CONSTRUCTION GUIDE PA-2
GUIDE FOR WELL DECOMMISSIONING
September 2007

This guide was originally developed by Bruce Benton, former geologist with NRCS in Pennsylvania. The types of wells normally encountered in NRCS field work are divided into two broad categories. Wells located in bedrock and those located on unconsolidated deposits. Under each of these categories addition types are outlined along with procedures for proper closure. The reference to Figures 1 thru 6 corresponds with Standard Drawings PA-076 thru -081, respectively.

Additional information and requirements can be found in PA Standard 351 and in the current PA DEP "Ground Water Monitoring Guidance Manual", Chapter 7 Well Abandonment Procedures, which is an upgrade from reference 3.

Unique situations may require the assistance of geologists and may be beyond the scope of this guide and NRCS activities. Refer to Conservation Practice Standard and Construction Specification PA351.

WELLS LOCATED IN BEDROCK

These are generally deep (greater than 100 ft.) wells 6 to 24 inches in diameter with steel casing seated into bedrock. Below the casing, the well is an open bore hole located within the aquifer. Wells may tap a single aquifer or multiple aquifers. The aquifer may be unconfined (water level at or below top of aquifer), confined or artesian (water level above the top of aquifer), or flowing artesian (hydrostatic head higher than the ground level). Sealing procedures are similar for wells in unconfined and confined aquifers but different for artesian flowing wells and wells in multiple aquifers.

A. Wells in an Unconfined Aquifer

Sealing Schedule (See Fig. 1 and Materials):

1. Place clean Fill Material up to within 10 ft. of the bottom of the casing. Note: If well has bacteria contamination (or suspected), and a well or spring is located within 50 ft., apply a chlorine treatment.
2. Place Sealing Material up to within 4 ft. of the ground surface.
3. Remove the top 4 ft. of well casing.
4. Place compacted Natural Soils to the ground surface and crown slightly.
5. Place about 0.5 ft. of Topsoil and crown the surface.

B. Wells in a Confined Aquifer

Sealing Schedule (See Fig. 2 and Materials):

1. Place clean Fill Material up to within 10 ft. of the bottom of the casing.
   Note: If well has bacteria contamination (or suspected) and a well or spring is located within 50 ft., apply a chlorine treatment.
2. Place Sealing Material up to within 4 ft. of the ground surface.
3. Remove the top 4 ft. of well casing.
4. Place compacted Natural Soils to the ground surface and crown slightly.
5. Place about 0.5 ft. of Topsoil and crown the surface.

C. Wells in Multiple Aquifers – These wells draw water from more than one aquifer. Generally, the casing extends from the ground surface into the top aquifer with the bore hole being open within each aquifer and cased within each impermeable layer between aquifers.

Sealing Schedule (See Fig. 3 and Materials):

1. Place clean Fill Material up to within 10 ft. of the bottom of the lower casing.
   Note: If well has bacteria contamination (or suspected) and a well or spring is located within 50 ft., apply a chlorine treatment.
2. Place Sealing Material a minimum of 10 ft.above the bottom of the lower casing.
3. Place Fill Material up to within 10 ft. of the bottom of the upper casing.
4. Place Sealing Material up to within 4 ft. of the ground surface.
5. Remove the top 4 ft. of well casing.
6. Place compacted Natural Soils to the ground surface and crown slightly.
7. Place 0.5 ft. of Topsoil and crown the surface.

D. Artesian Flowing Wells – These are wells which have a hydrostatic head above ground level causing water to flow to the surface. These conditions can be found in bedrock wells and wells in unconsolidated deposits.

The water flow may need to be lowered before sealing can begin. To stop the flow one of the following methods should be considered: introduce a

high-specific-gravity fluid, extend the pipe high enough above the ground surface, or pump the well or nearby wells to drawdown the water level.

Sealing Schedule (See Fig. 4 and Materials):

1. Place clean Fill Material up to the bottom of the casing.
2. Insert a Bridge Seal or wooden plug in the bottom of the casing. In a multiple aquifer well consider whether intermediate seals will be needed to prevent water passing from one aquifer to another.
3. Place Sealing Material above the upper most seal or plug up to within 4 ft. of the ground surface.
4. Remove the top 4 ft. of casing.
5. Place compacted Natural Soils to the ground surface and crown slightly.
6. Place about 0.5 ft. of Topsoil and crown the surface.

