

Fee Received

NORTHAMPTON TOWNSHIP
RICHBORO, PENNA.

Permit Number

- APPLICATION FOR PERMIT TO DRILL WELL -

In accordance with provisions of Ordinance No. 53, a permit to drill a water well is requested. Application must be submitted and permit received before drilling well.

Owner _____ Driller _____

Address _____ Address _____

Location of well _____ (sketch on back)

Water to be used for _____ Estimated yield _____

Quantity required, GPM in. _____ GP Day Max. _____ Min. _____

Proposed depth _____ Diam. _____ Method of drilling _____

Method of storage proposed _____

Method of treatment (Chlorination, Filtration) proposed _____

Describe other wells existing on Owner's property _____

In accepting permit, owner agrees to abide by the following general and special conditions:

- GENERAL CONDITIONS -

- 1-Issuance of this permit does not convey any rights to divert water.
- 2-This well will not be used for disposal of wastes or contaminated water.
- 3-In event this well is abandoned, owner will assume responsibility for plugging or sealing it in a manner satisfactory to the Township.
- 4-Compliance Form will be filled in and returned to the Township within ten (10) days after pump installation.
- 5-This permit is valid for one year from date of issue.

Date _____ Applicant's Signature _____

- PERMIT TO DRILL WELL -

Not to filled in by applicant

Permit Number _____ Issued _____

- SPECIAL CONDITIONS -

Samples of Cuttings required ^{yes}_{no} Analysis of Water required ^{yes}_{no}

Northampton Township by _____

Date _____ Permit Fee \$ _____

Received by _____

BCDH#	W	MUN	YEAR	SERIAL

Bucks County Department of Health

7321 New Falls Road, Levittown, PA 19055 – Phone: 267-580-3510 – Fax: 215-949-5819
 1282 Almshouse Road, Doylestown PA 18901 – Phone: 215-345-3336 – Fax 215-340-8456
 261 California Road, Quakertown, PA 18951 - Phone: 215-529-7000 – Fax: 215-529-7032

APPLICATION TO CONSTRUCT/MODIFY ALL WELLS

Well Owner: _____	Site Address: _____ Street
Mailing Address: _____	Post Office _____ State _____ Zip _____
Telephone #: _____	Subdivision Name _____ Lot # _____
	Municipality _____
	Tax Parcel # _____ - _____ - _____ - _____

Application Fee Required \$ _____ Date Received _____
 *(See current fee schedule)

Send copy/response to consultant/driller? Yes ☐ No ☐ Well Driller Company: _____
 License # _____

Type of Well Construction	Geothermal Wells	Method of Sewage Disposal
<input type="checkbox"/> New Well	<input type="checkbox"/> Open Loop	<input type="checkbox"/> Public <input type="checkbox"/> On-Site
<input type="checkbox"/> Deepen Existing Well	<input type="checkbox"/> Closed Loop	If on-site Sewage Permit # _____
<input type="checkbox"/> Hydrofracturing	# of Holes _____	Date Issued _____
<input type="checkbox"/> Abandoned	<input type="checkbox"/> Monitoring Wells	Date Finalized _____
<input type="checkbox"/> Other (specify) _____	# of Holes _____	

Plot Plan

Note: 4 copies of plot plan must accompany this application and be to a scale of 1" = 50' (minimum) on 8 1/2" x 11" paper (minimum size).

Note: For new or modified drinking water well construction a **RESIDENTIAL WELL WORKSHEET SA-131** must be filed and approved by Bucks County Department of Health **BEFORE** the water can be used for consumption.

Directions to Drilling Site: _____

Owner Declaration: I certify that the location herein proposed is accessible and meets all isolation distances presented in BCDH Rules and Regulations Governing all Wells and their Construction Specifications.

Owner(s) Name: _____ Owner's Signature: _____ Date _____

Original Signature Required / No Faxed Copies Will Be Accepted

For Department Use Only

Approval to Construct/Modify

BDCH Signature: _____

Date: _____

Approval to use

Date: _____

By: _____

Bucks County Department of Health
Division of Environmental Health
Quakertown Office (215) 529-7000
Doylestown (215) 345-3318
Levittown (267) 580-3510
Policy and Procedures to Construct / Modify a Well

The Bucks County Department of Health (BCDH) has established procedures and standards for the location, construction/modification and abandonment of residential wells, and water quality sampling as set fourth in the BCDH Rules and Regulations Governing all Wells, and their Construction Specifications. Well casing reconstruction, pitless installations, deepening a well or hydro fracturing are considered well modifications.

BCDH does not regulate construction for other type wells, such as test wells, monitoring wells, irrigation wells, and geothermal wells, exc. However, for these type wells, only those which were constructed following this application procedure may be converted to individual water supply wells.

Well Owner instructions:

- a. An application to construct/modify a well on form BCDH SA-130 and the current fee is required prior to be submitted prior to commencement of construction of any residential well which will provide drinking water.
- b. It shall be unlawful to install a new well or modify an existing well without a valid completed well water permit.
- c. The application to construct must be filed and signed by the current property owner or equitable owner. The well application must be in the same name as the current owner of a valid on-lot sewage disposal application (Act 537) for the property if applicable.
- d. This Department will field verify all features on plot plans and well locations. The well location must be marked with an appropriate visual stake marked for the well location. If it is not visual and a second field stop is necessary a fee will be charged (see current fee schedule).
- e. The application shall be approved or denied within (7) seven working days of receipt of an administratively complete application and fee. BCDH shall notify applicants if the application is determined to be incomplete or contains information that cannot be verified. Upon receipt of the supplemental information, BCDH has an additional (7) seven days to approve or deny the application.
- f. Municipal well permits do not supersede the requirement to obtain a valid BCDH well permit along with all supporting data and the appropriate fee. Check with the municipality in which the well will be located to determine if there is a separate ordinance governing the activity
- g. All sewage system component locations with in 125 ft. of the proposed well on said property and all neighboring properties must be clearly staked prior to approval of the well construction permit and commencement of well drilling.
- h. Verification of property lines is the responsibility of the property owner. It is recommended that the property owner have a qualified professional certify all isolation distances.
- i. Any relocation of the proposed well site from the permitted location must be submitted in writing and approved by BCDH.
- j. An application is neither a contract for, nor a guarantee of satisfactory water quantity or quality. An application is not a final approval to use the well, nor is it a guarantee that final approval will be granted.
- k. The BCDH must receive at least forty- eight (48) hours notice prior to drilling the well for an on site inspection.
- l. If well construction is not completed within (3) three years of the application approval date, the approval to construct shall expire.

Construction Specifications

Well Location:

- a. For the proposed well, minimum isolation distances shall be maintained from the designated facilities and potential pollution sources listed below.
- b. Any proposed deviation from the isolation distances in the referenced section, must be submitted in writing to the Department for review.

Individual Residential Water-Supply Isolation Distance (in feet)

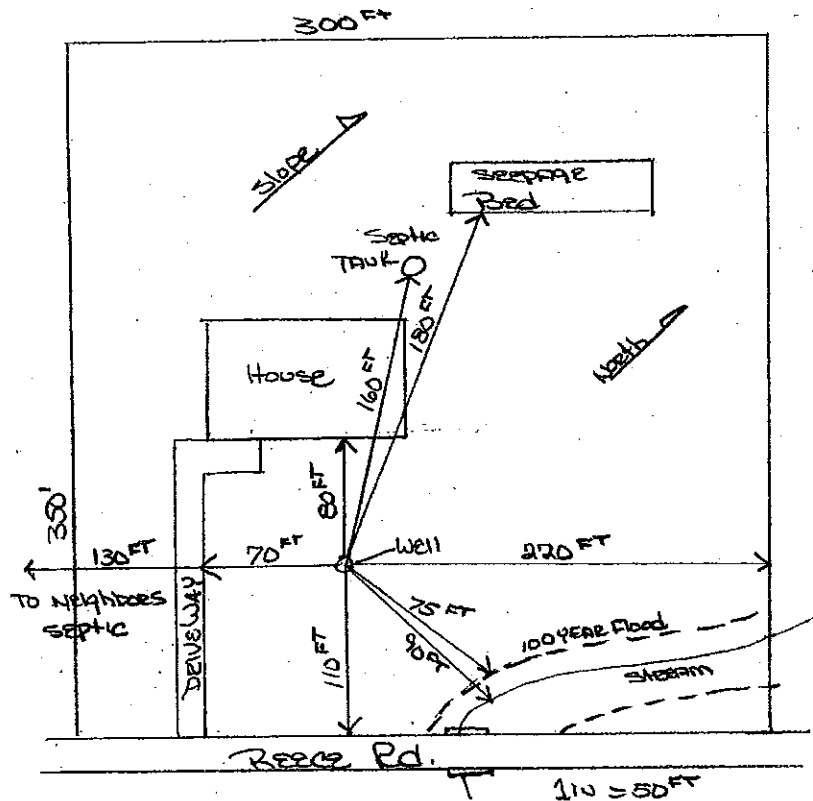
a. Delineated wetlands or 100 –year floodplain.	25
b. Storm drains, retention basins, storm water stabilization ponds, and rain water pits.	25
c. Community spray irrigation sites, sewage sludge and septic disposal sites.	100*
d. Lakes, ponds, streams or other surface waters.	50*
e. Farm silos, barn yards, manure pits, tanks or other storage areas of animal manure.	200*
f. Subsurface sewage absorption areas, elevated sand mounds, cesspools, sewage seepage pits, single family spray irrigation system, ext.	100*
g. Septic tanks, aerobic tanks, sewage pump tanks, holding tanks.	50*
h. Gravity sewer lines and drains carrying domestic sewage or industrial waste	50
i. Gravity sewage lines and drains using cast iron pipe with watertight lead caulked or neoprene gasketed joints, or Schedule 40 polyvinyl chloride (PVC) pipes with solvent welded joints.	10
j. Sewer lines and drains carrying domestic sewage or industrial waste under pressure (except welded steel pipe or concrete encased pipe).	50*
k. Commercial preparation area or storage area of hazardous spray materials, fertilizers or chemicals; salt piles.	300*
l. Drip irrigation zones.	102*
m. Building foundations, mobile homes, driveways, property lines, right aways and swimming pools	10

