

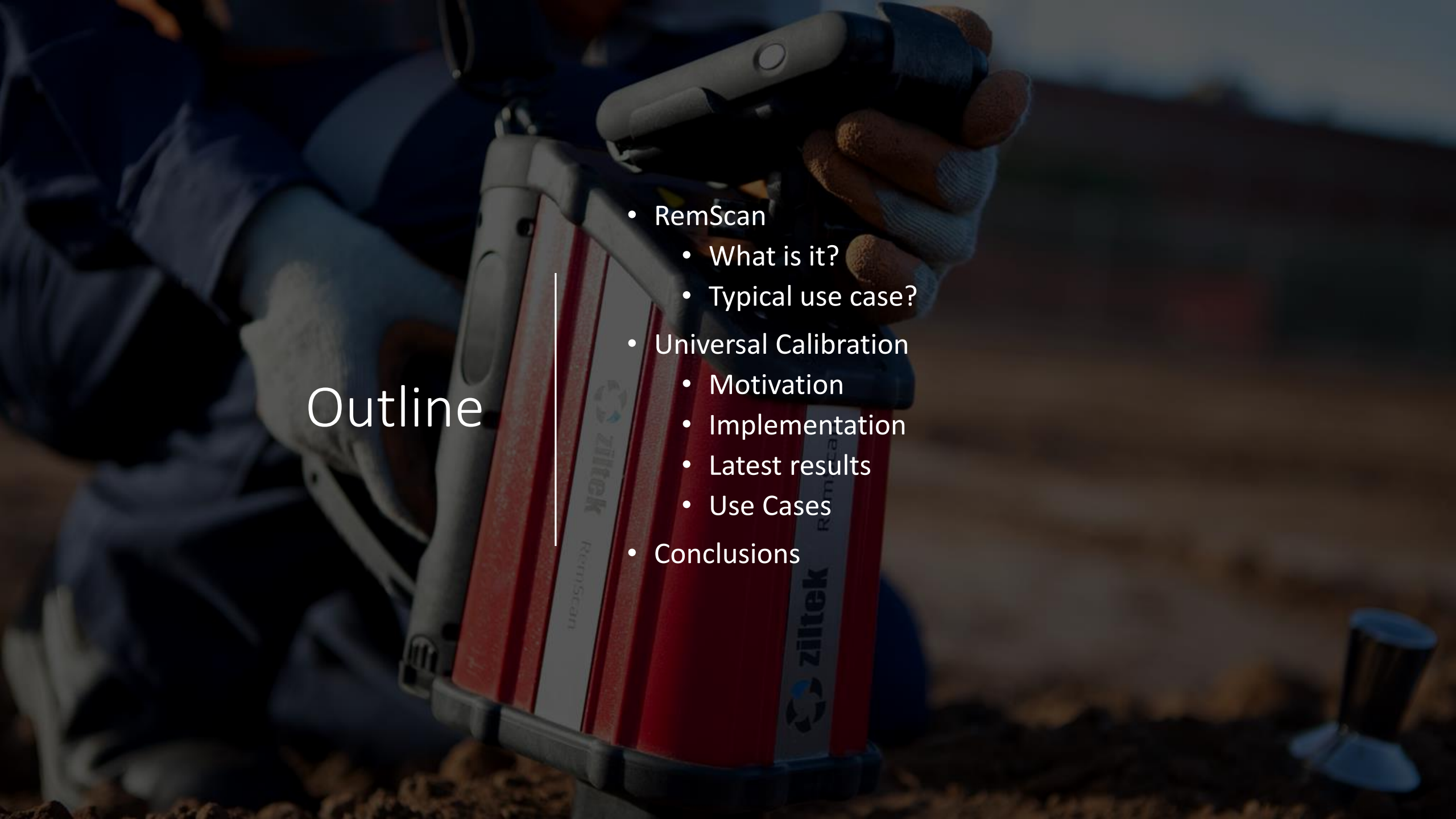
# A UNIVERSAL SITE CALIBRATION MODEL

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**RemScan®**



# Outline

- RemScan
  - What is it?
  - Typical use case?
- Universal Calibration
  - Motivation
  - Implementation
  - Latest results
  - Use Cases
- Conclusions

