DRILLING LOGS

Dr. MARK KING

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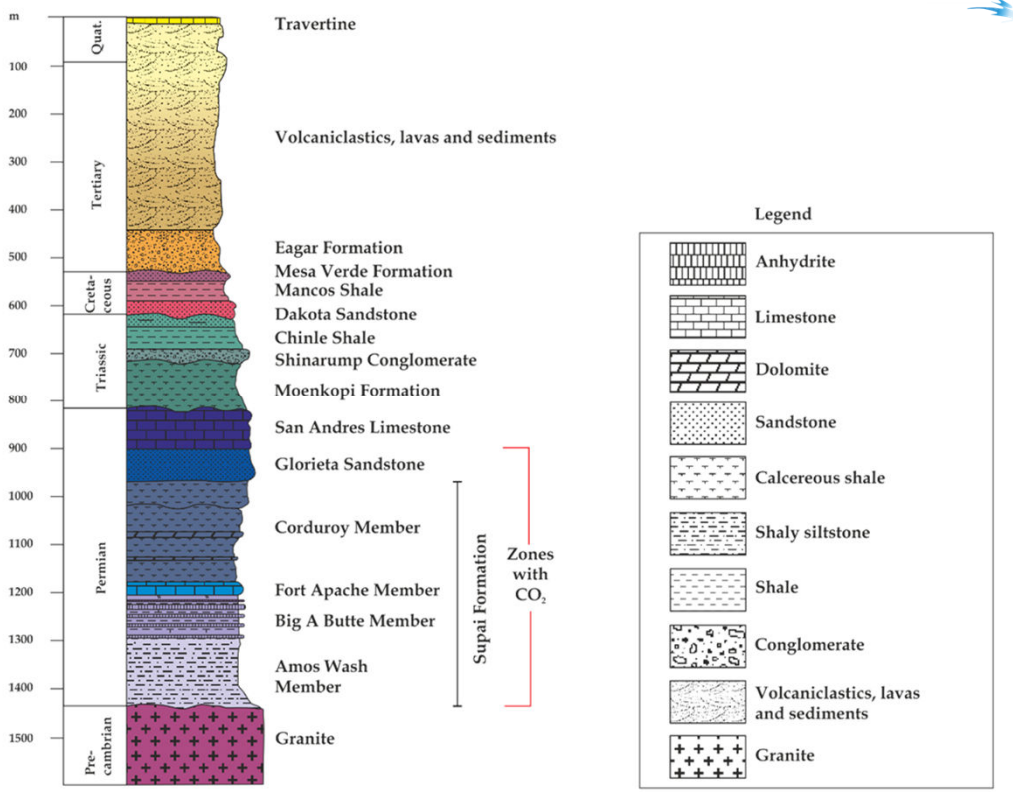
THE VILLAGE DRILL

Drilling logs



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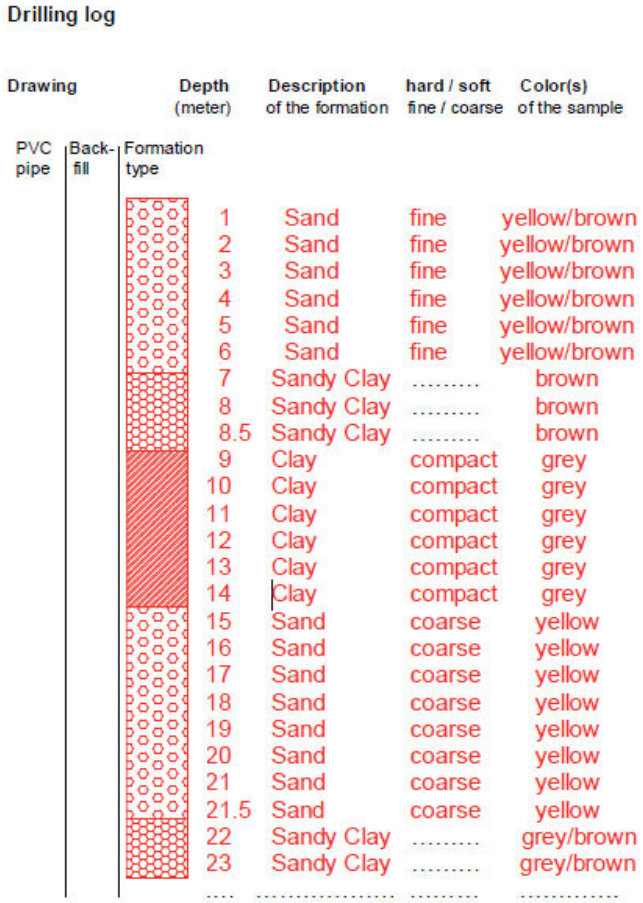
DRILLING LOGS

