Aerial and Bathymetric Drones Aid Detention Basin Inspections

Alan Stadler, PhD, PE
Conveyance Practice Lead

May 20, 2021

2021OHIO STORMWATER CONFERENCE

WADE TRIM

Acknowledgements

Mike Blair, Project Manager

Northeast Ohio Regional Sewer District

NORTHEAST OHIO REGIONAL SEWER DISTRICT
REGIONAL STORMWATER MANAGEMENT PROGRAM

Jason Yoscovits, Drone Pilot
Allison Tierney, Professional Engineer

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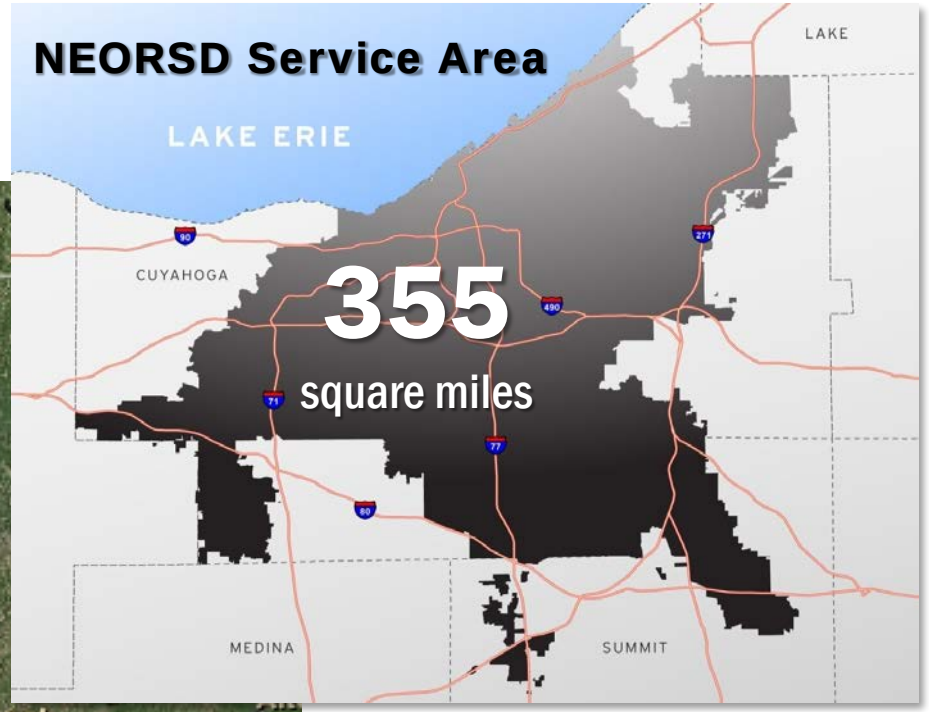
Agenda

- Introduction
- Project Overview
- Drone Data Acquisition
- Drone Data Use
- Comments & Observations
- Conclusions

Introduction

Northeast Ohio Regional Sewer District



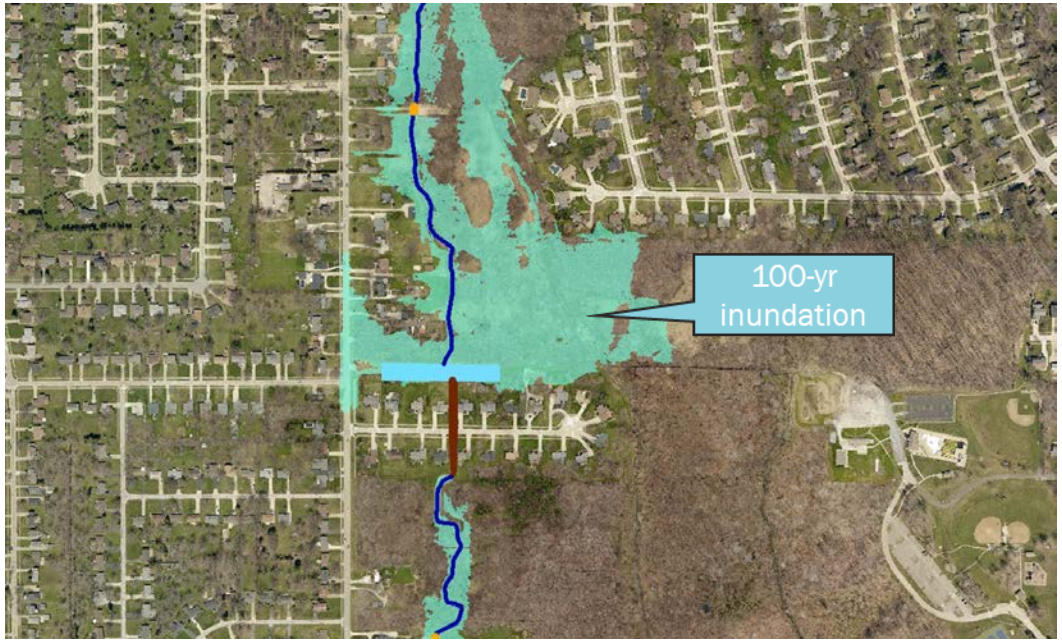
Serves:
- 62 municipalities
- >1M residents

