



Ground Water Resources and Low Yield Well Options

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Groundwater

- Water is the most important commodity for life.
- Approximately 42% of Ohioans rely on groundwater for their source of water.
- Knowing where groundwater can be obtained and how it can be managed is important for economic development.
- People are more likely to build if water is readily available.



Water Availability

- Many people, businesses, industry, etc. depend on local information to determine if water is available.
 - Well drillers
 - Local Health Districts
 - Soil and Water Districts
 - Ohio Department of Natural Resources
- Drilling a well can be expensive risk if you don't have the information up front.
- Local health districts should have general knowledge of the groundwater resource areas within you county. Good and Bad!



Yield

- Definition – to produce or provide
- With regards to private water system wells, we refer to the yield as sustainable yield.

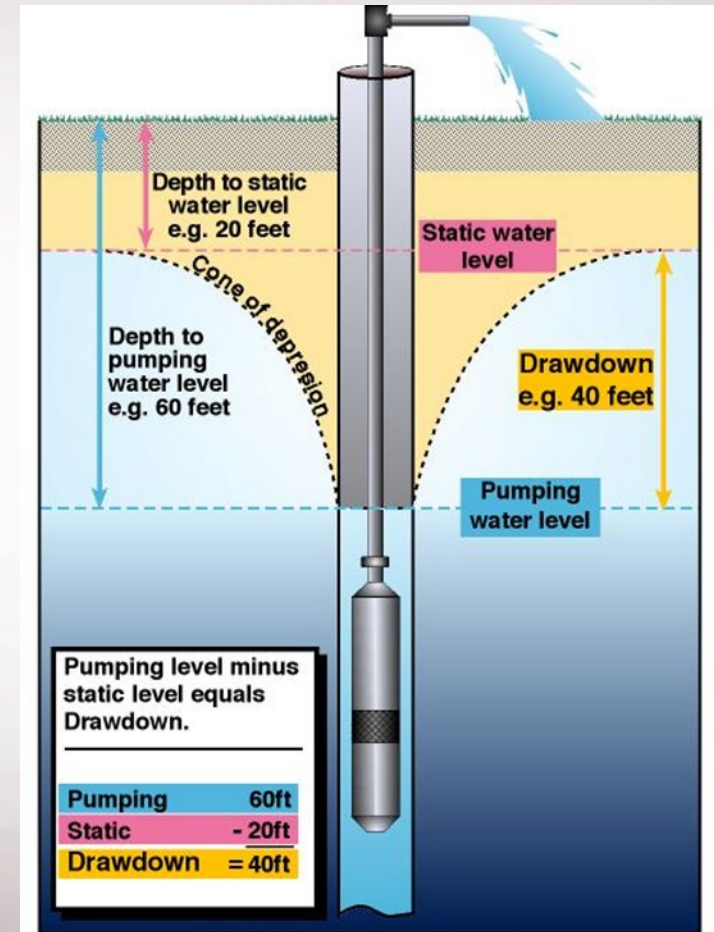


Sustainable Yield

- OAC 3701-28-11 (A)(3) - "Sustainable yield" means the volume of water that can be consistently discharged from a well over a period of time.
- The maximum rate in gallons per minute (GPM) that a well can be pumped without lowering the water level in the borehole below the pump intake.

How is the yield determined?

- OAC 3701-28-11(A)(2) – “Pump Test” means to withdraw water from a well at a constant or stepped rate while measuring the drawdown in the well at specific time intervals for a specific period of time.”
- Pump Test is the combination of the test rate, static water level, and drawdown information can give an indication of the yield available from the well.



Pump Test

After the well is completed, the drilling contractor will test the production ability of the well by bailing, pumping or blowing (air lift) the water out of the well for a specific amount of time, usually anywhere from 15 minutes to several hours.

WELL TEST *	
Pre-Pumping Static Level <u>50</u> ft.	Date <u>1/11/2019</u>
Measured from <u>TOP OF CASING</u>	
Pumping test method <u>AIR</u>	
Test Rate <u>20</u> gpm	Duration of Test <u>2</u> hrs.
Feet of Drawdown <u>0</u> ft.	Sustainable Yield <u>20</u> gpm
*(Attach a copy of the pumping test record, per section 1521.05, ORC)	
Is Copy Attached? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	Flowing Well? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No

Long-term or Sustainable Yield

People want to know if the groundwater resource will supply them with enough water for their needs.



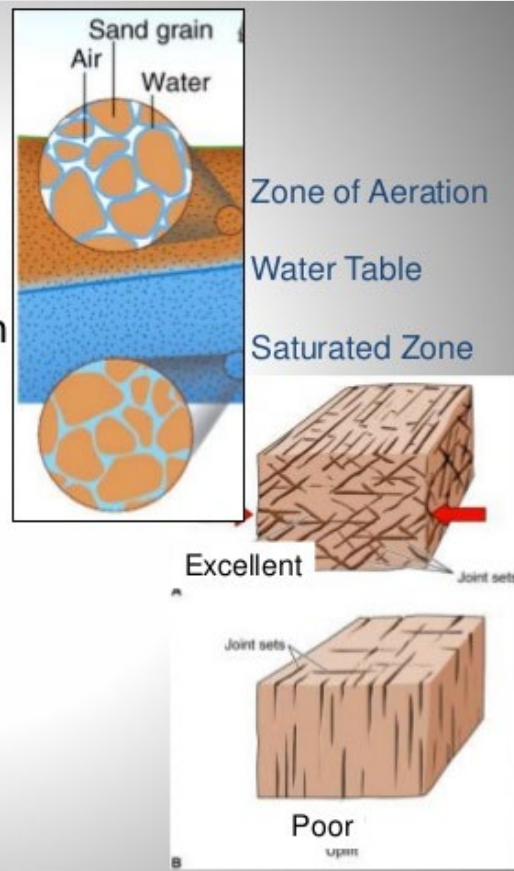
Low-Yield

- Definition – producing little; giving a low return
- Low-yielding wells are generally considered wells that may not be able to meet the peak water demand for the home, farm, business, etc.
- This does not necessarily mean the well is unacceptable.
- To obtain the necessary water, other options may be needed to supplement the needed water.
- Reasons for low yield
 - Permeability
 - Porosity

Permeability

Permeability

- **Permeability:** Ease with which water will flow through a porous material
 - **Sediment:** Proportional to sediment size
 - Gravel → Excellent
 - Sand → Good
 - Silt → Moderate
 - Clay → Poor
 - **Rock:** Proportional to fracture size and number. Can be good to excellent (even with low porosity)



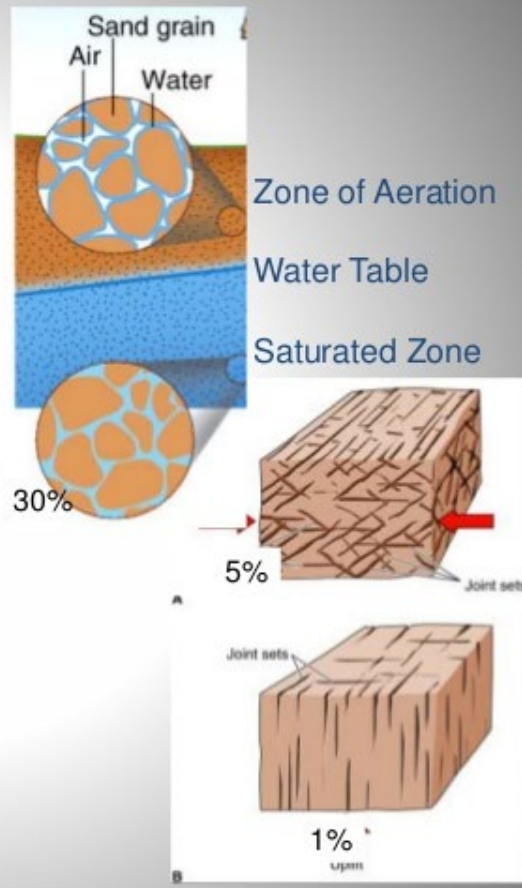
Low Permeability

- Aquifer that does not allow water to move freely to the well.
- There may be plenty of water but the water cannot travel quickly enough to replenish the water in the well.

