

Remote Sensing & AI: Tools for Improved Environmental Intelligence

OCTOBER 2025



Remote Sensing & AI Solutions Group



REMOTE SENSING & AI SOLUTIONS

Imagery Expertise Expert management and analysis of imagery to transform raw data into actionable insight

Forward Monitoring Ongoing observation strategies that identify change and support timely, informed decisions

AI/ML Analytics Automated, state-of-the-art analyses that transform imagery into actionable data for faster, smarter decision-making

Targeted Applications Tailored solutions that align with specific operational or regulatory objectives

Remote Sensing & AI: Tools for Improved Environmental Intelligence

The Challenge of Scale

- Monitoring large areas
- New solutions
- Remote Sensing & AI

Data & Delivery

- How it works
- Actionable data
- Integrations

Oil & Gas Applications

- Pipelines and Rights of Way
- Pads and Infrastructure
- Reclamation Assessments
- Landscape-Wide Impacts

The Challenge of Scale

The Challenge of Scale

Monitoring Large Areas

Challenges:

- Environmental Risk
- High Consequence Events
- Safety
- Man hours
- Remote Locations
- Large geographic area
- Timely notifications



The Challenge of Scale

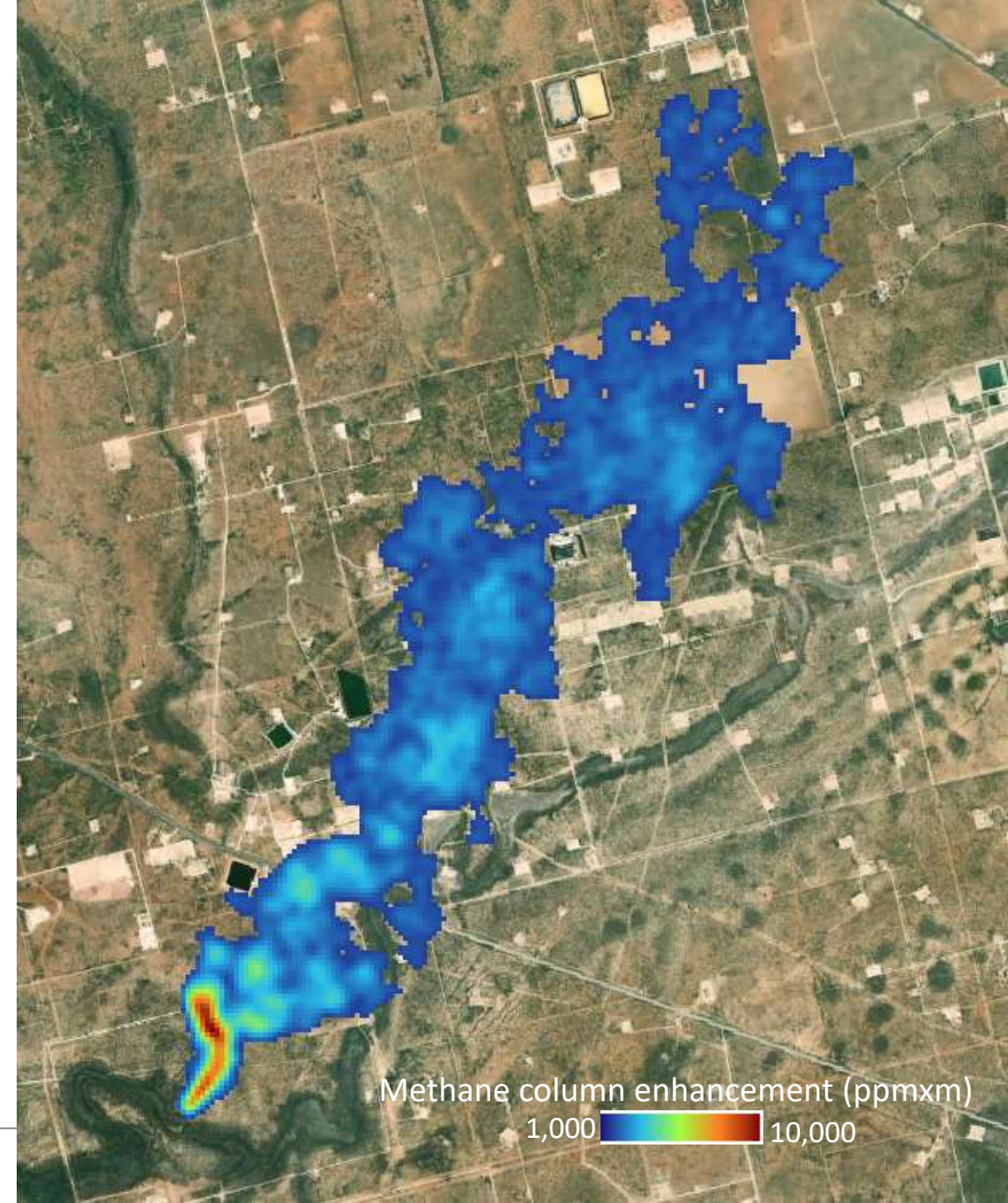
New Solutions

Remote Sensing

- Observe and analyze large geographic areas
- New sensors are tuned to specific applications

AI and Machine Learning

- Use new technology for rapid analysis
- From raw data to actionable insights automatically

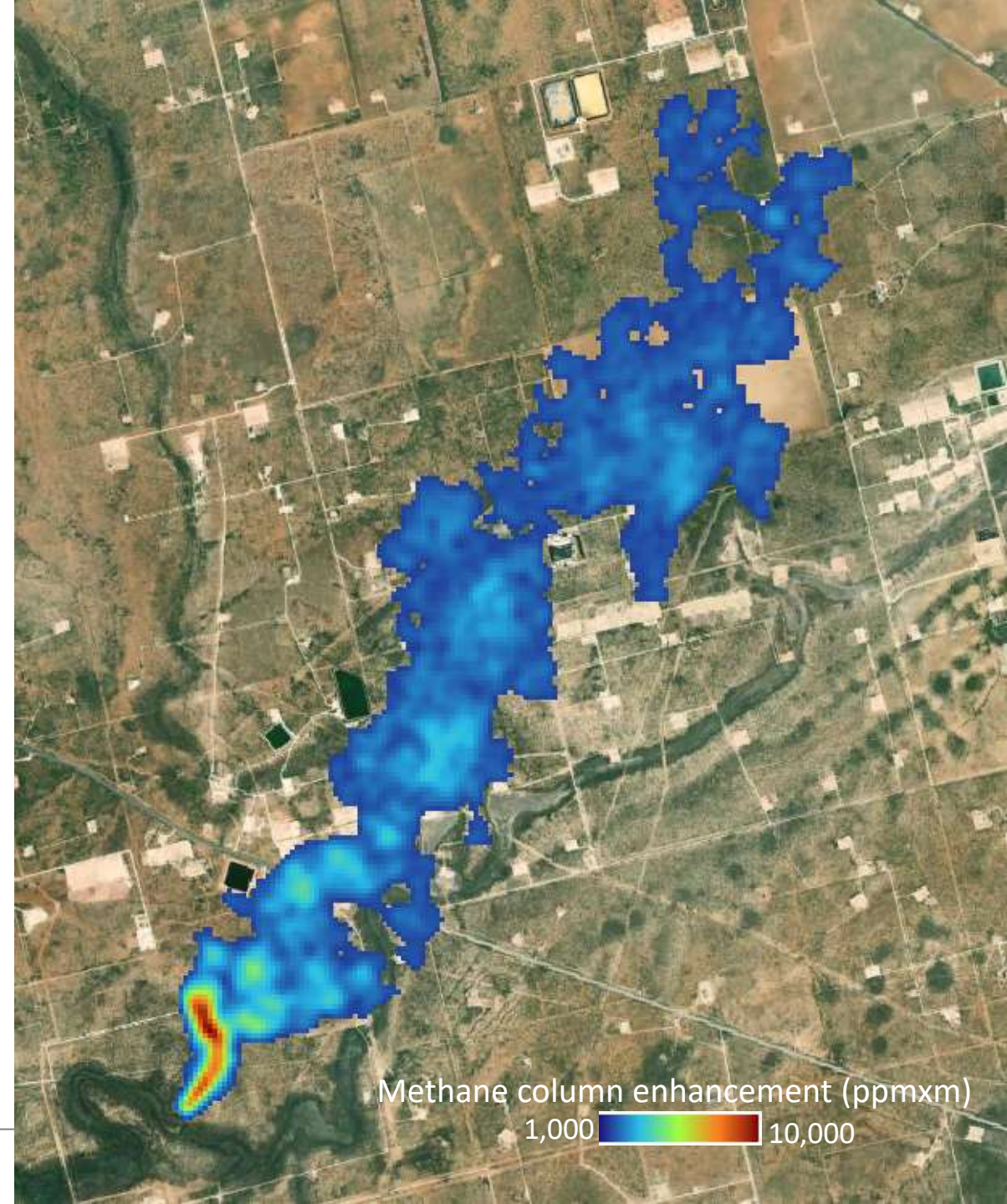


The Challenge of Scale

Remote Sensing

Remote Sensing

- UAV, aerial, satellite
- Focus on satellite
 - Coverage
 - Cost
 - Availability
 - Reliable sensors

