

## GROUNDWATER MEASUREMENT TECHNIQUES AND DATA ANALYSIS

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### General

- Groundwater is water that has permeated into the surface of the earth and down to impermeable layer called Aquifers.
- The wells which are being used continuously, a reliable and accurate groundwater level measurement is essential. Aquifers always follow the contours of the permeability of the soil.
- Sometimes monitoring wells sunk in to the ground and are used for measurement of groundwater level and other related information. Groundwater level measurement is often logged to graph an aquifer about its volume it and depth.
- In case of multiple aquifers at differing depths multiple sensors are required for a complete groundwater level measurement to find effect of precipitation or any seasonal changes and water extraction/pumping effects etc.
- If a borewell is continuously used for a longer duration, measurements should also be taken from the surrounding monitoring wells to make sure that they are not pulling the water level down too quickly and to secure that the resource can recover from the extraction.
- By pumping in set cycle times, the data from the groundwater level measurement before and after the pumping cycle at varying periods is compared to determine the recovery rate of the aquifer and how the underground water resource is affected by local weather, especially how much and how fast it reacts to certain amounts of precipitation.

### Groundwater level measurement

**Groundwater level measurement** is mostly performed by a submersible pressure transmitter. These hydrostatic level transmitters are small in diameter and directly suspended by their cable into the well, borehole, deep bore well or monitoring well. Groundwater level measurement may be logged locally or transmitted back to the control unit or by telemetric systems or underground line.

**Electronic Water Level Indicators** – These types of instruments consist of a spool of dual conductor wire, a probe attached to the end and an indicator. When the probe comes in contact with the water, the circuit is closed and a meter light and/or audible buzzer attached to the spool will signal contact.

The frequency of data measurement may vary from hourly, daily, weekly, monthly or seasonally.

To find out the groundwater level trend long term/historical data is required.

**The measurement of the groundwater** level in a well is frequently conducted in conjunction with ground water sampling to determine the “free” water surface. This potentiometric surface measurement can be used to establish groundwater direction and gradients. Groundwater level and well depth measurements are needed to determine the volume of water or drawdown in the well casing for proper purging. All groundwater level and well depth measurements should be made relative to an established reference point on the well casing and should be documented in the field records. This reference point is usually identified by the well installer using a permanent marker for PVC wells, or by notching the top of casing with a chisel for stainless steel wells. By convention, this marking is usually placed on the north side of the top of casing.

**If no mark is apparent**, the person performing the measurements should take both water level and depth measurements from the north side of the top of casing and note this procedure in the field logbook. To be useful for establishing groundwater gradient, the reference point should be tied in with local datum. For an isolated group of wells, it is acceptable to use an arbitrary datum common to all wells in that group, if necessary.

Water levels should be allowed to equilibrate prior to measurement after removing sealing caps. There are no set guidelines and appropriate equilibration times can range from minutes to hours depending on well recharge, local geology and topography, and project objectives.

#### **Precautions**

Care must be taken to minimize the risk of cross-contamination between wells when conducting water level and depth measurements. This is accomplished primarily by decontaminating the sounders or other measuring devices between wells.

Water levels and well depths measured should be properly documented

Groundwater gradients at some sites can be very shallow. Special care should be taken to allow the water level to equilibrate after removing sealing caps and the same sounder should be used for all measurements. The sounding activity should be coordinated to allow all wells to be sounded within the minimum possible time. This is particularly important in areas with potential tidal influences.

#### **Quality control**

Devices used to measure groundwater levels should be verified annually against standard traceable measuring tape/sounder techniques. These devices should check to within 0.01 feet per 10 feet of length with an allowable error of 0.03 feet in the first 30 feet.

All verifications and maintenance data should be documented electronically or recorded in a logbook maintained

The functional check and tape length verification should be performed

These devices should be decontaminated prior to use at the next well

### **Measurement of Total depth of well**

The well sounder, weighted tape or electronic water level indicators can be used to determine the total well depth. This is accomplished by lowering the tape or cable until the weighted end is felt resting on the bottom of the well. Because of tape buoyancy and weight effects encountered in deep wells with long water columns, it may be difficult to determine when the tape end is touching the bottom of the well and sediment in the bottom of the well can also make it difficult to determine total depth. Care must be taken in these situations to ensure accurate measurements. The operator may find it easier to allow the weight to touch bottom and then detect the 'tug' on the tape while lifting the weight off the well bottom. All total depth measurements must be made and recorded to the nearest 0.1 foot. As a cautionary note, when measuring well depths with the electronic water level indicators, the person performing the measurement must measure and add the length of the probe beneath the circuit closing electrodes to the depth measured to obtain the true depth. This is necessary because the tape distance markings are referenced to the electrodes, rather than the end of the probe.