Sentek sensor technologies

EasyAG® Installation Guide

Version 3.0

for

EasyAG® 50

and

EasyAG® 80

EasyAG® Installation Guide

EasyAG® 50
EasyAG® 80

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About this manual

This guide describes the principles of site selection and the materials and methods that are used to install **Sentek EasyAG** probes.

Document Conventions

Before you start it is important that you understand the conventions used in this manual.

Conventions	Type of Information
Bold text	Bold text is used to highlight names of products and companies, for example **Sentek**, or an emphasized word, for example, '**Note**:' or '**Warning'**
This font face	This font face is used for the names of tools, methods and miscellaneous items, for example *Regular T-Handle*.
Text presented under the heading:	
'Note:'	Is important information that should be considered before completing an action
'Hint:'	Is information that makes a process easier or saves time
Text presented under the heading:	
'Warning:'	Information which, if not strictly observed, could lead to misleading moisture trends and wrong irrigation management decisions. Critical information that must be considered before completing an action.
'Disclaimer:'	Critical information regarding the liability of Sentek and the responsibility of the client to use the equipment responsibly and as described in the manual.
'Caution:'	Information which, if not strictly observed, could result in damage to, or destruction of equipment.

Disclaimer:

The access tubes, probes and sensors supplied by Sentek are specifically designed to be used together. Other brands of probe and access tubs are not compatible with the Sentek products and should not be used as they may damage Sentek equipment. Damage to Sentek equipment through incorrect use will invalidate warranty agreements.

Sentek has developed precision installation tools are to be used for the installation of Sentek access tubes. The precision of the access tubes and tools is designed to complement the value of the readings taken by Sentek sensors. The value of both relative and absolute readings is compromised when poor and hasty installation methods are used.

Sentek does not accept any responsibility for damage caused by incorrect site selection, poor installation or inappropriate use of Sentek products.

Introduction

The EasyAG Installation Guide provides important information about how to select monitoring sites and install access tubes.

Site selection and access tube installation have a significant impact on the value of the soil moisture data that can be gathered on your property.

Warning: Good Site Selection is Critical

To obtain representative soil moisture readings, the site where the access tube is installed must reflect changes in soil moisture and crop water use trends which can then be used to representatively schedule irrigations over a defined area.

This area may be an entire field or a subsection of a field where irrigation water is applied during a watering shift.

The quality of access tube installation is critical. The access tube must fit tightly against the soil and cause the least possible disturbance to the surrounding soil profile.

To take soil moisture readings, access tubes are installed at monitoring sites, which should be chosen using a series of proven evaluation methods described in **Site Selection**.

It is important to select monitoring sites so that the information that is gathered from them is representative of the crop water use and soil water holding capacity of the surrounding area (e.g. irrigation valve or irrigation management unit). At each site, between one and three access tubes may be driven into the soil. The access tube prevents the direct contact of the **Sentek** probe with the soil.

Warning:

If you do not understand any of the information in the Site selection chapter, consult a trained Sentek reseller or agronomist. Incorrect site selection or poor installation can result in misleading data and/or crop damage.

If you have any questions, **Sentek** recommends consultation with a trained reseller or agronomist prior to installation. Trained resellers and agronomists understand the complexity of site selection for irrigation scheduling and the need for proper installation of the access tubes.

Site Selection

The key to effective soil moisture monitoring is to select monitoring sites which truly represent irrigation management areas where crop water use and soil water storage are similar. The same basic site selection principles apply to the full range of **Sentek** soil moisture monitoring devices. Many variables influence the spatial distribution of water across an area of land. These variables and their impact on site selection are discussed in more detail below.

What is site selection?

A site is defined here as:

"The location of the probe within a field or irrigation shift, where soil water readings are taken at different depth levels within the soil profile."

> **Note**:
> If readings are to be used as a basis for scheduling irrigations over larger defined areas, it is imperative that monitoring sites are representative of these areas.

Soil moisture data can provide information about the:

- Quality and depth of irrigations
- Levels of soil moisture retention
- Depth of the crop root zone
- Impact of weather and rainfall events on an area

> **Warning**:
> Do not select irrigation scheduling sites at random on your property. Poor site selection will result in soil moisture data that is unrepresentative of soil water changes and crop water use in that field.

Site selection is carried out in two stages:

- Macro zone selection
- Micro zone selection

Relationship between macro and micro zones in the field

Traditional practice within the field and across the whole farm has been for irrigation to be applied on a hypothetical "farm average" – in a similar way to traditional broad acre management practices.

Uniform application of irrigation across areas with highly variable soils and different levels of crop water use causes significant differences in yield and quality, creating commercial losses and environmental harm through increasing problems with rising water tables and increasing salinity.

If different soil types are ignored in terms of their different irrigation scheduling requirements, crop setbacks or failures may occur.

Macro zone selection defines the number of zones on a property where the amount of timing of irrigation applications can be specifically tailored to match soil and crop variability – a macro zone or irrigation management unit comprises areas with similar crop water use.

Crop water use is governed by many factors such as soil properties, crop stage, water quality, weather patterns and type of irrigation system. These factors need to be considered when defining the macro zones on your property and are described in the following pages.

Micro zone selection determines the position of access tubes in relation to the crop and irrigation system.

Micro zone selection considers the:

- Areas of root zone and canopy spread
- Water distribution uniformity (sprinkler pattern)
- Moisture pattern of drip irrigation
- Surface, topographic and soil anomalies

The consideration of these factors will help you find the best representative position or site for probe placement within the macro and micro zones.

Macro and micro zone selection is described in greater detail in the following pages. If you require further information, consult your Sentek reseller and/or a trained agronomist.

Important factors you should know that affect crop water use

All the factors listed below can have an impact on the way the water is stored in the soil and on the way that plants use that water. They affect transpiration and evaporation rates and have a direct impact on irrigation scheduling. In macro zone selection, it is important to consider the way these factors influence water use in a particular area or zone:

- Climate
- Soils
- Crop
- Cultural management
- Irrigation system

Climate

The most commonly recognized factor in influencing the amount of crop transpiration is the weather.

Temperature

Crops need to draw up water to compensate for water use through transpiration (water loss through the leaves) and evaporation (water loss from the surface of soil and leaves). The demand increases with increasing temperature up to a maximum threshold for each crop (when the stomata close and photosynthesis stops).

Humidity

Atmospheric demand for transpiration and evaporation is relative to the humidity (amount of water vapour in the air). The higher the humidity level, the lower the demand.

Wind speed

Crop transpiration and evaporation increase with increasing wind speed, creating an increased water demand. At higher wind speeds, transpiration eventually decreases due to stomata closure, but evaporation increases.

Solar radiation

On sunny days, crops can synthesize more basic sugars and more complex plant food compounds, through the combination of atmospheric carbon dioxide and soil-derived water, than on cloudy days. Although crops vary in their sensitivity of photosynthetic response, they all require access to greater amounts of soil water.

Rainfall

Rain is generally associated with higher humidity levels and lower solar radiation and temperatures. It follows that days on which rainfall occurs are associated with lower water demand and use than dry sunny days.

Notwithstanding the care taken to delineate macro zones, some variability in soil moisture levels is inevitable. For example: on large properties, rain events may cover only a portion of the land area, replenishing some soil reservoirs and leaving others dry.

