



# FACT SHEET

OFFICE OF DRINKING WATER & MUNICIPAL ASSISTANCE – ENVIRONMENTAL ASSISTANCE CENTER 800-662-9278

## FLOWING WELLS

### What causes a well to flow?

Flowing artesian wells are water wells where the pressure in the aquifer (water-bearing geologic formation) forces groundwater above the ground surface so that the well will flow without a pump. In artesian wells, water rises within the well to a point above the top of the aquifer. If the water also rises above the ground surface, the well is called a “flowing well,” or “flowing artesian well.” All flowing wells are artesian, but not all artesian wells are flowing wells.

Artesian conditions can be either geologically-controlled (geology causes well to flow) or topographically-controlled (topography of the land surface causes well to flow). For this reason, flowing wells are often found in lower areas near rivers or lakes.

### Well construction methods

Flowing wells with high artesian head (pressure) and large flow rates are more challenging and troublesome for well drilling contractors. In fact, some well drilling contractors avoid taking drilling jobs in areas where high volume flows are probable. Some drillers prefer to install the pumping equipment for the flowing well after they subcontract the flowing well construction to other well drillers. Insurance companies are now offering policies for Michigan well drilling contractors that specifically cover flowing artesian well breakouts.

Deep flowing wells (>200 feet) drilled in glacial drift, and flows from bedrock wells are less prone to flow breakout/control problems. Generally, the closer the top of the artesian formation is to the ground surface, the more difficulty in controlling the flow.

In known flowing well areas where artesian pressure at the wellhead is expected to be over 5 psi (11.5 feet of head) or where the flow rate is over 25 gpm, it is highly recommended that well drilling contractors install an outer casing before installing the permanent casing. The outer casing will:

1. maximize chances of controlling flow
2. contain the flow within a casing if drilling fluid weight is insufficient to overcome the pressure of the flow
3. stabilize the soil around the wellhead.

The outer casing should be at least 3 to 4 inches larger than the permanent casing so the permanent casing can be cemented within the outer casing. The outer casing should terminate in the confining layer and should not penetrate the underlying artesian aquifer.

Cement-based grouts, such as neat cement, are recommended for flowing well construction or repair. The solids content, density, specific gravity, and strength of cement grouts makes them more suitable for artesian well applications than bentonite grouts. The heavier slurry density of cement-based grouts results in higher downhole pressure within the borehole. Therefore, cement grouts overcome artesian head conditions more readily than lighter bentonite slurry grouts. Accelerators (e.g. calcium chloride) and lost circulation materials (e.g. cellophane flake) are useful cement additives in some situations.

The Department of Environmental Quality (DEQ) has a chart that calculates the downhole hydrostatic head pressure (DHHP) based on depth to top of flowing aquifer and artesian head above ground surface. Once the DHHP is determined, the chart further provides the contractor with the grouting material suitability. The chart clearly shows that heavy grouts, such as neat cement slurry or cement slurry with additives, have a

distinct advantage for flowing well work. Because cement-based grouts have a significantly higher density than bentonite grout, more downward grout pressure is exerted within the borehole.

### **Damage from flow breakouts**

Sealing the annular space surrounding the well casing is critical, since an ineffective seal or absence of a seal can result in the uncontrolled discharge of water on the outside of the well casing pipe. When groundwater breaks out on the outside of the well casing, erosion of the confining geologic layer and other overlying materials can occur. The uncontrolled discharge of groundwater from flowing wells can cause flooding of the well site and adjacent properties and damage to nearby structures.

The state well code requires that the flow be confined within the well casing. However, a well owner could request a deviation from the local health department to allow the well to flow. Before a deviation can be issued, the well owner or the owner's representative (e.g. well driller) must demonstrate any of the following:

1. Control of the flow is not practical
2. Control of the flow will likely result in the production of sand or turbidity in the water
3. The discharge is for a beneficial use such as a pond for irrigation or fish rearing or a flow of water for heating and cooling.

### **Existing flowing wells**

Trying to stop or reduce the flow from older flowing wells can be risky. Contractors and inspectors need to be aware of the risk for breakouts to occur if an attempt is made to control existing flow discharges. The flowing well control provisions in the well code apply to new well construction, not existing wells. Many older flowing wells have defective annular space seals or corroded casings. The poor well grouting practices of decades ago resulted in many older wells having unstable casing seals. Restricting the discharge at the wellhead can cause the artesian water to follow the path of least resistance, upward along the casing. Allowing the flow discharge from older wells to continue until the well is abandoned, may be the safest option.

### **Plugging flowing wells**

The plugging of an abandoned flowing well requires special practices. Flowing wells must be plugged with neat cement or concrete grout per the state well code. Special admixtures and materials can be accepted on a case-by-case basis, with approval of the local health department.

If the abandoned flowing well has a leaking annulus, the annulus should be sealed before proceeding with plugging the interior of the casing.

For additional information regarding flowing wells, refer to the Flowing Well Handbook on the DEQ well construction website at [www.michigan.gov/deqwaterwellconstruction](http://www.michigan.gov/deqwaterwellconstruction).

*For information or assistance on this publication, please contact the Office of Drinking Water and Municipal Assistance, through the DEQ's Environmental Assistance Center at 800-662-9278. This publication is available in alternative formats upon request.*

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