

# Evaluation of Soil Chloride Delineation Requirements

Daniel Pollard, M.Sc., P.Geo., Hydrogeologist  
Ashley Morgan, P.Geo., Hydrogeologist

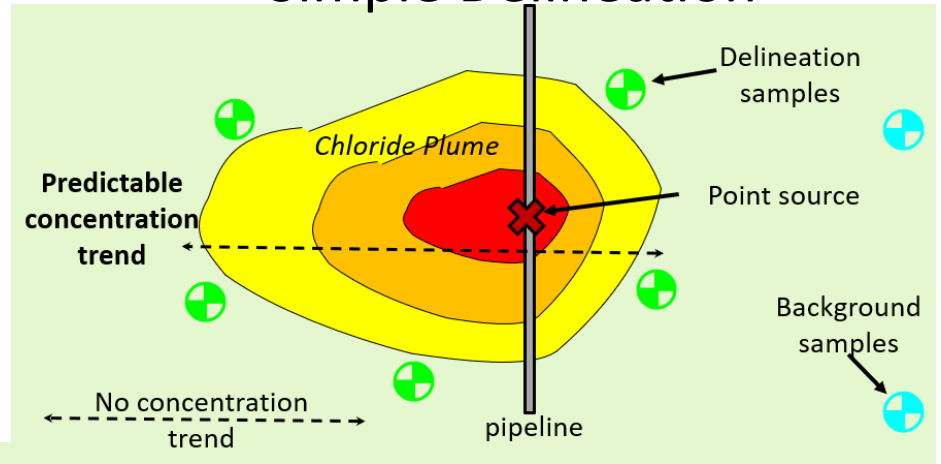
October 17, 2024

# The Challenge...

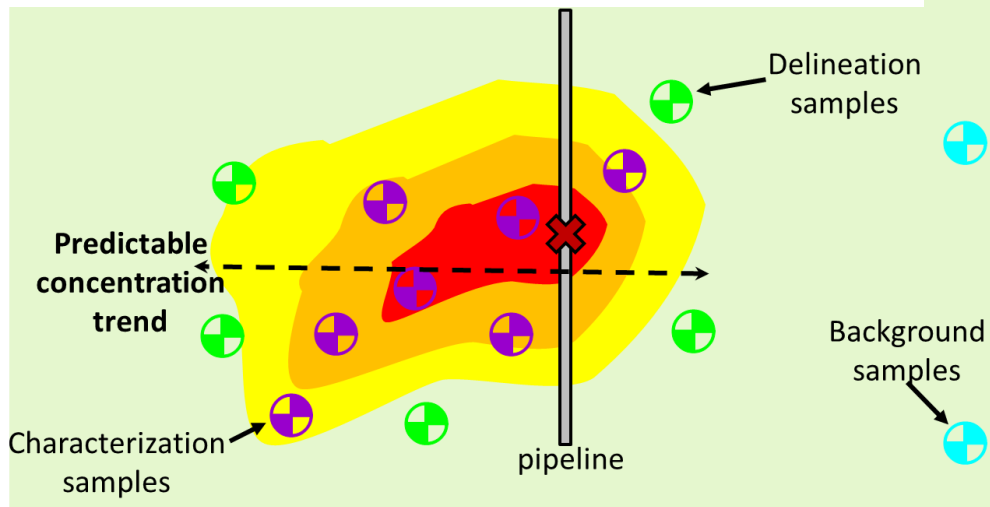


# Evaluation of Delineation

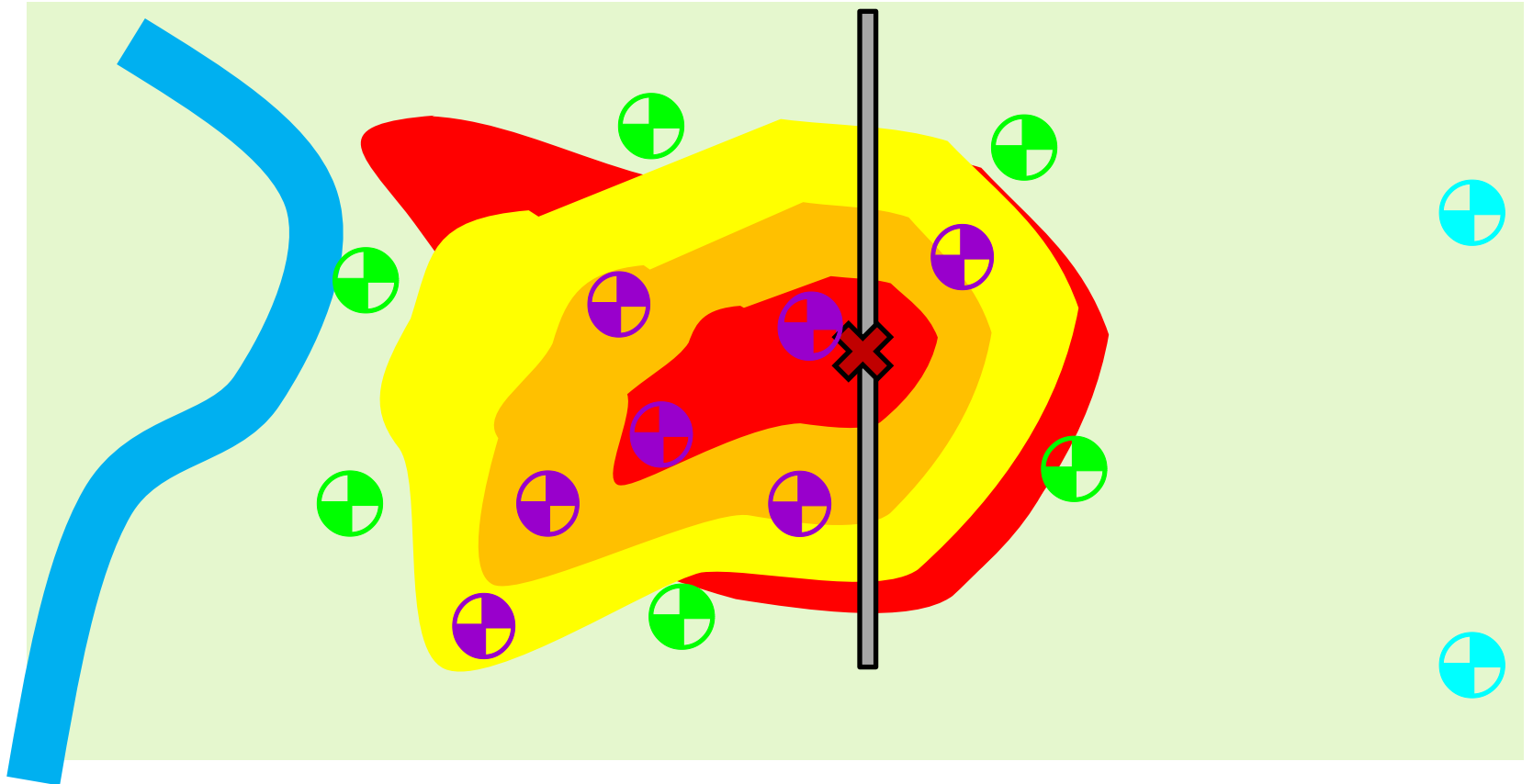
## Simple Delineation



## Advanced Delineation



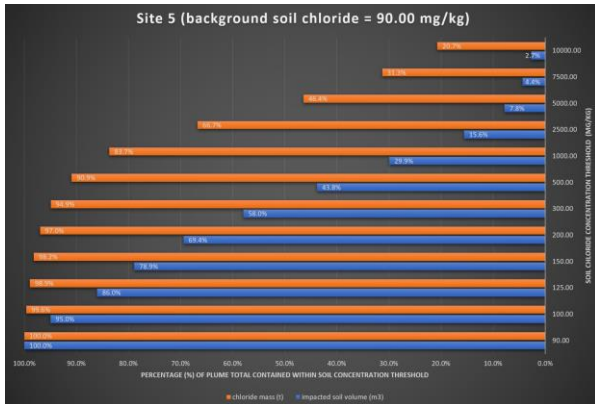