The aspect or orientation of sloping fields can subject the crop to more or less solar radiation, wind exposure or water run-off – all affecting crop water use.

Soils

An understanding of how soil type influences plant-soil-water-dynamics, and hence irrigation scheduling is important. Intrinsic soil properties are texture, structure, depth, soil chemistry, organic matter content, rocks and stones and clay type. Influencing factors include compaction, salinity, water-table development, drainage rate dynamics and topography.

Soil texture

Water storage in the soil profile and the rate it dries out, depends on the soil texture. At one end of the spectrum, sandier soils fill up and drain quickly. Hence these soils, in general, require smaller and more frequent irrigations. In contrast, heavier clay soils replenish and drain slowly and to a higher total water content than lighter (sandier) soils. An infinite range of textures exist between the two extremes. Textures often change within a profile, with the layering of different textural bands playing a large part in determining the water holding capacity of a soil.

Soil structure

Water infiltration rates and air and water permeability within the soil profile are closely related to the size and distribution of soil pores. Porosity in turn, is dependent upon the arrangement and aggregation (binding) of sand, silt and clay particles (soil structure). Soil structure is as important as soil texture in governing how much water and air move in the soil and therefore their availability to crops. Roots penetrate more easily and rapidly in soils that have stable aggregates than in similar soil types that have no or highly developed structures. The effectiveness of soil moisture, air and nutrient utilization is related to the efficiency of root colonization of the entire soil profile.

Soil depth

The effective depth of soil affects the extent of root penetration. The deeper the soil, the greater the volume of soil available for gaseous exchange and water and nutrient uptake. Drainage is also influenced by effective depth.

Soil compaction

Soil compaction from farm machinery can change pore size and distribution resulting from the natural arrangement of the sand, silt and clay particles. This can cause reductions in water infiltration rates, and air and water permeability within the soil profile. The resultant impact upon the effectiveness of root penetration, air exchange and nutrient and water uptake, affects plant growth efficiency and hence water demand.

Salinity

Salinity lowers the osmotic potential, reducing the efficiency with which water and nutrients are taken up by the plant. The dominance of the contributing ions can result in a nutrient imbalance causing deficiencies of essential macro and micro nutrients. The reduced plant health and vigor affect crop water use.

Water tables and drainage rate

Poor drainage can lead to the development of water tables and/or cause a temporarily saturated soil profile. The presence of impermeable soil layers can cause the formation of perched water tables, which saturate parts of the root zone. Efficient gaseous exchange becomes restricted and plant health and water use is reduced.

Organic Matter

The presence of organic matter and humus increases the cation exchange capacity (CEC), water holding capacity and structural stability of soils. This influence is predominantly in the top soil, although lamellae (thin organic matter layers further down the profile) can be important properties.

Soil chemistry

Acid, alkaline, sodic (soils characterized by a dominance of sodium ions) or nutrient deficient conditions impact on expected soil chemical properties. For example:

- pH conditions change CEC and the availability of nutrients (by changing their form)
- high levels of sodium can lead to structural collapse, infiltration problems and reduced water availability

Rocks and stones

Stones and rocks within a soil profile occupy part of the soil volume and hence reduce the soil water storage capacity. Very stony soils have a substantially lower water holding capacity than soils of the same texture that are free of stones.

Topography

Topography relates to the configuration of the land surface and is described in terms of differences in aspect, elevation and slope. This has an impact on plant-soil-water dynamics via influencing climatic conditions including:

- rain shadows and sunshine hours
- rainfall and temperature patterns up slopes
- elluviation (washing-out) of clays from higher elevations and illuviation (washing-in and accumulation) of clays at lower elevations
- relatively poorer drainage in low lying areas

Crop

Crop differences have an impact on crop water use and irrigation scheduling requirements. While all require management between full and refill point at most times, the depth of root extraction varies, as do specialized requirements, e.g. the deliberate stressing of wine grapes.

Most plant tissues contain about 90% water and the rate of uptake of water from the soil solution by plant roots is largely controlled by the rate of water loss through transpiration. Plant characteristics such as crop type, size, age, vigor, variety, rootstock, development stage, leaf area, nutritional status, crop load and harvest all affect crop water use. Specialized advice should be sought in this regard. A rough guide to water use can be obtained from crop coefficients, which are widely available in the literature for different growth stages of most crops. These express evapotranspiration as a ratio of reference evaporation.

Cultural Management

The impacts of cultural management (agronomic/horticultural practices) also need to be understood for proper irrigation scheduling.

Soil preparation

Cultivation increases evaporation from the topsoil, reducing soil water available to the plant. It may also reduce water run-off and improve the infiltration of rain and irrigation water, improving plant water availability.

Cover crop and mulch

Cover crops provide more competition for water, but reduce evaporation and facilitate infiltration of rain and irrigation water, reducing run-off.

Mulch can improve the infiltration rate of the soil, reduce water run-off, encourage root growth near the soil surface and increase the soil water holding capacity over time, through the accumulation of soil organic matter, and reduce soil temperature.

Oil spraying

Oily substances on leaves reduce water use by temporarily closing stomata. An example of this is mite control in citrus.

Fertilizer management

In order to ensure that no nutrients are deficient, fertilizer applications are normally based on soil and/or leaf sample analyses. The degree of precision varies from a rough averaging approach to precision farming where sample points are matched to requirements using satellite tracking technology. Healthy crops require more water and have different nutrient dynamics to crops that have been stunted or diseased through inefficient fertilizer management.

Pest/disease management

Good pest/disease management keeps the crop protected and in good health, sustaining its potential growth and transpiration rates. Infestations can result in lower than normal water uptake.

Irrigation System

The effectiveness of an irrigation system to deliver water affects crop water use. Variations in irrigation system pressure, flow and water distribution uniformity cause variations in irrigation application. This affects root zone wetting patterns and therefore crop water use.

The preceding crop water use factors should be taken into account when matching your irrigations to areas of similar crop water use. These areas are then represented by soil water monitoring sites and the data collected at these sites is used for irrigation scheduling purposes.

Water Quality

The source and constituents of irrigation water impact on osmotic potential and hence plant water uptake. Water quality can vary both within and between seasons and between water sources. Sodic waters can also affect soil structural properties, reducing water infiltration rates.

A general view of macro scale zone selection

Macro zone selection is used to identify the total number of required zones and their locations on your property. A macro zone comprises areas of similar crop water use. The aim of good site selection is to select a monitoring site that reflects changes in soil water content and crop water use trends.