Note: Closed loop Geothermal Systems, shall meet one half the isolation distances noted with an*

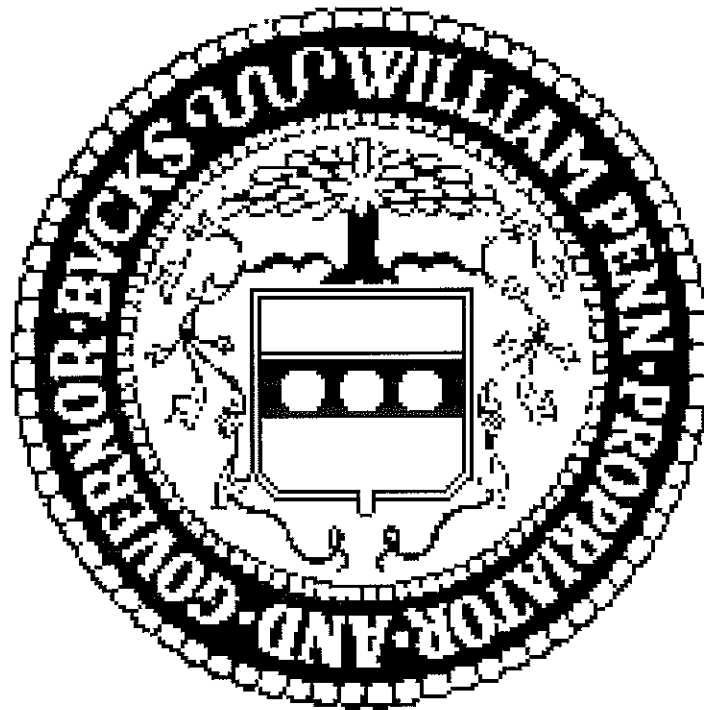
Plot Plans

- a. Must be submitted on 8 ½" x 11" or larger paper using the whole page @ 1" = 50' or more
- b. Must also include all of the following information:
 - Property lines, adjacent streets, lot dimensions, reference to north, direction of slope, delineation of floodplain (where applicable)

The following is an example of a plot plan required with the Application to Construct/modify an individual residential well.



***BUCKS COUNTY DEPARTMENT OF HEALTH
RULES AND REGULATIONS
GOVERNING ALL WELLS AND THEIR
CONSTRUCTION SPECIFICATIONS***



EFFECTIVE DATE: January 1st, 2011

SECTION ONE - GENERAL PROVISIONS

1.1 Legal Authority.

Under the provisions of the "Local Health Administration Law", Act No. 315, approved August 24, 1951, P.L. 1304; these following Rules and Regulations are hereby adopted.

1.2 Provisions.

The provisions of these Rules and Regulations shall apply to all municipalities in Bucks County within the jurisdiction of the Department and will apply equally to all persons. These Rules and Regulations shall supersede the previously adopted Rules and Regulations effective November 3, 2004, entitled, Rules and Regulations Governing Individual Water Supply Systems.

1.3 Purpose.

The purpose of these Rules and Regulations is to establish minimum standards for location, construction, modification and abandonment of individual residential drinking water supply wells, monitoring wells, test wells, and geo-thermal wells for the protection of the health and welfare of the public.

1.4 Scope.

No individual residential drinking water supply well shall be constructed or altered contrary to the provisions herein.

Except where noted in the regulation, the provisions of these regulations shall apply to all wells serving properties of Bucks County. This shall include; agricultural, monitoring, test and geo-thermal wells.

These regulations do not apply to any water supply systems exclusively regulated by the PA Department of Environmental Protection as set forth under the PA Safe Drinking Water Act.

SECTION TWO - DEFINITIONS

2.1 List of Definitions.

Abandonment - The process of properly filling and sealing a well, in accordance with these Rules and Regulations.

Alteration - Any action which necessitates entering a well with drilling tools; treating a well to increase yield; altering the physical structure or depth of the well; blasting; removal or replacement of well casing; modifications concerning grouting, curbing; or well abandonment.

Aggregate – Sand, crushed stone or similar materials used to eliminate the physical hazard and open space of abandoned well.

Agricultural well: Any water supply used specifically for farm or horticultural crops or animals with no possibility of human consumption.

Annular space - The space between two cylindrical objects, one of which surrounds the other, such as the space between a drill hole and a casing pipe and a liner pipe.

ANSI - American National Standards Institute.

API - American Petroleum Institute.

Aquifer – An underground geological formation that contains and transmits water.

ASTM - American Society for Testing Materials.

AWWA - American Water Works Association.

Casing - An impervious durable pipe placed in a well to prevent the walls from caving in and to seal off surface drainage or undesirable water, gas or other fluids and prevent them from entering the well.

Coliform - All of the aerobic and facultative anaerobic, gram negative, non-spore forming, rod-shaped bacteria that are capable of fermenting lactose with gas formation within forty-eight (48) hours at thirty-five (35C) degrees Celsius. Coliform is a group of bacteria commonly found in waste from humans and animals, and also occurs naturally in soil and surface water.

Closed- Loop Geothermal Borehole- A boring drilled to facilitate the installation of a pipe loop or tubing for a ground source heat pump system whether circulating water, heat transfer fluid, or refrigerant using direct exchange.

Construction of wells - All acts necessary to obtain groundwater, or artificially recharge groundwater. Provided, however, such term does not include acts necessary for obtaining or for prospecting for oil, natural gas, minerals, or products of mining or quarrying, or for inserting media to repressure oil, or natural gas formations for storing petroleum, natural gas, or other products and services. This includes the excavation or drilling of wells, but excludes installation of pumps and pumping equipment.

Decommissioned well - Any well that is no longer equipped in such a manner, as to be able to draw groundwater. This shall include wells where the pump, piping and/or electrical components have been disconnected or removed.

Department - means the Bucks County Department of Health (BCDH).

Disinfection - A process that inactivates pathogenic organisms in water by chemical oxidants or equivalent means, such as ultraviolet light.

Drilling - Any act of penetrating soil or rock such as by boring, coring, washing, jetting, driving or digging for purpose of developing a well.

Drinking water well - Any residential water well which provides or is intended to provide water for human consumption.

Emergency well - A well drilled to address conditions which pose an immediate and significant danger to public health and welfare.

Geothermal well - Any well or borehole in the ground constructed for the purpose of extracting heat from or transferring heat to the ground or groundwater. These shall include wells drilled as supply and/or return wells for open-loop systems; or closed-loop geothermal boreholes.

Ground Source Heat Pump Equipment- Any components of a heating or cooling system in a well or borehole. This shall include pumps for supply wells used solely for heating or cooling and pipe loops for use in closed-loop applications using a heat transfer fluid or direct exchange systems.

Grout - A permanent water tight joint or connection made by filling with concrete, neat cement, or other approved impervious material between the casing and the undisturbed formation surrounding the well or between two (2) strings of casing.

Hydrofracturing - (or hydrofracking) A process to increase yield whereby water is pumped into a new or existing well to clear existing fractures.

IGSHPA- International Ground Source Heat Pump Association.

Individual residential drinking supply well – A well that is used as a potable water source for residential use and serves less than twenty-five (25) people and/or less than fifteen (15) homes.

Lot - Any part of a subdivision or a parcel of land used as a building site or intended to be used for building purposes, whether immediate or future.

Monitoring well - A well used to observe water levels and/or obtain samples of ground water and which will not be used as a drinking water well.