- It is important to determine (and record) the exact depth of aquifers and impermeable layers in the borehole.
- To do this, simple but accurate drilling logs should be created.
- A drilling log is a written record of the geological formations (soil layers), according to depth.



Drilling log

Drawing: PVC pipe	Drawing: Back-fill	Drawing: Formation type	Depth (meter)	Description of the formation	hard / soft fine / coarse	Color(s) of the sample
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			22	Sandy Clay	.....	grey/brown
			23	Sandy Clay	.....	grey/brown
			....	.....	.....	.....

DRILLING LOGS

- Soil samples should be taken at regular depths (e.g., every meter), then described and recorded on a “Drilling Log”.
- The drilling log is used to determine well design features, including:

1. The best aquifer for installation of the well-screen
2. Depth and length of the well-screen
3. Depth and thickness of the gravel pack
4. Location of the sanitary seal

Drilling log

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	....	.....	.....	.....

DRILLING LOGS

Database

- Besides the direct use of drilling logs in the field, drilling logs are also important for general knowledge of the drill site.
- For example, if at a later stage other wells are drilled in the same village or area, it will be useful to know the geology, depth of the water table and likely total drilling depth.

Drilling log

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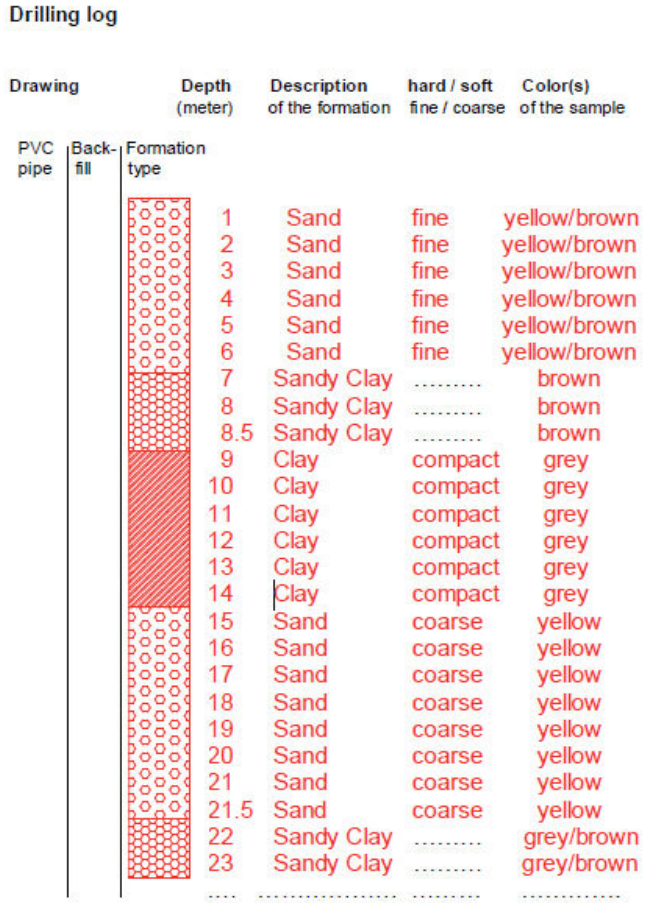
			....	.....	.....	.....

