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Soil Moisture Monitoring For Pasture

» Why Monitor Soil Moisture

- **Primary focus :**
  - **Maximising water use efficiency**
  - **Highest DM production per mm of rain**
- **Factors**
  - Best pasture mix for location
  - Maximising opportunities for re-growth
  - Best management of number of stock and when to move on and off paddock

» Why Monitor Soil Moisture (ctd)

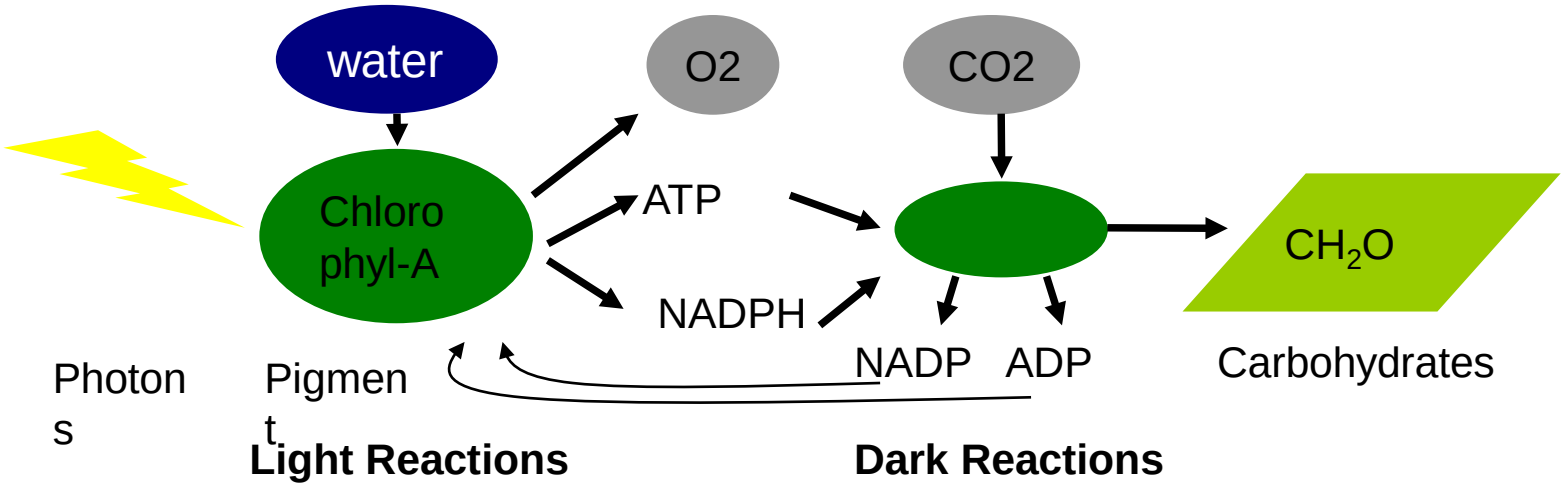
- **Soil Moisture Probes can help**
  - Provide another tool : one more piece of information to consider
  - Show what is otherwise invisible: moisture status of plants

    - Likelihood of meeting objectives with
      - (a) current moisture levels and
        - (b) likely future rain

» Plants as a Chemical Process

Inputs: CO2 + Water + light

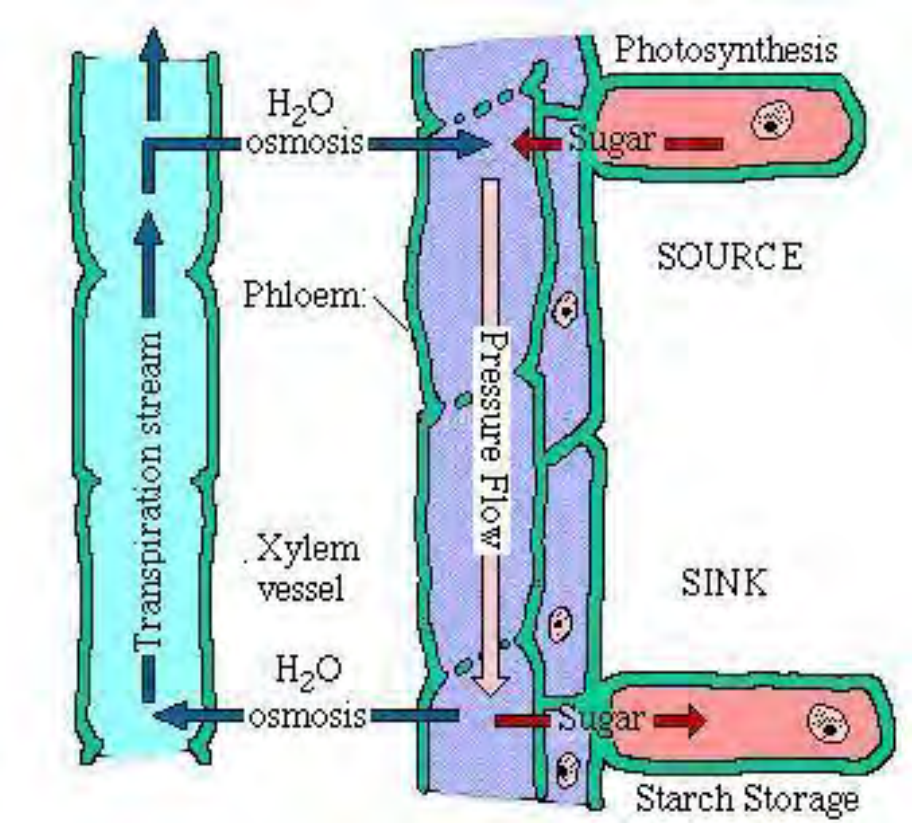
Outputs: Glucose + Oxygen + Water



» Plants as a Siphon

Driven by suction created by water exiting leaves

- 10% : Used in photosynthesis (growth)
- 90% : Used in transpiration (Cooling, transport, turgour)

