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Plugging Abandoned Wells

Michigan State University Cooperative Extension Service

Water Quality Extension Publications

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PLUGGING ABANDONED WELLS

mations (aquifers) of different quality may allow lower-quality water to migrate into and degrade a higher-quality aquifer.

WHAT IS AN ABANDONED WELL?

An abandoned well is a well that is no longer in use or that is in such disrepair that groundwater can no longer be obtained from it. Wells that are contaminated and pose a health risk also meet Michigan's legal definition of an abandoned well.

No one knows exactly how many abandoned wells there are in Michigan, but experts estimate that there may be more than one million. Each year, many wells are abandoned when they are replaced with new wells or when homes are connected to community water systems. An abandoned well that is not plugged, or that is plugged improperly, is a hazard to the health and safety of the people living around it. If you are not sure if you have an abandoned well on your property, please refer to the section entitled, *How can I find out if I have an abandoned well on my property?*

WHAT PROBLEMS DO ABANDONED WELLS PRESENT?

- They are a public safety hazard. People (especially children) and small animals may be injured or killed by falling into wells that are left open.
- They are a health hazard because they serve as potential routes for groundwater contamination. Many of these wells are poorly constructed or badly deteriorated, and can allow runoff water (carrying bacteria, sediment, fertilizer, pesticides, and other chemicals) to flow directly down into groundwater. This bypasses the natural filtering and degradation processes that can take place as these materials move through the soil.
- They may allow contaminated or poor quality water to move between aquifers. An abandoned well that connects two water-bearing geologic for-

- They may lead to unnecessary waste of water (if the abandoned well is an artesian or flowing well).

WHY MUST ABANDONED WELLS BE PLUGGED?

Merely capping an abandoned well is not enough to prevent it from becoming a problem. In order to protect the health and safety of the people living near them, these wells must be properly plugged (or sealed) soon after abandonment. The recommended procedures for plugging abandoned wells in Michigan are provided in this bulletin.

You should realize that you are required by state law to have your unused well(s) properly plugged. This should be done soon after the well is taken out of use. You may save money by having your old well plugged at the same time a new well is being drilled. Protecting the quality of your new well by having your old well(s) properly plugged is a wise investment!

You should also be aware that you may be held potentially liable under laws guiding Michigan's cleanup program (Part 201, PA 451 of 1994) if groundwater contamination is shown to have been caused by your abandoned well. Thus, spending a few dollars now to properly plug your abandoned well may prevent you from having to pay large sums of money for restoration and cleanup costs in the future.

WHAT TYPES OF WELLS ARE WE TALKING ABOUT?

There are three types of water wells used in Michigan, and the recommended plugging procedures differ for each type of well. Thus it is important for you to know the type of abandoned well you have



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Procedures Common to the Plugging of All Wells in Michigan

Though the particular method to be used for plugging a well depends upon the type of well and the existing geological conditions, several steps are common to the plugging of all abandoned wells:

- 1) Contact your local health department to request a copy of the well log. This is a record filed by the well driller upon completion of the well. It provides information on well depth, casing diameter, depth to water, geologic formations penetrated, and more.
- 2) Remove all pumping equipment, pipes, debris, and other obstructions from the well.
- 3) Measure the well depth and casing diameter to determine the volume of plugging material needed. A weighted tape or string is suitable for this purpose.
- 4) Plug the well using the materials and procedures described in the next two sections of this bulletin.
- 5) It is recommended that the well casing be cut off at least 4 feet below ground level to eliminate interference with future use of the site. Generally, well casings are not required to be removed entirely.
- 6) Mound and compact low permeability soil over the plugged well to prevent ponding of surface water above the site.

An Abandoned Well Plugging Record (form EQP 2044, available from your local health department) must be completed and submitted to the local health department within 60 days from the date the well is plugged.

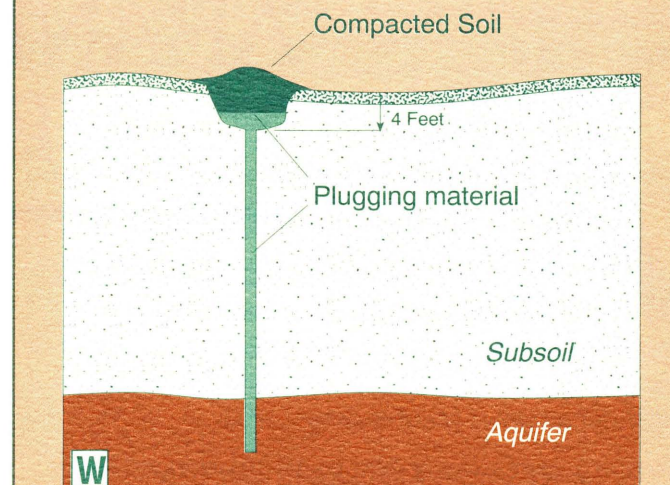
prior to plugging. The three types of wells are:

Driven wells - consist of a pointed well screen attached to a 1½- or 2-inch steel pipe driven into the ground, generally to a depth of 30 feet or less.