DRILLING LOGS

- Any previous drilling logs available for the area will be a useful source of information, to review before the new drilling starts.

- By taking care to record and preserve good drilling logs, the drilling crew will present itself as a professional and skilled Team to their clients.



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DRILLING LOGS - TAKING SOIL SAMPLES

- The first step in making a drilling log, is to take *representative samples of the soil (geological formations) encountered in drilling.*
- To do this, all loose sediments are removed from the first sump, in advance of drilling the interval to be sampled.
- When drilling of the sample interval is completed, the sediments that have accumulated in the sump (through transport in drilling mud) are sampled with a strainer.
- These samples should be placed on a layer of plastic and the depth intervals should be labelled with a piece of cardboard. Sub-samples may be collected into small bags, for future reference, and also labelled.
- Identification of materials will be somewhat obscured by the slurry, but it will generally be possible to assess the sand, gravel and clay content, as well as colour. In addition, the driller can provide information on the ease with which the sample interval was drilled.

DRILLING LOGS - TAKING SOIL SAMPLES

- Samples should be taken every meter and/or every time the formation (soil) type changes.

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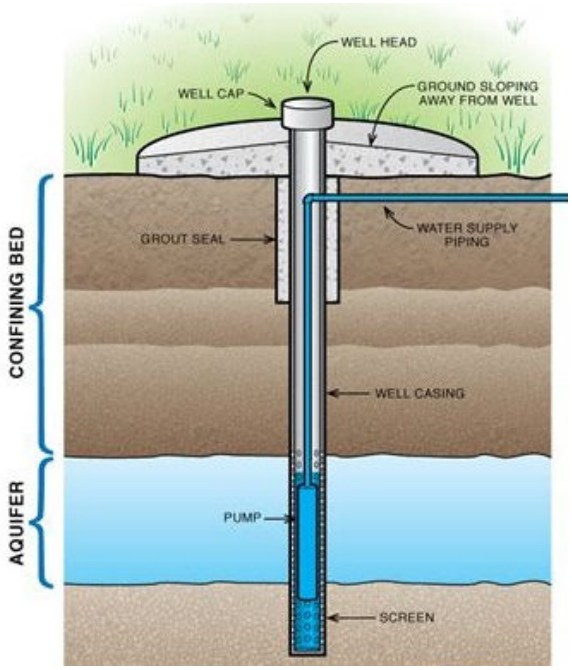
DRILLING LOGS - DRILLING DEPTHS

- The final drilling depth is reached when at least 4-6 metres has been drilled into a water bearing permeable layer. Although more is better.
- It is also recommended to drill *two extra metres (if possible)* for installation of a sump (settling section for particles in the borehole)



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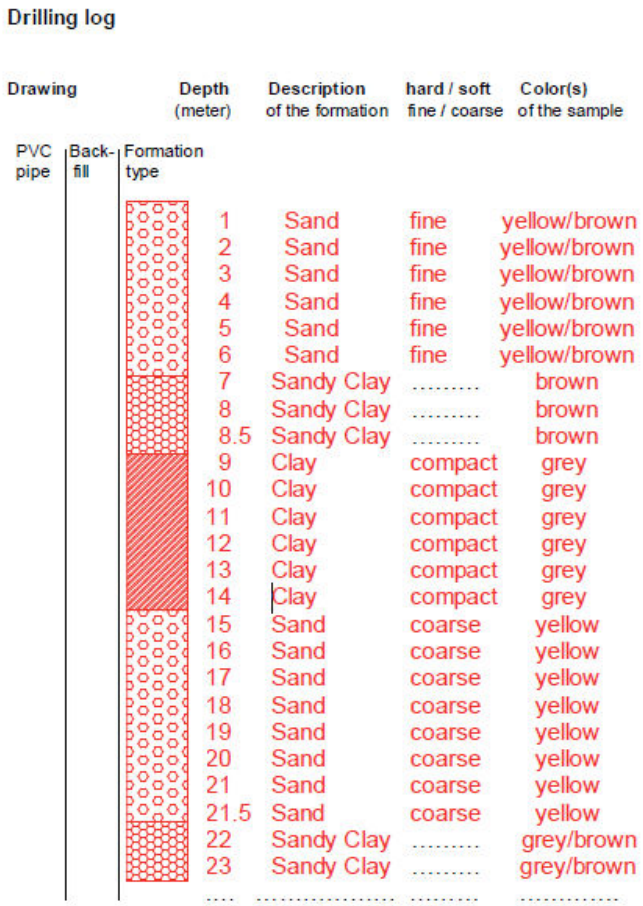
DRILLING LOGS - FILLING IN THE DRILLING LOGS

