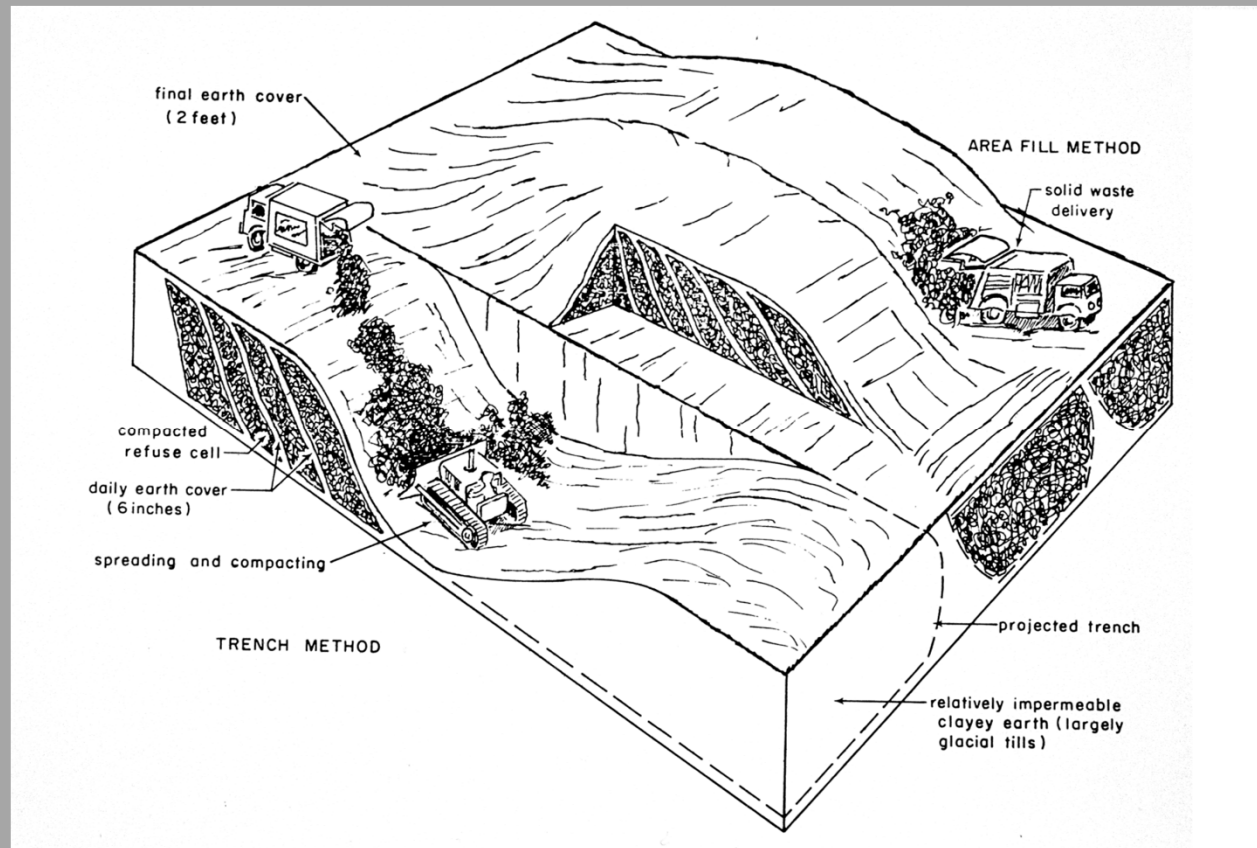


Illinois' Legacy Landfills, and Implications for Mahomet Aquifer Groundwater Resources



Christopher Stohr, PhD, PG
Engineering Geologist

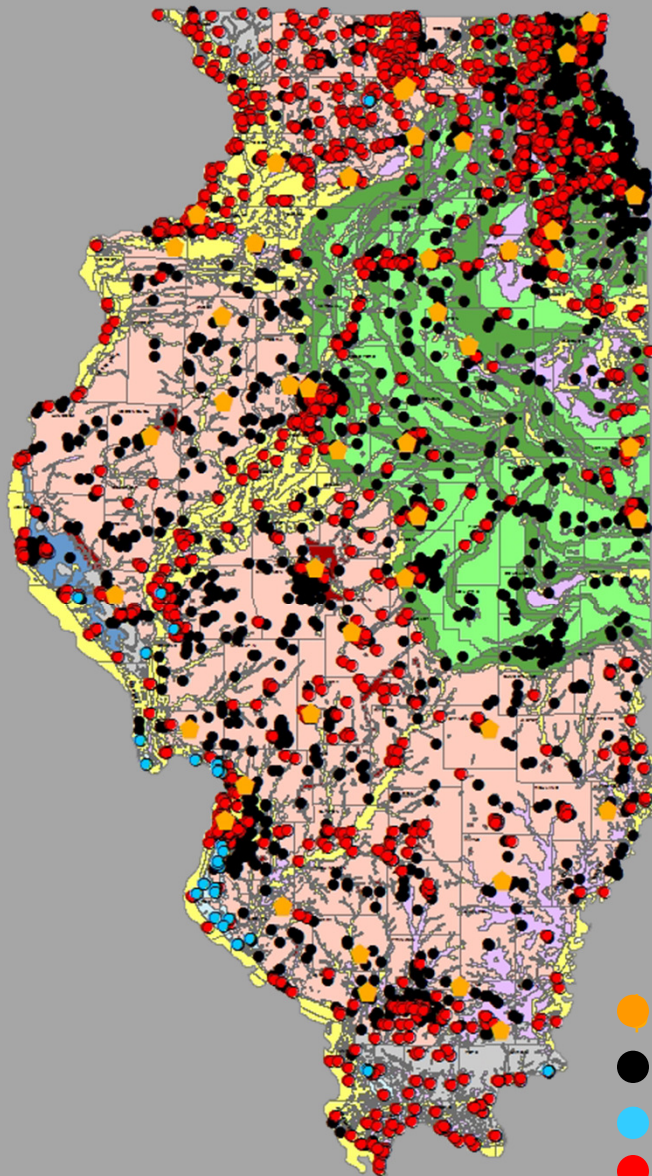
Research Associate, Illinois State
Geological Survey,
Prairie Research Institute
University of Illinois at Urbana-
Champaign

Applied Geo-Imaging Solutions, Inc.

