TerranearPMC

# Automated Coverage Gap Identification

*Using Point Cloud Data and Geographic Information Systems*

SAGEEP 2025

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# Introduction

APEX integrated with SLAM

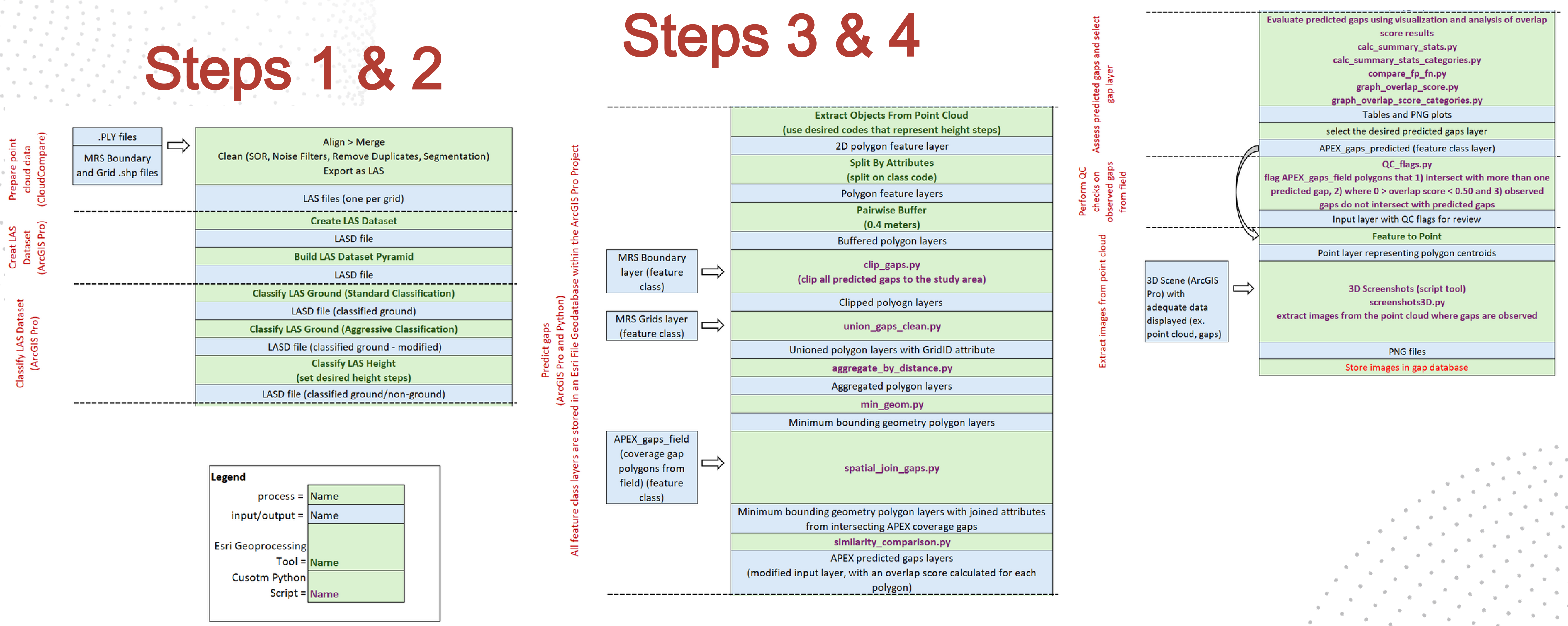
- Increase in use of SLAM on MMRP sites
- Opportunity to utilize point cloud data for QC, streamline gap annotation, and improve data review