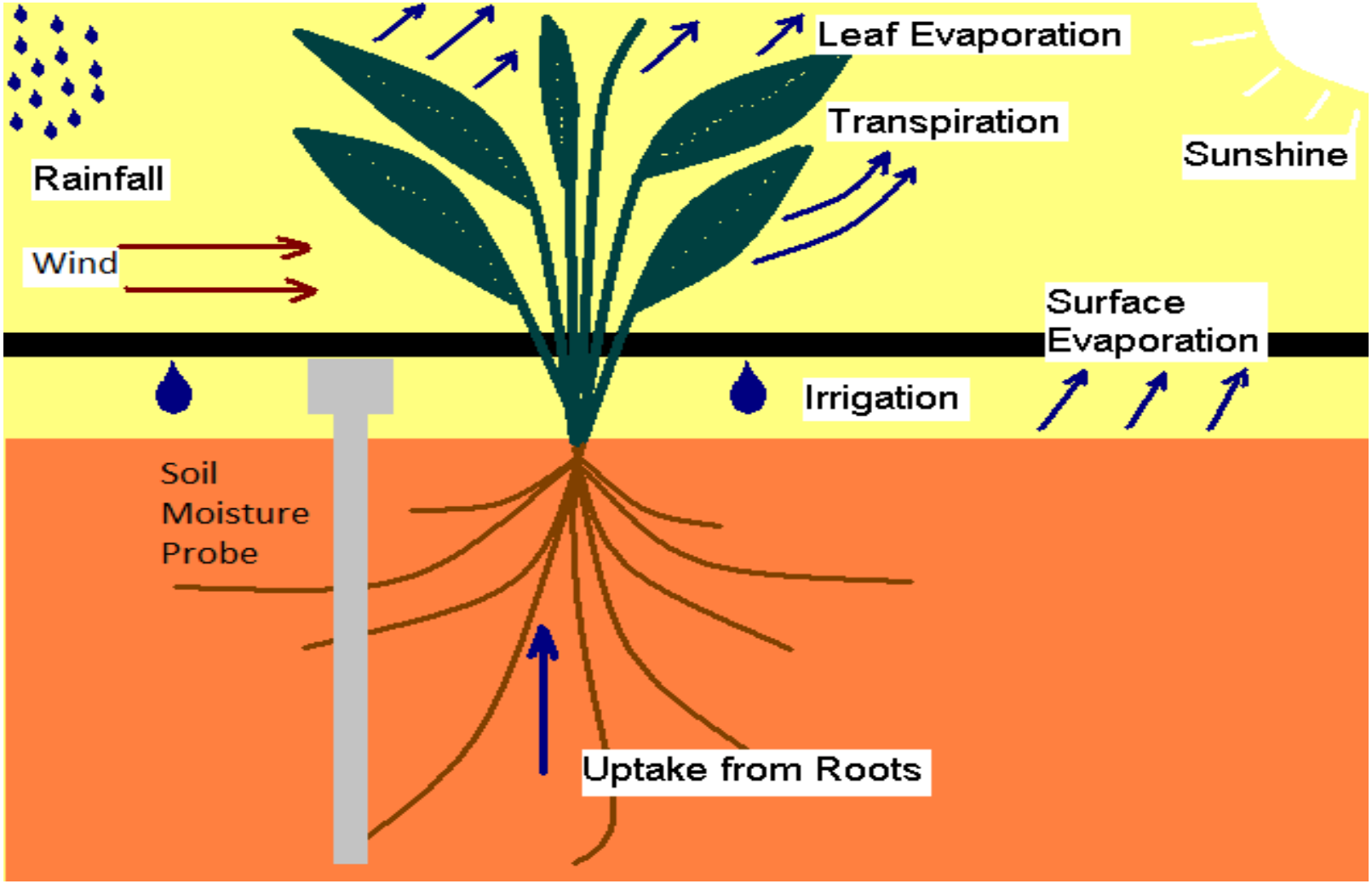


Source: http://home.earthlink.net/~dayvdanls/plant_transport.html
Plant Transport Mechanisms

» The Plant as an Engine – Evapotranspiration

Inputs:
Sunlight,
Water,
Nutrients

Outputs:
CO2, O2,
Plant
Tissue



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» Drivers of Water Use (Evapotranspiration)

Factor	Relationship to Water Use	Impact
Solar Radiation		Primary Driver of Growth - Provides energy for cell growth & division - Increased radiation = increased growth
Air Temperature		Air molecules more active, easier for moisture to escape
Relative Humidity		Harder for water molecules to escape to the air
Wind Speed		More air passing over leaf surface -> more water removed

» Limiters of Water Use (Evapotranspiration)

Other factors which limit ET (& hence Growth)

- Nutrient availability
  - Appropriate fertiliser regime
- Root zone depth (size of bucket)
  - Improve soil health to build bucket
- Physical barriers
  - Difficult & expensive to remediate
- Chemical barriers (in soil) : Deep rip?

- In most regions of Australia, dominant factor is water availability

» What the Plant Sees

3 Competing Forces:

Matric potential

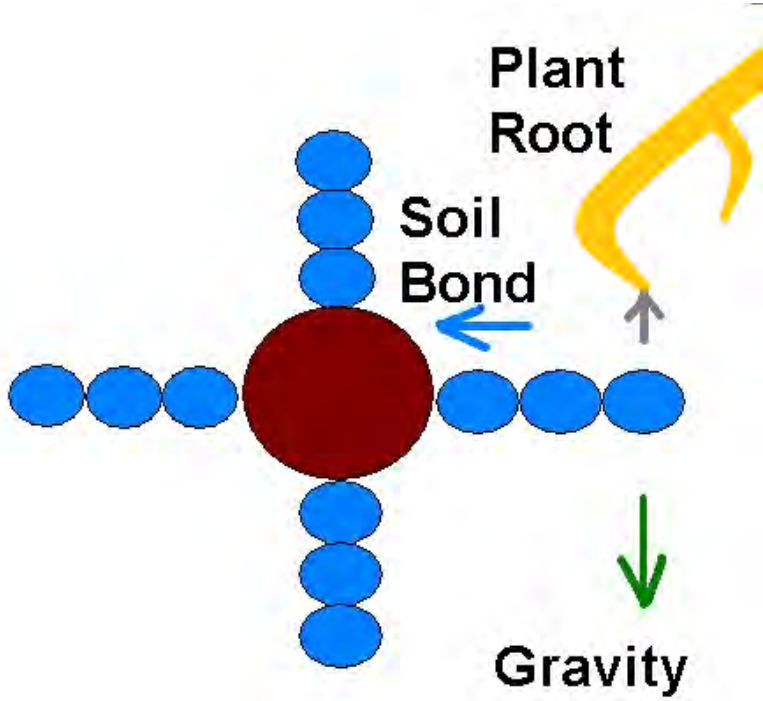
- Force being exerted through root membranes