Champaign County Board

Mahomet Aquifer Protection
Task Force
Rantoul, IL
August 6, 2018

What is the condition of 3,430 landfills in Illinois?



3,430 – unlined, thin covered landfills

1,524 – lie over shallow aquifers w/in 20' surface

94 – lie within karst areas

44 – Actively operating landfills





80% - ½ km High & Medium Intensity Development

95% - ½ km H/M/L Intensity Development

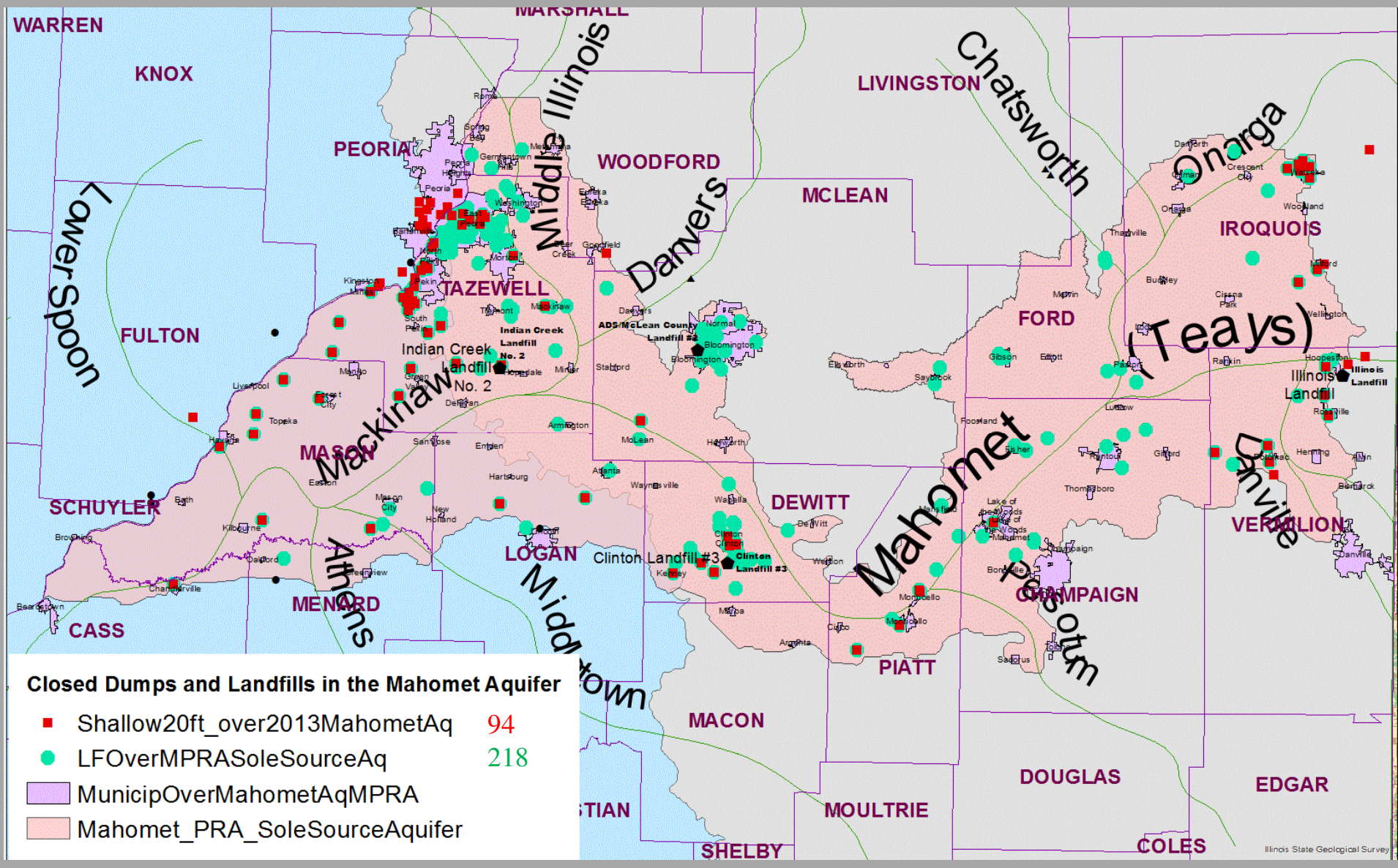
Which require maintenance, remedial action?

What sort of repair? When – now or later?

Is there a way to use technology to help?

-  2014 IEPA 44 active landfills
-  Illinois Landfills
-  Landfills over Karst
-  Landfills w/in 20 feet shallow aquifers

East Central Illinois – Mahomet Aquifer



Why are Old Landfills Important?

“Dry Tomb” design philosophy

- Isolate wastes from ecosystem,
- Infiltration (**leaky roof**) = gas & leachate,
 - ~50% of precipitation infiltrates landfill cover,
- Added head pushes **leachate** > sides and bottom,
- Contaminated fluids degrades water/air quality,
- Cover is only part accessible from surface.

