

# Smarter Irrigation Summary

## Water Use Efficiency

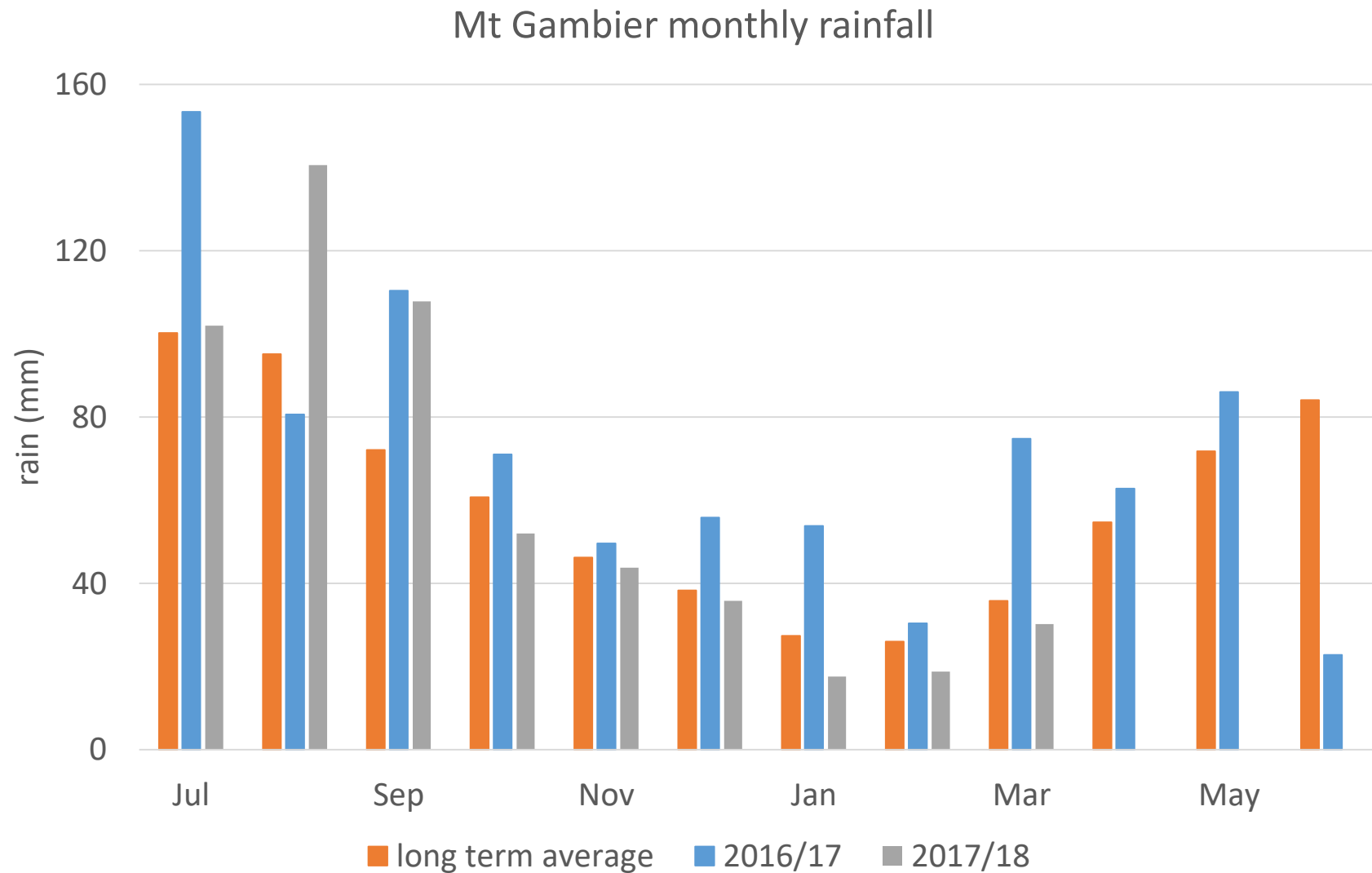
Blue Lake Golf Course, 12 April 2018

Nigel Fleming, SARDI

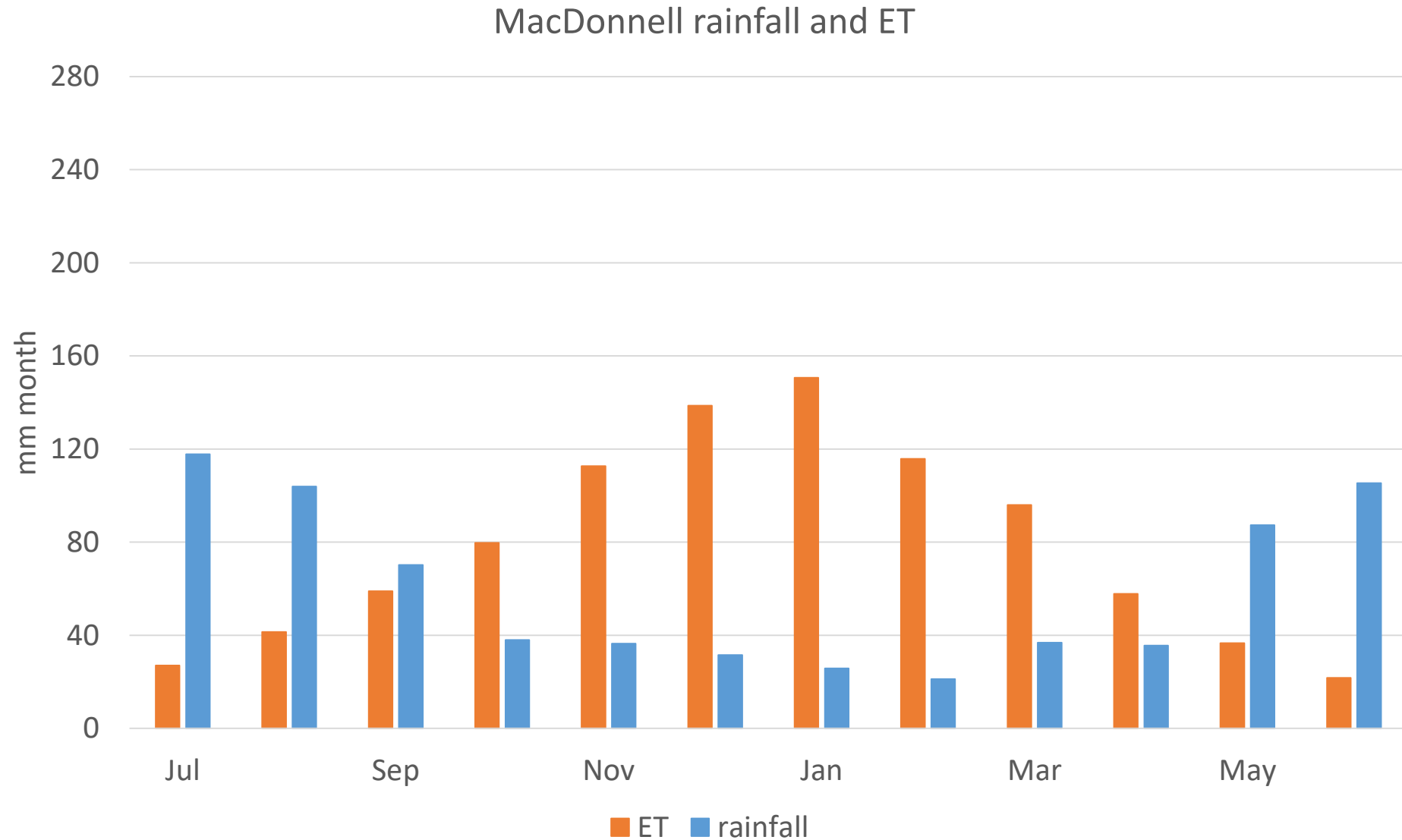
# Water Use Efficiency is determined by

- crop and climate = how much water needed
- irrigation infrastructure (pump, centre pivot) = how effectively water is delivered
- management = amount and timing of irrigations