# RemScan

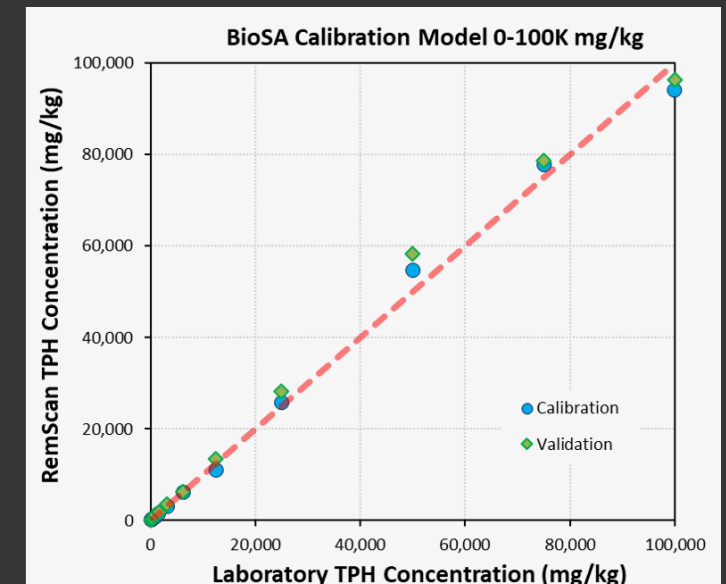
- 
- Handheld NIR-MIR spectrometer + Chemometrics + GUI
  - Used for in-field TPH measurement of soils
    - More applications coming soon!
  - Rapid Screening tool
  - Used for medium to large scale soil remediation projects
  - Provides:
    - Rapid and accurate screening
    - Increased site sampling
    - Spatially resolved measurements
  - Customers include:
    - Global Petro-chemical companies
    - Analysis laboratories
    - Universities
    - Research organisations
    - Government bodies





# A Typical Use Case

- An area has become contaminated with petro-chemicals
- Customer samples their site with guidance from Ziltek
- Samples that represent the soil variation are identified mathematically from IR spectra
- Dilution series are produced and scanned with RemScan (sometimes we use natural sampling)
- These data are used to generate calibration models for field use
- Typically achieve accuracies better than  $\pm 200$  mg/kg for TPH concentrations  $< 1,000$  mg/kg



# Site Specific Models

## **Pros:**

- Accurate
- Reliable
- Utilises well known algorithms
- Specific to clients needs



## **Cons:**

- Labour intensive
- Set-up overhead
- Site drift decreases accuracy
- Required for every new site



# Universal Calibration

- The goal is to have a Universal calibration model which will allow:
  - Use anywhere in the world
  - Zero set-up time
  - Minimal training
  - Rapid site assessment
  - Cost effective for short term / small projects
  - Short term instrument rental





# Methodology

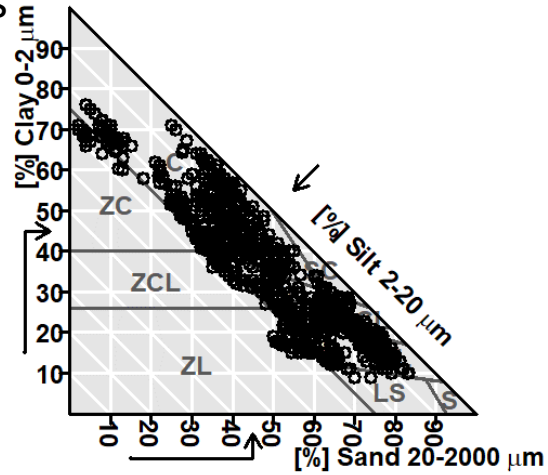
## Regional soil sampling guided by CSIRO

- >200 samples
- Sourced primarily from Victoria
- Some South Australian samples



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**Broad variety in soil  
lithologies**