Soil bond

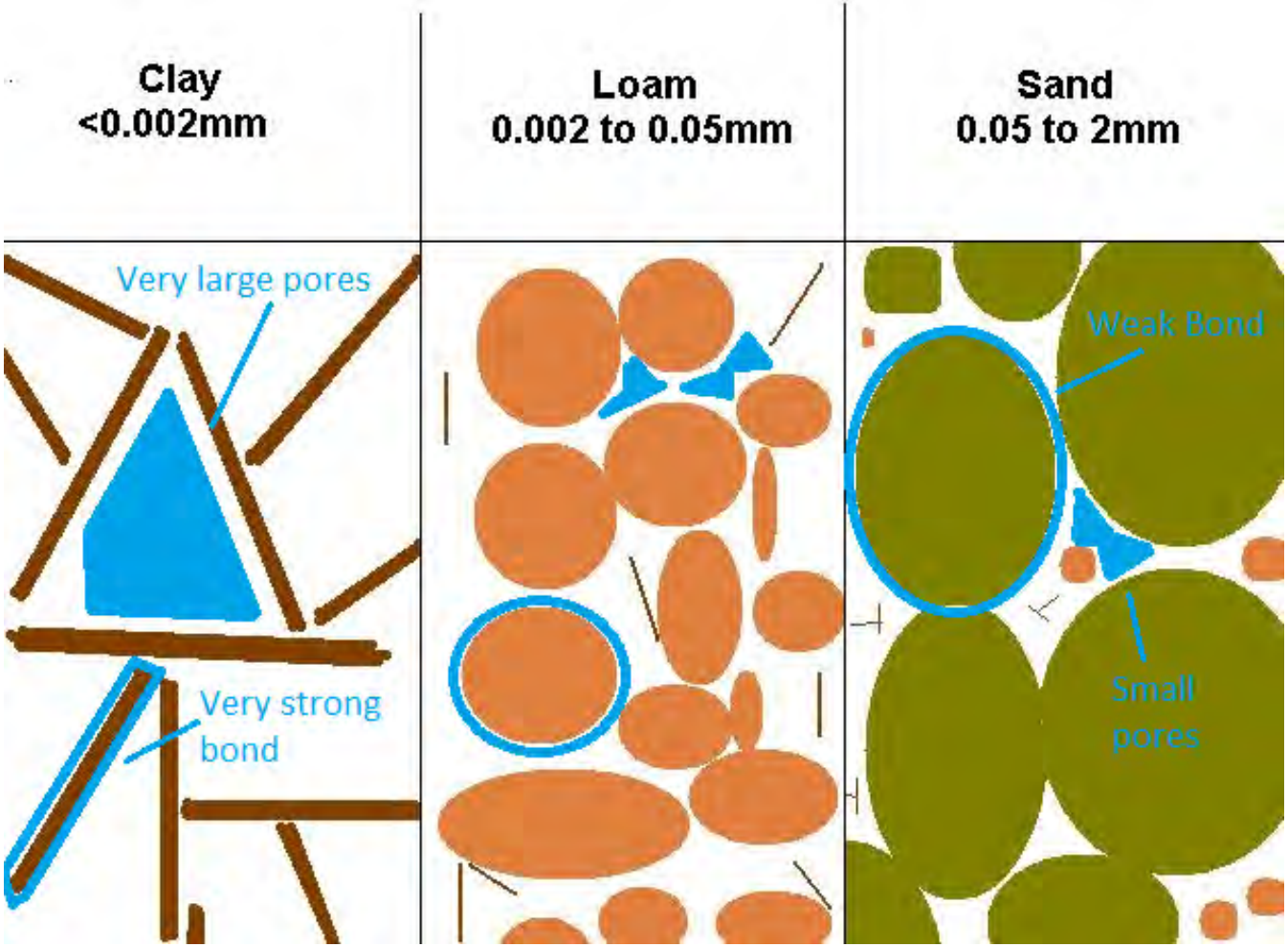
- Larger particles : weaker bond
- More water : weaker bond

Gravity

- Eventually pulls water away as drainage



» How does soil type influence this?



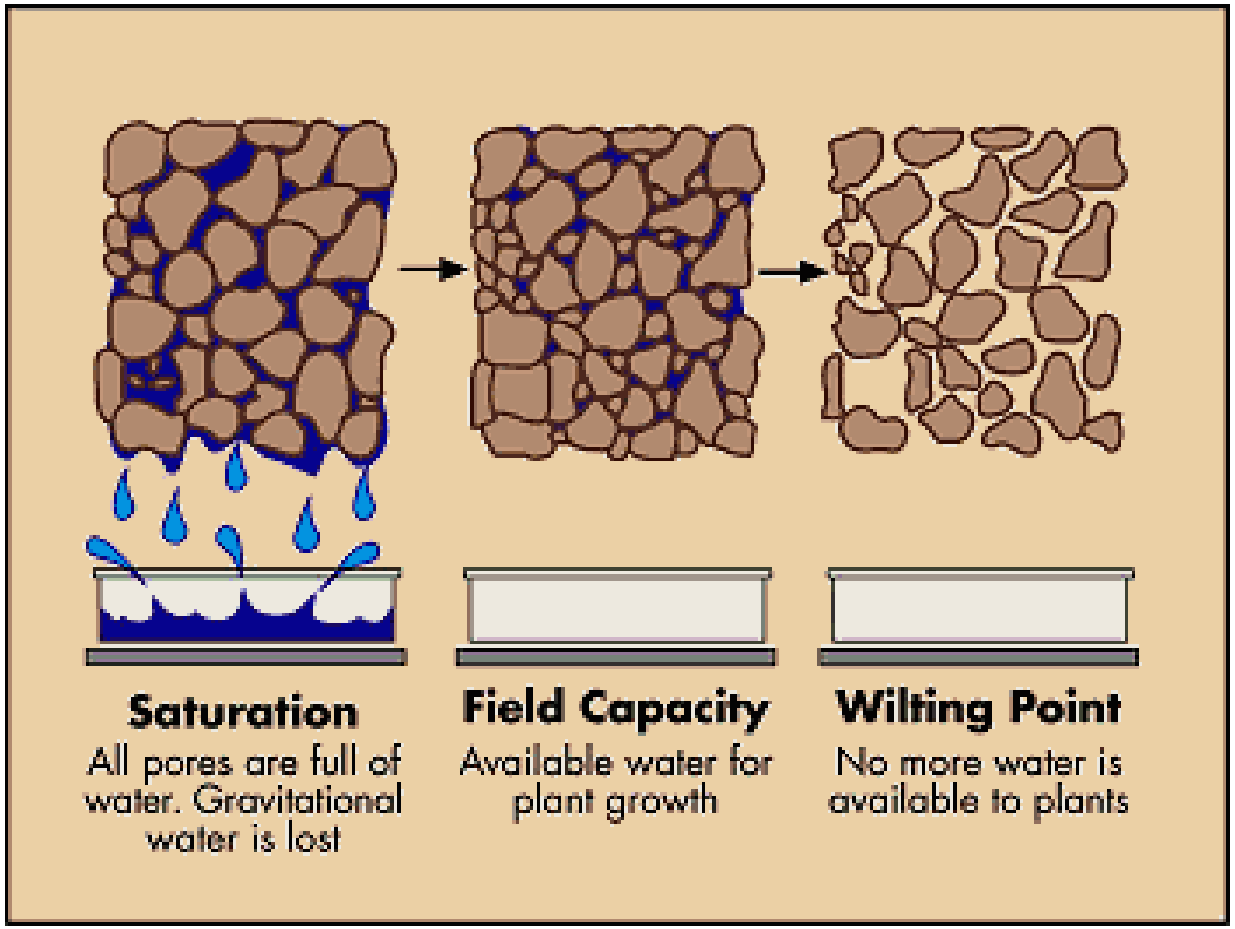
»The Influence of Soil Type

Clay Soils:
- Hold the most water
- A lot is too tightly held to be used by plants