STENCIL 2-16

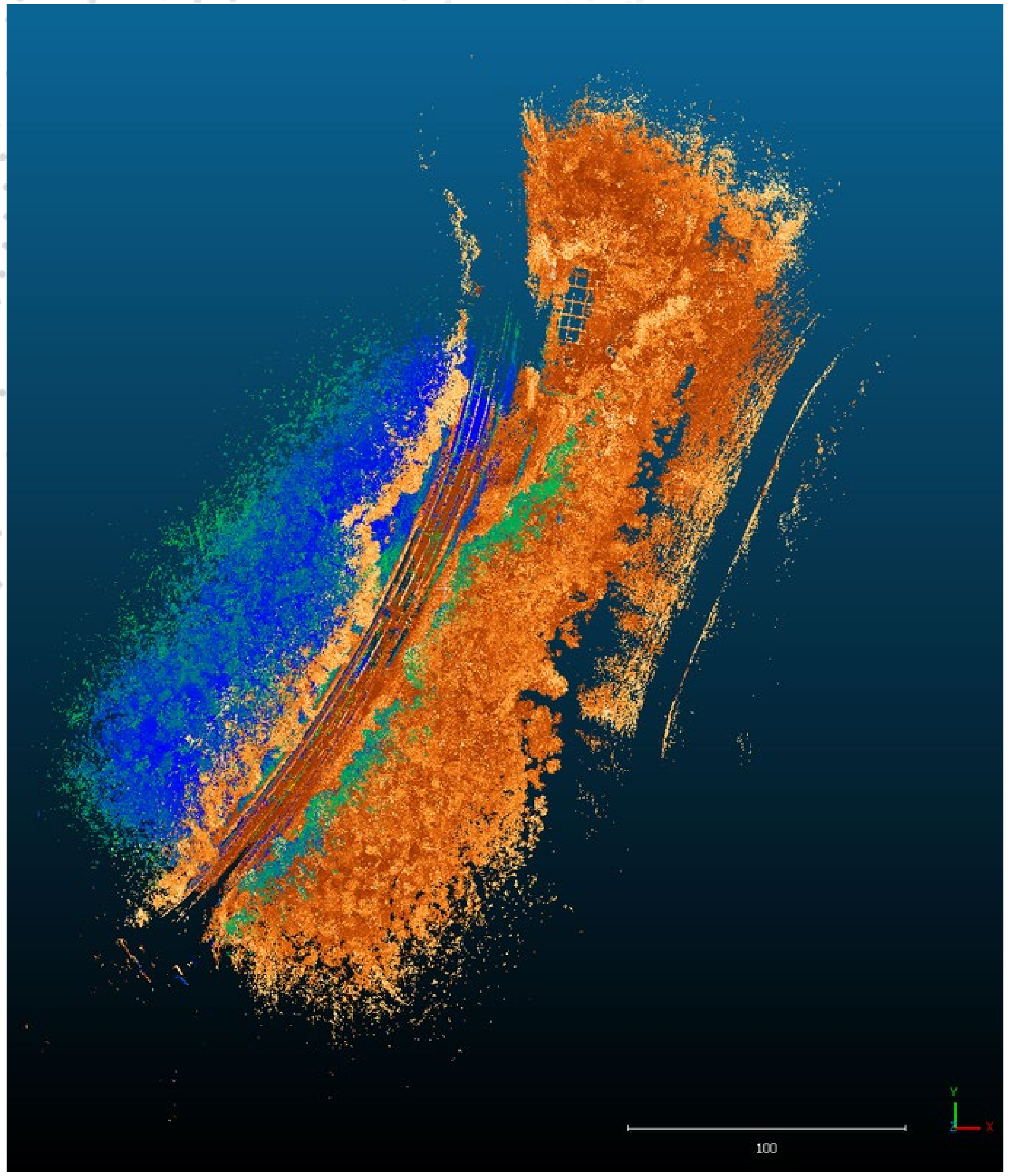
POWERED BY KAARTA ENGINE

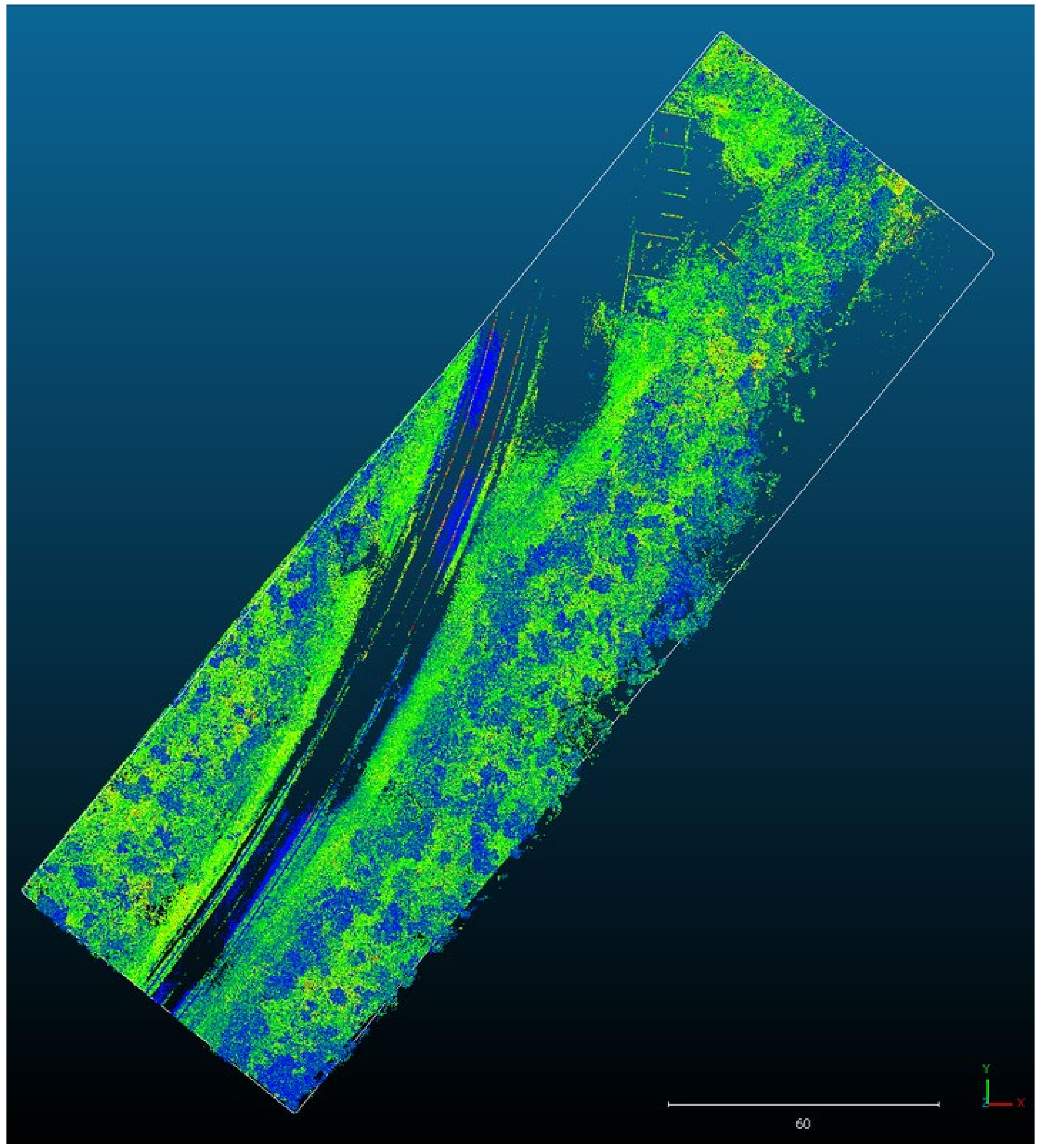
Real-time, high fidelity 3D mobile scanning and generation

