Flood Elevation

Such as but not limited to treatment plants, pumping stations, storage tanks, etc., but not including water intakes and connecting pipelines.

PHC 19-13-B102(d)(1)

(1) New facilities are to be located:

PHC 19-13-B102(d)(1)
(continued)

- (A) Above the level of the one hundred year flood.
- (B) Where chlorine gas will not be stored or used within three hundred feet of any residence.
- (C) Where the facility is not likely to be subject to fires or other natural or manmade disasters.

- *Refer to Water Supplies Section, Regulation Clarification, "Well Location Relative to High Water Mark and 100 Year Flood Level," in Appendix C.*

WSS, RC

III.B.4.c Groundwater Under the Direct Influence of Surface Water

Refer to Water Supplies Section, Recommended Procedure, "Groundwater Under the Direct Influence of Surface Water," in Appendix B.

WSS, RP

III.B.5 Well Depths

Minimum protected depths of drilled wells shall provide watertight construction to such depth as may be required by the Department, to

RSWW 3.2.5.2

- a. exclude contamination, and
- b. seal off formations that are, or may be, contaminated or yield undesirable water.

III.B.6 Well Pit

III.B.6.a General

- (a) The use of a well pit shall be avoided whenever practical. When used, it shall be large enough to permit ready access to equipment.
- (b) A well pit and its juncture with any other structure shall be watertight, or suitably drained to insure dryness as provided in section 19-13-B51i.
- (c) Every conduit or similar connection with a well pit shall be made watertight.

PHC 19-13-B51h

III.B.6.b Well Pits Construction Detail

- (a) Where there is no danger of flood or back flow, the water from a pit shall be drained onto the surface of the ground. The pipe used shall be at a grade of not less than one-eighth inch per foot toward the outlet. The junction between the pit floor and the drain pipe shall be made watertight. The drain pipe and joints shall be watertight to a distance of twenty-five feet from the pit. Any drain to the ground surface shall be screened to prevent entrance of animals and insects.
- (b) No well pit drain shall be connected directly with any sewer, house drain or storm drain. The drainage of any well pit shall not be dependent on the operation of any pumping system except where gravity drainage at the location cannot be secured, in which case

PHC 19-13-B51i

PHC 19-13-B51i
(continued)

automatic sump pumps may be installed with the concurrence of the approving authority.

- (c) When a well pit is constructed in impervious soil, no porous material shall be used as a base under the well pit floor. If fill is required, it shall be clean, impervious earth, well tamped.

III.B.7 Well Casing

III.B.7.a *Materials*

Pipe used for casing a well other than a dug well shall be made of steel or other material approved by the commissioner of health. They shall be free from flaws or defects and shall have watertight connections.

PHC 19-13-B51f(a)

- *Temporary Steel Casing*

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

RSWW 3.2.5.3

- *Permanent Steel Casing Pipe*

Permanent steel casing pipe shall

RSWW 3.2.5.4

- a. be new single steel casing pipe meeting AWWA Standard A-100, ASTM or API specifications for water well construction,
- b. have minimum weights and thickness indicated in Appendix H,
- c. have additional thickness and weight if minimum thickness is not considered sufficient to assure reasonable life expectancy of a well,
- d. be capable of withstanding forces to which it is subjected,
- e. be equipped with a drive shoe when driven, and
- f. have full circumferential welds or threaded coupling joints.

- *Nonferrous Casing Materials*

- a. Approval of the use of any nonferrous material as well casing shall be subject to special determination by the Department prior to submission of plans and specifications.
- b. Nonferrous material proposed as a well casing must be resistant to the corrosiveness of the water and to the stresses to which it will be subjected during installation, grouting and operation.

RSWW 3.2.5.5

III.B.7.b *Upper Terminal of Casing*

The casing of every well shall project not less than six inches above the established grade at the well or above the pump house floor. The well contractor shall ascertain the established grade before completion of the well. Where a pitless adapter is used, it shall be designed to, and made of materials that will, keep soil and water from entering the well during the life of the casing. A below-ground connection shall not be submerged in water

PHC 19-13-B51f(e)

PHC 19-13-B51f(e)
(continued)

at the time of installation. Where a pump is not installed immediately following the construction of the well, the well shall be tightly sealed and suitably vented.

III.B.7.c Packers

Packers shall be of material that will not impart taste, odor, toxic substances or bacterial contamination to the well water. Lead packers shall not be used.

RSWW 3.2.5.6

III.B.8 Drilled Wells

III.B.8.a Method of Construction of Wells.

Drilled well. The construction of a drilled well shall provide for shutting out all water except that from the water bearing formations which are intended to supply water to the well. The casing shall extend at least ten feet below ground surface. Any annular space surrounding the casing pipe needed for drilling shall be filled with concrete grout to a depth of at least ten feet below the ground surface. Below ten feet, any clean fill material can be used. Where the unconsolidated material above consolidated rock is less than twenty feet deep and the casing ends in the consolidated rock, the casing shall be effectively sealed in the rock.

PHC 19-13-B51f(d)

III.B.8.b Casing of Drilled Wells.

- (a) The bottom end of the primary casing shall be equipped with a hardened drive shoe of the appropriate size.
- (b) The casing shall extend at least six (6) inches above the land surface. Annular space shall be grout filled from the frost level to the bottom of the casing, except that, where special or unusual conditions exist, the annular space shall be grout filled from the frost level to a distance of at least ten (10) feet below the land surface.
- (c) Upon completion of the well unit and until such time as the well is equipped with a pump, the top of the casing shall be a metal cap fixed to prevent unwarranted access.
- (d) The primary casing shall be new steel and shall be free of pits, breaks, or other serious imperfections. All casing pipes and couplings used shall have minimum weights and wall thicknesses per diameter, as specified in Table 1. (Refer to Appendix H of this document).
- (e) In the event casing pipes are assembled together, they shall be joined by means of watertight welded joints, screw couplings joints, or slip joints. In the use of welding joints, the weld shall be at least as thick as the wall thickness of the well casing.
- (f) In the event the diameter of a casing is reduced at any point along its length, the annular space between the larger and smaller casings shall be made watertight.

