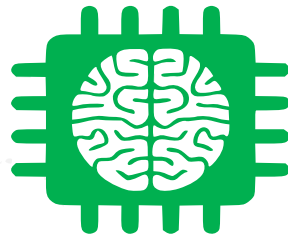


# **RAPID FIELD ANALYSIS OF ELECTRICAL CONDUCTIVITY, CHLORIDES, SULFATE AND SAR AND AUTOMATED SALINITY PLUME VISUALIZATION.**

MAAPER ANALYTICS INC.



# OUTLINE

- Reflectance Spectroscopy
- Methods
- Results
- Conclusions





# FIELD EC MEASUREMENT

- Bulk EC Measurement – Confounding Variables
  - Clay Content
  - Water Content
- Relationship between bulk EC and these variables are non-linear
- Solution – Multiple sensors and machine learning

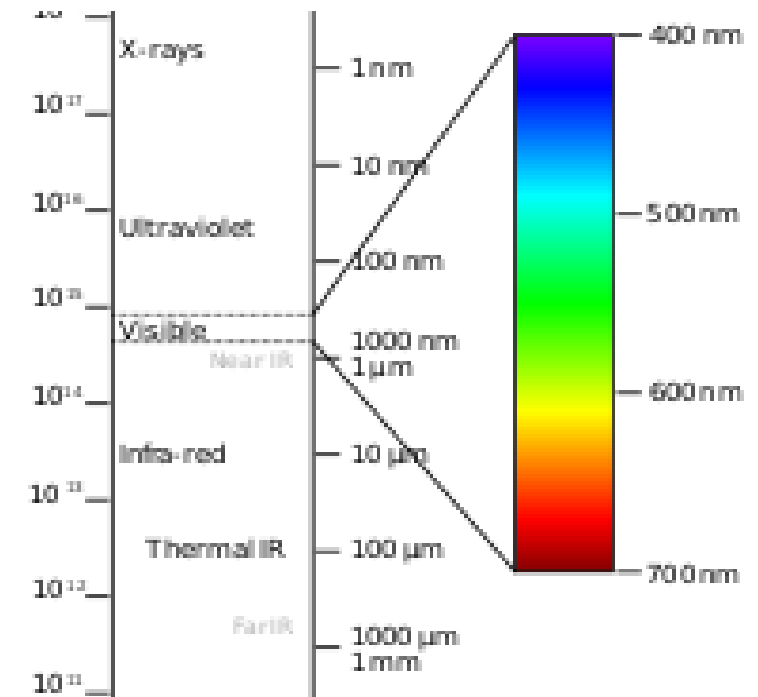


[http://sis.agr.gc.ca/cansis/taxa/soil/solonetzc/solodized\\_pr.jpg](http://sis.agr.gc.ca/cansis/taxa/soil/solonetzc/solodized_pr.jpg)



# REFLECTANCE SPECTROSCOPY

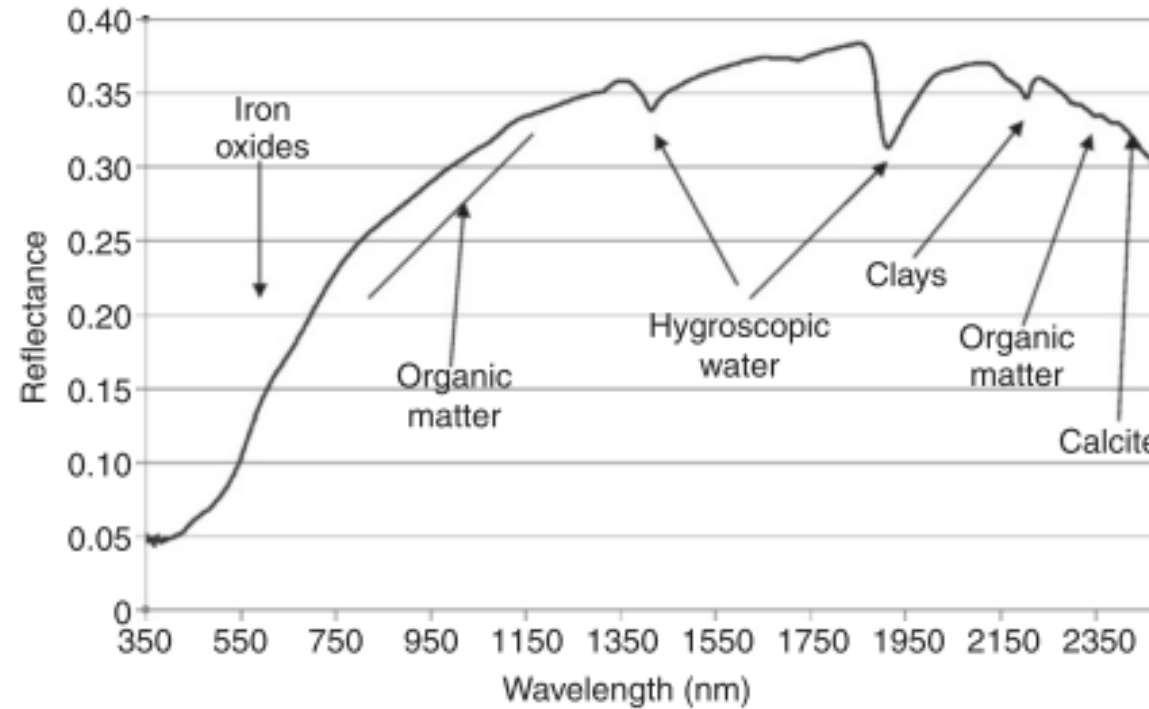
- Different types of covalent bonds absorb different specific light wavelengths
- Majority of soil properties have spectral features in the short wave infrared portion of the electromagnetic spectrum







# REFLECTANCE SPECTROSCOPY



**Figure 3** A soil spectra (Haploxeralf) that represents the major chromophors in soils (see text for more details).

Ben-Dor, E., R.G. Taylor, J. Hill, J. a M. Demattê, M.L. Whiting, S. Chabrilat, and S. Sommer. 2008. Imaging Spectrometry for Soil Applications. *Adv. Agron.* 97(07): 321–392.