E. *Sealing Wells with Voids* – These are wells where the open portion of the well has penetrated limestone cavities or deep mine voids.

Sealing can be accomplished by using the sealing schedule in A. and Fig. 1. Fill Material within the void should be coarse enough to withstand the groundwater flow velocities. If the flows and/or voids are too large to fill, then consider installing a Bridge Seal and follow the sealing schedule A. and Fig. 4.

WELLS LOCATED IN UNCONSOLIDATED DEPOSITS

F. *Large Diameter Dug or Bored Wells* – These are typically older, shallow (less than 50 ft.) hand dug wells greater than 24 inches in diameter with steel, stone-lined or wood crib casing. The wells are generally located in alluvial or glacial deposits having an unconfined or water table aquifer.

Because of the shallow depth and large diameter, all materials can be placed in the well at the well head.

Sealing Schedule (See Fig. 5 and Materials):

1. Place clean Fill Material up to 1 ft. below the measured static water level (SWL).
   Note: If a well has bacterial contamination (or suspected) and a well or spring is located within 50 ft., apply a chlorine treatment.

2. Place a minimum of 2 ft. of Sealing Material. This material should lie about 1 ft. above and 1 ft. below the measured SWL.
3. Place and slightly compact Natural Soil to within 4 ft. of the surface Sealing Material may be substituted.
4. Remove the top 4 ft. of well casing (steel, stone wall or cribbing).
5. Place a minimum of 1 ft. of Sealing Material.
6. Place compacted Natural Soil to the ground surface and crown slightly. Sealing Material may be substituted.
7. Place about 0.5 ft. of Topsoil and crown the surface.

G. *Small Diameter Bored Wells* – These are typically shallow (less than 100 ft.) wells 4 to 12 inches in diameter with steel casing. The wells are generally located in alluvial or glacial deposits having an unconfined or confined aquifer.

Sealing Schedule (See Fig. 6 and Materials):

1. Place clean Fill Material up to 2 ft. below the measured SWL.
   Note: If well has bacteria contamination (or suspected) and a well or spring is located within 50 ft., consider applying a chlorine treatment.
2. Place Sealing Material up to within 4 ft. of the ground surface.
3. Remove the top 4 ft. of well casing(s).
4. Place compacted Natural Soil to the ground surface and crown slightly.
5. Place about 0.5 ft. of Topsoil and crown the surface.

H. *Sealing Sandpoint Wells* – These are typically shallow small diameter (1 ¼ to 2 inches) wells driven or jetted into sand and gravel deposits of alluvial or glacial origin.

By removing the casing and sandpoint from the well the hole should close. In the event the casing and sandpoint cannot be removed, the entire well should be filled with Sealing Material. The top 2 ft. of the well should be excavated and Natural Soil compacted and crowned at the surface.

MATERIALS

1. Fill Materials: clean sand and gravel, pea gravel, crushed stone. Use where sealing is not required.

2. Sealing Materials:

   Neat Cement – mix 6 gallons of water to 94 lbs of Portland cement. Pump into well through a Tremie pipe when placing below the water level or if well is less than 18 inches in diameter.

   Bentonite Clay – granular and pellet sizes. Can be placed below the water level by pouring slowly into hole and agitated to avoid bridging.

   Bentonite Slurry – mix 10% processed bentonite (by weight) and clean water (equivalent to a Marsh fluid viscosity of 70 seconds per quart using Marsh funnel viscometer). Pump into well through a Tremie pipe when placing below the water level or if well is less than 18 inches in diameter.

   Sand/Cement Grout – mix 94 lbs. of Portland cement with an equal volume of clean masonry sand and 6 gallons of clean water. Pump into well through a Tremie pipe when placing below the water level or if well is less than 18 inches in diameter.

   Concrete – mix 94 lbs of Portland cement with equal volumes of sand and gravel and 6 gallons of clean water. Pump into well through a Tremie pipe when placing below the water level or if well is less than 18 inches in diameter.

3. Natural Soils: mineral soil with a USCS classification of: CL, ML; or GC, GM, SC, SM with greater than 25% fines. Use where sealing well is not required.