New construction - Any building or structure which is constructed or whose use is modified between residential, commercial or industrial after the effective date of these regulations.

Open-Loop Geo-Thermal System-These systems draw groundwater from a source well, to a heat exchanger, and then discharge the water via injection wells or return flow wells.

PA DCNR - Pennsylvania Department of Conservation and Natural Resources.

PA DEP - Pennsylvania Department of Environmental Protection.

Person - Shall include any individual, landowner (which is defined as any person holding title to or having a proprietary or equitable interest in either surface or subsurface rights), landlord, lessor, land occupier (including but not limited to easement owner, tenant, lessee or occupant of a structure or land, whether the landowner or not), any corporation, including public or private corporation for profit or not for profit, association, partnership, firm, trust, trustee, estate, executor, executrix, administrator, administratrix or other fiduciaries, department, board, bureau or agency of the Commonwealth, political subdivision, municipality, district, authority or any other legal entity whatsoever which is recognized by law as the subject of rights and duties, and any agent for any individual or corporation or other legal entity set forth above. Whenever used in any clause prescribing and imposing a penalty or imposing a fine or imprisonment the term "Person" shall include all of the above set forth individuals and entities as well as members, officers, and/or employees of any corporation, an association, partnership or firm and the officers, directors of any local agency, municipality, municipal authority and/or political subdivision and the supervisors, councilmen, of any political subdivision public or private corporation for profit or not for profit.

Pitless adapter - A device or assembly of parts which will permit water to pass through the wall of the well casing or extension thereof, and which provides access to the well and to the parts of the water system within the well in a manner to prevent entrance of pollution into the well and the water produced.

Potable water – Water for human consumption that meets the biological and chemical standards of 25 Pa. Code Chapter 109 as promulgated under the Pennsylvania Safe Drinking Water Act.

Pumps – Any mechanical device which uses natural or artificially generated pressure difference to withdrawal or obtain groundwater.

Pumping equipment – Any materials connected to a pump including, but not limited to, piping well seals and tanks, together with fittings and controls.

Sealant – Used in well abandonment to provide a watertight barrier to the migration of water in the borehole. Sealants usually consist of Portland cement based grouts, bentonite clay, or combinations of these substances.

Test well - A well constructed for the purpose of obtaining information on groundwater or hydrogeologic conditions including yield and quality. Test wells are temporary and not considered individual supply wells. Once the intended use of the well has been completed the well shall be abandoned, or decommissioned.

Well Driller- A person who is licensed by the state of Pennsylvania to drill wells, or in the case of geo-thermal wells has IGSHA certification.

Well seal - An approved device or method used to protect a well casing or water well system from the entrance of any external pollutant at the point of entrance into the casing of a pipe, electric conduit, or water level measuring device.

Well yield - The quantity of water per unit of time that may flow or be pumped from a drinking water well under specified conditions.

SECTION THREE - APPLICATION TO CONSTRUCT OR MODIFY

3.1 General.

- a. It shall be unlawful to install a new well or modify an existing well without a valid completed well water permit.
- b. Prior to constructing a new well or modifying an existing well, the property owner shall file the appropriate application with BCDH and pay all applicable fees.
- c. The application to construct or alter a well must be filed on behalf of the current property owner or equitable owner.
- d. BCDH shall approve or deny the application within seven working days of receipt of a complete application and fee. The BCDH must field verify the location of the proposed well and all applicable isolation distances as outlined in Section 4 of these regulations. The BCDH shall notify applicants if the application is determined to be incomplete or contains information that cannot be verified. If a subsequent field evaluation is required to verify permit conditions a fee will be charged. Upon receipt of the requested supplemental information, the BCDH has an additional seven working days to approve or deny the application.
- e. Any requirement to obtain a well permit by a local municipality shall not supersede the requirement to obtain a valid well permit from the BCDH.
- f. All sewage system component locations within 125 ft. of the proposed well on said property and all neighboring properties must be clearly staked out prior to approval of the well construction permit and the commencement of well drilling.
- g. In the case of new or replacement septic systems, the well permit applicant must have a valid septic system permit prior to a well permit being issued and the permitted sewage system disposal area must be staked out for field verification per the approved septic system design.
- h. Any relocation of the proposed well site from the permitted location must be submitted in writing and approved by BCDH.
- i. If well construction is not completed within three years of the well permit issuance date, the approval to construct shall expire.

- j. All well deepening requests will be individually evaluated for best technical guidance (BTG).

SECTION FOUR - CONSTRUCTION SPECIFICATIONS

4.1 Well Location.

- a. For all wells, minimum isolation distances shall be maintained from designated facilities and potential pollution sources as listed in the table below.
- b. Any proposed deviation from the isolation distances must be submitted in writing to the Department. See Section Eleven (Variance Procedures).

Individual Residential Water-Supply Isolation Distances:

	Potential Pollution Source	Isolation Distance (ft.)
1)	Delineated wetlands or 100-year floodplain	25
2)	Storm drains, retention basins, storm water stabilization ponds, and rainwater pits	25
3)	Community spray irrigation sites, sewage sludge and septage disposal sites.	100*
4)	Lakes, ponds, streams or other surface waters.	50*
5)	Farm silos, barnyards, manure pits or tanks or other storage areas of animal manure.	200*
6)	Subsurface sewage absorption areas, elevated sand mounds, cesspools, sewage seepage pits, single family spray irrigation system, etc.	100*
7)	Septic tanks, aerobic tanks, sewage pump tanks, holding tanks.	50*
8)	Gravity sewer lines and drains carrying domestic sewage or industrial waste (unless item 9 applies).	50*
9)	Gravity sewer lines and drains using cast iron pipe with watertight lead caulked or neoprene gasketed joints, or Schedule 40 polyvinyl chloride (PVC) pipe with solvent welded joints.	10
10)	Sewer lines and drains carrying domestic sewage or industrial waste under pressure (except welded steel pipe or concrete encased pipe).	50*
11)	Commercial preparation area or storage area of hazardous spray materials, fertilizers or chemicals; salt piles.	300*
12)	Drip irrigation absorption zones.	102*
13	Building foundations, mobile homes, driveways, property lines, right-of-ways and swimming pools.	10

NOTE	Closed loop geothermal systems shall meet one half the isolation distances noted with an asterisk (*) above.	*
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4.2 Casing.

- a. All wells shall be equipped with water-tight steel casing of a minimum thickness of .28 inch and weight of (19) lbs./ft. The casing shall be carried to a minimum depth of (30) feet and (5) feet into hard bedrock or other impervious strata, whichever is deeper, and grouted in place. A minimum annular clearance of 1.5 inches must be maintained so that grout may be placed in accordance with the provisions of Section 4.3. The criteria established in AWWA Standard A 100-90 must be followed.
- b. Steel casings shall be new pipe meeting ASTM or API specifications for water well construction. If minimum thickness is not considered sufficient to assure reasonable life expectancy of the well, additional thickness will be provided. Steel casing will be equipped with a drive shoe, if needed, and have full circumference welds or threaded pipe joints.
- c. The casing and well head shall extend above the finished grade a minimum of twelve (12) inches. The ground level shall be graded to drain away from the casing in all directions.
- d. Where surface installations (i.e. pump rooms, etc.) are used, a watertight reinforced concrete platform at least four (4) inches thick and extending for at least two (2) feet in all directions from the center of the casing shall be poured around the casing to provide an effective watertight seal with casing, or shall be made watertight with an effective permanent seal. The surface of the platform shall slope to the edges. The casing shall extend through the slab for at least twelve (12) inches. All pumping equipment shall be protected against freezing. If a pump room is proposed, it shall be so sized to allow adequate working space.
- e. All casings shall be fitted with a metal, bolted, water-tight, vermin resistant well cap. All monitoring, agricultural and test wells during use shall further be protected from tampering and abandoned properly when use is completed.
- f. Well screens when used, shall provide the maximum amount of open area while still maintaining structural strength, have the size of openings in the screen based on a sieve analysis of the material contained in the surrounding geological formation or gravel pack, be constructed of materials resistant to damage by chemical action of the ground water or cleaning operations, have sufficient diameter to provide adequate specific capacity and low aperture velocity. The entrance velocity should not exceed 0.1 feet per second, be installed so that the pumping water level remains above the screen under all conditions, be designed and installed to permit removal or replacement without adversely affecting water-tight construction of the well, and be provided with a bottom plate or washdown bottom fitting of the same material as the screen.
- g. Pitless installations are those installations where the casing terminates above the ground surface. Where pitless installations are used, they shall be of a design that provides an effective seal against the entrance of ground or surface water into the well, access casing, and into the piping leading to the pump. All buried suction lines shall be effectively encased, or otherwise protected to prevent external damage or contamination. Pitless installations must be designed as to be structurally sound and to provide for ready removal of drop piping without excavation. To avoid

freezing, pitless installations and associated piping shall be kept at a minimum depth of 36 inches.