Sandy Soils:
- Hold the least water
- Water is readily available

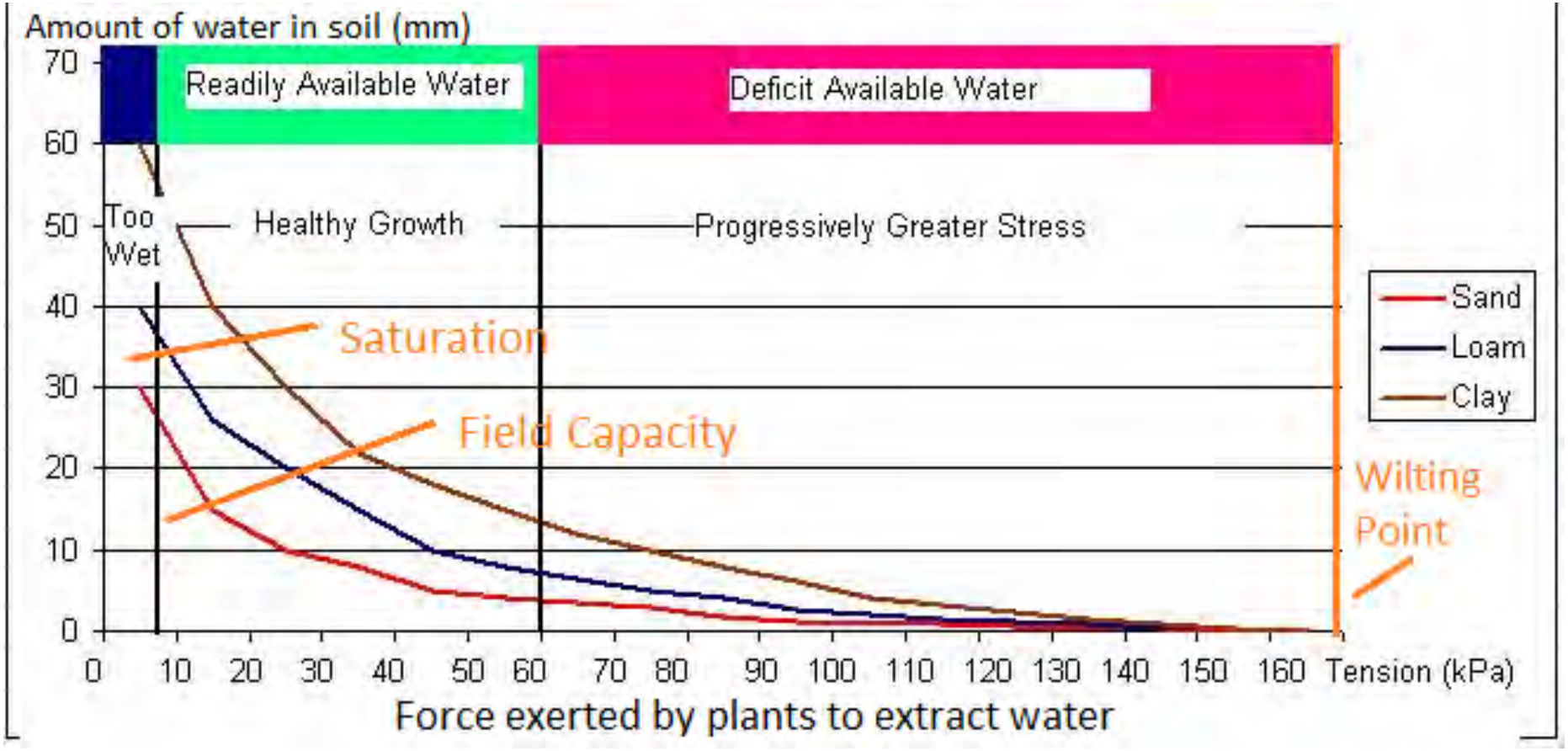
Loam Soils:
- Hold less water than clays
- But more of it is available
- The best choice for many situations

»Key Water Storage Points



Source: www.bettersoils.com.au

» Soil Water Release Curve



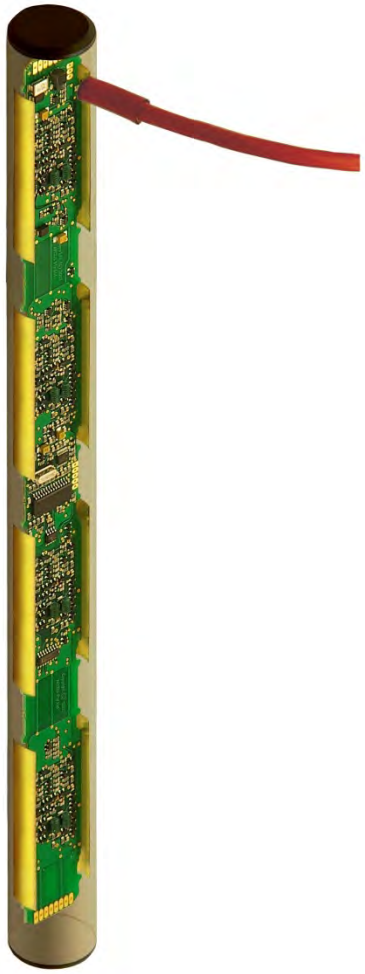
» Soil Moisture Measurement

Measure	Units	Thresholds	Sensors	Comments
Content (Volu-metric)	**% mm**	**Soil Specific – different for each soil**	Capacitance Probes, Neutron Probe, TDR	**Wide Range** **Easy to install** **Hard to Interpret**
Tension (Matric Potential)	**kPa**	**Fixed – related to plant physiology**	Tensiometers, Gypsum Blocks	**Limited Range** **Easy to Use** **Not practical to install**

»Soil Moisture Measurement

Capacitance Probes

- May not be the best sensor, but the most practical
- Measure ability of soil to store electrical energy
- Read at multiple depths
- Simplest to install
- Can be buried below surface



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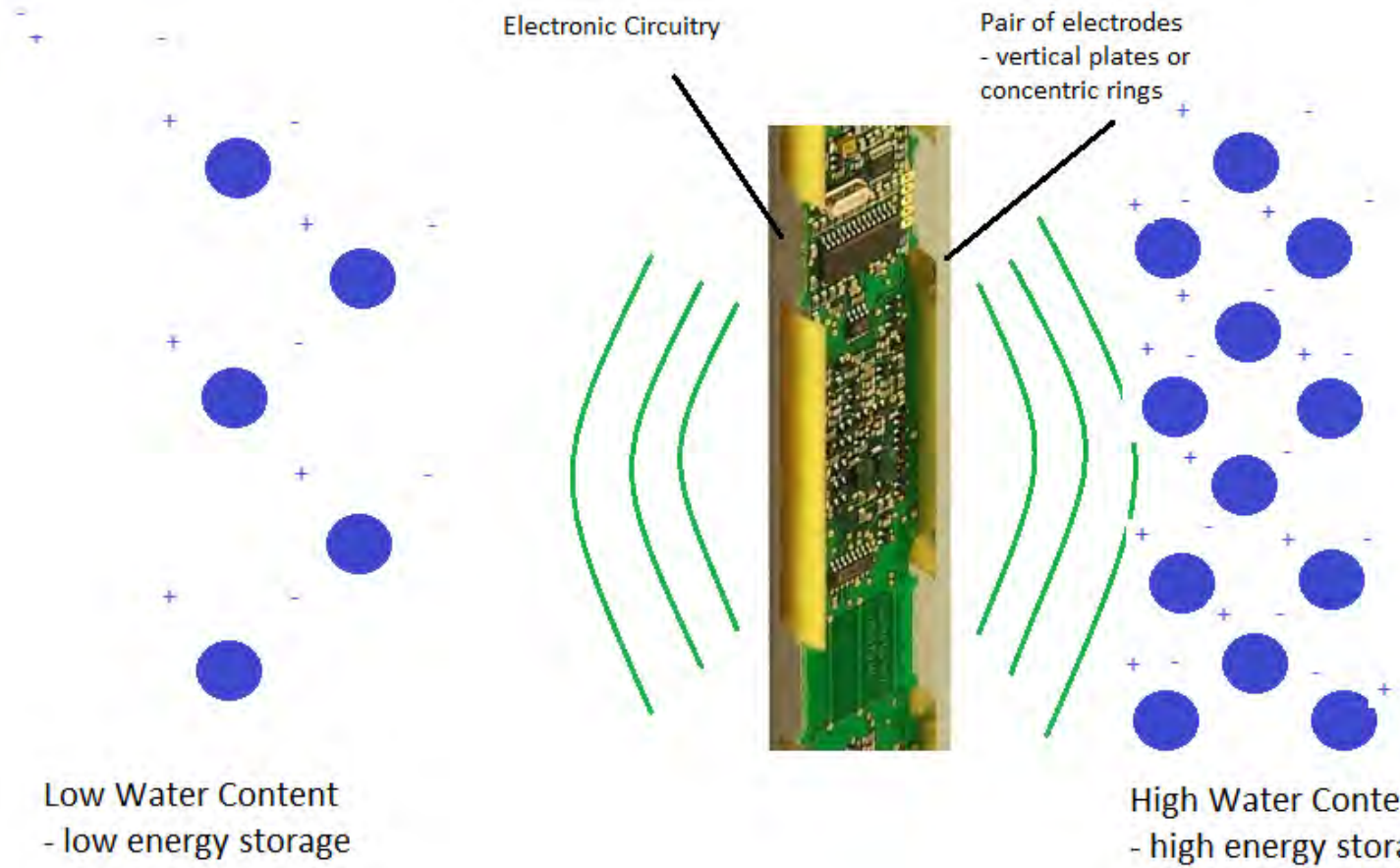
»Capacitance Sensors – how they work



