HydroServices
A DIVISION OF AQUALINC

Installation and Field Calibration of Soil Moisture Sensors

1. Installation

All dielectric sensors must be installed carefully to ensure there are no air gaps between the sensor and the soil; i.e. there is **perfect contact**. Any air gap will result in errors in the soil moisture measurement. The ability to have perfect contact limits universal application of dielectric sensors:

- Stony soils are not ideal because it is nearly impossible to install the sensor and ensure perfect contact along the entire length of the sensor.
- Clay soils will shrink away from the sensor and leave an air gap as they dry down toward the irrigation trigger point.
- Silt loam soils are the most suited for dielectric sensors.

Some manufacturers recommend placing the sensor in a pilot hole and filling the hole with a slurry to ensure a tight fit. The slurry will not be representative of the surrounding soil and readings will not be accurate.

The zone of influence of dielectric sensors is relatively small:

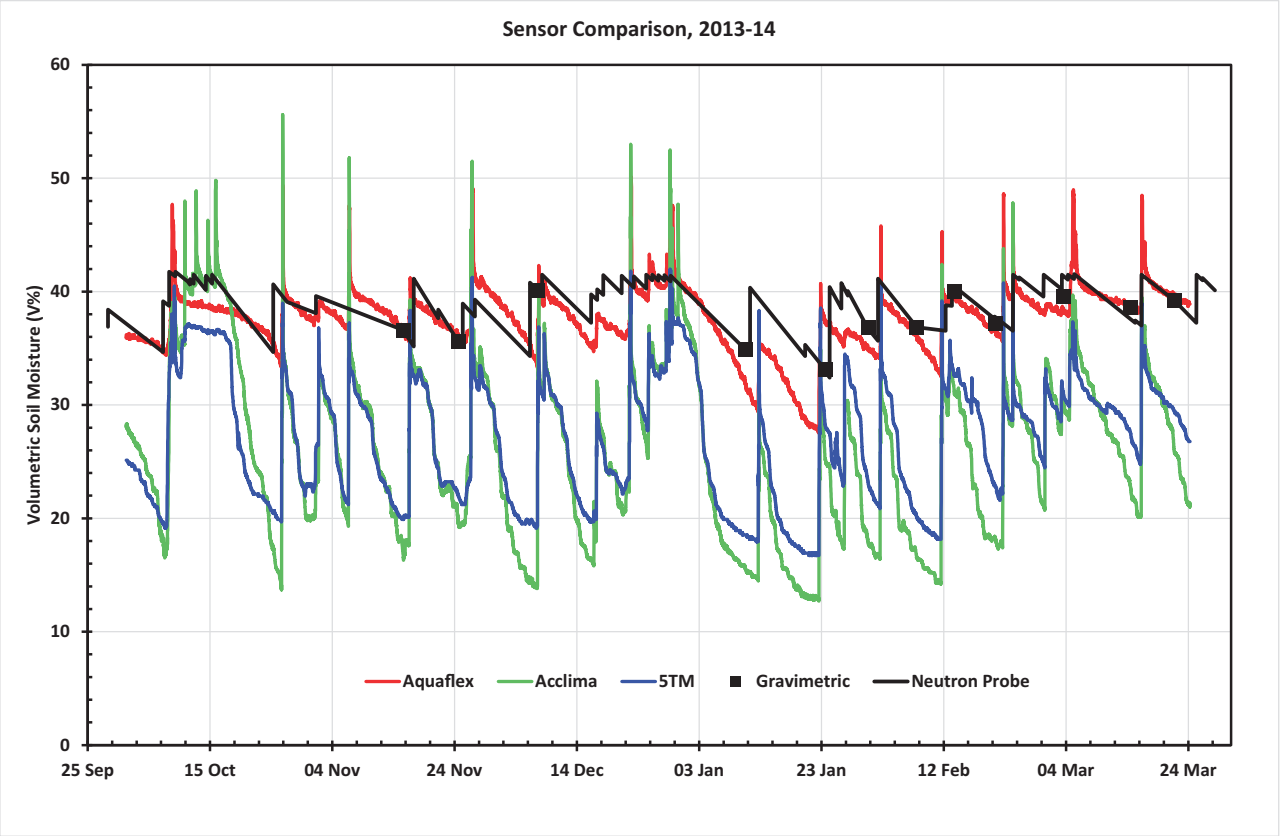
- For Time Domain Transmissivity type sensors (Acclima, Aquaflex and 5TM or 5TE) the zone of influence is about 25mm.
- For capacitance type sensors the zone of influence is up to 100mm from the sensor.

The small zone of influence is further reason for installation to be carefully and meticulously carried out.

2. Calibration

All sensors measuring the dielectric constant require calibration to obtain volumetric soil moisture. Most manufacturers provide a universal "factory calibration", others provide a calibration(s) based on soil texture (normally sand, silt or clay) and nearly all recommend field calibration.

HydroServices experience is that **all** sensors should be field calibrated to accurately measure soil moisture V%. At a trial site in Canterbury a number of different sensors are installed in a silt loam soil, the most appropriate soil texture for dielectric type sensors. Each sensor has had the "factory" calibration applied (universal or silt loam calibration). Only the Aquaflex sensor closely matches the gravimetric and the neutron probe soil moisture measurements (Figure 1). The sensors all show different response to soil moisture changes following rainfall or irrigation or drying cycle. Soil moisture measured by the 5TM and Acclima sensors dry to V% that are too dry – close to wilting point for this soil type and not likely under a well irrigated pasture. The Aquaflex sensor is less sensitive and does not dry to the same degree as the 5TM and Acclima sensors. Field calibration is required to ensure accurate soil moisture readings.



Comparison of soil moisture sensors in a silt loam soil, Canterbury, New Zealand

Field calibration is not as simple as applying a correction factor. Soil moisture (V%) must be measured at different soil moisture content to develop a relationship – an equation to correct the sensor measurements. Figure 2 shows a "factory" calibrated 5TM sensor and the soil moisture following field calibration – it is not a simple offset or correction factor.

Field calibration has an important outcome for available soil moisture. Once field calibrated the readily available soil moisture increases from about 12mm (factory calibration) to 19mm (field calibration) in the 0-20cm depth for this soil. The accurate measure of available water has a significant effect on:

- Return interval for irrigation; i.e. 7mm is the about 2 days crop water use;
- Overseer drainage and N leaching; i.e. higher water holding capacity results in lower N leaching.