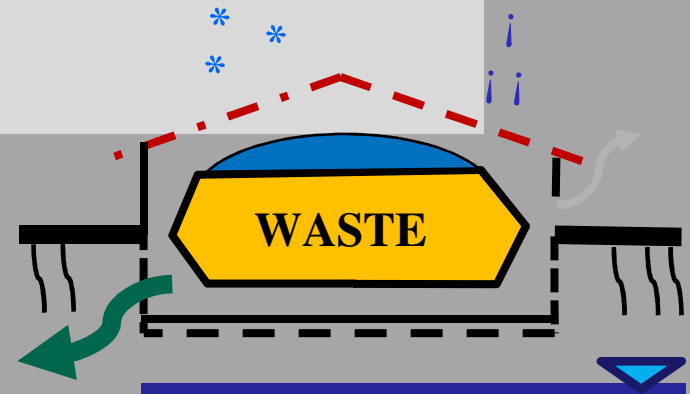
\$4,000,000 to re-cover a landfill.
Spot repairs are less expensive.



~36 inches of rain falls on Illinois / year. What happens to that rainfall?

Where does leachate go?

- Fluids travel laterally or vertically or both.
 - Shallow aquifers recharge streams.
 - Migration between aquifers?
 - Gas, liquids likely differ in composition over time.
- Not a problem – until it is.
 - Nobody really looks for trouble unless stream or well contamination is discovered.
- So, is this a problem?
 - Expendable aquifers?
 - Future water needs?



Some communities already facing water shortage.

Postclosure Monitoring Strategies

- Passive – what is currently being performed.
 - Monitoring wells
 - Field “walkover” inspections
- Active – sustainable asset management
 - Remote sensing technology, “aerial traverse”
 - Focused field inspection for preventive maintenance
 - GIS-based sustainable asset management

Flaws of “walkover traverses”



- Entire landfill will NOT be traversed in 1 hour.
- Human perception is obscured by vegetation.
- Observations skewed by season, rainfall, access.
- Paper tracking and memory.
- Is there a better way?

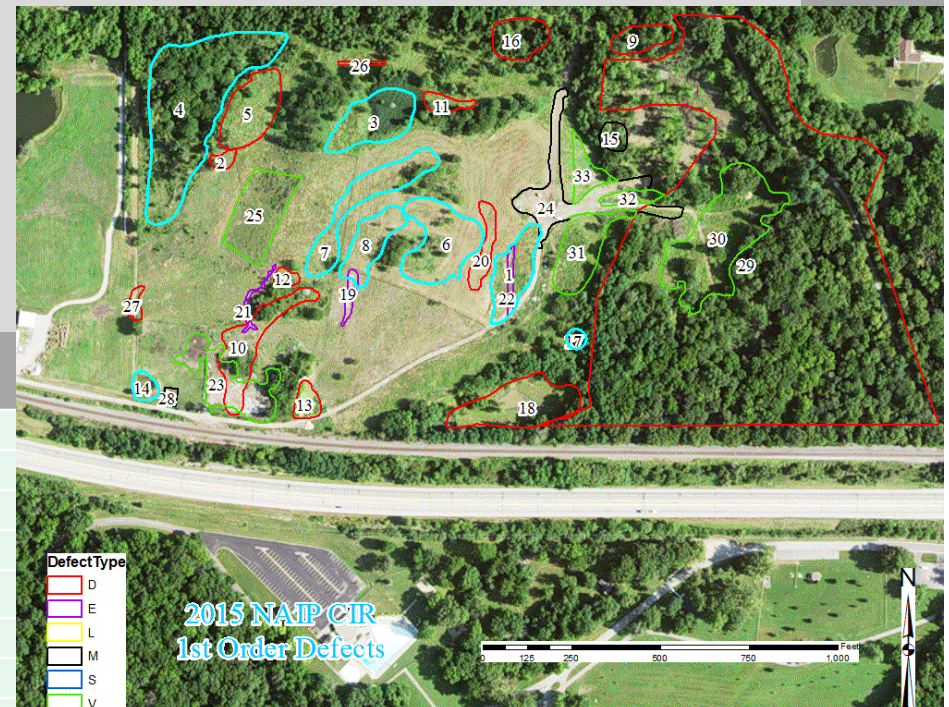
Postclosure Maintenance Strategies

- Passive – what is currently being performed.
 - Monitoring wells
 - Field “walkover” inspections
- Active – sustainable asset management
 - Remote sensing technology, “aerial traverse”
 - Focused field inspection for preventive maintenance
 - GIS-based sustainable asset management

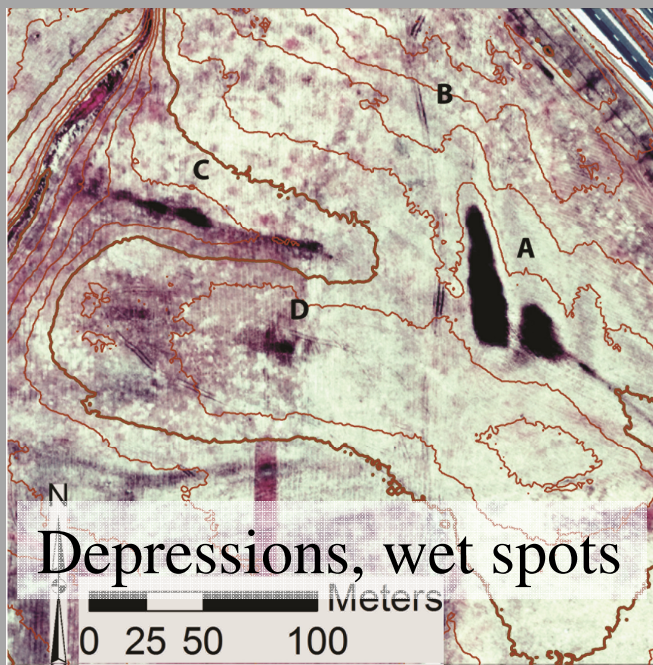
Advantages of “aerial traverses”

- Synoptic perspective – “bird’s eye view.”
- Performed in office prior to onsite visit.
 - Image-based record of features
 - Compare changes
 - Virtual revisits
 - Focused inspections

Id	DefectType	Look4
1	Landslide	Persistent wet spot, veg anomaly
3	Depression	Persistent wet spot & depression, FeO
4	Depression	Low area, asperities, seeps on wooded fill?
6	Depression	Asperities atop crest, FeO
7	Depression	Asperities along contour, drain?
8	Depression	Asperities on flank, low slope, drain?