WDC 25-128-43

III.B.8.c Length of Casing, Drilled Wells

A twenty (20) foot minimum length of casing pipe shall be required in the construction of any drilled well, subject to the following exceptions for specific, geological and hydrological conditions:

WDC 25-128-44

- (a) All unconsolidated overburden and other loose, caving zones shall be cased.
- (b) The casing pipe shall extend at least five (5) feet into the bedrock, as shown by Figure 1. (Refer to Appendix H of this document).
- (c) In the event, however, that the overburden or the upper five (5) feet of the bedrock constitute the primary potable water producing zones, the requirement of length of subsection (b) shall not apply.
- (d) In the condition of the presence of caving zones, the casing pipe or other adequate protective seal shall extend as great a distance below the caving zone as the driller deems necessary to insure well stability.
- (e) In the event geological conditions require telescoping of the casing pipe and the use of linear pipe, the respective lengths and diameters necessary to accomplish effective drilling shall be used, the annular spaces shall be made watertight where appropriate to prevent the travel of contaminants.

III.B.9 Gravel Wells

III.B.9.a *Method of Construction of Gravel Wells*

- **Gravel well.** The casing of a gravel well shall be surrounded with concrete grout to a depth of at least ten feet below the ground surface. The annular space between the casings of a gravel well with artificially placed gravel shall be protected at the top by a watertight covering to prevent any foreign matter entering the well through the gravel.
- *Aquifer types and construction methods – Special conditions*
Sand or gravel wells
 - (a) If clay or hard pan is encountered above the water bearing formation, the permanent casing and grout shall extend through such materials.
 - (b) If a sand or gravel aquifer is overlaid only by permeable soils the permanent casing and grout shall extend to at least 20 feet below original or final ground elevation, whichever is lower.
 - (c) If a temporary outer casing is used, it shall be completely withdrawn as grout is applied.

PHC 19-13-B51f(c)

RSWW 3.2.6

RSWW 3.2.6.1

III.B.9.b *Length of Casing, Gravel Wells*

- (a) The length of the casing in a gravel well shall be such that the pumping level does not drop below the top of the screen.
- (b) In conditions of aquifers alternated with silt clay and other undesirable zones, the casing shall extend at least two (2) feet into the aquifer underlying the cased zones, as shown by Figure 2. (Refer to Appendix

WDC 25-128-45

WDC 25-128-45

(continued)

H of this document).

- (c) In conditions of aquifer overlain by layers of clay, silt, fine sand, or any other sand that cannot be developed for ground water, the casing pipe shall extend at least five (5) feet into the aquifer. But if the aquifer thickness is less than five (5) feet, the casing shall extend into the aquifer as much as feasible to serve the general purpose of casing, as shown by Figure 3. (Refer to Appendix H of this document).
- (d) In conditions of aquifer overlain by till, the casing pipe shall extend at least five (5) feet below the bottom of the till. But if the aquifer is less than five (5) feet thick, the casing shall extend into the aquifer as much as feasible to serve the general purpose of casing, as shown in Figure 4. (Refer to Appendix H of this document).
- (e) In conditions of aquifer overlain by clay, the casing shall extend at least five (5) feet below the bottom of the clay. But if the aquifer is less than five (5) feet thick, the casing shall extend into the aquifer as much as feasible to serve the general purpose of casing, as shown in Figure 5. (Refer to Appendix H of this document).
- (f) In conditions of aquifer overlain by unconsolidated material without clay beds, the length of the casing shall be such that the pumping water levels do not drop below the top of the screen.
- (g) In the event the aquifer consists of very coarse gravel and no screen is used, the casing pipe shall extend into the aquifer as much as feasible to develop the required quantity for water.

III.B.9.c Gravel Specifications and Packing

- (a) The gravel in a gravel packed well shall be composed of material that does not react chemically with the water in the well, and will not create or enhance encrustation or corrosion.
- (b) The gravel shall be clean, rounded, uniform, water-washed, and free from clay, silt, or other deleterious substance.
- (c) The size of the gravel shall be as determined by a grain size analysis of the formation material.
- (d) The gravel shall be disinfected by adding sufficient chlorine to the placement fluid to produce a chlorine residual of approximately one hundred parts per million (100 ppm).
- (e) The gravel shall be placed in such a manner that no bridging or layering occurs.
- (f) The gravel pack shall not connect aquifers or zones which have differences in water quality classification or in static water levels.

- *Gravel Packed Wells*

- (a) Gravel pack shall be well rounded particles, 95 per cent siliceous material, that are smooth and uniform, free of foreign material, properly sized, washed and then disinfected immediately prior to or during placement.

Gravel pack shall be placed in one uniform continuous operation.

- (b) Gravel refill pipes, when used, shall be Schedule 40 steel pipe incorporated within the pump foundation and terminated with

WDC 25-128-47

RSWW 3.2.6.2

RSWW 3.2.6.2
(continued)

- screwed or welded caps at least 12 inches above the pump house floor or concrete apron.
- (c) Gravel refill pipes located in the grouted annular opening shall be surrounded by a minimum of 1 ½ inches of grout.
 - (d) Protection from leakage of grout into the gravel pack or screen shall be provided.
 - (e) Permanent inner and outer casings shall meet requirements of Section III.B.7 of this document.
 - (f) Minimum casing and grouted depth shall be acceptable to the Department.

III.B.10 Dug Wells

III.B.10.a *Method of Construction of Wells*

Dug well. The casing or sidewalls of a dug well shall be constructed of watertight concrete at least four inches thick to a depth of at least ten feet below the ground surface. Below the depth of the watertight casing, loosely laid stone, concrete block, brick or other materials approved by the commissioner of health may be used. The annular space between the face of the excavation and the watertight section of casing shall be filled with clean clay or other impervious material.