Maintains & Operates:
- Interceptor Sewers
- 3 WWTPs

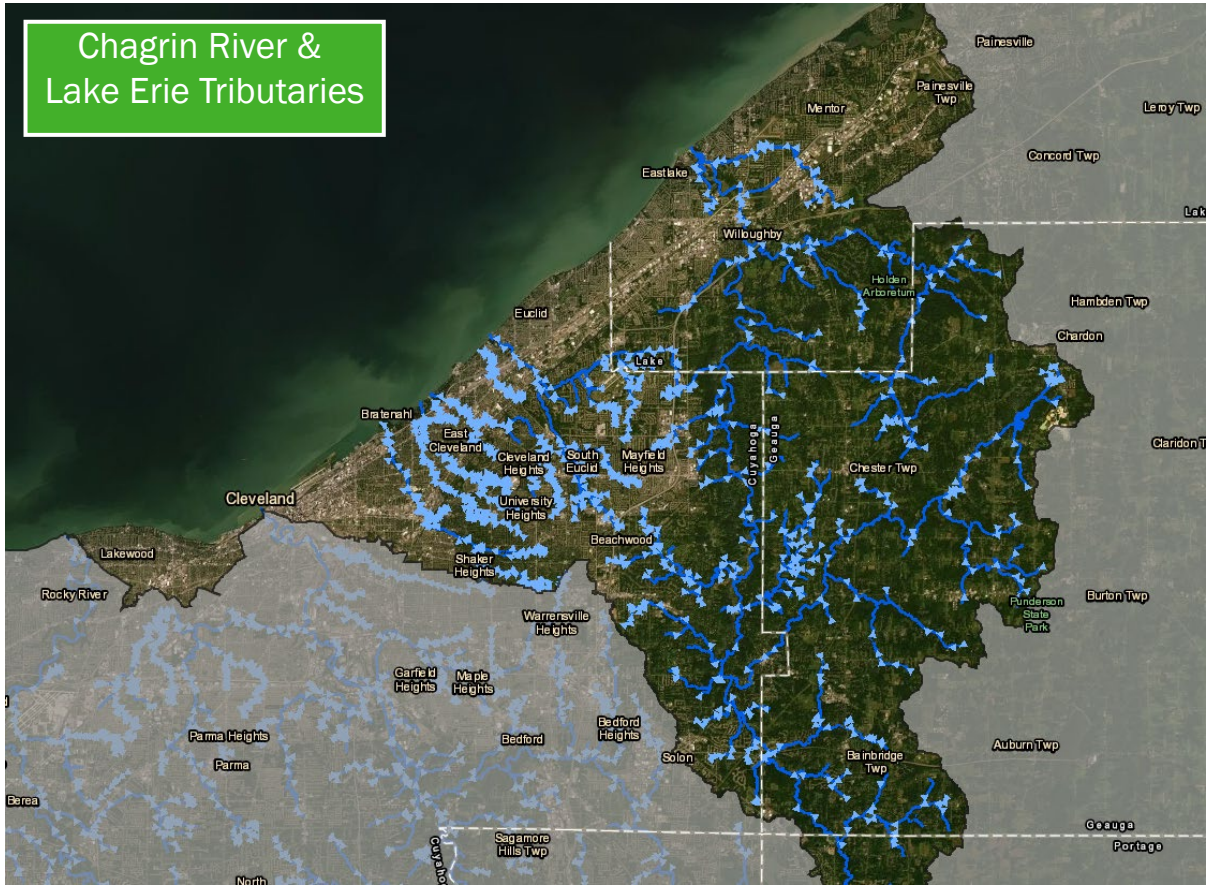
NORTHEAST OHIO REGIONAL SEWER DISTRICT

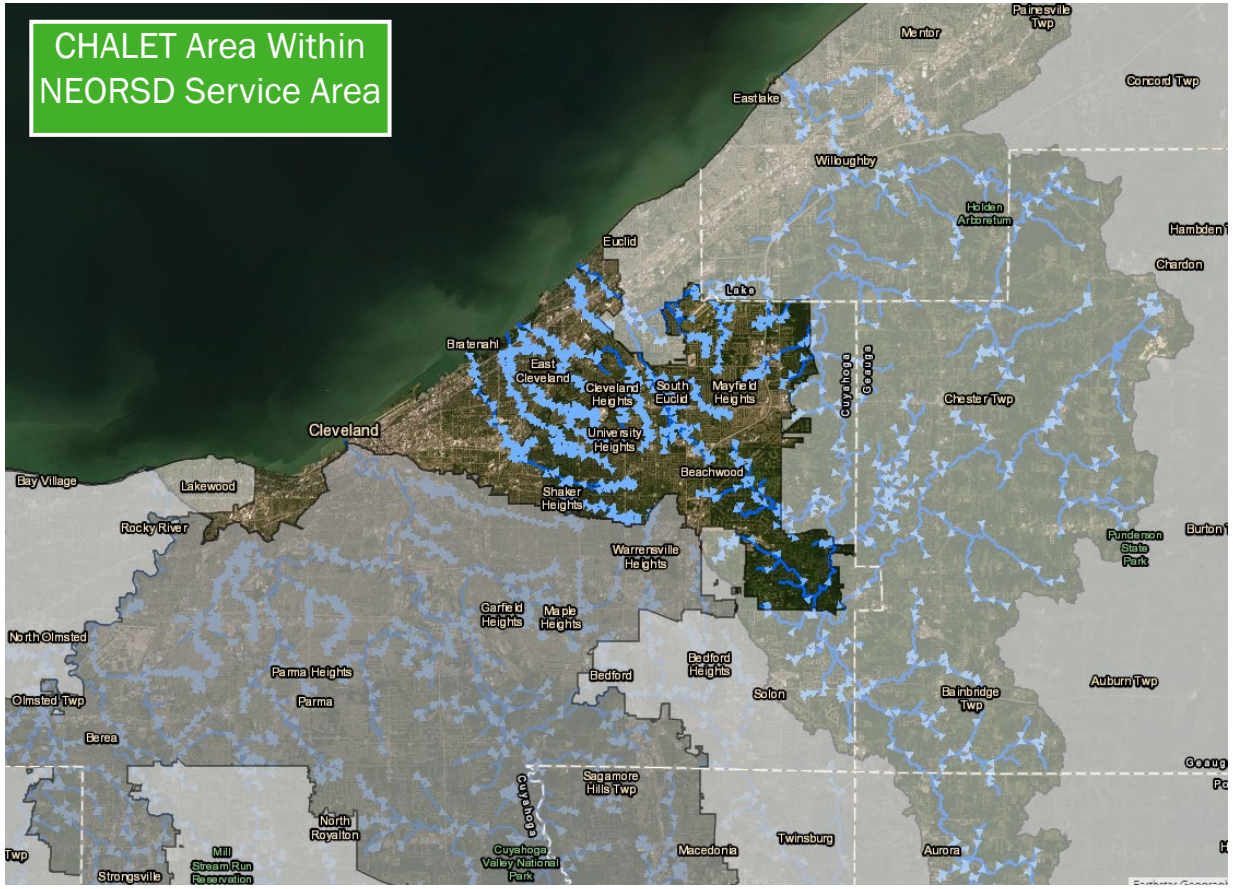
REGIONAL STORMWATER MANAGEMENT PROGRAM

- Stormwater Master Planning Effort
  - Evaluation of flooding, erosion, and water quality issues on the Regional Stormwater System (RSS)
  - Problem Identification
  - Recommendations for problem elimination, performance improvements and O&M activities