Defects and Features of Interest Developed in Landfill Covers



Leachate seep



Erosion

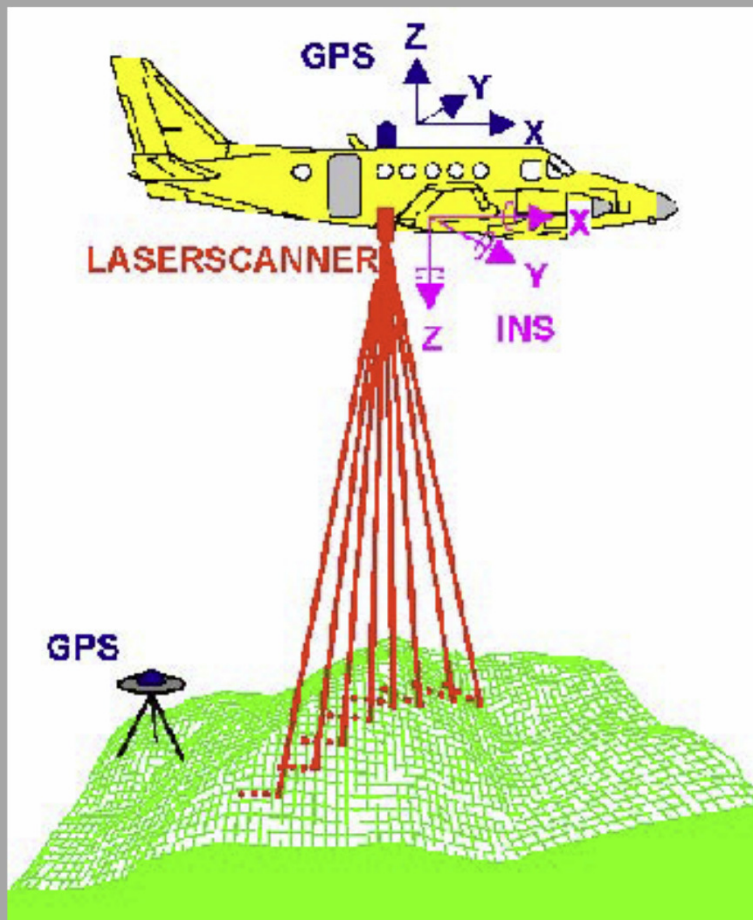
Improved Postclosure Monitoring Sustainable Asset Management

“aerial traverse”

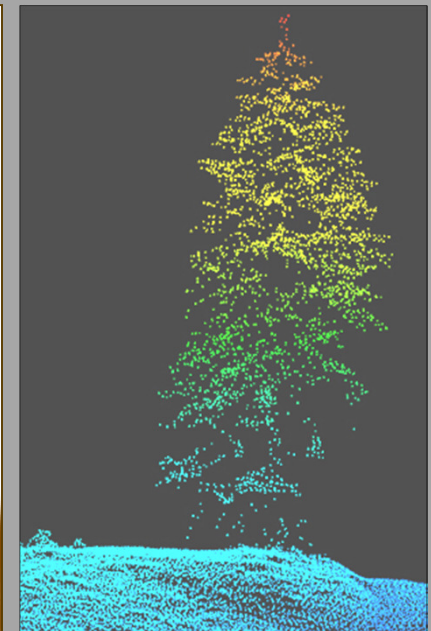
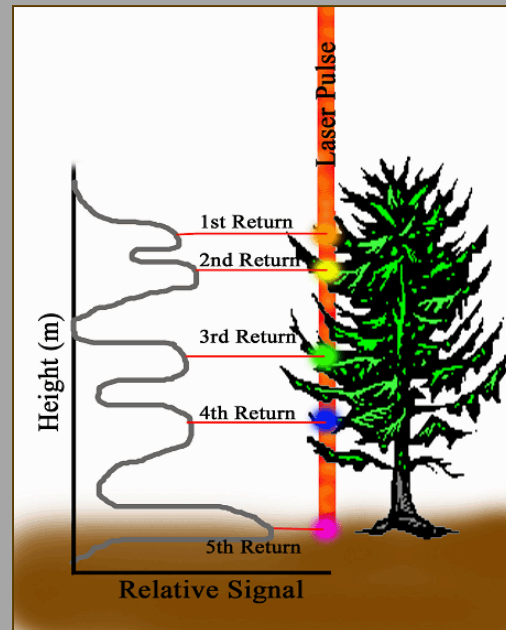
- LiDAR → Surface topography
- Aerial Photography → Feature detection
- Focused walkover reconnaissance
- GIS/CAD + measurements + field notes

LiDAR or lidar

Light Detection And Ranging



Pulse is measured 5 times.
Used to make topographic maps.