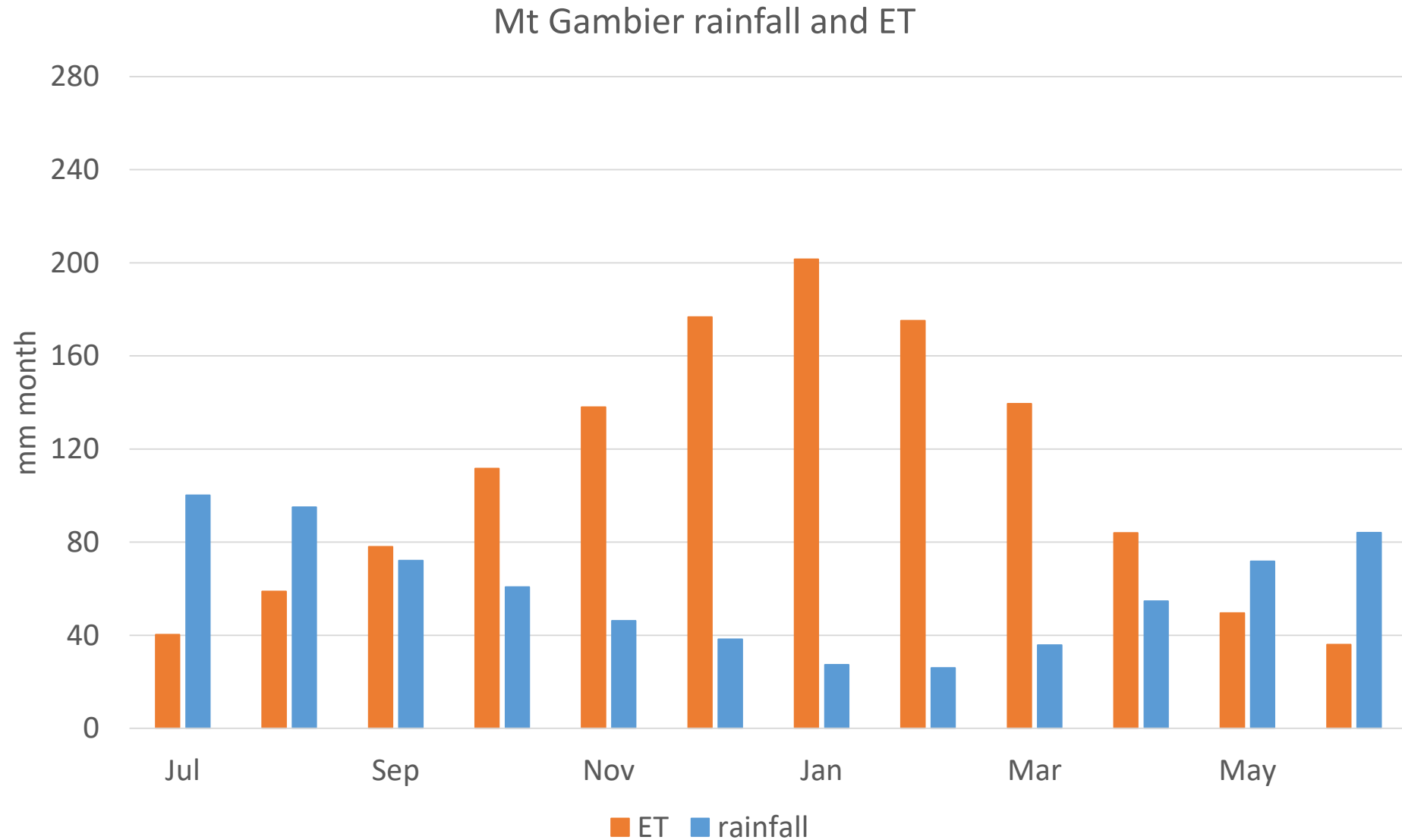
# Climate – annual



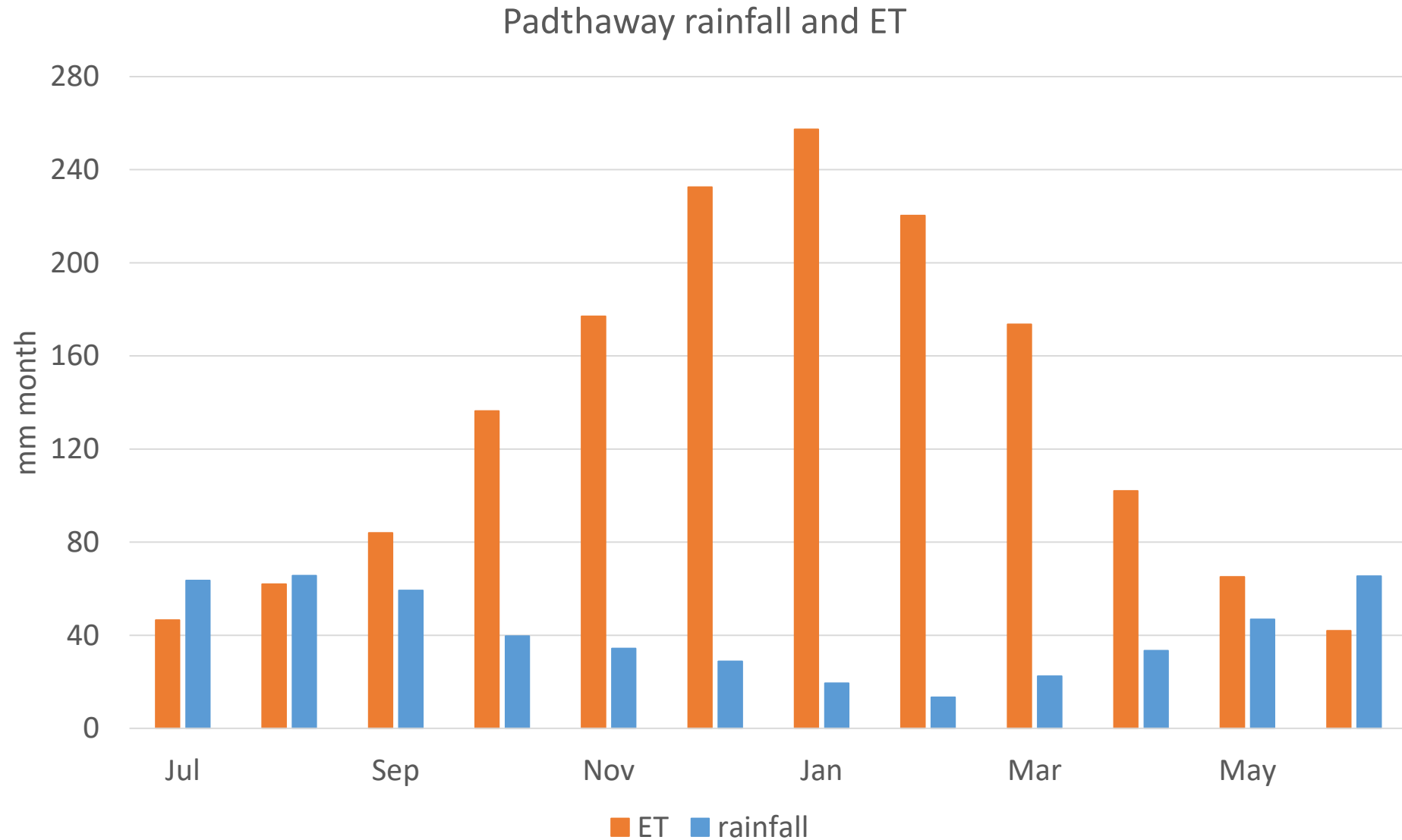
# Climate – location



# Climate – location



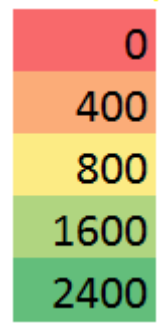
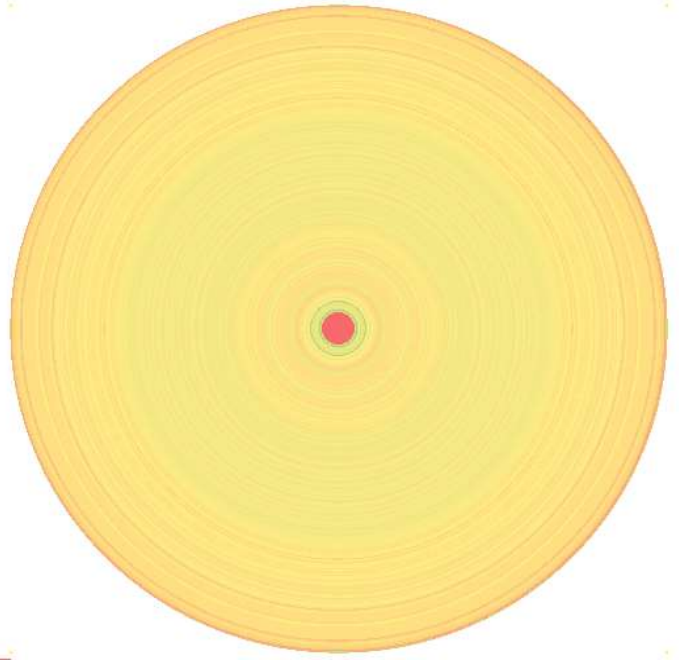
# Climate – location



# Infrastructure

- pump efficiency – match pump and motor to system
- diesel engine revs
- centre pivot – catch cans

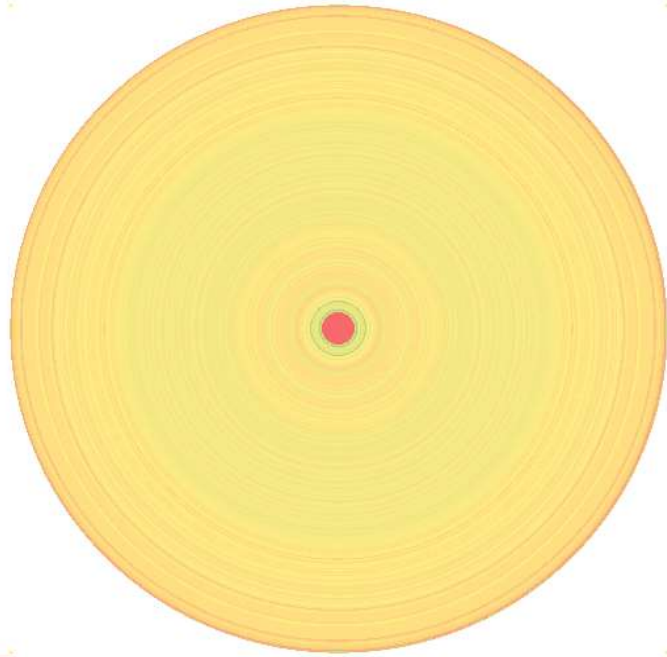
2 years old



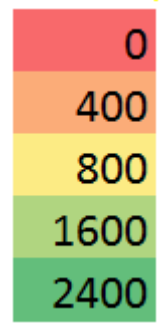
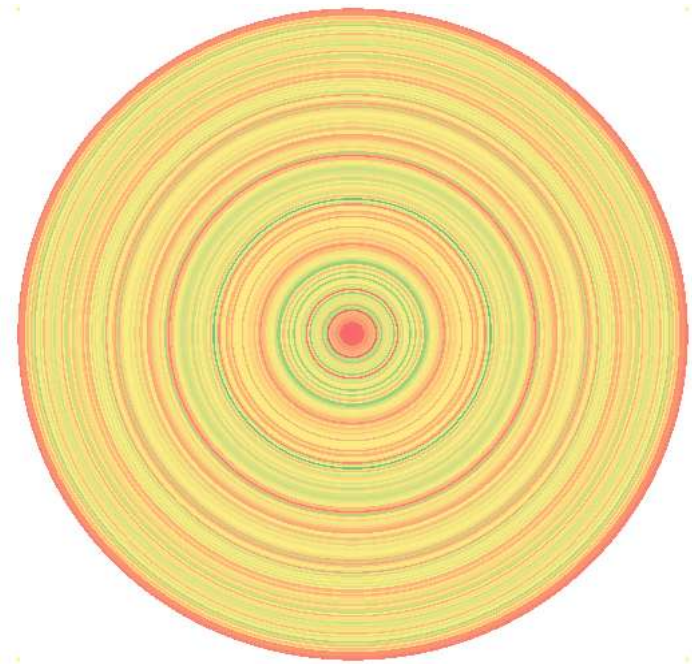
mm/yr applied