Electric field "polarises" water molecules
- polarity changes millions of times a second
- each change takes energy
- more water means more energy stored in soil
- measure as "Capacitance"

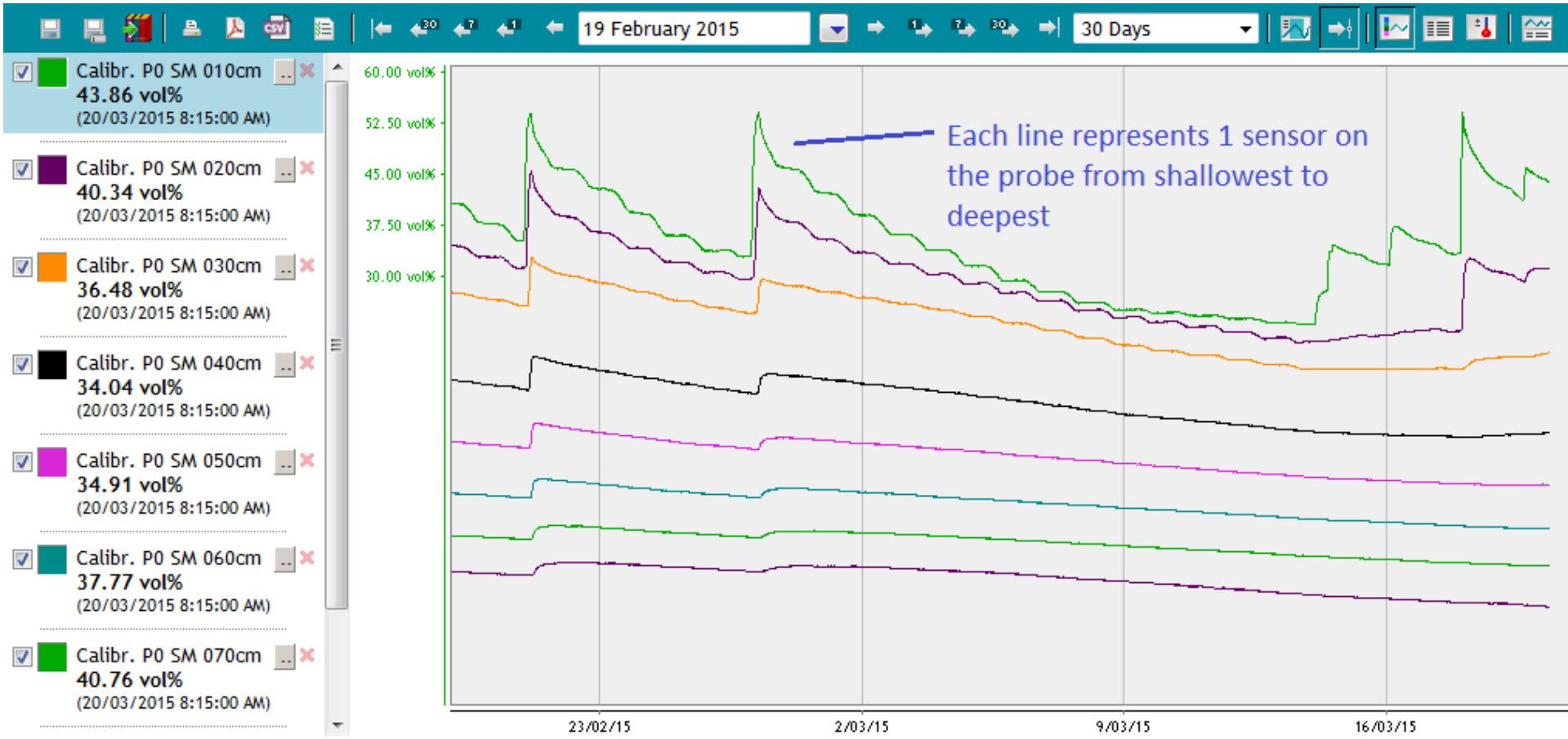
» Pasture Soil Monitoring Station

- **Location**
  - Flaxman Valley, Keyneton, Kooyunga
- **Equipment**
  - Solar powered telemetry unit
  - Rain gauge
  - Sub-surface soil moisture probe
  - Temperature & humidity
  - Wind speed