4. Chlorine Treatment: 1 gallon of 5% chlorine bleach (5% Na Hypochlorite) to 500 gallons of well water volume.

5. Well Capacities:

Hole Diameter (inches)	Volume Per Foot of Depth (gal/ft)	(ft^3/ft)
2	0.17	0.02
4	0.65	0.09
5	1.02	0.14
6	1.47	0.20
8	2.61	0.35
10	4.08	0.55
12	5.87	0.79
14	7.00	1.07
16	10.44	1.40
18	13.22	1.77
20	16.32	2.18
24	23.51	3.14
30	36.72	4.91
36	52.88	7.07
40	65.29	8.73
48	94.01	12.57

References:

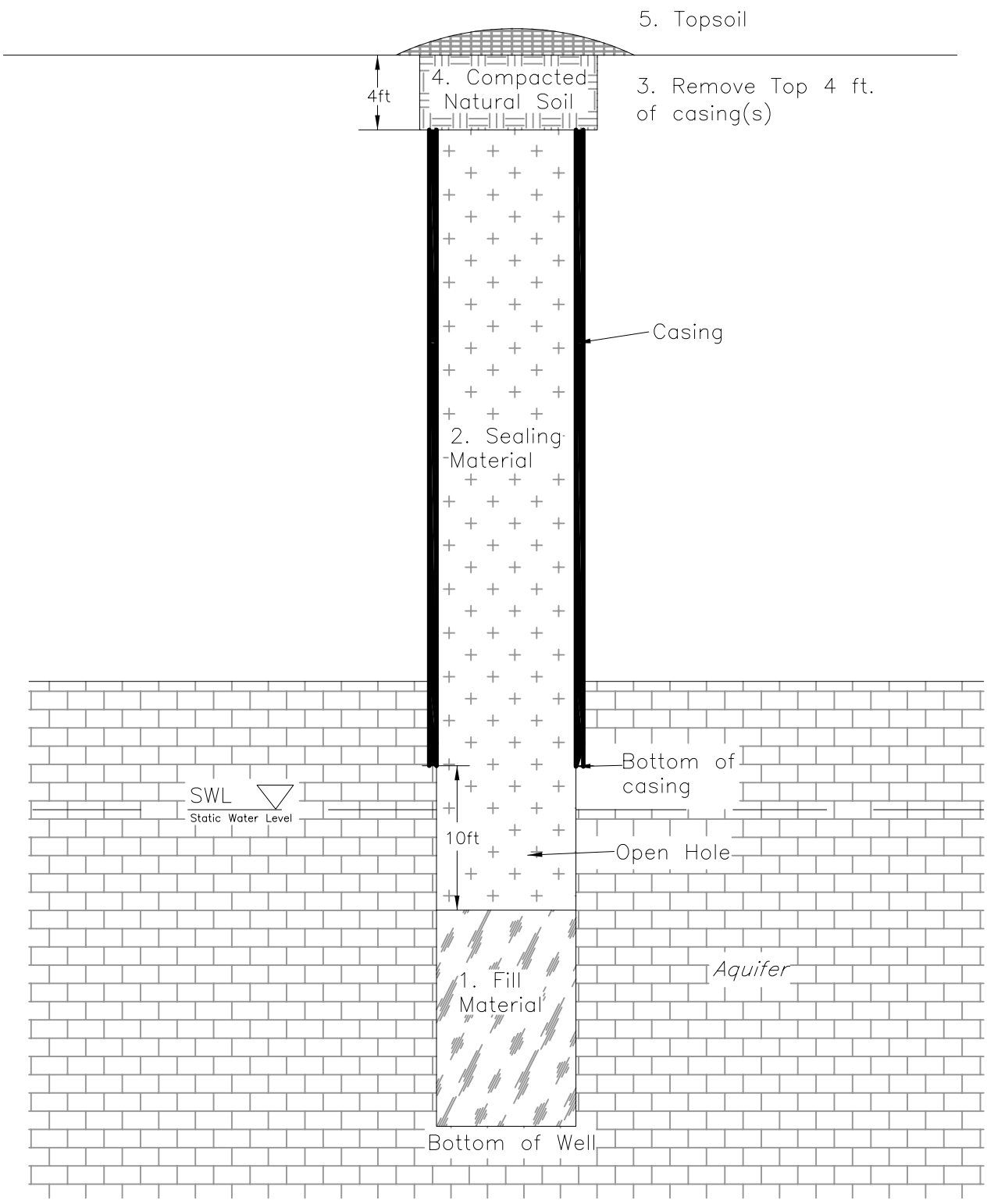
1. Driscoll, F.G., 1987, Groundwater and Wells: Minnesota, Johnson Division, 1089 p.