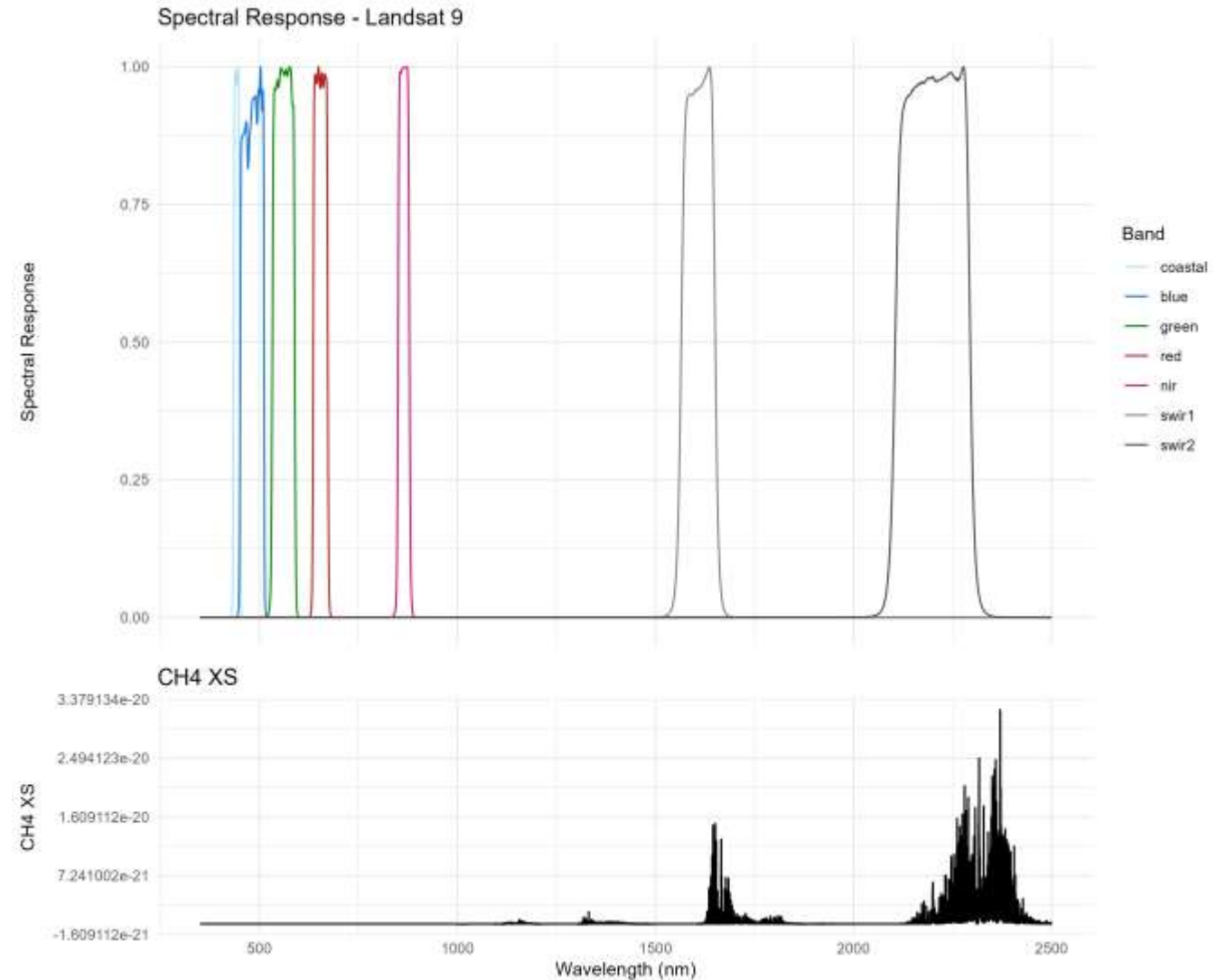


The Challenge of Scale

Remote Sensing

Remote Sensing

- Sensors are tuned to capture specific wavelengths of light
- Each object (like water, vegetation, oil, or methane) reflects and absorbs light differently across these spectral bands- this is called its spectral signature
- Quantify physical parameters (e.g. methane, TSS in water)
- Label objects (e.g. pump jacks, oil release)

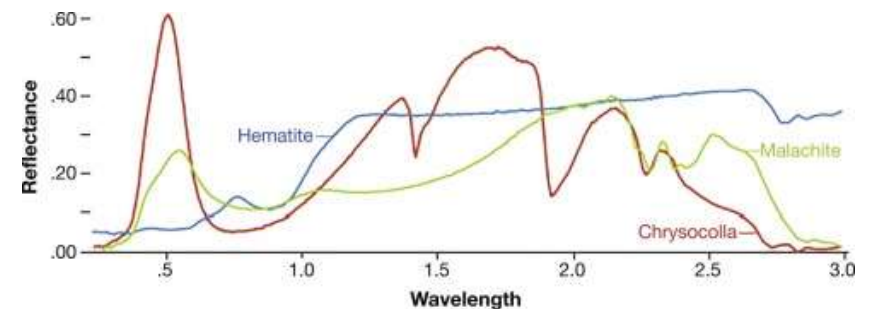
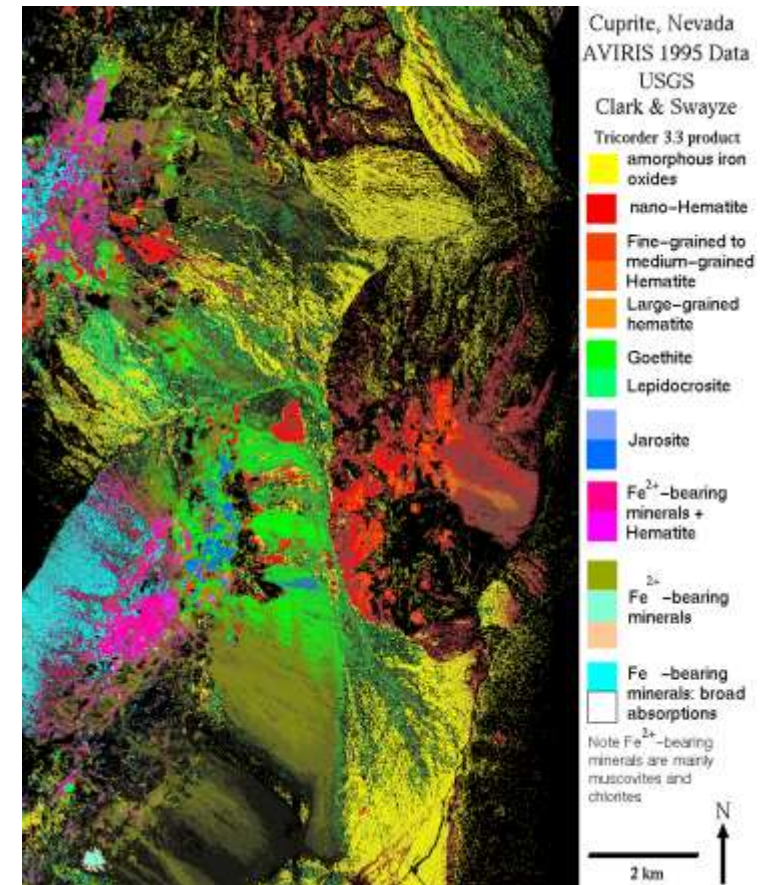


The Challenge of Scale

Remote Sensing

Example: Infer pH from mine drainage

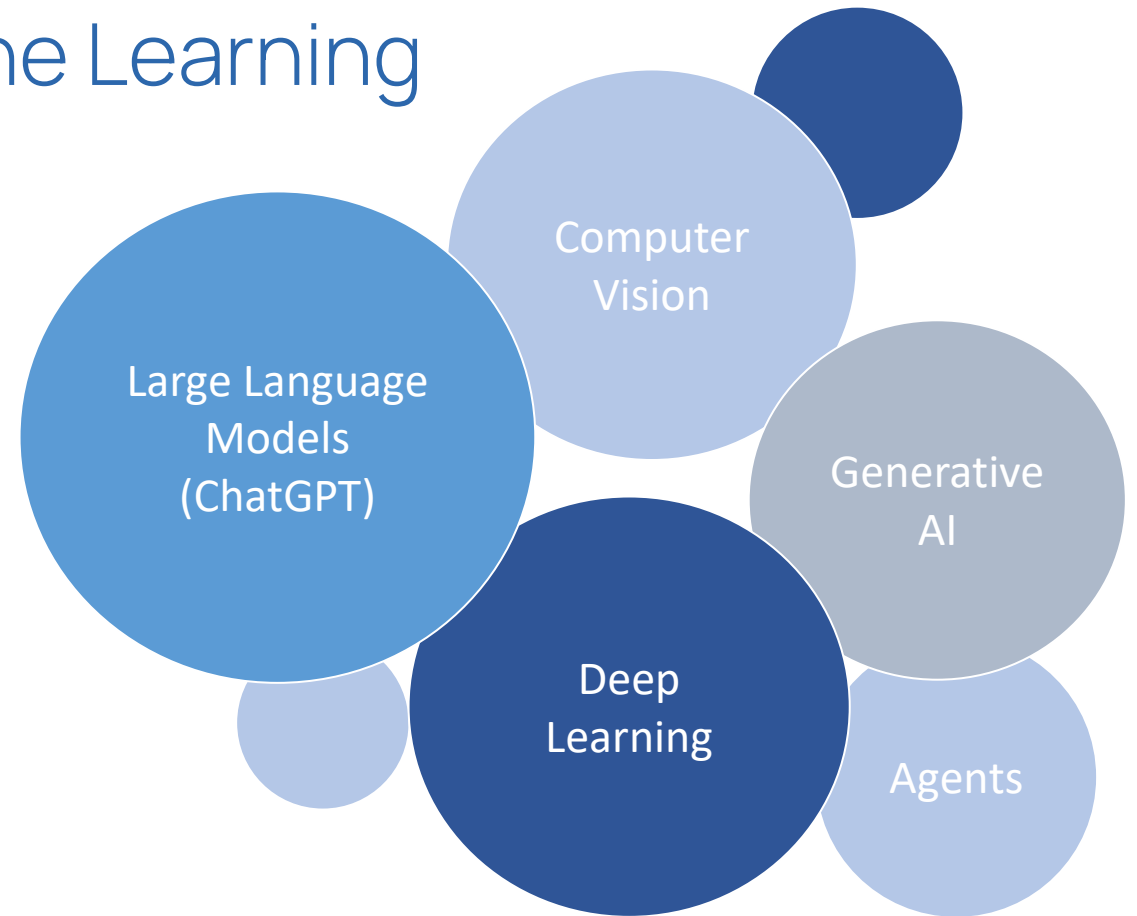
- Using the spectral signature, mineral deposits can be mapped
- Secondary oxidation of pyrite can be used to infer the pH of the water when the mineral was deposited