2 years old

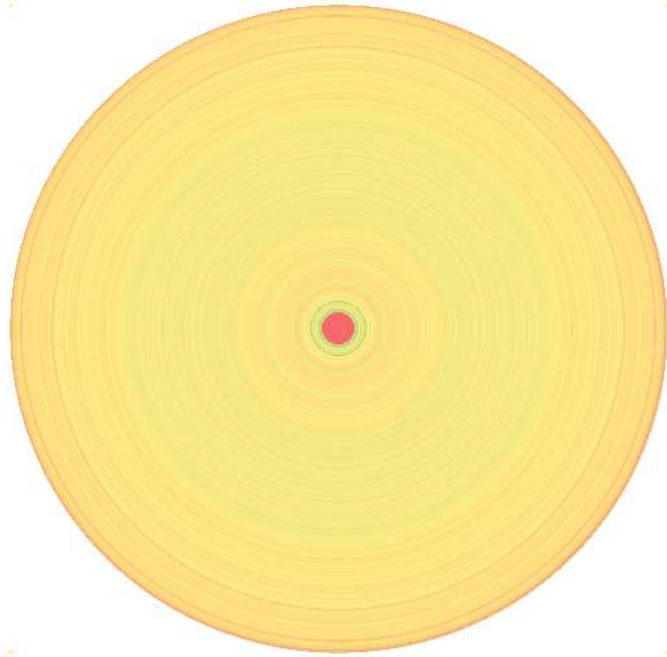


15 years old

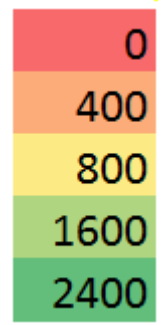
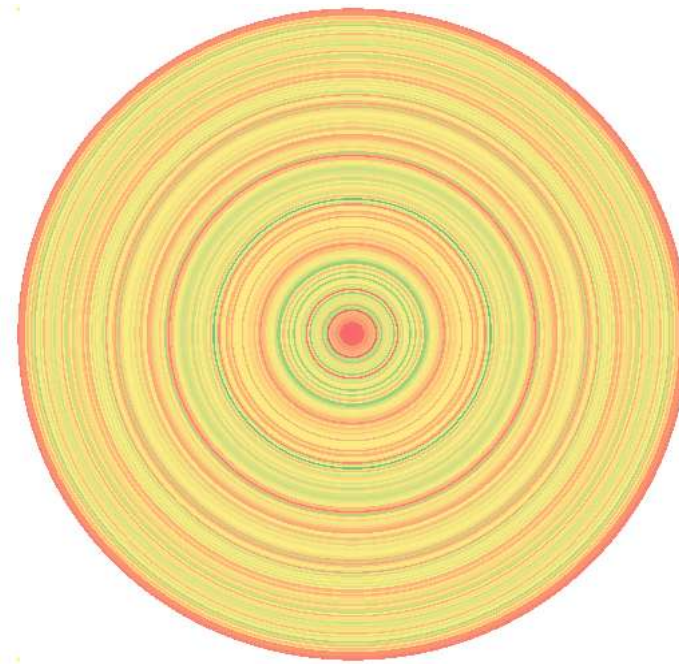


mm/yr applied

2 years old

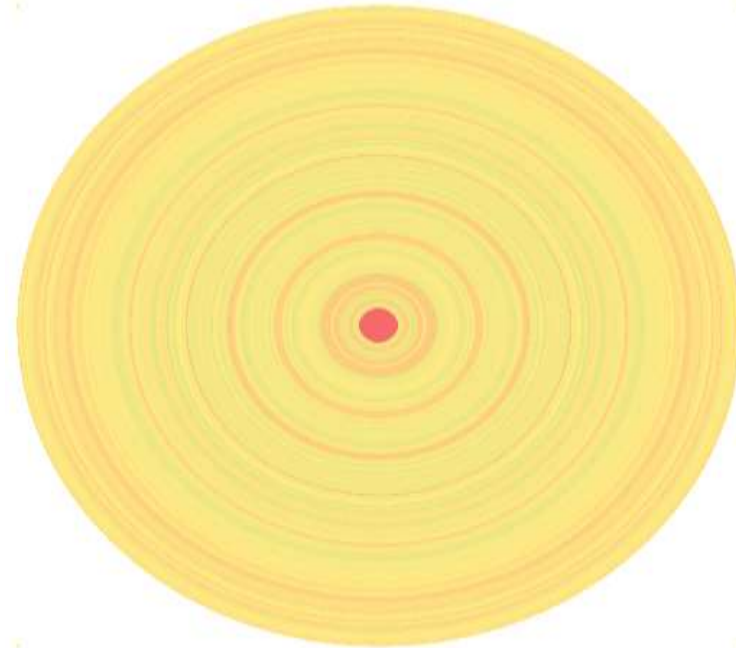


15 years old



mm/yr applied

new sprinkler pack



# Irrigation Management - how much and when?

- how much - mm per irrigation?
- set to RAW of most sensitive soil of importance
- e.g. soil A, RAW = 20mm, covers 60% of pivot  
soil B, RAW = 10mm, covers 40% of pivot
- irrigate to RAW of soil B, i.e. 10mm per application

# Irrigation Management - how much and when?

- if rate is less than RAW – need more frequent irrigations
- if rate is greater than RAW – waste water
- e.g. RAW of 10mm. With 15mm irrigation:

10mm to pasture production

5mm drainage (waste)



# Irrigation timing?

- keep soil moisture between:
  - as wet as possible without drainage (field capacity) and
  - as dry as possible without reducing growth rate (irrigation trigger level)
- Irrigation timing is a balancing act
  - soil moisture sensors can help

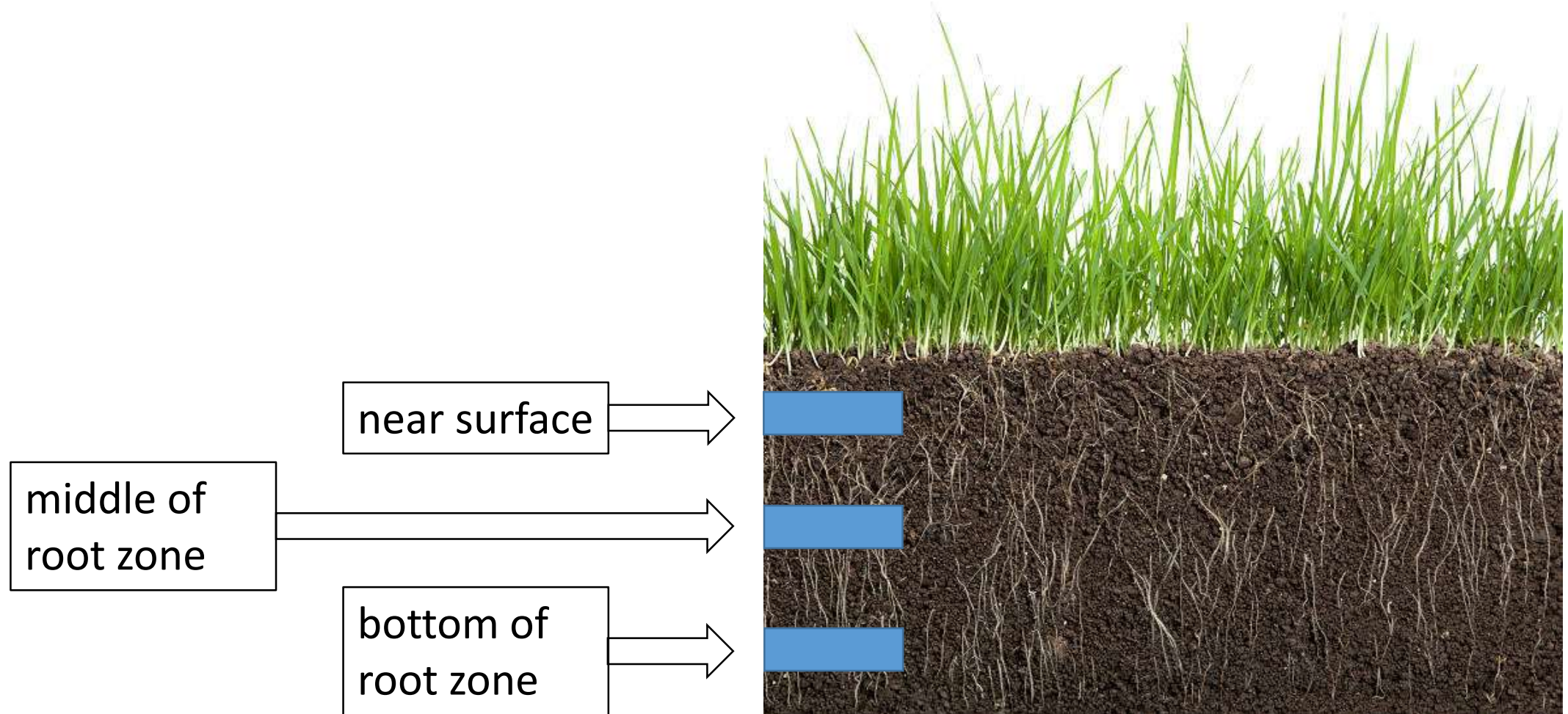
# Soil Moisture Sensors – why bother?

- cost
- time and effort
- already know what to do

# Soil moisture sensors will help your irrigation to work better

- need to keep soil between field capacity (wettest) and trigger level
- how?