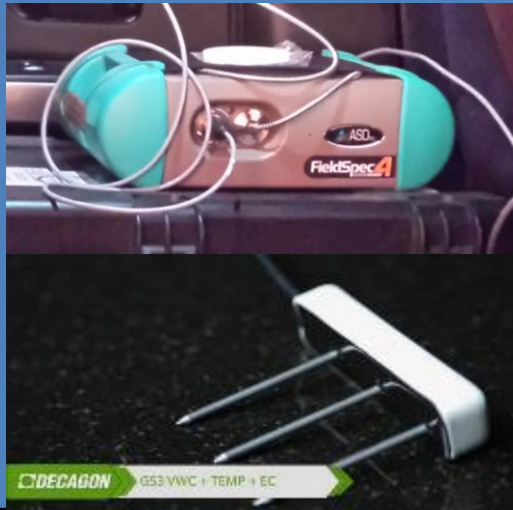
# METHODS

- Samples prepared in the laboratory with spiking and collected from the field
- Samples analyzed using Maapera's multi-sensor fusion approach
- Samples analyzed with saturated paste for comparison
- Field trials conducted in Alberta and Saskatchewan

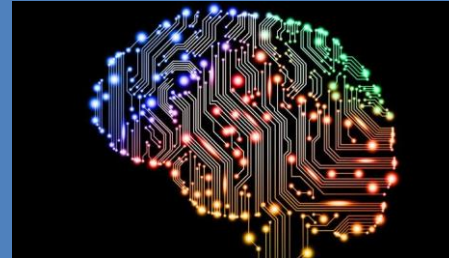


# Methods

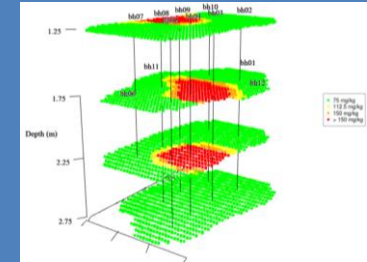
## Sensor Data



## Machine Learning and Advanced Data Analysis



## Automated Visualization Data Products – delivered as HTML





# Process in the Field

Set up scanner and allow for 30 min start up cycle and Calibrate by optimizing system to background signal and scanning Spectralon<sup>®</sup> reference panel



Scan calibration soil samples – supplied by Maapera – to confirm set up is correct



Collect Sample in typical industry practice and take sample to scanning set up (skinning is recommended)



Place contact probe with attached spacer that leaves 1 cm gap up to the sample



Entering location tag, comments and then press button on laptop to scan (2sec)