Dug wells - large diameter wells (12 inches or greater) usually excavated into shallow aquifers, with the well bore supported by stone, brick, concrete, tile or other curbing material.

Drilled wells - wells generally deeper than 30 feet, cased with 2- to 6-inch steel pipe or 5-inch plastic pipe. When plugging a drilled well, it is important to know whether it is a rock well or a sand/gravel (screened) well.

Figure 1. Recommended plugging sequence for driven wells.



CAN I PLUG THE WELL MYSELF?

In most cases, driven wells and large diameter dug wells can be successfully plugged by a well owner with a minimal amount of special equipment. Be aware, however, that a poor well plugging job is no better than an open well. The use of improper materials or methods can lead to groundwater contamination. Also, once a well has been plugged improperly, it is quite costly to correct, since the defective plug must be drilled out. Thus, it is often wise to seek qualified help by contacting a Michigan licensed water well drilling contractor. They have the special tools, equipment, and skills needed to properly plug wells.

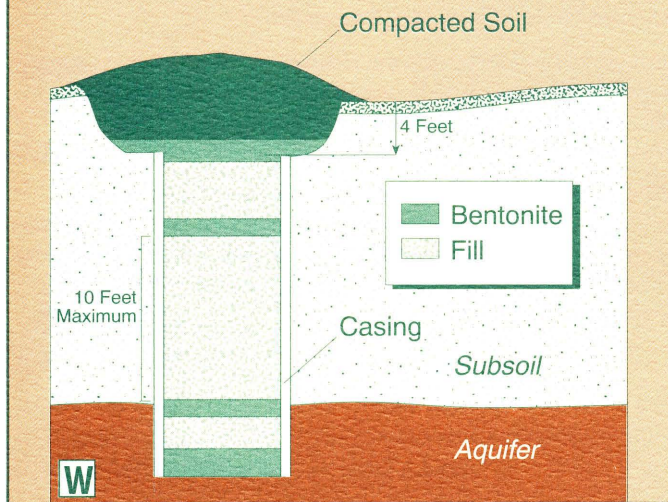
It is recommended that wells with one or more of the following characteristics be plugged by well drilling professionals only:

- drilled wells;
- flowing wells;
- wells greater than 100 feet deep;
- wells where water is seeping from around the casing;
- wells which produce gas;
- wells where pumping equipment is difficult to remove.

P Wells denoted with this symbol should be plugged by well drilling professionals only.

W Wells denoted with this symbol can be plugged by a well owner.

Figure 2. Recommended plugging sequence for dug wells.



SPECIFIC PLUGGING REQUIREMENTS BASED ON WELL TYPE

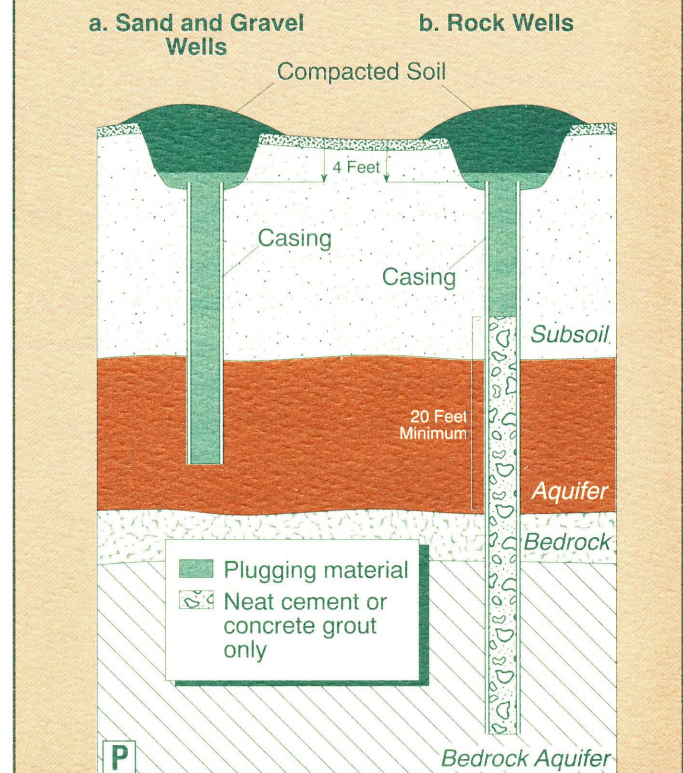
W Hand driven wells — are normally abandoned with the casing and point left in place, using bentonite chips or pellets, or using neat cement poured through a funnel and 1-inch grout pipe (Figure 1). The plugging materials should be applied as described in the next section, *Well Plugging Materials and Placement Recommendations*.