Porosity

Porosity

- **Porosity:** Percent of volume that is void space.
 - **Sediment:** Determined by how tightly packed and how clean (silt and clay), (usually between 20 and 40%)
 - **Rock:** Determined by size and number of fractures (most often very low, <5%)



Low Porosity

- Not as much water in the aquifer to supply a well.
- Some bedrock formations may not have enough fracture volume to allow for water to be stored.

Well Test – Ex. of High Yield

WELL TEST *	
Pre-Pumping Static Level	5 ft. Date 2/4/2019
Measured from TOP OF CASING	
Pumping test method AIR	
Test Rate	80 gpm Duration of Test 1 hrs.
Feet of Drawdown	25 ft. Sustainable Yield 80 gpm
*(Attach a copy of the pumping test record, per section 1521.05, ORC)	
Is Copy Attached?	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
Flowing Well?	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No

Well Depth = 53 ft

Static water = 5 ft

Total water column = 48 ft

(Total depth – static water level)

Feet of drawdown over period of
test = 25 ft in 1 hour with 80 gpm
pump

[illegible]

Well Test – Ex. of Low Yield

WELL TEST *	
Pre-Pumping Static Level <u>50</u> ft.	Date <u>1/25/2019</u>
Measured from <u>TOP OF CASING</u>	
Pumping test method <u>AIR</u>	
Test Rate <u>2</u> gpm	Duration of Test <u>3</u> hrs.
Feet of Drawdown <u>150</u> ft.	Sustainable Yield <u>2</u> gpm
*(Attach a copy of the pumping test record, per section 1521.05, ORC)	
Is Copy Attached? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	Flowing Well? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No

Well Depth = 220 ft

Static water = 50 ft

Total water column = 170 ft

(Total depth – static water level)

Feet of drawdown over period of
test = 150 ft in 1 hour with 2 gpm
pump

[illegible]

Well Test – Ex. of Dry Hole

Comments on water quality/quantity and well construction:
 DRY HOLE

WELL TEST *

Pre-Pumping Static Level 100 ft. Date 1/10/2018

Measured from GROUND LEVEL

Pumping test method _____

Test Rate _____ gpm Duration of Test _____ hrs.

Feet of Drawdown _____ ft. Sustainable Yield _____ gpm

*(Attach a copy of the pumping test record, per section 1521.05, ORC)

Is Copy Attached? ☐ Yes ☒ No Flowing Well? ☐ Yes ☒ No

Static water = 100 ft

Total depth = 100 ft

[illegible]

Ohio Dept. of Natural Resources

<http://water.ohiodnr.gov/>

(614) 265-6620

Division of Geological
Survey

The screenshot shows the website for the Ohio Department of Natural Resources, Division of Water Resources. The header features the ODNR logo, the text "ODNR Division of WATER RESOURCES", a search bar, and social media icons for Facebook, Twitter, and YouTube. A navigation menu includes links for OHIO DNR, I WANT TO..., RECREATION, REGULATION, LANDOWNERS, PROGRAMS, MEDIA & NEWS, and CONTACT. The main content area has a large image of a person using a pump to extract water from a well, with the text "Groundwater Mapping and Technical Services" overlaid. To the right of this image are three buttons: "Search Water Well Logs" with a gear icon, "Dam Safety" with a dam icon, and "Floodplain Management" with a water drop icon. On the left side, there is a sidebar menu with links: "Water Resources Home", "Search File Well Logs", "Water Use & Planning", "Safety", "Maps", "Publications", "Contacts/About Us", and "General Inquiries". Below the "General Inquiries" link, it states "General inquiries can be directed to (614) 265-6620" and provides a "Make a Request" link. The main content area also features a section titled "Protect Your Groundwater Day" with a date of 8/15/2017, a "Water Resources" label, and a "read more..." button. Below this, there are two logos: "September 5, 2017 protect your groundwater day" and "CAP IT PLUG IT". At the bottom right of the section, it says "Tuesday, September 5, 2017 is Protect Your Groundwater Day" and "Next >>".

ODNR Division of
WATER RESOURCES

OHIO DNR I WANT TO... RECREATION REGULATION LANDOWNERS PROGRAMS MEDIA & NEWS CONTACT

Groundwater Mapping and
Technical Services

Search Water Well Logs

Dam Safety

Floodplain Management

Water Resources Home >

Search File Well Logs

Water Use & Planning ▼

Safety ▼

Maps ▼

Publications

Contacts/About Us ▼

General Inquiries

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[Make a Request](#)

Protect Your Groundwater Day

8/15/2017 Water Resources

September 5, 2017 protect your groundwater day

CAP IT PLUG IT

Tuesday, September 5, 2017 is Protect Your Groundwater Day

[read more..](#)

Next >>

Map Information Available

- Floodplain mapping for watersheds
- Interactive maps for Oil & Gas Wells, Mines, Water Boater Access & Amenities
- Groundwater Resources Maps
- Hydrologic Atlas – Precipitation, Temperature, Streamflow, Water Loss, Evaporation
- Ohio Interactive Dam Locator & Ohio Low-head Dams
- Pollution Potential Maps
- Potentiometric Surface Maps
- Statewide Aquifer Maps
- Water Withdrawal Atlas
- Watershed & Drainage Basin Maps

Ground Water Resource Maps

In the early 1970's, ODNR's Division of Water (now Division of Geological Survey) developed a program to map the ground water availability in the State of Ohio. They began producing a series of maps to describe the ground water resources on a county by county basis.

The maps are developed using information recorded on well logs submitted to ODNR.

The maps are intended to aid homeowners, industries, municipalities, and regional water systems in developing reliable ground water supplies.

Groundwater Resources Map

Ohio Department of
Natural Resources
Division of Geological
Survey

[http://water.ohiodnr.gov
/maps/groundwater-
resources-maps](http://water.ohiodnr.gov/maps/groundwater-resources-maps)



Groundwater Resources Map

Downloadable Ground Water
Resource Maps for each
county in Ohio

Includes a tab for how to read
& use the maps.