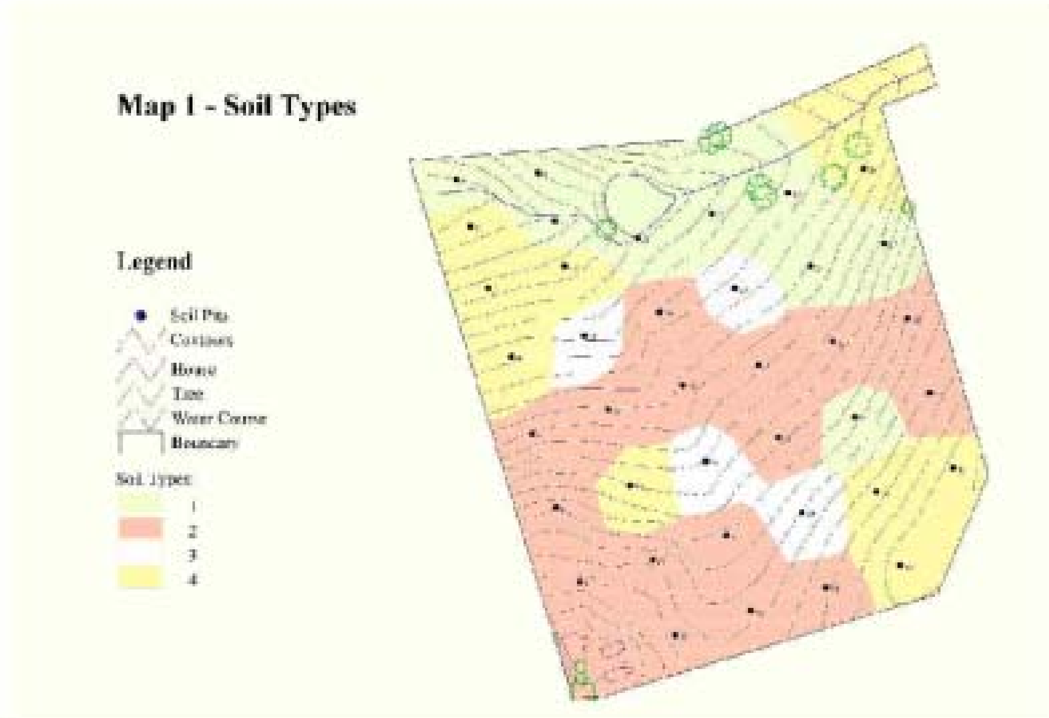
The representative data gained from monitoring sites is used to schedule irrigations over a larger defined area. This area (or macro zone) may be an entire field, or a sub-section of a field, where irrigation is applied during a watering shift.

As an irrigator, you want to replenish the soil water used by plants for growth and transpiration. So, it is important to understand the many factors which affect crop water use or transpiration and how these factors may vary on your farm.

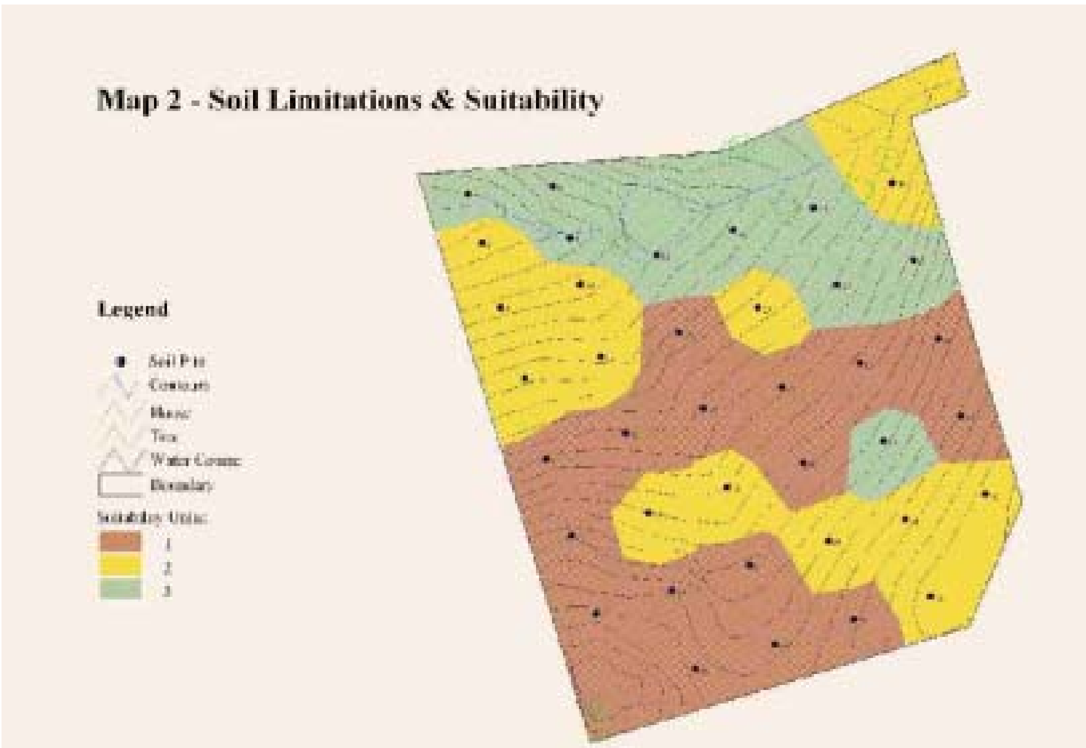
A primary goal of good irrigation management is to match irrigations to areas with similar crop water use, within the limits of your irrigation system flexibility. This consideration will ultimately determine how many monitoring sites you will need and where you should locate them.

The diagrams on the following pages show an example of how 'factors that affect crop water use' can be used to determine macro zones. Consult your local soil specialist for further information on the soils at your site.

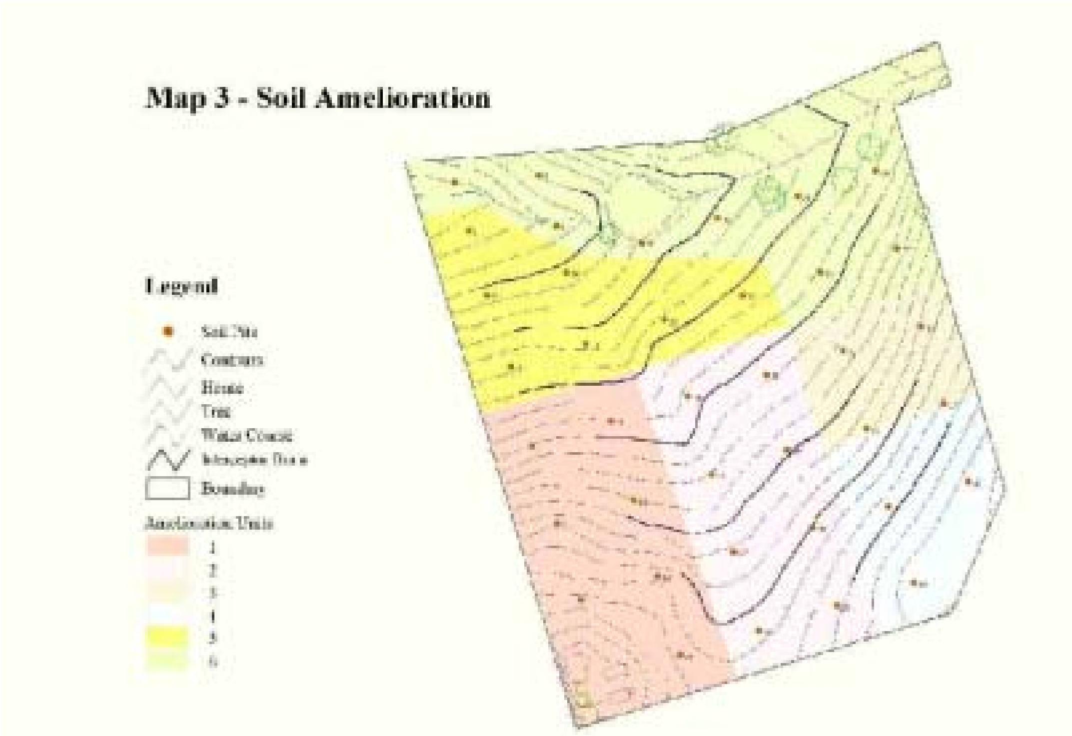
Firstly the soil properties and types are considered, to differentiate between areas of varying soil-water properties:



