Guidance for Deep and Shallow Well Determinations

This guidance document clarifies the Iowa Department of Natural Resources' (DNR) definitions of **"deep"** and **"shallow"** wells to help ensure proper well construction and compliance with setback distances. Following these guidelines helps protect both groundwater quality and your well's water quality.

Background

Iowa Administrative Code Chapters 40 and 49 require wells to meet specific setback distances from contamination sources. **Shallow wells** need greater setbacks because they are more vulnerable to surface water infiltration and have less protection from the surrounding soil and bedrock. **Deep wells** are better protected and can have smaller setbacks.

The DNR has found that some wells, which are shallow by definition, are being drilled with deep well setbacks, resulting in costly violations. This guidance aims to prevent those violations by clarifying the key definitions.

Definitions and Key Criteria

The terms "deep well," "shallow well," and "low permeability unit" are defined in 567Iowa Administrative Code Ch. 40 and Ch. 49. A **"deep well"** is defined by the presence of a **"low permeability unit,"** which is also referred to as a **confining unit**.

What is a Confining Unit?

A low permeability unit is a continuous layer of rock (like shale) or unconsolidated material (like till) that is at least **5 feet thick** and located at least **25 feet below the ground surface** that is all or partially saturated and has a permeability low enough (10-7 cm/sec or slower) to give water in the aquifer artesian head. This layer must significantly slow the vertical movement of water. This speed is the equivalent of a water molecule taking 50 years to travel through a 5-foot-thick layer. This layer must be laterally and vertically continuous.

The three most common confining units in Iowa are:

- **Till**: A laterally continuous, unoxidized, unfractured, and saturated layer.
- **Shale or siltstone**: A laterally continuous, unfractured, and saturated layer.

Note: Carbonate bedrock (limestone and dolomite), which is common in Iowa, generally **does not** meet the definition of a low permeability unit. Clay, often found in alluvial settings, often **does not** meet the standard of a deep well due to its laterally non-continuous nature.

Deep vs. Shallow Wells

- A **deep well** is cased and constructed to draw water from a **confined aquifer**, whichis located beneath a confining unit. The static water level in a deep well must be higher than the bottom of the confining unit (known as **artesian head**).
- A **shallow well** is constructed where there is no continuous confining unit. It draws water from an **unconfined aquifer**. The static water level in a shallow well istypically the same as the local water table.

Special Considerations for Karst Geology

Areas with **karst geology** (sinkholes, fractures, highly porous carbonate bedrock) like in northeast Iowa, are particularly sensitive to surface contamination. In these regions, surface water can quickly migrate downward. Even wells drilled to depths of 300-500 feet in these areas are often classified as "shallow" because the fractured bedrock does not act as a continuous confining layer. To be considered a deep well in a karst region, the well must be cased and grouted into a confining layer located beneath the karst bedrock.

How to Determine Well Classification

To classify a well as deep or shallow, you must consult publicly available geologic data, with **well logs** being the most reliable source. The confining unit must be shown as laterally continuous on multiple well logs within the area.

Key resources for well logs and geologic data:

- **Iowa Geological Survey's (IGS) GeoSam database**: This is the best resource for well logs and strip logs.
- **Iowa Wells Information System (IWIS) database**

Summary Checklist for a Deep Well Classification

To be classified as a deep well, the proposed well design must satisfy **all** of the following criteria:

- The well must be screened or opened below a confining layer.
- The confining layer must be a laterally continuous layer of unoxidized, unfractured, and saturated till, shale, or siltstone.
- The confining layer must be at least **5 feet thick** and its top must be at least **25 feet below ground surface**.
- The well's static water level must be higher than the top of the confining aquifer (i.e., artesian head).
- In areas with karst geology, the well must be cased and grouted through the karst bedrock into a continuous confining layer below.

If the design fails to meet any of these criteria, the well is considered **shallow**.

Questions or Unsure? Contact Us

It's crucial to make this determination **before** starting a project. If you are unsure about the classification of a proposed well, please consult with the DNR.

For questions, please contact:

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Table 1: Vertical Hydraulic Conductivity (cm/sec) for Geological Materials

Material	Lowest (cm/sec)	Highest (cm/sec)	Low Permeability?
Clay	1.00×10−9	4.70×10−7	Yes - if unoxidized
Coarse sand	9.00×10−5	6.00×10−1	No
Fine sand	2.00×10−5	2.00×10−2	No
Gravel	3.00×10−2	3.00×100	No
Karst and reef limestone	1.00×10−4	2.00×100	No
Limestone, dolomite	1.00×10−7	6.00×10−4	No, in almost all cases
Medium sand	9.00×10−5	5.00×10−2	No
Sandstone	3.00×10−8	6.00×10−4	No (typically used as an aquifer)
Shale	1.00×10−11	2.00×10−7	Yes - if unbroken and continuous
Silt, loess	1.00×10−7	2.00×10−3	No
Siltstone	1.00×10−9	1.40×10−6	Yes - if unbroken and continuous
Till	1.00×10−10	2.00×10−4	Yes - if unoxidized

Reference: HydroSOLVE, I. (2014) Hydraulic Properties: Aquifer Testing 101. Aqtesolv.com