# Sensors usually installed at 3 depths





# near surface

- shows every irrigation and rainfall
  - changes quickly
  - OK to dry out if water in other parts of root zone
  - irrigation needs to get past this sensor and go into rest of root zone
- shows the amount of water held in upper root zone



# middle sensor

- shows the amount of water held in main root zone
- registers irrigation and rainfall



# lower sensor

- shows water held at the bottom of the root zone
- also shows water getting past the root zone (drainage = waste)
- ideally stays fairly stable
- can show gradual increase or decrease over time for fine tuning



ideal



OK



OK



OK



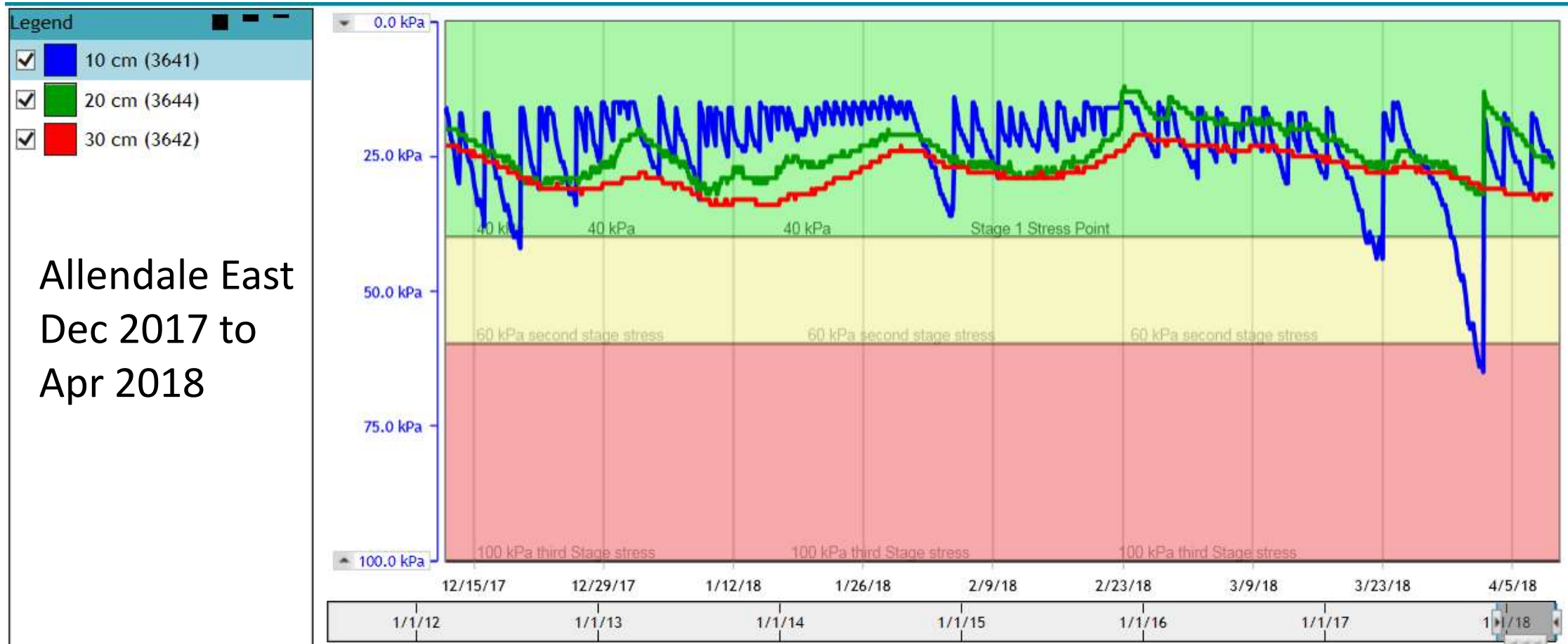
need to irrigate





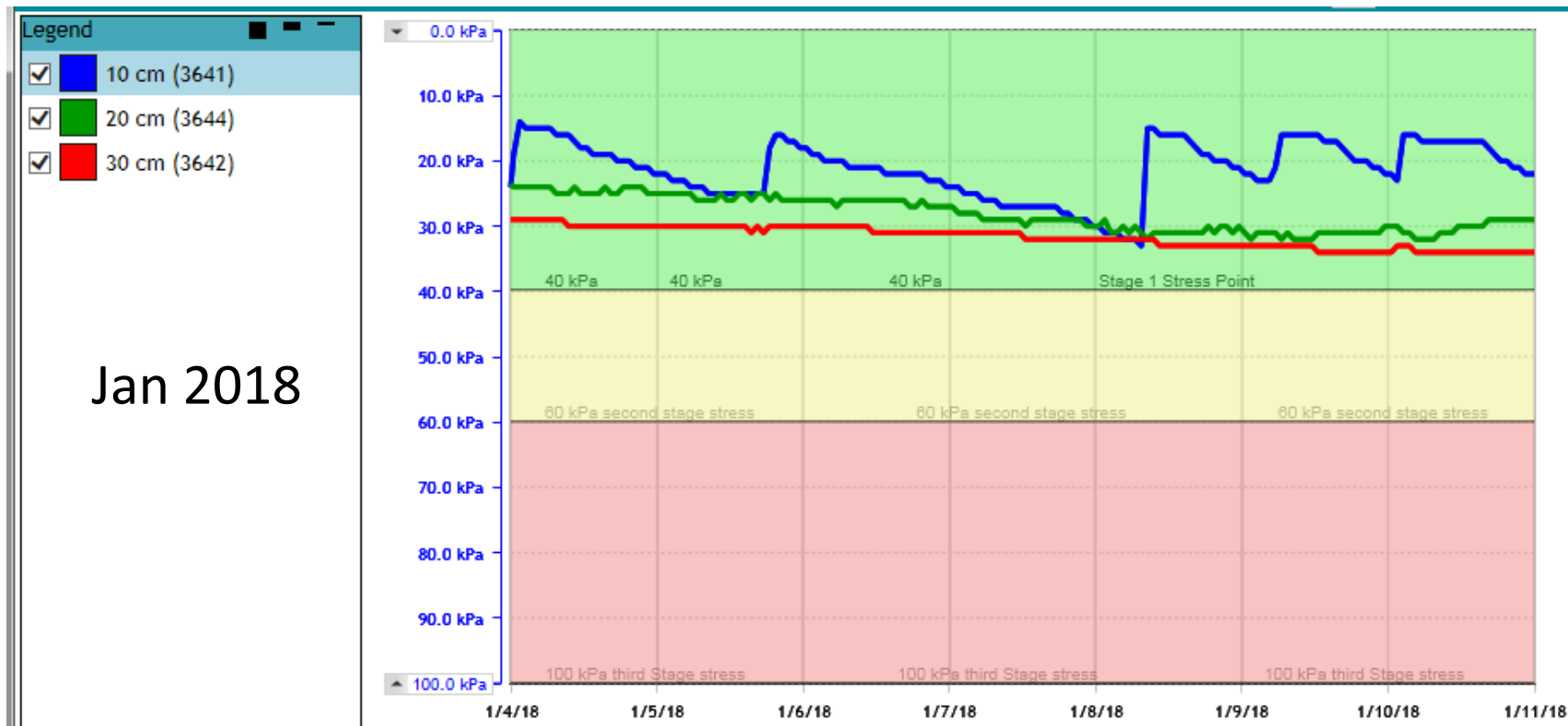
# Where to start?

- Find your “green zone” and keep soil moisture there



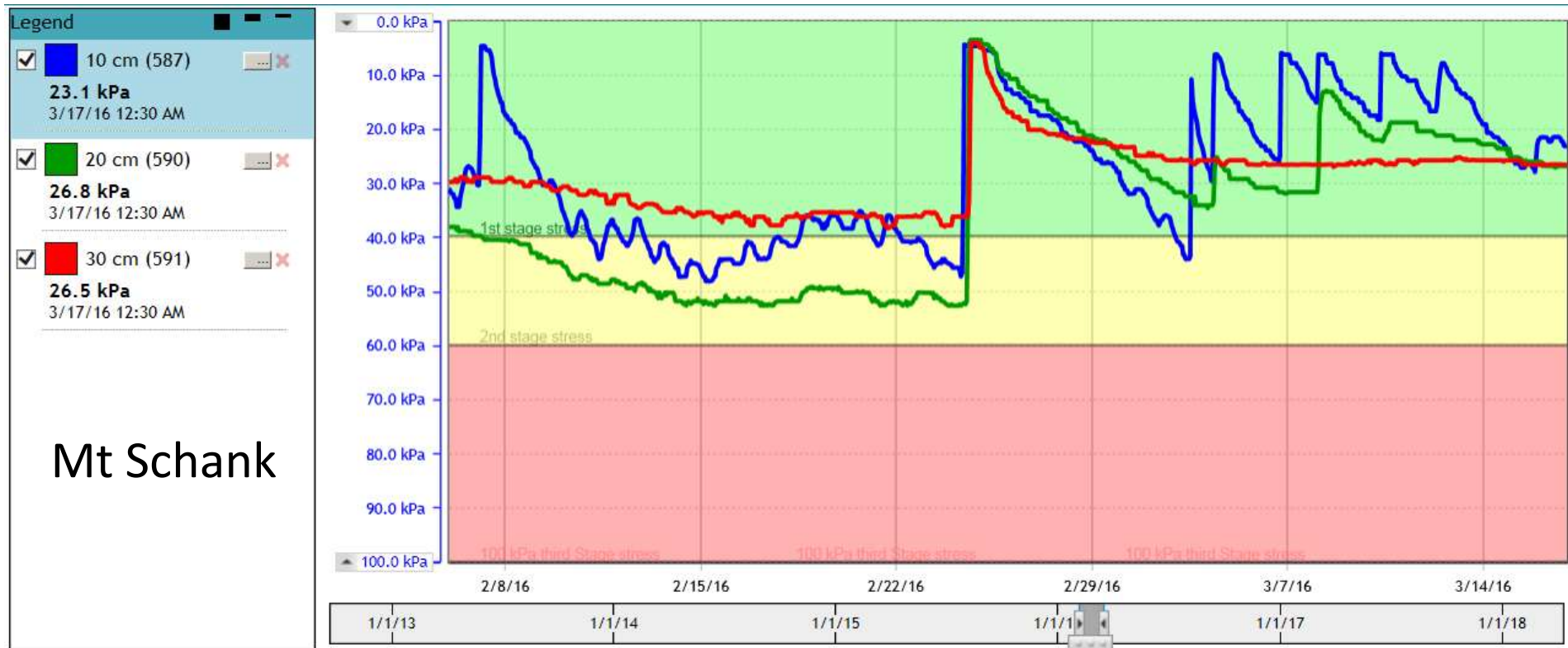
# Where to start?