Analyze spectral data using machine learning algorithms



# Process in the Field



Insert salinity probe  
into soil sample



Enter salinity data in  
salinity fields on  
spectrometer software



Analyze spectral data  
using machine  
learning algorithms

# Process in the Field







# Field Trial

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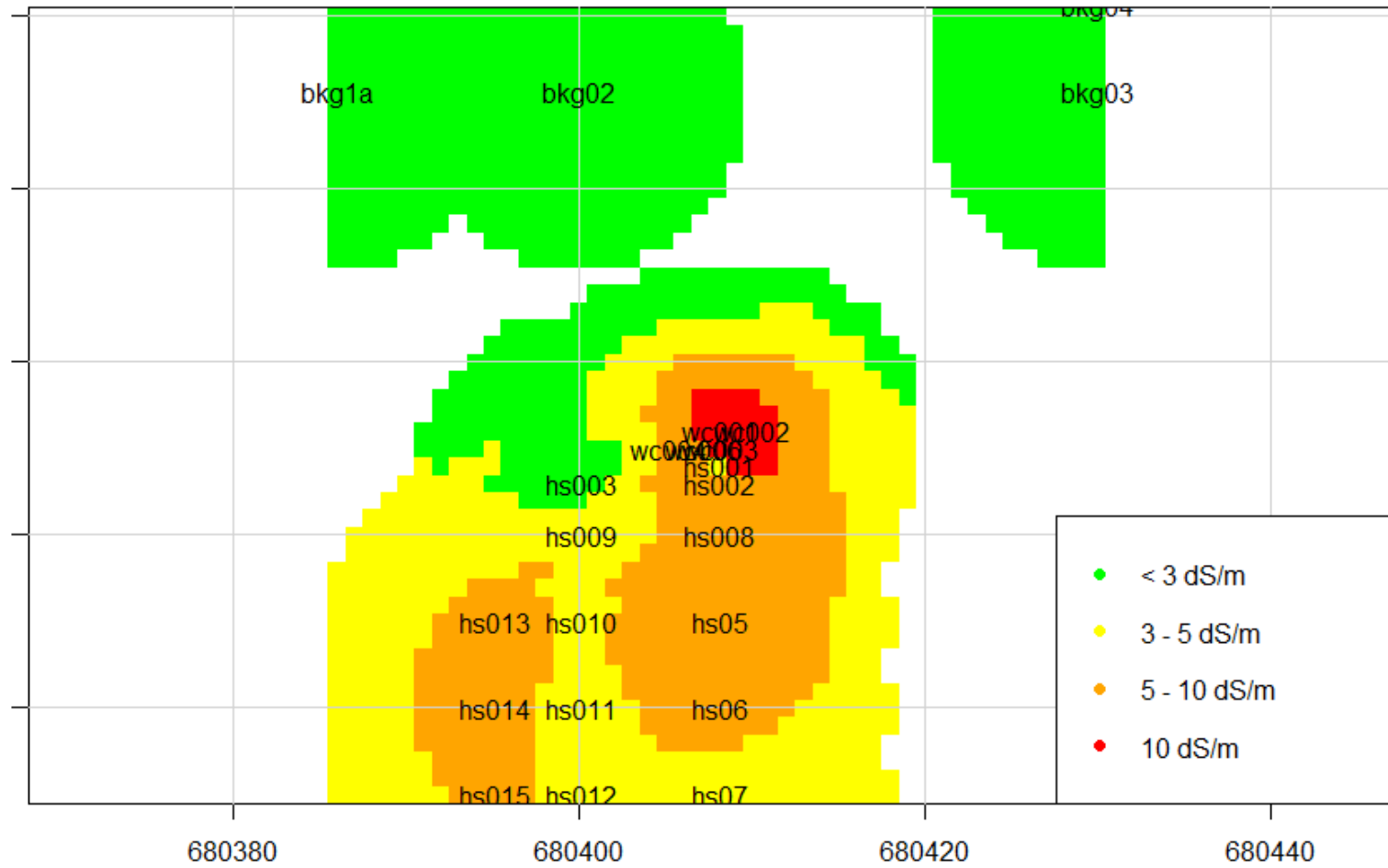
# Field Trial

- Salt impacted site in SE Saskatchewan
- Historic produced water spill
- Trial objectives were to evaluate how field data compared to laboratory data