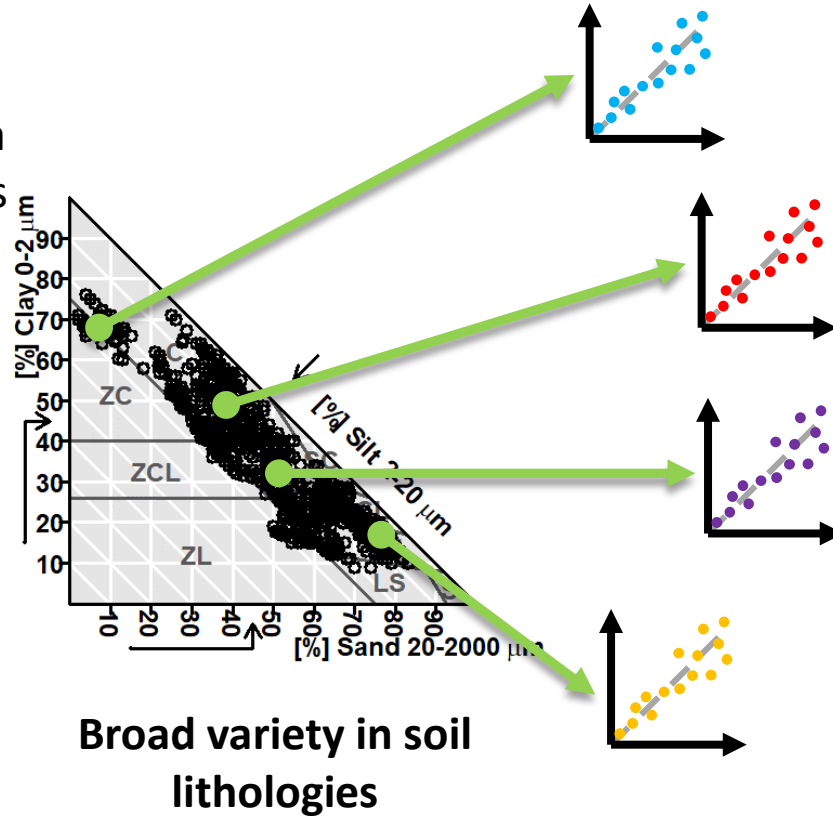
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## Dilution series produced from samples

