GIS AND UAS AT MDOT AERONAUTICS

Michigan Aeronautics Commission Meeting

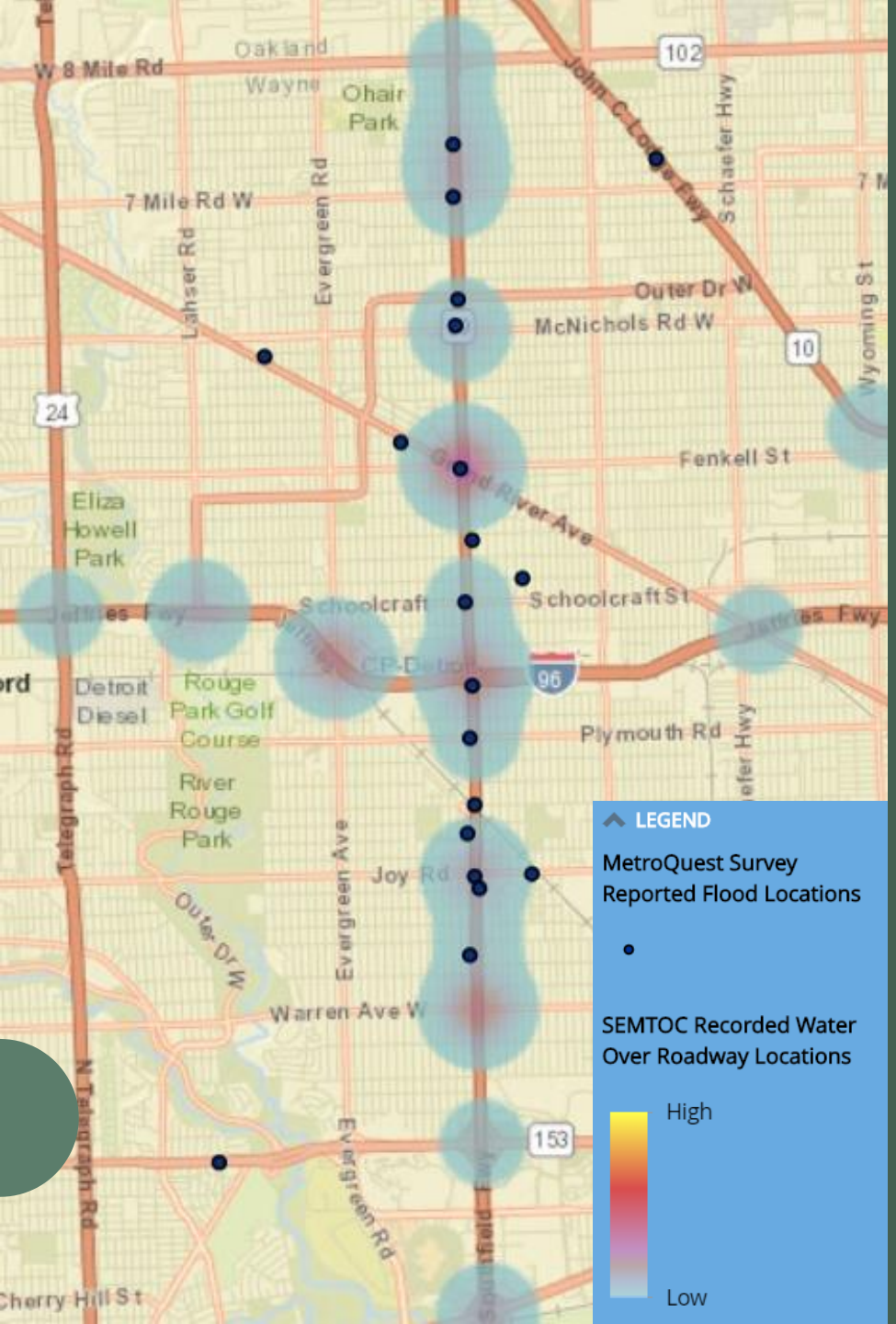
11/6/2019

Outline

- GIS/UAS overview
  - What is UAS
  - What is GIS
- UAS Runway Obstruction Surveys
  - GIS and Google Earth 3D
  - Drone flight and Pix4D processing
  - Further analysis in ArcGIS
- The future of GIS/UAS at Aero