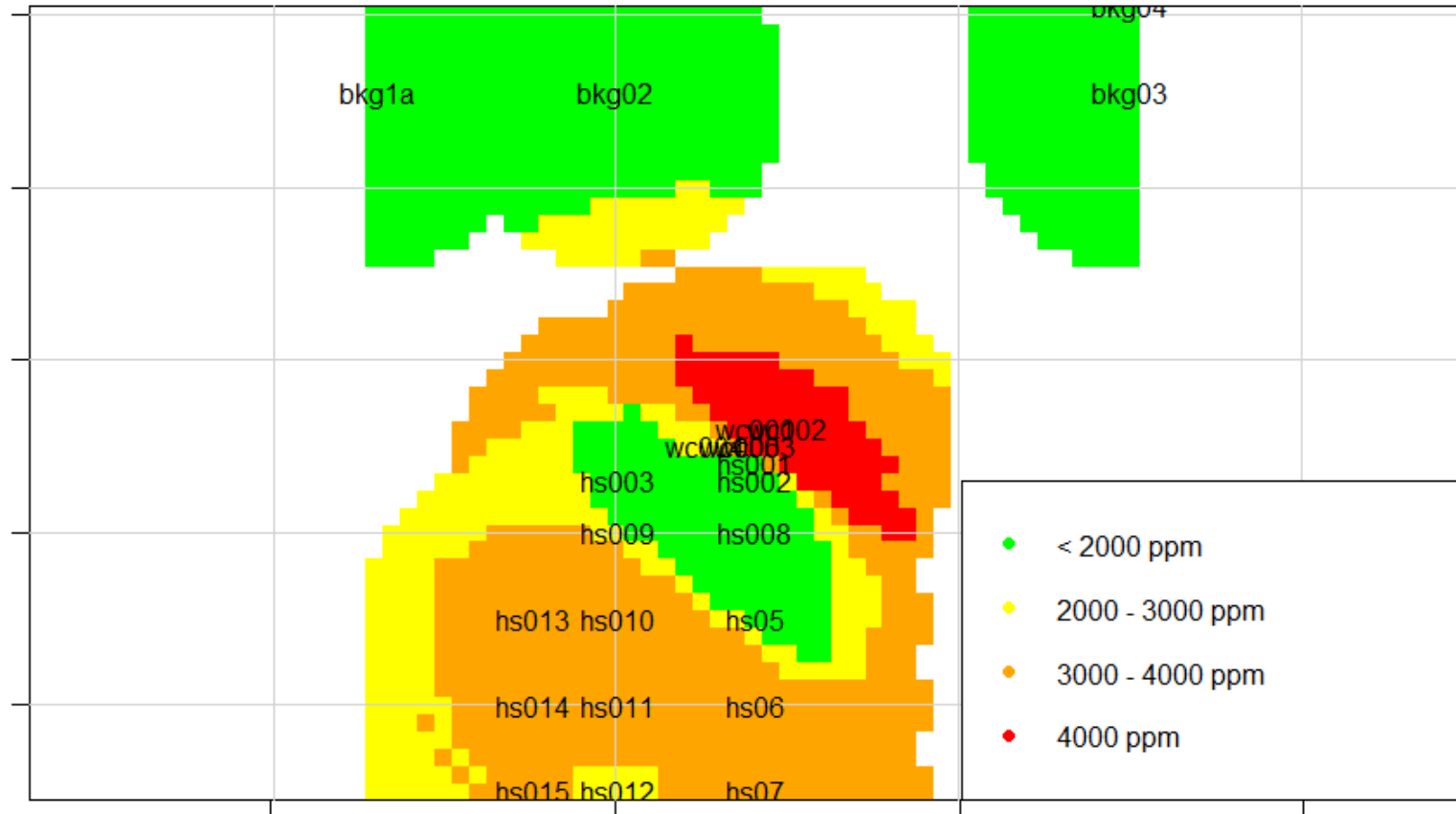




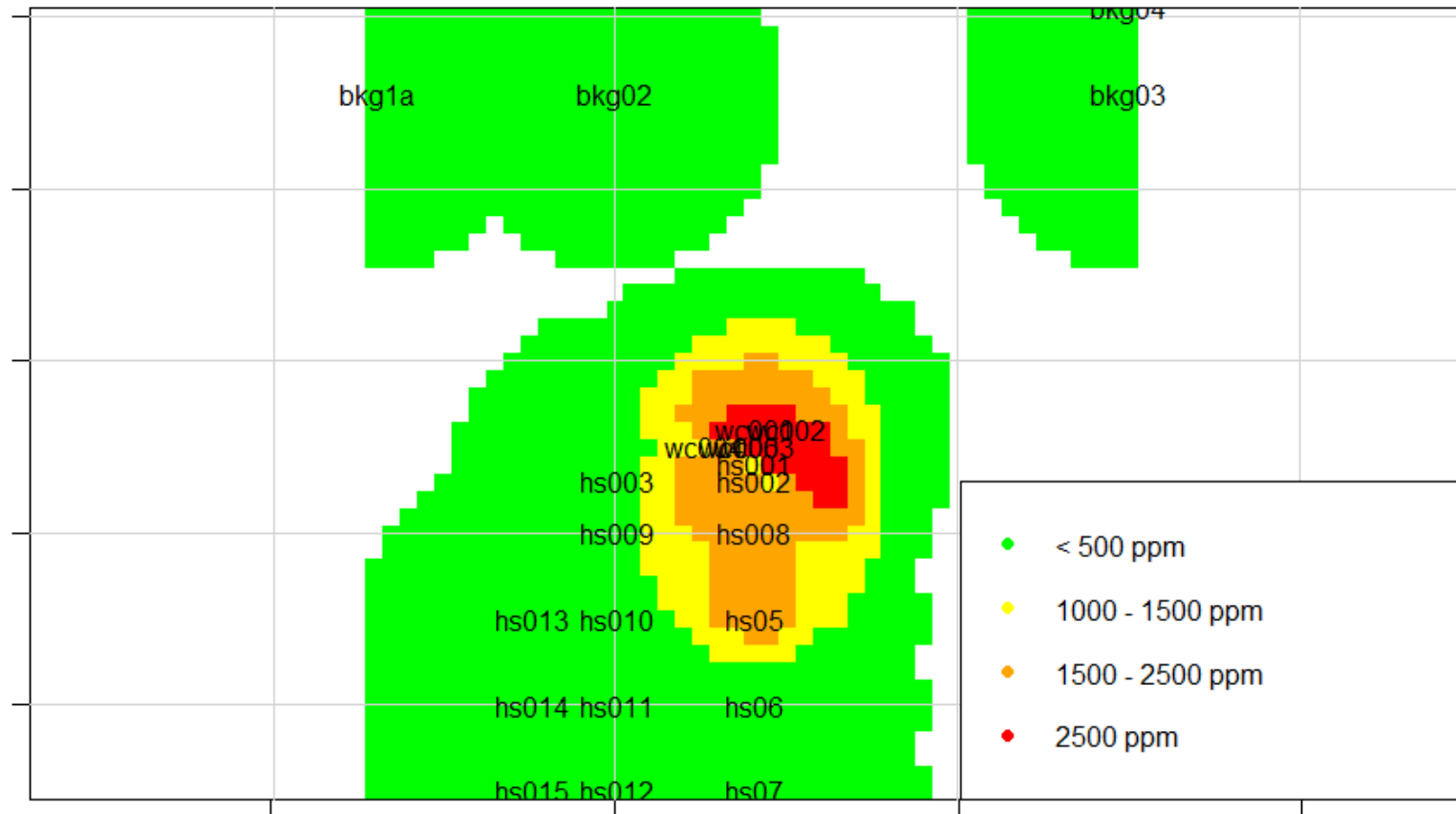
## EC Plot