- Scanned on RemScan
- >10,000 spectra



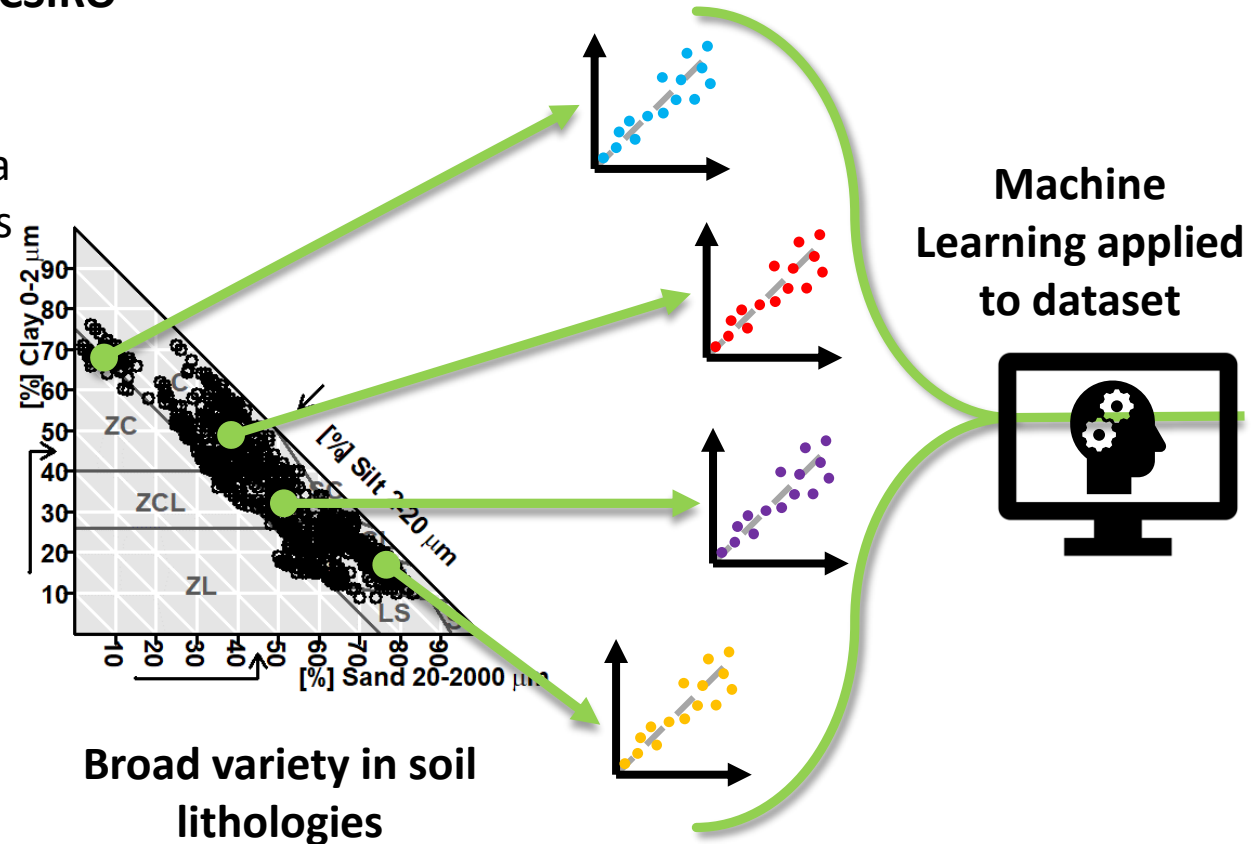
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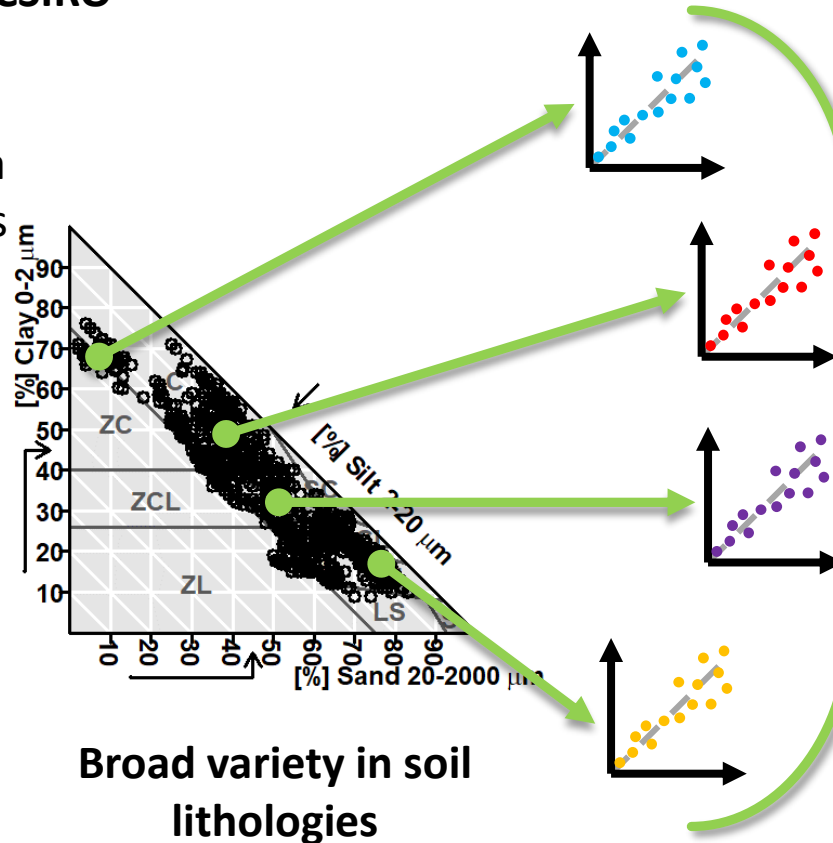
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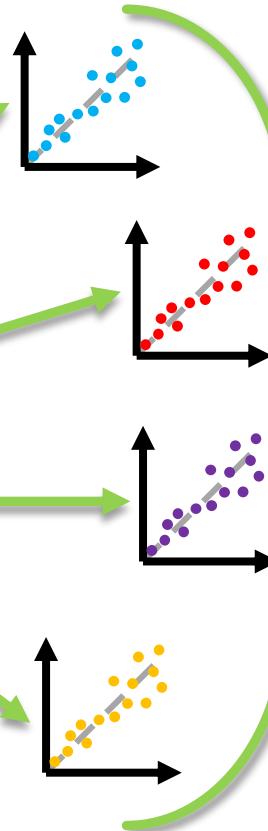
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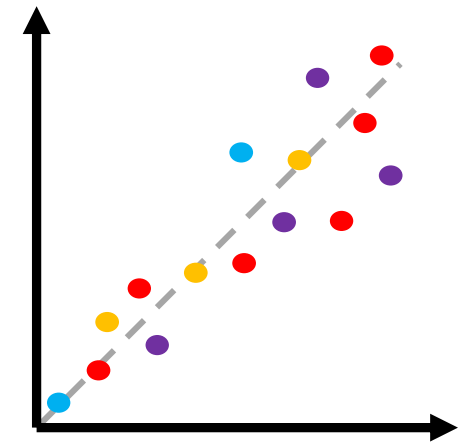
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Machine Learning applied to dataset