- Allendale East - adjust irrigation timing for ET and rainfall



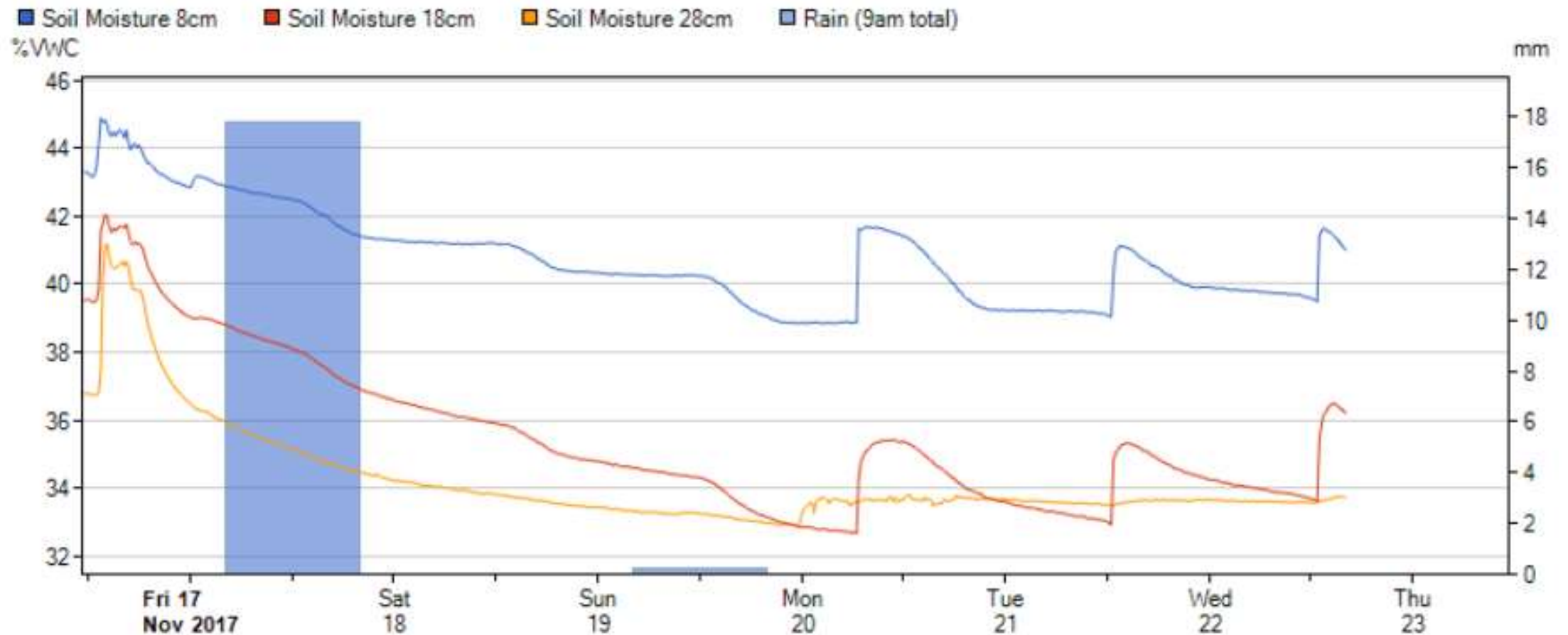
# What else can you use the sensors for?

- follow recovery from missed irrigations
  - pivot breakdown
  - silage cutting, etc