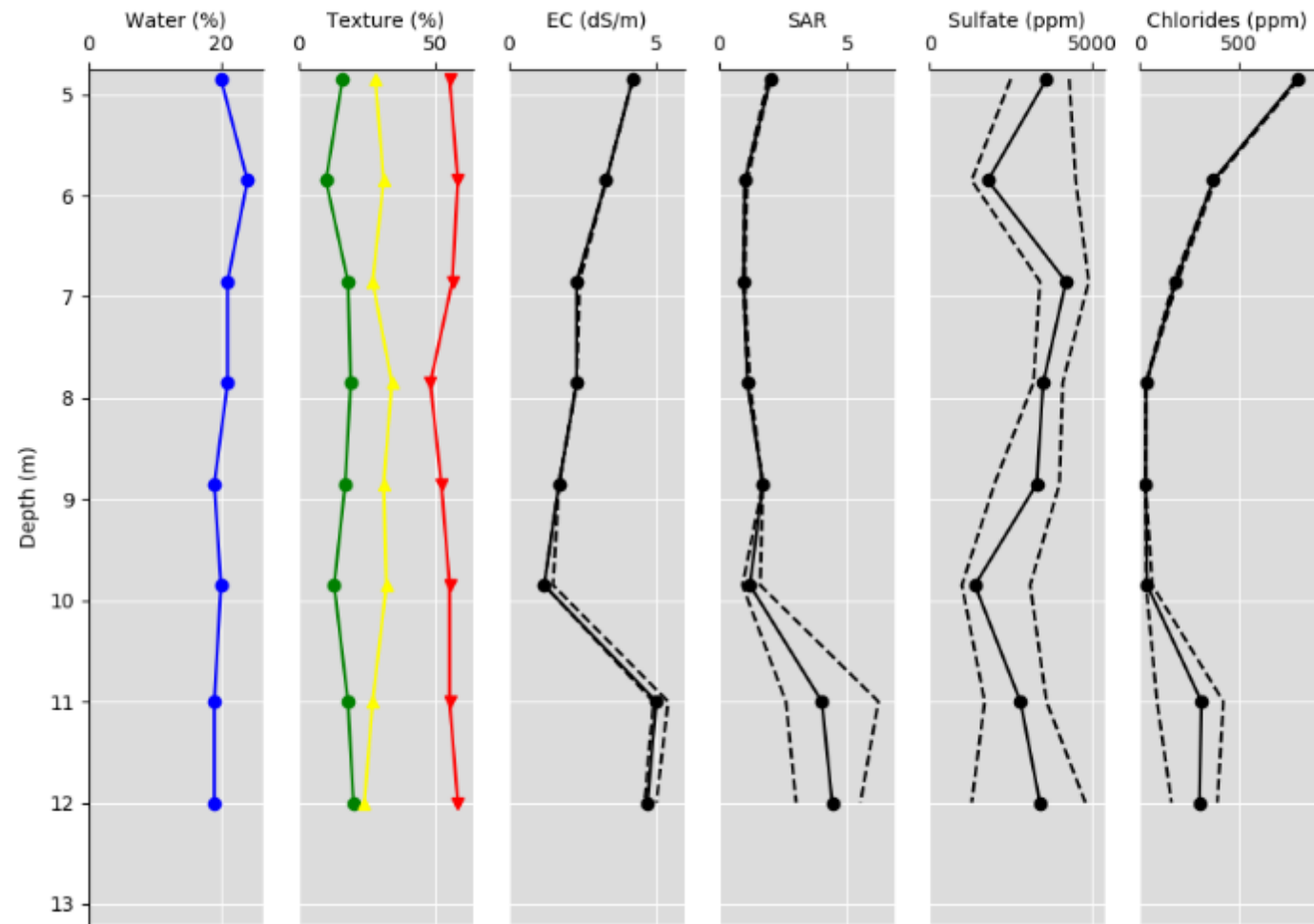
Sulfate Plot



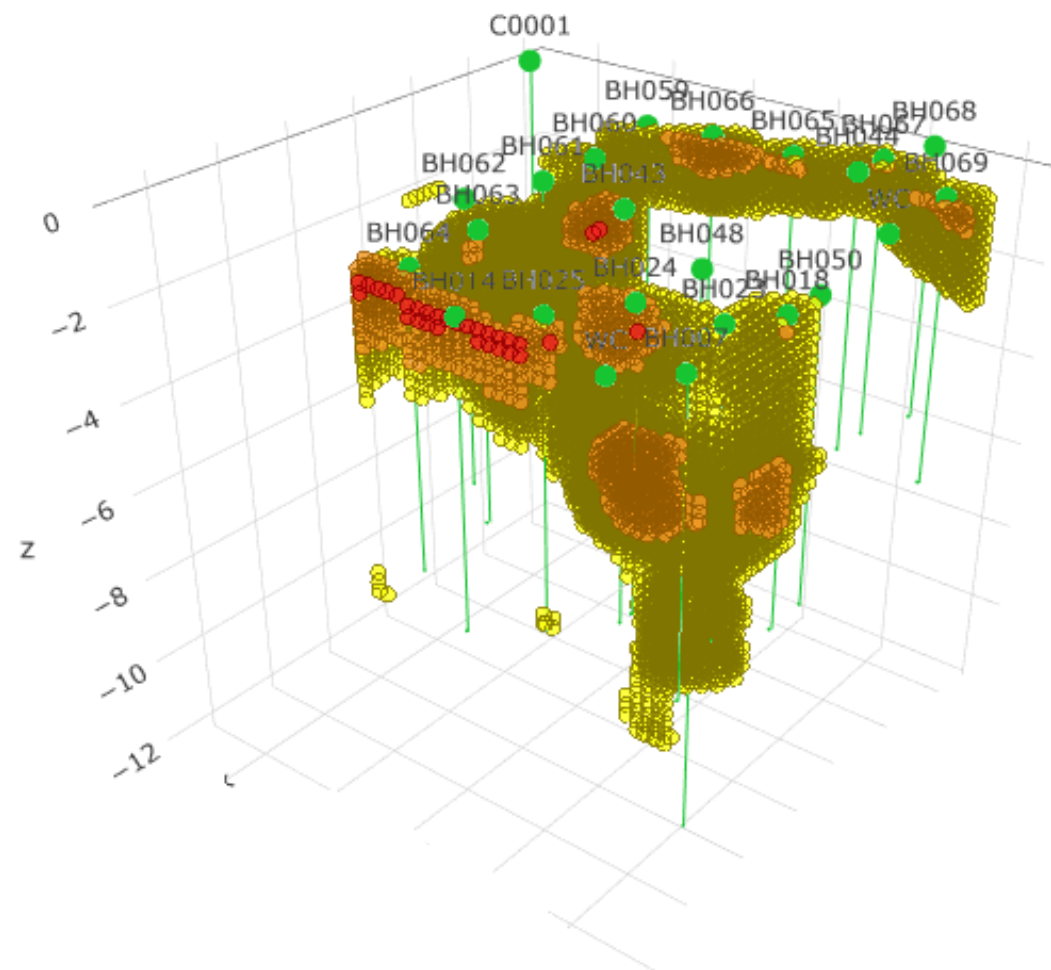
Chloride Plot