PHC 19-13-B51f(b)

III.B.10.b *Well Cover*

- (a) The cover of the dug well shall be made of substantial reinforced concrete at least four inches thick. Other material approved by the commissioner of health may be used. It shall be of sufficient diameter to overlap the casing or side walls by at least two inches. A tight joint shall be provided between the casing and cover. If a pump is set on the slab, the top of the slab shall be sloped to drain away from the pump or drop pipe sleeve.
- (b) A manhole shall be installed if the cover slab cannot be readily removed, and such manhole shall be provided with a curb extending at least two inches above the slab and equipped with a watertight overlapping cover. The manhole cover shall be locked or bolted in place in such manner to prevent tampering or shall be isolated in a locked housing.

PHC 19-13-B51g

III.B.10.c *Special Conditions*

- (a) Dug wells may be considered only where geological conditions preclude the possibility of developing an acceptable drilled well.
- (b) A watertight cover shall be provided.
- (c) Minimum protective lining and grouted depth shall be at least ten feet below original or final ground elevation, whichever is lower.
- (d) Openings shall be curbed and protected from entrance of foreign material.
- (e) Pump discharge piping shall not be placed through the well casing or wall.

RSWW 3.2.6.5

III.B.11 Annular Space and Grouting

III.B.11.a *Annular Space*

- (a) Any annular space between the outside of the casing and the natural materials penetrated by the well shall be filled with suitable material to make this space as impervious to the movement of fluids and competent to support the casing as are the natural materials surrounding the well. The driller may fill the annular space with the natural materials excavated during the drilling of the well to meet the following requirements:
- (1) the annular space shall be fitted as completely as possible from the bottom of the casing to the land surface without any depressions, voids, holes or channels;
 - (2) the driller shall employ whatever techniques are effective for the existing conditions to achieve maximum density, strength and impermeability of the fill material; and
 - (3) the surface of the fill material shall be sloped away from the casing.
- (b) In cases where potentially contaminating or corrosive fluids are encountered, or impermeable natural materials cannot be adequately placed and compacted to where geological conditions or the isolation distance may not be adequate, the annular space shall be grouted for the full length 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.

WDC 25-128-48a

III.B.11.b *Grouting Requirements*

All permanent well casing, except driven Schedule 40 steel casing with the approval of the Department, shall be surrounded by a minimum of 1 ½ inches of grout to the depth required by the Department. All temporary construction casings shall be removed. Where removal is not possible or practical, the casing shall be withdrawn at least five feet to insure grout contact with the native formation.

RSWW 3.2.5.8

- a. Neat cement grout
 1. Cement conforming to ASTM standard C150 and water, with not more than six gallons of water per sack of cement, must be used for 1 ½ inch openings.
 2. Additives may be used to increase fluidity subject to approval by the Department.
- b. Concrete grout
 1. Equal parts of cement conforming to AWWA A100 Section 7 most current revision, and sand, with not more than six gallons of water per sack of cement may be used for openings larger than 1 ½

inches.

2. Where an annular opening larger than four inches is available, gravel not larger than one-half inch in size may be added.

RSWW 3.2.5.8
(continued)

c. Clay seal

Where an annular opening greater than six inches is available a clay seal of clean local clay mixed with at least 10 per cent swelling bentonite may be used when approved by the Department.

d. Application

1. Sufficient annular opening shall be provided to permit a minimum of 1 ½ inches of grout around permanent casings, including couplings.
2. Prior to grouting through creviced or fractured formations, bentonite or similar materials may be added to the annular opening, in the manner indicated for grouting.
3. When the annular opening is less than four inches, 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.
4. When the annular opening is four or more inches and less than 100 feet 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.
5. When the annular opening exceeds six inches, is less than 100 feet in depth, and a clay seal is used, it may be placed by gravity.
6. After cement grouting is applied, work on the well shall be discontinued until the cement or concrete grout has properly set.

e. Guides

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

III.B.12 Well Screens

• *Well Screens*

WDC 25-128-46

- (a) Any well constructed to obtain water from an unconsolidated formation may be equipped with a screen, for the purpose of preventing the entrance of formation material into the well after the well has been developed and completed.
- (b) The well screen shall:
 - (1) be of a standard design and manufacture, for the specific purpose of well construction;
 - (2) be made of material adequate to withstand normal physical and chemical forces, applied to it during and after installation;

- (3) shall have openings free of rough edges, irregularities, or other defects that may contribute to corrosion or clogging; and
- (4) shall be provided with such fittings as are necessary to seal the top of the screen to the casing and to close the bottom.
- (c) Any well constructed in very coarse gravel shall not, however, be required to have a screen; or if a screen is used, the bottom may be left open.
- (d) Any well constructed with multiple screens shall not connect aquifers or zones which have differences in water quality, classification or which maintain different piezometric surfaces.

WDC 25-128-46
(continued)

- *Screens*

shall

RSWW 3.2.5.7

- (a) be constructed of materials resistant to damage by chemical action of groundwater or cleaning operations,
- (b) have size of openings based on sieve analysis of formation and/or gravel pack materials,
- (c) have a sufficient length and diameter to provide adequate specific capacity and low aperture entrance velocity. Usually the entrance velocity should not exceed 0.1 feet per second,
- (d) be installed so that the pumping water level remains above the screen under all operating conditions,
- (e) where applicable, be designed and installed to permit removal or replacement without adversely affecting water-tight construction of the well, and
- (f) be provided with a bottom plate washdown bottom fitting of the same material as the screen.

III.B.13 Vents

- *Well Head Arrangement*

Every well in which the drawdown is ten feet or more shall be fitted with an adequate air vent. Such vent shall be extended to the height of at least twelve inches above any possible high water level. The vent shall be shielded and screened in such manner as to permit the entrance of air but keep out foreign matter.