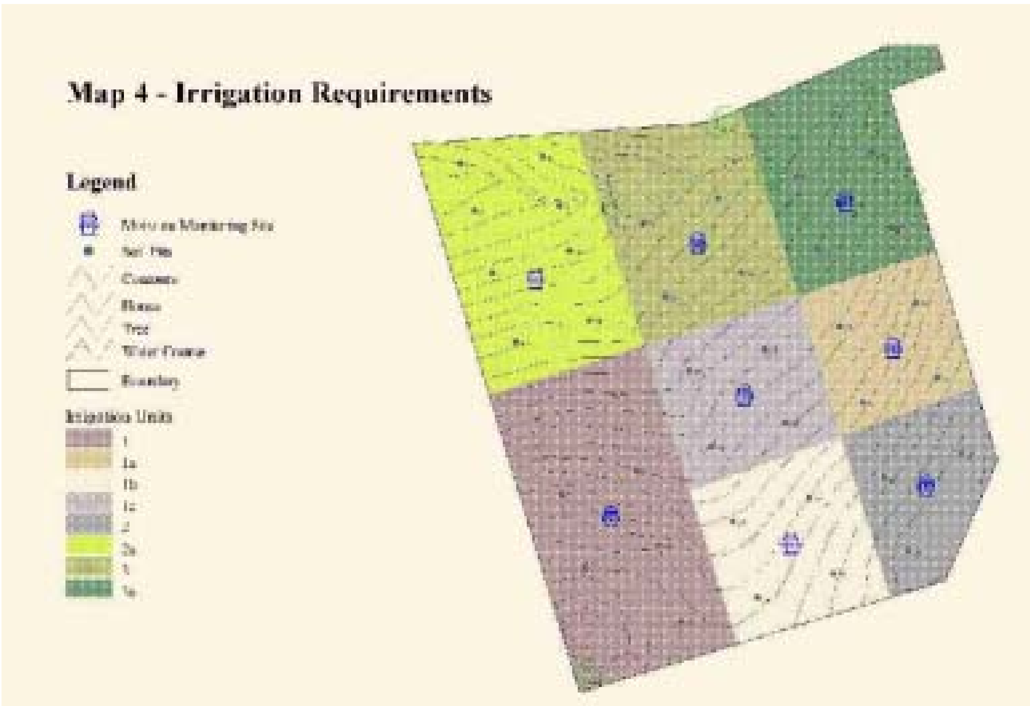
Then the soil limitations and suitability for the proposed are identified in order to determine the need for soil improvements and amelioration:



From this the requirements for soil improvements and amelioration are outlined:



Once the soil has been ameliorated and improved then the altered soil properties are considered in conjunction with the topography, irrigation system and crop types to delineate irrigation management units.



Overlaying all this information makes it possible to identify, within a property, areas (zones) that have significantly different requirements.

In the example used, the property has been divided into eight macro zones. Each macro zone requires a monitoring site. Potential sites are shown by the dots, but final positioning can be determined by the information in the micro scale zone selection.

Micro scale zone selection

With macro zone selection you have identified the irrigation management units on your property. Micro scale zone selection is used to target the actual site of the access tube in relation to crop, micro-scale soil variability and irrigation delivery point.

Note: Micro zone selection is equally as important as macro zone selection and has a direct effect on the representative value of the data.

In soil-based monitoring the measurements are taken from a small part of the root zone. Sentek sensors record the dynamics of moisture in the part of the soil profile where the probe has been installed. If you miss the root system or install the probe in dry or wet irrigation spots, the data will not make sense and cannot be used for irrigation scheduling as it will not be representative of an entire irrigation management unit.

Soil moisture monitoring instruments are often blamed if there is no increase in moisture content after irrigation, but testing will almost always show that the micro siting of the equipment is wrong. For example it is common to find that the probe is placed in a dry spot, caused by a sprinkler system having poor distribution uniformity. Also, on sloping ground, the lateral movement of water needs to be taken into consideration when siting the access tube.

Where there are variations in the micro relief or soil properties and depth over very small distances that affect the root distribution and growth of the plant (e.g. in gilgai soils), it may be necessary to install more than one soil moisture probe in the same area to represent these variations.

In drip irrigation, more than one probe should be installed to measure the lateral and vertical spread of soil moisture.

Micro zone selection guidelines

Following is a set of guidelines for selecting access tube installation sites within irrigation management units. Three major factors need to be taken into account; irrigation, plant health and soil type.

Irrigation system

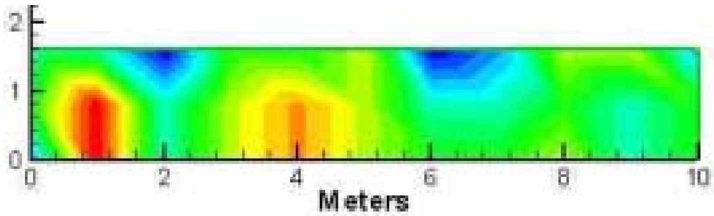
It is important to check that your irrigation system is performing as per the design specifications prior to installation. Variations in sprinkler pressure and flow, pump performance, distribution uniformity and wind can result in uneven patterns of watering and irrigation depths. This can lead to salinity problems, development of water tables, water logging, root death and an overall decline in crop health, yield and quality.

Before you commence irrigation scheduling make sure your irrigation system performance is at an acceptable level. Read the recommended literature to perform detailed checks on irrigation systems or contact your irrigation consultant or Department of Agriculture for further advice. It is important to check your irrigation system at least once a year.

Conducting a distribution uniformity (DU) test

Prior to installing the site, it is also necessary to check the distribution uniformity of the system. The uniformity of water distribution from sprinklers can be checked with a simple can test. The method involves arranging cans or cups in a grid pattern within the wetted area and measuring the volume of water in each can, as shown in the photo below.

This information is then plotted as shown in the example below. Cans in the blue shaded area received above average water; those in the red shading below average; while those in the green shaded area received an average amount.

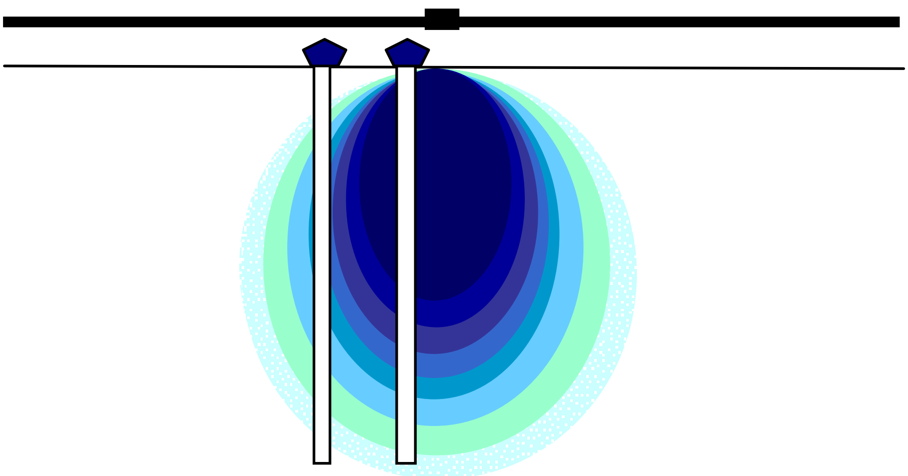


Due to the specific nature of each site in terms of irrigation system, it is inappropriate to give prescriptive advice on probe placement. For soil moisture monitoring, it should however, be representative and consistent. General guidelines for commonly used systems and principles of sample site selection follow.