The Challenge of Scale

Artificial Intelligence & Machine Learning

- Many types of models, all with specific purposes
- Learns from examples
- Find patterns in data
 - Spatial (shape, size, texture, edges)
 - Spectral (color, wavelengths, absorption)
- Learns from mistakes and teaches itself
- Makes predictions on new data



The Challenge of Scale

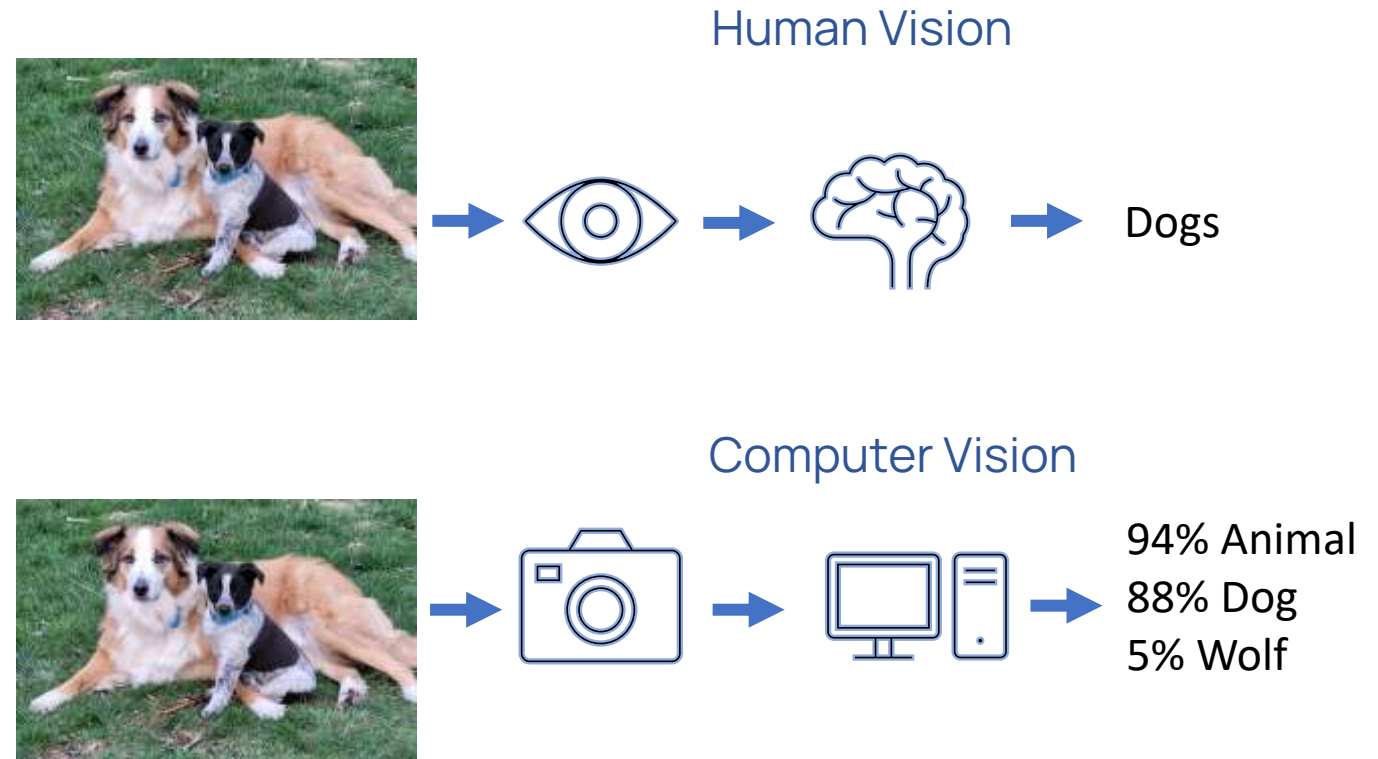
Machine Learning & Computer Vision

Machine Learning

- Statistical algorithms that learn and generalize

Computer Vision

- Subfield of ML
- Tuned to imagery and audio analysis
- Identify, delineate, quantify, or classify objects

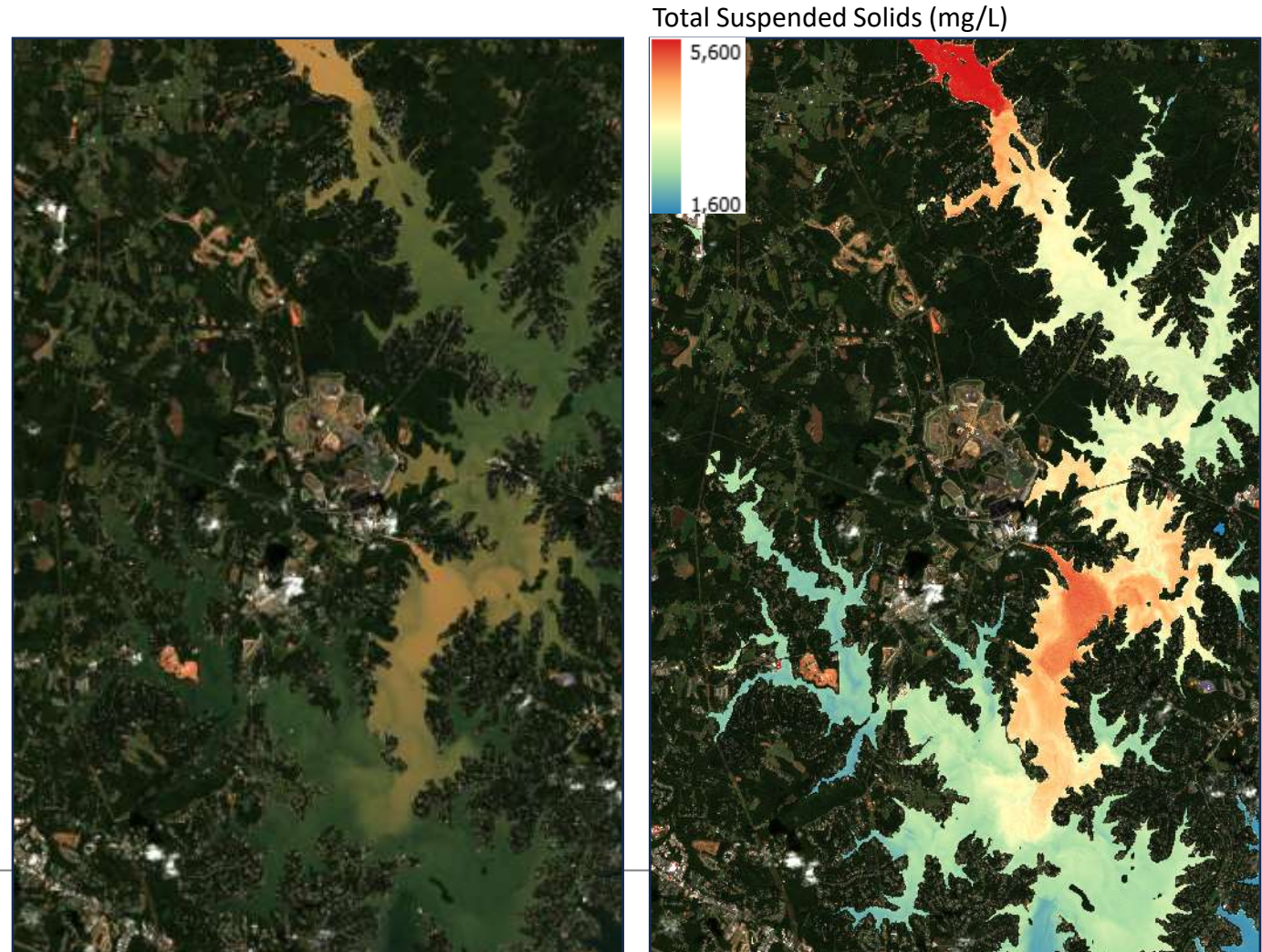


The Challenge of Scale

Machine Learning & Computer Vision

Regression (Quantification)

- Water quality parameters
- GHG Quantification
- Temperature
- Soil Moisture
- Bathymetry
- ... and more...