+ Production Status of Groundwater Resources Maps		
- Downloadable Ground Water Resources Maps		
Adams [pdf 6Mb]	Guernsey [pdf 7.1Mb]	Noble [pdf 5.5Mb]
Allen [pdf 4.6Mb]	Hamilton [pdf 4.5Mb]	Ottawa [pdf 3.6Mb]
Ashland [pdf 5.7Mb]	Hancock [pdf 6.6Mb]	Paulding [pdf 3.4Mb]
Ashtabula [pdf 9Mb]	Hardin [pdf 4.5Mb]	Perry [pdf 5.3Mb]
Athens/Meigs [pdf 3.7Mb]	Harrison [pdf 4.3Mb]	Pickaway [pdf 6.9Mb]
Auglaize [pdf 4.6Mb]	Henry [pdf 10.2Mb]	Pike [pdf 6.5Mb]
Belmont [pdf 7.9Mb]	Highland [pdf 6.3Mb]	Portage [pdf 7.7Mb]
Brown [pdf 5.3Mb]	Hocking [pdf 6.5Mb]	Preble [pdf 4.8Mb]
Butler [pdf 8.2Mb]	Holmes [pdf 4.3Mb]	Putnam [pdf 5.0Mb]
Carroll [pdf 4.8Mb]	Huron [pdf 4.7Mb]	Richland [pdf 5.6Mb]
Champaign [pdf 4.6Mb]	Jackson/Vinton [pdf 3.1Mb]	Ross [pdf 13.3Mb]
Clark [pdf 6.8Mb]	Jefferson [pdf 6.2Mb]	Sandusky [pdf 4.3Mb]
Clermont [pdf 7.9Mb]	Knox [pdf 6.2Mb]	Scioto [pdf 8.9Mb]
Clinton [pdf 6.8Mb]	Lake [pdf 5.1Mb]	Seneca [pdf 4.5Mb]
Columbiana [pdf 7.2Mb]	Lawrence/Gallia [pdf 2.9Mb]	Shelby [pdf 3.7Mb]
Coshocton [pdf 6.3Mb]	Licking [pdf 5.4Mb]	Stark [pdf 12.6Mb]
Crawford [pdf 5.1Mb]	Logan [pdf 8.3Mb]	Summit [pdf 9.0Mb]
Cuyahoga [pdf 7.9Mb]	Lorain [pdf 7.8Mb]	Trumbull [pdf 7.7Mb]
Darke [pdf 7.1Mb]	Lucas [pdf 3.8Mb]	Tuscarawas [pdf 6.1Mb]
Defiance [pdf 8.2Mb]	Madison [pdf 5.1Mb]	Union [pdf 4.2Mb]
Delaware [pdf 7.9Mb]	Mahoning [pdf 6.3Mb]	Van Wert [pdf 3.1Mb]
Erie [pdf 4.0Mb]	Marion [pdf 5.1Mb]	Vinton/Jackson [pdf 3.1Mb]
Fairfield [pdf 6.7Mb]	Medina [pdf 7.4Mb]	Warren [pdf 5.7Mb]
Fayette [pdf 4.6Mb]	Meigs/Athens [pdf 3.7Mb]	Washington/Morgan [pdf 5.1Mb]
Franklin [pdf 12.8Mb]	Mercer [pdf 6.7Mb]	Wayne [pdf 11.8Mb]
Fulton [pdf 8.6Mb]	Miami [pdf 5.9Mb]	Williams [pdf 9.0Mb]
Gallia/Lawrence [pdf 2.9Mb]	Monroe [pdf 5.7Mb]	Wood [pdf 4.4Mb]
Geauga [pdf 8.4Mb]	Montgomery [pdf 6.8Mb]	Wyandot [pdf 4.6Mb]
Greene [pdf 5.3Mb]	Morgan/Washington [pdf 5.1Mb]	
	Morrow [pdf 8.4Mb]	
	Muskingum [pdf 7.8Mb]	

Ground-Water Resources of MONTGOMERY COUNTY

by James J. Schmidt



Well Yields

AREAS IN WHICH YIELDS OF MORE THAN 100 TO 1,000 OR MORE GALLONS PER MINUTE MAY BE DEVELOPED
 Permeable sand and gravel deposits beneath the floodplain of the Monticelli River. Properly constructed large diameter drilled wells yield in excess of 1,000 gallons per minute at depths ranging from 50 feet to as much as 100 feet.

AREAS IN WHICH YIELDS OF 100 TO 400 GALLONS PER MINUTE MAY BE DEVELOPED
 Regionally extensive, thick permeable deposits of sand and gravel may yield as much as 400 gallons per minute. Extensive bedrock is thought to contribute to the permeability of the deposits at depths ranging from 100 feet to as much as 150 feet.

AREAS IN WHICH YIELDS OF AS MUCH AS 75 GALLONS PER MINUTE MAY BE DEVELOPED
 Frequent, moderate to large glacial drift of variable thickness. Wells range from 40 to 110 feet deep, although average well is less than 80 feet deep.
 Water-bearing deposits of sand and gravel interbedded with thick layers of clayey silt. General deposits may be more than 200 feet thick but permeable deposits are usually developed at average depths of 60 feet.

AREAS IN WHICH YIELDS OF 5 TO 25 GALLONS PER MINUTE MAY BE DEVELOPED
 Locally extensive, thin permeable deposits of sand and gravel as much as 15 gallons per minute at depths of less than 60 feet. Drilling is thought to be non-water bearing. Occasional clay lenses are not uncommon.
 General water-saturated fine sand, silt, and gravel deposits interbedded with relatively thick layers of clayey silt. Wells are usually developed at depths of less than 100 feet and deeper drilling into the underlying bedrock may be recommended.
 Sand and gravel consisting of clay with sand and gravel layers. Depth to rock may range from 100 to 200 feet. Wells encountering coarse sands and gravels may obtain yields of 10 to 15 gallons per minute from properly developed artesian wells. These bedrock is a poor water source.

AREAS IN WHICH YIELDS OF 2 TO 10 GALLONS PER MINUTE MAY BE DEVELOPED
 Average yields for wells developed in these glacial sandstone bedrock range from 2 to 10 gallons per minute. Drilling deeper than 100 feet is not advised, owing to the presence of the non-water-bearing Ordovician shaly limestone bedrock. Casing and/or storage may be necessary for peak periods of water demand.
 Relatively thick, unconsolidated gravel deposits of fine sand and clayey silt. The layers of water-bearing sand and gravel may be encountered at depths ranging from 20 to more than 100 feet. Casing drilling is advised to attempt the development of adequate water supplies.

AREAS IN WHICH YIELDS OF LESS THAN 2 GALLONS PER MINUTE MAY BE DEVELOPED
 Over 100 feet of less than 40 feet thick overlying with water-bearing Ordovician shaly limestone bedrock. Very large quantities are available and cased and/or additional storage necessary to maintain daily water requirements.