PHC 19-13-B51j(b)

- *Well Head Completion and Equipment*

The well shall be equipped with a tightly fixed vent cap or a sanitary seal with an access port for ventilation. The access port shall have a minimum, inside diameter of one quarter (1/4) inch. It shall be installed and maintained in such a manner as to prevent the entrance of water, dust, insects, or other foreign material, and to permit ready access for the purpose of water level measurement.

WDC 25-128-49(d)

- *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 1 ½ 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.

RSWW 3.2.7.5

III.B.14 Wellhead

III.B.14.a Wellhead Arrangement

- (a) Any equipment, piping or appurtenance, permanently installed in a well, shall be joined watertight to the well casing at the point of entrance to the well by a well top seal or equally effective means.
- (b) Every well in which the drawdown is ten feet or more shall be fitted with an adequate air vent. Such vent shall be extended to the height of at least twelve inches above any possible high water level. The vent shall be shielded and screened in such manner as to permit the entrance of air but keep out foreign matter.
- (c) The foundation for a reciprocating pump shall be constructed with sufficient clearance around the well casing and the base of the power head to permit the assembly in place of a watertight well top seal. The well casing shall extend at least six inches above the floor.
- (d) The foundation for a turbine pump may be of concrete upon which the power head may rest directly. It shall be so constructed that the well opening is adequately covered and all openings through the base shall be sealed watertight. The well casing shall be installed at least six inches above the floor.
- (e) A hand pump shall be constructed so that a stuffing box or other arrangement prevents entrance of contamination around the pump rod. The pump spout shall be of covered type. The base shall be of the one-piece flange type. Provision shall be made for leading waste water away from the top of the well. A hand pump shall be frostproof and shall not require priming. A hand pump shall be mounted:
 - (1) When a well is cased with iron pipe, upon a base flange which is attached rigid and watertight to the well casing;
 - (2) on a concrete platform or similar structure when a well is not cased with iron pipe. A metal sleeve shall be used through the concrete platform or cover slab and extend above the slab into the pump base; or
 - (3) by other sanitary method approved by the commissioner of health.

PHC 19-13-B51j

- Refer to Appendix I for an approved list of certified watertight well caps.

Appendix I

III.B.14.b Well Head Completion and Equipment

The completion of the well head and the equipment used shall be as follows:

WDC 25-128-49

- (a) The top of the casing shall be cut off reasonably smooth and level.

- (b) In the event the well head is enclosed, the enclosure shall be adequately drained. In the event a well pit is used, it shall be drained in the manner provided by Section 19-13-B51 of the PHC.
- (c) All water piping shall be protected against freezing.
- (d) The well shall be equipped with a tightly fixed vent cap or a sanitary seal with an access port for ventilation. The access port shall have a minimum, inside diameter of one quarter (1/4) inch. It shall be installed and maintained in such a manner as to prevent the entrance of water, dust, insects, or other foreign material, and to permit ready access for the purpose of water level measurement.

WDC 25-128-49
(continued)

III.B.14.c Upper Terminal Well Construction

- (a) Permanent casing for all groundwater sources shall project at least 12 inches above the pumphouse floor or concrete apron surface and at least 18 inches above final ground surface.
- (b) Where a wellhouse is constructed, the floor surface shall be at least six inches above the final ground elevation.
- (c) Sites subject to flooding shall be provided with an earth mound to raise the pumphouse floor to an elevation at least two feet above the highest known flood elevation, or other suitable protection as determined by the Department.
- (d) The top of the well casing at sites subject to flooding shall terminate at least three feet above the 100 year flood level or the highest known flood elevation, which ever is higher, or as the Department directs.

RSWW 3.2.5.9

III.B.14.d Capping Requirements

The well cap shall be as approved by the Department. See Appendix I for an approved list.

Appendix I

III.D.15 Well Alignment

- *Plumbness and Alignment Requirements*
 - a. Every well shall be tested for plumbness and alignment in accordance with AWWA standards.
 - b. The test method and allowable tolerance shall be clearly stated in the specifications.
 - c. If the well fails to meet these requirements, it may be accepted by the engineer if it does not interfere with the installation or operation of the pump or uniform placement of grout.

RSWW 3.2.4.2

III.B.16 Well Pumps

III.B.16.a General

- *Wellhead Arrangement*
 - (c) The foundation for a reciprocating pump shall be constructed with sufficient clearance around the well casing and the base of the power head to permit the assembly in place of a watertight well top seal. The well casing shall extend at least six inches above the

PHC 19-13-B51j(c) – (d)

PHC 19-13-B51j(c) – (d)

- floor.
- (d) The foundation for a turbine pump may be of concrete upon which the power head may rest directly. It shall be so constructed that the well opening is adequately covered and all openings through the base shall be sealed watertight. The well casing shall be installed at least six inches above the floor.

(continued)

- *Pumps and Pumping Equipment*

WDC 25-128-40

- (a) Pumps and pumping equipment shall be installed in the well to make the most efficient use of well storage.
- (b) Pumps and pumping equipment shall be located to permit convenient access for inspection, maintenance and repair.
- (c) In the event the base plate of a pump is placed directly over the well, the base plate shall be of a type designed to form a watertight seal with the well casing or pump foundation, as provided by Section 19-13-B51j of the PHC.
- (d) The well shall be properly vented at the well head to allow for pressure changes within the well.
- (e) The electrical wiring used in connection with the pump shall conform to specifications of the State Basic Building Code.
- (f) Contaminated water shall not be used for the purpose of priming any pump.

III.B.16.b Line Shaft Pumps

Wells equipped with line shaft pumps shall

RSWW 3.2.7.1

- 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,
- b. have the pump foundation and base designed to prevent water from coming into contact with the joint, and
- c. avoid the use of oil lubrication at pump settings less than 400 feet.