The Challenge of Scale

Machine Learning & Computer Vision

Object Classification – label items

- Invasive species mapping
 - Cheatgrass, Brazilian peppertree
- Surface and subsurface oil/gas releases
- Object detection
 - Encroachments
 - Infrastructure labels and changes
- Change detection



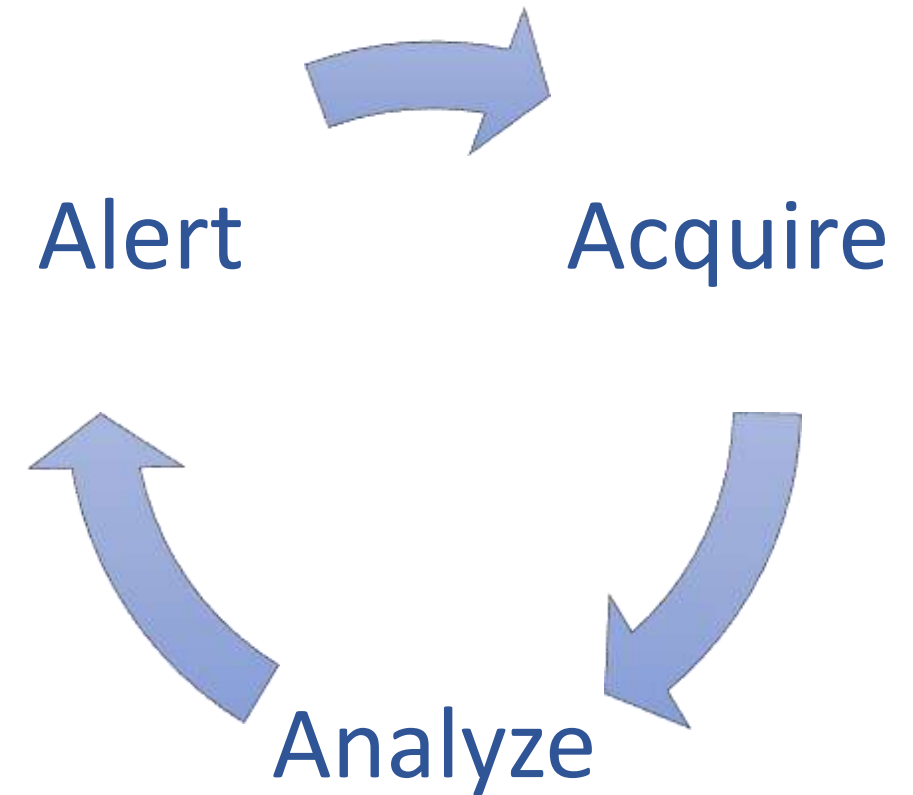
Data & Deliveries

Data and Deliveries

Automation:

- Acquire
 - Imagery is acquired and ingested near real time
- Analyze
 - AI/ML algorithms are applied automatically
- Alert
 - Immediate reporting to client
 - GIS-ready data for easy integration
 - Field-suitable reports and summaries

Automation



Data and Deliveries

How it works:

- Provide infrastructure files
- Establish a monitoring cadence
- As each image is collected, we apply our custom models to detect anomalies that indicate potential releases
- Anomalies are reported to the operator immediately after detection

Corridor

Pipeline



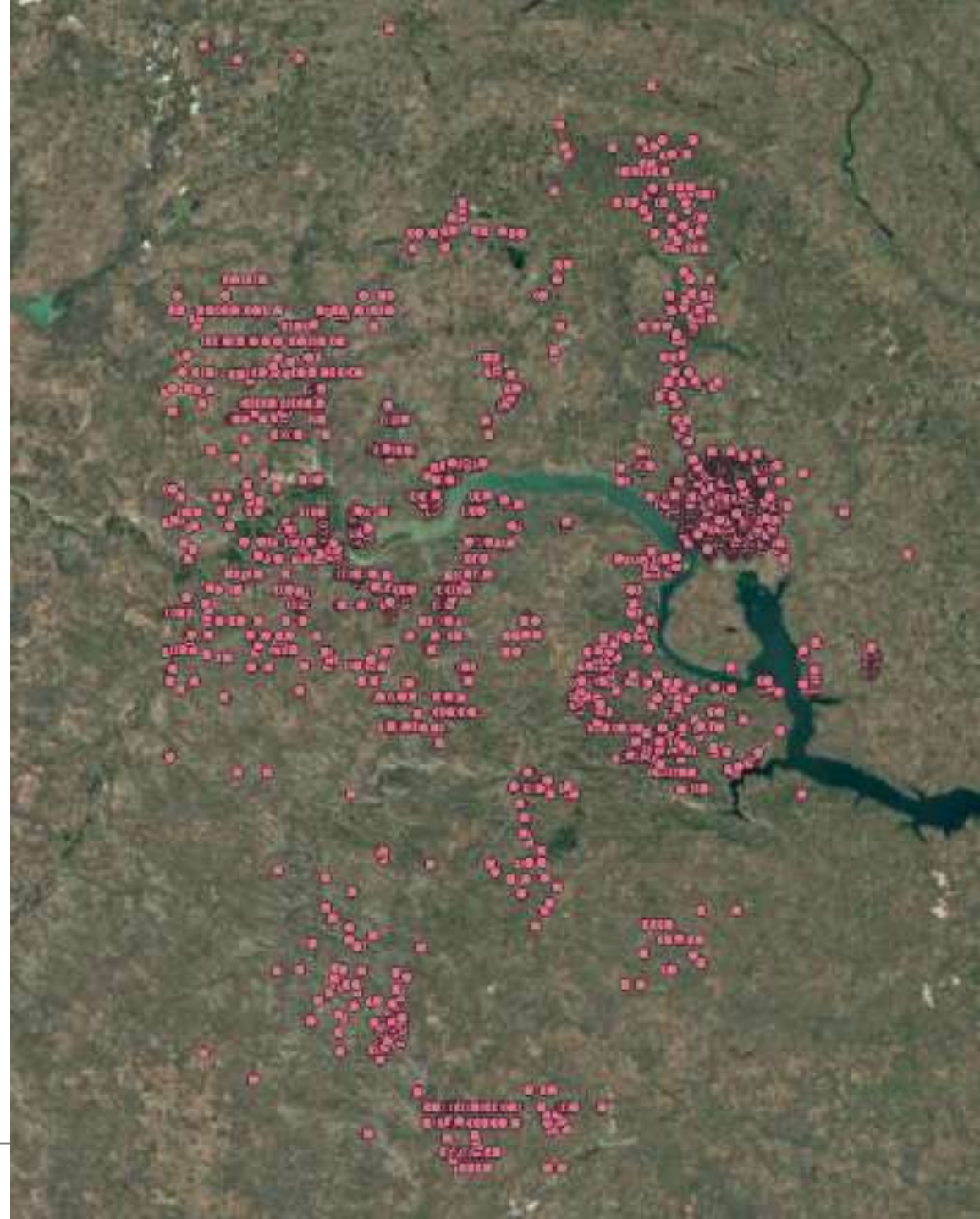
Data & Deliveries

Setup

Share infrastructure files (e.g. pipelines, pads, risers)

- Shapefile, kmz/kml, geopackage
- Any identifying fields that will be included in the delivery

Choose analysis frequency (e.g. weekly, monthly)