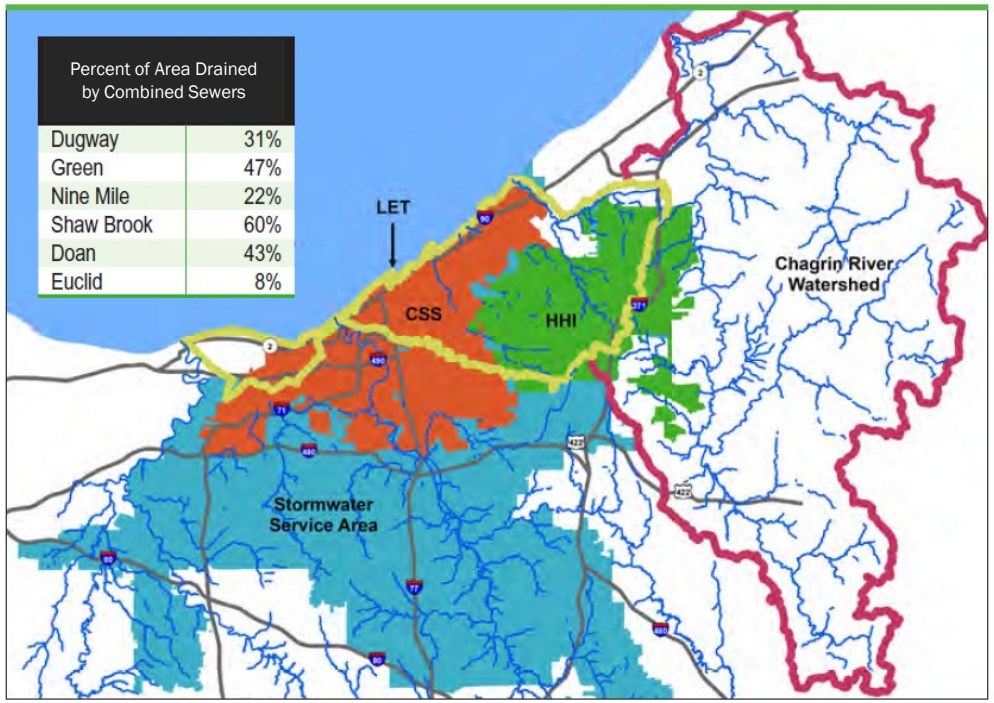
CHALET Stormwater Master Plan





Chagrin River (CHA) + Lake Erie Tributaries (LET) = CHALET

CHALET SWMP Project Overview



Study Area Overview Map

Task 1: Project Management

- Meetings, invoicing, consultant coordination

Task 2: Data Collection

- Existing data collection and evaluation
- Data Collection and management
- Inspections (streams, surveys, basins, spherical imagery, culverted streams and CSS assets)

Task 3: Model Development and Application

- Hydrologic and Hydraulic model development and evaluation
- CSS model updates
- Targeted local sewer system evaluations
- Problem area identification

Task 4: Alternative Development

- Formulate, size and evaluate alternatives
- Early action projects

Task 5: Stormwater Master Plan Recommendations

- TBL Evaluations of Alternatives
- Implementation Plan and Phasing
- Prepare Stormwater Master Plan Report(s)

Task 6: Stakeholder Support

- Materials for local community meetings and WACs

Task 7: Monitoring

- HWM data collection
- USGS stream gage data collection
- Recommendations on additional monitoring required

Task 8: Model Data Management

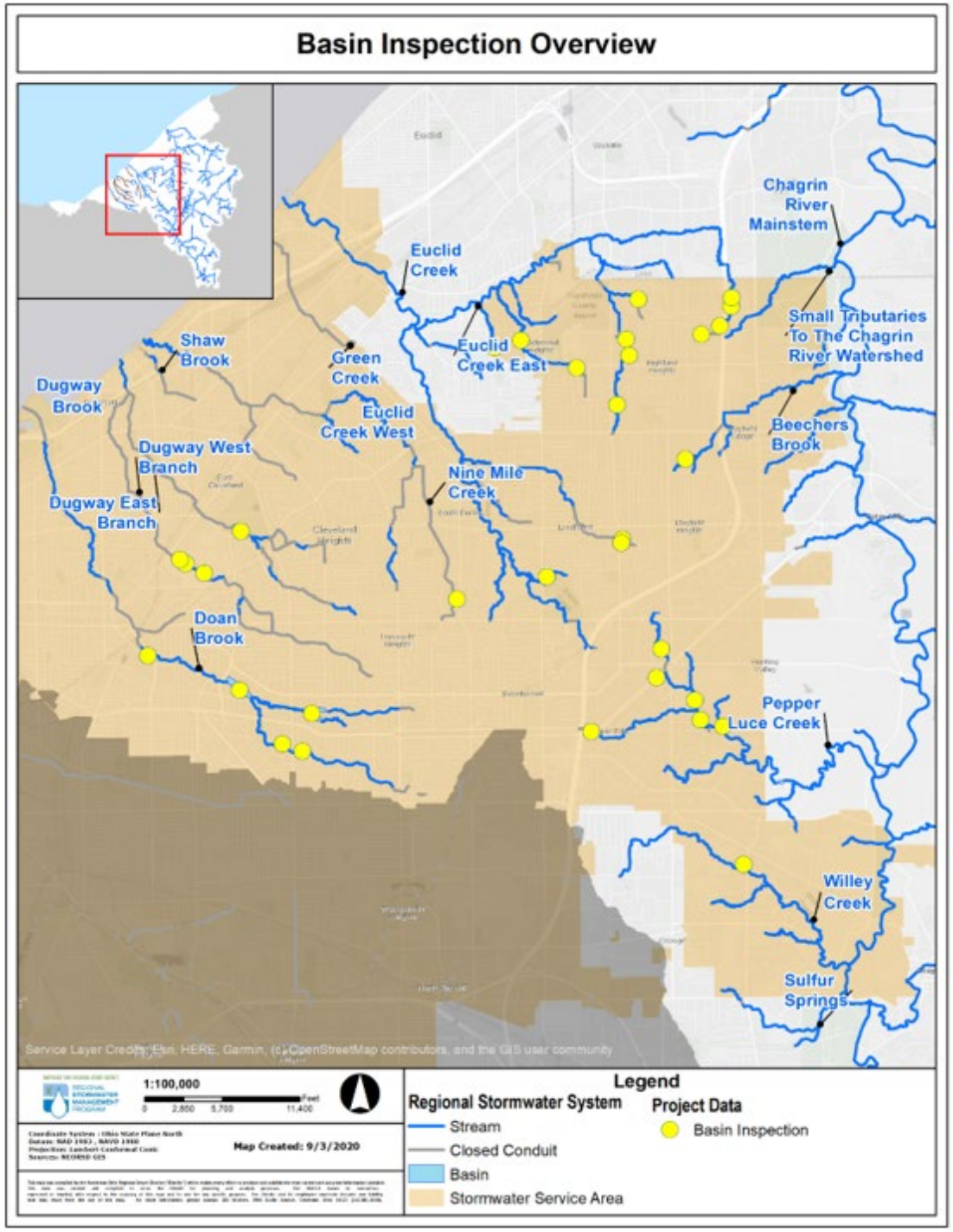
- Master Model Development for CRS, CRN and Rocky River Watersheds
- Model Data Management Protocol
- Design review