DEM = digital elevation model

- First
- Second
- Third
- Fourth (last)

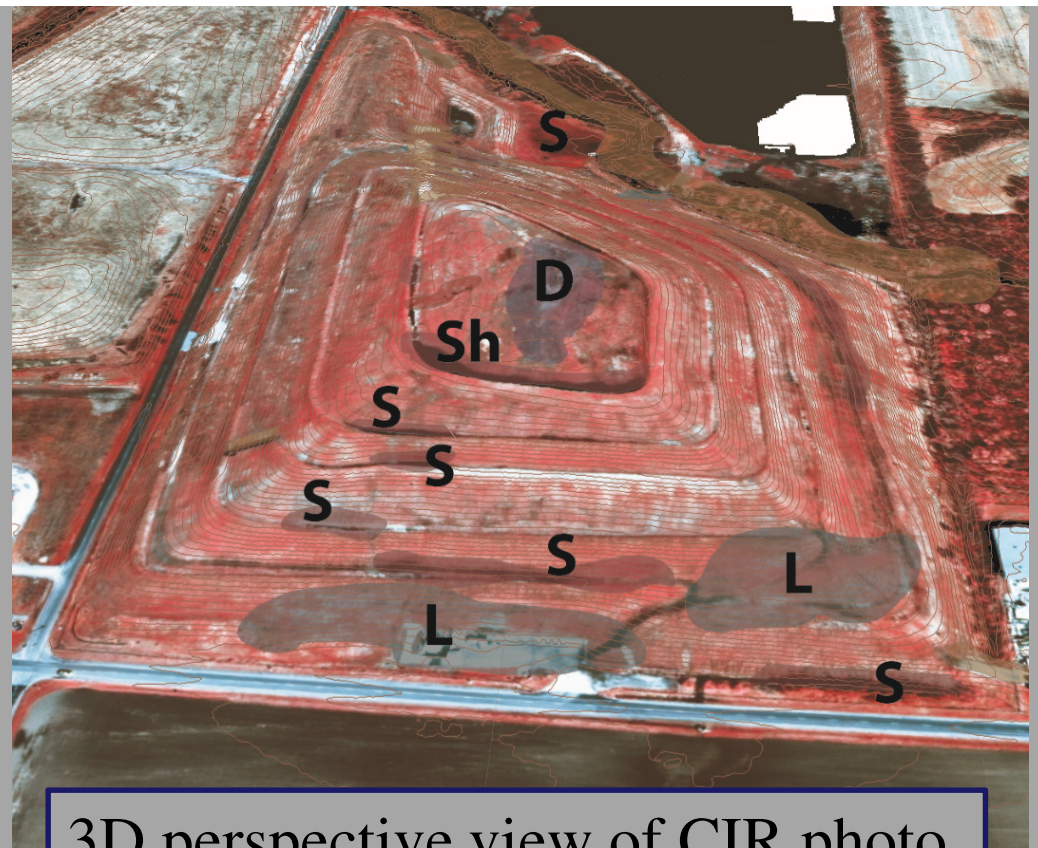
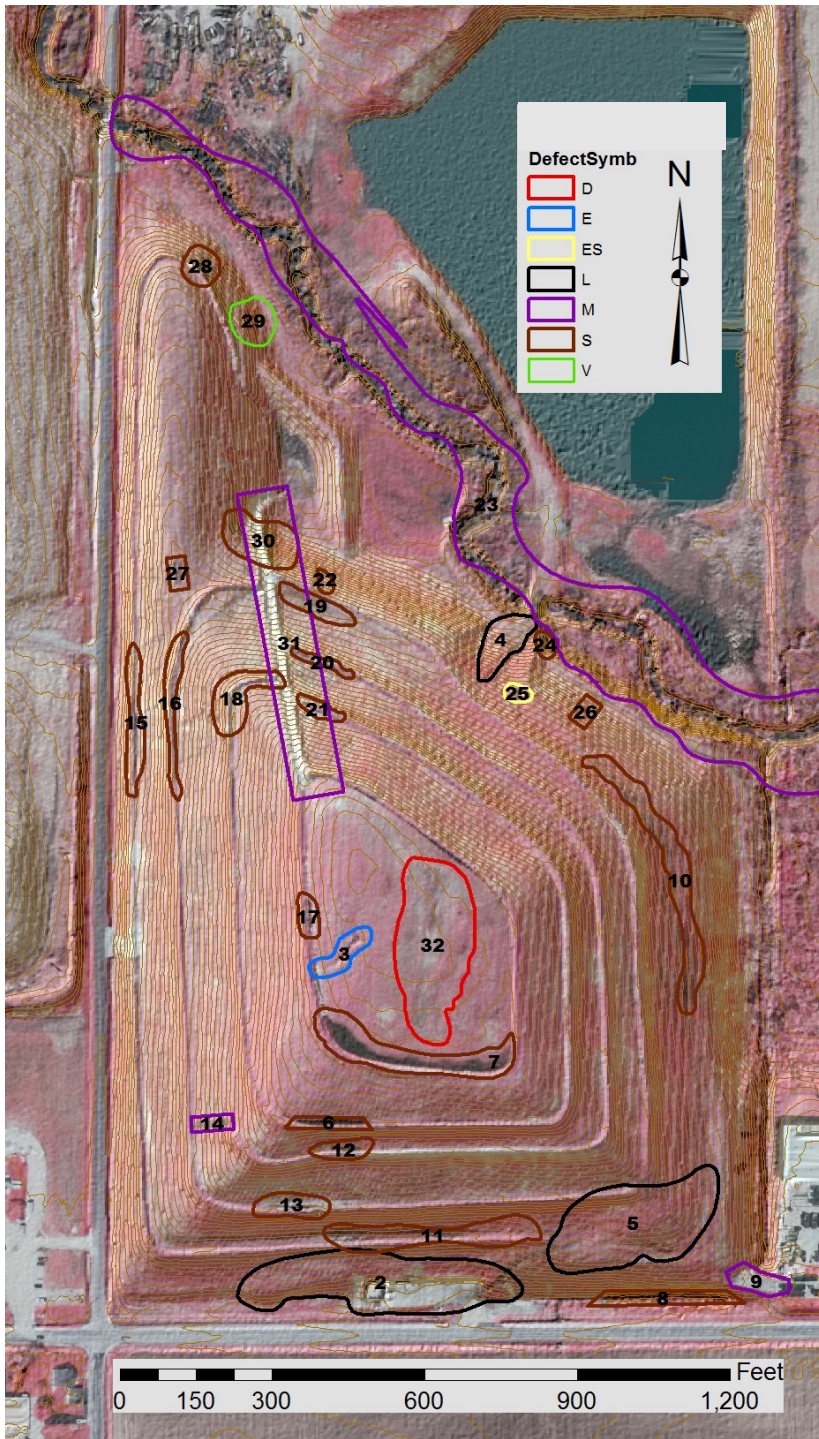