Unmanned Aircraft Systems (UAS)

- Drones are remotely operated by a ground team
- Drone operations can make tedious tasks safer, quicker and more cost effective
- Use cases in SOM
  - EGLE - Air quality testing in hazardous areas
  - MDNR - Disease control in tree saplings
  - MDOT - Bridge sounding and scoping
  - MSP - Accident scene reconstruction

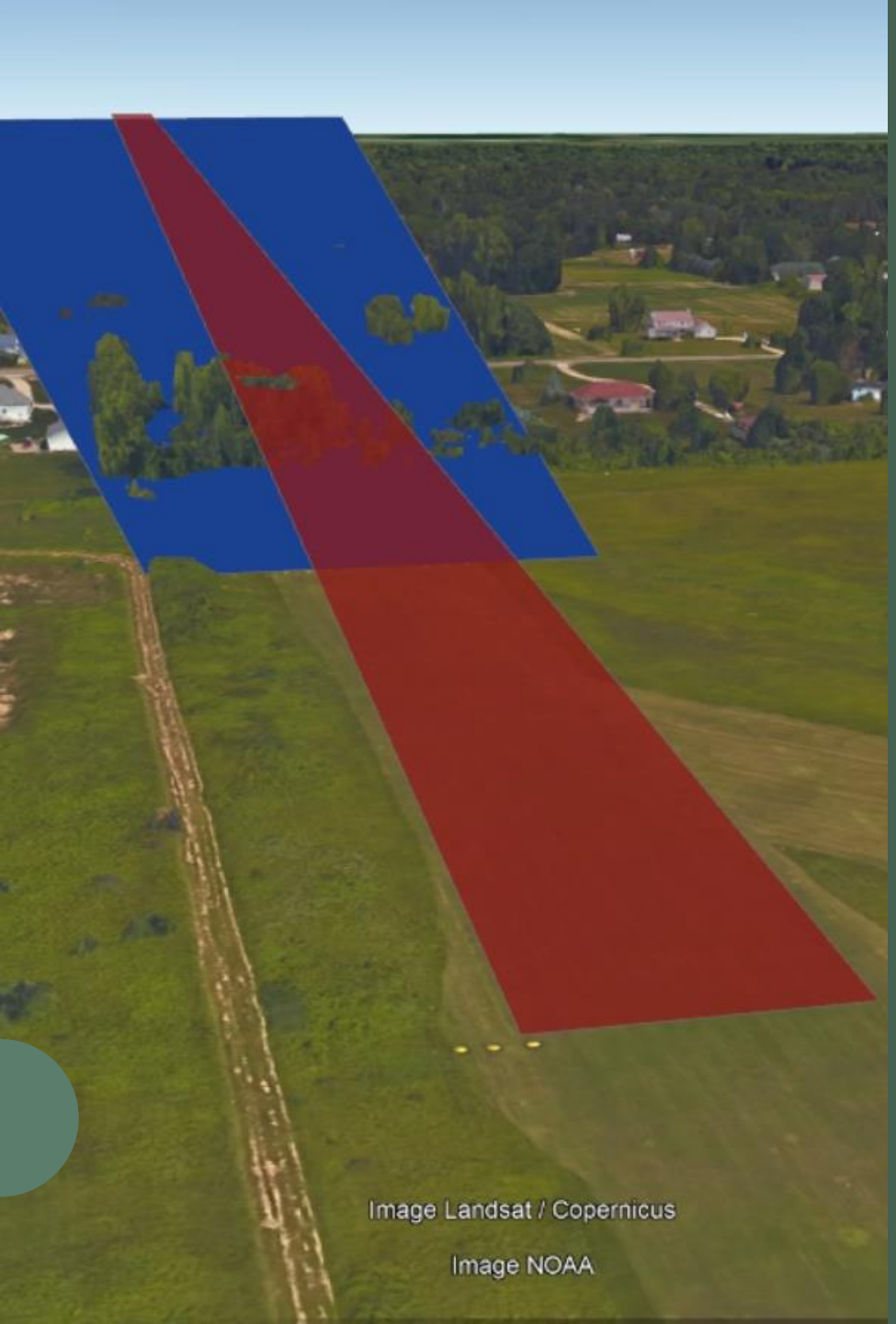


Geographic Information Systems (GIS)

- GIS is a framework used for gathering, managing, and analyzing spatial data
- Layers in GIS are spatially referenced using coordinate systems
  - Layers are aware of each other's location
  - Powerful spatial analysis in both 2D and 3D
- At MDOT, GIS is primarily being used for asset management
  - The MDOT GIS Unit hosts a GIS Open Data Portal
    - Layers available to the public
  - Used in planning projects

Runway Obstruction Surveys

- Determining approach slope obstructions using GIS and drones
- Two primary methods of data collection:
  - Google Earth 3D
  - Drone flights and full processing in Pix4D
- Additional analysis in ArcGIS



GIS and Google Earth

- Google Earth provides a 3D mesh in some areas of Michigan
- Create the approach slope in ArcGIS and import the KMZ file into Google Earth
- No time spent in the field
- Able to grab exact coordinates of treetops as well as elevation data
- No timestamps of when the 3D mesh was created