2. Iowa Department of Natural Resources, 1988, Guidelines for Plugging Abandoned Water Wells, Tech. Info. Ser. 15, 46p.

3. Pennsylvania Department of Environmental Resources, Bureau of Topographic and Geologic Survey, 1993, Draft-"Well Abandonment Section, Ground Water Quality Protection Strategy", 10p.

Fig. 1 Bedrock Wells in an Unconfined Aquifer

(NOT TO SCALE)



SHEET NO ____ OF ____	DRAWING NO. PA–076	CAD FILE NAME	NRCS Natural Resources Conservation Service, United States Department of Agriculture

_____ COUNTY, PENNSYLVANIA

Well Profile Figure 1

		DATE
DESIGNED	Bruce A. Benton	
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Fig. 2 Bedrock Wells in a confined Aquifer

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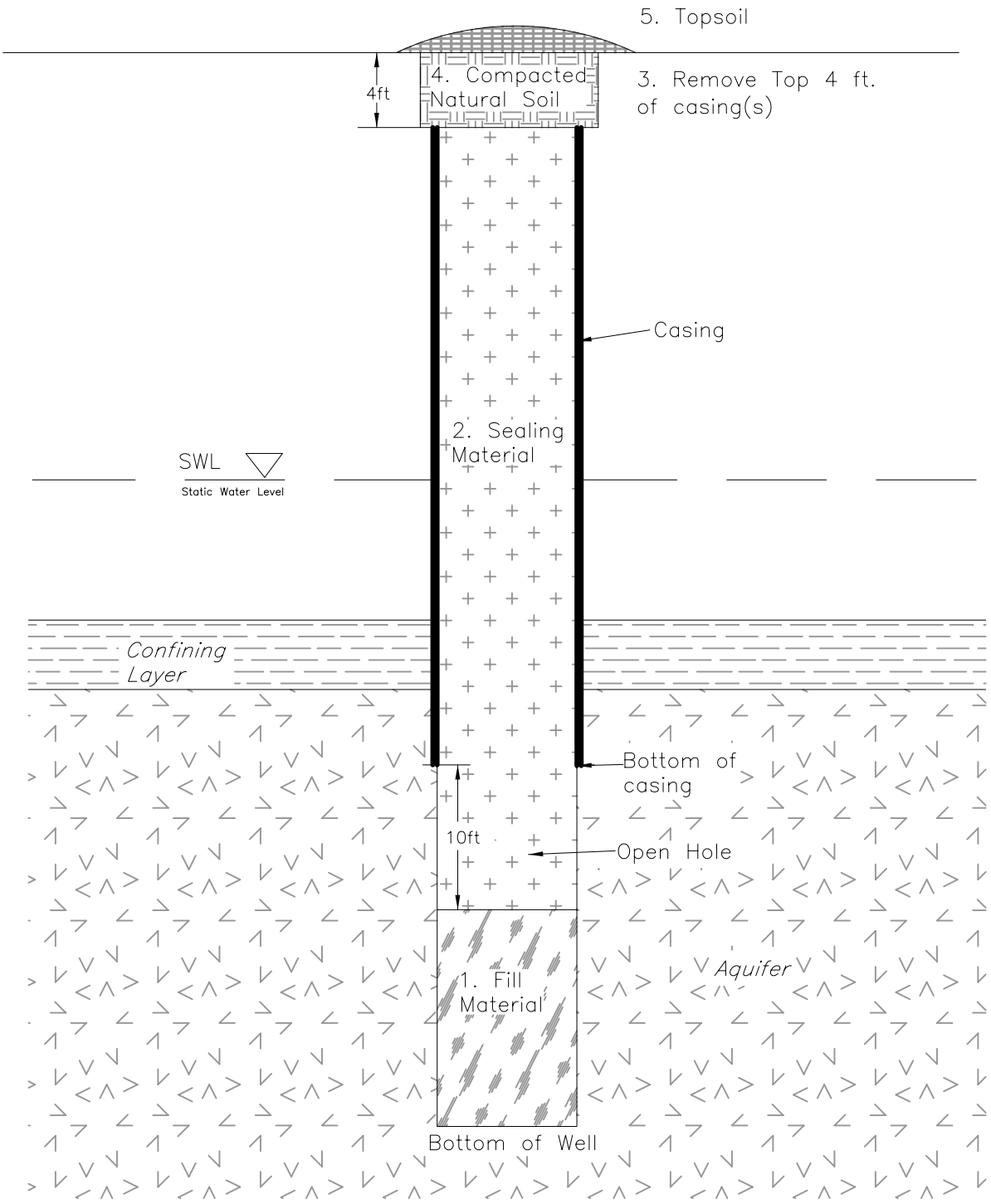