# Workflow Overview



# Step One: Prepare Point Cloud

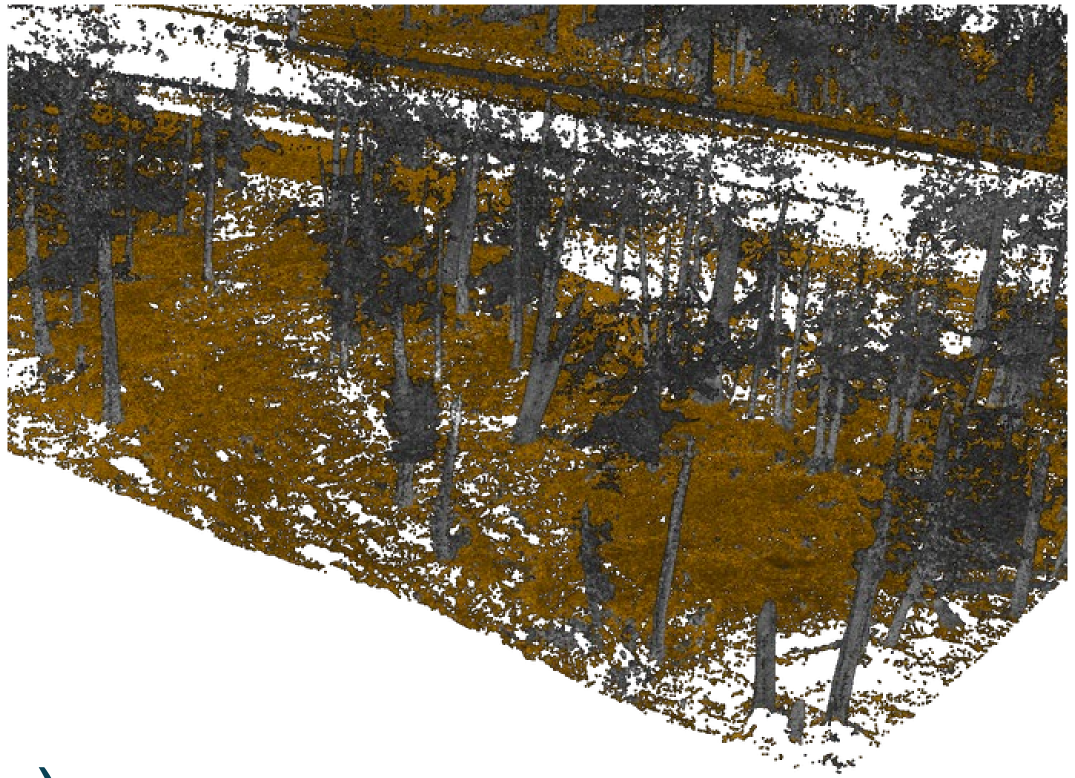



- Align and Merge
- Clean (SOR/Noise Filters, Remove Duplicates, Segmentation)
- Export as LAS

# Step Two: Ground Classification

## Why is it important?



Classification Methods Tested

- CSF Filter
- ESRI Classify LAS Ground (Standard)
- ESRI Classify LAS Ground (Aggressive)
- LidarGroundPointFilter (Whitebox Tools)
- Manual Classification