# how long to hold off irrigation after heavy rainfall?

- four days in this case

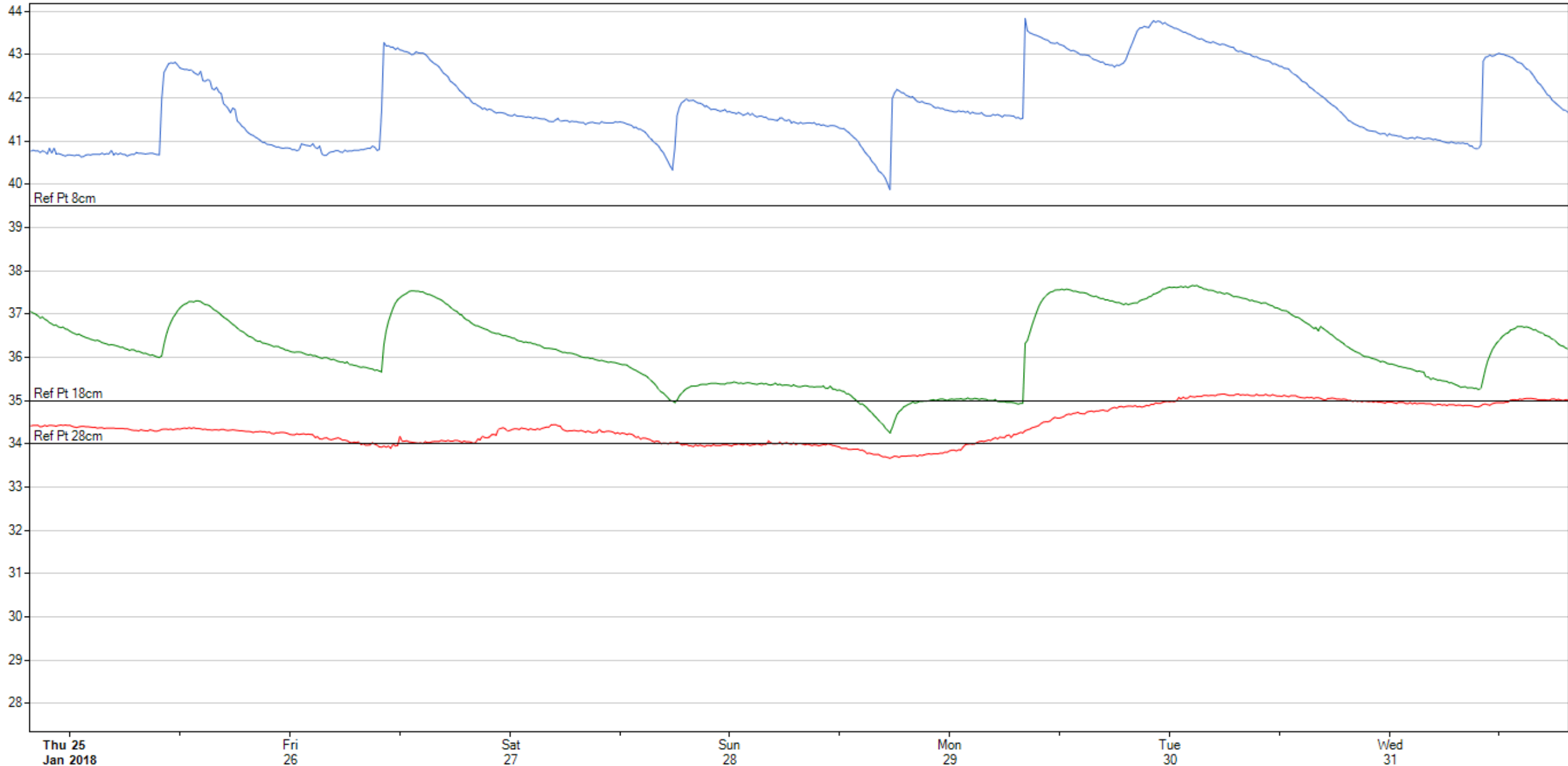


# 3 different sensor locations at pivot 6

- what is most representative?
  - dry area
  - normal area
  - wet area

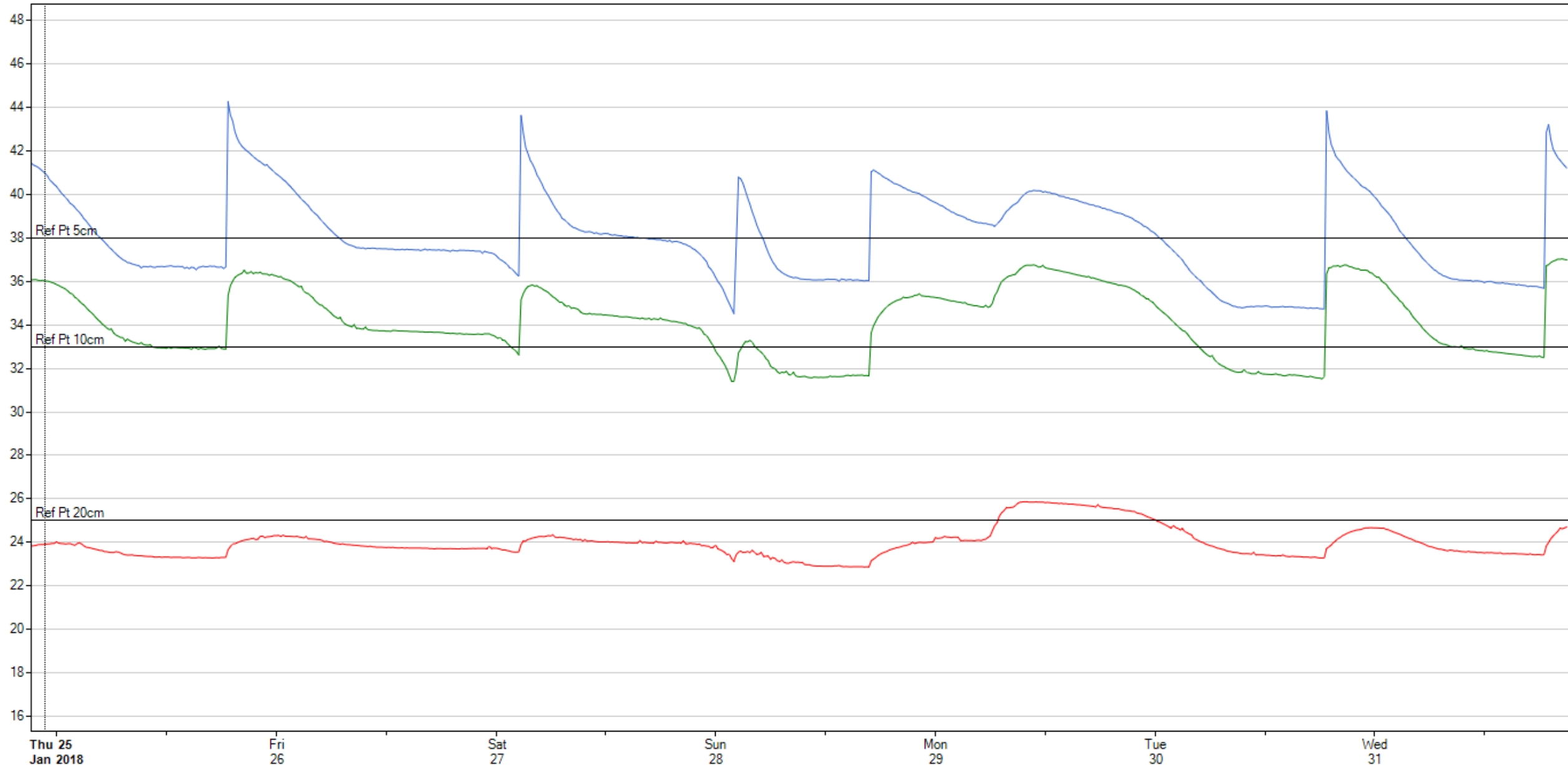
# Dry Area Soil Moisture Line Graph

%WVC



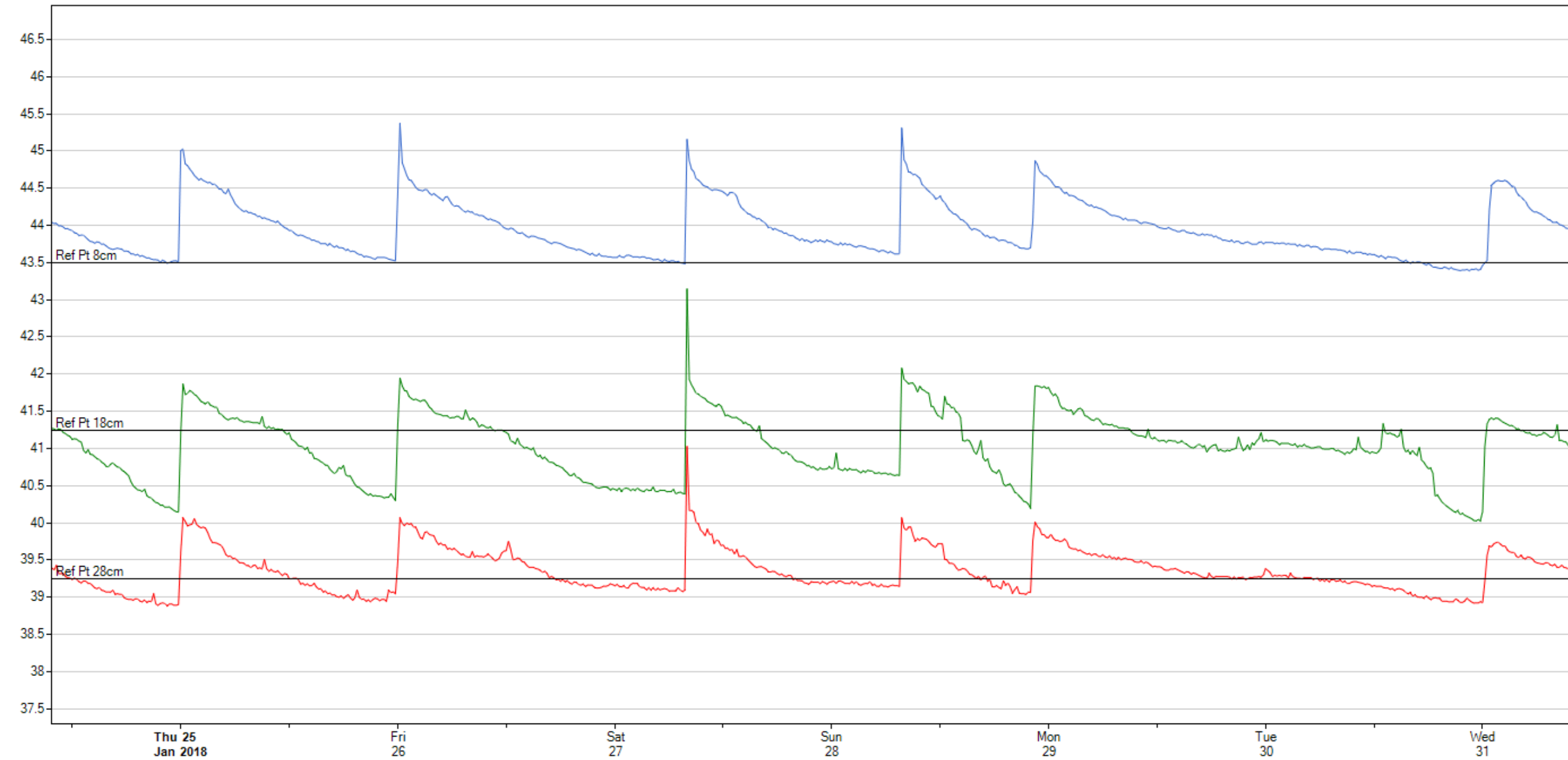
Normal Area Soil Moisture Line Graph

%VWC



# Wet Area Soil Moisture Line Graph

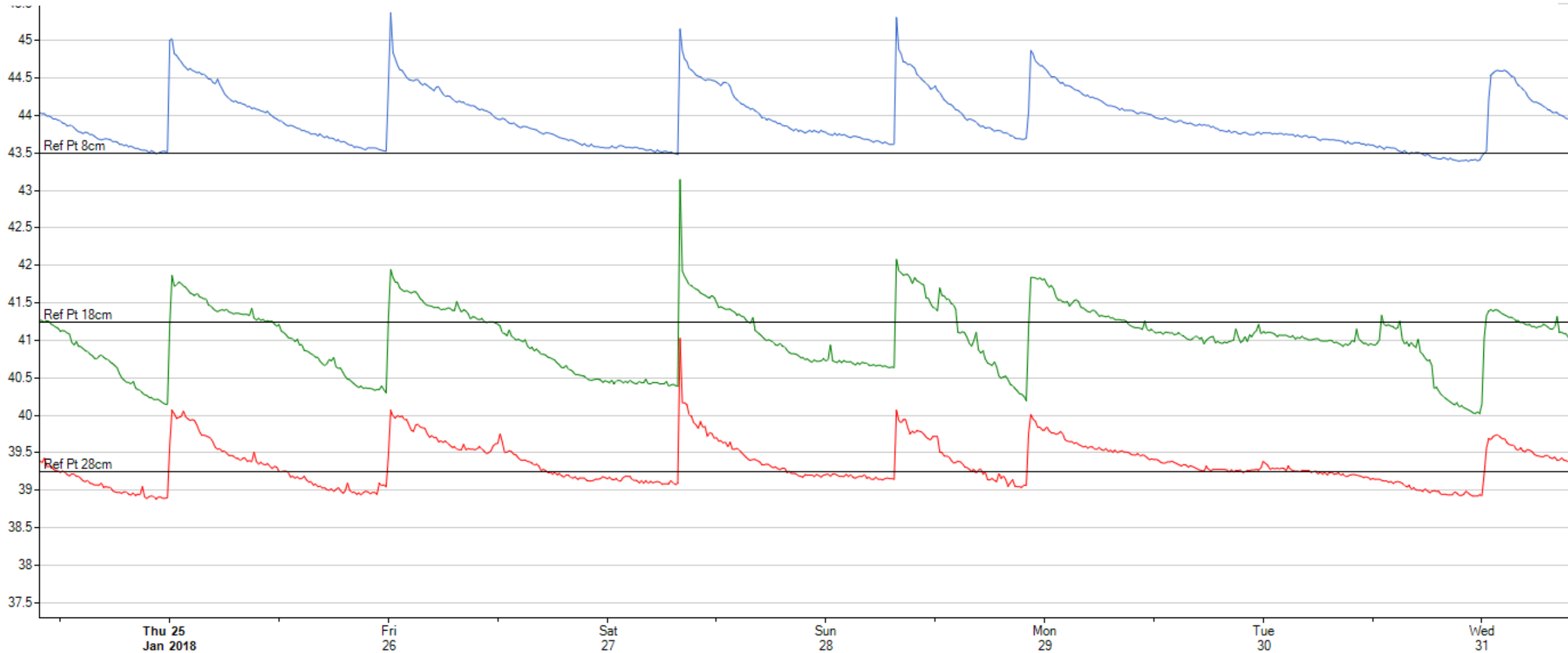
%WVC





Wet Area Soil Moisture Line Graph

Every irrigation is going straight past the surface, middle and bottom sensors. This area is getting water seepage from other parts of the pivot



# using soil moisture sensors

- generally takes a season or so to get familiar with how they work
- use your normal management, have a look at the data to see how it is going
- walk the paddocks now and again to make sure that what the sensors are saying agrees with what you see in the field
- mobile phone apps make looking at the data very easy

# Water Use Efficiency

- different ways to calculate:
  - production per ML irrigation water
  - production per ML irrigation and effective rainfall
  - irrigation efficiency (compared to “perfect” irrigation)
  - soil type

# production per ML irrigation water

- most common method, but has its weakness
- dry season = lots of irrigation = low T DM/ML  
e.g. 15 T DM/ha. With 7.5 ML/ha this is 2T DM/ML
- wet season = little irrigation = high T DM/ML  
e.g. 15 T DM/ha. With 5 ML/ha this is 3T DM/ML