Notes

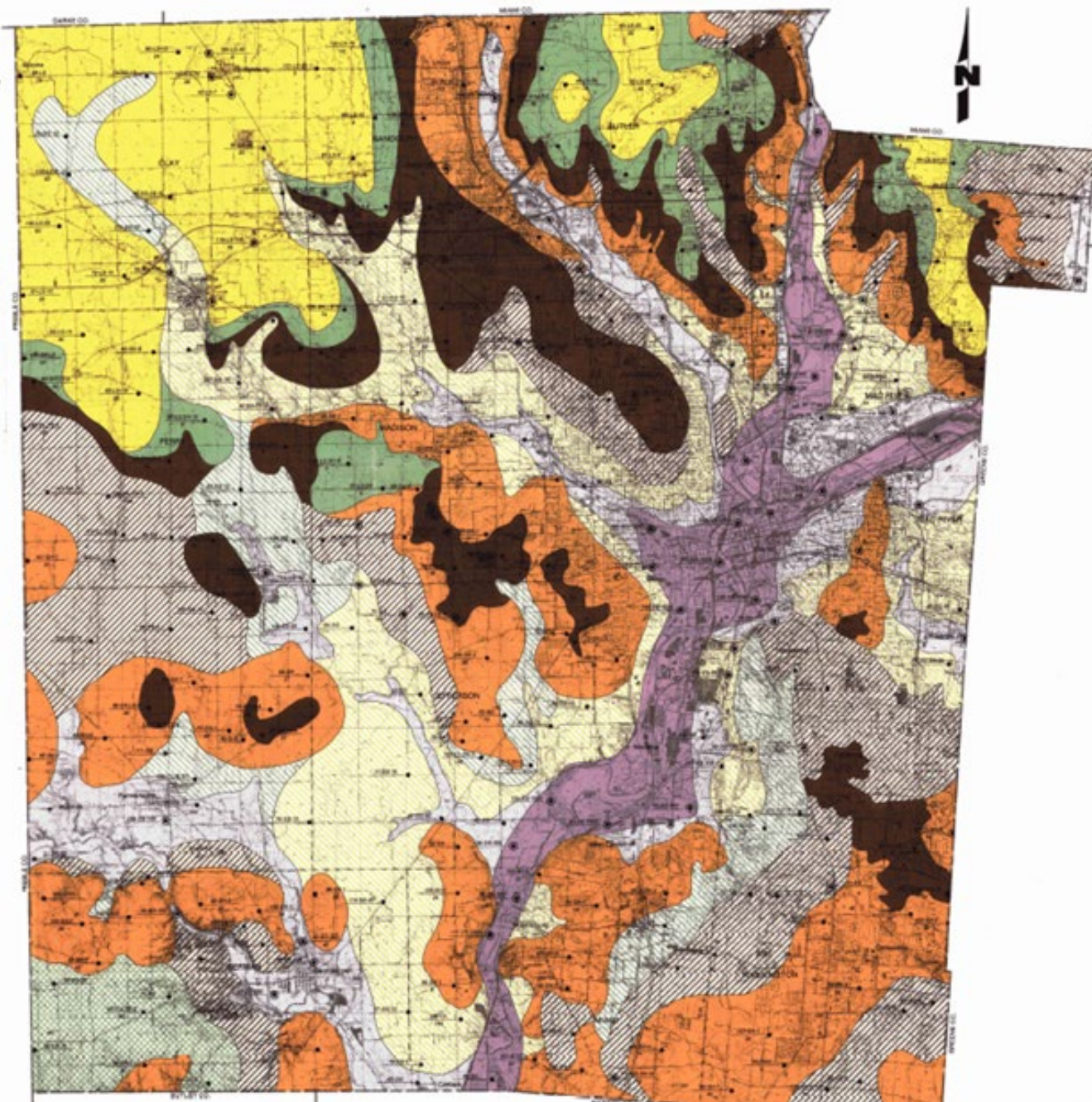
The ground-water characteristics have been mapped regionally, based upon interpretations of water well records and the geologic geology and hydrology. Well characteristics were selected as typical for the area of each interpretation regarding specific values rather than absolute values of water.

Well Site Symbols



PS - Fine Sand
 S - Sand
 G - Gravel
 SG - Sand & Gravel
 CL - Clay
 SL - Silt
 L - Limestone

● Well Site
 ○ Municipal Well



Well Yield Legend

Well Yields

AREAS IN WHICH YIELDS OF MORE THAN 500 TO 1,000, OR MORE, GALLONS PER MINUTE MAY BE DEVELOPED.

Permeable sand and gravel deposits beneath the floodplain of the Mad and Miami Rivers. Properly constructed large diameter drilled wells yield in excess of 1,000 gallons per minute at depths ranging from 85 feet to as much as 185 feet.

AREAS IN WHICH YIELDS OF 100 TO 500 GALLONS PER MINUTE MAY BE DEVELOPED.

Regionally extensive, thick permeable deposits of sand and gravel may yield as much as 500 gallons per minute. Extensive test drilling is recommended to locate coarse deposits at average depths of 75 feet but ranging from 30 to as much as 150 feet.

AREAS IN WHICH YIELDS OF AS MUCH AS 75 GALLONS PER MINUTE MAY BE DEVELOPED.

Niagara limestone aquifer range from 40 to 116 feet deep, although average well is less than 60 feet deep.

Water-bearing deposits of sand and sand and gravel interbedded with thick layers of clayey till. Glacial deposits may be more than 250 feet thick but permeable deposits are usually developed at average depths of 65 feet.

AREAS IN WHICH YIELDS OF 5 TO 20 GALLONS PER MINUTE MAY BE DEVELOPED.

Relatively shallow basal Niagara limestone aquifer yields as much as 15 gallons per minute at depths of less than 90 feet. Deeper drilling to non-water-bearing Ordovician shaly limestone is not recommended.

Ground water obtained from thin, not extensive, sand and gravel deposits interbedded with relatively thick layers of clayey till. Wells are usually developed at depths of less than 135 feet and deeper drilling into the underlying bedrock may be non-productive.

End moraine consisting of clay with sand and gravel layers. Depth to rock may range from 160 to 230 feet. Wells encountering coarse sands and gravels may obtain yields of 10 to 15 gallons per minute from properly developed screened wells. Shale bedrock is a poor water source.

AREAS IN WHICH YIELDS OF 3 TO 10 GALLONS PER MINUTE MAY BE DEVELOPED.

Average yields for wells developed in basal Silurian limestone bedrock ranges from 4 to 6 gallons per minute. Drilling deeper than 80 feet is not advisable owing to the presence of the non-water-bearing Ordovician shaly limestone bedrock. Cisterns and/or storage may be necessary for peak periods of water demand.