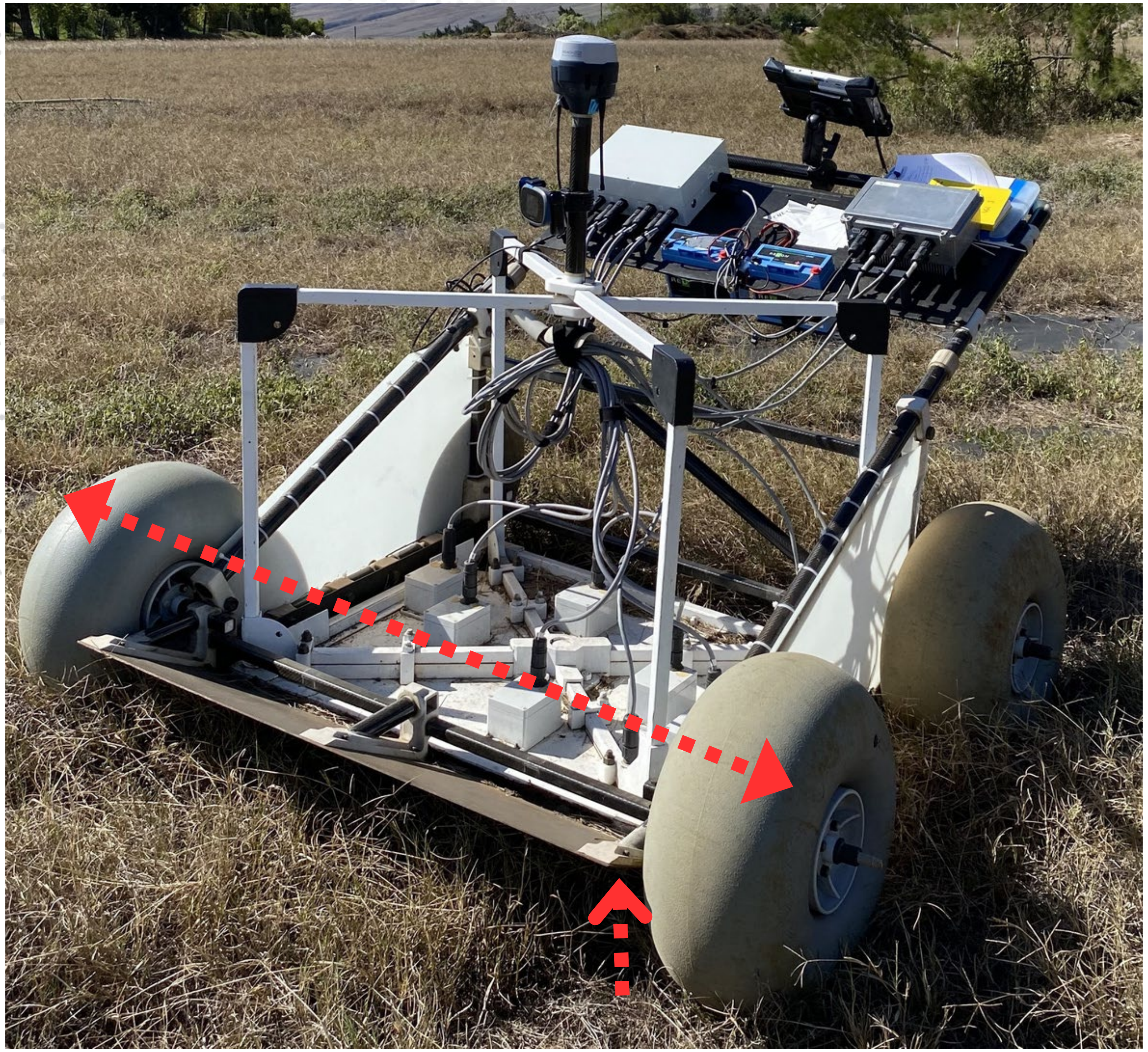
CloudCompare V2

ArcGIS® Pro

Whitebox Geospatial Inc

Innovative geospatial software built on open-source

# Step Three: Predict Gaps



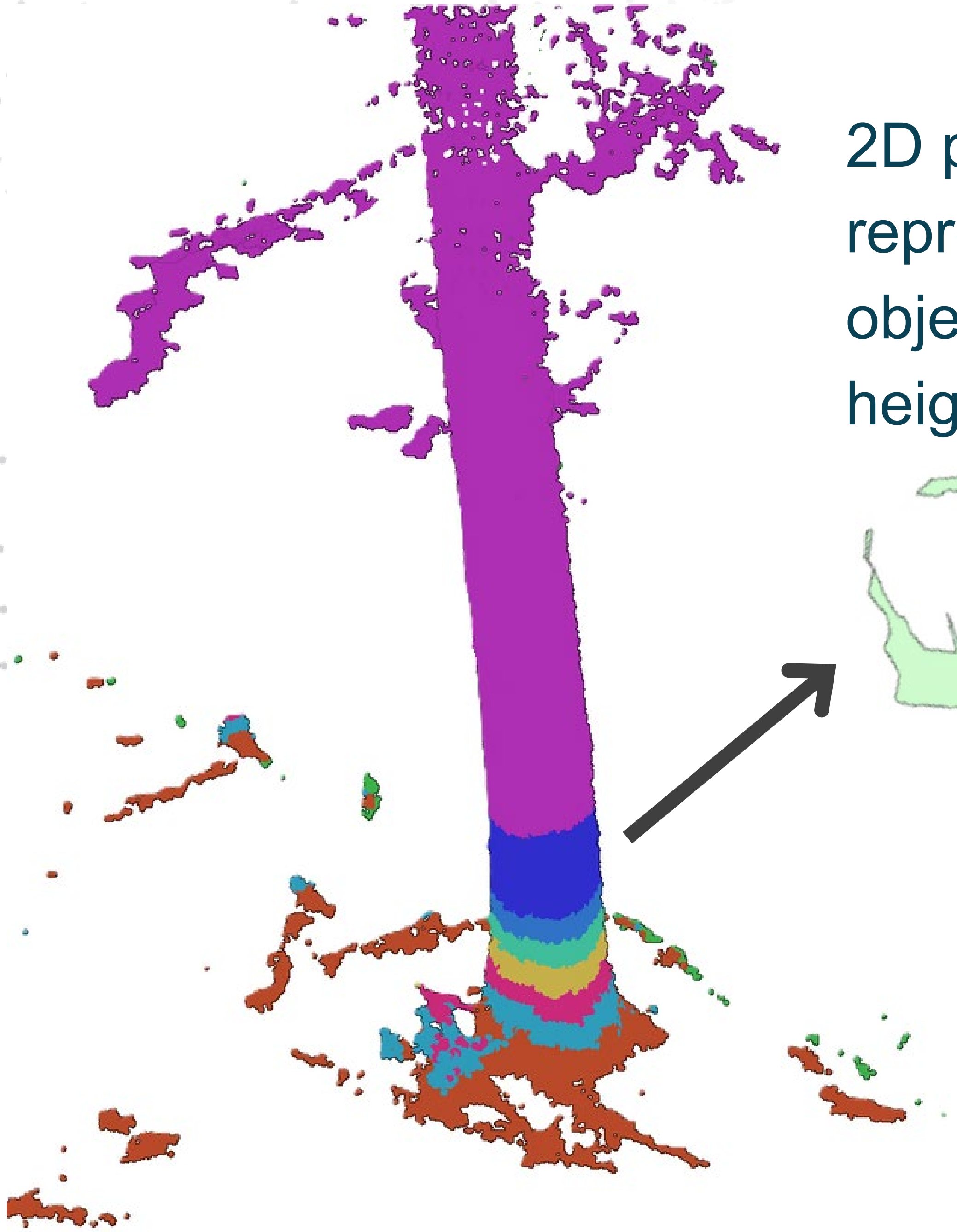
**APEX Dimensions**

- 100cm x 80cm plate