Drone Missions

- Fly runway approaches with drones and collect pictures to create our own 3D point cloud
- Most up-to-date data with known timestamps
- Three main components when on-site:
  - Ground control points
    - GPS located plates that correct the position of the photos
  - Drone flight
    - Drone follows a pre-determined flight grid and takes photos with the correct overlap
    - Pilot in command watches the controls and visual observer watches the drone
  - Initial Data verification
    - Ensure there are no major issues with photos before we pack up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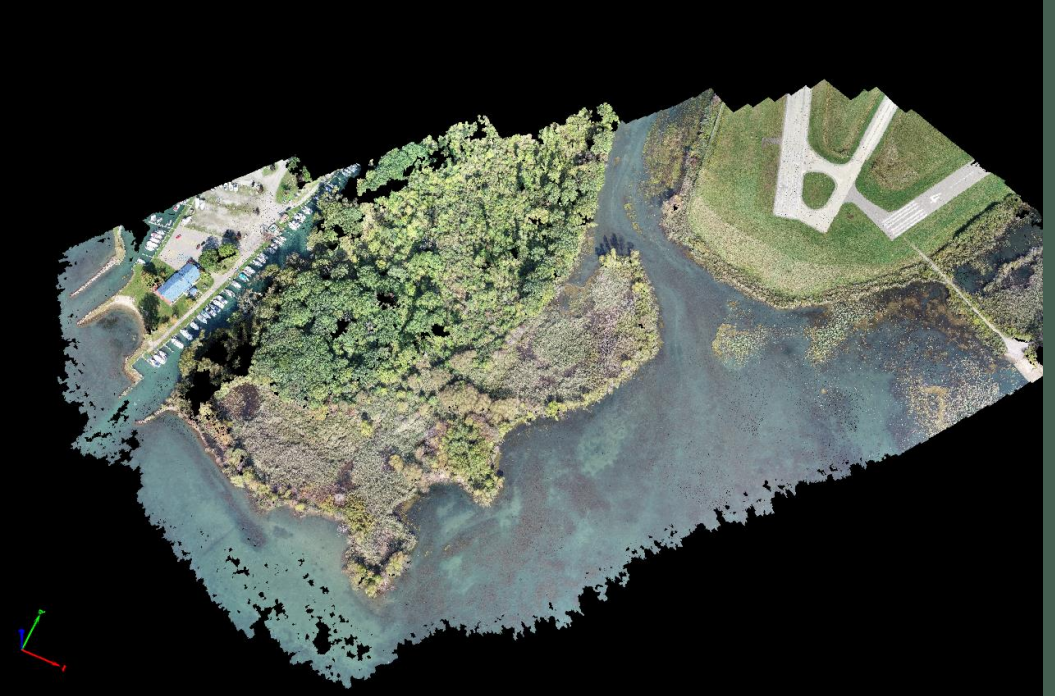
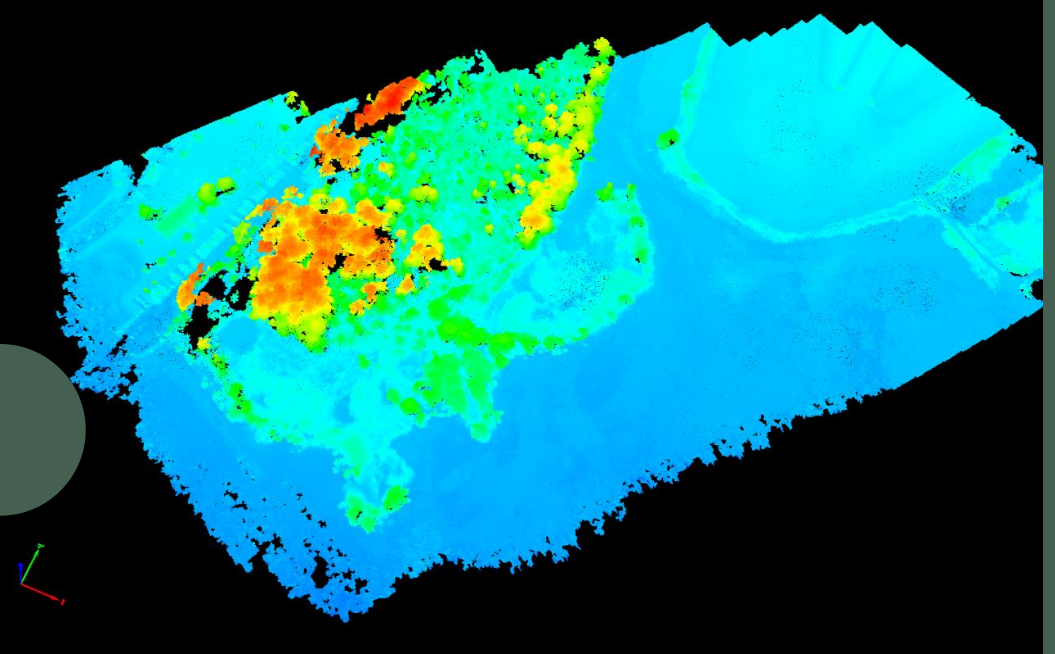
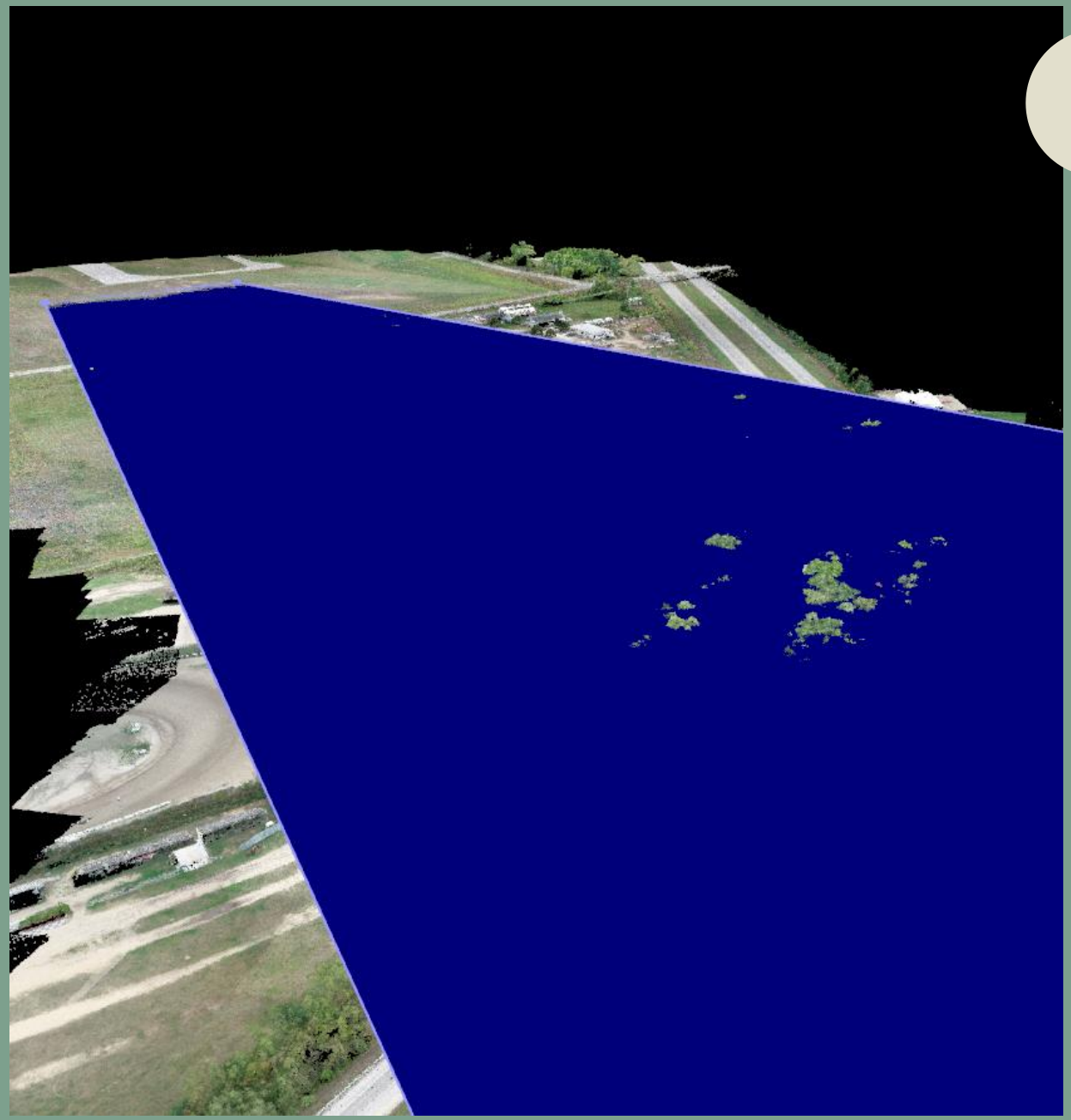
INITIAL DATA VERIFICATION