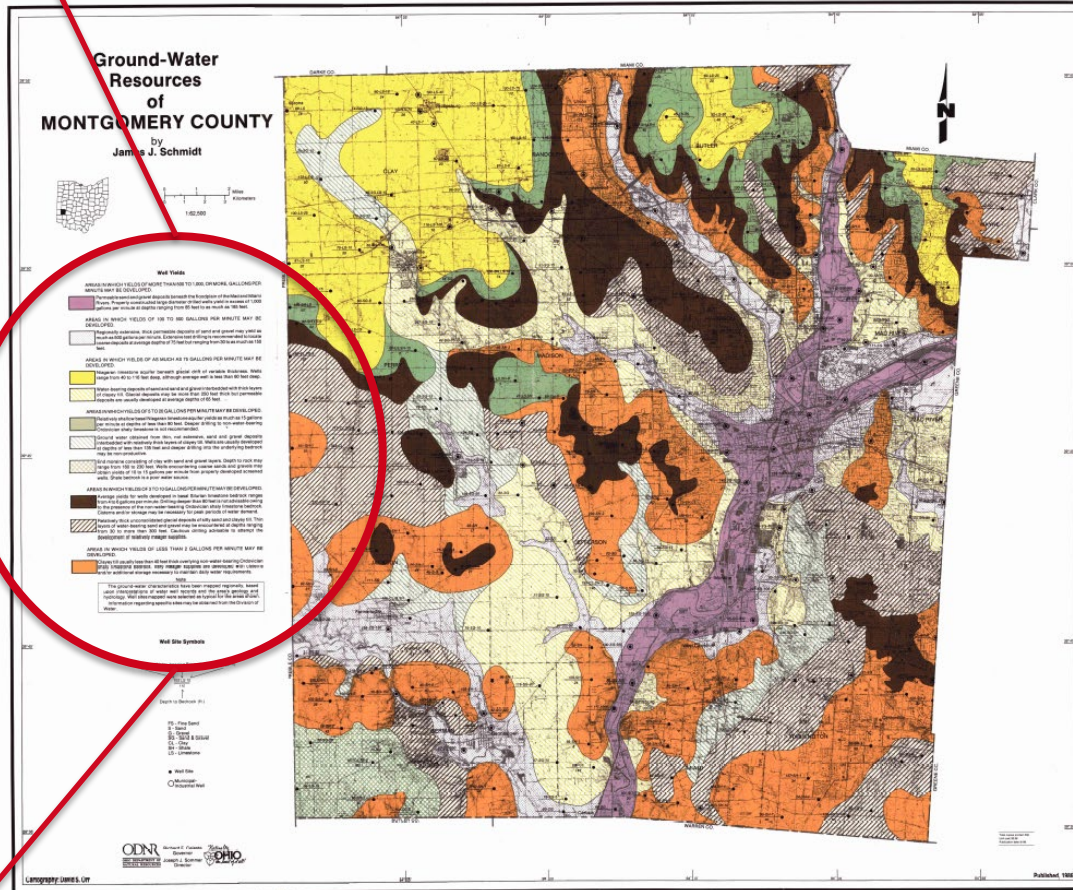
Relatively thick unconsolidated glacial deposits of silty sand and clayey till. Thin layers of water-bearing sand and gravel may be encountered at depths ranging from 30 to more than 300 feet. Cautious drilling advisable to attempt the development of relatively meager supplies.

AREAS IN WHICH YIELDS OF LESS THAN 2 GALLONS PER MINUTE MAY BE DEVELOPED.

Clayey till usually less than 40 feet thick overlying non-water-bearing Ordovician shaly limestone bedrock. Very meager supplies are developed with cisterns and/or additional storage necessary to maintain daily water requirements.

Ground-Water Resources of MONTGOMERY COUNTY

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Low Yield Wells Options

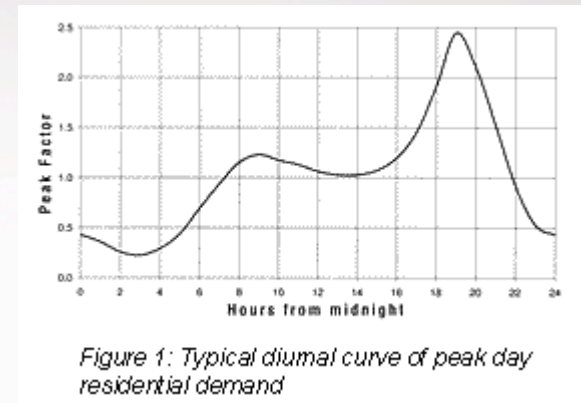
What options are available?

1. Reducing the Peak Water Use
 - Changing the timing of water use activities
 - Reduce the amount of water used by changing the water use behaviors
2. Increasing Water Storage

Peak Demand

What is peak demand?

Periods of largest instance of water usage in the household, business or industry.



For most households the peak demand is during the early morning and/or evening and will last from 30 minutes to about 2 hours.

This information should be considered and determined prior to drilling the well.

Peak Demand

- To understand how to deal with low-yielding wells, there must be an understanding of the peak demand.
 - A well that yields 1 GPM of water can still produce 1,440 gallons of water in a day.
- On average, 1 person will use 80-100 gallons per day.
- Usage is not even in a household throughout the day.
- For most households the peak demand is during the early morning and/or evening and will last from 30 minutes to about 2 hours.
- This information should be determined prior to drilling the well.

Reducing the Peak Water Use

1. Changing the timing of water use activities
 - May be inconvenient but there is no added cost
 - Ex. – Spread the laundry loads throughout the week instead of doing it all in one day
 - Ex – Spread showers between morning and night so there not all at one time

Reducing the Peak Water Use

2. Reduce the amount of water used by changing the water use behaviors, such as:
 - Taking shorter showers
 - Not washing the vehicle
 - A more permanent and costly water-conservation solution is to install water-saving devices, such as:
 - Front loading washers
 - Low-flush toilets
 - Low-flow faucets and showerheads
 - Water efficient dishwashers
 - These changes can reduce household water usage up to 30%

Water use during peak demand

Typical water use at home is from the

- Bath - 36 gallons/use
- Showers - ~2-5 gallons/min (older showerheads 5 gal/min; newer - ~2 gallons/min)
- Water saving showerheads - ~2 gallons/min
- Brushing teeth - <1 gallon to over 2 gallons
- Hands/face washing – 1 gallon
- Shaving – 1 gallon
- Dishwasher – 6-16 gallons (EnergyStar – 6; older models – 16)
- Hand dishwashing - 8-27 gallons (older faucets – 1.5-2 gal/min)
- Clothes washer – 25 gallons/load for newer washers (older – 40 gal/load)
- Toilet flushing – 3 gallons (low flush – 1.6 gal/flush; older – 4 gal/flush)
- Glasses to drink – 8 oz per glass
- Outdoor watering – 2 gal/min depending on force of outside faucet.

Comparison of fixtures

- Clothes washer
 - Top-loading – 51 gal/load
 - Front-loading – 27 gal/load
 - Water savings – 24 gal/load
- Toilet
 - Standard – 5 gal/flush
 - Low-flush – 1.6 gal/flush
 - Water Savings – 3.4 gal/flush

Comparison of fixtures

- Faucets/Showerheads
 - Standard – 3 gal/min
 - Low-flow – 0.5 to 2.5 gal/min
 - Water savings – 0.5 to 2.5 gal/min
- Dishwasher
 - Standard – 14 gal/load
 - Low-flush – 4.5 gal/load
 - Water Savings – 7 to 9.5 gal/load

Test Wells (Test Hole)

OAC 3701-28-01(HHHH)

"Test well or test hole" means any excavation, regardless of design or method of construction, done for the purpose of determining the most suitable site for removing ground water from an aquifer for use in a private water system and is regarded as new well construction."

Permitting

OAC 3701-28-03(A)

*“No person shall construct, alter or seal a private water system, **test well** or part thereof, unless a valid permit for the system has been issued by the board of health pursuant to this rule.”*

OAC 3701-28-03(B)

“Each application to construct a private water system shall contain information about the location, design, construction, installation and development of the private water system or installation of test holes....”

Fees for permits

- Fees must be established through the Board of Health for the Fee Category for Test Wells.
- OAC 3701-28-06(E) “Fees established by a board of health of a city or general health district pursuant to section 3709.09 of the Revised Code for private water systems shall be specified in accordance with the following categories:...
- (2) The construction of a test well for any private water system.”