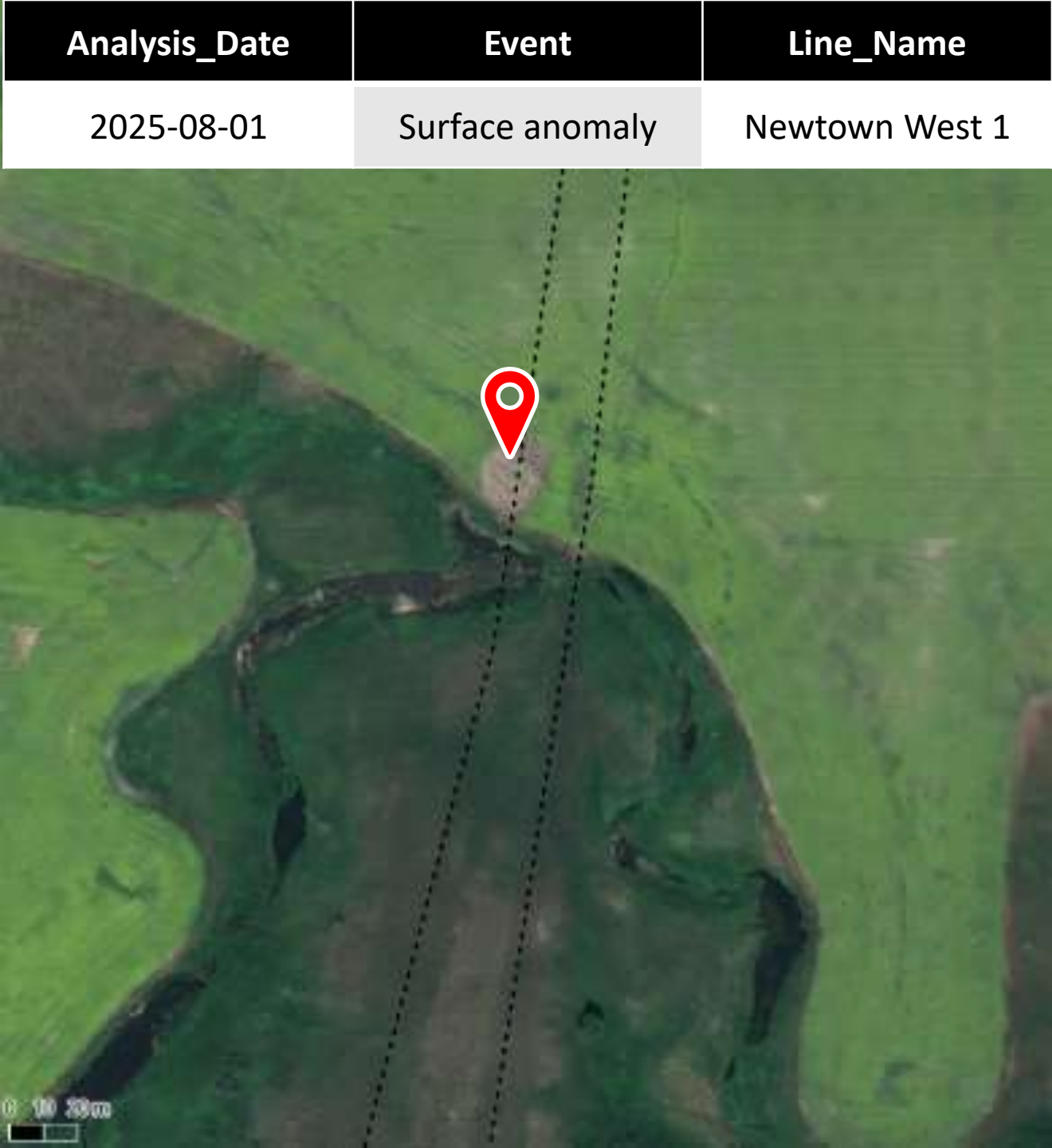


Data & Deliveries

Delivery

Delivery includes:

- Natural color satellite image for use as a basemap in any GIS
- Vector (geospatial) file of detections
- Additional documents as requested (e.g. PDFs, CSVs)