For sprinkler systems, it is preferable to use two probes per site, placing one into an area receiving average precipitation and the other one into a wet or dry spot, depending on a soil salinity or water table problem.

In centre pivots, if the distribution uniformity tests show significant variation between booms, two or more probes should be installed, with at least probe in each different area. For high pressure rain guns, measure the water application pattern under different wind conditions to ensure that you don't pick on area of extremely low or high water application.

Installation of probes in drip irrigated crops needs consideration of the extent of the 'wetting onion.' Use at least two probes to monitor soil moisture of drip irrigated crops to measure both the vertical and the lateral spread of water. The schematic below shows an example of the variation in the wetting pattern below a dripper. The darker blue colour signifies wetter soil conditions, while the lighter blue colour signifies drier soil conditions. The plant roots will utilize the water from different locations under the dripper at different intervals; therefore it is very important to measure these differences using more than one probe.



In addition, in drip irrigation, the slope needs to be taken into consideration, to account for movement of water down slope.

In furrow irrigated fields, probes should be installed 50 to 100 metres away from the head ditch. Probes should not be installed at the opposite side to the head ditch, as tail water from the irrigation may back up the furrows and give unrepresentative readings. Placement of probes here may be considered when measurement of deep percolation below an irrigated field is required. Consideration should also be given to placing another probe in the middle of the field to measure the depth of irrigation there.

Plant health

Select a site next to an average-sized, healthy plant representing the *Irrigation management unit*. Avoid:

- Stunted or sick plants
- Unusually large plants or trees
- Spots where plants are missing

General guidelines for key crops include:

- In field crop and vegetable production choose a uniform crop stand, and ensure that the probes are inserted within the actively growing root zone.
- In orchards, use two probes to monitor the site. Place one probe under the tree canopy and another outside the canopy. There will be some interception of rainfall by the canopy so less rain water will penetrate the ground directly under the canopy. Select a site that represents dynamic data trends (more root activity) and again consider irrigation distribution uniformity.

Soil properties

Soil properties influence probe placement in drip irrigation, as the wetting pattern is highly dependent upon the soil. In uniform sands, most of the water applied under the dripper will tend to move vertically through the profile, with minimal lateral spread. Conversely, in uniform clay soils, the water will tend to spread laterally as well as vertically. In soils of contrasting textures, there will be varying wetting patterns that need to be taken into consideration.

In many soils there are substantial variations in the thickness of horizons and in the potential rooting depth. This can lead to significant variations in soil water storage capacity and plant growth over relatively short distances. Under these conditions, it is recommended to install two probes to ensure that this variability is taken into account.

Other micro zone selection considerations

There are several other factors when considering micro zone selection that also need to be taken into consideration. These are:

- Do not install probes in outside rows. These locations are usually exposed to wind and dust, particularly in the vicinity of roads or adjoining broad-acre properties.
- Avoid the 'drip ring' in, for example, citrus orchards, where sprinkler irrigation water is channeled by the canopy to the outside bottom edge of the foliage creating wetter soil conditions at the edge of the canopy.
- Avoid wheel tracks (and wheel track rows) as the soil is more compacted in these areas and stores less readily available water than the rest of the field (non wheel track rows).

Disclaimer:

Sentek is not responsible for incorrect or poor selection of site locations. The data recorded by the probes is only accurate for the soil immediately surrounding the probe. How that information is extrapolated to reflect what is happening over a larger area is dependent upon the location of the probe and whether or not it is representative. Sentek can not be held responsible for the impact of management decisions made for a larger area based on data recorded from a probe.

Installing EasyAG probes

Safety

Sentek encourages the use of safe practices that minimize the risks to users, their machinery and their property. The following safety information is provided to help prevent accidents during installation.

Carrying the equipment into the field

Some of the equipment used in this procedure is heavy. Care must be taken when carrying it into the field for the installation, such that muscle and back injuries are avoided. Where possible, weight should be shared between each arm and multiple trips taken to transfer the equipment to the working site.

Removing the soil sampler and access tube from the ground

Of particular note is the step at which the soil sampler is removed from the ground. This action has the potential to stress the operator's back and legs. In sticky soils, it may be necessary to remove the soil sampler in stages, or share the load between two people.

The above also applies to the removal of access tubes from the ground. It is far better to take a longer time in digging the access tube out of the ground than to risk muscular or back injury in a difficult extraction.

Using a metal sledgehammer

When using a metal sledgehammer to beat another metal body, there is the possibility that metal shards may be produced from the impact. These may be thrown at great speed, so it is advisable to wear some form of eye protection. While spectacles may be of some protection, the very best security may be achieved by wearing safety goggles. These provide a barrier to fragments approaching from the side of the head as well as from the front.

Hand protection

Leather or rubber gloves provide protection from miss-hits of the beating head on the soil sampler, and should be used wherever possible. They also provide protection from blister formation.

Protection and care of equipment

Equipment should be cleaned after use, removing all soil residues. This is not only to lengthen their effective life span, but also to allow optimal ease of use. A soil sampler which has not been properly cleaned will be harder to insert in subsequent installations.

When not in use, the equipment should be stored in a dry, sheltered place.

Disclaimer

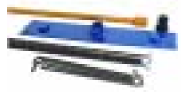
Sentek Pty. Ltd. will not be held accountable for any personal injury suffered or damage to machinery that may occur during the installation of its equipment, beyond those guarantees governing the performance of Sentek proprietary equipment.

Sentek Pty. Ltd. can also not be held responsible for the spread of disease that may occur due to improper cleaning of tools and probes by the user between installations.