- h. Where venting is required, an overlapping cover or pipe with the opening facing downward shall be required. Such venting shall be effectively protected against the entrance of insects and rodents.

4.3 Grout Materials.

The annular space of all well installations must be filled with one of the following listed grout materials:

- a. Neat cement grout shall consist of a mixture of API Class G (or Class B similar to ASTM C150 Type II) and water in the ratio of 0.67 cu. ft. (0.019 m³) of water per 94 lb. (42.7 kg) sack weighing approximately 228 lbs./cu. ft. A maximum of six percent by weight bentonite and two percent by weight of calcium chloride may be added.
- b. Pozmix-cement grout shall consist of a mixture of fifty percent by volume of Pozzolan A (74 lbs. cu. ft.) (1185kg/m³) and fifty percent by volume of API Spec. 10, Class G. Cement with 0.77 cu. ft. (0.02m³) of water per 84 lbs. (38.2 kg) of mixture. To this mixture may be added a maximum of two (2) percent by weight, bentonite and a maximum of two percent of calcium chloride, at the discretion of the contractor.
- c. Concrete grout shall contain 5.3 sacks of Portland cement (ASTM C150 Type II) per cubic yard of concrete and a maximum of 7 gal. (0.026 m³) of water per 94 lb (42.7 kg) sack of cement. The maximum slump shall be 4 in. The aggregate shall consist of 47 percent sand and 53 percent coarse aggregate, conforming to ASTM Designation C-33. The maximum size aggregate should be 0.75 in. Concrete grout shall not be placed in an annulus of less than 3 in.
- d. Sand cement grout shall consist of a mixture of Portland cement (ASTM C150 Type II), sand and water in the proportion of not more than two parts by weight of sand to one part of cement with not more than 6 gal. (0.002 m³) of water per 94 lb. (42.7 kg) sack of cement.
- e. Bentonite grout shall be pure bentonite with at least 20% solids by weight when mixed with water. Hydration of the bentonite must be delayed until the bentonite mix has been placed down the well. This can be done by using additives with the dry bentonite or in water, mixing calcium bentonite with sodium bentonite, or by using granular bentonite, which has less surface area. In all well installations if rapid loss of grout material occurs during placement, coarse fill material (e.g. sand gravel, crushed stone dry cement) may be used in the zone or zones in which the rapid loss is occurring. The remainder of the annular space shall be grouted as provided below. In no case shall pouring, dumping or shoveling of grout material into the annular space be deemed an approved method of grout placement.
- f. When drilling is to be continued after grouting, a curing time of twelve (12) hours for Type III cement, and twenty-four (24) hours for Type I or II cement must be provided during which drilling is not permitted, unless a bentonite plug with cement grout or bentonite grout is used.

4.4 Grout Placement.

- a. **Grout Pipe Outside Casing.** The minimum annular space of 1 ½ inches around the entire outside of the casing shall be provided by drilling a borehole 3 inches larger

than the outside diameter of the casing to be inserted. All grout shall be placed by pumping through the grout pipe. The entire interval to be grouted shall be open and without obstructions. Washing or jetting with water is required for cleaning the borehole and may serve to remove obstructions caused by caving which otherwise would prevent a proper grout. It is required that the grout pipe extend from the surface to the bottom of the interval to be grouted. The grout pipe may remain extended to the bottom of the interval during and after grouting, or it may be raised slowly as the grout is placed provided that the discharge end of the grout pipe remains submerged on the emplaced grout at all times until grouting is completed. In the event of interruption in the grouting operations, the bottom of the grout pipe shall be raised above the grout level and should not be resubmerged until the air and water have been displaced from the grout pipe.

- b. **Grouting Depth Greater than 30 ft.** The minimum length of grout pipe that shall be inserted into the annular space is 30 feet.
- c. **Grouting Depth of 30 ft. and less.** Grout may be placed by a tremie pipe inserted only a short distance (approximately 5 feet) into the annular space provided that the entire interval to be grouted is clearly visible from the surface and is dry. An annular space larger than the minimum of 1 ½ inches may be required to assure visibility from the surface
- d. **Grout Pipe Casing.** The bottom of the casing is fitted with a packer arrangement, also referred to as a cementing shoe or float shoe, and the casing is placed in the borehole a short distance off the bottom. The float shoe allows grout to be pumped through the grout pipe and upward into the annular space, while preventing grout leakage into the casing during grouting and after removal of the grout pipe. Grouting is continued until cement appears at the surface at which time the grout pipe is disconnected from the float shoe. The float shoe is drilled out after the grout sets and hardens sufficiently.
- e. **Interior Method Two Plug.** The first plug separates the grout from the fluid in the casing and the other separates the grout from water pumped in above it. First, the casing is placed a short distance off the bottom. After pumping water through the casing to circulate fluid in the annular space and clear any obstructions from the hole, the first plug is inserted, and the casing is capped. A measured volume of grout is pumped in, which is sufficient to fill the annular space. The casing then is opened and the second plug inserted. A measured volume of water is pumped in above the second plug until it is pushed to the bottom of the casing and most of the grout is expelled up and into the annular space. The water in the casing is held under pressure to prevent the backflow of grout until it has set and hardened.
- f. **Interior Method Upper Plug.** The casing is placed a short distance off the bottom, and the water is pumped into the casing to circulate fluid through the annular space to clear any obstructions from the hole. A measured quantity of grout slightly greater than that needed to fill the annular space is pumped into the capped casing. Because this grout is in direct contact with the drilling fluid, there will be a narrow zone of weak grout between the drilling fluid and good grout; however, this zone should remain inside the casing and not be forced into the annular space. The casing is opened, and a drillable plug is inserted. A measured volume of water is pumped in above the plug until it is pushed to the bottom of the casing and most of the grout is expelled up and into the annular space. The water in the casing is held under pressure until the grout sets and hardens.

- g. **Interior Method Capped Casing.** The casing is placed a short distance off the bottom, and water is pumped into the casing to circulate fluid in the annular space and clear any obstructions from the hole. The grout pipe passes through an airtight cap at the top of the casing and is positioned 3 to 4 feet above the bottom of the casing. The grout pipe is assembled so that it can be pulled through the cap a distance of about 20 feet after the injection of grout is completed. A bleeder valve is provided to release air from inside the casing as it is filled with water. With the upper end of the casing closed, grouting is started by forcing the cement through the grout pipe upward into the annular space. Grouting is continued until the cement overflows around the casing at ground surface. Just enough water is pumped to clear the cement from the grout pipe, and the grout pipe is lifted free of the grout. Both the casing and grout pipe shall be kept tightly closed under pressure until the cement sets and hardens.
- h. **Grout Displacement Method.** The hole is filled with the estimated volume of grout required to fill the annular space, and the casing is lowered into the hole. The bottom of the casing is closed with a tight drillable plug. Guides often are used to keep the casing centered in the hole. As the casing is lowered, the grout is forced upward around it to fill the annular space. If the pipe does not sink to the bottom under its own weight, it is filled with water.
- i. **Unconsolidated Formations.** When drilling through an unconsolidated formation, a steel drive shoe shall be required. Grouting shall be done in accordance with the following:
 - 1. If caving conditions are experienced on wells deeper than 30 feet, the annular space shall be grouted from the point where caving occurred or from a depth of 30 feet, whichever is greater, to land surface.
 - 2. If the annular space cannot be grouted in accordance with these regulations, the well shall be abandoned and sealed.
 - 3. Other grouting methods and materials may be used subject to prior written approval of the Department.
- j. **Packers.** Packers, when used, shall be of materials that will not impart taste, odor, toxic substances or bacterial contamination to the well water.
- k. **Gravel Packs.** Gravel packs when used shall be well rounded particles, 95 percent siliceous material, that are smooth and uniform, free of foreign material, properly sized, washed and disinfected immediately prior to or during placement, shall be placed in one uniform continuous operation.
- l. **Gravel Refill Pipes.** 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, gravel refill pipes located in the grouted annular opening shall be surrounded by a minimum of 1.5 inches of grout. Protection from leakage of grout into the gravel pack or screen shall be provided.

SECTION FIVE-INSPECTION

5.1 Drilling Inspection.

- a. Notice of drilling or well modification must be given to BCDH a minimum of two (2) working days prior to commencement of the work.

5.2 Well Casing and Grouting.

- a. A BCDH representative is to be on site to observe the installation of the well casing,
- b. A BCDH representative is to be on-site to observe the grouting of the well and any other inspection during the well construction.

5.3 Pitless Adapter

- a. The BCDH must inspect the pitless adapter installation.

5.4 Well Modification

- a. A Representative of the BCDH is to be on-site to observe the welding of a steel coupler or other mechanical sealing coupler approved by the BCDH.