- Step 1 - Describe samples during breaks in the drilling process, writing down the depth, name and characteristics on the drilling log.
- Step 2 - Hatch the formation column to show the difference between permeable, semi permeable and impermeable layers by different hatching.
- Step 3 – Note the static water level. With experience, the driller may be able to estimate this during drilling, or it may be measured at the start of each day, before any movement of the drill bars.



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DRILLING LOGS - FILLING IN THE DRILLING LOGS

- Step 4 – When drilling is complete, the well can be “designed”, with target placement of: screen, casing, gravel pack, sanitary seal and cuttings
- Step 5 – The log should be updated with final depths of all well features, when construction is complete
- In the example shown on the right, a 6 metre well-screen was installed between 15 and 21 metres below ground level. And a 1.5 metre sump was placed at the bottom end of the well-screen.

Drilling log

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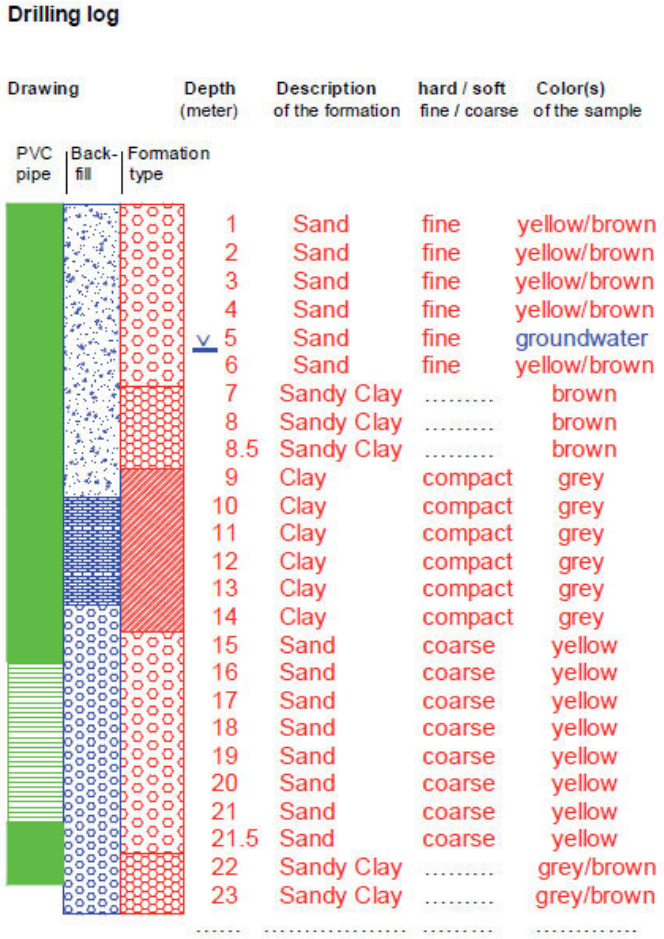
DRILLING LOGS - WELL SCREEN AND BACKFILLING

Well-screen: position and length

- For manually drilled boreholes, the well-screen usually will not exceed a length of 6 metres,
- Fine materials are often present in the extreme upper and lower parts of an aquifer.
- To prevent these *fines* (which may cause turbidity and pump wear) from entering the well-screen it is important to avoid installing the well screen at the same level as the fines. In other words, the screen should be installed in a *permeable layer, ideally* consisting of sand or gravel.