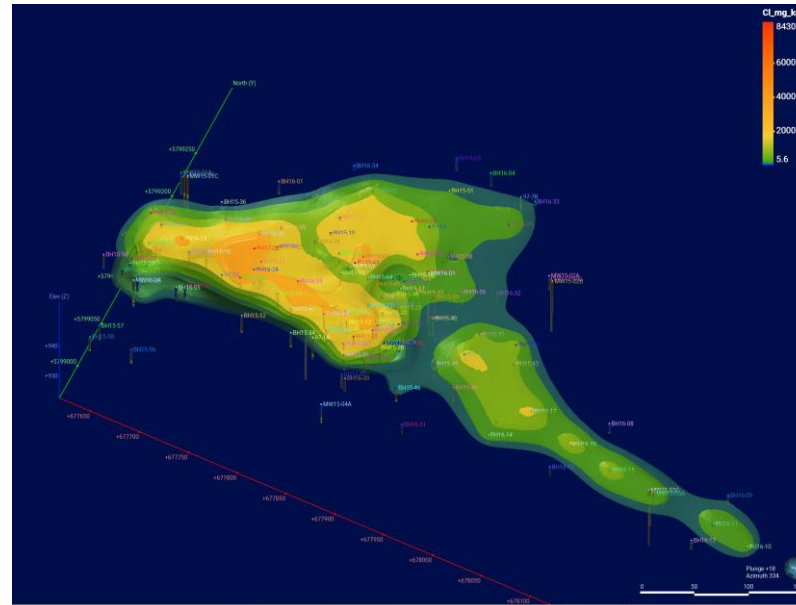
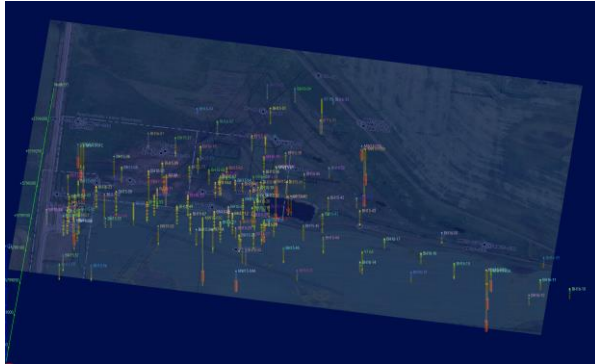
# Simple Delineation Process Issues



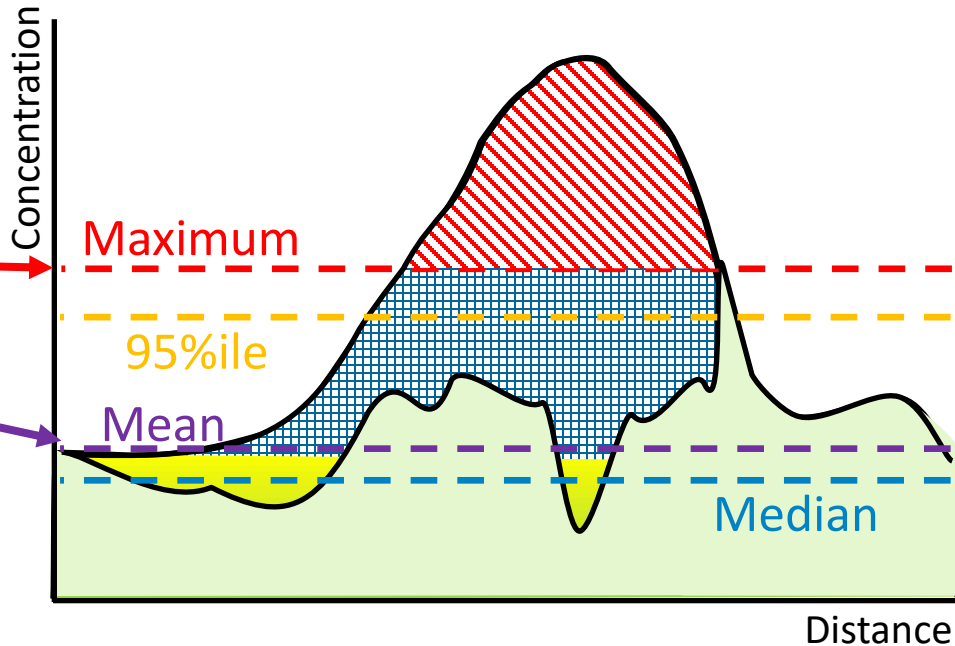
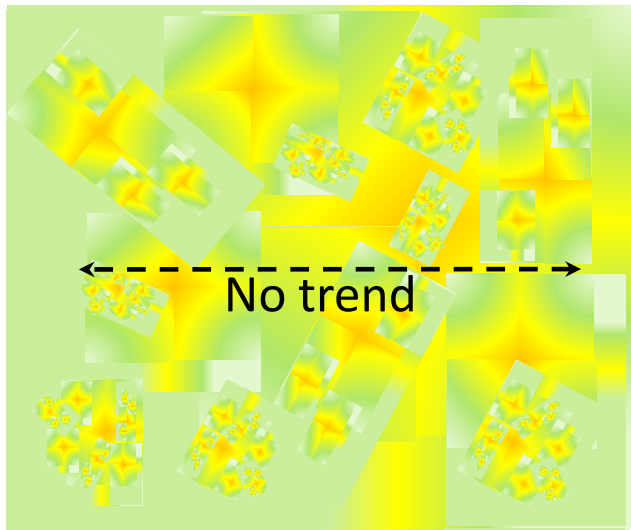


# Geospatial Modelling

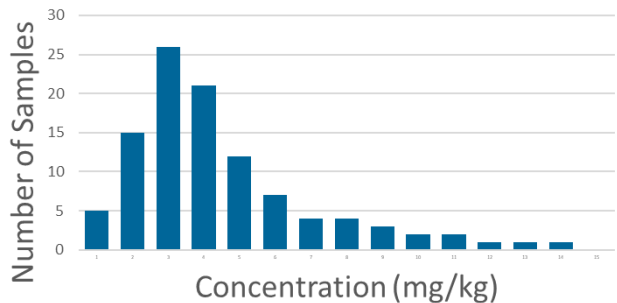
- Interpolate chloride in soil plume
- 3D Radial Basis Function
- Apply block model to plume to discretize mass