- 160cm wheel to wheel
- 0.15m sensor to ground offset (cart mode)
- 80cm swath of coverage

**Key Parameters**

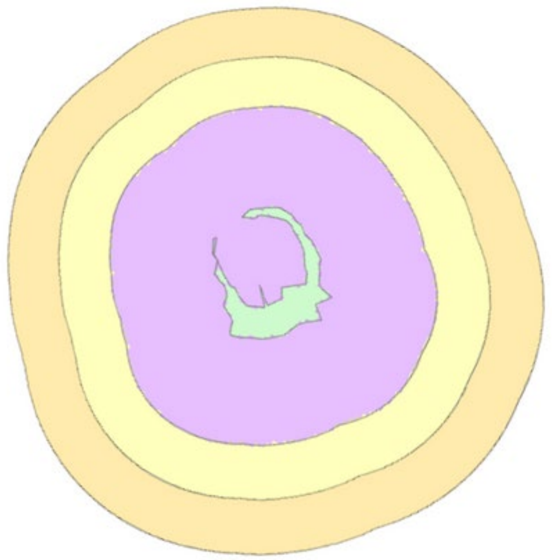
- *Classify LAS by Height*
  - 0.15m, 0.25m, etc.
- *Buffer Gaps*
  - 0.2m, 0.3m, 0.4m
- *Aggregate Gaps*
  - gaps < 1.1m apart