DRILLING LOGS - WELL SCREEN AND BACKFILLING

- Even with careful sampling, the exact *depth* of origin of the soil samples may be somewhat inaccurate.
- So, to avoid *fines* from entering, the well screen and backfill should be installed with a safety margin of at least 1 metre
- For example, in the drilling log shown to the right, the well-screen was placed in the middle of the aquifer, leaving a 1 metre margin of sand at each end.



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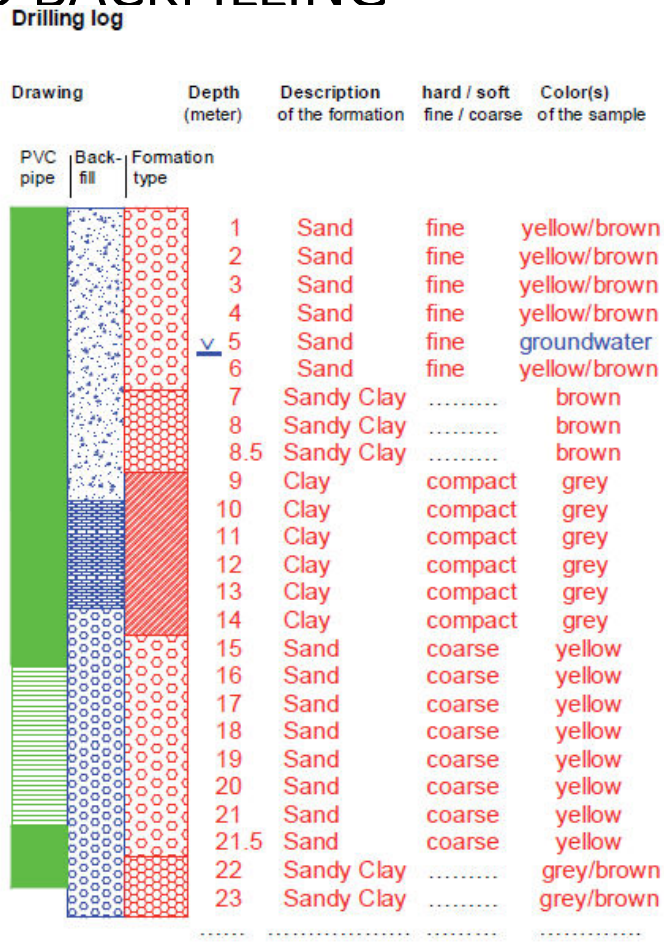
DRILLING LOGS - WELL SCREEN AND BACKFILLING

Sump

- After the installation and during the use of a well, some *soil particles* may still enter the well-screen.
- The particles (which can cause damage and wear to the pump) will eventually *settle* to the bottom of the well.
- To prevent loss of well-screen surface area, a *sump* of 1-2 metres should be placed during well construction.



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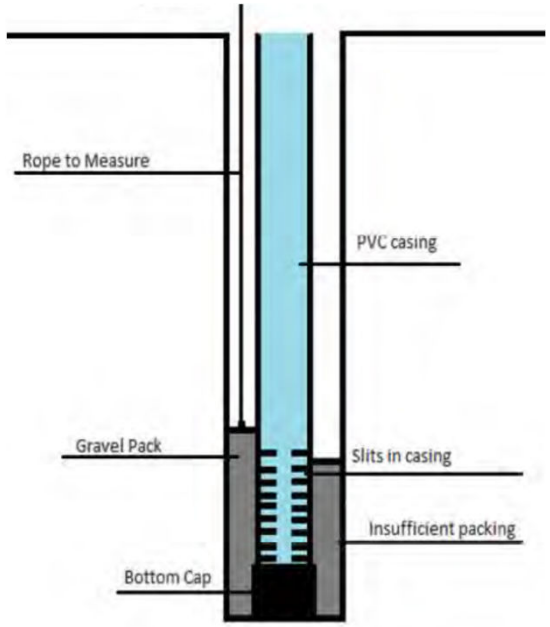
DRILLING LOGS - WELL SCREEN AND BACKFILLING