5.4 Failure to Comply.

- a. Failure to comply with the BCDH inspection may result in termination of the drilling or alteration activities, and may cause the revocation of the Approval to Construct.

SECTION SIX - WELL DRILLERS

6.1 Driller License.

- a. Only well drillers with a PA DCNR license shall be permitted to construct individual residential water supply wells. Geothermal well drillers shall have a PA DCNR or IGSHPA accreditation.
- b. All drilling rigs must also be licensed by the PA DCNR.

SECTION SEVEN GEO-THERMAL WELLS

7.1 Geo-Thermal HVAC Systems.

- a. Installation must be by a PA DCNR approved well driller or a IGSHPA accredited geothermal system installer. In all cases, the well drilling rig must also be approved by PA DCNR.
- b. The proposed system design must be submitted and approved by the Department prior to installation. Isolation distances according to Section 4.1 must be confirmed.

7.2 Open-Loop Geo-thermal HVAC Systems

- a. Best Management Practices shall be used to prevent aquifer contamination. Return wells shall be drilled into the same aquifer as the withdraw well to prevent introduction of contaminants from one aquifer to another. If this is not possible, the water quality of both the withdraw well and return well shall be tested and the withdraw well aquifer cannot be of lesser quality (as determined by the Department), than the return well aquifer. To prevent thermal degradation, the withdraw and return wells must be a minimum of 50 feet apart. All other isolation distances outlined in Section 4 must also be adhered to.
- b. Only PA DCNR approved well drillers using PA DCNR approved well drilling rigs shall drill the withdraw and return flow wells for this type of system.
- c. Return flow wells shall be designed and screen lengths doubled. Extended pump testing of 12-24 hours shall be done to determine the hydraulic characteristics of the well, and a blind flange shall be installed to allow for emergency surface discharge of water. Any emergency surface discharge shall conform to applicable state regulations.
- d. Surface discharge of water from an open loop system to a surface water body may require a National Pollutant Discharge Elimination System (NPDES) permit. The person

requesting a geothermal permit from the Department is required to submit proof of an NPDES permit or exemption with any application.

e. An EPA reporting requirement exists for injection of water to a return well for groundwater heat pump systems.

f. Under no circumstances may additives of any kind be placed in this type of geothermal system to enhance heat transfer or reduce freezing points of the circulating water.

7.3 Closed-Loop Geo-Thermal HVAC Systems

a. Installation must be by a PA DCNR approved well driller or IGSHPA accredited geothermal system installer. In all cases the well drilling rig must be licensed by the PA DCNR.

b. The proposed system design must be submitted to and approved by the Department prior to construction. The system design shall be made by a IGSHPA accredited person or firm or an engineering firm familiar with loading and heat transfer requirements for the site specific proposed HVAC system.

c. Construction:

General: Prior to construction, a site meeting with the Department will be required to layout the proposed design under actual field conditions. Any changes required based on the field layout must be addressed by the firm designing the system prior to moving to the actual construction phase. The system must be pressure tested prior to backfilling or grouting but after flushing the pipe to remove debris.

Trench System- A minimum of 6 inches of sand or screenings is to be added to the bottom of the trench to prevent the loop piping from rubbing on stones.

Vertical Bores- pipe loops must be in intimate contact with soil or grout to minimize air pockets. Three to five percent of the piping should extend up from the bore holes or trenches to compensate for relaxation or stretching.

The IGSHPA recommendation that the heat exchanger be isolated and tested to 150% of design pressure or 300% of system operating pressure shall be followed. No leaks shall occur within a 30 minute period.

All pipe and heat fused material shall be manufactured to outside diameters, wall thickness, and respective tolerances as specified in ASTM D 3035, or D 2447, as specified in the PPI handbook of Polyethylene Pipe HVAC Applications.

Copper piping is not acceptable for heat transfer use.

The vertical bore holes shall be grouted using an appropriate grout with thermal transfer properties.

7.4 Thermally Enhanced Grouts

a. All pre-mixed grouts labeled as thermally enhanced and bearing the seal of the National Sanitation Foundation (NSF) are acceptable.

b. The maximum amount of quartz sand to be mixed for a thermally enhanced grout shall be 400 pounds/bag of cement or bentonite.

c. Quartz sand used for thermally enhanced grout shall meet the following sieve test specifications:

Sieve Number	Percentage Passing
8	100
16	95-100
30	55-80
50	30-55
100	10-30
200	0-10

d. Any proposed custom mixed thermally enhanced grout must be approved by the Department. The Department has the following handout available for review:

Guidelines For Mixing And Placing Thermally Conductive Cementitious Grout (Mix111).

SECTION EIGHT - DISINFECTION OF WELL DISTRIBUTION SYSTEM

8.1 General.

- a. Following completion of construction and installation of the pumping equipment, or alteration of a well, the well shall be pumped until the water discharge is clear. The well and distribution system shall be disinfected according to the American Water Works (AWWA) procedures. This procedure shall apply to all interior plumbing in any dwelling that is newly constructed or has had extensive re-plumbing work.

SECTION NINE - WATER QUALITY

9.1 General.

- a. Water analysis of the completed new well must be conducted by a PA DEP Certified Drinking Water Laboratory. Sample results are to be submitted to the BCDH within 60 days.
- b. Water analysis must include the Primary PA DEP regulated contaminants: total coliform, 21 regulated volatile organic chemicals, arsenic, nitrates and the secondary contaminants: pH, iron, manganese, total dissolved solids, and chlorides.
- c. Analyses for additional parameters may be required if BCDH has reason to suspect that substances may be present in the water that could affect potability.
- d. In the case of a newly constructed dwelling or where a dwelling has been extensively re-plumbed a re-test for bacterial quality shall be completed. Results must be submitted to the BCDH within 60 days.
- e. Agricultural wells shall be exempt from these requirements.

9.2 Treatment.

- a. If any well water parameter tested for a new well exceeds the maximum primary contaminant level established by PA DEP, treatment to remove the contaminant shall be required. For any secondary contaminants found treatment shall be recommended. For new or modified wells on existing properties treatment shall be recommended regardless of whether it is a primary or secondary contaminant.

SECTION TEN - CERTIFICATE OF USE

10.1 General.

- a. Upon completion of the well or alteration, the following information must be submitted to the Department for approval to use the individual residential water supply:
 1. Completed forms SA-130 Application to Construct/modify an Individual Residential Well, SA-131 Residential Well Work Sheet.
 2. Water analysis results as required in Section 8.
 3. Description of any treatment system that was installed.
 4. All required paperwork must be submitted within 10 days of the completion of each stage of work.
- b. A Certificate of Use for an individual residential water supply system shall be issued or denied within seven days of receipt of the information required in section 10.1 a.
- c. No individual residential water supply well constructed after promulgation of these Rules and Regulations shall be used unless the individual residential water supply system receives a Certificate of Use from BCDH.

SECTION ELEVEN - WELL ABANDONMENT

11.1 General.

- a. A permit must be obtained prior to abandoning all wells.
- b. Abandonment procedures shall be subject to the BCDH inspection.
- c. Well abandonment procedures must minimally comply with the specifications referenced in the PA DEP/DCNR Water Well Abandonment Guidelines.*
- d. A copy of the PA DEP/DCNR Water Well Abandonment Form* shall be submitted to the BCDH within ten days of abandonment.

*Available from BCDH or PA DEP Southeast Regional Office.

11.2 Well Preparation.

- a. The borehole must be cleared of obstructions prior to abandonment. Pumps, pipes, wiring, and air lines must be pulled. An attempt to remove the casing should be made as long as it will not jeopardize the integrity of the borehole. If the casing cannot be removed, it should be cut below the land surface.
- b. Damaged, poorly constructed or dilapidated wells may need to be redrilled in order to apply proper abandonment techniques.

11.3 Materials and Methods

- a. Aggregates
 1. Aggregates may be used in the following circumstances: a) There is no need to penetrate or seal fractures, joints or other openings in the interval to be filled, b) A watertight seal is not required, c) The hole is caving, d) The interval does NOT penetrate a perched or confined aquifer, e) The interval does not penetrate more than one aquifer.
 2. Aggregates should be uncontaminated and of consistent size.
 3. If aggregate is used, a casing seal must be installed. Generally, this can be accomplished by filling at least the upper ten feet of open borehole and the lower five feet with sealant. The length of open borehole sealed should be increased if

extenuating circumstances exist. This would include a history of bacterial contamination or possibly deep fracture zones.