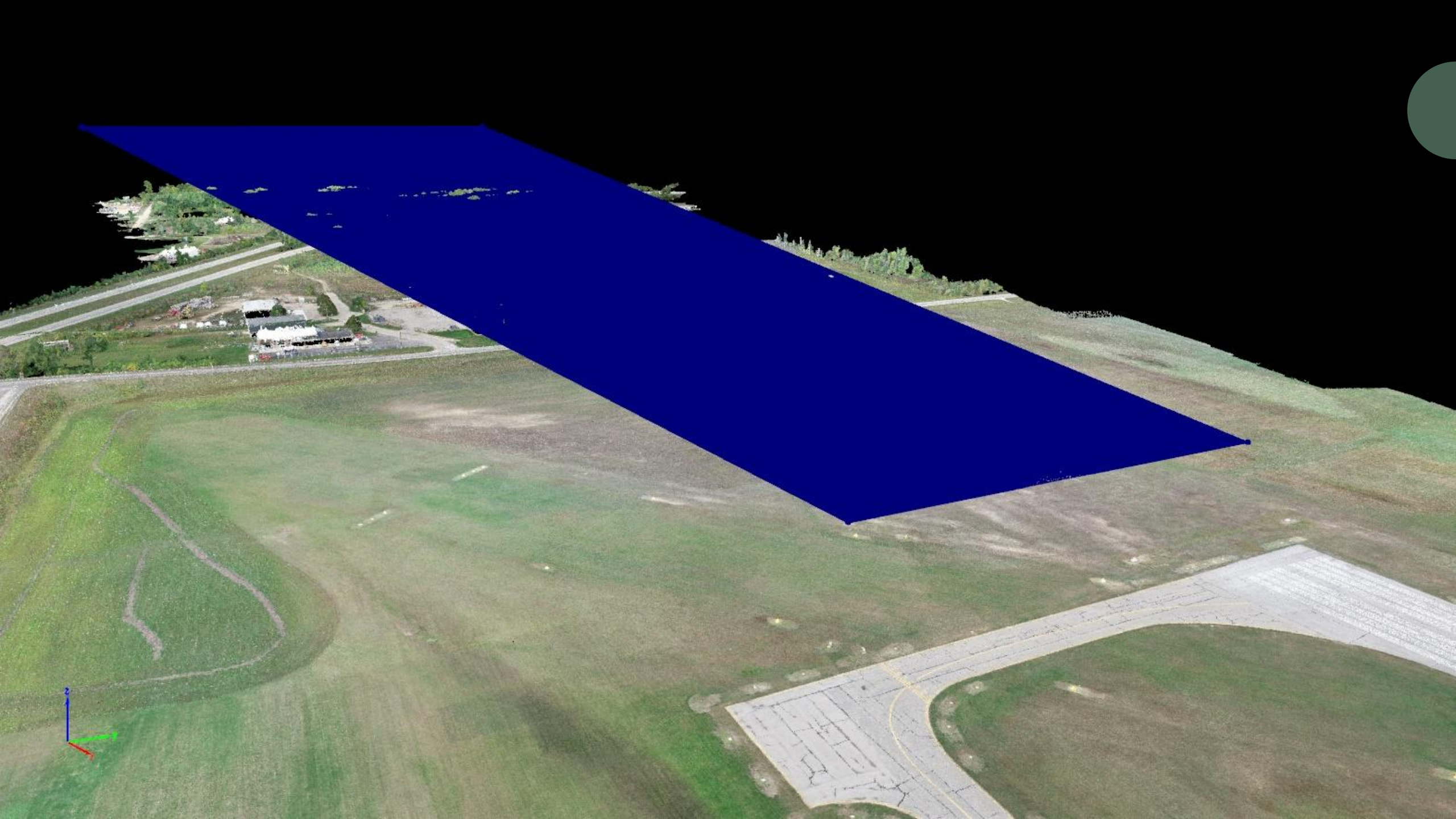


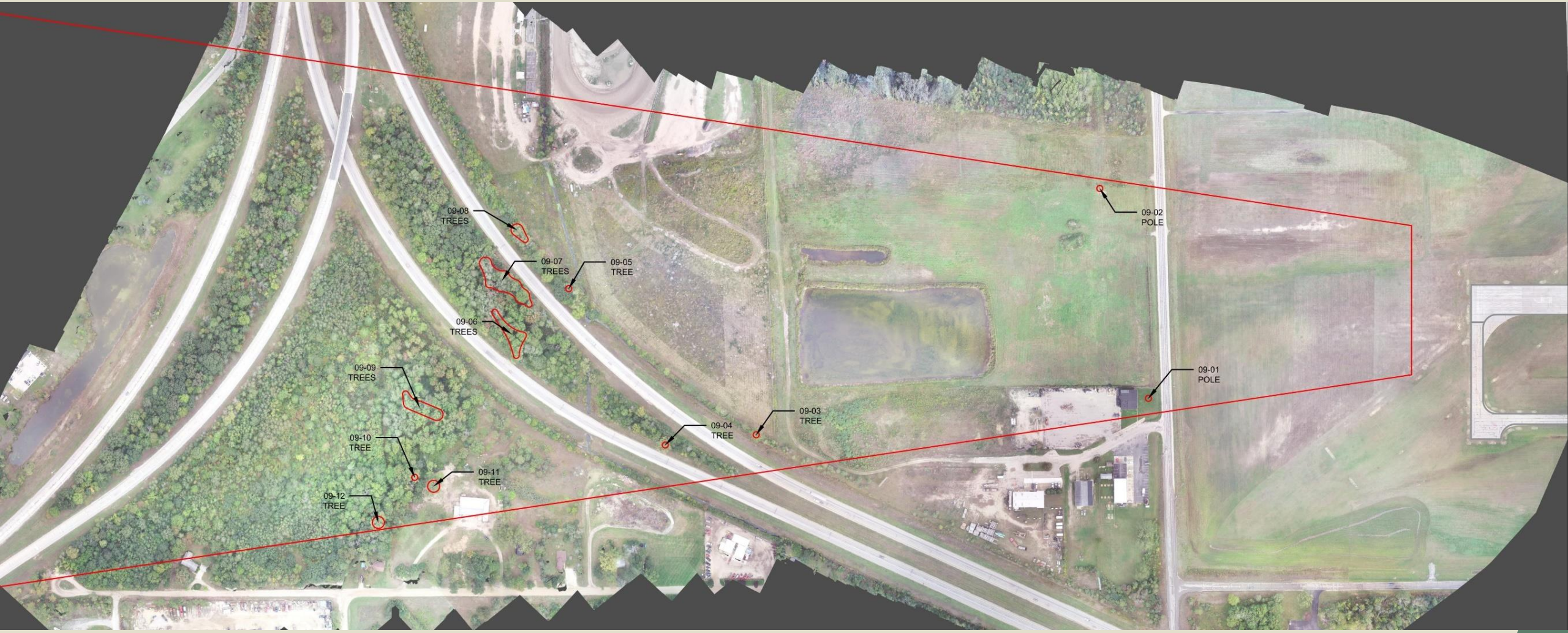


Full Processing in Pix4D

- Import the photos and GCP data into Pix4D and start the full processing
- Pix4D reconstructs a 3D point cloud from the photos taken
  - The largest point cloud thus far has been 441 million points from 981 photos
  - Takes about 13 hours for a larger project
  - With GCPs, reconstruction has a sub 3-inch error (thus far)
- Import the approach slope cut surface and determine what obstructions are present
  - Able to grab exact coordinates of treetops as well as elevation data