Thickness of the gravel pack

- Once the well-screen position is designed and placed on the drilling log, the position and thickness of the *gravel pack* can be determined.
- The annulus (open space) around the well-screen is filled with coarse sand or fine gravel of specific size (gravel pack), up to 1-2 metre above the top of the well-screen.



- The extra length is required because during the development of the well, the gravel pack may *settle*.

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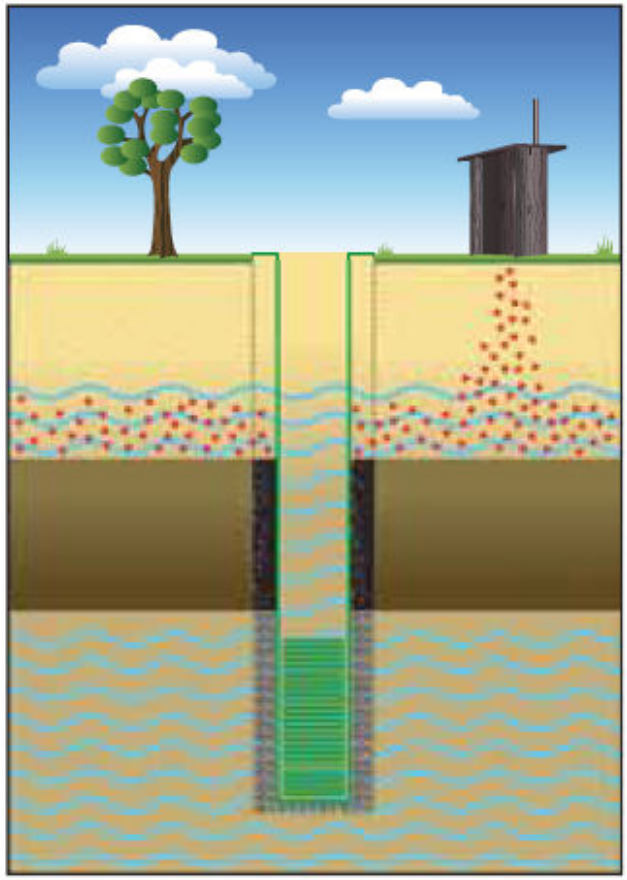
DRILLING LOGS - WELL SCREEN AND BACKFILLING