4. Aggregates **shall** not prevent the flow of water through the borehole.
- b. Sealants – Sealants are used to provide a watertight barrier to the migration of water in the well bore. An abandoned contaminated well or a well in an area where the groundwater is at a high risk for future contamination require complete and uniform sealing of the well from the bottom to the surface.
 1. Sealing mixtures should be formulated to minimize shrinkage.
 2. A pump and tremie pipe are preferred for delivering the sealant to the bottom of the well.
 3. If aggregate is to be placed above the sealant, sufficient amount of curing time must pass before placing the aggregate above the seal.
 4. Types of sealant: a) *neat cement grout*: a ratio of one 94 lb. Bag of Portland cement to no more than 6 gallons of water, b) *concrete grout*: a ratio of one 94 lb. Bag of Portland cement to no more than 6 gallons of water and an equal volume of sand, c) *grout additives*: some bentonite (2% to 8%) can be added to neat cement or concrete grout to decrease the amount of shrinkage. Other additives may be used to alter the curing time or the permeability of the grout, such as calcium chloride can be used as a curing accelerator, d) *high solids sodium bentonite*: composed of 15% to 20% solids content by weight of sodium bentonite when mixed with water, e) *chip bentonite*: chip (coarse grade) or palletized bentonite will form adequate seals. When placed above the water level, water must be added frequently to hydrate the bentonite.

SECTION TWELVE - VARIANCE PROCEDURES

Should an applicant believe that these regulations impose an undue hardship, an applicant may apply to the BCDH for an administrative hearing by submitting a hearing request and proper fee for a hearing. At any administrative hearing, it shall be the burden of the applicant to prove via clear and convincing evidence that 1) the applicant is suffering an undue hardship; and 2) that the applicant has taken sufficient steps to ensure that any variance from these regulations will not adversely affect any aspect of the public health or environmental health. The administrative hearing officer shall have discretion to weigh the evidence to determine whether the applicant has met their burden. The administrative hearing officer can make no decision contrary to regulations promulgated by DCNR. The administrative hearing officer may condition the variance upon other reasonable restrictions.

SECTION THIRTEEN - SEVERABILITY

If any section, subsection, paragraph, clause, or provision of these Rules and Regulations shall be declared by a court of competent jurisdiction to be invalid, such decision shall not affect the validity of the Rules and Regulations as a whole or any part thereof. It is hereby declared to be the intention of the Bucks County Department of Health, the Bucks County Board of Health and the Bucks County Commissioners that the remainder of the Rules and Regulations would have been enacted if such invalid section had not been enacted and that it is their intent, intention and desire that the remaining portion of the Rules and Regulations remain in effect.

SECTION FOURTEEN - PENALTY PROVISIONS

14.1 Summary Offense.

In accordance with the provisions of Act No. 315, approved August 24, 1951, P.L. 1304, as amended, any person who violates any of the provisions of these Rules and Regulations or who interferes with the Health Director or any other agent of the Bucks County Department of Health in the discharge of their official duties or who refuses to permit the Director of the Bucks County Department of Health or their authorized representatives to inspect any premises when such inspection is authorized by a properly issued search warrant, shall, for the first offense, upon conviction thereof in a summary proceeding before a District Justice of Bucks County, be sentenced to pay the costs of prosecution and a fine of not less than Thirty (\$30.00) Dollars nor more than Three Hundred (\$300.00) Dollars, and in a default thereof, to undergo imprisonment of not less than ten (10) days nor more than thirty (30) days.

14.2 Misdemeanor Offense.

Any person who violates any of the provisions of these Rules and Regulations, or who interferes with the Health Director or any other agent of the Bucks County Department of Health in the discharge of their official duties, or who refuses to permit the Director of the Bucks County Department of Health or his authorized representative to inspect any premises when such inspection is authorized by a proper issued search warrant, convicted of a second or subsequent offense, shall be guilty of a misdemeanor and shall, upon conviction thereof, be sentenced to pay a fine of not less than Five Hundred (\$500.00) Dollars nor more than One Thousand (\$1,000.00) Dollars or to undergo imprisonment not exceeding one (1) year, or both.

Approved Bucks County Board of Health:

November 4th, 2010

Approved Bucks County Board of Commissioners:

December 15th, 2010

Effective Date:

January 1st, 2011

WATER-WELL ABANDONMENT GUIDELINES

Previously published as Chapter 7 in the DEP publication
Ground Water Monitoring Guidance Manual

INTRODUCTION

Unsealed or improperly sealed wells may threaten public health and safety, and the quality of the groundwater resources. Therefore, the proper abandonment (decommissioning) of a well is a critical final step in its service life.

Act 610, the Water Well Drillers License Act, includes a provision for abandonment of wells. This legislation makes it the responsibility of a well owner to properly seal an abandoned well according to the rules and regulations of the department. In the absence of more stringent regulatory standards, the procedures outlined in this section represent minimum guidelines for proper abandonment of wells and borings. These procedures may be applicable for, but not limited to, public and domestic water supply wells, monitoring wells, borings or drive points drilled to collect subsurface information, test borings for groundwater exploration, and dry wells (drains or borings to the subsurface).

Proper well abandonment accomplishes the following: 1) eliminates the physical hazard of the well (the hole in the ground), 2) eliminates a pathway for migration of contamination, and 3) prevents hydrologic changes in the aquifer system, such as the changes in hydraulic head and the mixing of water between aquifers. The proper decommissioning method will depend on both the reason for abandonment and the condition and construction details of the boring or well.

WELL CHARACTERIZATION

Effective abandonment depends on knowledge of the well construction, geology, and the hydrogeology. The importance of a full characterization increases as the complexity of the well construction, site geology, and the risk of aquifer contamination increases. Construction information for wells drilled since 1966 may be available from the Bureau of Topographic and Geologic Survey's (BTGS) Water Well Inventory System database. Additional well construction data and information describing the hydrologic characteristics of geologic formations may be available from reports published by BTGS and the United States Geological Survey (USGS). Site or program records also may exist. The well should be positively identified before initiating the abandonment. Field information should be compared with any existing information.

Water levels and well depths can be measured with a well sounder or weighted tape measure. In critical situations, well construction details and hydrogeology can be determined with borehole geophysics or a downhole camera. For example, a caliper log, which is used to determine the borehole diameter, can be very helpful in locating cavernous areas in open hole wells.

WELL PREPARATION

If possible, the borehole must be cleared of obstructions prior to abandonment. Obstructions such as pumps, pipes, wiring, and air lines must be pulled. Well preparation also may involve fishing obstacles out of the borehole. An attempt should be made to pull the casing when it will not jeopardize the integrity of the borehole. Before the casing is pulled, the well should be grouted to near the bottom of the casing. This will at least provide some seal if the well collapses after the casing is pulled.

The presence of nested or telescoped casing strings complicates well abandonment. Inner strings should be removed when possible, but only when removal will not jeopardize the abandonment of the well. If inner strings cannot be removed and sealing of the annular space is required, then the inner string should be vertically split (plastic cased wells) or cut (metal-cased wells) at intervals necessary to insure complete filling of the annular space.

Damaged, poorly constructed or dilapidated wells may need to be redrilled in order to apply proper abandonment techniques. Also, in situations where intermixing of aquifers is likely, the borehole may need to be redrilled.

MATERIALS AND METHODS

Aggregate

Materials that eliminate the physical hazard and open space of the borehole, but do not prevent the flow of water through the well bore, are categorized as aggregate.

Aggregates consist of sand, crushed stone or similar material that is used to fill the well. Aggregates should be uncontaminated and of consistent size to minimize bridging during placement.

Aggregate is usually not placed in wells smaller than two inches in diameter. Nominal size of the aggregate should be no more than 1/4 of the minimum well diameter through which it must pass during placement. Because aggregate is usually poured from the top of the well, care must be taken to prevent bridging by slowly pouring the aggregate and monitoring the progress with frequent depth measurements.

Aggregates may be used in the following circumstances: 1) there is no need to penetrate or seal fractures, joints or other openings in the interval to be filled, 2) a watertight seal is not required in the interval to be filled, 3) the hole is caving, 4) the interval does not penetrate a perched or confined aquifer, and 5) the interval does not penetrate more than one aquifer. If aggregate is used, a casing seal should be installed (see Section 7.5.1). The use of aggregate and a casing seal must be consistent with the future land use.

Sealants

Sealants are used in well abandonment to provide a watertight barrier to the migration of water in the well bore, in the annular spaces or in fractures and openings adjacent to the well bore. Sealants usually consist of portland cement based grouts, "bentonite" clay, or

combinations of these substances. Additives are frequently used to enhance or delay specific properties such as viscosity, setting time, shrinkage, or strength.

Sealing mixtures should be formulated to minimize shrinkage and ensure compatibility with the chemistry of the groundwater in the well.

A grout pump and tremie pipe are preferred for delivering grout to the bottom of the well. This method insures the positive displacement of the water in the well, and will minimize dilution or separation of the grout.

If aggregate is to be placed above sealant, a sufficient amount of curing time should pass before placing the aggregate above the seal. Curing time for grout using Type 1 cement is typically 24 - 48 hours, and 12 hours for Type III cement.