Pipelines & Rights of Way

Proactive Monitoring

Analysis Through Time



Corridor

Pipeline



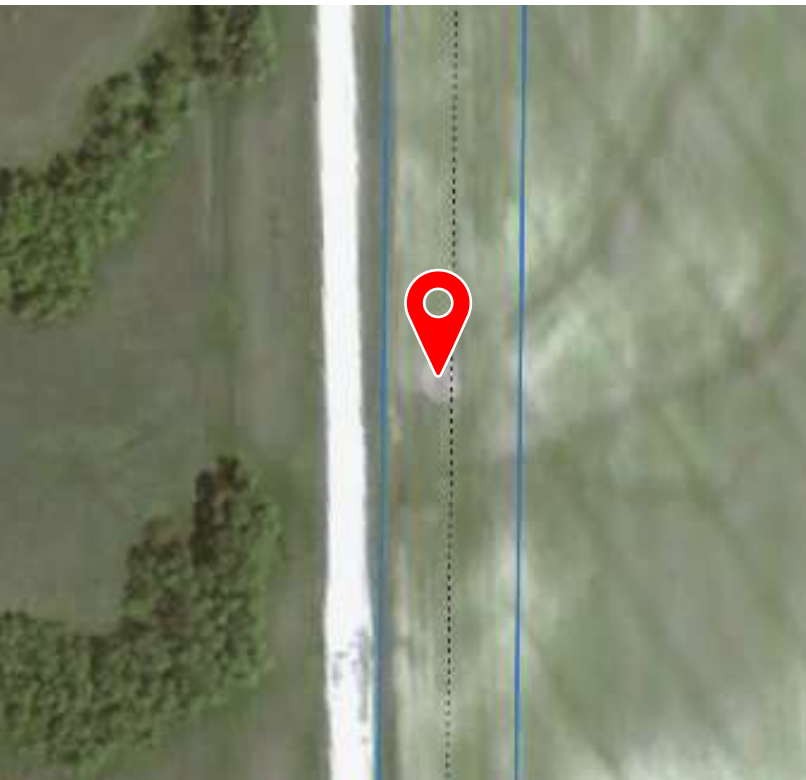
2023-08-14

No anomalies detected



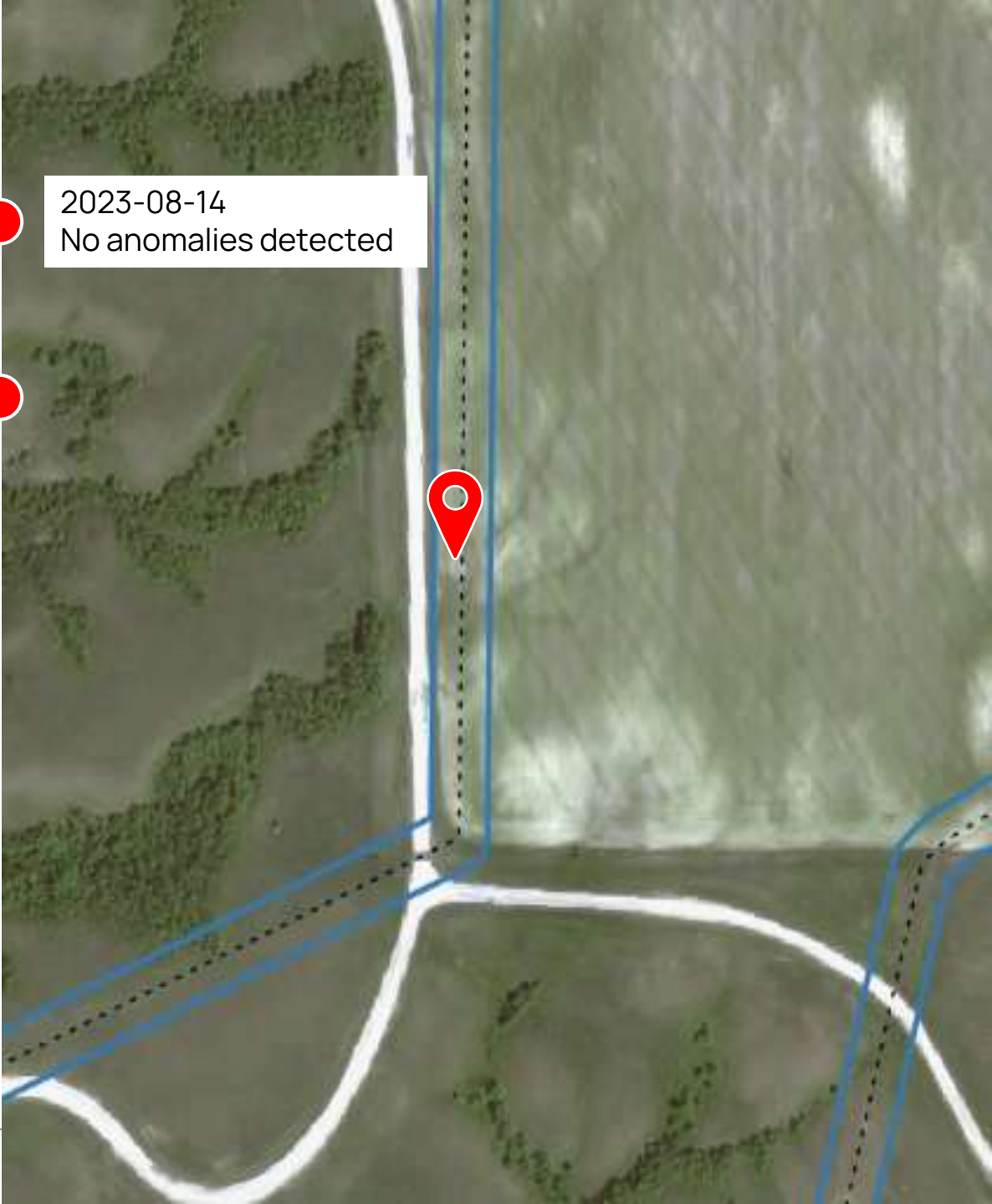
Proactive Monitoring

Analysis Through Time



2024-06-12
Anomaly detected
Alert issued

2023-08-14
No anomalies detected



Proactive Monitoring

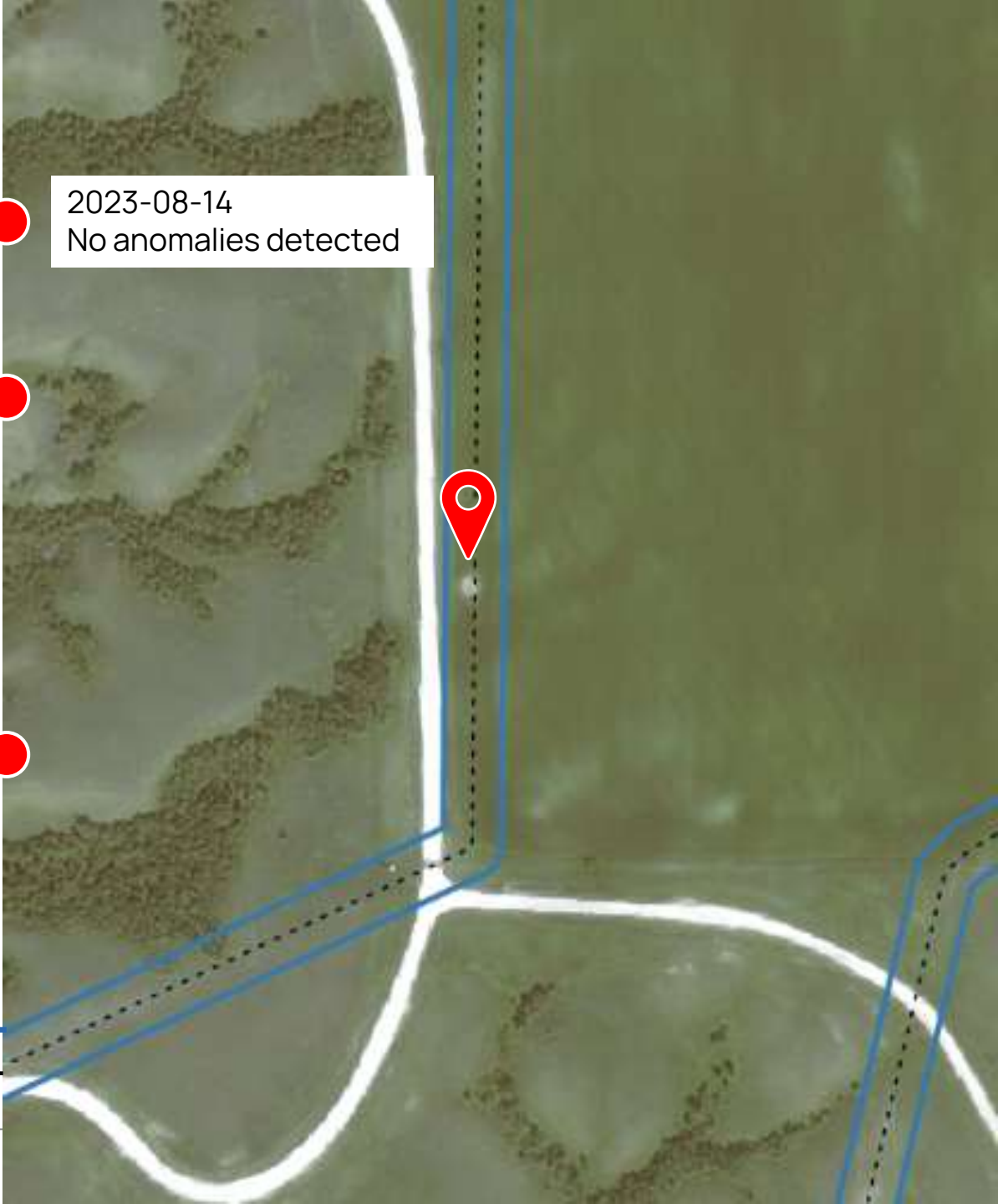
Analysis Through Time



2024-06-12
Anomaly detected
Alert issued

2024-07-25
Repair completed

2023-08-14
No anomalies detected



Proactive Monitoring

Analysis Through Time

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Anomaly detected
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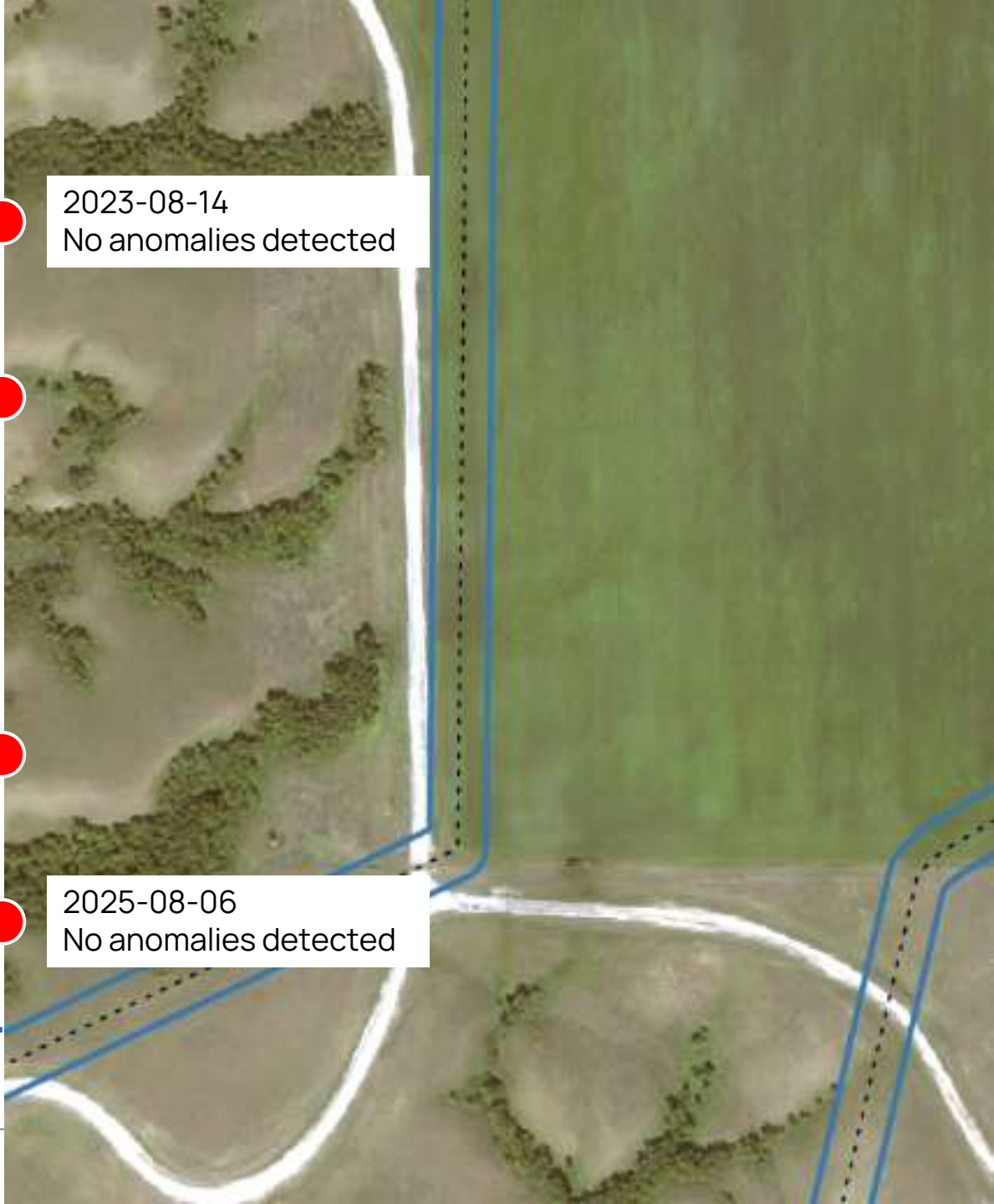
2023-08-14
No anomalies detected

2025-08-06
No anomalies detected



Corridor

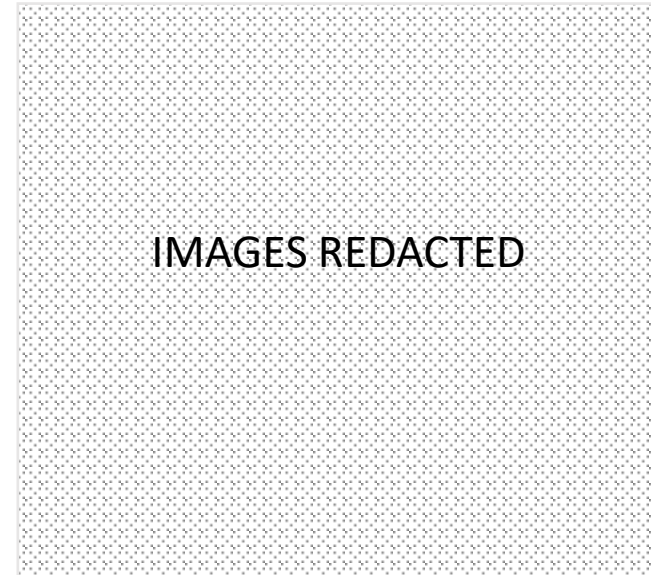
Pipeline



Pipelines & Rights of Way

Surface Release Detection

- Continuously scan satellite imagery to identify crude oil and produced water releases on the surface
- Ensure consistent, high-confidence inspections across large areas
- Operators are immediately notified upon detection, enabling swift response and mitigation
- Detect releases early to minimize impacts



Pipelines & Rights of Way

Surface Release Detection

- Timely alerts before impacts escalate
- Minimize regulatory exposure and cleanup costs