# Step Three: Predict Gaps

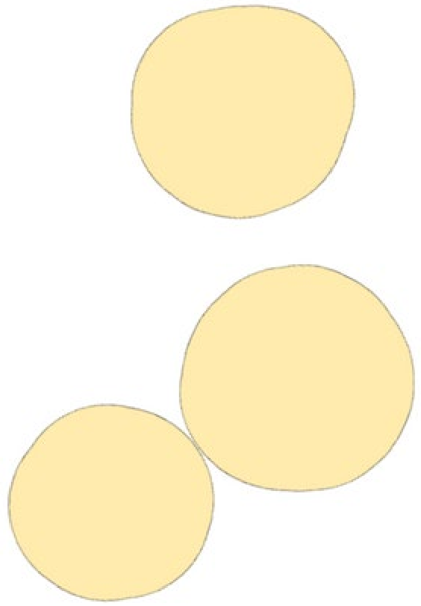


point cloud classified
by height (tree)

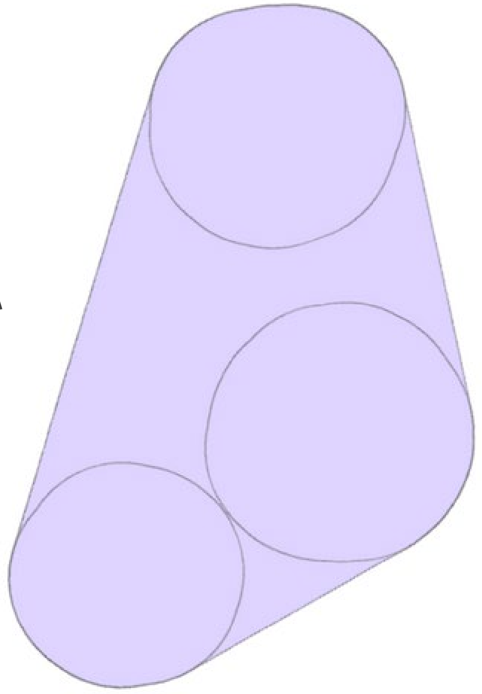
2D polygon
representing slice of
object at specified
height



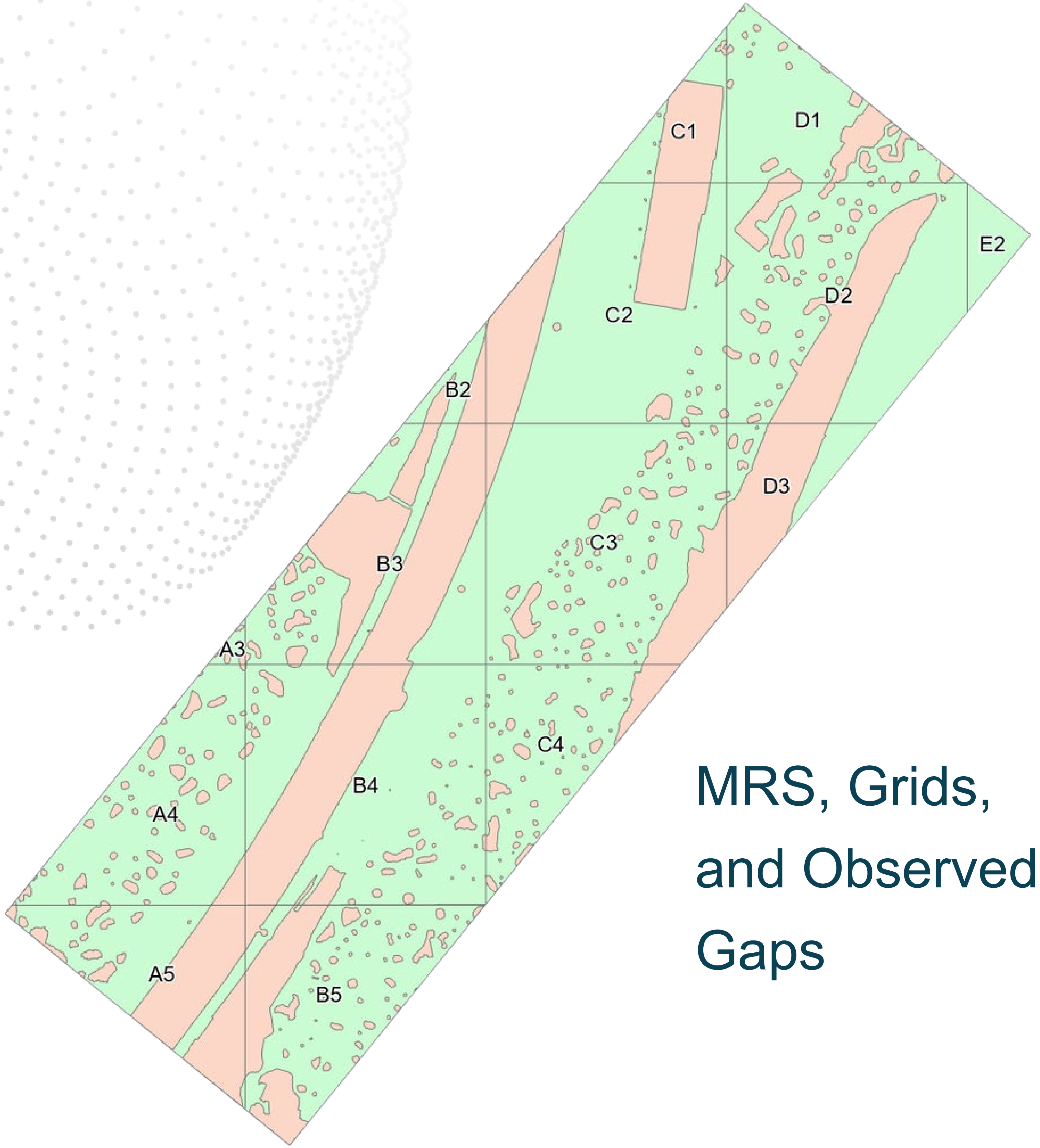
buffered polygon layers
representing gaps



aggregated gaps
(gaps < 1.1m apart)