Construction of wells and test wells

OAC 3701-28-03(I)

- *“If a permit has been issued for the construction of a well to be used for a new private water system, and the first attempt to drill the well is unsuccessful, then additional wells may be drilled within the area designated on the permit or the drilling site without obtaining additional permits, provided the original permit has not expired....”*

Construction of wells and test wells

OAC 3701-28-03(I)

- *“...All dry holes and test holes not converted to private water systems, or boreholes left without casing, grout and caps and not completed within thirty days, shall be sealed according to rule 3701-28-17 of the Administrative Code and a well sealing report or well log as required under section 1521.05 of the Revised Code shall be filed for each dry hole with the Ohio department of natural resources, division of soil and water resources, the board of health, a copy provided to the private water system owner, and a copy retained by the registered contractor who performed the sealing.”*

Making A Decision

This is a decision that must be made at the time of construction. No additional permit is needed to seal the well as long as the permit to construct a test well is still valid.

Keeping it

If the well is to be kept, it must at a minimum contain

- Casing
- Grouted annular space, and
- Cap
 - End caps may be used to secure the well until they begin the alteration process to complete the system.

Therefore, it must meet the construction standards for drilling a well as required in OAC 3701-28-10 and OAC 3701-28-09.



Completing the system

When it is time to complete the system, a permit for an alteration must be obtained to finish the well as the source for a private water system.

OAC 3701-28-01(A)(6)

““Alter or alteration” means to make a change in the type of construction or configuration of a private water system, including without limitation, ...

Conversion of a permitted test well to a private water system.”

Quick Compare



Test well – cased, grouted, and capped



Completed well

Low Yield Wells Options

What options are available?

1. Reducing the Peak Water Use

- Changing the timing of water use activities
- Reduce the amount of water used by changing the water use behaviors

2. Increasing Water Storage

- Pressure tank storage
- Storage reservoir
- Hauled Water Storage Tank
- Pump Capacity
- Borehole storage
- Adding a 2nd water supply

Increasing Water Storage

- Borehole storage
- Pressure tank storage
- Storage reservoir tanks
- Pump Capacity
- Hauled Water Storage Tank
- Adding an 2nd water supply

Increasing the Borehole Storage

- For existing wells, an Alteration Permit must be obtained, but is limited to only deepening the well.
 - The private water systems contractor will set the drilling rig over the well to drill the borehole deeper.
- For new construction, a well can either be drilled deeper, wider, or both for additional storage. The groundwater resource yield is reasonably known based on information supplied by the maps, well logs, or the contractors experience in the area.
 - To satisfy the customer, the contractor must be able to figure the depth they need to the appropriate storage to meet the peak demand with the peak time.

Storage Capacity of Borehole



Well Diameter (in inches)	Storage capacity (in gallons) per foot of water
4	0.653
5	1.02
6	1.47
8	2.61
10	4.08
12	5.87

Deeper vs. Wider


- Drilling the borehole deeper could be a beneficial method of storage if the additional drilling does not encounter ground water of a poorer quality.
 - Risk of drilling into undesirable aquifers, such as oil, gas, saline water, and sulfur.
- Over drilling a well deeper into a relatively non-water bearing formation.
- Drilling a larger borehole to a shallower depth is recommended

Example

- Peak Demand

- Each person uses approximately 100 gallons of water per day.
- There are 2 peak periods  each person would use 50 gal/period.
- 5 people in the house  250 gal/period or 500 gal/day.
- 2 bath house

- Peak Time

- Is the time frame in which amount of water that has to be available.
- This is equal to the peak demand divided by the number of bathrooms x 3 gpm (3 gpm is used because it is the average flow rate through a standard faucet).
- 250 gal/period divided by 6  Peak time = ~ 42 minutes

Determining the Safe Yield

The well was figure to have a yield of 2 gpm.

What would make this a safe yield based on the peak demand and time.

Peak demand is 250 gallons

Peak time is 42 minutes

$$250 \text{ gal} - (42 \text{ min} \times 2 \text{ gpm}) = 166 \text{ gallons}$$

166 gallons would be needed above the pump to make this a safe yield and to meet the peak demand.

This information would allow the contractor to determine the depth to drill deeper or wider and so the pump can be set at the proper location.

Pressure Tank Storage

- Allows a water system to operate automatically.
- A pressure tank is essentially a storage tank.
- The purpose to create and maintain pressure on the water in the pipeline.
- Install larger pressure tank for more storage. This will allow the pump to provide water at a much lower rate when no one is using water.
 - 42 gal tank will discharge 8 gal before the pump kicks on.
 - 82 gal tank -- 16 gal
 - 120 gal tank – 24 gal

How does a pressure tank work?

The Private Well Class webinar video that shows how a pressure tank works. It is a little over 4 minutes long.

<http://privatewellclass.org/videos/postid/1192/how-does-my-private-well-pressure-tank-work>

Intermediate Storage

- Storage reservoir added to receive water from the well to meet the peak demand.
- To determine the size of storage tanks needed for a job, multiply the number of people living in the house by 100 gallons. This value will be the number of gallons needed per day for household use.
- Size the pump to the safe capacity of the well. The well pump should have a rated pumping capacity slightly less than the yield of the well but also at a safe capacity.
 - Ex – if the yield is 2gpm, then the pump should be ≥ 2 gpm

Intermediate Storage

- Low level cut-off switches may be used to avoid overheating the well pump.
 - Extreme fluctuations of the water level in the well will cause oxidation of minerals on the borehole wall, which will decrease the well yield considerably over time.
- A float switch in the storage tank should operate the well pump. It is important to make sure that the well pump runs for at least two minutes each time it is started to prevent excessive wear on the motor.

Reservoir Requirements

- *OAC 3701-28-07(C)(3) – “Plastic or fiberglass tanks for disinfection retention, supplemental water storage, and low yield well reservoir tanks less than one thousand gallons may be placed in the basement of a home.”*
- *OAC 3701-28-08(O) - “Water storage tanks and reservoirs shall meet the criteria of paragraphs (A) and (B) of rule 3701-28-12 of the Administrative Code and also comply with all other applicable provisions of rule 3701-28-12 of the Administrative Code. For the purpose of this rule a storage tank does not include a pressure tank.”*
 - ASTM C913 specifications – concrete tanks
 - NSF standard 61 – plastic and fiberglass tanks
- *OAC 3701-28-08(P) – “Wells discharging to a non-pressurized reservoir tank must be protected by a dual check valve prior to entering a reservoir tank.”*

Supplemental Cistern/HWST

- **OAC 3701-28-08(P)** - Non-pressurized tank, so must have a backflow prevention device between the well and hauled water storage tank.
- **OAC 3701-28-07(C)(1)** – Cannot be located within the foundation of a building unless the building is specifically designed and constructed to solely house the pumping and water system equipment.
- **OAC 3701-28-08(F)(8)** - Sample tap required but may be after the backflow device.

Supplemental Cisterns/HWST

- OAC 3701-28-12 (C)
 - They must be sized to meet the needs of the household.
 - Cisterns must be no less than 1250 gallons.
 - Hauled Water Storage Tanks may be less than 1000 per dwelling only if used as supplement water tank for a well.
- Both must still meet all requirements of OAC section 3701-28-12.