## Universal Calibration Model



THIS IS YOUR MACHINE LEARNING SYSTEM?

YUP! YOU POUR THE DATA INTO THIS BIG  
PILE OF LINEAR ALGEBRA, THEN COLLECT  
THE ANSWERS ON THE OTHER SIDE.

WHAT IF THE ANSWERS ARE WRONG?

JUST STIR THE PILE UNTIL  
THEY START LOOKING RIGHT.





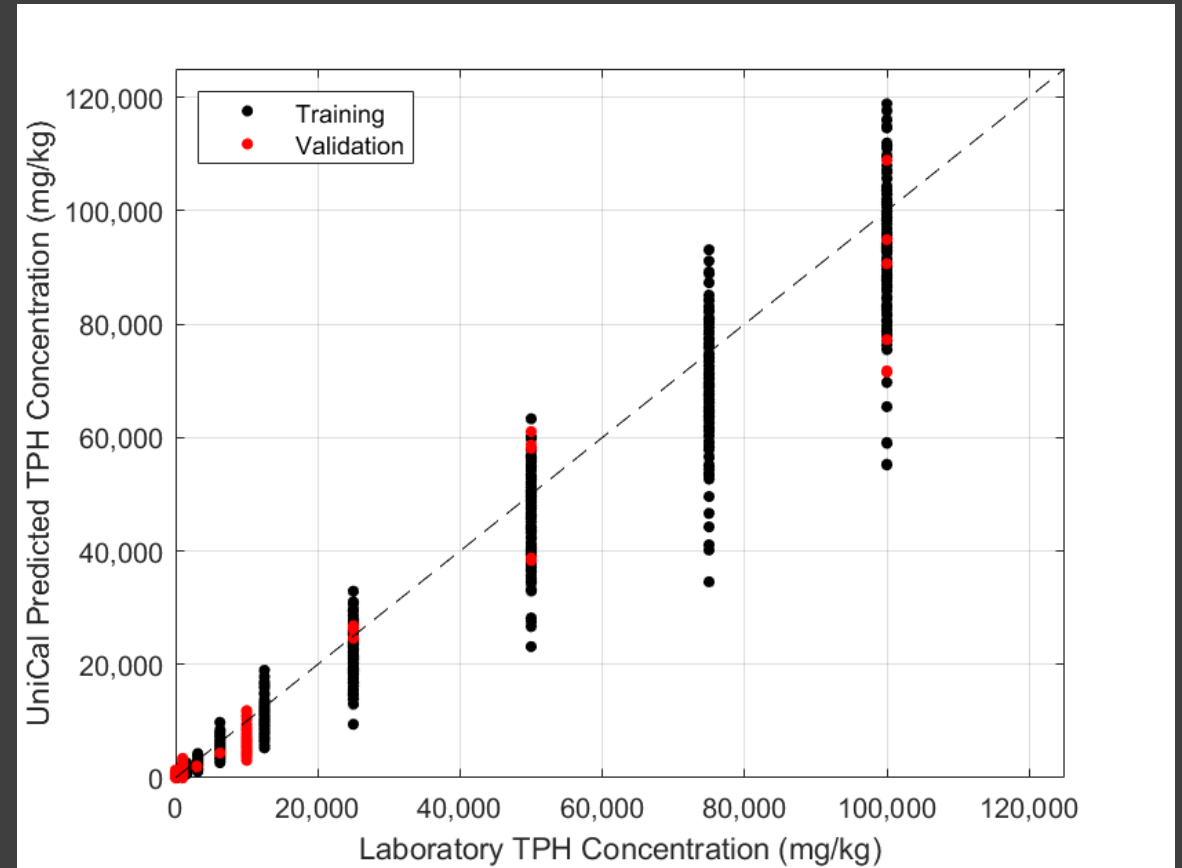
Results

The image shows a close-up of a worker's hands holding a red and white Zilttek RmScan handheld scanner. The worker is wearing an orange safety vest over a blue jacket and white work gloves. The scanner has the 'zilttek RmScan' logo on its side. The background is a clear, bright blue sky.