# Impact of Background Concentrations

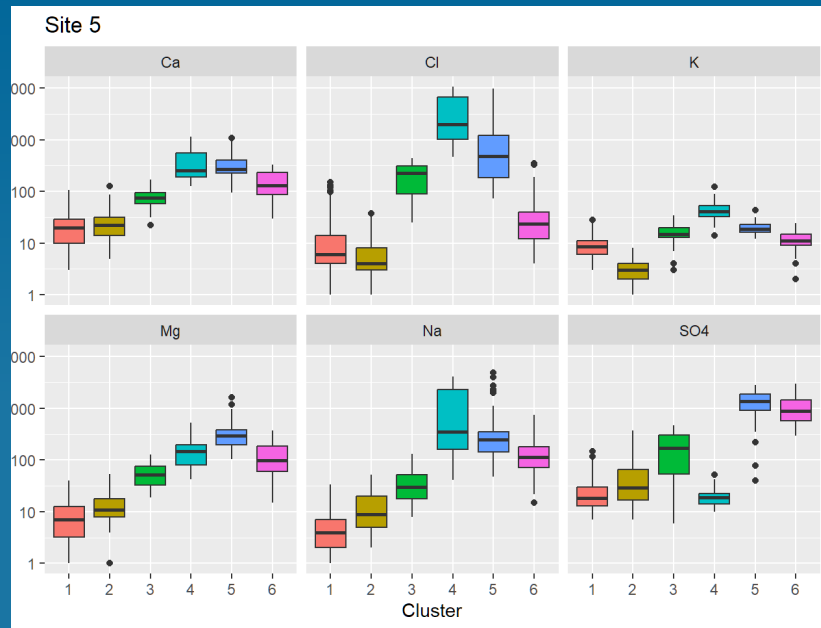
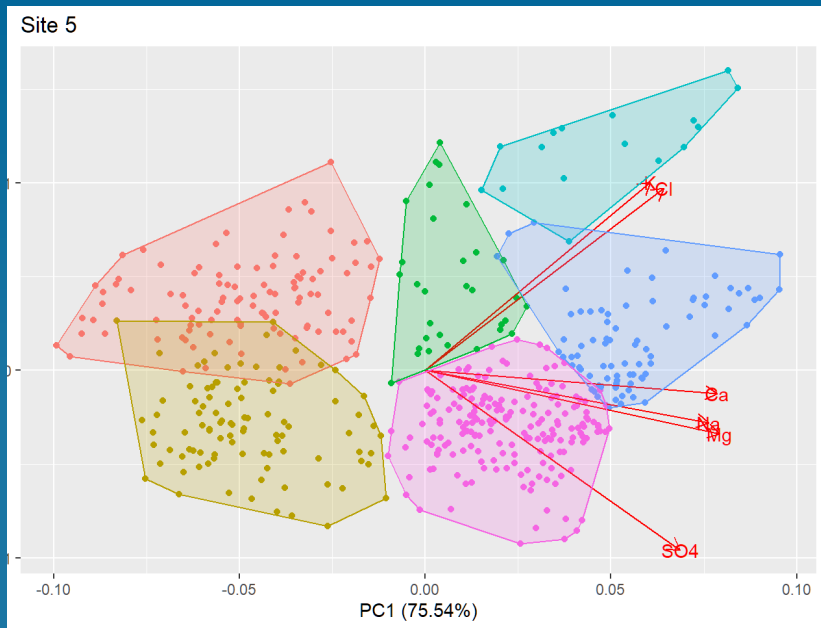


Background Data Distribution



# Background Analysis

## Principal Component Analysis (PCA)



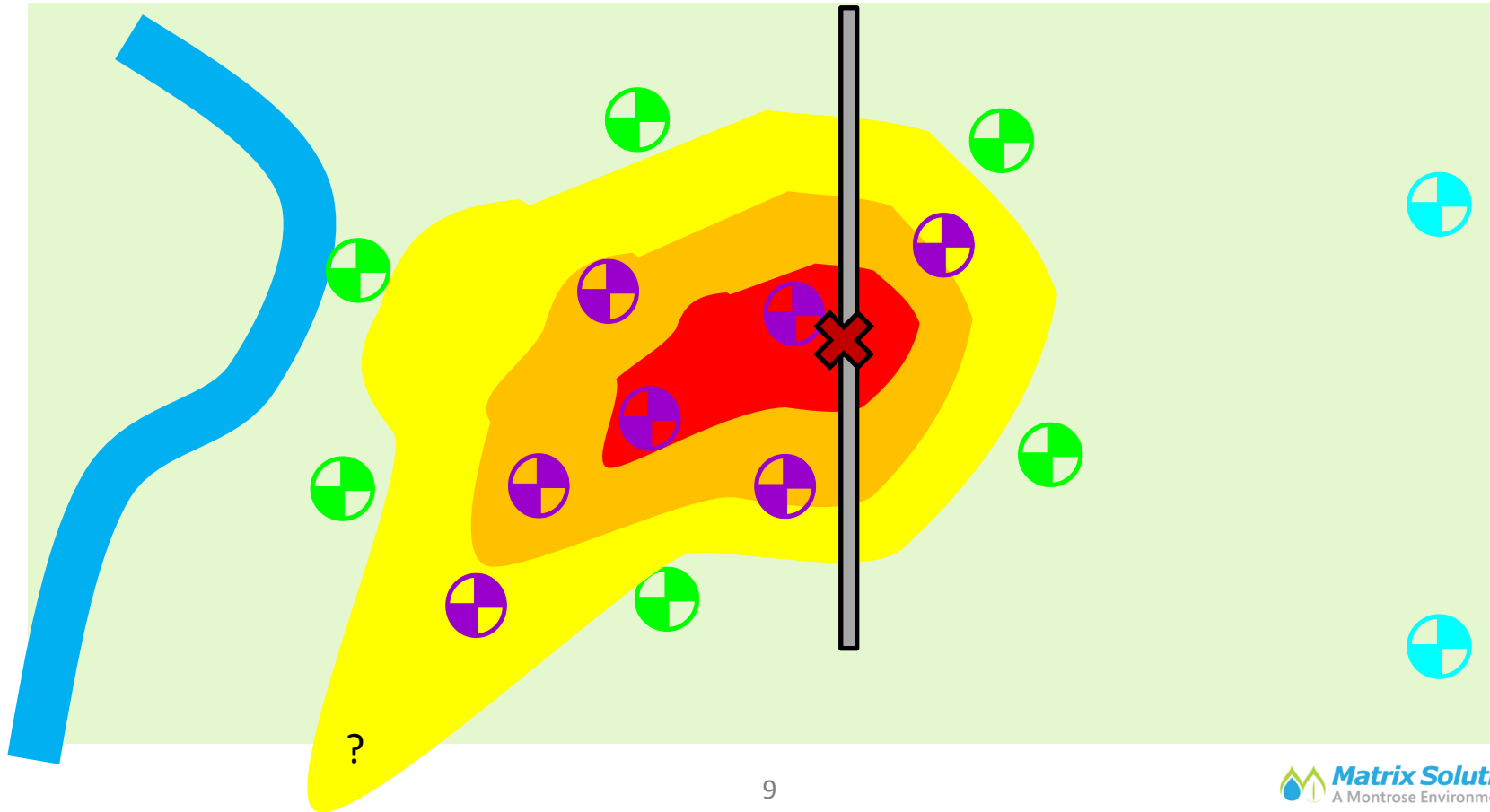
## Stage 2

- Increased focus on plume fringes
  - Viability of delineation through interpolation methods?
- Statistical validation method
  - Testing to confirm interpolation is appropriate?



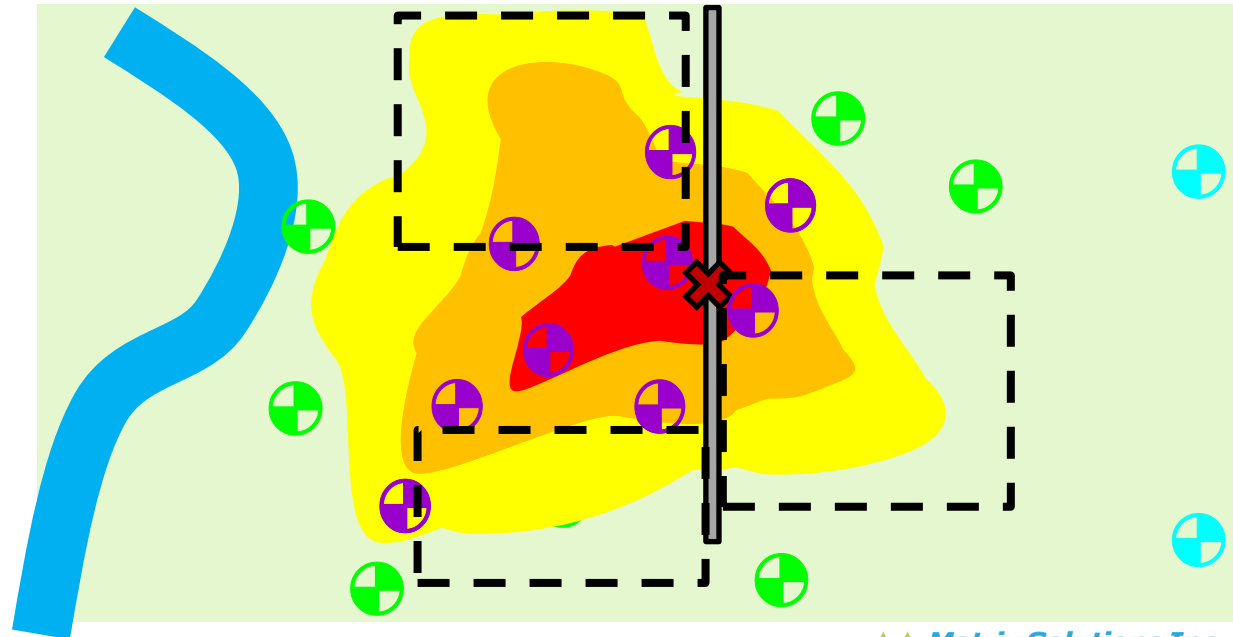


# Delineation by Interpolation



	No Data Removed	1 Sample Removed	2 Samples Removed	3 Samples Removed
Volume (m <sup>3</sup> ) of Plume	2500	2600	2750	3200
Mass (tonnes) of Chloride in plume	10	10.3	11	14