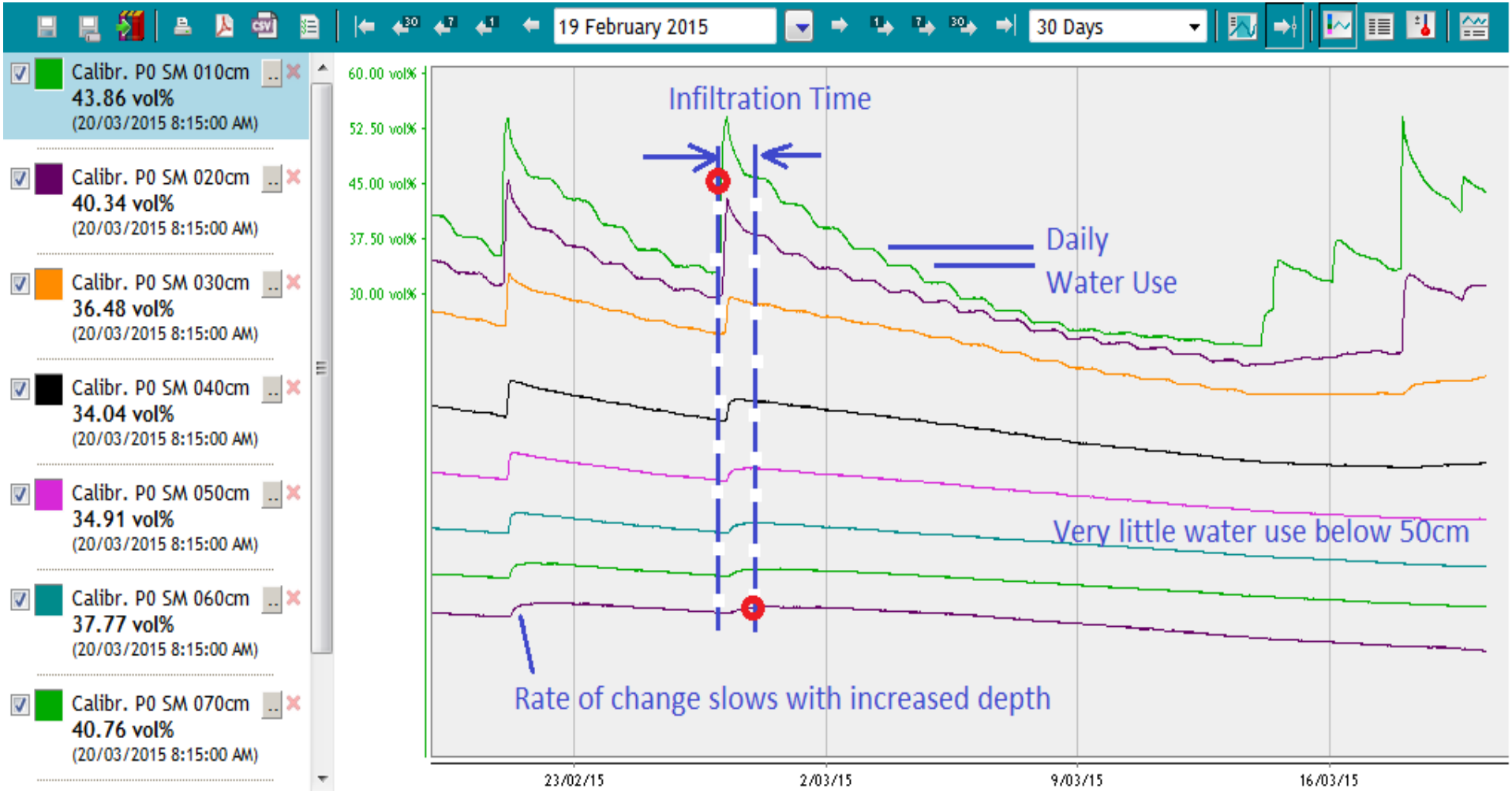
» Broadacre Soil Monitoring Station (ctd)

- **Probe Installation**
  - Buried 15cm below surface
  - Measuring moisture and temperature at depths of 20, 30, 40, 50, 60, 70, 80, 90cm
  - Cabled back to telemetry unit

»Soil Moisture – Stacked Graph



» Interpreting Stacked Graph



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» Stacked Graph with Rain

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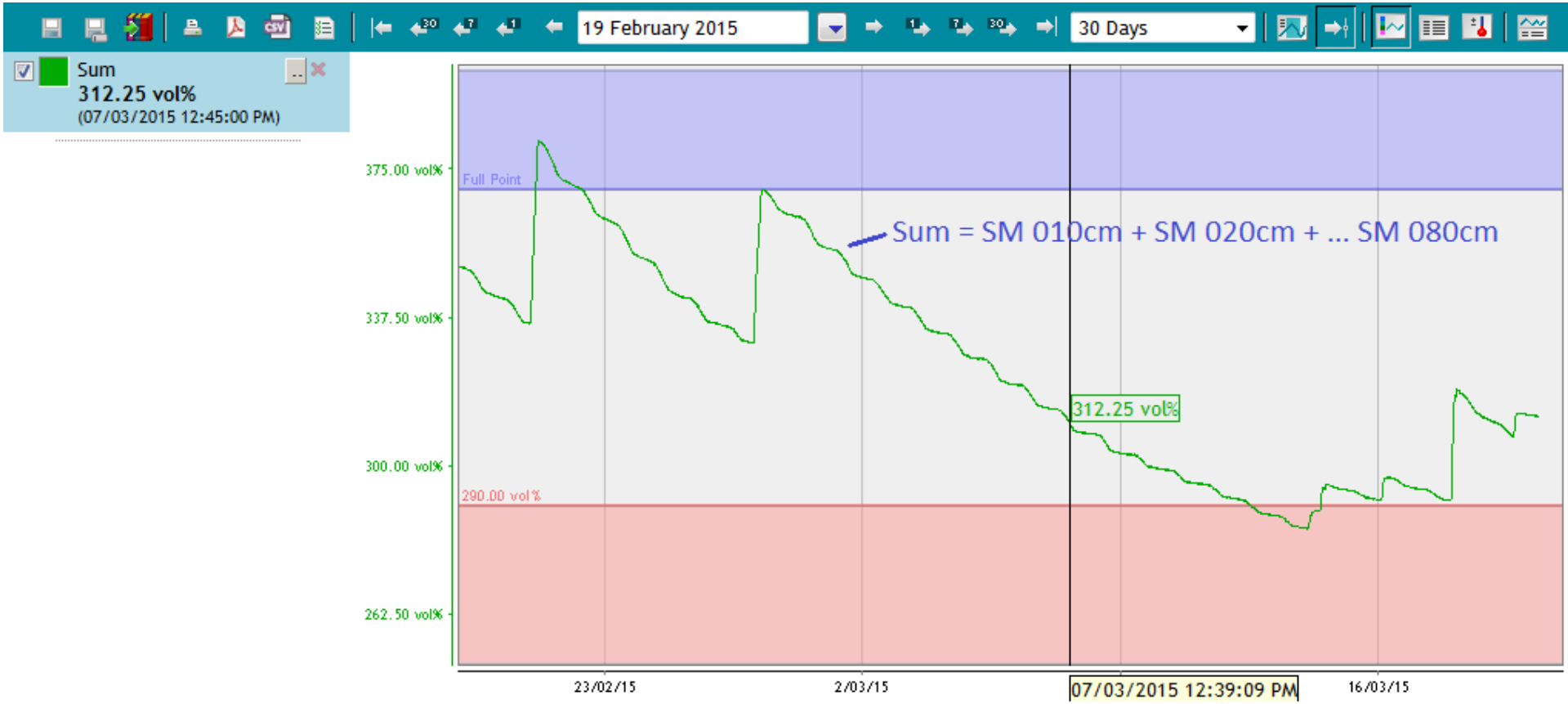
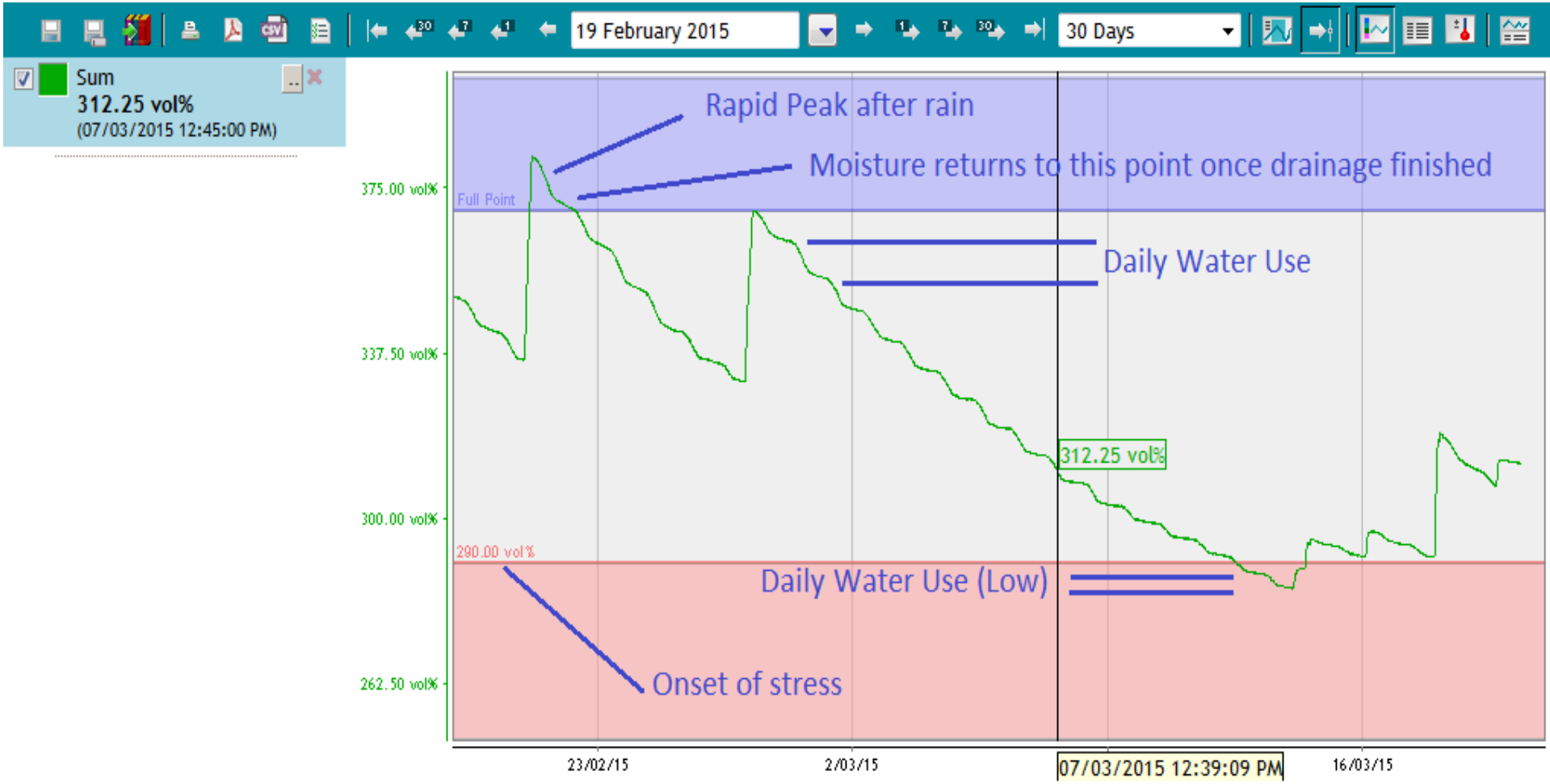
»Soil Moisture – Summed Graph