III.B.16.c Submersible Pumps

Where a submersible pump is used

RSWW 3.2.7.2

- 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.

III.B.16.d Handpumps

A hand pump shall be constructed so that a stuffing box or other arrangement prevents entrance of contamination around the pump rod. The pump spout shall be covered type. The base shall be of the on-piece flange

type. Provision shall be made for leading wastewater away from the top of the well. A hand pump shall be frostproof and shall not require priming. A hand pump shall be mounted:

- (1) When a well is cased with iron pipe, upon a base flange which is attached rigid and watertight to the well casing;
- (2) on a concrete platform or similar structure when a well is not cased with iron pipe. A metal sleeve shall be used through the concrete platform or cover slab and extended above the slab into the pump base; or
- (3) by other sanitary method approved by the commissioner of health.

III.B.17 Pitless Well Units

- *Method of Construction of Wells*

Where a pitless adapter is used, it shall be designed to, and made of materials that will, keep soil and water from entering the well during the life of the casing. A below-ground connection shall not be submerged in water at the time of installation.

PHC 19-13-B51f(e)

- *Well Pumps, Discharge Piping and Appurtenances, Pitless Well Units*

a. The Department must be contacted for approval of specific applications of pitless units.

RSWW 3.2.7.4

b. Pitless units shall

1. be shop fabricated from the point of connection with the well casing to the unit cap or cover,
2. be threaded or welded to the well casing,
3. be of watertight construction throughout,
4. be of materials and weight at least equivalent and compatible to the casing,
5. have field connection to the lateral discharge from the pitless unit of threaded, flanged or mechanical joint connection, and
6. terminate at least 18 inches above final ground elevation or three feet above the 100 year flood level or the highest known flood elevation, whichever is higher, or as the reviewing authority directs.

c. The design of the pitless unit shall make provision for

1. access to disinfect the well,
2. a properly constructed casing vent meeting the requirements of Section III.B.13 of this document,
3. facilities to measure water levels in the well,
4. a cover at the upper terminal of the well that will prevent the entrance of contamination,
5. a contamination-proof entrance connection for electrical cable,

RSWW 3.2.7.4
(continued)

- 6. 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
 - 7. at least one check valve within the well casing or in compliance with requirements of the Department.
- d. If the connection to the casing is by field weld, the shop-assembled unit must be designed specifically for field welding to the casing. The only field welding permitted will be that needed to connect a pitless unit to the casing.
- Refer to Figure 7 in the Figures section of this report for detail on a typical pitless unit.

III.B.18 Well Yield Test

- *Post Construction*

The well contractor shall make a yield test to determine the quantity and stability of flow of water from the well. The date of the test and the maximum drop in water level in the well during the test shall also be recorded (drawdown). The rate of test pumping shall equal or exceed the rate of withdrawal required for the particular installation. In the case of nonpublic water supply wells with a required withdrawal rate less than ten gallons per minute, the period during the drilling and clearing may be included in the time of the yield test. The minimum length of such yield test shall be four hours for a well with a required withdrawal rate of less than ten gallons per minute; thirty-six hours for a well with the required withdrawal rate of from ten to fifty gallons per minute; and seventy-two hours for a well with a required withdrawal rate of more than fifty gallons per minute. Test pumping shall be continuous at a constant rate for the period required. In the case of a public well, drawdown shall have held essentially stable for the last twelve hours prior to the completion of the test. The well contractor or tester shall record the date of the yield test; the water level in the well shortly before the yield test begins; the length of the pumping period; the constant pumping rate; the water level at reasonable intervals after pumping begins and within five minutes before the pumping ends; and the water level in the well at reasonable intervals thereafter for a sufficient time to allow recovery to the water level prior to the yield test. He shall furnish a copy of such record to the owner.

PHC 19-13-B51k(b)

- *Tests of Yield*

The test shall be made by one of the following methods: the pump method, the bailer-recovery method, the air rotary drill method, or the air lift method. For wells serving a single family the well may be tested for yield by removing as much water as is practicable from the well and measuring the rate of recovery.

WDC 25-128-51

- All wells shall be subjected to a minimum 72-hour yield test, by a qualified well yield tester, such that at a constant pumped discharge rate, the drawdown level has stabilized for at least a 24-hour period. The pump must

DPUC 16-262m-8(d)(3)

run continuously during the yield test for the entire 72 hour period regardless of the anticipated well yield. The following items must be recorded and measured during the test:

- (A) Static water level before pumping
- (B) Date, time, pump rate and drawdown (at least hourly);
- (C) Time and water levels after pump has been shut down until well has recovered;
- (D) Each well shall have a drawdown curve plotted from the results of the yield test, with the tester's established safe daily yield at its stabilized drawdown certified and printed thereon. Suitable provisions shall be made in cases of wells that are located in close proximity to each other and subject to "interference." In such cases a simultaneous pumping of each well shall be required;
- (E) Whenever possible, the pump test shall be performed during the summer months and should be conducted during a time period absent of precipitation or as reasonably close to non-precipitation as possible;
- (F) Suitable provisions including data from observation wells shall be made in cases of wells located in close proximity to wetlands, drainage ways, or watercourses in order to quantify the effect of induced recharge on flows in such wetlands, drainage ways or watercourses;

- *Testing and Records*

Yield Tests and Drawdown Tests shall

- a. be performed on every production well after construction or subsequent treatment and prior to placement of the permanent pump,
- b. have the test methods clearly indicated in the project specifications,
- c. have a test pump capacity, at maximum anticipated drawdown, at least 1.5 times the quantity anticipated, and
- d. provide for continuous pumping for at least 24 hours at the design pumping rate or until stabilized drawdown has continued for at least six hours when test pumped at 1.5 times the design pumping rate,
- e. provide the following data:
 - 1. test pump capacity-head characteristics,
 - 2. static water level,
 - 3. depth of test pump setting,
 - 4. time of starting and ending each test cycle; and
 - 5. the zone of influence for the well or wells.
- f. provide recordings and graphic evaluation of the following at one hour intervals or less as may be required by the Department:
 - 1. pumping rate,
 - 2. pumping water level,
 - 3. drawdown, and
 - 4. water recovery rate and levels.