## Plume Interpolation Approach

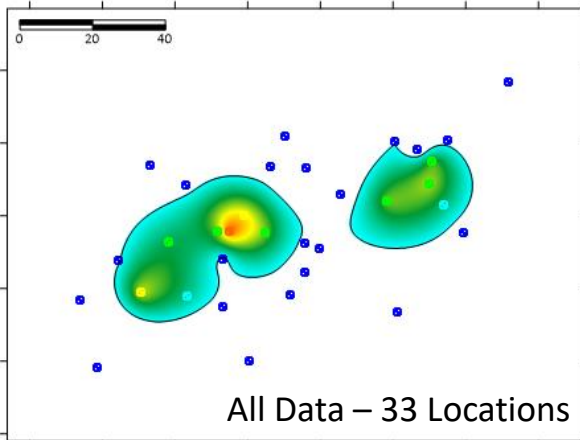


# Simple Interpolation Approaches

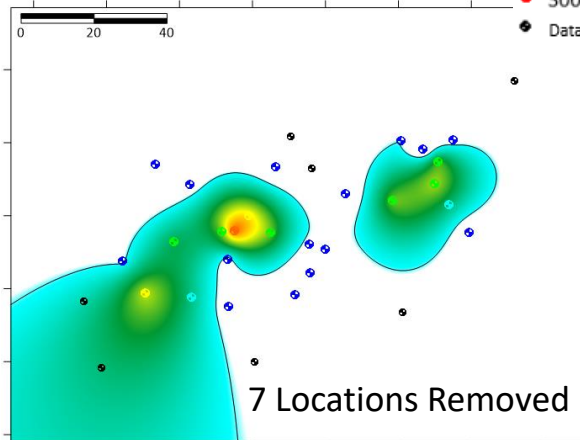
- 0 to 100
- 101 to 225
- 226 to 550
- 551 to 1275
- 1275 to 3000
- 3001 to 7000

● Data point removed from interpolation

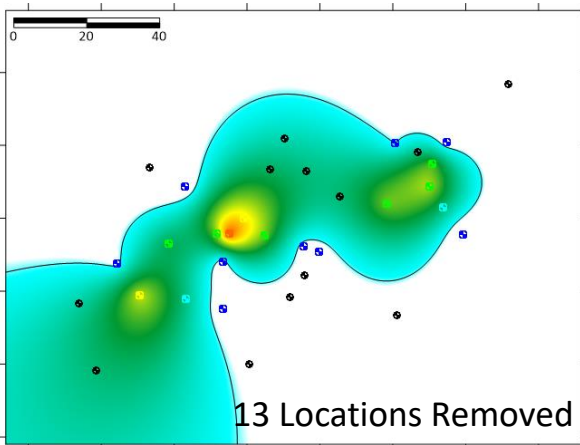
Mass = 300 T  
Area = 1,950 m<sup>2</sup>



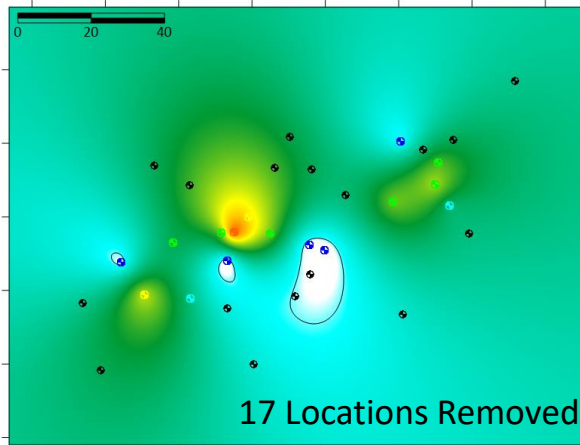
Mass = 390 T  
Area = 2,800 m<sup>2</sup>



Mass = 520 T  
Area = 4,200 m<sup>2</sup>



Mass = 1,100 T  
Area = 8,800 m<sup>2</sup>



# Leapfrog

No data removed

Mass = 10.4 T

Volume = 28,019 m<sup>3</sup>

Lowest 10 % of chloride  
mg/kg samples removed

Mass = 10.7 T

Volume = 29,106 m<sup>3</sup>

Lowest 25 % of chloride  
mg/kg samples removed

Mass = 11.1 T

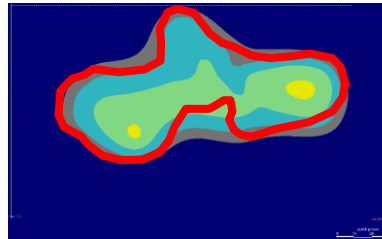
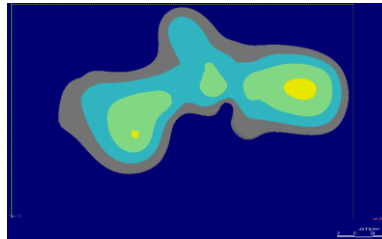
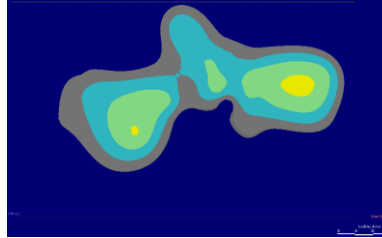
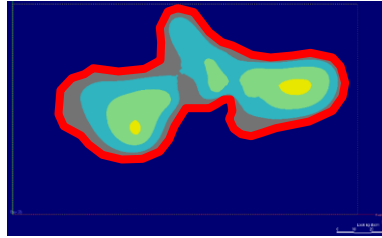
Volume = 30,742 m<sup>3</sup>

Lowest 50 % of chloride  
mg/kg samples removed

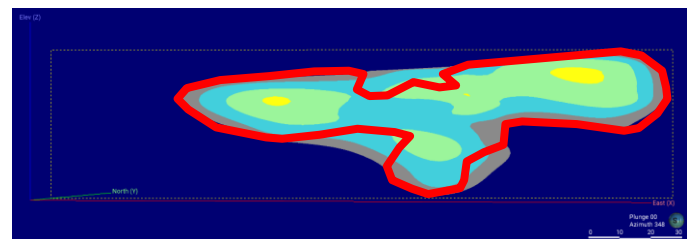
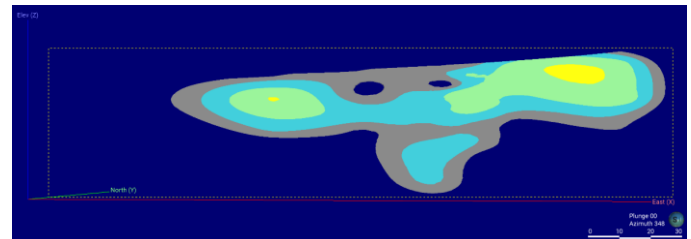
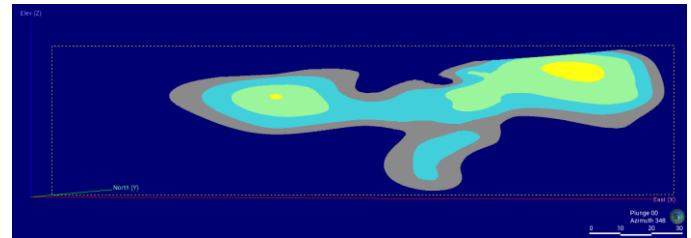
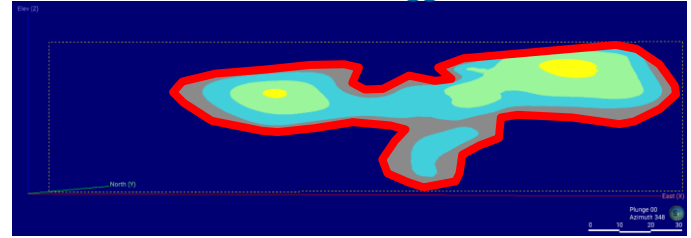
Mass = 13.8 T