vector point cloud data

0 150 300 600 900 1,200 Feet

‘solid’ mesh ~ shaded relief





3D perspective view of CIR photo draped over LiDAR with contours aids in defect identification.

2D view of CIR photo with contours and interpretations.

Improved Postclosure Monitoring Sustainable Asset Management

“aerial traverse”

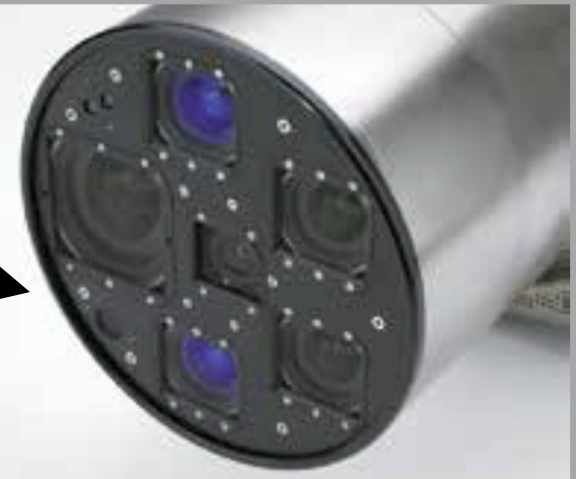
- LiDAR → Surface topography
- **Aerial Photography → Feature detection**
- Focused walkover reconnaissance
- GIS/CAD + measurements + field notes

Digital Aerial Photography

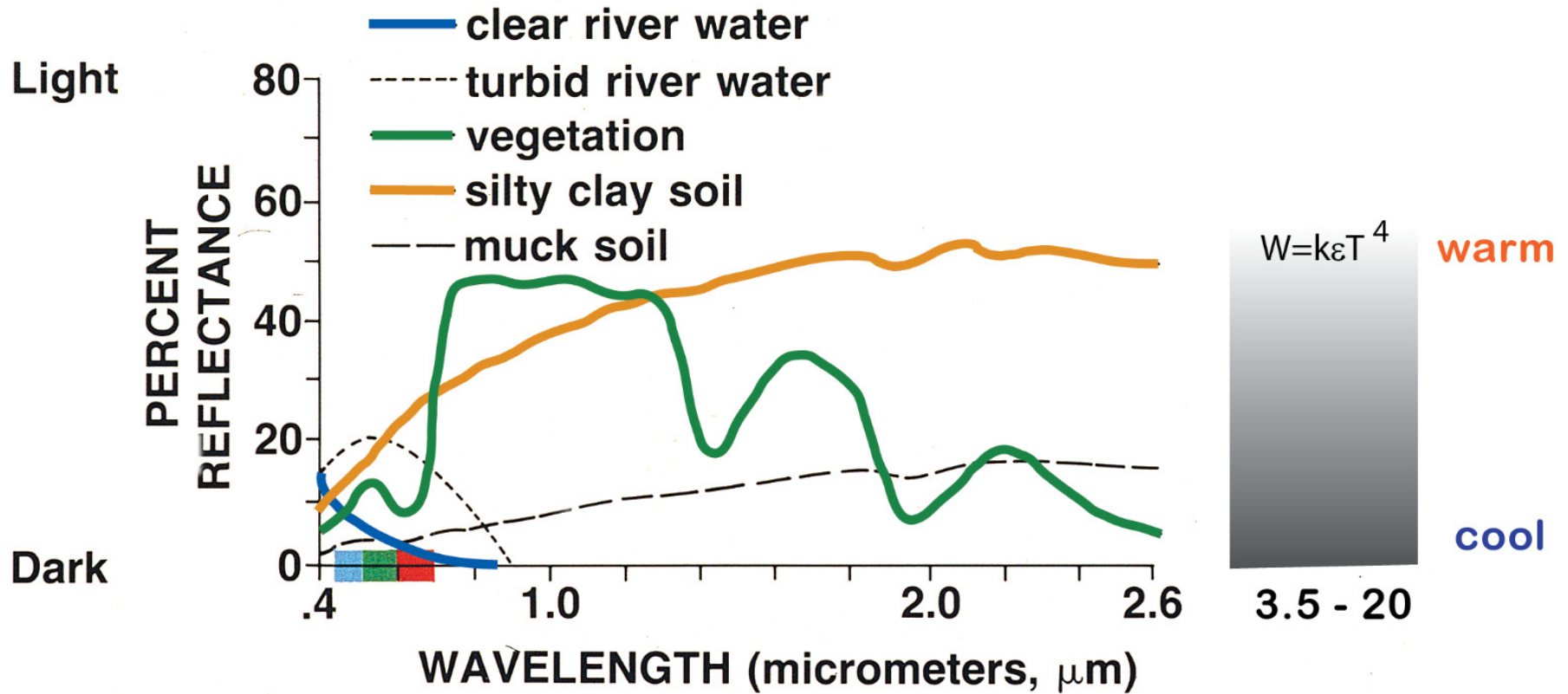
- Digital Mapping Camera
 - 4 bands = VNIR = blue, green, red, near infrared
 - Orthophotography – radial displacement removed
 - Georeferenced - image map for GIS/CAD