Tank pump sizing

- Properly size the pump that withdraws water from the storage tank.
- A float switch in the storage tank should operate the well pump.

Table 1. Recommended flow rates for home water system.

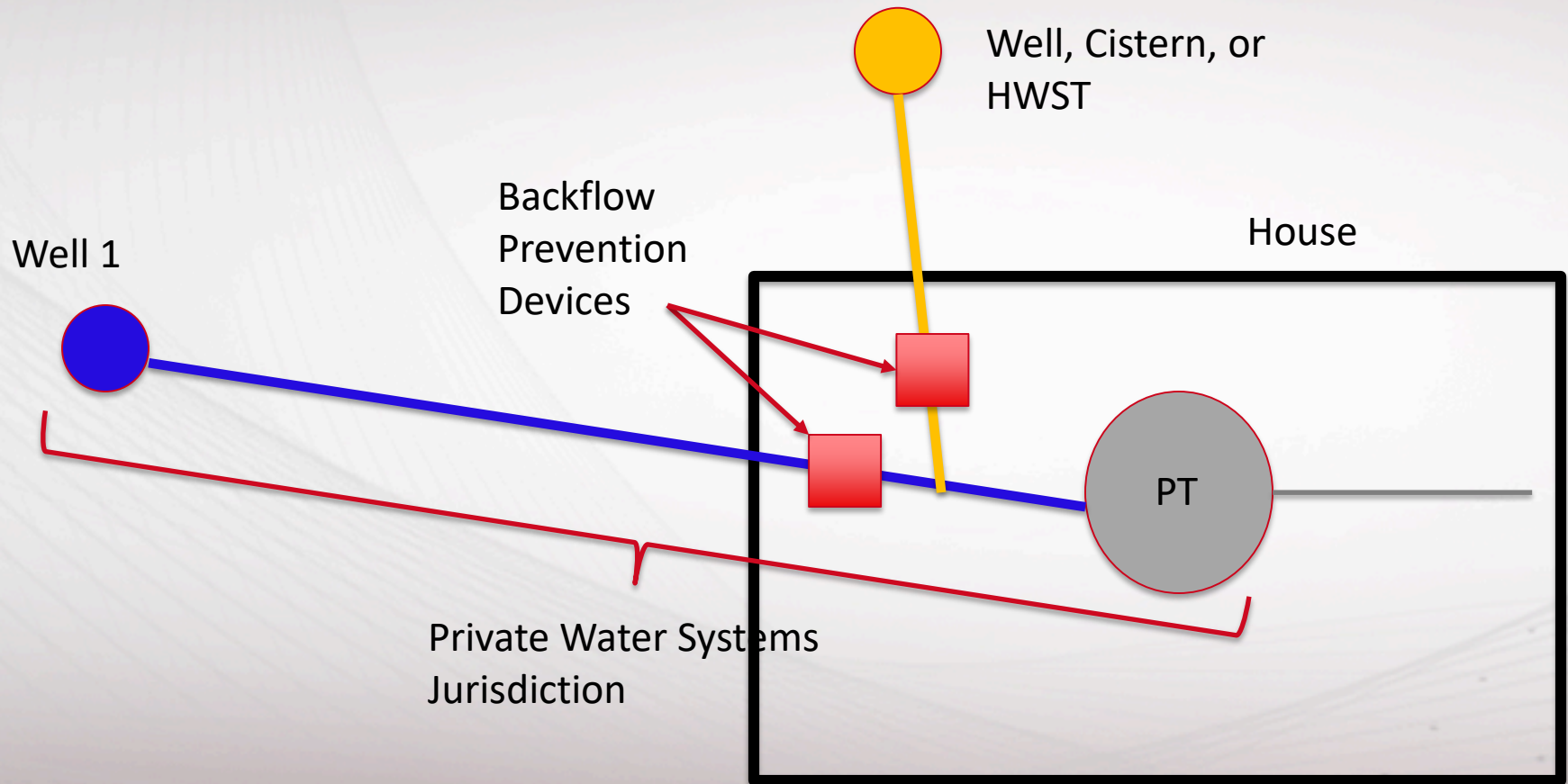
No of Bedrooms	Number of bathrooms in home			
	1	1.5	2	3
2	6	8	10	12
3	8	10	12	14
4	10	12	14	16
5	12	13	15	17
6	13	15	16	18
Flow rate in gallons per minute				

(Modified from Private Water Systems Handbook)