General types of sealants are defined as follows:

Neat cement grout: Neat cement grout is generally formulated using a ratio of one 94 lb. bag of portland cement to no more than 6 gallons of water. This grout is superior for sealing small openings, for penetrating any annular space outside of the casings, and for filling voids in the surrounding rocks. When applied under pressure, neat cement grout is strongly favored for sealing artesian wells or those penetrating more than one aquifer. Neat cement grout is generally preferred to concrete grout because it avoids the problem of separation of the aggregate and the cement. Neat cement grout can be susceptible to shrinkage and the heat of hydration can possibly damage some plastic casing materials.

Concrete grout: Concrete grout consists of a ratio of not more than six gallons of water, one 94-lb. bag of Portland cement, and an equal volume of sand. This grout is generally used for filling the upper part of the well above the water bearing zone, for plugging short sections of casings, or for filling large-diameter wells.

Concrete grout, which makes a stronger seal than neat cement, may not significantly penetrate seams, crevices or interstices. Grout pumps can handle sand without being immediately damaged. Aggregate particles bigger than this may damage the pump. If not properly emplaced, the aggregate is apt to separate from the cement. Concrete grout should generally not be placed below the water level in a well, unless a tremie pipe and a grout pump are used.

Grout additives: Some bentonite (2 to 8 percent) can be added to neat cement or concrete grout to decrease the amount of shrinkage. Other additives can be used to alter the curing time or the permeability of the grout. For example, calcium chloride can be used as a curing accelerator.

High-solids sodium bentonite: This type of grout is composed of 15-20 percent solids content by weight of sodium bentonite when mixed with water. To determine the percentage content, the weight of bentonite is divided by the weight of the water plus the weight of the bentonite. For example, if 75 lbs. of powdered bentonite and 250 pounds of granular bentonite were mixed in 150 gallons of water (at 8.34 lbs. per gallon), the

percentage of high-solids bentonite is approximately 20 percent ($325/(1251+325)$). High-solids bentonite must be pumped before its viscosity is lowered. Pumping pressures higher than those used for cement grouts are usually necessary. Hydration of the bentonite must be delayed until it has been placed down the well. This can be done by 1) using additives with the dry bentonite or in the water, 2) mixing calcium bentonite (it expands less) with sodium bentonite, or 3) using granular bentonite, which has less surface area.

In addition, positive displacement pumps such as piston, gear, and moyno (progressive cavity) pumps must be used because pumps that shear the grout (such as centrifugal pumps) will accelerate the congealing of the bentonite. A paddle mixer is typically used to mix the grout. A high-solids bentonite grout is not made from bentonite that is labeled as drilling fluid or gel.

Chip Bentonite: Chip (coarse grade) or pelletized bentonite can form adequate seals. This type of bentonite is poured directly down the borehole. The size of the bentonite chips also should be no more than 1/4 of the minimum well diameter through which it must pass during placement. Because of the potential for bridging, this material may not be suitable for deep wells or borings where positive displacement is necessary to seal the well.

When coarse bentonite is placed above the water level, water must be added frequently to hydrate the bentonite. Care must be taken with chip or pelletized bentonite to not overload the interval to be sealed. Rapidly swelling bentonite could result in incomplete hydration and a heterogeneous seal containing lumps of dry bentonite. The level of the bentonite should be checked often to make sure that bridging of the chips does not occur.

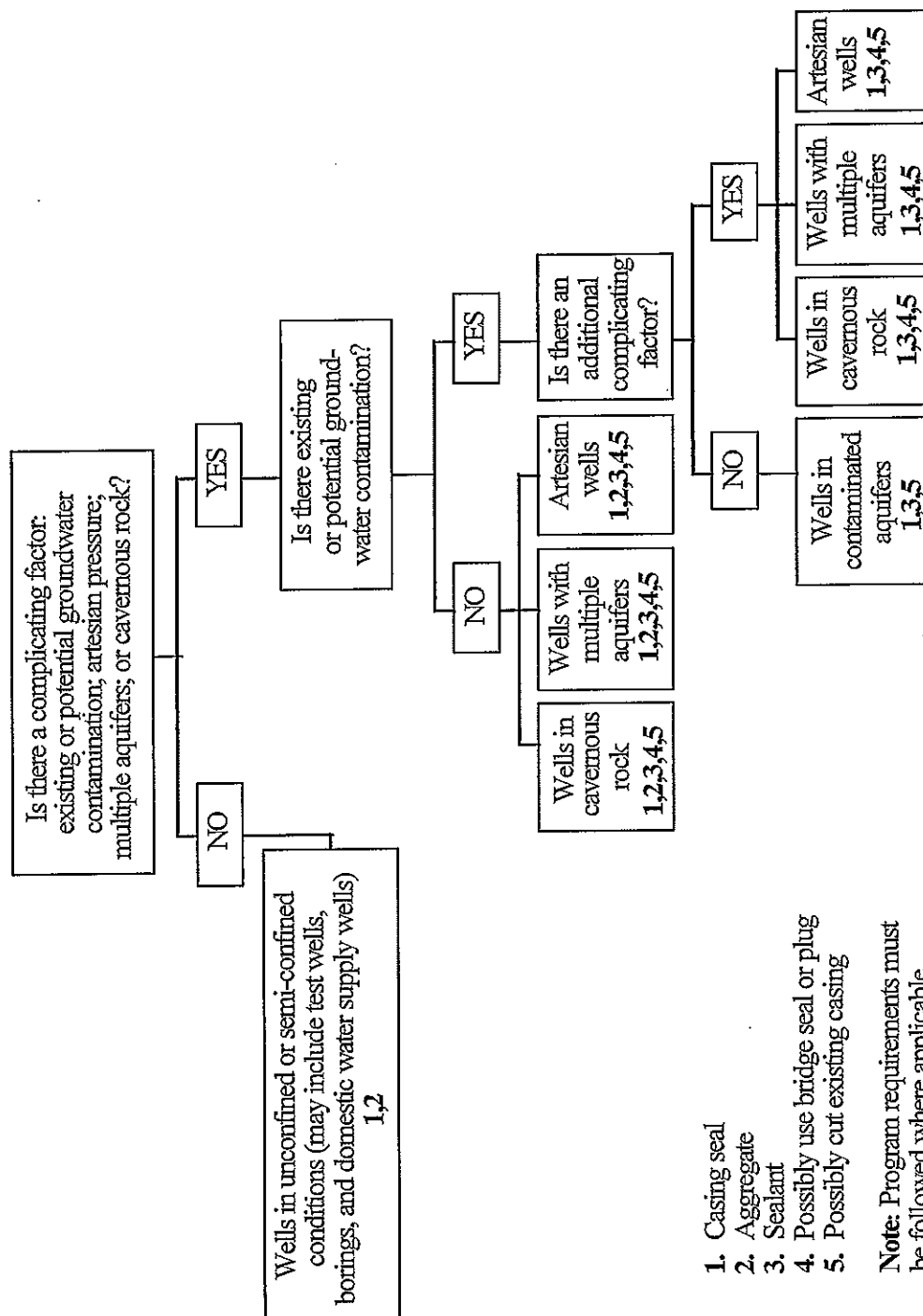
Bridge Seals

A bridge seal can be used to isolate cavernous sections of a well, to isolate two producing zones in the well, or to provide the structural integrity necessary to support overlying materials (and thus protect underlying aggregate or sealants from excessive compressive forces). Bridge seals are usually constructed by installing an expandable plug made of wood, neoprene, or a pneumatic or other mechanical packer. Additional aggregate can be placed above the bridge.

RECOMMENDATIONS

The complexity of the abandonment procedure depends primarily on the hydrogeology, geology, well construction, and the groundwater quality. Four principal complicating factors have been identified; they include 1) artesian conditions, 2) multiple aquifers, 3) cavernous rocks, and 4) the threat or presence of contamination. The recommended procedures for abandoning wells will be more rigorous with the presence of one or more complicating factors. The procedures may vary from a simple casing seal above aggregate to entirely grouting a well using a tremie pipe after existing casing has been ripped or perforated. Figure 10 summarizes the general approach to well abandonment.

Figure 10. Summary of procedures for well abandonment.



Casing Seal

The transition from well casing to open borehole is the most suspect zone for migration of water. In order to minimize the movement of water (contaminated or otherwise) from the overlying less consolidated materials to the lower waterbearing units, this zone must be sealed. Generally this can be accomplished by filling at least the upper 10 feet of open borehole and the lower five feet of casing with sealant. The length of open borehole sealed should be increased if extenuating circumstances exist. Such circumstances would include a history of bacterial contamination, saprolitic bedrock, or possibly deep fracture zones. Waterbearing zones reported in the upper 20 feet or so of open borehole are indications of fractures and would warrant additional sealant. Casing that is deteriorated should be sealed along its entire length. If the casing is to be pulled the sealant used should remain fluid for a period of time adequate for removal of the casing.