Not calibrated, unknown processing

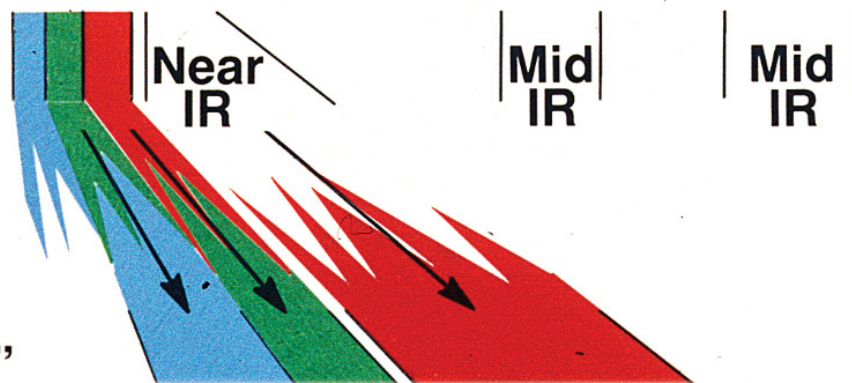
VNIR – 4 band
+ Panchromatic
Boresite viewer



COMPARISON OF TYPICAL VEGETATION, SOIL AND WATER REFLECTANCE



Natural
or "true color"



Color infrared
or "false color"

Publicly-Available Aerial Imagery

- Google Earth – Good resolution, convenient,
No adjustment or enhancement, No color infrared
- Satellite – Has RGBN, but costs \$\$, coarse resolution.

Better way is GIS-base + publicly available

- NAIP – National Agricultural Imagery Prog, leaf on, VNIR
- DOT – airborne lidar, leaf off, VNIR
- Counties – airborne lidar, leaf off, VNIR