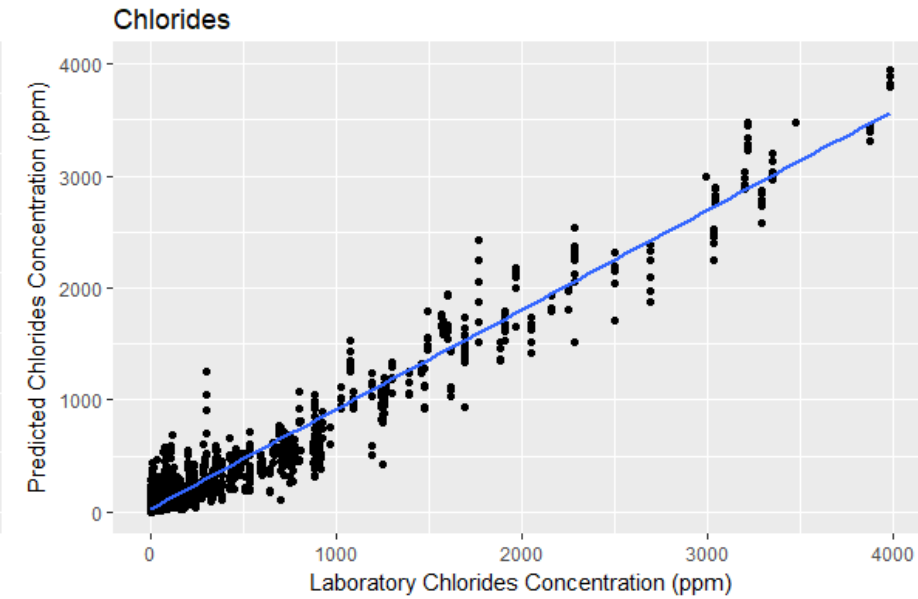
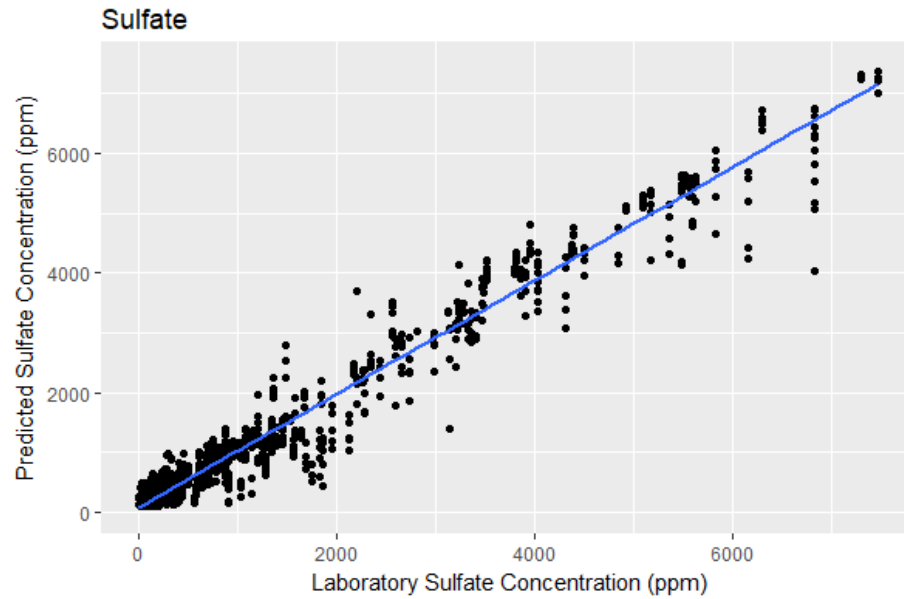
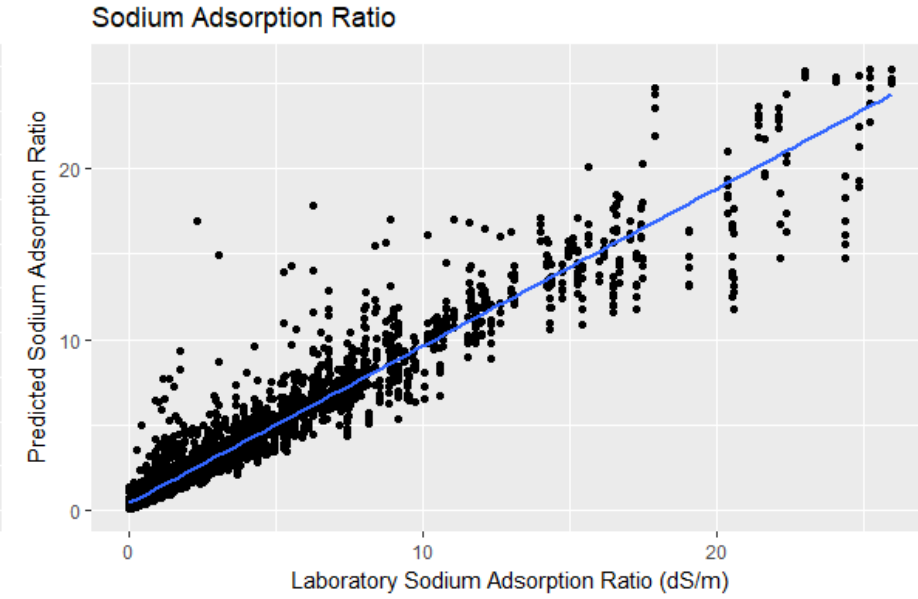