Volume = 37,719 m<sup>3</sup>

Plan View



Cross Section – Vertical Exaggeration 3x



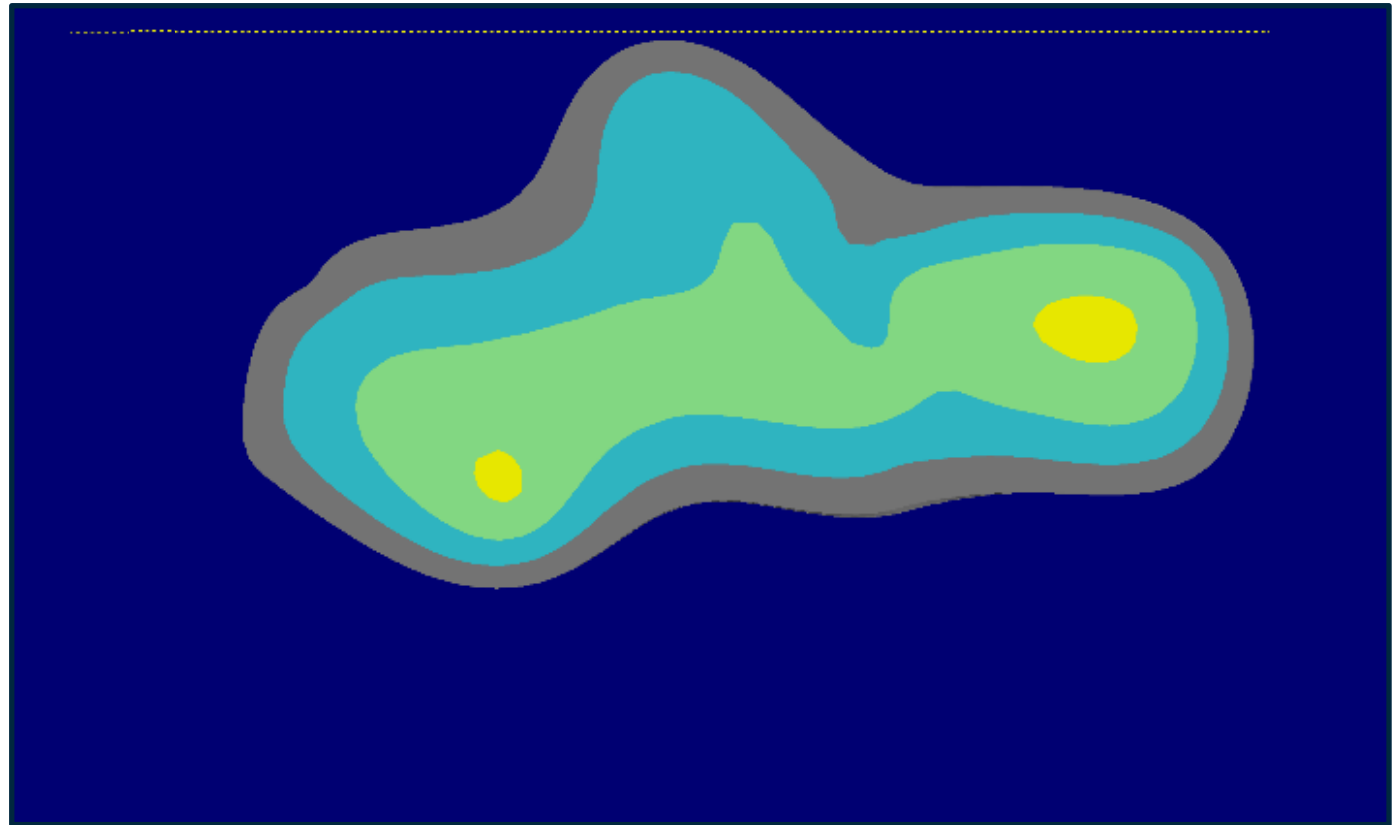
# Leapfrog

No data removed

Lowest 10 % of chloride  
mg/kg samples removed

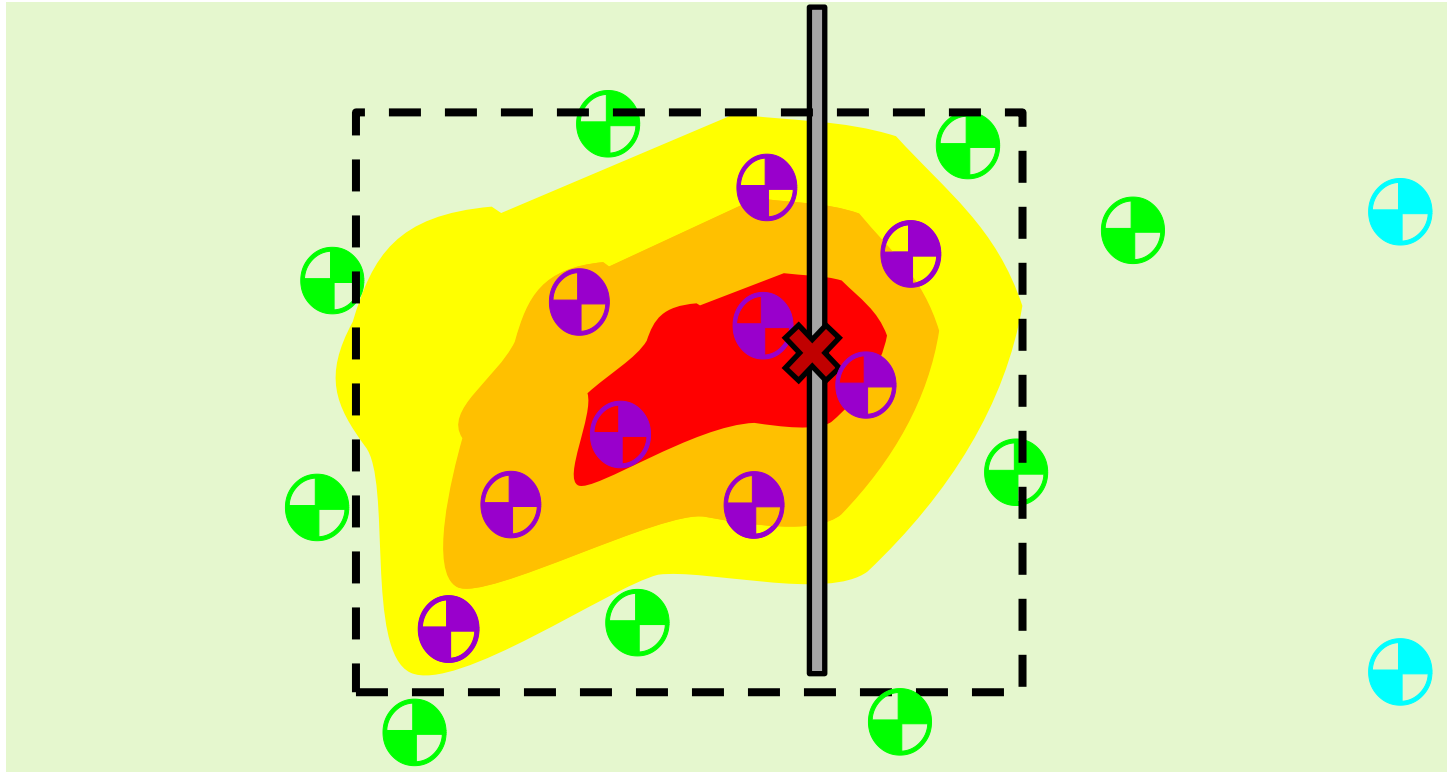
Lowest 25 % of chloride  
mg/kg samples removed