W Dug wells — due to the large volume of these wells, fill materials (such as clean soil) may be used to reduce plugging costs. A layer of bentonite chips or pellets at least 6 inches thick should be placed at the bottom of the well (Figure 2). Layers of clean soil not more than 10 feet thick are then placed alternately with layers of bentonite chips or pellets (at least 6 inches thick) between each soil layer. It is recommended that the upper 4 feet of concrete crock, stone, or brick be removed. Prior to backfilling and mounding, a layer of bentonite chips or pellets at least 6 inches thick should be laid down, followed by water to expand the bentonite.

Dug wells can also be plugged with neat cement or a high-solids bentonite slurry placed through a pipe extending to the bottom of the well. Because of the large diameter of a dug well, concrete grout can be poured directly into the well if the water has been removed from the well prior to plugging.

P Drilled wells — should be plugged by well drilling professionals only! These wells may be several hundred feet deep, and removal of pumping

Figure 3. Recommended plugging sequence for drilled wells in a) sand and gravel and b) bedrock.



equipment may require special equipment. The specific plugging procedures depend on whether the well is a sand/gravel (screened) well or a rock well (i.e., drilled in bedrock).

Sand/gravel wells — should be plugged by filling with neat cement, concrete grout, high-solids bentonite slurry, bentonite chips, or bentonite pellets (Figure 3a). Apply materials as described in the section, *Well Plugging Materials and Placement Recommendations*.

Rock wells — must be plugged by filling with neat cement or concrete grout from the bottom of the well to at least 20 feet above the top of the bedrock. **Bentonite is not acceptable for plugging the rock portion of the well!** The remainder of the well (from 20 feet above the bedrock up to the surface) should be plugged with neat cement, concrete grout, high-solids bentonite slurry, bentonite chips or bentonite pellets (Figure 3b).

P Flowing wells — must be plugged with neat cement or concrete grout from the bottom of the well to the ground's surface, using a grout pipe and

pump. The added slurry weight of the cement-based materials is necessary to overcome the naturally-occurring pressure characteristic of flowing wells. Due to this factor, a registered well drilling contractor should plug flowing wells.

WELL PLUGGING MATERIALS AND PLACEMENT RECOMMENDATIONS

Careful selection and use of materials are essential to effective well plugging. Never use waste materials for well plugging. Plugging materials are used to prevent water from migrating into or between aquifers. They are less permeable to water than native soil or rock. The following well plugging materials are approved for use in Michigan:

- **Neat cement** — a mixture of one 94-pound bag of Portland cement (Type I or IA) to not more than six gallons of water. Portland cement is readily available at building supply stores.
- **Concrete grout** — a mixture of neat cement with 1 cubic foot of sand or aggregate added per bag of cement.
- **Bentonite clay** — a swelling clay available as granules or powder that can be mixed with water to form a high-solids slurry, or as chips or pellets that swell in water to form an effective plug. Bentonite clay can be purchased from water well drilling supply stores.

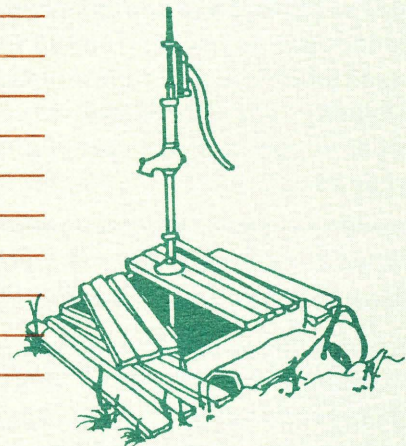
Other plugging materials and methods may be used

on a case-by-case basis if prior approval is given by the local health department.

Neat cement, concrete grout, and high-solids bentonite slurry must be placed continuously from the bottom of the well up to the surface through a pipe (1" to 2") extending to the bottom of the well. The pipe is gradually withdrawn as the plugging material is placed. The use of bentonite slurry requires special mixing and pumping equipment. Due to its viscosity and tendency to swell during pumping, only well drilling contractors should use bentonite slurry to plug wells. Neat cement is more easily mixed, does not "set up" as quickly as bentonite, and is better suited for use by a well owner. When using either of these materials, clean-up of pumping equipment must be accomplished immediately after use.