Items required for installation

Sentek Items

EasyAG 50 Probe Complete		**Description**	**Part Number**
5 wire interface		EasyAG probe that connects to an RT6 logger via proprietary Sentek communication protocol	15005
Voltage interface		EasyAG probe that has a voltage communication protocol	15009
SDI-12 interface		EasyAG probe that has an SDI-12 communication protocol	15012
RS232 interface		EasyAG probe that has an RS232 communication protocol	15232
RS485 interface		EasyAG probe that has an RS485 communication protocol	15485

EasyAG Installation Kit includes the following:		Installation tools that, in conjunction with the AMS soil sampling auger, are used to install the EasyAG 50 and EasyAG 80 probes	70500
1 x stabilization plate		The stabilization plate is designed to minimize vibrations and sideways movements when hammering in the AMS Soil Sampling Auger and EasyAG probe to maintain the integrity of the installation.	Not avail. as separate item.
1 x polyguide, stabilization plate		The polyguide holds the AMS Soil Sampling Auger firmly within the neck of the stabilization plate.	70505
4 x stabilization plate pins (long)		The long stabilization pins hold the stabilization plate firmly in place when installing into mounded sites.	70502
4 x stabilization plate pins (short)		The short stabilization pins hold the stabilization plate firmly in place when installing on flat ground.	70503
1 x EasyAG dolly		The EasyAG 50 dolly is used to hammer in the EasyAG 50 probe plastics into the pre-drilled hole made by the AMS Soil Sampling Auger	70525
1 x dolly rubber		The dolly rubber holds the EasyAG 50 dolly and EasyAG 80 dolly centrally within the probe plastics to minimize sideways movement and vibration when hammering in the probe	70538

1.1 metre AMS soil sampling auger and cleaning tool		The AMS Soil sampling auger is used to pre-drill a slightly undersized hole for insertion of the EasyAG 50 and EasyAG 80 probes	70510
1 x EasyAG extraction tool (optional item)		The EasyAG extraction tool assists in the removal of EasyAG probes plastics from the ground. The tool is used to grip the probe plastics for attachment to a winch, jack, hydraulic lifting device, or similar.	70548

Miscellaneous Items (Installer to supply)

- 1 x Sledgehammer – to drive the *AMS soil sampler* into the soil
- Gloves – to protect your hands when hammering in the *AMS soil sampler*
- Safety goggles - to protect your eyes against possible metal splinters when hammering
- Tarpaulin – to lay out tools and electronics during installation and keep them clean and dry
- Silicone glue – to seal the cable gland against water intrusion into the top cap
- 1 x notepad and pencil – to record depth and texture variation throughout the soil profile and any other site information
- Duck boards – to prevent soil compaction around the access tube during the installation process
- Bucket – to collect augered soil and dispose of away from site

Installing EasyAG 50 probes

Step 1 - Assembling the stabilization plate

The *stabilization plate* can be used on both flat ground and raised soil beds. There are two different types of *stabilization plate pins* for this reason: a short pin for flat ground and a long one for raised soil beds.

Step 2 - (option A) Fixing the stabilization plate on flat ground

1. Place the *stabilization plate* on the ground where the *probe* is to be situated.
2. Insert the *short stabilization plate pins* through the holes in the *stabilization plate*.

3. Drive the *stabilization plate pins* all the way into the ground using a *sledgehammer*. The *stabilization plate* should be in firm contact with the soil without compressing it significantly.
4. Put the soil sampler *polyguide* in place. The *stabilization plate* is now ready for insertion of the *AMS soil sampler*.

Step 2 (option B) Fixing the stabilization plate to a raised soil bed

1. Insert each of the four *long stabilization plate pins* into the holes in the *stabilization plate* and tighten the *wing nuts* with light finger pressure.

2. Place the assembled *stabilization plate* on the ground directly above the required position of the *probe*.

3. Apply gentle pressure directly down onto the *stabilization plate* to force the pins into the ground. Ensure that the *stabilization plate pins* remain parallel to one another.

4. Using a *sledgehammer* alternately beat the *stabilization plate* at the points provided to force it closer to the ground. Do not beat continuously on any one side in advance of the other. The aim is to achieve a situation where the pins are near parallel in the ground.

5. The *stabilization plate* should be firm to the ground without causing significant soil compression

Warning

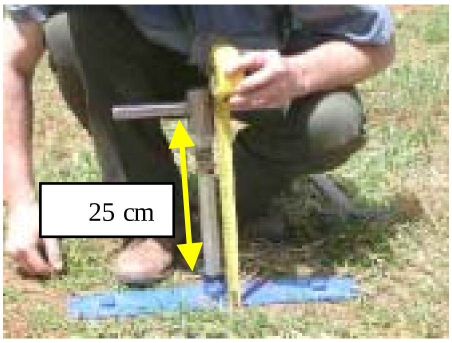
Do not compress the soil such that normal water infiltration into the soil is likely to be inhibited. This is particularly important on clay soils.

6. Insert the *soil sampler polyguide*. The stabilization plate is now ready for insertion of the *AMS soil sampler*.

Step 3: Preparing the hole

1. Insert the *AMS soil sampler* and force downward in a single smooth action by hand until the resistance becomes too great.

2. Using a *sledgehammer,* beat the *AMS soil sampler* into the ground until the bottom of the beating head sits 25 cm above the *stabilization plate*. **Note**: While it is preferable to go all the way in one insertion, successful installation may be possible in heavier soils with 2 insertions. Ensure accurate blows are made such that lateral deflection of the soil sampler is minimized.



Warning
Do not compress the soil such that normal water infiltration is inhibited

3. Turn the *AMS soil sampler* one single complete rotation clockwise.
4. Carefully lift the *AMS soil sampler* directly out of the ground. To remove the soil collected in the soil sampler, simply beat on its side with the hand or foot. The design is such that the soil core taken is slightly compressed, and of a lesser internal diameter than the *soil sampler* itself. In heavier textures, the *soil sampler cleaning tool* is used to clear the soil sampler by screwing it into the compressed soil in the end of the *soil sampler*. The extracted soil should be deposited away from the *probe* site.

Warning
If you experience difficulties at this point, remove the *soil sampler* in stages, or obtain extra assistance to avoid back injury.

5. Remove the *AMS soil sampler polyguide*.

6. If the soil is dry, add a small quantity of water into the hole using a squirt bottle.

Step 4 - Assembling the EasyAG probe

1. Attach the cutting tip to the base of the probe with firm pressure. No glue is required.

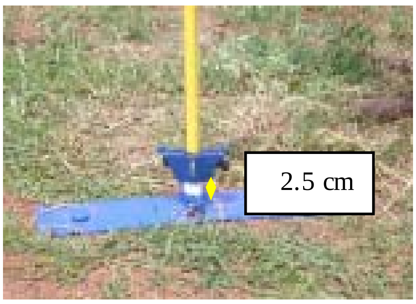
2. Remove the lid of the *top cap* and extract the probe electronics. Place this safely to one side on a clean, dry surface such as a tarpaulin.

Step 5 - Inserting the access tube

1. Insert the assembled complete *probe* into the *stabilization plate* and push it into the ground in a single gentle movement as far as it will go. Do not cause undue inflection of the access tube, as this will destroy the integrity of the installation.

2. As the probe enters the prepared hole in the soil, it shaves off a soil residue that is eventually stored in the cutting tip or falls to the bottom of the hole.
3. Slide the *dolly rubber* to the top of the *EasyAG dolly*. Insert the *EasyAG dolly* into the *access tube* and position it on top of the joiner at the base of the access tube. Gently slide the *dolly rubber* into the *top cap* to stabilize the *EasyAG dolly*.

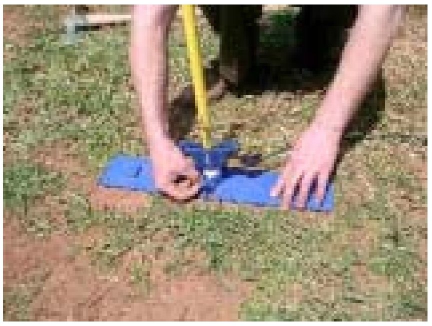
4. Continue inserting the *probe* by hammering on the insertion dolly with a *sledgehammer* until there is a 2.5 cm (1 inch) gap between the base of the *top cap* and the edge of the *stabilization plate* tube guide.