# production per ML irrigation and effective rainfall

- accounts for amount of rainfall
- calculates useable rainfall based on time of year and frequency of rain
- lower value than production per ML irrigation water, but more consistent between years

# irrigation efficiency

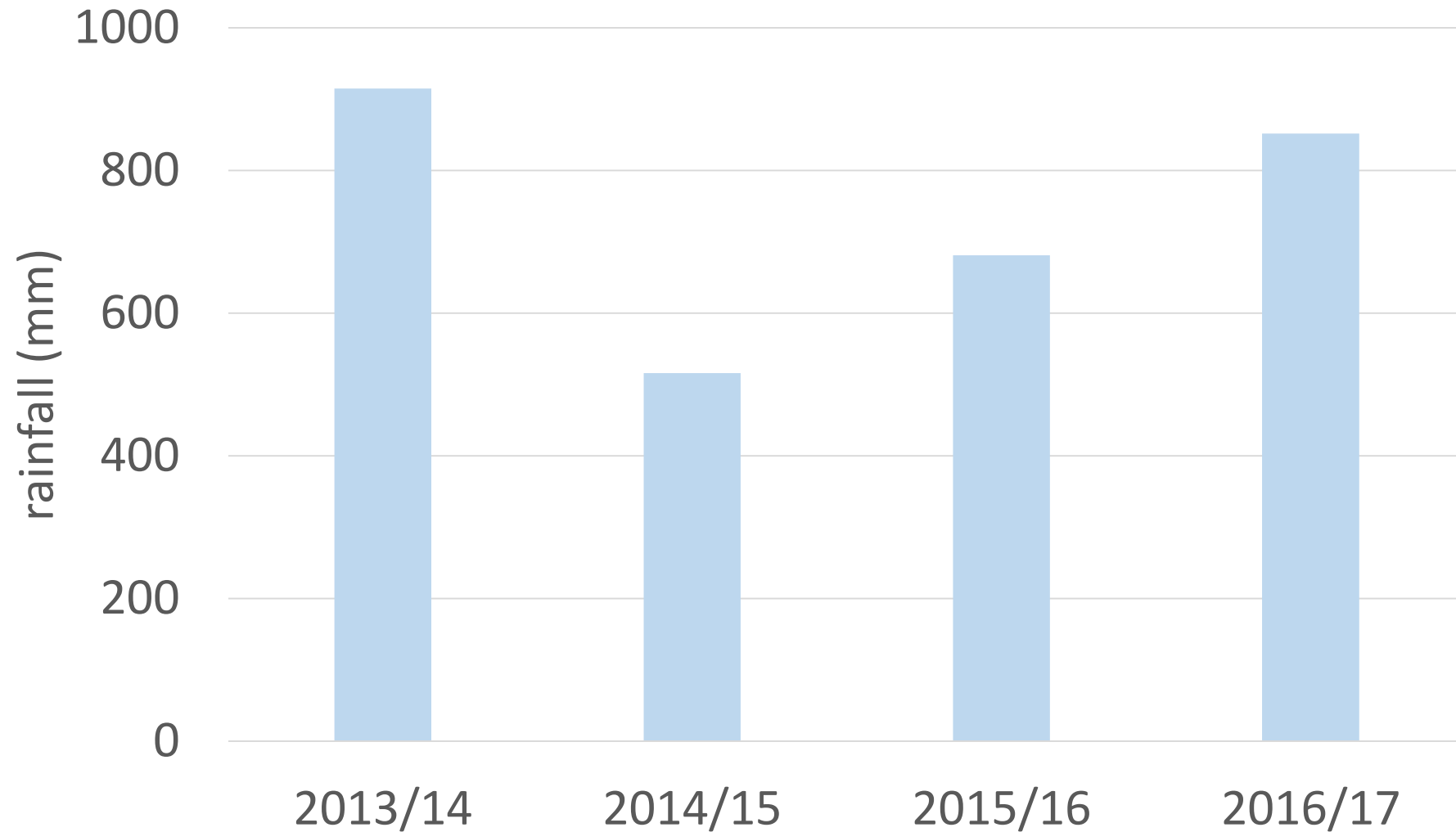
- compares actual water used to theoretical irrigation (low water use = high efficiency, high water use = low efficiency)
- based on simple daily water balance
- varies with irrigation system
- good centre pivot system 85-90% efficiency
- higher efficiency may mean underwatering or other factor such as getting groundwater

# Water Use Efficiency

- dry matter production divided by water use
- water use is easy to get (metered)
- dry matter production is generally estimated (reverse feed budgeting, etc)
- very difficult to measure DM production accurately, so
- water use efficiency results are fairly general