Basin Inspections

- **Task:** Perform field investigations and condition assessment of 33 regional stormwater system (RSS) basins
  - 18 wet
  - 15 dry

- **Deliverable:** Summarize field findings in a Condition Assessment Tech Memo

- **Uses:** Establish baseline conditions, identify O&M needs, acquire data on physical characteristics to include in hydraulic models



Basin Inspection

District's SWIM Basin Inspection Manual

Northeast Ohio Regional Sewer District

Stormwater Inspection & Maintenance

Basin Inspection Manual

BASIN STRUCTURAL CONDITION ASSESSMENT
STORMWATER INSPECTION & MAINTENANCE - NEORSD

ASSET ID_____ WO#_____ WET/DRY_____ DATE_____

COMMUNITY_____ SUBWATERSHED_____

ASSET COMPONENTS

INLET WORKS (Section 1.1)			
1. Primary Inlet Type		2. Primary RSS Inlet Channel / Pipe Condition	
3. Primary Inlet Endwall(s) Condition		4. Primary Inlet Trash Rack Condition	
5. Secondary Inlet Type		6. Secondary Inlet Condition	
7. Inlet Scour Condition		8. Forebay Condition	
BASIN INTERIOR (Section 1.2)			
9. Interior Slope Gen Erosion / Stability Condition		10. Rodent Activity	
11. Interior Basin Floor Vegetation Condition			
IMPOUNDING STRUCTURE (DAM) (Section 1.3)			
12. Material Type:			
Upstream Face			
13. Interior Slope Seepage Condition		14. Gen Erosion / Stability Condition	
15. Rodent Activity		16. Vegetation Condition (Earthen)	
17. Joint / Alignment Condition (Concrete/Masonry)			
Downstream Face			
18. Interior Slope Seepage Condition		19. Gen Erosion / Stability Condition	
20. Rodent Activity		21. Vegetation Condition (Earthen)	
22. Joint / Alignment Condition (Concrete/Masonry)			
Crest			
23. Gen Erosion Condition (Earthen)		24. Rodent Activity	
25. Vegetation Condition (Earthen)		26. Joint / Alignment Condition (Concrete/Masonry)	

TLET WORKS (Section 1.4)			
Primary Outlet Condition		28. Primary Outlet Stilling Basin Condition	
Primary Outlet Trash Rack Condition		30. Primary Outlet Scour Condition	
Secondary Outlet Condition		32. Secondary Outlet Stilling Basin Condition	
Secondary Outlet Trash Rack Condition		34. Secondary Outlet Scour Condition	
Lake Drain Condition		36. Emergency Spillway Rodent Activity (Earthen)	
Emergency Spillway Vegetation Cond. (Earthen)		38. Emergency Spillway Gen Condition (Concrete)	
Emergency Spillway Gen Condition (Earthen)			
SCELLANEOUS (Section 1.5)			
Fencing / Gates		41. Aesthetics	
Sediment Condition		43. Debris Condition	