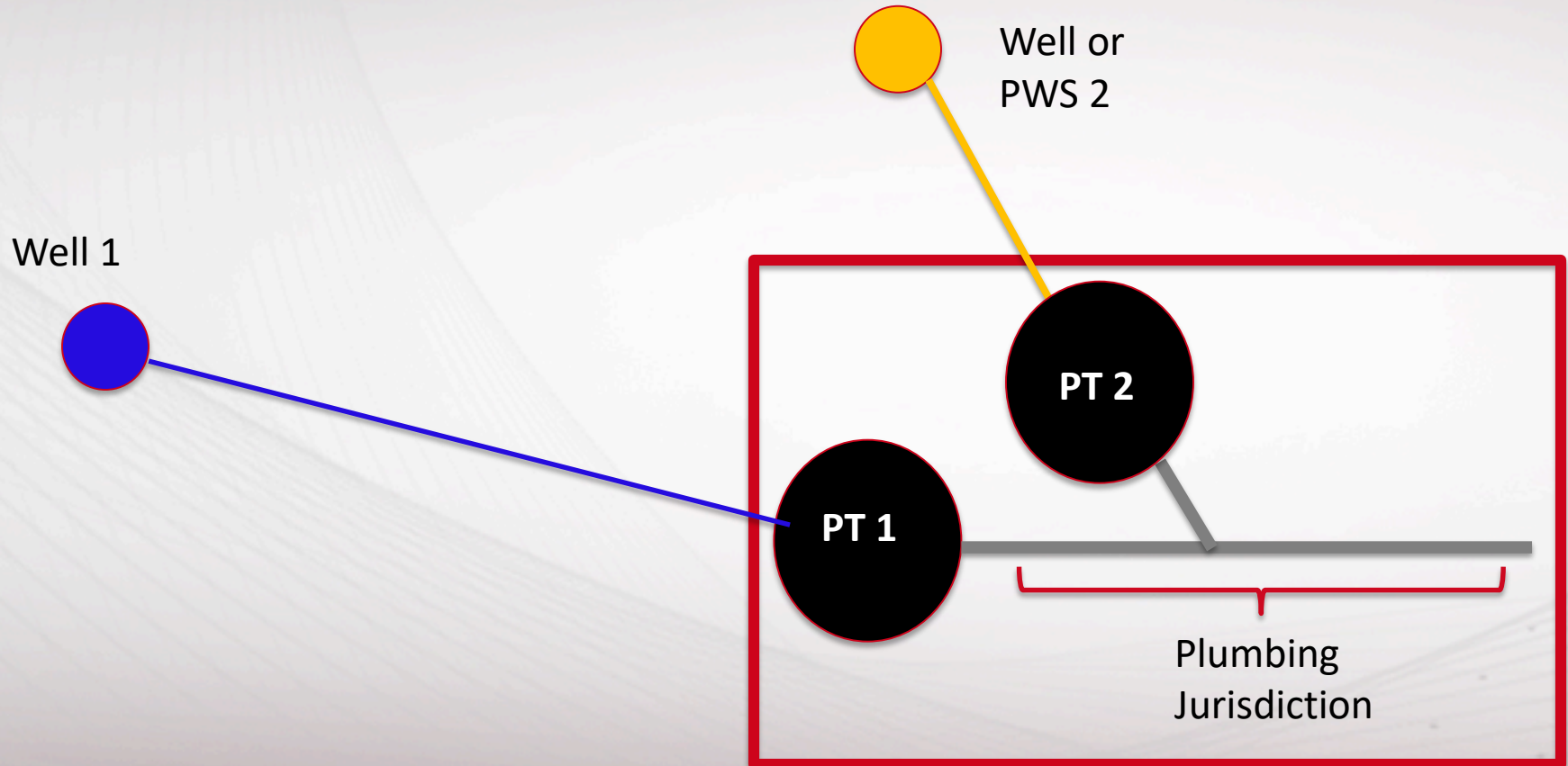
Dual Systems

- If a second system is installed separate from the well but are connected to the same pressure tank. Both systems will need to have backflow protection prior to the connection of the lines coming from those sources.
- OAC 3701-28-08(H)(2) *“The private water system shall have an approved backflow prevention device installed in line prior to any connections from other water sources to prevent the backflow of one water source into another and a sampling port place prior to the backflow prevention device; and”*

Dual Systems



Separate Systems



Not Keeping The Well

The borehole, dry hole, test well must be sealed in compliance with OAC Chapter 3701-28.

OAC 3701-28-17(A)

“Upon completion of testing, a test hole shall either be permanently sealed or converted into a well with the minimum installation of well casing, grout, and cap, and the construction shall comply with all applicable requirements of this chapter.”

OAC 3701-28-17(C)

“All dry holes that are not being used as a private water system shall be sealed in accordance with the provisions of this rule or may be converted to a geothermal system and meet the requirements of paragraph (A) of this rule. “

Dry holes

OAC 3701-28-01

““Dry hole” means an open borehole or cased borehole that does not produce water in sufficient quantity and that can not be modified with a low yield pump and storage reservoir, or combined with another water source to produce water for the intended use.”

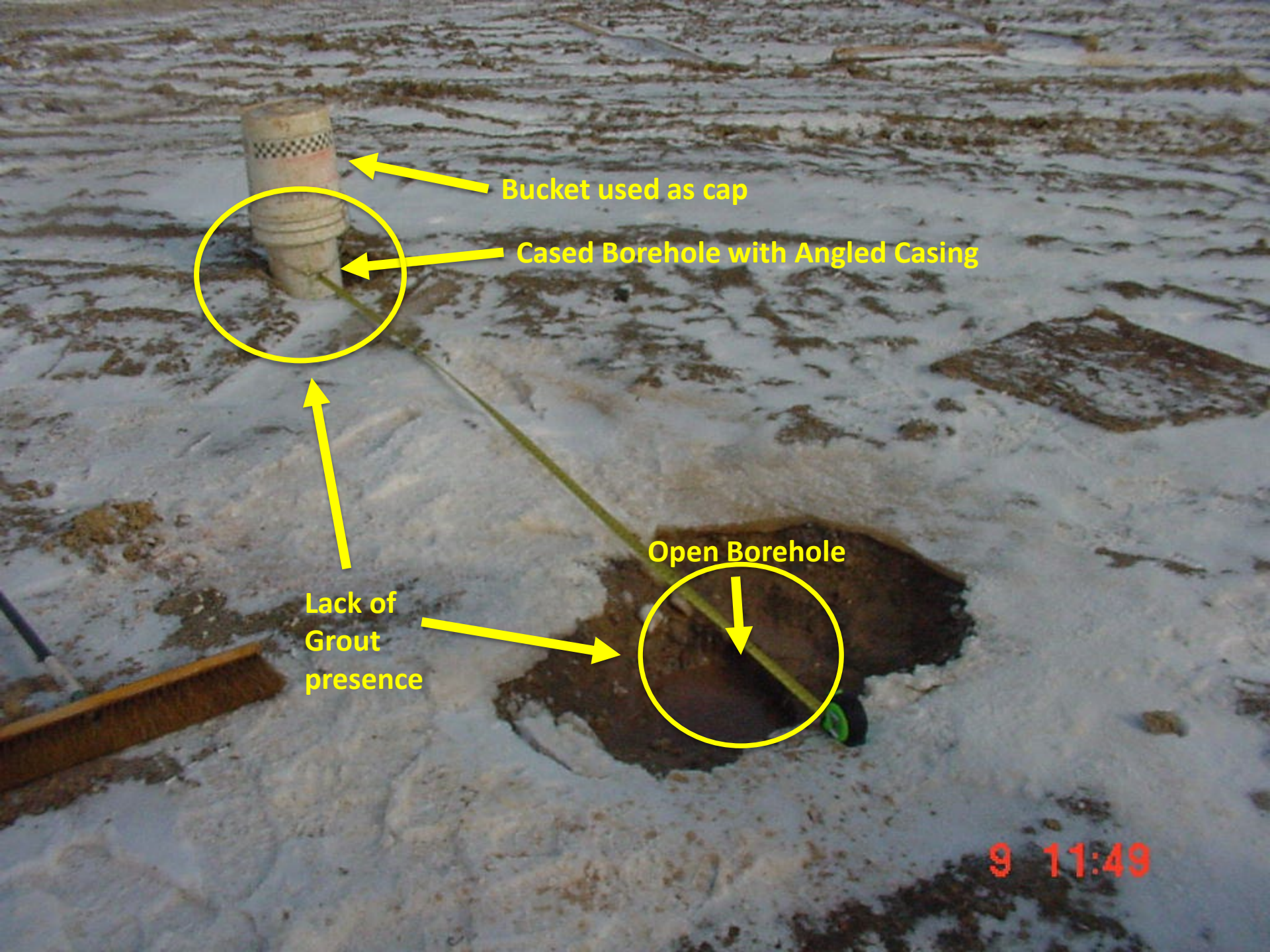
Dry holes

OAC 3701-28-17(C)

“All dry holes that are not being used as a private water system shall be sealed in accordance with the provisions of this rule or may be converted to a geothermal system and meet the requirements of paragraph (A) of this rule.”

Submit well log / sealing report

- A well log or sealing report must be submitted within 30 days of the completion date of the test hole (test well) as required in ORC section 1521.05 and OAC 3701-28-03(Q).
- OAC 3701-28-03(Q) *“Within thirty days of the drilling, alteration or sealing of a well, dry hole, or test hole, or the date of completion of a well, a copy of the well log or sealing report required to be filed with the Ohio department of natural resources, division of soil and water resources, as required under section 1521.05 of the Revised Code shall also be submitted to the board of health, to the private water system owner, and the registered contractor shall retain a copy.”*



Bucket used as cap

Cased Borehole with Angled Casing

Open Borehole

Lack of
Grout
presence

9 11:49

Acknowledgements

- Ohio Department of Natural Resources, Div. of Geological Survey
- Pennsylvania State Extension
- The Private Water Class

Questions



Contact Information

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