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Well Profile Figure 2

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Fig. 3 Bedrock Wells in Multiple Aquifers

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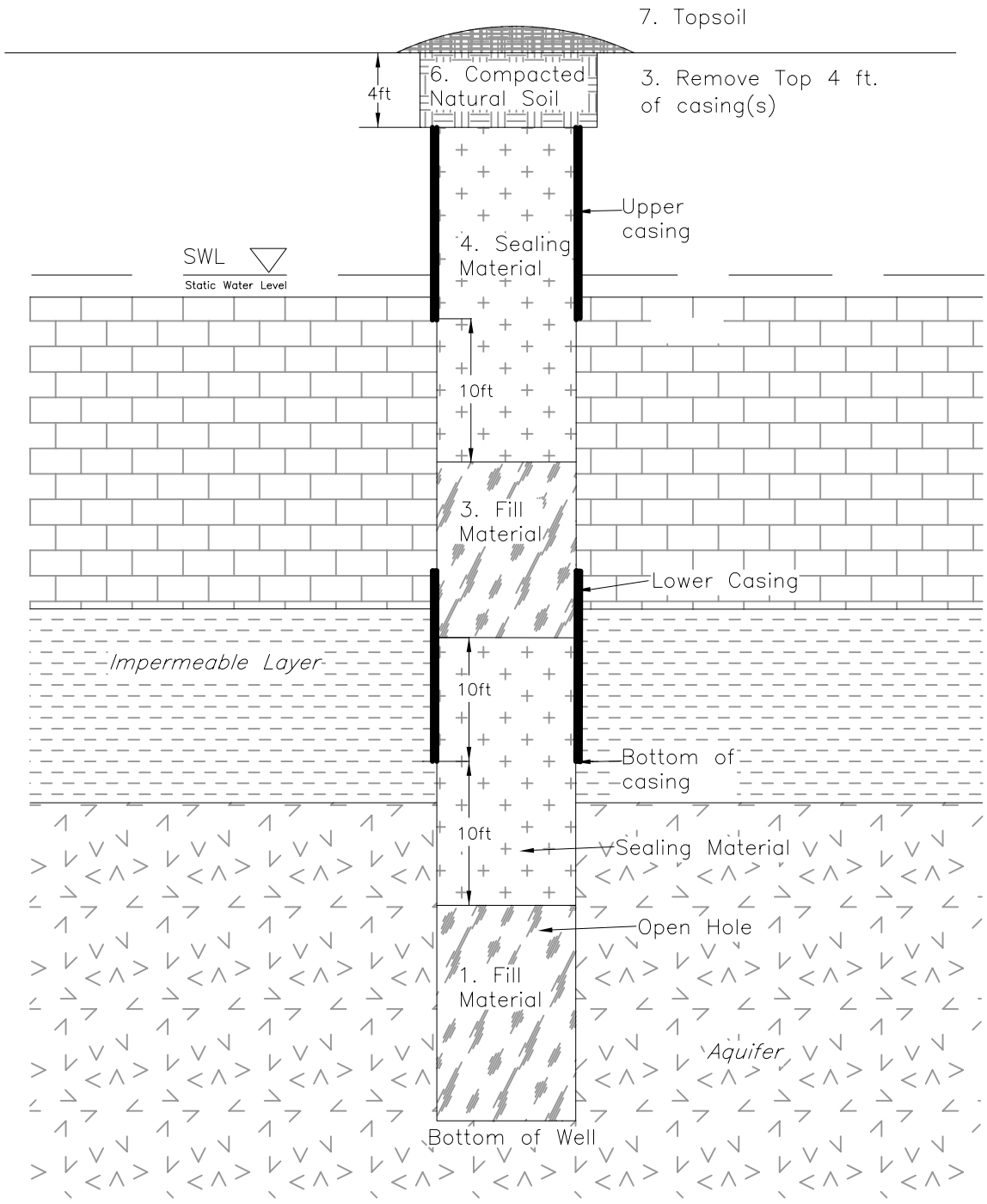