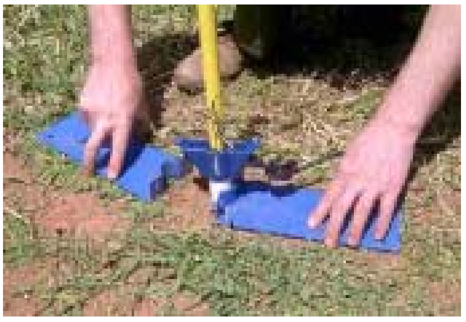
Note: This clearance height is important. If you hammer the probe in too far you will not be able to lift the stabilization plate off the long stabilization plate pins.

5. Feed the cable through the *FairRite bead* and the *cable gland* into the *top cap*. It is simpler to push the cable through the cable gland at this point than when the access tube is installed in the ground.

6. Remove the *stabilization plate wing nuts*.



7. Remove the stabilization plate pins and separate the 2 halves of the *stabilization plate* and remove them.



8. Continue inserting the probe into the ground with **gentle** blows of the *sledgehammer* using the *EasyAG 50 dolly*, until the base of the *top cap* is level with the ground. This will place the top *sensor* at 10 cm (3.9 inches) below the ground surface. Remove the EasyAG 50 dolly.

Step 6 – Fitting the top cap lid

1. Carefully slide the probe into the access tube, ensuring that the top of the probe seats correctly into the grooves in the top cap. Connect the cable to the green phoenix connector on the top of the probe. Refer to the EasyAG Hardware Manual for wiring instructions for the specific probe interface.

2. Pull the excess cable back through the cable gland. The outer sheath of the cable should be trimmed back as far as the point where the cable enters the inside of the top cap. Apply silicone around the wires of the cable at the end of the outer sheath, to prevent moisture from traveling along the cable into the inside of the top cap.

3. Ensure that the sealing gasket on the top cap is **clean**, in **good condition** and positioned correctly, and replace the *lid* of the *top cap*. Tighten the screws evenly completely to ensure an effective seal.

4. Tighten the *FairRite bead* into position and tighten the cable gland. The probe is now installed and upon connection to the data logger is ready for use.

Installing EasyAG 80 probes

Step 1 - Assembling the stabilization plate

The *stabilization plate* can be used on both flat ground and raised soil beds. There are two different types of *stabilization plate pins* for this reason: a short pin for flat ground and a long one for raised soil beds. The methodology of assembling the stabilization plate is identical to that used for the EasyAG 50 probe.

Step 2 - (option A) Fixing the stabilization plate on flat ground

1. Place the *stabilization plate* on the ground where the *probe* is to be situated.

2. Insert the *short stabilization plate pins* through the holes in the *stabilization plate*.
3. Drive the *stabilization plate pins* all the way into the ground using a *sledgehammer*. The *stabilization plate* should be in firm contact with the soil without compressing it significantly.

4. Put the soil sampler *polyguide* in place. The *stabilization plate* is now ready for insertion of the *AMS soil sampler*.

Step 2 (option B) Fixing the stabilization plate to a raised soil bed

7. Insert each of the four *long stabilization plate pins* into the holes in the *stabilization plate* and tighten the *wing nuts* with light finger pressure.


8. Place the assembled *stabilization plate* on the ground directly above the required position of the *probe*.
9. Apply gentle pressure directly down onto the *stabilization plate* to force the pins into the ground. Ensure that the *stabilization plate pins* remain parallel to one another.


10. Using a *sledgehammer* alternately beat the *stabilization plate* at the points provided to force it closer to the ground. Do not beat continuously on any one side in advance of the other. The aim is to achieve a situation where the pins are near parallel in the ground.


11. The *stabilization plate* should be firm to the ground without causing significant soil compression

Warning
Do not compress the soil such that normal water infiltration into the soil is likely to be inhibited. This is particularly important on clay soils.

12. Insert the *soil sampler polyguide*. The stabilization plate is now ready for insertion of the *AMS soil sampler*.

Step 3: Preparing the hole

1. Insert the *AMS soil sampler* and force downward in a single smooth action by hand until the resistance becomes too great.

2. Using a *sledgehammer,* beat the *AMS soil sampler* into the ground until the beating head is just above the *stabilization plate*. (While it is preferable to go all the way in one insertion, successful installation may be possible in heavier soils with 2 insertions). Ensure accurate blows are made such that lateral deflection of the soil sampler is minimized. Do not compress the soil with the final blow.

Warning
Do not compress the soil such that normal water infiltration is inhibited

3. Turn the *AMS soil sampler* one single complete rotation.

4. Carefully lift the *AMS soil sampler* directly out of the ground. To remove the soil collected in the soil sampler, simply beat on its side with the hand or foot. The design is such that the soil core taken is slightly compressed, and of a lesser internal diameter than the *soil sampler* itself. In heavier textures, the *soil sampler cleaning tool* is used to clear the *soil sampler* by simply screwing it into the compressed soil. The extracted soil should be deposited away from the *probe* site.

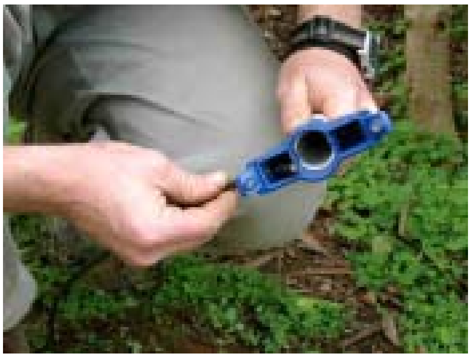
Warning
If you experience difficulties at this point, remove the *soil sampler* in stages, or obtain extra assistance to avoid back injury.

5. Remove the *soil sampler polyguide*.

Step 4 - Assembling the EasyAG probe

1. Attach the *cutting tip* to the base of the probe with firm pressure. No glue is required.

2. Remove the lid of the *top cap* and extract the electronics. Place this safely to one side on a clean, dry surface such as a tarpaulin.
3. Feed the cable through the *FairRite bead* and the *cable gland* into the top cap. It is simpler to push the cable through the cable gland at this point than when the access tube is installed in the ground.



Step 5 - Inserting the access tube

1. If the soil is dry, add a small quantity of water into the hole using a squirt bottle.

2. Insert the assembled complete *probe* into the *stabilization plate* and push it into the ground in a single gentle movement as far as it will go. Do not cause undue inflection of the access tube, as this will destroy the integrity of the installation.

3. As the probe enters the prepared hole in the soil, it shaves off a soil residue that is eventually stored in the cutting tip and at the base of the hole.
4. Slide the *dolly rubber* to the top of the *EasyAG 80 dolly*. Insert the *EasyAG 80 dolly* into the *access tube* and position it on top of the joiner at the base of the access tube. Gently slide the *dolly rubber* into the *top cap* to stabilize the *EasyAG 80 dolly*.

5. Continue inserting the *probe* by hammering on the insertion dolly with a *sledgehammer* until there is a 2.5 cm (1 inch) gap between the base of the *top cap* and the edge of the *stabilization plate* tube guide.