# Step Four: Compare Gaps

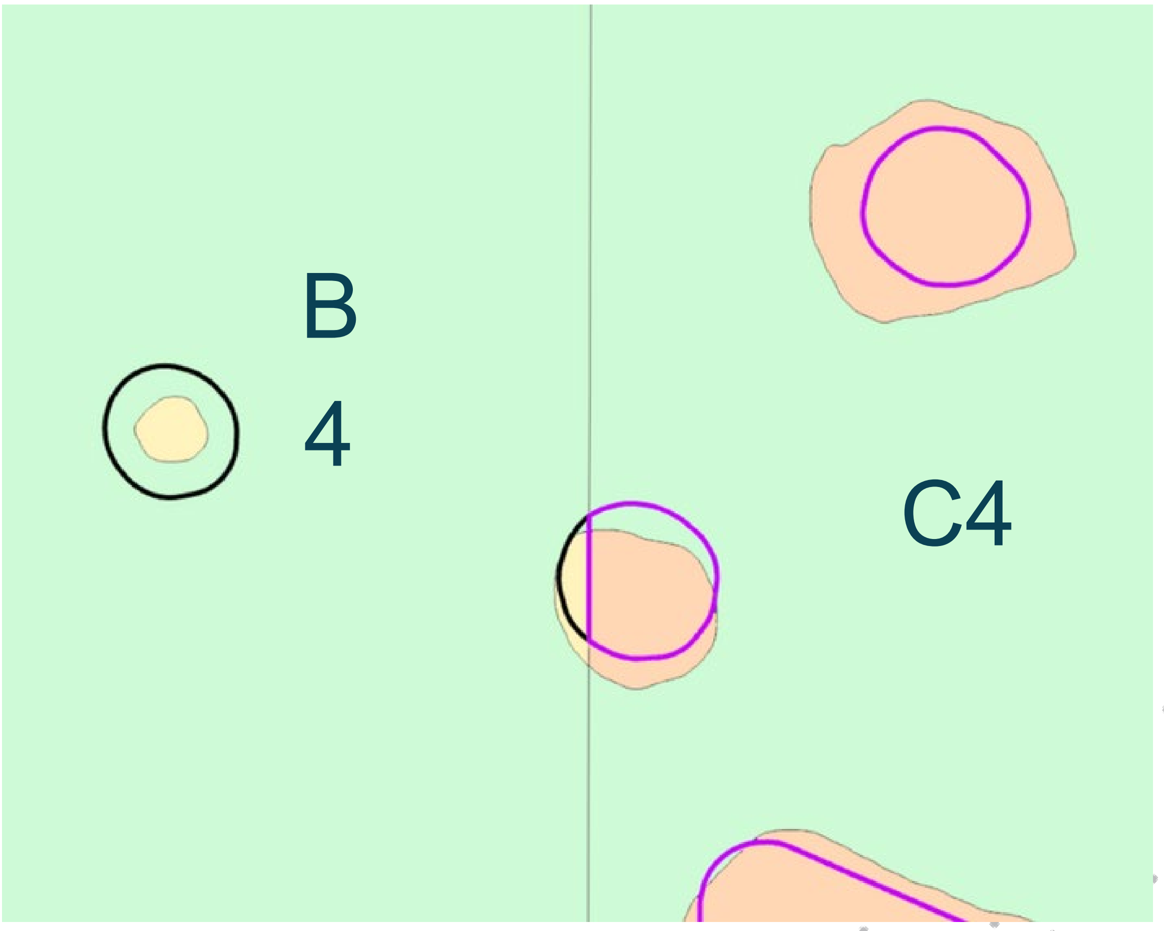



MRS, Grids, and Observed Gaps

- Split predicted gaps by MRS grid
- Spatially join with observed gaps

**B4 Predicted Gap**

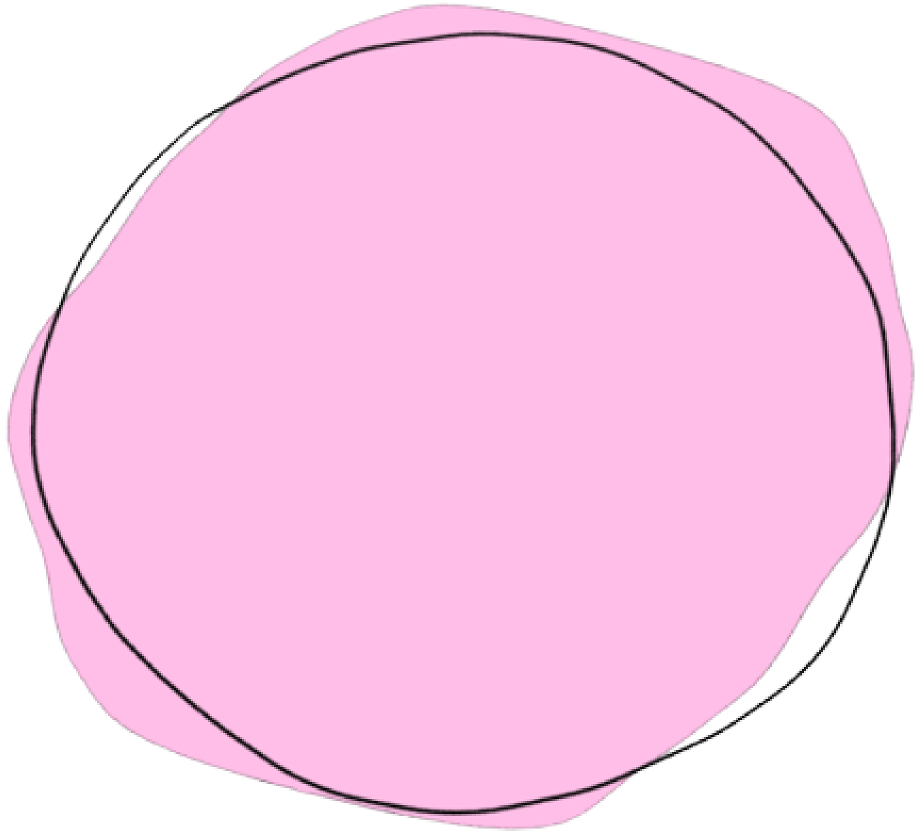
**C4 Predicted Gap**



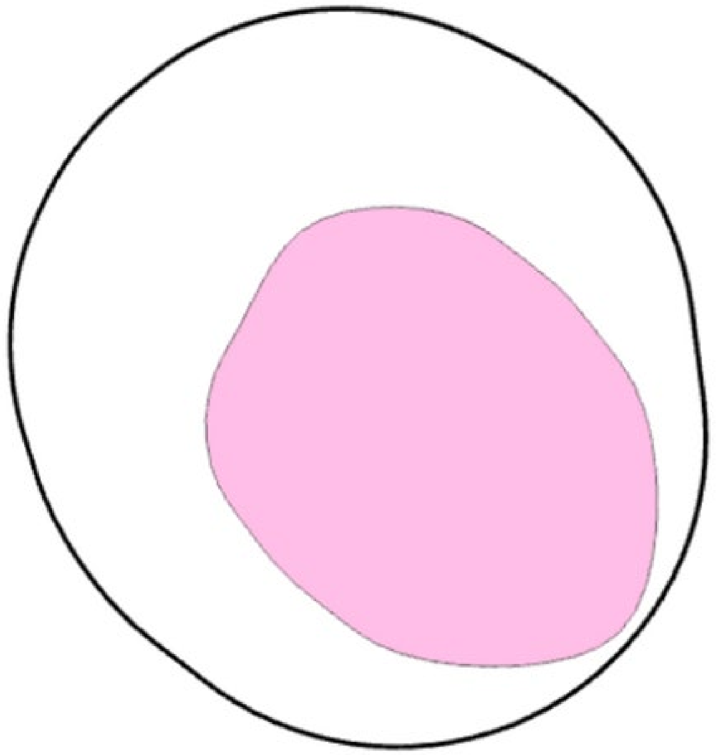
# Step Four: Compare Gaps

Jaccard Index of Similarity

$$J(A,B) = \frac{A \cup B}{A \cap B} = \frac{|A \cup B|}{|A| + |B| - |A \cap B|}$$