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Fig. 4 Artesian Flowing Wells

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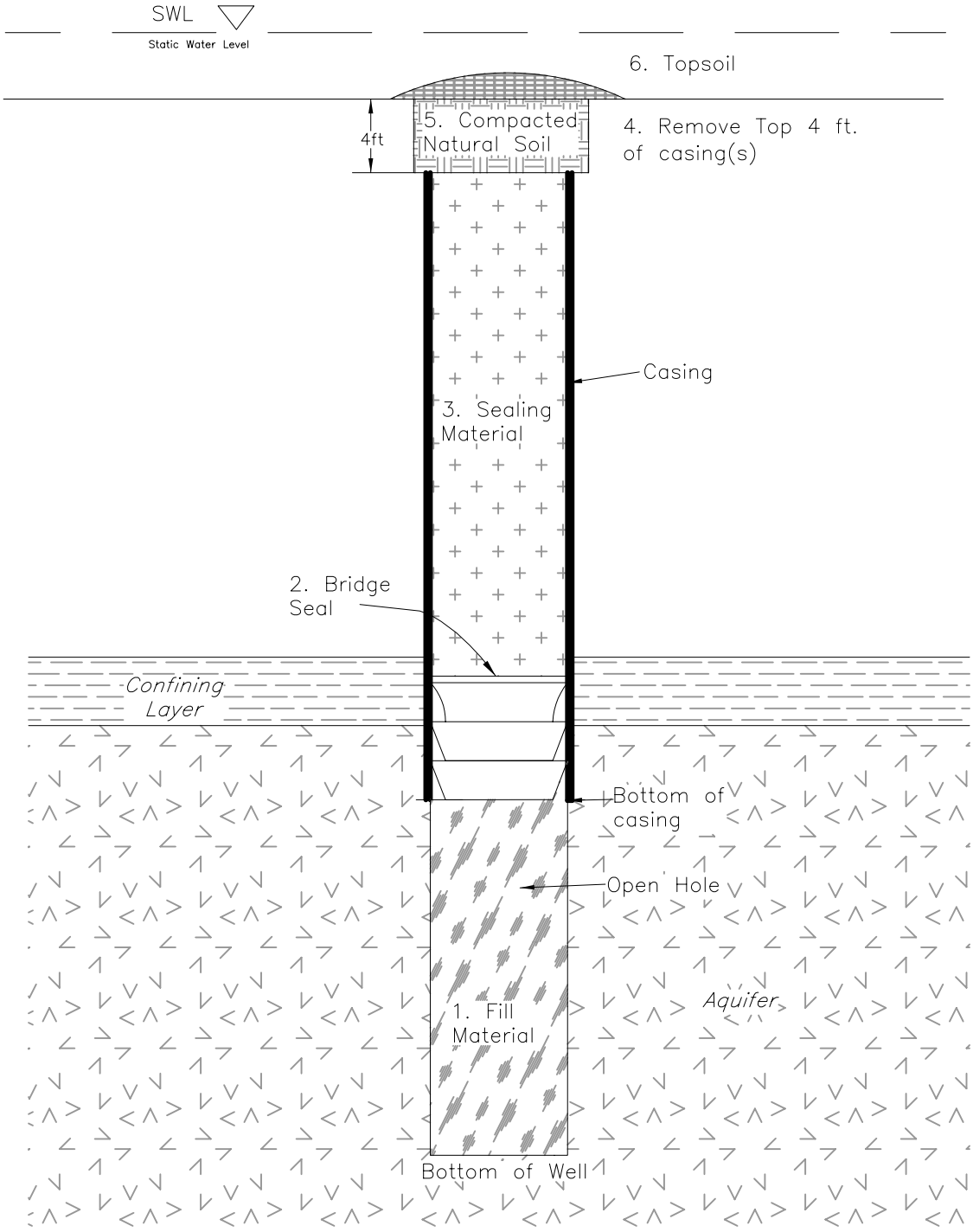