RSWW 3.2.4.1

III.B.19 Well Flushing and Chlorination

Post Construction

- On completion of the well, the well contractor shall pump or otherwise flush the well sufficiently to clear the water of cuttings.
- The pump installer shall disinfect each new well system before use. Disinfection shall be accomplished by treating the water in the well, storage tank and connected piping with a chlorine solution of fifty milligrams per liter (parts per million) strength so as to obtain a residual of ten milligrams per liter (parts per million) of chlorine after three hours detention. The side walls and piping shall be rinsed with the chlorine solution. The chlorinated water shall not be removed from the water system until after a detention period of at least three hours.

PHC 19-13-B51k(a)

PHC 19-13-B51k(c)

Disinfection of Water Mains, Valves and Structures

- After November 15, 1948, in the case of construction of or repairs to any system of water supply furnished to the public, precautions shall be exercised in the handling, laying or installing of water pipe, valves or other structures through which water for potable purposes is delivered, so as to reduce to a minimum the entrance of foreign material and contamination, before such pipe, valves or other structures are placed in service. After said date no new main, standpipe, reservoir, tank or other pipe or structure through which water is delivered to consumers for potable purposes shall be put into service on any system of water supply furnished to the public, nor shall the use of any such structure or main be resumed after it has been cleaned or repaired, until such structure or main has been effectively disinfected; provided this shall not apply to mains, tanks, reservoirs or structures, the waters from which are subsequently adequately treated or purified.

PHC 19-13-B47

III.B.20 Wellhouse Layout

- (1) Well pit and/or pumphouse construction shall be designated to prevent the entrance of rodents and other small animals. All facilities shall be locked and fenced and otherwise protected and secured to prevent entrance of unauthorized persons;
- (2) Adequate drainage of all well houses and pits including the use of floor drains shall be provided as required in PHC Regulation 19-13-B51h;
- (3) Necessary electrical controls shall be installed to enable both manual and automatic operation of all pumps, motors, and accessory equipment. All controls must be clearly labeled as to their function. All electrical wiring, controls and appurtenances shall be installed in conformance with the National Electrical Code;
- (4) Flow meters capable of measuring totalized and instantaneous flow shall be installed to accurately measure independently each source of supply and their installation shall provide for ease of meter reading, repair and/or removal. Additional meters may be required where water treatment and/or other conditions dictate;
- (5) Water treatment, when required, shall be installed in accordance with

DPUC 16-262m-8(m)

DPUC 16-262m-8(m)
(continued)

- procedures established by the Department of Health Services;
- (6) Smooth end (e.g. threadless chrome) sampling taps shall be installed on the discharge line of each well and at a representative point(s) off the discharge pipe(s) coming from the storage tank(s). Where treatment is used, taps before and after treatment facilities shall also be installed. Taps shall be at least 12 inches above the finished floor and any possible high water level. Taps must point downward;
 - (7) Suitable over and under voltage protection shall be provided on the various electrical equipment;
 - (8) The waterworks facilities shall be provided with suitable lighting, heat and ventilation. If necessary, a dehumidifier shall be used during summer operations;
 - (9) The pumphouse, wells and other plant facilities should be accessible to the various maintenance vehicles.

III.B.21 Valves and Appurtenances

III.B.21.a *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 pumphouse floor when an above-ground discharge is provided,
 - 3. be protected against the entrance of contamination,
 - 4. be equipped with a check valve, a shutoff 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.

RSWW 3.2.7.3

III.B.21.b *Water Level Measurement*

- a. Provisions shall be made for periodic measurement of water levels in the completed well.
- b. Where pneumatic water level measuring equipment is used it shall be made using corrosion resistant materials attached firmly to the drop pipe or pump column and in such a manner as to prevent entrance of foreign materials.

RSWW 3.2.7.6

RSWW 3.2.7.6
(continued)

III.B.21.c *Sampling Taps*

Sample taps shall be provided so that water samples can be obtained from each water source and from appropriate locations in each unit operation of treatment. Taps shall be consistent with sampling needs and shall not be of the petcock type. Taps used for obtaining samples for bacteriological analysis shall be of the smooth-nosed type without interior or exterior threads, shall not be of the mixing type, and shall not have a screen, aerator, or other such appurtenance.

RSWW 2.10

III.B.21.d *Electrical Controls*

Main switch gear electrical controls shall be located above grade, in areas not subject to flooding.

RSWW 2.5

III.B.22 Standby Power

- a. To ensure continuous service when the primary power has been interrupted, a standby power supply shall be provided through:
 - 1. connection to at least two independent public power sources, or
 - 2. portable or in-place auxiliary power.
- b. When automatic pre-lubrication of pump bearings is necessary, and an auxiliary power supply is provided, the pre-lubrication line shall be provided with a valved by-pass around the automatic control, or the automatic control shall be wired to the emergency power source.

RSWW 3.2.1.3

• ***On-Site Standby Power***

- 1. Wherever possible, there shall be included on-site a permanently installed gasoline, propane-fueled, diesel, natural gas or oil fired generator capable of supporting at least the largest well pump, one transfer pump, any high service booster stations and all treatment systems simultaneously in the event of an electrical outage. Portable generators may be considered acceptable as an alternate to an on-site generator;
- 2. Fuel storage shall be above ground, and provided with a containment area capable of holding the full volume of the fuel tank.

DPUC 16-262m-8(h)

III.B.23 Final Approvals and Requirements

III.B.23.a *Approval*

Public water supply wells shall be sampled by the state Department of Public Health or local director of health for bacteriological, physical and sanitary chemical examination. Approval of the commissioner of public health shall be obtained before the well water is made available for use.