Confirmed gas release



Pipelines & Rights of Way

Surface Release Detection

- Clusters of detections help operators prioritize areas of concern



Pipelines & Rights of Way

Surface Release Detection

- Identify releases along miles of pipelines without manual observation

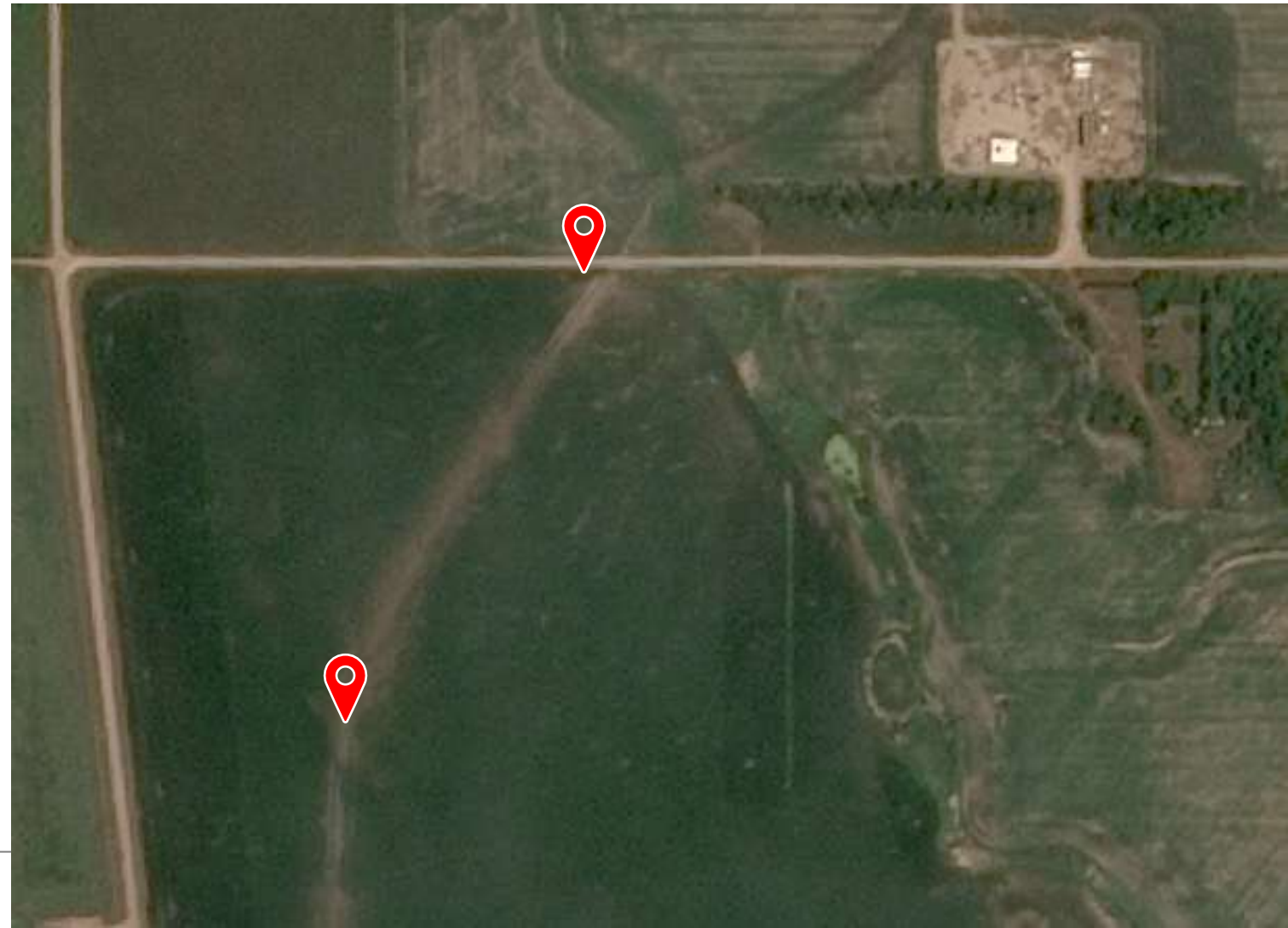


Pipelines & Rights of Way

Subsidence & Erosion

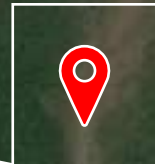
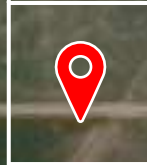
- Detect erosion and subsidence along pipeline corridors before it threatens infrastructure integrity

Subsidence over a repaired
pipeline section



Pipelines & Rights of Way

Subsidence & Erosion



Pads & Infrastructure

Pads & Infrastructure

Asset Inventory

- Identify and count critical assets
- Track changes through time
- Ideal for due diligence, compliance, and asset audits

Date	Flare	GSM	H2S	Heater Treater	LACT	Loadout Line
5/4/2025	1	2	1	2	2	2

Pump Jack	Steel Berm	Structure	Tank
4	1	1	10



Pads & Infrastructure

Surface Releases

- Detect liquid releases on pads, even in challenging conditions

Produced water release



Pads & Infrastructure

Vegetation Encroachment

- Receive notifications when vegetation encroaches on pads
- Enable targeted vegetation management before it impacts operations or compliance



Reclamation Assessment

Reclamation Assessment

Revegetation

- Quantify revegetation on remediation sites
- Track progress and closures

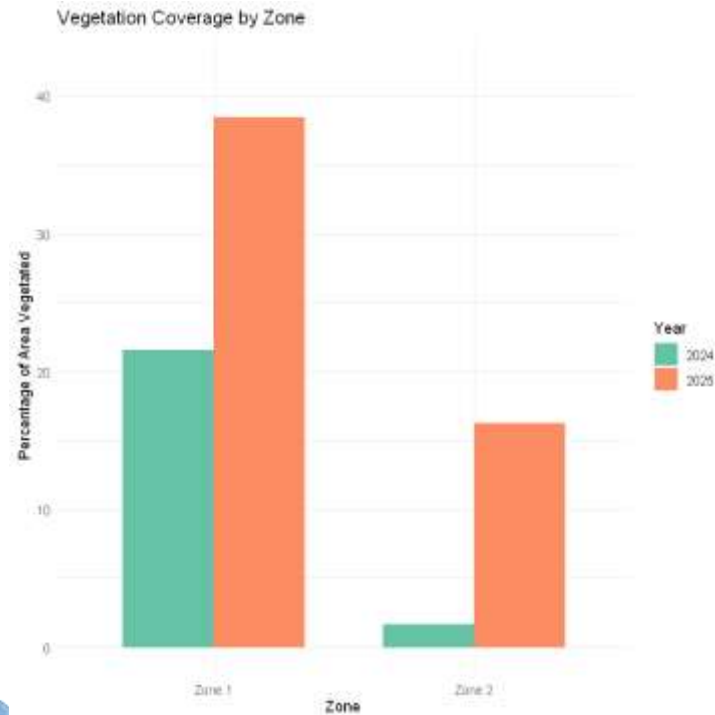


IMAGE REDACTED

Reclamation Assessment

Vegetation Stress

- Identify stressed vegetation that indicates impacted reclamation efforts
- Quantify impacted areas for more precise estimates and planning