Lowest 50 % of chloride  
mg/kg samples removed

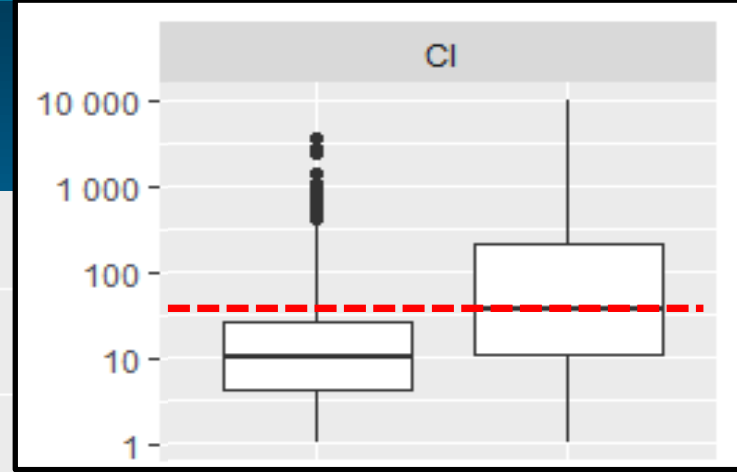
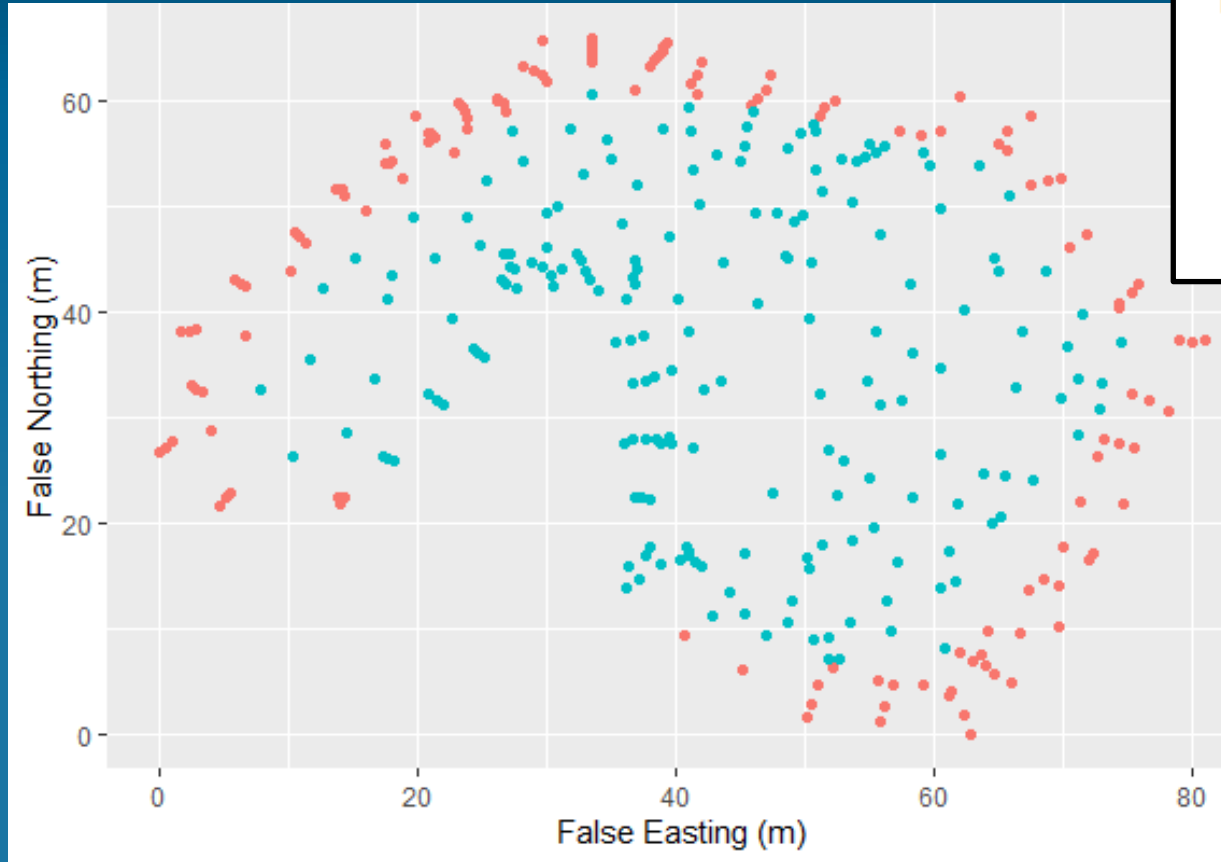