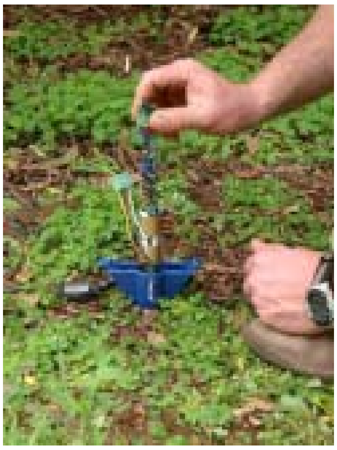
Note: This clearance height is important. If you hammer the probe in too far you will not be able to lift the stabilization plate off the long stabilization plate pins.

6. Remove all of the *stabilization plate wing nuts*.
7. Lift both sections of the *stabilization plate* to clear the threads of the *stabilization plate pins*.
8. Separate the 2 halves of the *stabilization plate* and remove them.

9. Continue inserting the probe into the ground with gentle blows of the *sledgehammer*, whilst holding the top of the probe steady with one hand, using the *EasyAG 80 dolly*, until the base of the *top cap* is level with the ground. This will place the top *sensor* at 10 cm (3.9 inches) below the ground surface. Remove the *EasyAG 80 dolly*.

Step 6 – Fitting the top cap lid

1. Carefully slide the probe into the access tube, ensuring the top of the probe seats correctly into the grooves in the top cap. Connect the cable to the green phoenix connector on the top of the probe. Refer to the EasyAG Hardware Manual for wiring instructions for the specific probe interface.



2. Pull the excess cable back through the *cable gland*. The outer sheath of the cable should be trimmed back as far as the point where the cable enters the inside of the top cap. Apply silicone around the wires of the cable at the end of the outer sheath, to prevent moisture from traveling along the cable into the inside of the *top cap*.

3. Ensure that the sealing gasket on the top cap is **clean**, in **good condition** and positioned correctly, and replace the *lid* of the *top cap*. Tighten the screws evenly completely to ensure an effective seal.

4. Tighten the *FairRite bead* and into position and tighten the cable gland. The probe is now installed and upon connection to the data logger is ready for use.

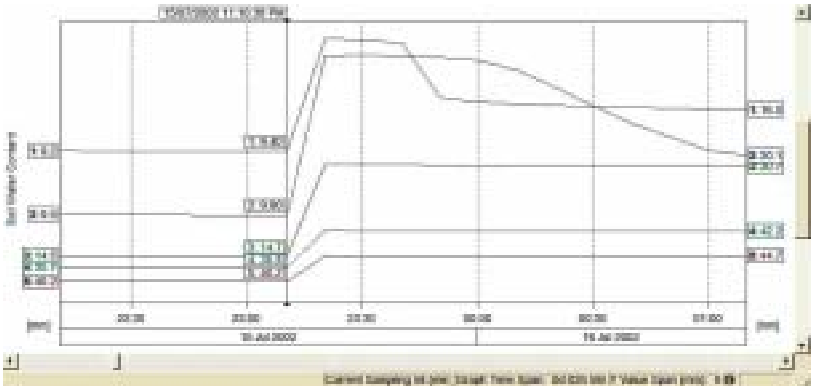
Troubleshooting the preferred installation method

A few known factors may cause anomalies in the data obtained from the **EasyAG** probes. The data itself gives the best indication of a potential problem.

Good versus poor installation

The aim of any installation is to cause as little disruption to the normal soil structure as possible, and provide an environment where the soil moisture may be detected repeatedly and accurately over an extended period of time.

If the surrounding soil is disturbed during the installation process, then air gaps may form down the side of the tube, which can lead to preferential flow of water between the soil and the access tube. Water will travel deeper than in the surrounding soil, leading to a misleading representation of water movement in the soil. The figure below shows preferential flow of water down the side of the access tube, where the wetting front moves to the bottom sensor almost instantaneously.



The movement of wetting front should match the hydraulic properties of the soil, such as shown in the example below.

Techniques for avoiding poor installation

Soil Suitability

EasyAG probes may be installed into a range of soil types ranging in texture from light sand to heavy clay. It is unsuitable for installation in stony ground, where the average stone size is greater than 10 mm. This is because large stones may damage the plastic cutting tip of the probe and divert the direction of the insertion.

Problems may be encountered when installing **EasyAG** probes in **dry** soil. Hammering the probe into dry soil can cause significant back pressure, which can create substantial vibration of the tube and widening of the hole. In extreme situations, hammering the tube into hard, dry soil may cause the dolly to break through the bottom of the access tube. It is recommended that the whole moisture monitoring unit be well-watered to a depth of 1 metre prior to installation. Squirting a small amount of water into the hole prior to installation of the probe may also assist if pre-watering is not possible.

Hammering Technique

Blows from the sledgehammer should be well directed straight down onto the beating head of the *AMS soil sampler* with as little lateral (sideways) impact as possible. This minimizes the chance of an air gap forming between the soil and the access tube. Any air gap will result in preferential flow of water down the side of the access tube. This must be avoided.

Soil Sampler Extraction

When extracting the *AMS soil sampler*, care must be taken to ensure the integrity of the hole is not compromised. The *soil sampler* must be pulled upward directly and smoothly.

Air Gap Correction

At every stage, it is important to avoid the formation of an air gap between the soil and the access tube. In some very loose, recently mounded soils, the formation of small air gaps at or near the surface is almost unavoidable. In these soils, small air gaps of 1-2 mm between the soil and the access tube near the surface may be closed be pressing the soil against the tube using light finger pressure, without causing major errors in soil moisture detection.

Air gaps of greater than 2 mm between the soil and the *access tube* at or near the surface in these soils may be corrected by pushing the soil against the *access tube*. This can be done by carefully pushing a spade into the soil adjacent to the probe and **gently** levering the soil against the *access tube*.

> **Note**: The spade should be at least 15 cm away from the access tube when this is done to limit any errors in soil moisture detection. Any grooves formed by the spade should also be filled in to avoid the formation of areas of water accumulation.

This procedure should **not** be adopted as standard practice in all situations. Sufficient care should be taken to avoid air gaps where possible, and reinstallation should be considered as the first option if air gaps do occur. The above procedure is only recommended in those very loose soils that have been recently formed into mounds, seed beds or similar, where the development of air gaps is almost unavoidable.

Removing EasyAG access tubes

Removal of access tubes is a relatively simple process in loose, sandy soils. It may be done with the electronics in place. Simply excavate some soil from around the probe, then turn the probe in the soil and pull upwards. In heavier soils, it may be necessary to excavate the soil around the probe to a greater depth before the probe can be removed by hand.

Alternatively, the access tubes can be extracted with an extraction tool and with a winch, jack, tractor hydraulics, Sentek extraction tripod or similar. If an extraction tool is used, then the probe electronics should be removed first.

Recommended reading

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Sentek EasyAG® 5-wire Manual Version 0.1

Sentek EnviroSMART™ and EasyAG® RS232/RS485 Modbus Probe Interface Manual Version 3.0.2

Sentek EnviroSMART™ and EasyAG® Voltage Probe Interface Manual Version 1.3

Sentek EnviroSMART™ and EasyAG® SDI-12 Probe Interface Manual Version 2.1

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