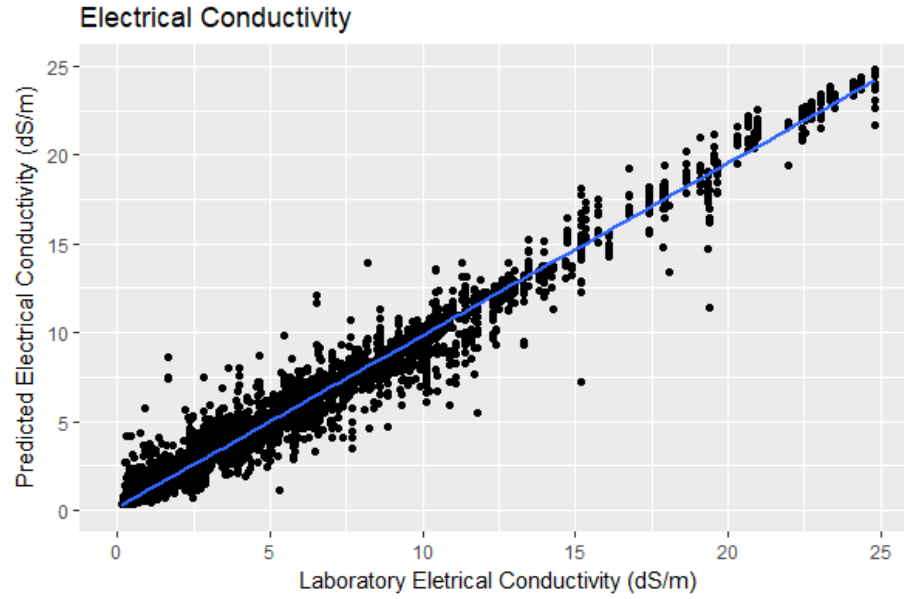
- 190 m<sup>3</sup> over excavation
- ~\$19,000 at \$100/m<sup>3</sup>