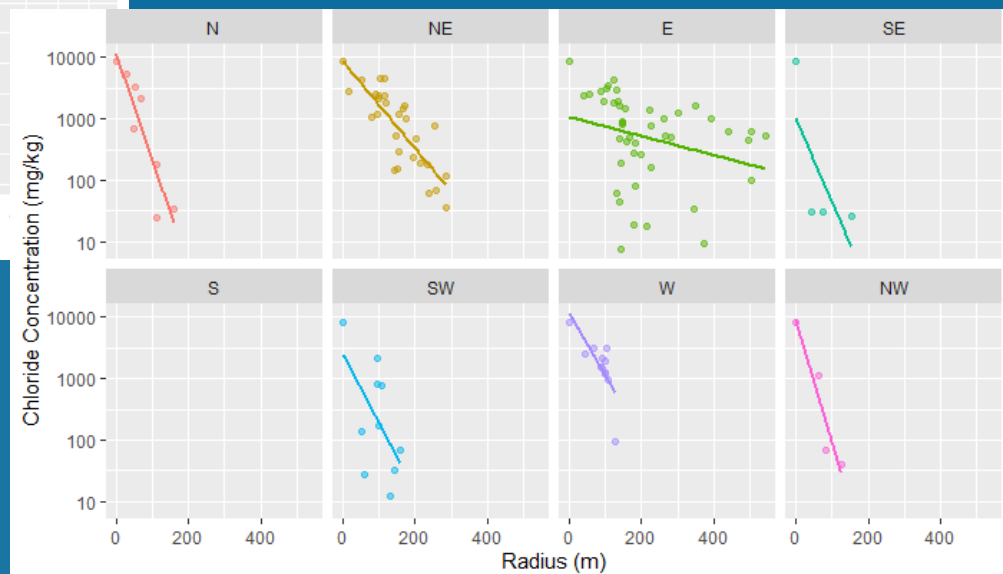
# Plume Interpolation – Implications



# Convex Hulls

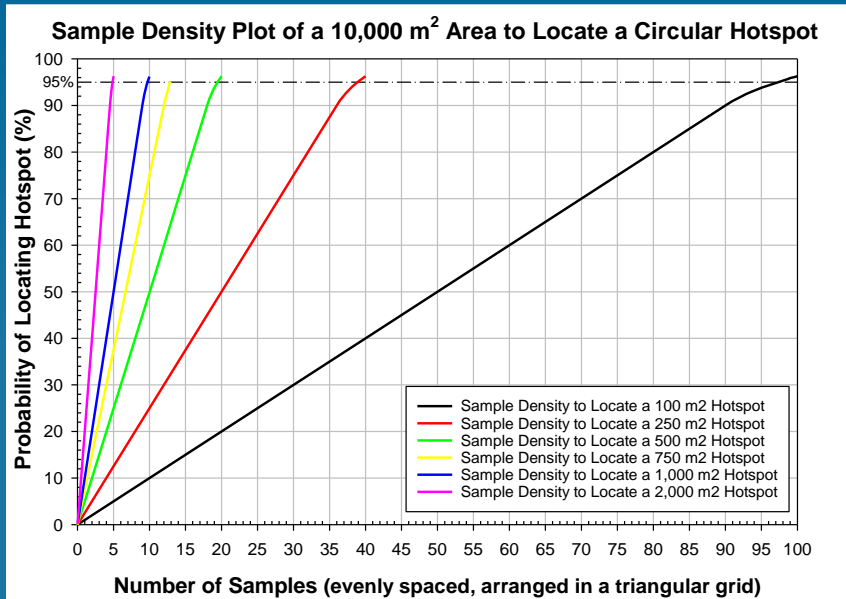


# 1-D Gradient

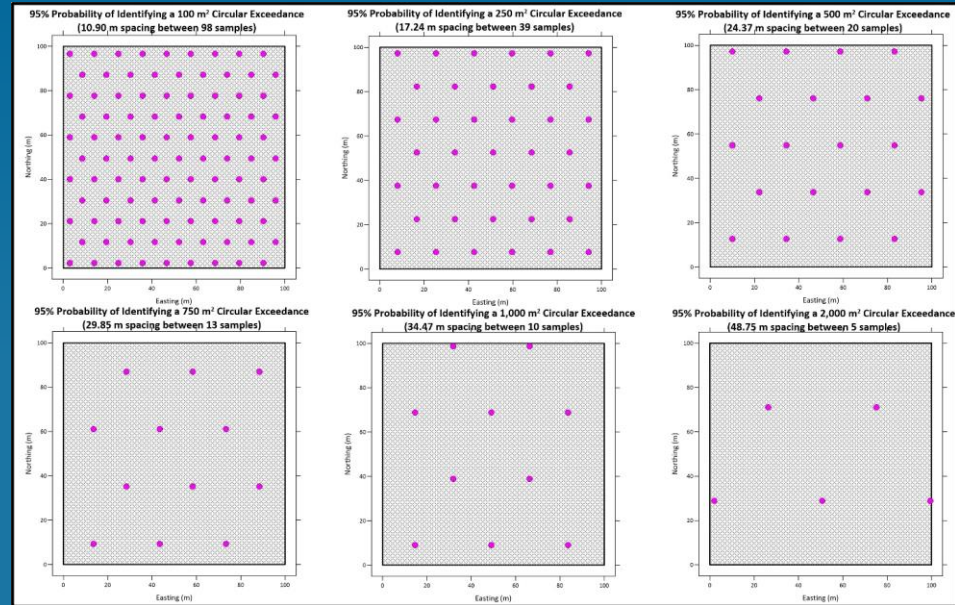


# Sample Density: VSP – Visual Sampling Plan

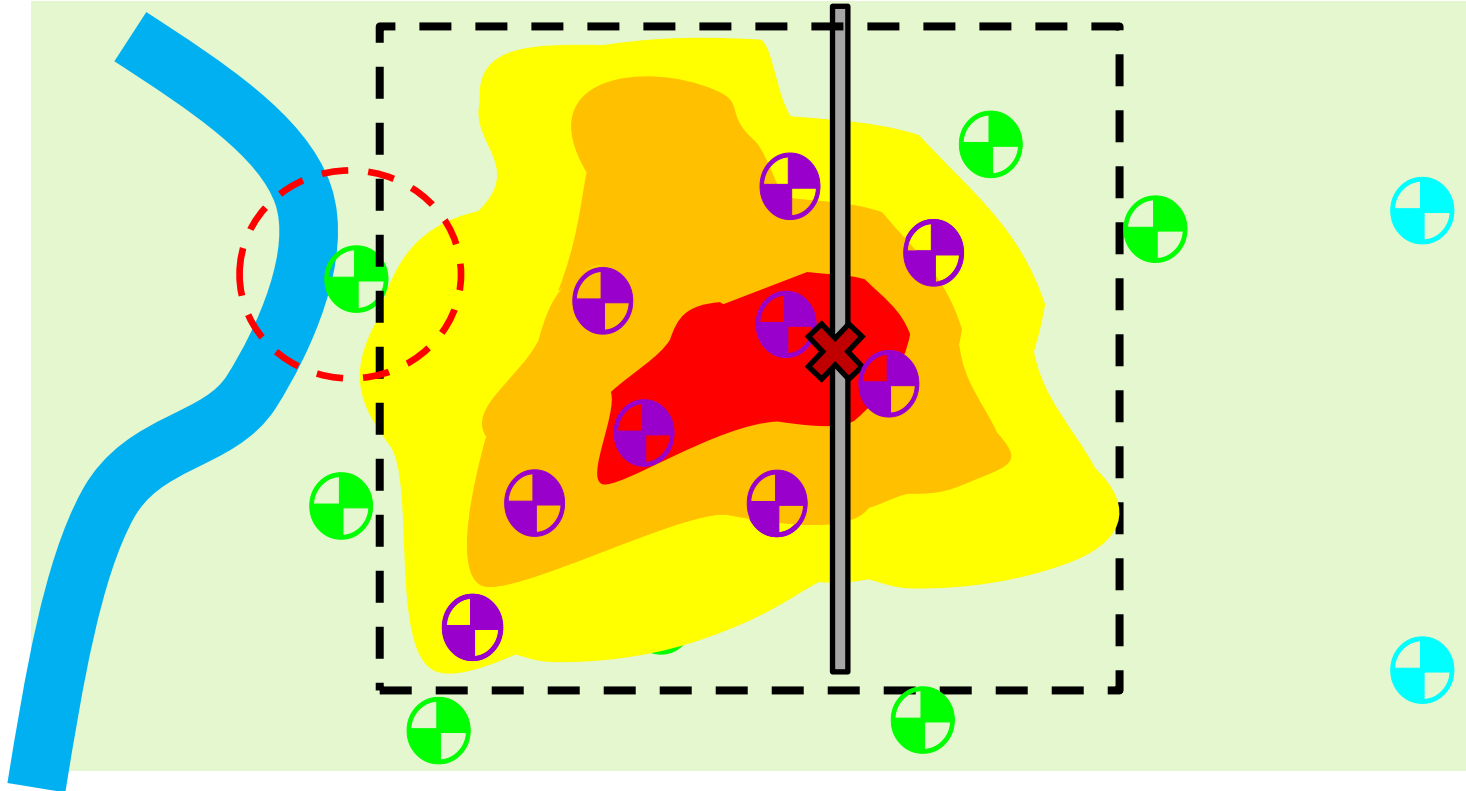
Sample Density to Locate Various-Sized Circular Hotspots in a 1.00 ha Sample Area, with Varying Confidence Intervals



Theoretical Sample Locations to Identify Various Circular Hotspots in a 1.00 ha Sample Area with 95% Probability