PHC 19-13-B511

PHC 19-13-B511
(continued)

III.B.23.b *Water Ready for Consumption.*

Water ready for consumption shall conform to the following:

(1) Physical Tests

Color is not to exceed fifteen (15) standard units leaving the treatment plant nor at representative sampling points in the distribution system.

Turbidity is not to exceed five (5) standard units at representative sampling points in the distribution system.

Odor is not to exceed a value of two (2) in the treatment plant effluent on a scale of 0-5 as follows:

- | | |
|--------------|------------|
| 0-None | 3-Distinct |
| 1-Very Faint | 4-Decided |
| 2-Faint | 5-Strong |

For systems that are not required to install optimal corrosion control treatment under subsection (j) (7) of this section, the pH value is not to be less than 6.4 nor to exceed 10.0 entering the distribution system.

(2) Inorganic Chemicals

Community, non-transient non-community and seasonal water systems shall test for inorganic chemicals specified below. Transient non-community water systems shall test for nitrate and nitrite only.

Inorganic Chemicals^(a) and their limits

Chemical	Maximum Contaminant Level (mg/l)	Maximum Contaminant Level Goal (mg/l)
Antimony	0.006	
Arsenic	0.05	
Asbestos	7.0 MFL ⁽¹⁾	
Barium	2.0	
Beryllium	0.004	
Cadmium	0.005	
Chromium	0.1	
Cyanide	0.2	
Fluoride	4.0	
Mercury	0.002	
Nickel	0.1	
Nitrate Nitrogen	10.0 as N	
Nitrite Nitrogen	1.0 as N	
Nitrate Nitrogen plus Nitrite Nitrogen	10.0 as N	

Chemical	Maximum Contaminant Level (mg/l)	Maximum Contaminant Level Goal (mg/l)
Selenium	0.05	
Silver	0.05	

PHC 19-13-B102(e)

PHC 19-13-B102(e)
(continued)

Sulfate	**	
Chloride	250	
Thallium	0.002	
Lead	***	(0)
Copper	***	1.3
	Notification Level (mg/l)	
Sodium	28.0	

Notes:

^(a)The method detection limits for inorganic chemicals shall conform to those accepted and approved by EPA.

**MCL has not been established for this chemical.

***See Section 19-13-B102 (j) (6).

⁽¹⁾MFL=million fibers per liter longer than ten (10) micrometers.

3) Pesticides, Herbicides and PCBs

Community, Non-Transient Non-Community and seasonal water systems shall test for pesticides, herbicides and PCB specified below.

Pesticides, Herbicides, PCB and their limits

Chemical ⁽¹⁾	Maximum Contaminant Level (mg/l)
Alachlor	0.002
Aldicarb	**
Aldicarb sulfoxide	**
Aldicarb sulfone	**
Aldrin	**
Atrazine	0.003
Benzo (A) Pyrene	0.0002
Butachlor	**
Carbaryl	**
Carbofuran	0.04
Chlordane	0.002
Dalapon	0.2
Di (2-ethylhexyl) adipate	0.4

Chemical ⁽¹⁾	Maximum Contaminant Level (mg/l)
Di (2-ethylhexyl) phthalates	0.006
Dicamba	**
Dieldrin	**

PHC 19-13-B102(e)
(continued)

Dinoseb	0.007
Diquat	0.02
Dibromochloropropane (DBCP)	0.0002
2,4-D	0.07
Ethylene dibromide (EDB)	0.00005
Endrin	0.002
Endothall	0.1
Glyphosate	0.7
Heptachlor	0.0004*
Heptachlor epoxide	0.0002*
Hexachlorobenzene	0.001
Hexachlorocyclopentadiene	0.05
3-Hydroxycarbofuran	**
Lindane	0.0002
Methoxychlor	0.04
Methomyl	**
Metolachlor	**
Metribuzin	**
Oxamyl (vydate)	0.2
Picloram	0.5
Propachlor	**
Simazine	0.004
2,3,7,8-TCDD (dioxin)	0.00000003
Polychlorinated biphenyls (PCB)	0.0005
Pentachlorophenol	0.001
Toxaphene	0.003
2,4,5-TP (silvex)	0.05

Notes:

⁽¹⁾The method detection limits for all pesticides, herbicides, and PCB shall conform to those accepted and approved by EPA.

**MCL has not been established for this chemical.

*If monitoring results in detection of one (1) or more of these contaminants, then subsequent monitoring shall analyze for all these contaminants.

(4) Organic Chemicals

Community, non-transient, non-community (NTNC) and seasonal water systems shall test for organic chemicals specified below.

Organic Chemicals^(a) and their limits

Chemical ^(b)	Maximum Contaminant Level (mg/l)
Benzene	0.005
Bromobenzene	**
Bromomethane	**
n-Butyl Benzene	**
Carbon Tetrachloride	0.005

PHC 19-13-B102(e)
(continued)

Chlorobenzene	0.1
Chloroethane	**
Chloromethane	**
o-Chlorotoluene	**
p-Chlorotoluene	**
Dibromomethane	**
m-Dichlorobenzene	**
o-Dichlorobenzene	0.6
p-Dichlorobenzene	0.075
1,1-Dichlorethane	**
1,2-Dichlorethane (EDC)	0.005
1,1-Dichlorethylene	0.007
cis-1,2-Dichloroethylene	0.07
trans-1,2-Dichloroethylene	0.1
Dichloromethane (Methylene Chloride)	0.005
1,2-Dichloropropane	0.005
1,3-Dichloropropane	**
2,2-Dichloropropane	**
1,1-Dichloropropene	**
1,3-Dichloropropene	**
Ethylbenzene	0.7
Methyl Tert Butyl Ether (MTBE)	**
Naphthalene	**
n-Propyl Benzene	**
Styrene	0.1
1,1,1,2-Tetrachloroethane	**
1,1,1,2,2-Tetrachloroethane	**
Tetrachloroethylene	0.005
Toluene	1.0
Total Trihalomethanes (TTHM)	0.100
Bromodichloromethane	*
Bromoform	*
Chlorodibromomethane	*
Chloroform	*
1,1,1-Trichloroethane	0.200