If the casing is to remain, then whenever feasible, it should be cut off below land surface. After the casing seal discussed above achieves adequate strength, the open casing should at a minimum, be filled with aggregate. It is strongly suggested that a sealant be used in the upper 2 to 5 feet of casing.

Wells in Unconfined or Semi-Confined Conditions

These are the most common type of wells in Pennsylvania. The geology may consist of either unconsolidated or consolidated materials. When applicable, unconfined wells in non-contaminated areas may be satisfactorily abandoned using aggregate materials up to 10-15 feet below the ground surface. This would apply mainly to domestic wells, and test borings or wells not covered by existing regulations. Monitoring wells that are not covered by specific regulatory programs and are located at sites with no known contamination, might be abandoned in this manner. Above the aggregate, the casing seal should be installed. A sealant may be used over the entire depth.

Wells at Contaminated Sites

An abandoned, contaminated well often mixes contaminated groundwater with uncontaminated groundwater. Complete and uniform sealing of the well from the bottom to the surface is required. Therefore, proper well preparation (Section 7.3) must be done before the well is sealed with a proper sealant (Section 7.4.2).

Wells in Cavernous Rocks

Problems can arise when filling wells that penetrate cavernous rock. Although such wells are usually located in carbonate terrain, voids can also occur in areas that have been deep mined. Care must be taken to insure that aggregates and sealants are of a size and consistency to prevent their removal by water flowing in the void. Large voids or high flow velocities warrant placement of a bridge in competent rock over the void. Aggregate and sealants can then be placed above the bridge.

Multiple Aquifer Wells

The main goal in sealing wells that extend into more than one aquifer is to prevent the flow of groundwater from one aquifer to another. If no appreciable movement of water is encountered, and there is no threat of groundwater contamination, sealing with concrete,

neat cement, grout, or alternating layers of these materials and aggregate will prove satisfactory. When groundwater velocities are high, the procedures for wells with artesian flow (see the next section) are recommended. If alternating plugs (or bridges) and aggregate layers are used, the plugs should be placed in known nonproductive horizons or, if locations of the nonproductive horizons are not known, at frequent intervals.

Flowing Wells

The sealing of artesian wells requires special attention. The flow of groundwater may be sufficient to make sealing by gravity placement of concrete, cement grout, neat cement, clay or sand impractical. In such wells, large stone aggregate (not more than 1/4 of the diameter of the hole), well packers (pneumatic or other), or wooden plugs will be needed to restrict the flow and thereby permit the gravity placement of sealing material above the zone where water is produced. If plugs are used, they should be several times longer than the diameter of the well to prevent tilting. Seals should be designed to withstand the maximum anticipated hydraulic head of the artesian aquifer.

Because it is very important in wells of this type to prevent circulation between water yielding zones, or loss of water to the surface or to the annular spacing outside of the casing, it is recommended that pressure grouting with cement be done using the minimum volume of water during mixing that will permit handling.

In wells in which the hydrostatic head producing flow to the surface is low, the movement of water may be stopped by extending the well casing to an elevation above the artesian pressure surface.

Wells with Complicating Factors at Contaminated Sites

Wells with one or more of the above complicating factors that are to be abandoned in areas with contaminated groundwater or in areas where the groundwater is at a high risk for future contamination, require the most rigorous abandonment procedures. In general, the entire length of these wells should be sealed.

When the threat of contamination has been established, the elimination of a potential flowpath is critical. For example, a contaminated well in a karst terrain must be carefully sealed to avoid worsening the situation. In general, the entire lengths of these wells should be sealed. In some situations, a bridge seal may have to be installed, and casing may have to be perforated. In each case, a prudent method should be selected that will eliminate all potential vertical flowpaths.

Monitoring Wells

Monitoring wells should be abandoned in accordance with the rules and regulations of the program under which they were installed and operated. Monitoring wells which do not fall under the jurisdiction of a regulatory program, or fall under a program that has no rules or regulations for abandonment, should be abandoned under the following guidelines.

Monitoring wells that were installed and continue to function as designed, can usually be abandoned in place. Exceptions would include wells whose design precludes complete and effective placement of sealant and wells in locations subject to future disturbance that could compromise the abandonment. In such instances all tubing, screens, casings, aggregate, backfilling, and sealant should be cleaned from the boring and the hole should be completely filled with an appropriate sealant.

Monitoring wells that are abandoned in place should be completely filled with sealant. Screened intervals can be backfilled with inert aggregate if sealant will alter the groundwater chemistry and thereby jeopardize ongoing monitoring at the facility. Intervals between screens, and between the last screen and the surface, must be filled with sealant. Generally, sealant must be emplaced from the bottom of the interval being sealed. Protective casings, riser pipes, tubing, and other appurtenances at the surface which could not be removed should be cut off below grade after the sealant has properly set. When the abandonment will be completed below the finished grade, the area of the boring should be covered with a layer of bentonite, grout, concrete, or other sealant before backfilling to grade.

EXISTING REGULATIONS AND STANDARDS

The Water Well Drillers License Act requires that the owner or consultant who is to abandon the well notify the department of the intent to decommission a well at least 10 days before the well is sealed or filled. Individual department bureaus may have specific regulations or guidelines.

The Bureau of Oil and Gas Management regulates the plugging of oil and gas wells. Plugging provisions for oil and gas wells in coal and non-coal areas are established in § 210 and § 211 of Act 223, and § 78.91 - 78.97 of Chapter 78. These sections describe methods that would stop any vertical flow of fluids or gas within the well bore. Alternate methods of plugging also are allowed if they would afford the same level of protection. Alternate methods must be approved before the plugging is initiated.

The Bureau of Mining and Reclamation regulates the abandonment of borings and wells associated with the mining of coal. Coal exploration holes must be abandoned according to the § 87.93 for surface mining of bituminous coal, § 88.83 for anthracite coal mining, § 89.54 for deep mining of bituminous coal, and § 90.93, coal refuse disposal.

The Bureau of Water Supply and Community Health uses the AWWA Standard A 100-90 for abandonment of public water supply wells. This standard is referenced in Section 3.3.5.11 of Part II of the Public Water Supply Manual.

REPORTING

All abandoned wells shall be reported to BTGS, along with any bureau that requires a report, on forms required by BTGS (and any other forms). If available, the original driller's log should be included along with the details of the well abandonment procedure. A photograph should be taken

of the site, and a reference map should be made to locate the abandoned well. It also may be appropriate to survey the exact location of the well. This is especially important for wells associated with contaminated sites.

REFERENCES

AMERICAN WATER WORKS ASSOCIATION, 1990, Abandonment of Test Holes, partially completed wells and completed wells: AWWA Standard for Water Wells, A100-90, pp. 25-26.

DRISCOLL, F.G., 1986, Groundwater and Wells, 2nd ed., Johnson Filtration Systems, Inc., St. Paul, Minnesota 55112, 1089 pp.

NYE, J.D., September 1987, Abandoned Wells - How One State Deals with Them, Water Well Journal, pp. 41-46

RENZ, M.E., May 1989, In Situ Decommissioning of Ground Water Monitoring Wells, Water Well Journal, pp. 58-60.

U.S. ENVIRONMENTAL PROTECTION AGENCY, 1975, Manual of Water Well Construction Practices, Office of Water Supply, EPA-570/9-75001.

WELL ABANDONMENT FORM

CONTRACTOR/AGENT: _____ REGISTRATION NO. _____

DATE: _____ TYPE OF SITE OR PROGRAM: _____

1. WELL LOCATION: (Show sketch of location on back of this form.)

Municipality _____ County _____

Quadrangle _____
(Road, community, subdivision, lot no.)

Latitude _____ Longitude _____

2. OWNER AND ADDRESS: _____

3. TOPOGRAPHY: (Circle) hilltop, slope, stream terrace, valley, stream channel, draw, local depression, flat

4. USE OF WELL: _____

WELL DIAGRAM: sketch a diagram showing depths of well, casing (if present), grouting materials, perforations, etc.

5. DEPTH OF WELL: _____ DIAMETER OF WELL: _____

6. AMOUNT OF CASING REMOVED: _____ DIAMETER: _____

7. SEALING MATERIAL:	bags	neat	sand
	(94 lb):	cement	cement
	gals of	_____	_____
	water:	_____	_____
	yds of	_____	_____
	sand:	_____	_____

OTHER MATERIAL: _____ amount: _____

8. EXPLAIN METHOD OF EMPLACEMENT OF MATERIAL:

9. CERTIFICATION: We hereby certify that this well abandonment record is true and exact, and was accomplished on _____ day of the month of _____, _____, with our active participation and that we are qualified to participate in such abandonment actions.

1. Signature of Participant: _____ 2. Signature of Participant: _____

Date: _____ Address: _____ Date: _____ Address: _____