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Fig. 5 Large Diameter Dug or Bored Wells in Unconsolidated Deposits

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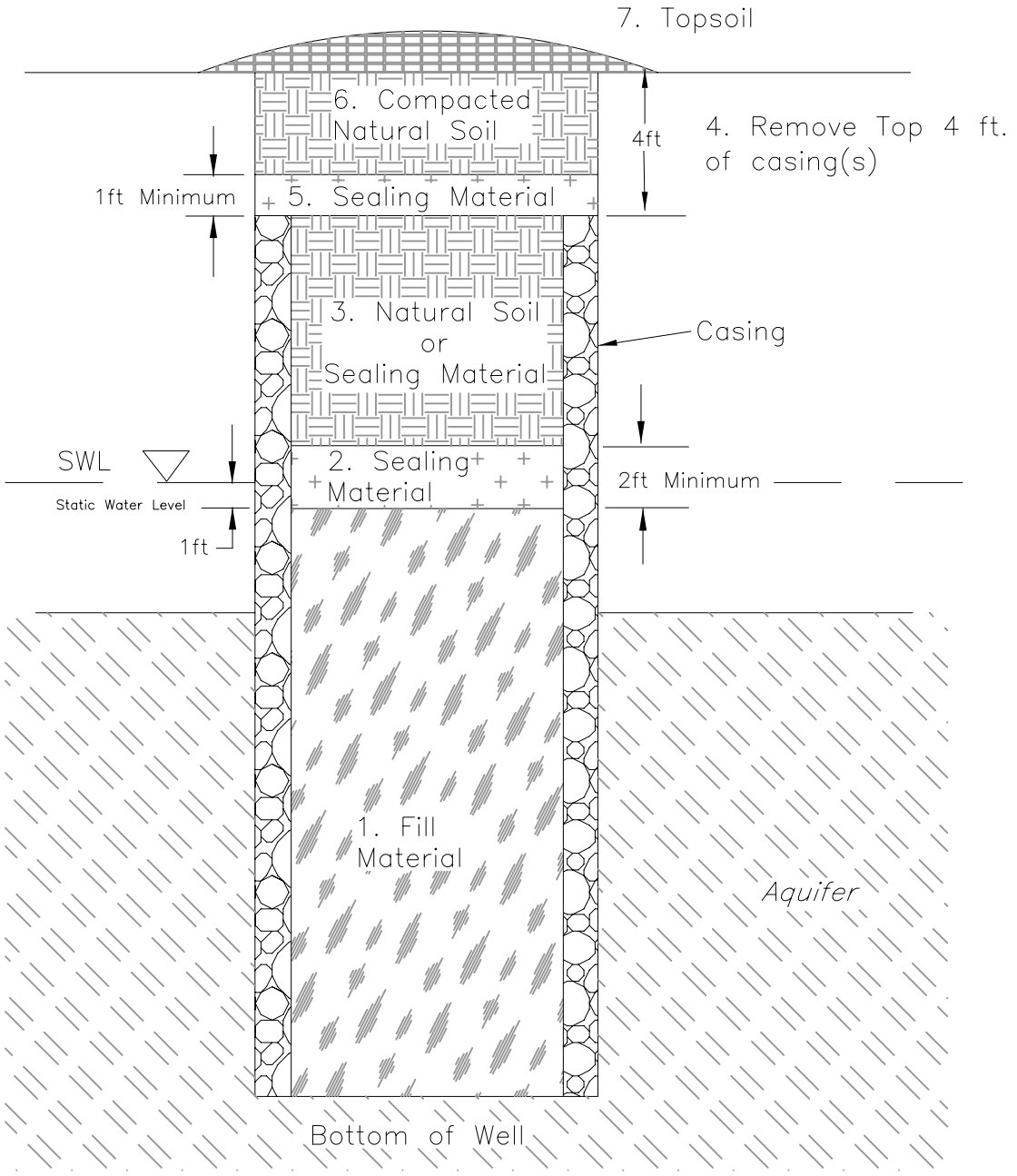