Google Earth

2012NAIP

2011IDOT

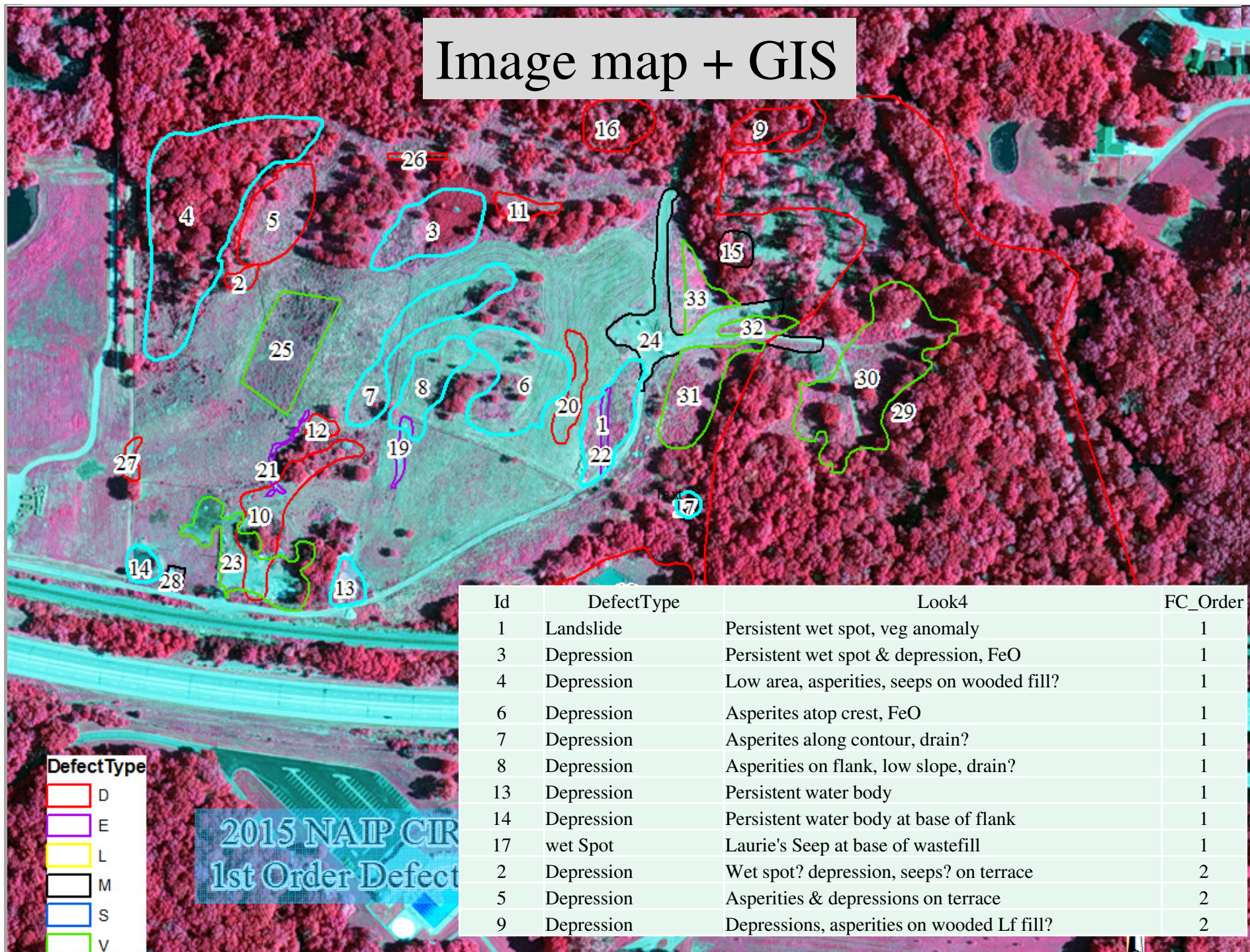


Improved Postclosure Monitoring and Custodial Care

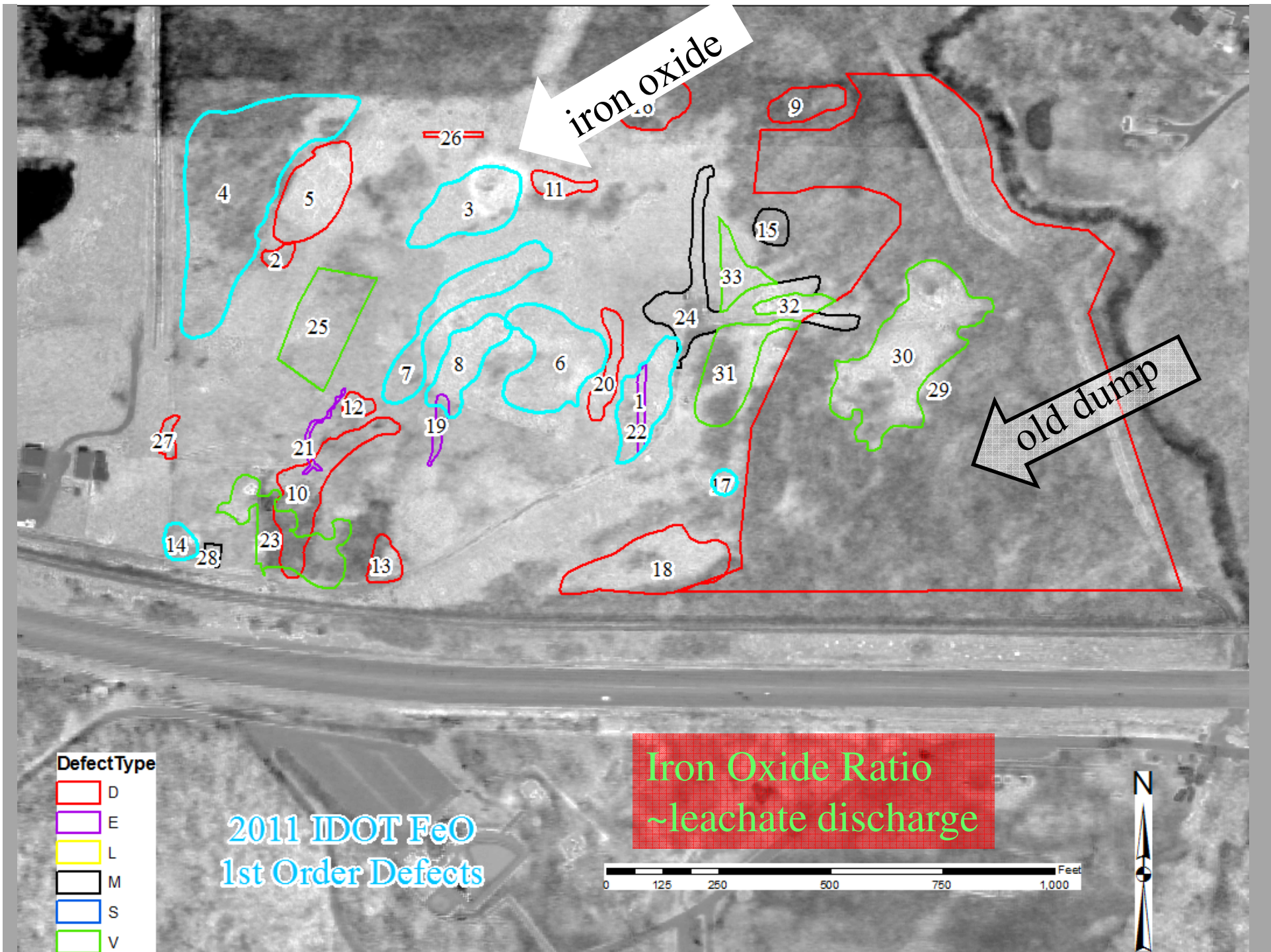
“aerial traverse”

- LiDAR → Surface topography
- Aerial Photography → Feature detection
- **Reconnaissance map → Focused walkover**
- **GIS/CAD + measurements + field notes**

Image map + GIS



Id	DefectType	Look4	FC_Order
1	Landslide	Persistent wet spot, veg anomaly	1
3	Depression	Persistent wet spot & depression, FeO	1
4	Depression	Low area, asperities, seeps on wooded fill?	1
6	Depression	Asperities atop crest, FeO	1
7	Depression	Asperities along contour, drain?	1
8	Depression	Asperities on flank, low slope, drain?	1
13	Depression	Persistent water body	1
14	Depression	Persistent water body at base of flank	1
17	wet Spot	Laurie's Seep at base of wastefill	1
2	Depression	Wet spot? depression, seeps? on terrace	2
5	Depression	Asperities & depressions on terrace	2
9	Depression	Depressions, asperities on wooded Lf fill?	2



Sustainable Legacy Landfill Management

- Identify, measure, check, and assess.
 - Which legacy landfills pose risk to Mahomet Aquifer?
 - Identify defects on earthen covers for field verification.
 - Prioritize maintenance and repair of defects.
- Sustainable maintenance.
 - Update training of field inspectors.
 - Collect landfill data and information into a geodatabase.
 - Subsequent use w/ Forest & Park Districts, C-Clubs.
 - Minimize deferred maintenance risk. [stitch in time]

Maintenance - Important, unglamorous.