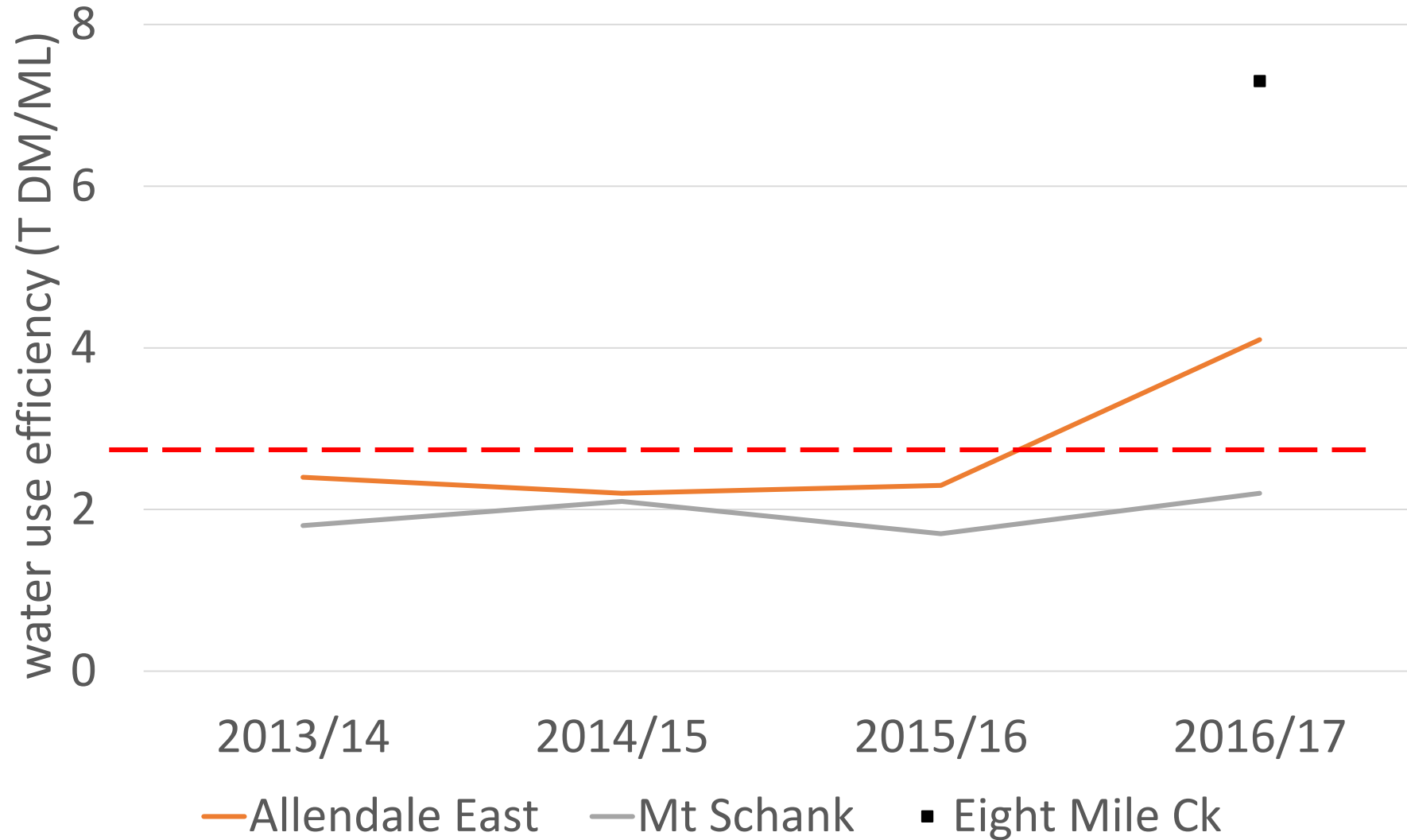
# Climate

## Water-year rainfall

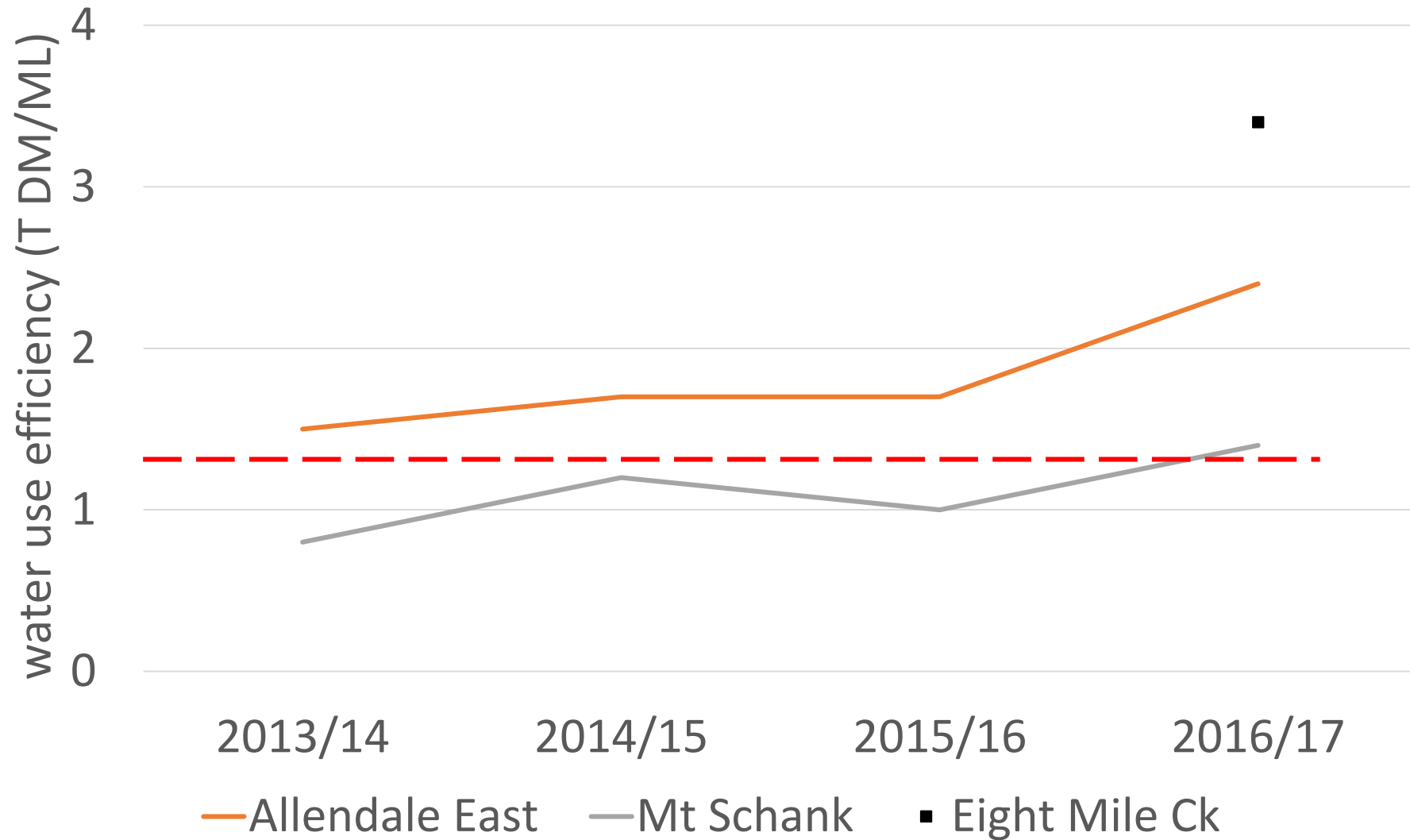




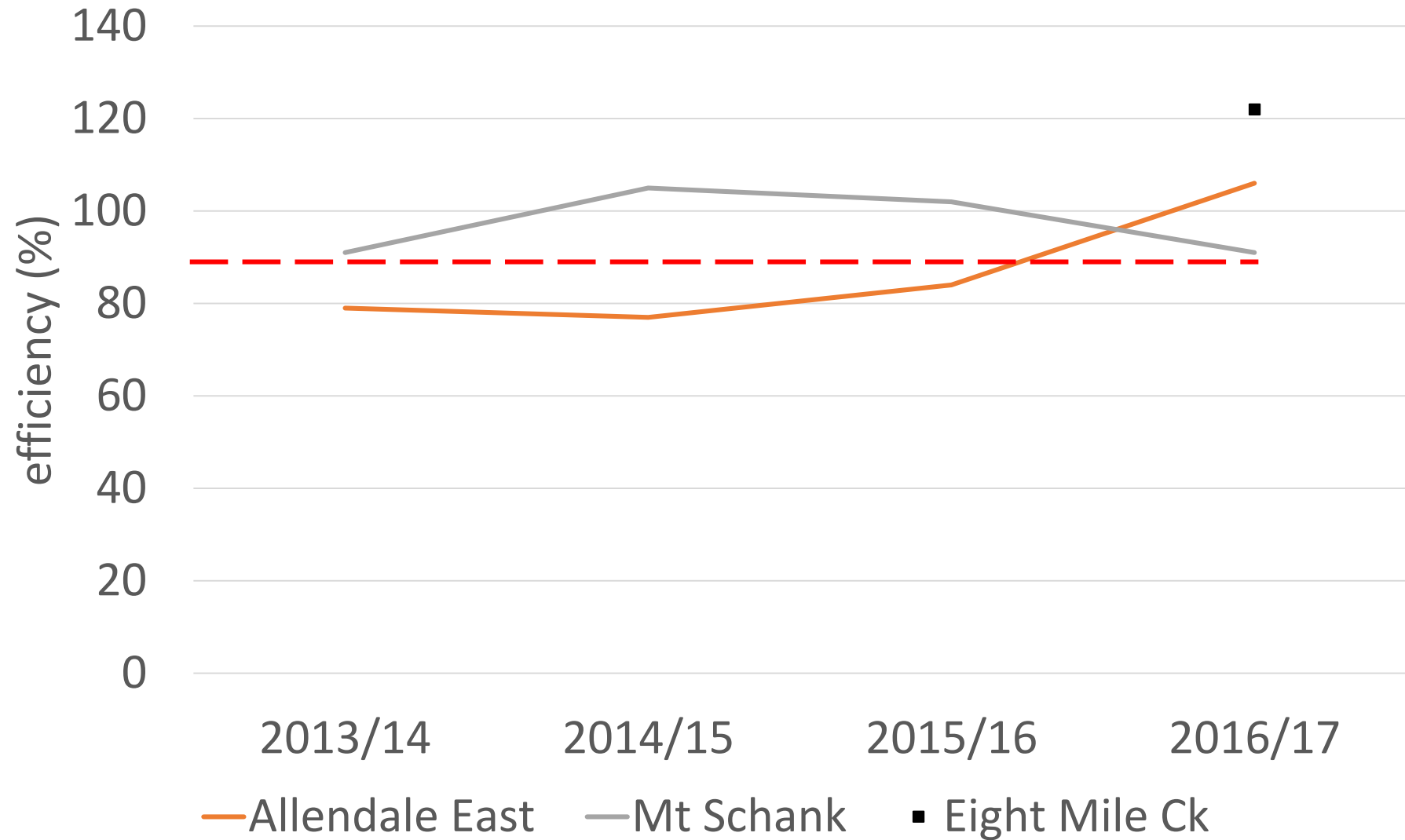
# Irrigation Water Use Efficiency



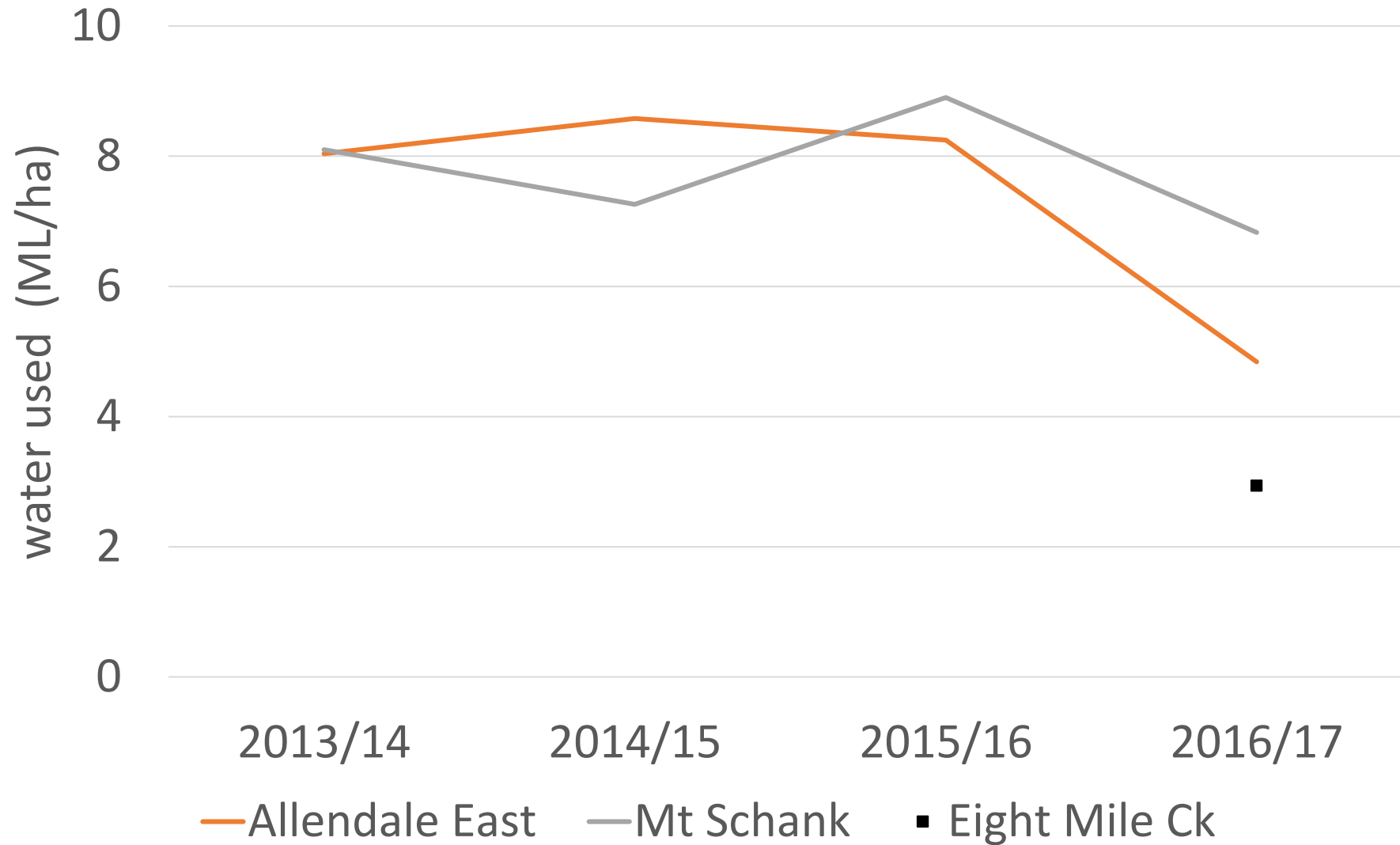
# Irrigation and effective RF WUE



# Irrigation Efficiency



# Irrigation Water Used



# Water Use Efficiency

- climate and crop
- infrastructure
- irrigation management
  
- measured values in this project
  - generally near benchmarks
  - strong seasonal effect
  - not precise

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## Water Use Efficiency

Blue Lake Golf Course, 12 April 2018

Nigel Fleming, SARDI