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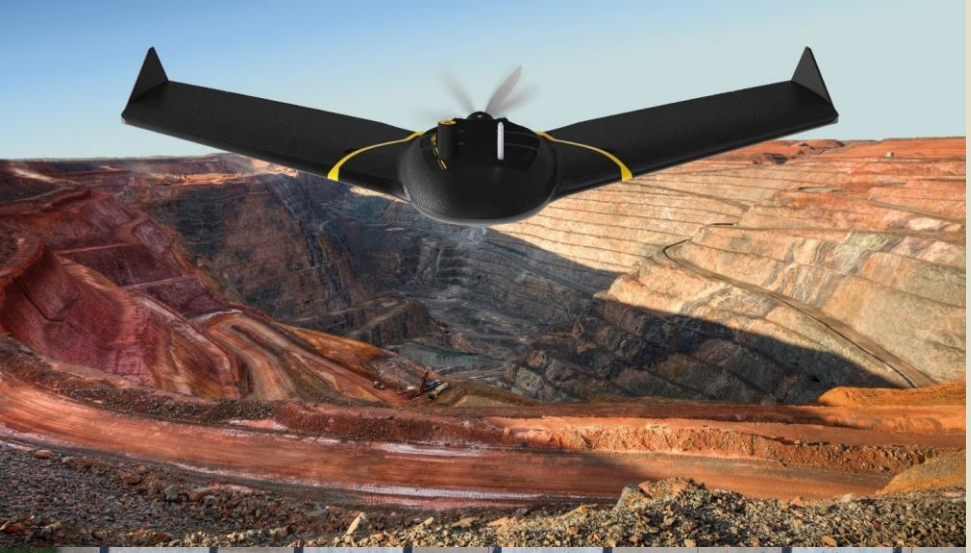
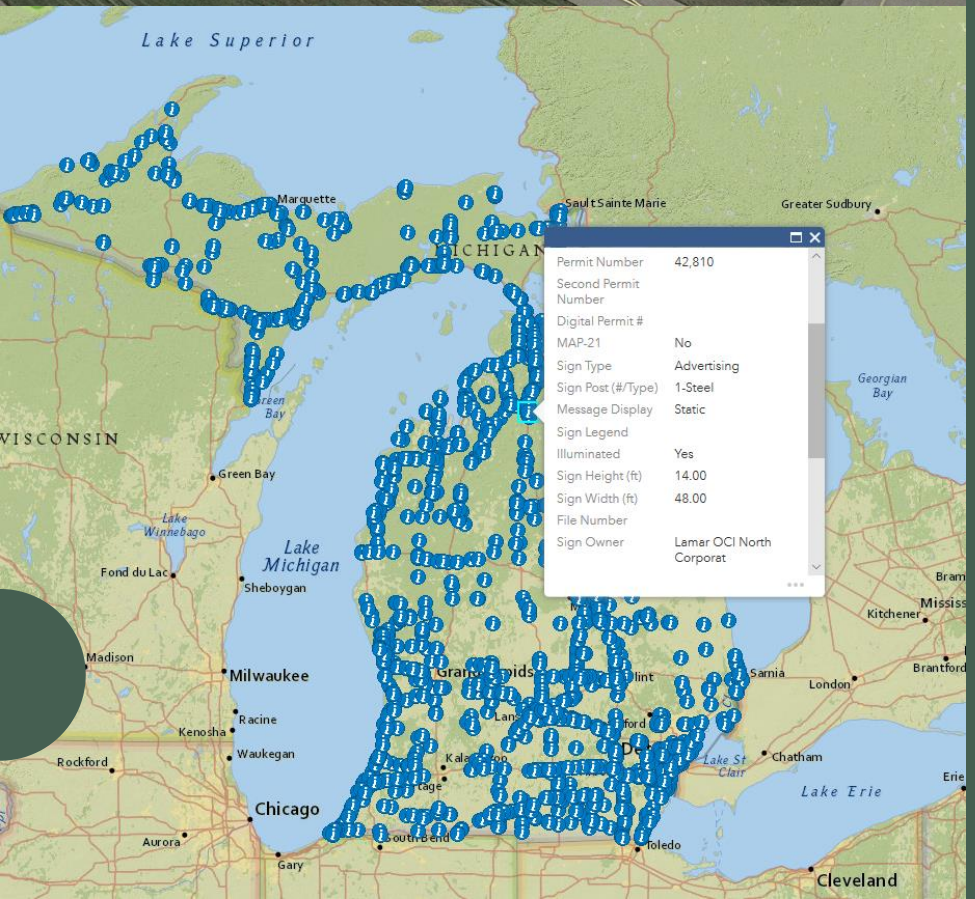


Future of UAS

- Asset management
  - Fly entire runways as well as buildings on airport property
    - Pavement conditions
    - Manage runway markings
    - Build airport asset databases
- Assist with airport inspections
  - Provide obstruction data to inspectors before they inspect
    - Help identify controlling obstructions
    - Elevations and distances
- Drone advancements
  - RTK drones with improved accuracy
  - Fixed wing drones with long battery life



Future of GIS

- GIS
  - Determining who is responsible for obstructions with spatial analysis on easements
  - Determine compliance for proposed and existing obstructions
  - Asset management through GIS databases
  - Planning for future airport projects
  - Interconnect with existing ArcGIS systems set up by the MDOT GIS Unit

Questions