● 2.25 Acres

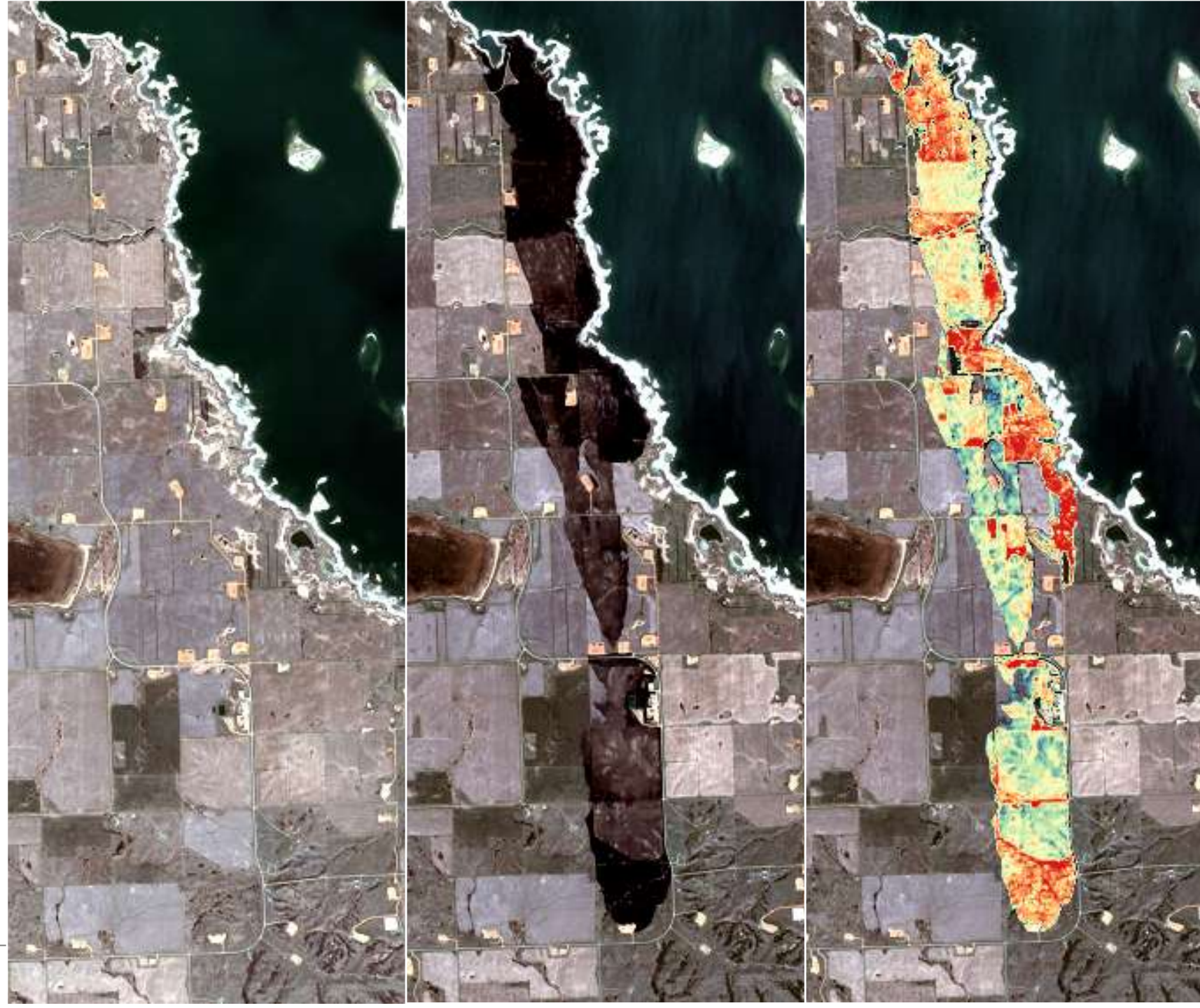


Landscape-Wide Impacts

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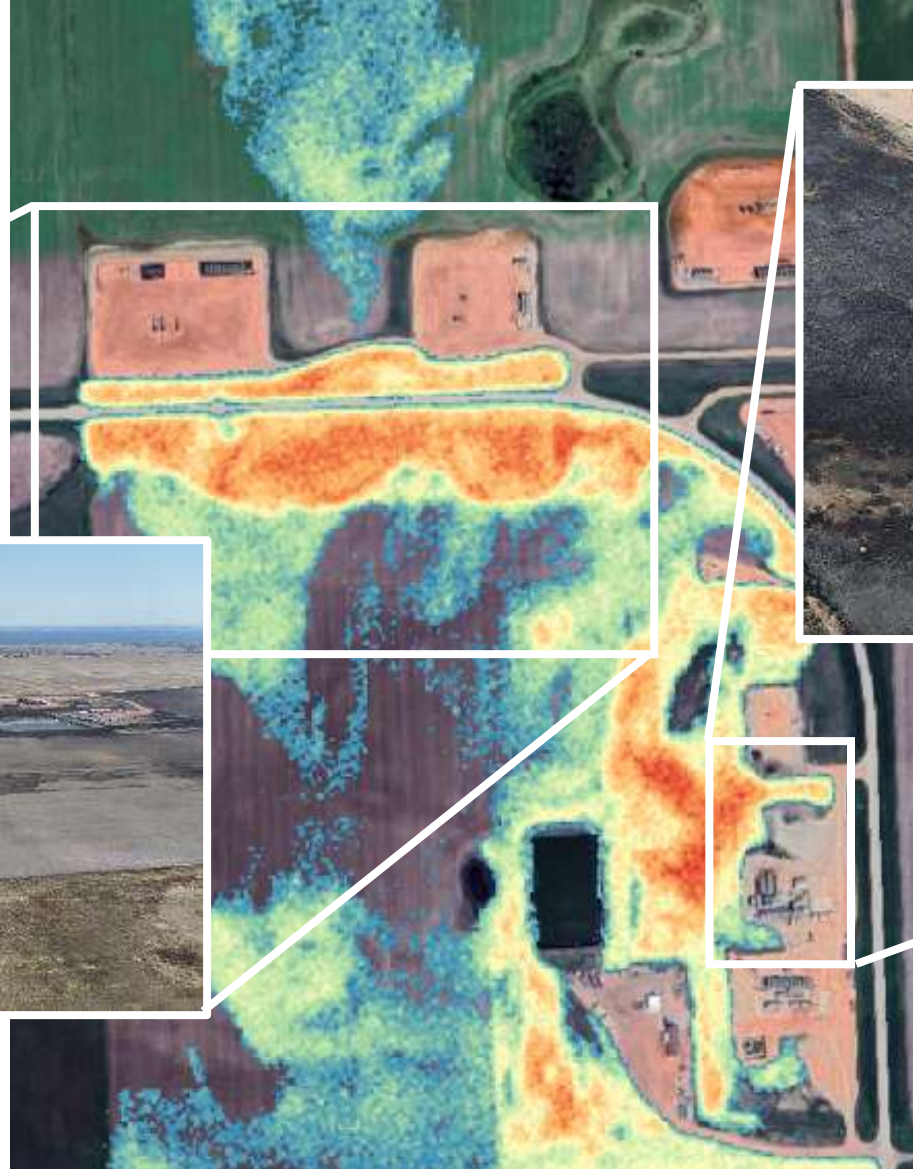
Fire

- Respond rapidly to landscape-wide changes
- Precisely map vulnerable infrastructure and identify impacted parcels



Landscape-Wide Impacts

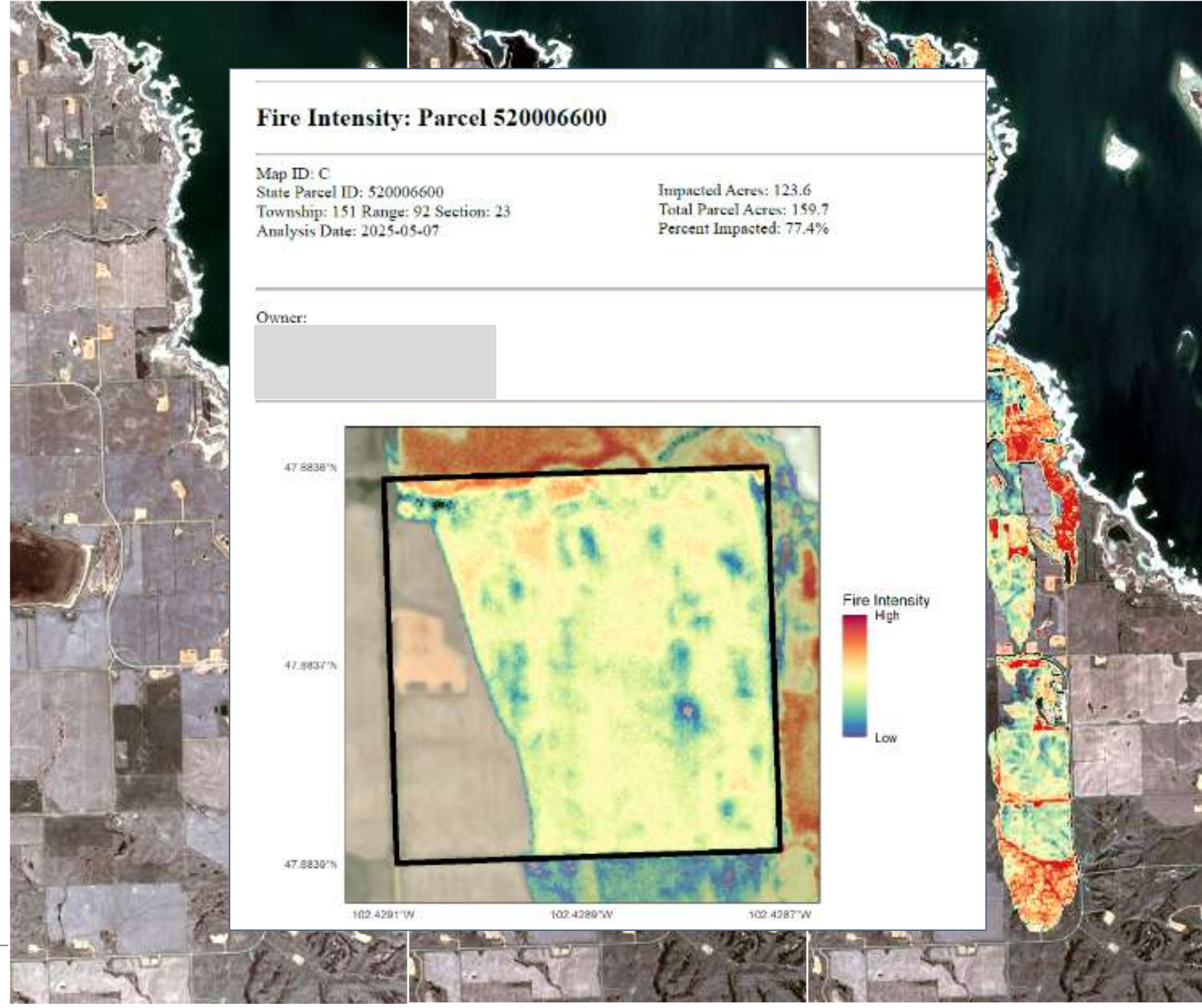
Fire



Landscape-Wide Impacts

Fire

- Review fire intensity at macro and micro levels
- Quantify impacts to assist remediation



Questions?

Remote Sensing & AI:
Tools for Improved
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