# Current UniCal Performance

- >300 soil samples from Ziltek's soil library
- >1,500 validation spectra collected and predicted
- The Root Mean Squared Error of Prediction (RMSEP) on validation data is:
  - 1,800 at 10,000 mg/kg
  - 500 at 0 mg/kg
- These levels of accuracy have already provided great benefits to clients

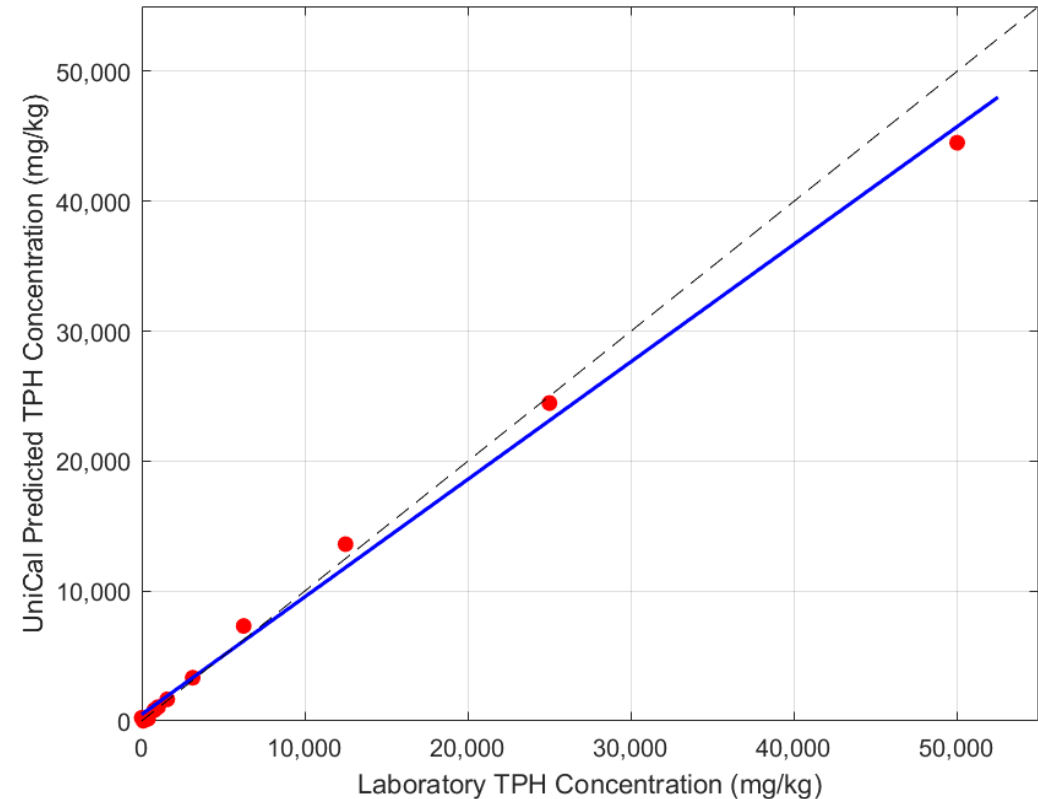
## Universal Calibration Model Predictions on Training and Testing Data