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Fig. 6 Small Diameter Bored Wells in Unconsolidated Deposits

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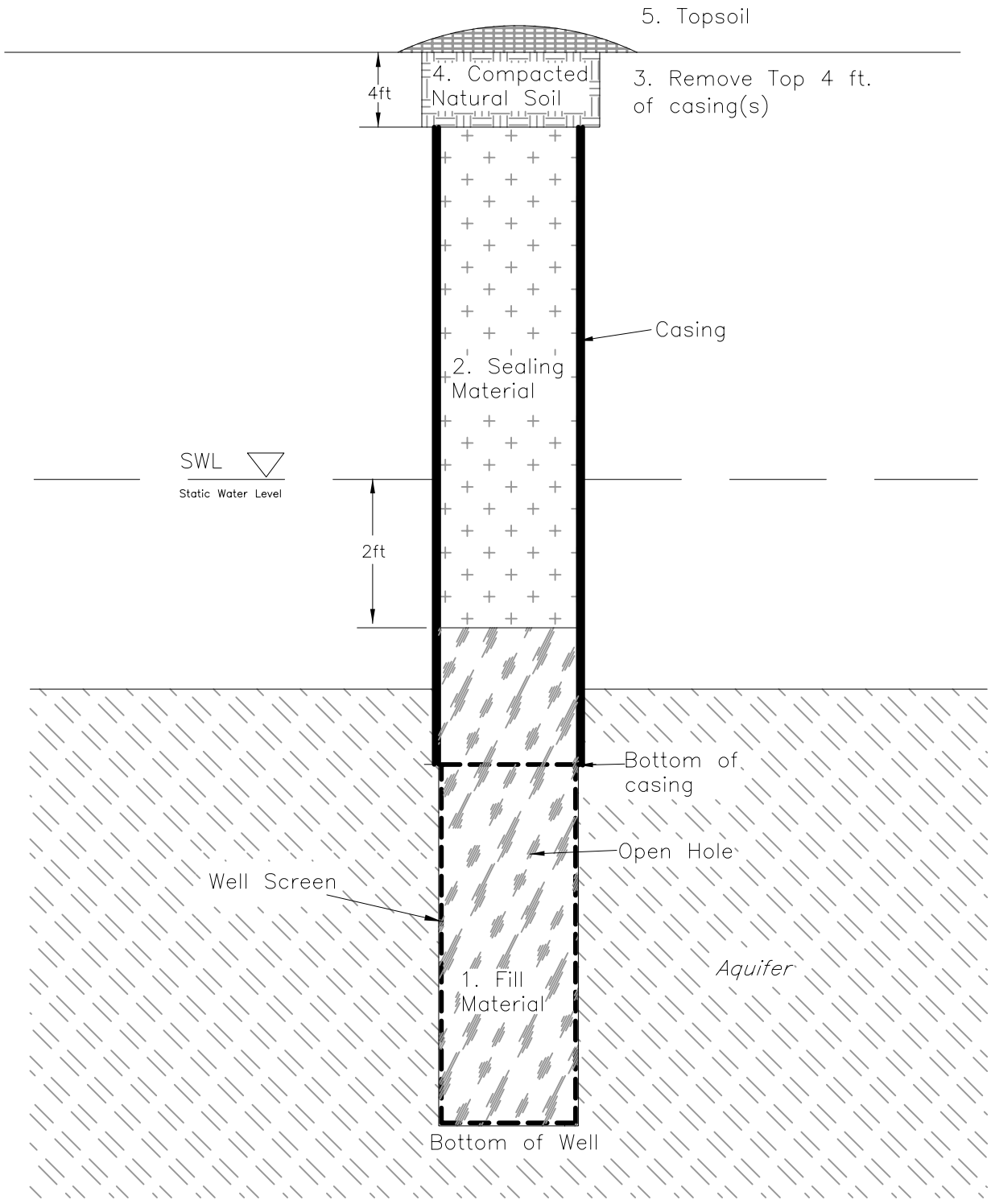

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