»Interpreting Summed Graph



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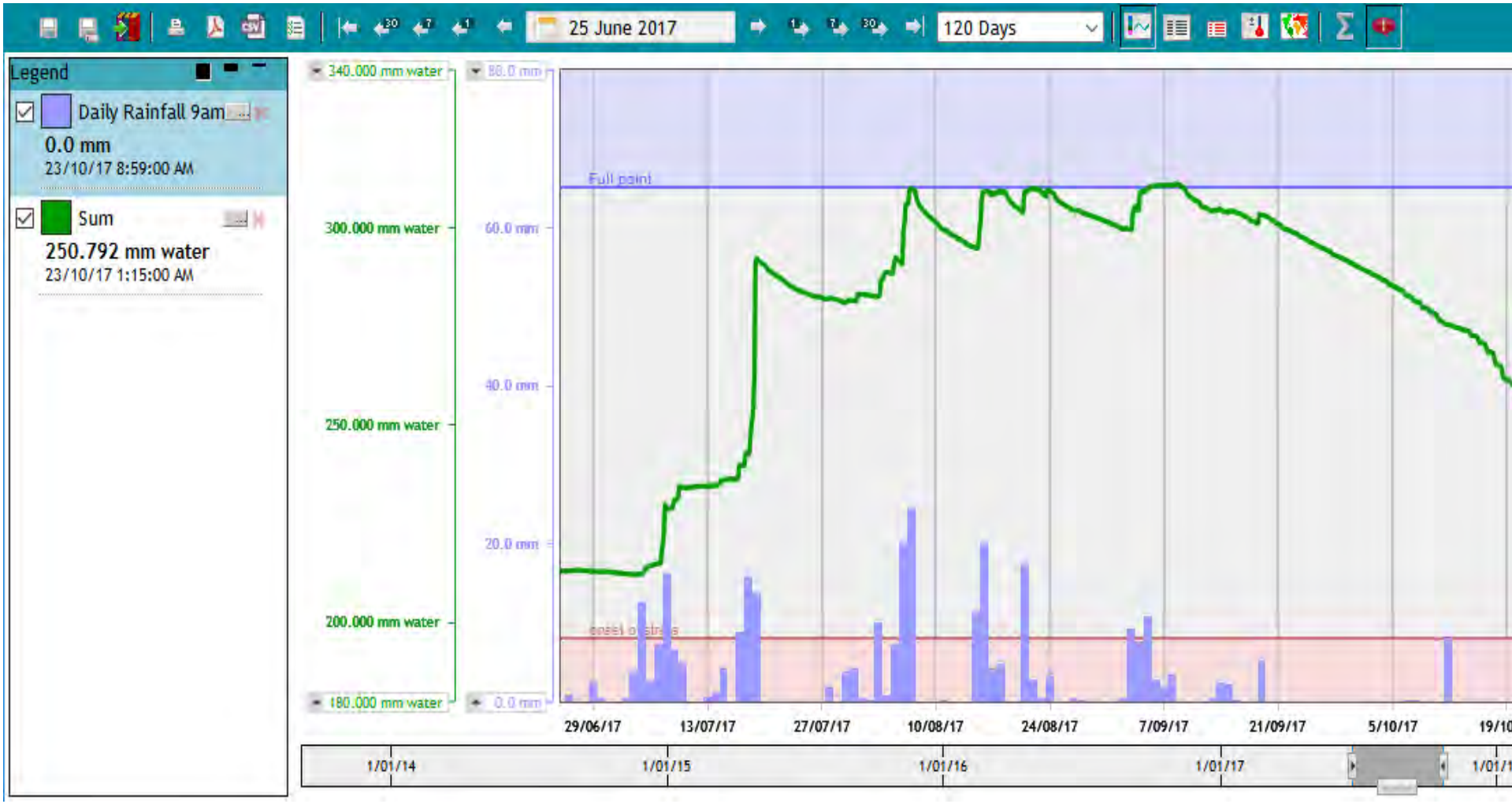
»Soil Moisture – Sum with Rain