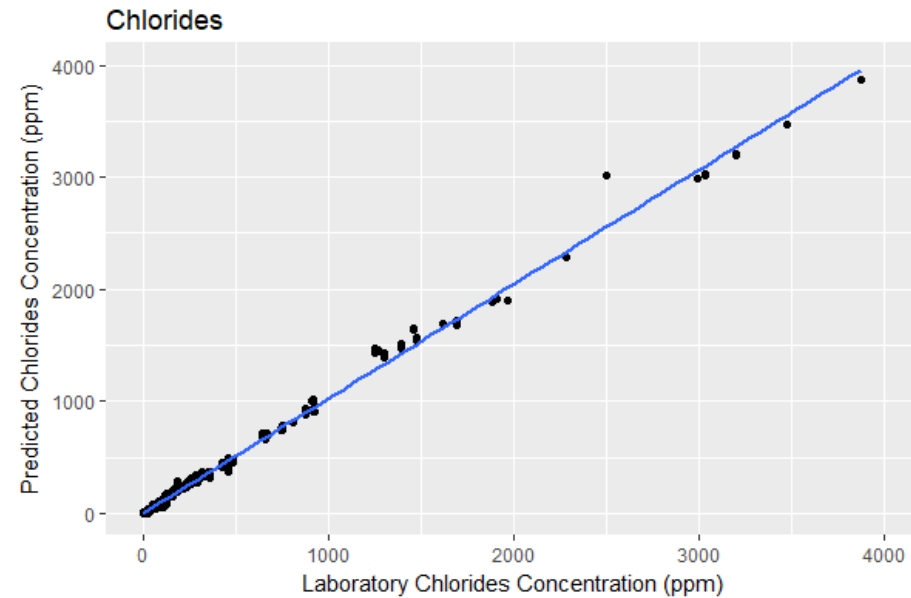
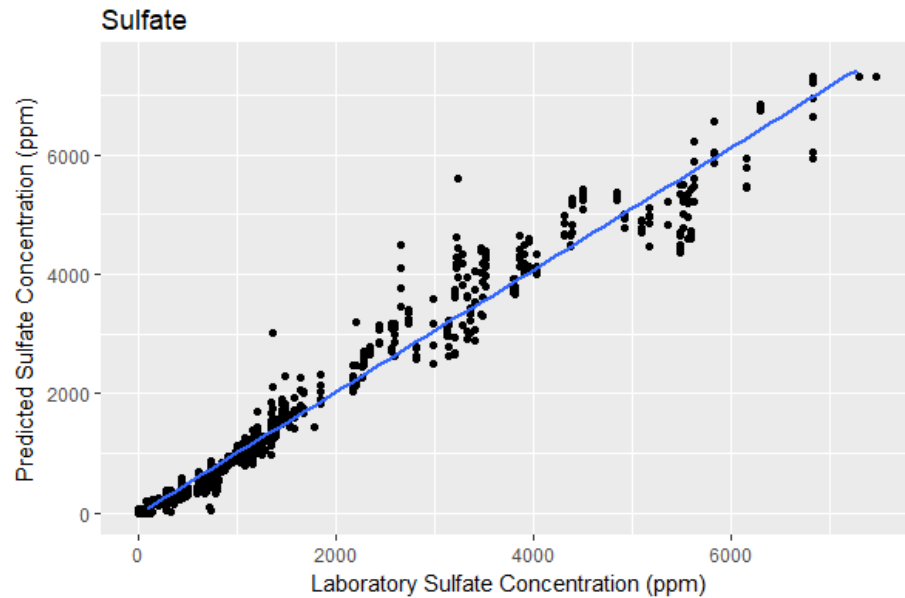
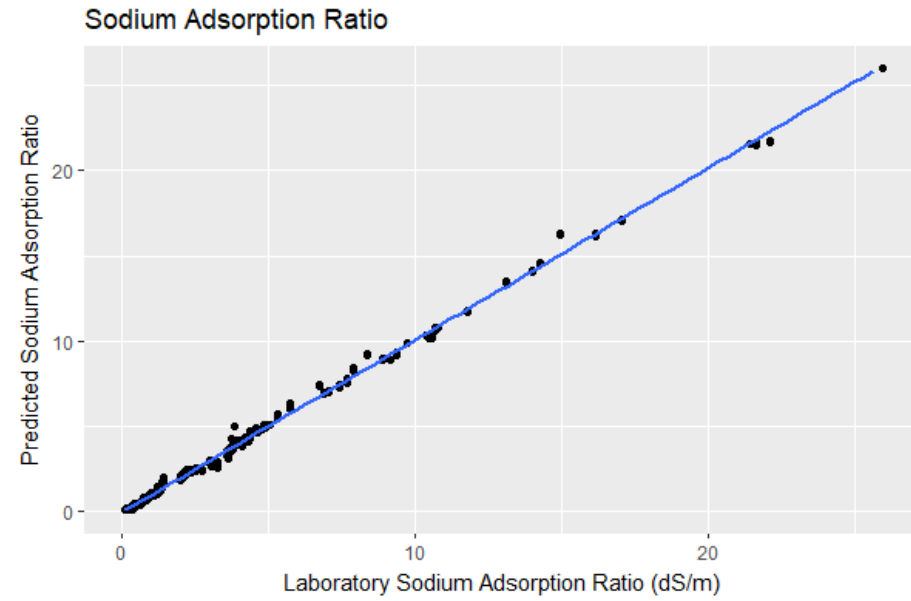
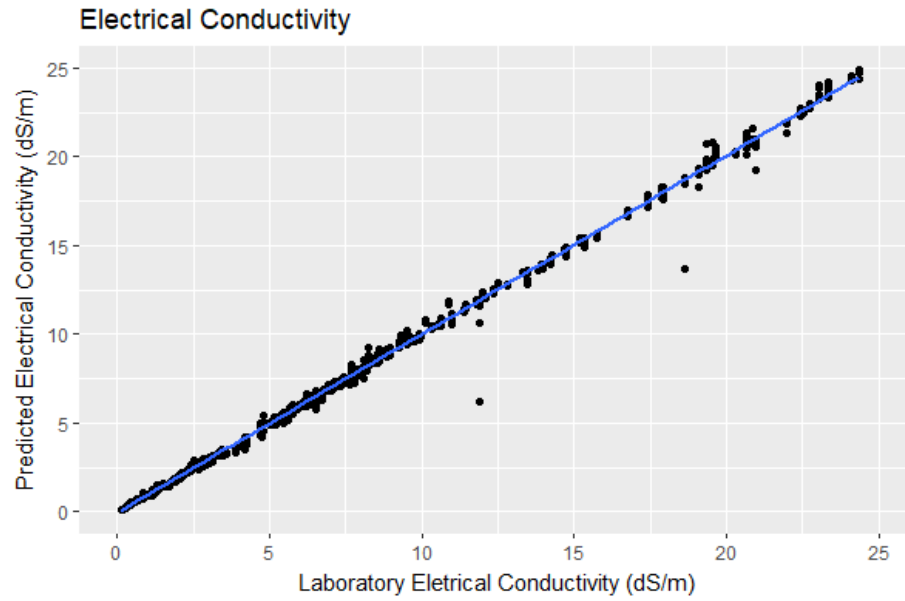




# General models



## Site specific models



# CHALLENGES AND FUTURE DEVELOPMENTS

- Samples can be measured directly on large piece of soil.
  - If sample consists of small aggregates or is loose, then it needs to be packed into a container
  - Insufficient packing can cause poor contact with probe and artificially low readings
- Samples need to be above 5% gravimetric water content for an accurate EC reading. If a sample is dry distilled water can be added for an accurate reading.
- Accuracy of chloride and sulfate readings decrease when samples are completely saturated.



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