Thickness of the sanitary seal

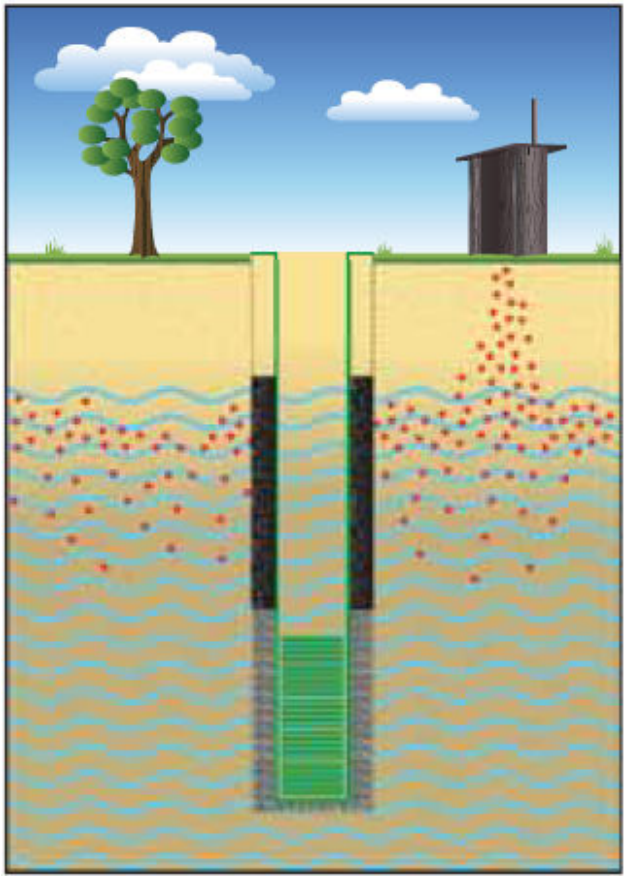
- When an impermeable layer is penetrated, a *sanitary seal* of clay (bentonite) or cement should be placed in the corresponding section of the borehole
- The purpose of the seal is to ensure that the well does not become a pathway for water to move through the impermeable layer
- The thickness of this sanitary *seal* should be at least 3-5 metres.



DRILLING LOGS - WELL SCREEN AND BACKFILLING

Thickness of the sanitary seal

- In cases where no impermeable layer is encountered, the well may be constructed in the first aquifer
- In this case the *sanitary seal* should be installed directly on top of the *gravel pack* (1-2 metres above the well-screen) and should have a thickness of at least 5 metres.



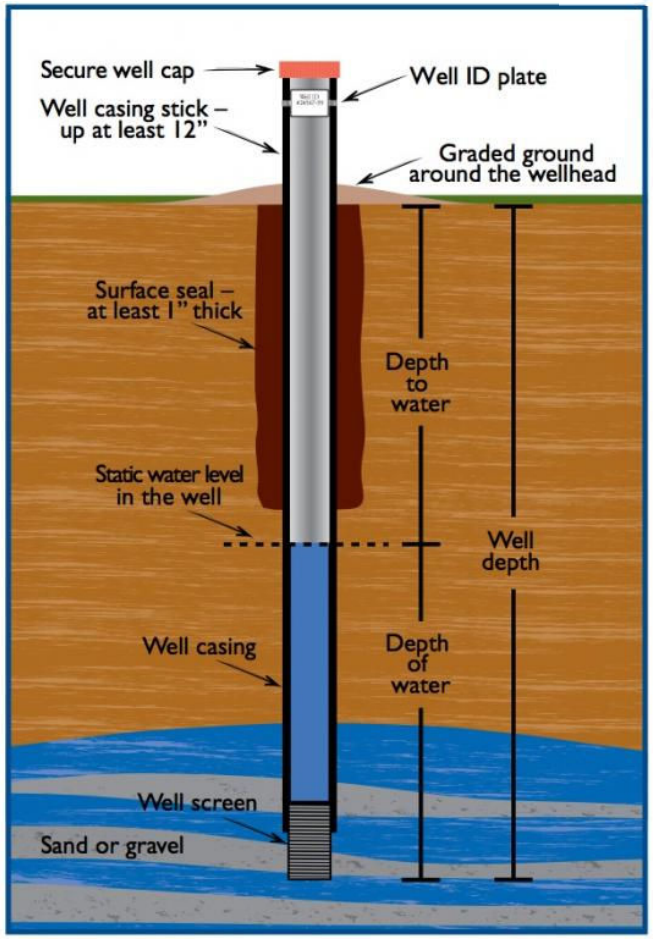
DRILLING LOGS - WELL SCREEN AND BACKFILLING

Cuttings

- The borehole section above the sanitary seal should be backfilled with cuttings recovered from the sumps
- These should be segregated during drilling and set aside to drain and dry out

Sanitary top-seal

- An upper sanitary top-seal of 3-5 metres should be placed in the top section of the borehole, to prevent entry of surface water



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