Bentonite chips or pellets are effective well plugging materials that are simple to use. These materials do not require special mixing or pumping equipment and are placed into the well by pouring. The large particle size ($\frac{1}{8}$ " to $\frac{3}{4}$ ") falls rapidly through water. However, bridging may occur if the bentonite is poured too fast or if fine powder which accumulates in the shipping container is not sifted out. Bridging is when the plugging material fails to fall and accumulates above an open space. The bridge may collapse later, resulting in an incomplete and ineffective seal. The chips or pellets have a greater chance

Well diameter (inches)	Volume per lineal foot		Feet of well plugged	
	(cubic feet)	(gallons)	Neat cement (per 94 lb. bag)	Bentonite chips (per 50 lb. bag)
1 1/4	0.01	0.07	118.0	70.0
2	0.02	0.17	51.3	31.3
3	0.05	0.38	23.1	14.3
4	0.09	0.66	13.4	7.9
5	0.14	1.00	8.5	5.1
6	0.20	1.50	5.9	3.5
8	0.35	2.60	3.4	2.0
12	0.80	6.00	2.1	0.9
18	1.77	13.20	0.7	0.4
24	3.14	23.50	0.4	0.2
36	7.07	53.00	0.2	0.1



of bridging in small diameter wells and in deep wells. A pouring rate not to exceed 10 pounds of material per minute is recommended for 4-inch diameter or larger wells. For 2- or 3-inch diameter wells, a rate not to exceed 5 pounds per minute is recommended. When plugging 1¼-inch driven wells, the chips or pellets should be placed individually.

Bentonite chips or pellets should be poured into the well through a funnel with a spout about one-half the diameter of the well. A simple 2 ft. x 2 ft. trough made of hardware cloth with ¼-inch openings can be placed on the edge of the funnel to sift out the fine powder. During plugging, check the well periodically with a pipe or a weighted tape to make sure that bridging has not occurred. If a bridge has formed, it should be broken with the pipe or drilled out. Once the chips or pellets have been brought to the surface, water should be poured in to expand the bentonite above the water in the well.

HOW MUCH PLUGGING MATERIAL DO I NEED?

The table on page 4 will help you determine how much plugging material is needed. When plugging wells drilled in bedrock, it is a good idea to have additional material on hand. Borehole irregularities increase the volume of plugging material required.

HOW MUCH WILL PLUGGING MY ABANDONED WELL COST?

Costs vary depending on the well depth, casing diameter, the amount of plugging material used, and other factors. A shallow driven well may be plugged for as little as \$50. The average cost for plugging a well in Michigan is approximately \$400. Costs can be reduced by having your old well plugged at the same time your new well is being drilled. Since an unplugged abandoned well can contaminate your water supply well, the cost of plugging is a worthwhile investment.

HOW CAN I FIND OUT IF I HAVE AN ABANDONED WELL ON MY PROPERTY?

A simple look around may help you identify an abandoned well. The most obvious evidence of an abandoned well is a pipe sticking out of the ground. Typically, a well casing will be a metal pipe that is

1¼ to 6 inches in diameter. A small concrete slab or a manhole cover may be the sign of a pit where an abandoned well is located. A ring of rocks, bricks, or concrete 12 to 36 inches or more in diameter may be a sign of a dug well. Windmills are often located over abandoned wells, and an old shed may be an old well house. Also, a broken or inoperative hand pump may be connected to a well that should be plugged.

Some abandoned wells may be more difficult to identify. Many are hidden among weeds or patches of brush. A depression in the ground may occur where an old well was buried. A wet area may indicate that a flowing well was never properly plugged.

To help you determine if you have an abandoned well on your property, you may wish to consult:

- Former property owners or neighbors, who may remember where a well was located;
- Old photographs, which may show windmills, sheds, houses, or other locations where old wells might be found;
- Well drillers, who may remember (or have records of) where they drilled a well that is no longer being used;
- Fire insurance plan drawings, which may contain information about old wells;
- Your local health department or public water utility may have records of wells located in your area or other information associated with water line extension projects.

WHAT SHOULD I DO IF MY HOME IS CONNECTED TO A NEW MUNICIPAL SERVICE LINE?

Locate the old well which formerly served the home. If the well is not operational:

- Plug the well following these guidelines, or;
- Contact a registered well drilling contractor to plug the well for you, or;
- Contract with a registered well drilling contractor or a registered pump installer and a licensed master plumber to repair and re-plumb the well system so that it is operational.

WHO CAN I CONTACT FOR INFORMATION AND/OR ASSISTANCE?

- Your local health department
- Licensed well drilling contractors (in the Yellow Pages under Water Well Drilling & Service).
- The Michigan Groundwater Association at (734) 428-0020.
- Your local Soil Conservation District office.
- The Michigan Department of Environmental Quality, Abandoned Well Management Program at (517) 335-9322.

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