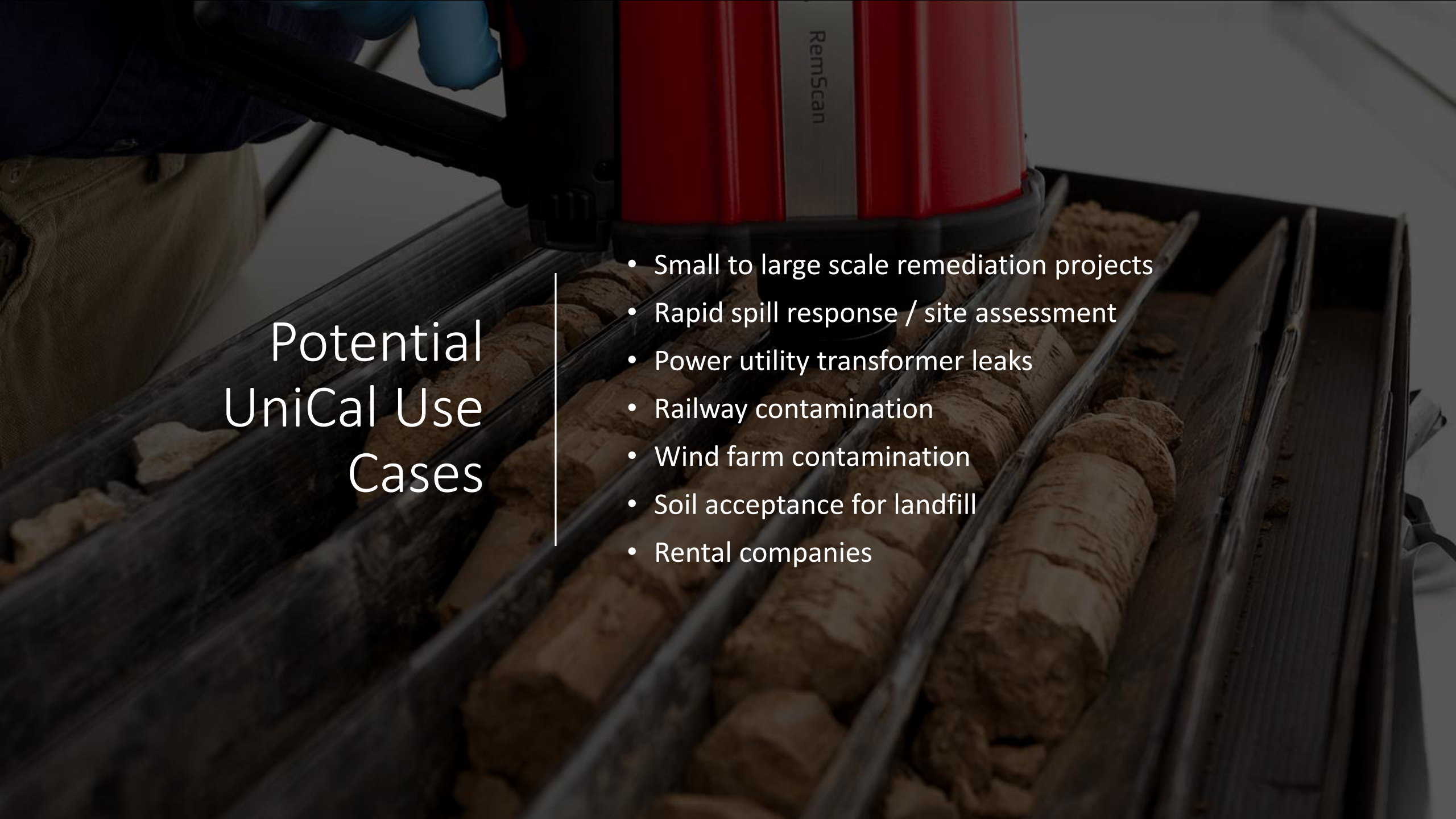


# Current UniCal Performance

- Spiked dilution series of local (SA) soil
- Single lithology
- Prediction statistics :
  - RMSEP = 380 at 10,000 mg/kg
  - RMSEP = 240 at 0 mg/kg
- Excellent linear trend for a single soil
  - $R^2 = 0.995$
- Easily scaled with a couple of lab assays (GC-FID) to increase accuracy of results

## Universal Calibration Model Predictions on a Single Soil Type





## Potential UniCal Use Cases

- Small to large scale remediation projects
- Rapid spill response / site assessment
- Power utility transformer leaks
- Railway contamination
- Wind farm contamination
- Soil acceptance for landfill
- Rental companies

## Conclusions

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- Ziltek have developed a Universal Calibration model for TPH in soil
- Beta version to be released to selected customers for final testing and refinement Q3 2019
- Expected full release Q1 2020
- Please contact us if you have any inquiries:

**Tel: +61 8 8152 9390**

**[www.ziltek.com](http://www.ziltek.com)**