Chemical ^(b)	Maximum Contaminant Level (mg/l)
1,1,2-Trichlorethane	0.005
1,2,4-Trichlorobenzene	0.07
Trichloroethylene	0.005
1,2,3-Trichloropropane	**
1,2,4-Trimethylbenzene	**
1,3,5-Trimethylbenzene	**
Vinyl Chloride ^(c)	0.002
Xylenes (total)	10.0

PHC 19-13-B102(e)
(continued)

M-Xylene	***
O-Xylene	***
P-Xylene	***

Notes:

* The MCL for Total Trihalomethanes (TTHM) is 0.100mg/l, this is the sum of the four (4) constituent Trihalomethanes.

** MCL has not been established for this chemical.

*** The MCL for Xylenes (total) is 10.0 mg/l, this is the sum of the three (3) constituent xylenes.

- (a) The method detection limit (MDL) for all organic chemicals is 0.0005 mg/l with the exception of MTBE which has an MDL of 0.002 mg/l.
- (b) The department may require the testing of other chemicals for which a Maximum Contaminant Level Goal has been proposed by EPA or which the department has reason to believe may be health threatening.
- (c) Quarterly analysis for vinyl chloride is required for ground water systems only when one or more of the following compounds are detected: Trichloroethylene, 1,2 Tetrachloroethylene, 1,2 Dichloroethane, 1,1,1 Trichloroethane, Cis 1,2 Dichloroethylene, Trans 1,2 Dichloroethylene, or 1,1 Dichloroethylene. If the first analysis does not detect vinyl chloride, the Department may reduce the frequency of vinyl chloride monitoring to once every three (3) years.

(5) Radioactivity

Natural Radioactivity

Contaminant	Maximum Allowable Level Picocuries Per Liter (pCi/l)
Combined radium-226 and radium-228	5
Gross alpha particle activity (including radium-226 but excluding radon and uranium)	15

Procedure. Community systems are to test gross alpha by June 1, 1979. They are to test a composite sample of four (4) quarterly samples, or tests may be made on each of four (4) quarterly samples and the results averaged for reporting purposes.

When gross alpha is more than five (5) pCi/l, the sample is to be tested for radium-226 also. When radium-226 exceeds three (3) pCi/l, the sample shall then be tested for radium-228 in addition.

Tests are to be repeated every four (4) years for ground water supplies and every four (4) years for surface water supplies.

PHC 19-13-B102(e)
(continued)

Non-community supplies are not required to test.

Man-Made Radioactivity

Contaminant	Annual Average Maximum Allowable Level
Dose equivalent of beta particles plus photon radioactivity	4 millirems
or	
Gross beta particle activity	50 pCi per liter
Tritium	20,000 pCi per liter
Strontium-90	8 pCi per liter
Dose equivalent of Tritium plus Strontium-90	4 milliems

Systems utilizing surface water and serving more than 100,000 persons are to test a composite of four (4) quarterly samples or are to average the results of individual tests on four (4) quarterly samples by June 1, 1979. Tests are to be repeated every four (4) years.

Systems using only groundwater shall not test. Systems serving less than 100,000 persons shall not test.

(6) Total Coliform

- (A) The MCLG for microbiological contaminants which includes E. coli and fecal coliforms is zero (0).
- (B) The maximum contaminant level (MCL) is based on the presence or absence of total coliforms in a sample, rather than coliform density. Compliance shall be based on a monthly MCL for total coliforms.
 - (i) For a system which collects at least forty (40) samples per month, if more than five percent (5.0%) of the samples collected during the month are total coliform-positive, the system is in violation of the MCL for total coliforms.
 - (ii) For a system which collects fewer than forty (40) samples per month, if more than one (1) sample collected during a month is total coliform-positive, the system is in violation of the MCL for total coliforms.
- (C) A system shall determine compliance with the MCL for total coliforms for each month in which it is required to monitor for total coliforms.

PHC 19-13-B102(e)
(continued)

III.B.23.c Water Quality Monitoring of Proposed/ New Sources

Refer to Water Supplies Section Regulation Clarification, "Water Quality Monitoring of Proposed/New Sources," in Appendix C.

WSS, RC

III.B.24 Production Meters and Records

- *Reservoir, Ground Water and Water Use Monitoring*

PHC 19-13-B102(n)

Meters shall be provided at all sources of water supply for community water systems so that the amount of water delivered to the distribution system can be measured. Representative weekly readings of instantaneous flow rate and total quantity of water delivered over the previous week shall be taken, recorded, and retained for reference. Such records shall be submitted to the department upon request. More frequent readings shall be taken upon request of the department. Any water company maintaining a reservoir shall submit records of reservoir status to the Department according to a schedule specified in the Department which include at least weekly measurements of water elevation, instantaneous usable storage capacity, reservoir withdrawals and amount of precipitation. Any water company with a ground water source in an unconsolidated unconfined aquifer shall submit records of groundwater status to the department according to a schedule specified by the department which shall include at least weekly measurements of instantaneous pumping rates and ground water elevations. A system of observation wells, approved by the department, shall be maintained to provide sufficient information of ground water elevations and ground water quality. Any water company serving more than 1,000 people or 250 service connections and any other water company notified by the department, shall submit to the department according to a schedule specified by the department records of water use which shall include at least weekly measurements of the volume of water withdrawn from each source and for the total system. The volume of water bought from or sold to another water company, and the type of restrictions, if any, imposed on water use and at least annual records of the volume of water used and average number of customers. Forms provided by the department shall be utilized when available.