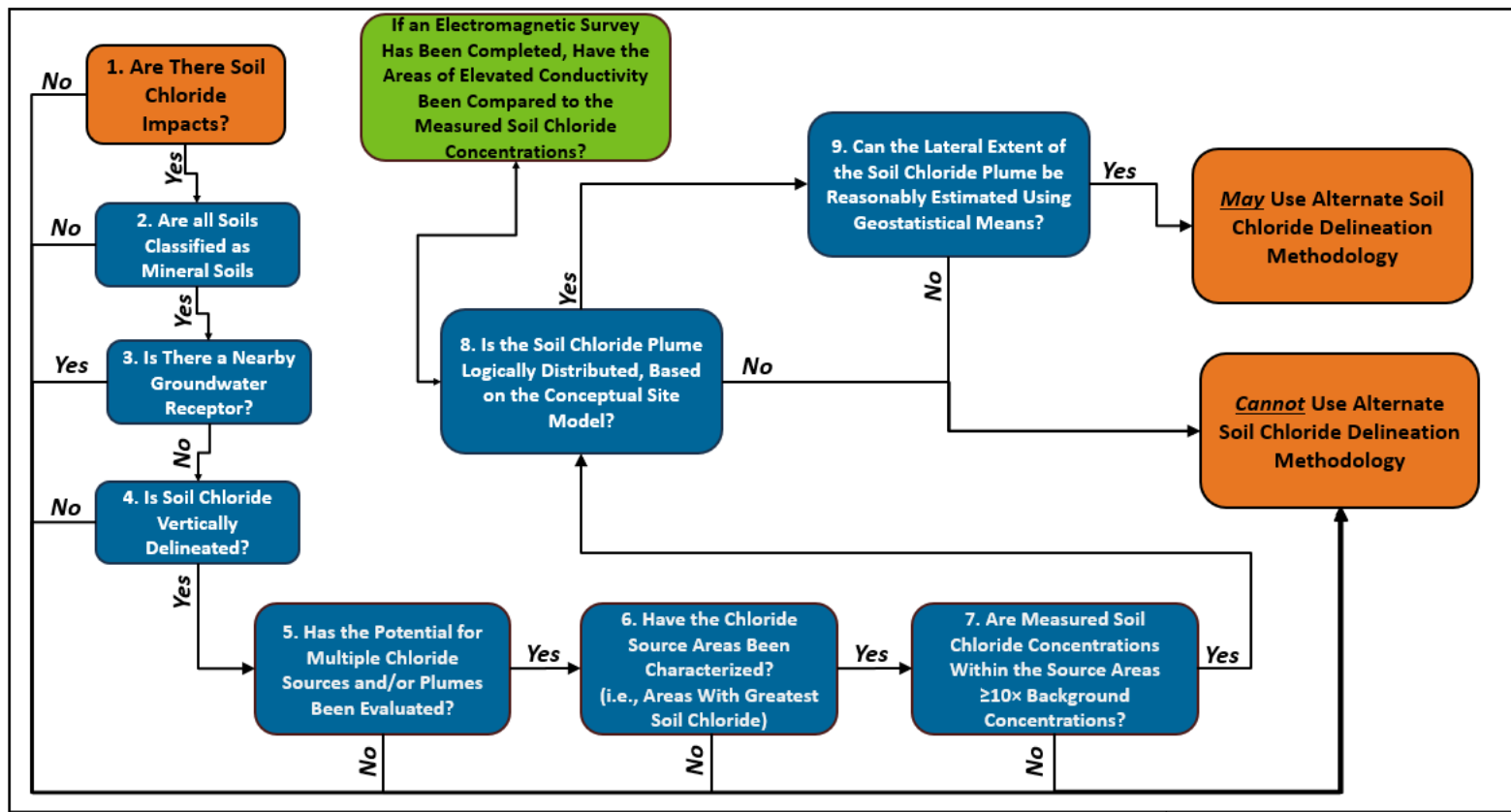


# Summary





# Process Flow Approach



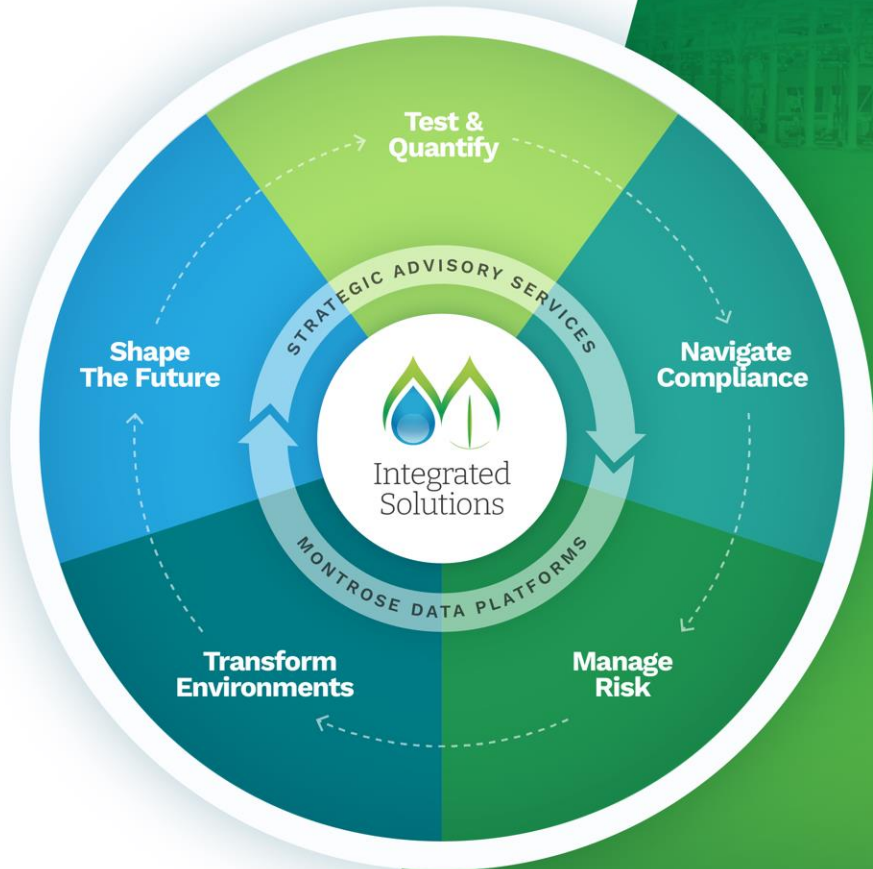
# Acknowledgements

This presentation was based on work conducted for PTAC



Major contributors:

- Tom Knapik - PMC
- Lorie Mayes, Tannis Such, and Allan Fogwill – PTAC
- Sheila Luther, Carl Ayer, Henry Hecky, Tyler Prediger, Ashley Morgan – Matrix Solutions Inc. a Montrose Environmental Company



## Montrose At A Glance

Montrose provides strategic, integrated solutions that guide organizations through environmental challenges, ultimately delivering business value and positively impacting our planet and society.

We implement environmental solutions that scale.

- ~3,200 employees
- ~100 locations worldwide
- ~5,600 clients from the private and public sectors
- 6 patents issued in 2022, for a total of 18 patents



# Questions?



# Contact Us

Daniel Pollard, M.Sc, P.Geo.  
Senior Contaminant Hydrogeologist  
[dpollard@matrix-solutions.com](mailto:dpollard@matrix-solutions.com)  
Direct: 236-330-6111

Ashley Morgan, P.Geo.  
Senior Hydrogeologist  
[amorgan@matrix-solutions.com](mailto:amorgan@matrix-solutions.com)  
Direct: 403-727-0264

[matrix-solutions.com](http://matrix-solutions.com)



# Disclaimer

- Project is in DRAFT and has NOT received Regulatory endorsement.
- Conclusions based on sites that were reviewed as part of this project and can not necessarily be applied to all sites.

Matrix Solutions Inc. certifies that this presentation is accurate and complete and accords with the information available during the project. Information obtained during this work or provided by third parties is believed to be accurate but is not guaranteed. Matrix Solutions Inc. has exercised reasonable skill, care, and diligence in assessing the information obtained during the preparation of this presentation.

This presentation was prepared for the Petroleum Technology Alliance Canada Remediation Reclamation Forum in June, 2024. Any uses of this presentation by a third party or any reliance on decisions made based on it are the responsibility of that party. Neither Matrix Solutions Inc. nor its affiliates are responsible for damages or injuries incurred by any third party as a result of decisions made or actions taken based on this presentation.