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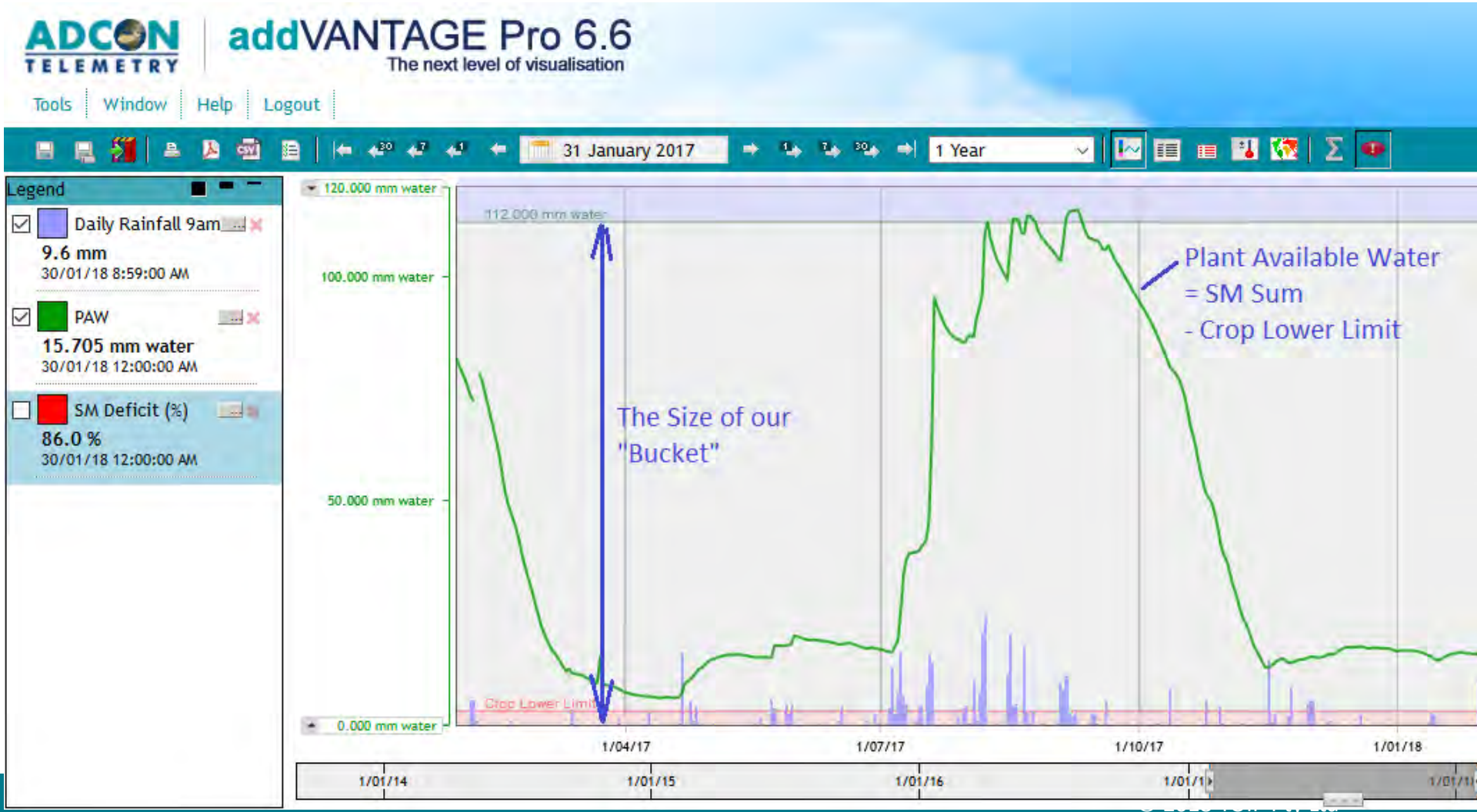
»Soil Moisture – Plant Available Water



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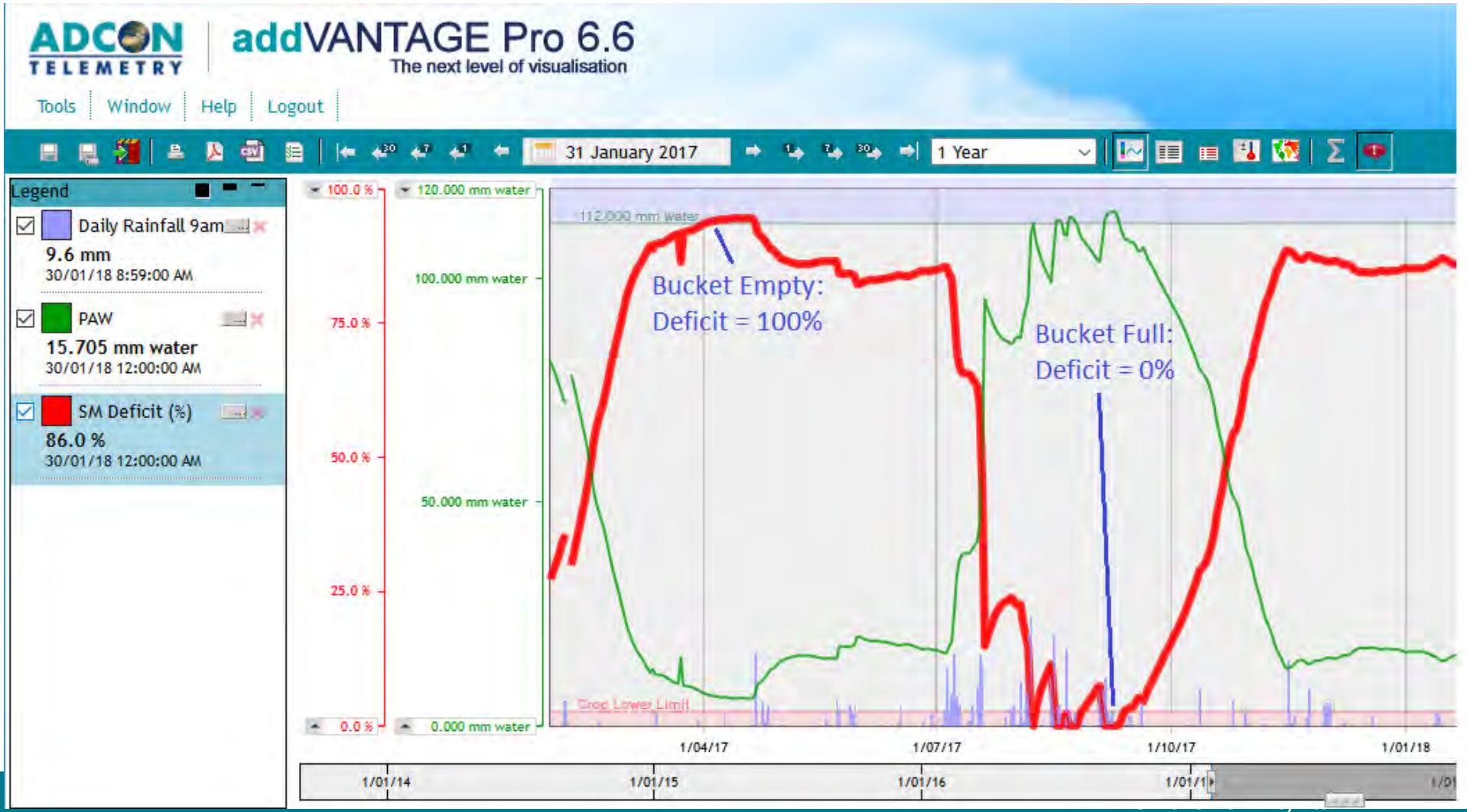
»Soil Moisture – SM Deficit



» Accessing BIGG Soil Moisture Information

- **From BIGG Web Site**

  http://biggroup.org.au/project/soil-moisture-monitoring/

- **Follow links to Flaxman Valley, Keyneton, Koonunga**