similarity
score = 0.89

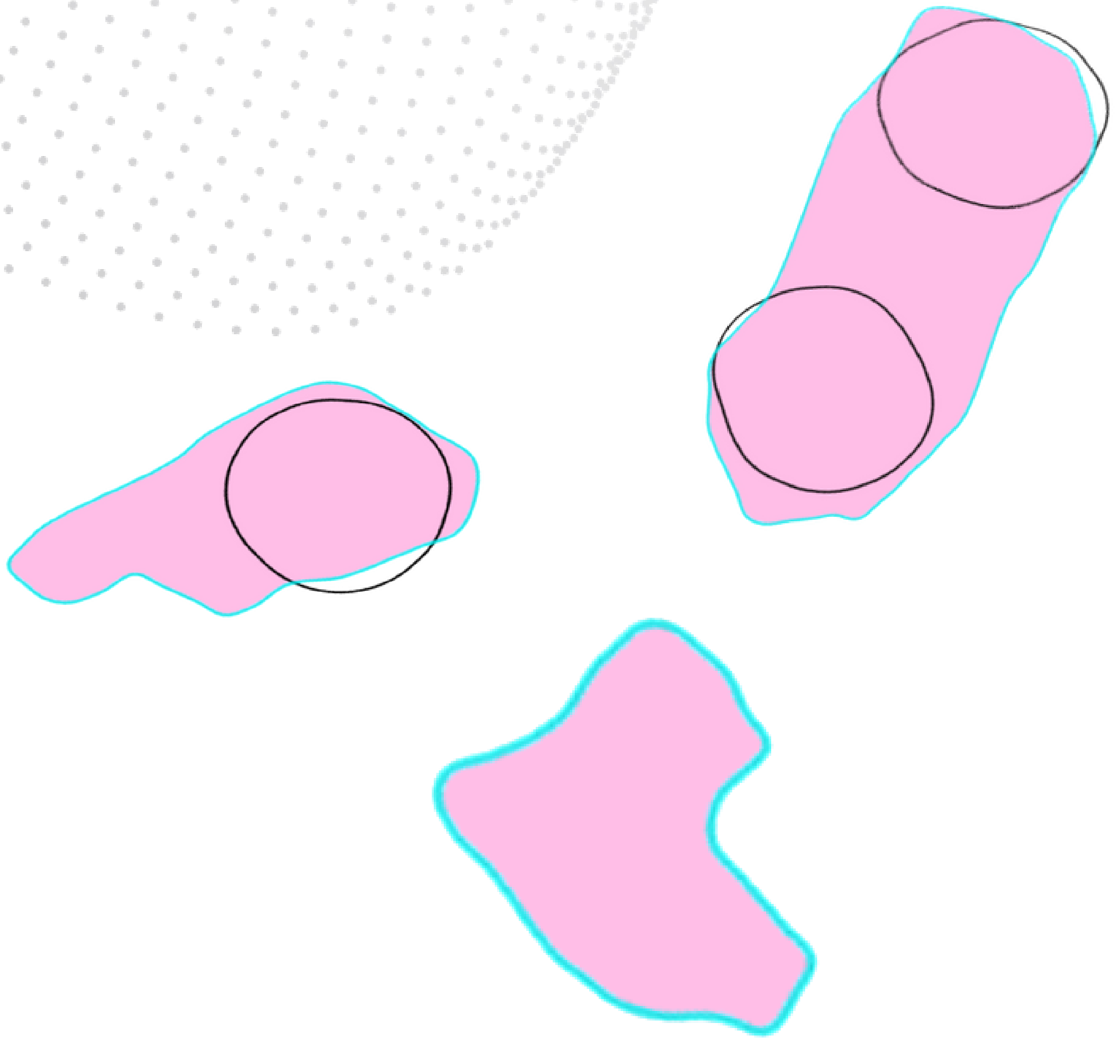


similarity
score = 0.39

Predicted Gap
Observed Gap

# Step Five: QC Review

| GapID | GridID | QC_Flags |
| --- | --- | --- |
| A3_1 | A3 | check spacing; check geometry |
| A3_2 | A3 | check spacing; check geometry |
| A3_3 | A3 | check geometry |
| A3_4 | A3 | check geometry |
| A4_1 | A4 | <Null> |
| A4_10 | A4 | check false negative |
| A4_11 | A4 | <Null> |



Python Script designed to flag **observed gaps** (APEX coverage gaps) that:

1. intersect with more than one predicted gap
2. where $0 < \text{overlap score} < 0.5$
3. observed gaps do not intersect with predicted gaps

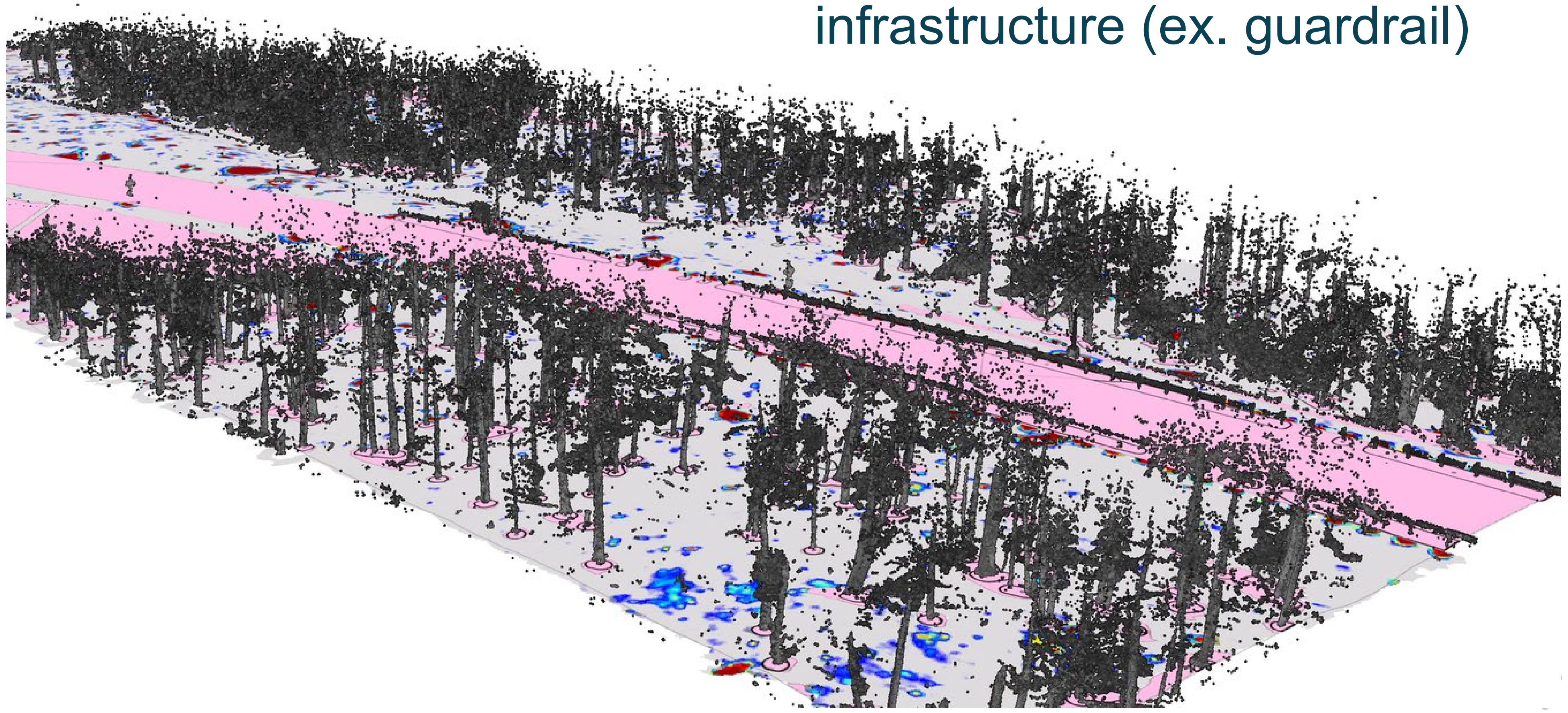
Key for identifying areas where infill is needed, or field annotation is necessary.

# Step Six: Generate Outputs

- Extract images (python script) from point cloud where gaps are observed and store them in a gdb
- Export layers to AGOL web app for viewing/sharing

example screen capture

3D scene with detection data can aid in QC and identifying EM anomalies associated with infrastructure (ex. guardrail)



# Conclusions

- Streamlined, automated approach to gap prediction and identification improves field efficiency and promotes faster delivery of completed grid packages
- Advanced QC testing ensures MQOs for 100% coverage are met
- Tools for improved visualization and data interpretation
- Ground classification and parameter insights
- Field data collection recommendations

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# Questions?

Thank you to Jacobs for providing the MRS point cloud and AGC data used for this analysis.