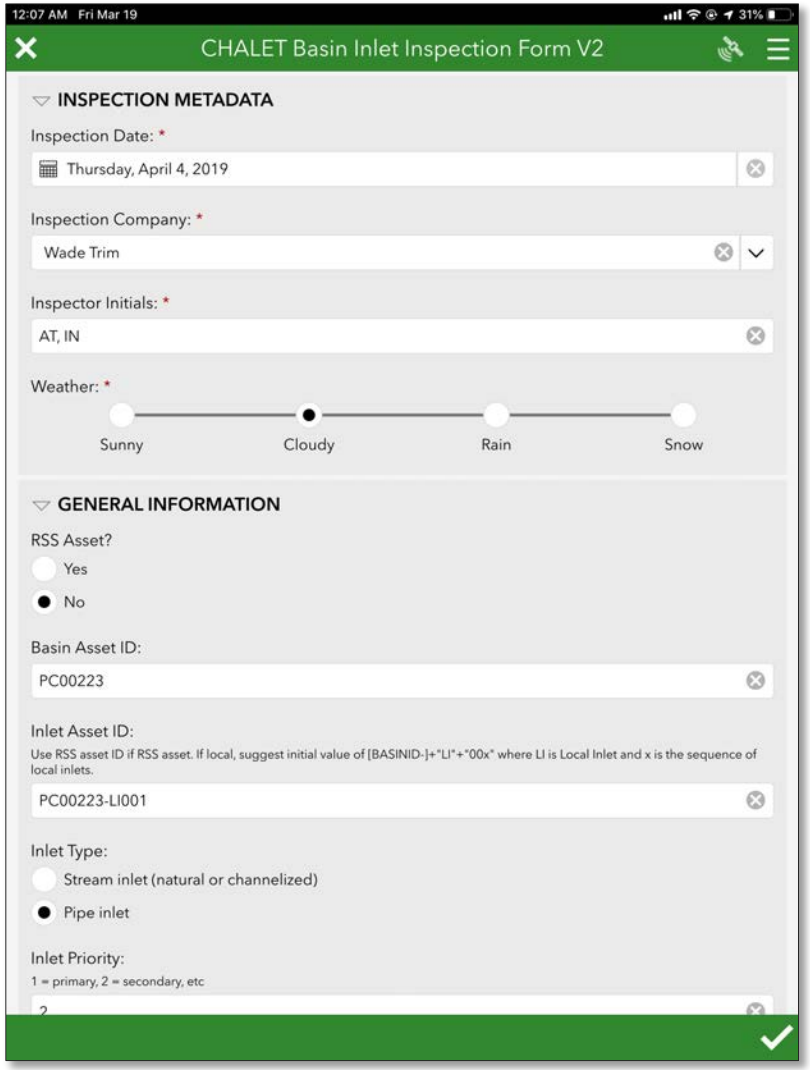
OMMENTS

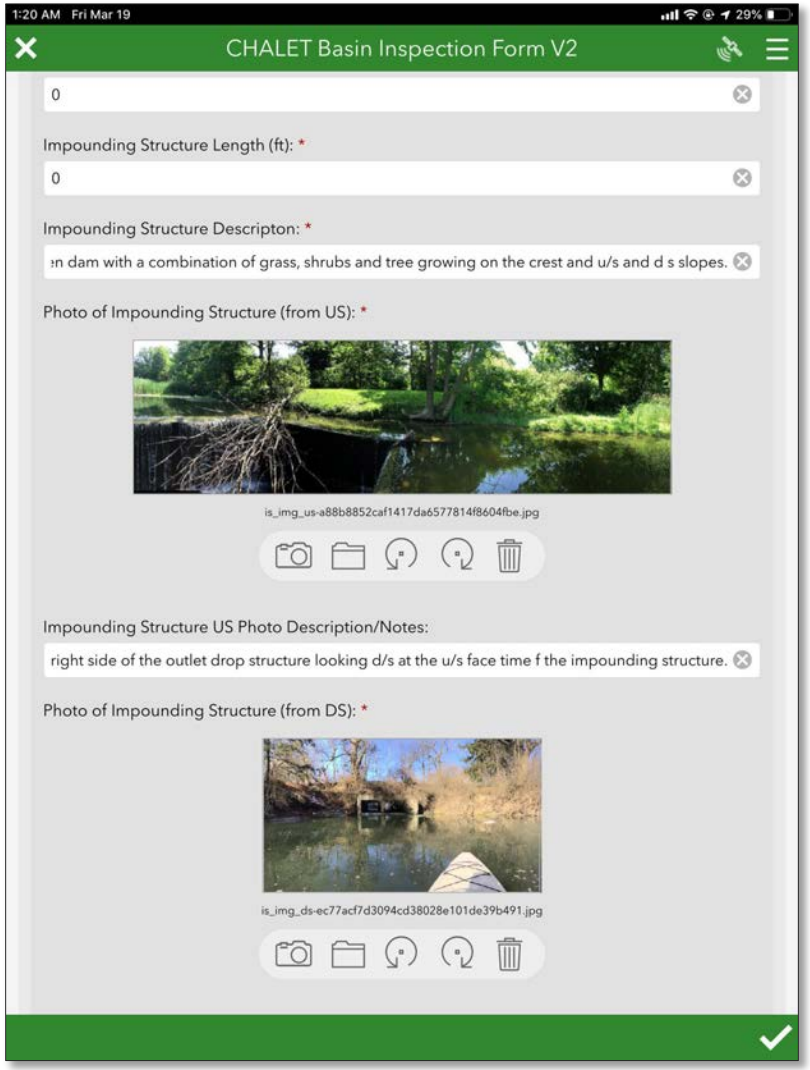
SPECTED BY: _____ DATE: _____

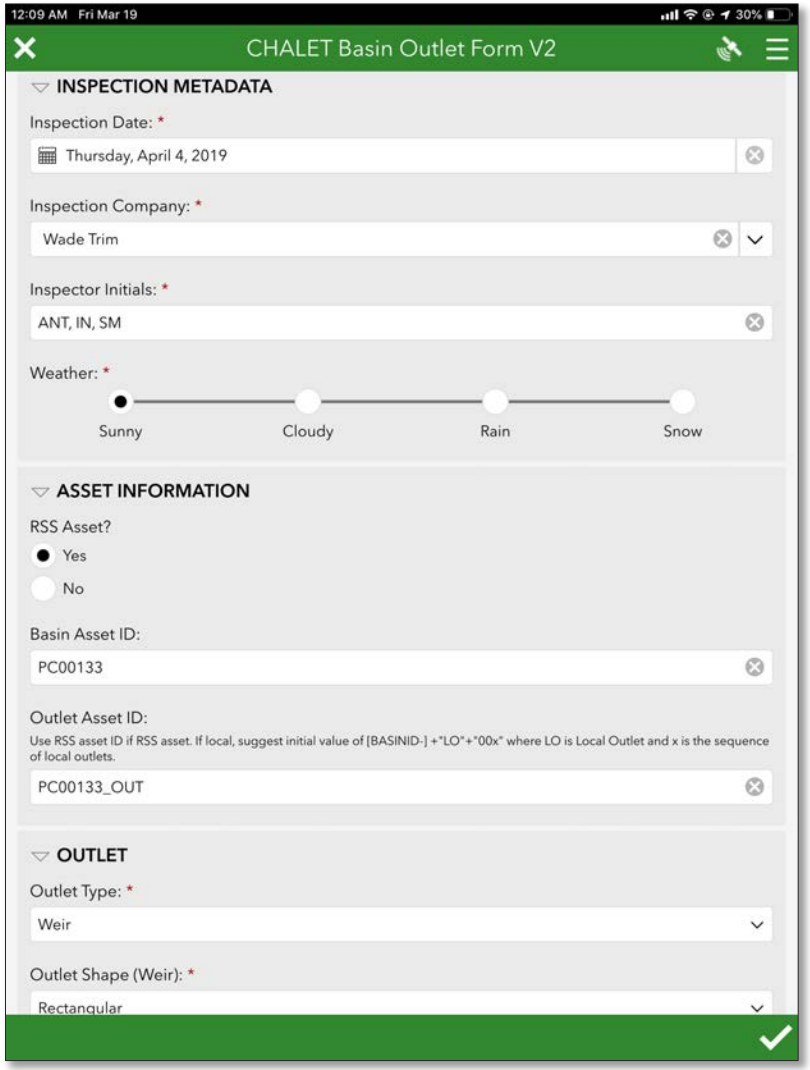
VIEWED BY: _____ DATE: _____

Basin Inspection

Populate Survey123 forms on iPad

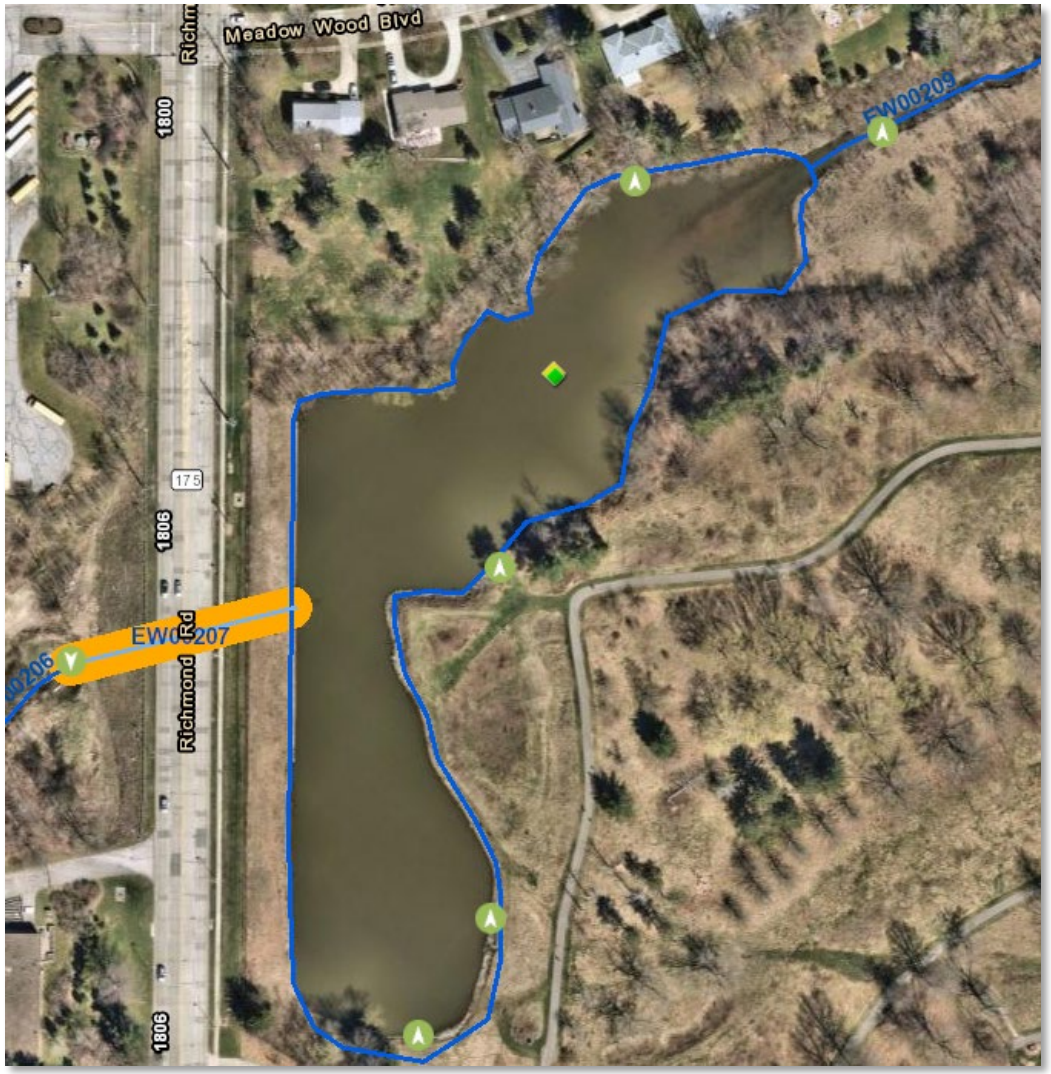






Basin Inspection – Data Management

Upload Survey123 forms to the District's AGOL



Basin Inspection - Technical Memorandum

Automate tech memo writing

PrintAndSortBasinFigures.py - P:\Neo5015\01e\GIS-data\Zipped Python Scripts\PrintAndSortBasinFigures.py

File Edit Format Run Options Window Help

```
import shutil
import os
import arcpy
proj = arcpy.mp.ArcGISProject(r'P:\Neo5015\01e\GIS-data\Projects\Basin Repo

srcDir = r'P:\Neo5015\01e\GIS-data\Projects\Basin Report Figures\Figures'
targLoc = r'P:\Neo5015\01e\GIS-data\Output\Basin_Figures\Full_Export'

srcDir = r'C:\Temp\Figures'
targLoc = os.path.join(srcDir,'FigsByBasin')

##for layout in proj.listLayouts():
##    layout.mapSeries.exportToPDF(srcDir+'\\'+layout.name.split(' ')[0],
##                                 multiple_files = 'PDF_MULTIPLE_FILES_PAG
##                                 resolution = 250)
    #Check syntax between exportToPDF and exportToJPG - goal is JPG

for layout in proj.listLayouts('*BasinFigures'):
    lName = layout.name
    print('Exporting '+lName)

    if layout.mapSeries is not None:
        if layout.mapSeries.enabled:
            ms = layout.mapSeries
            for pNum in range(1,ms.pageCount+1):
                ms.currentPageNumber = pNum
                msName = getattr(ms.pageRow,ms.pageNameField.name)
                layout.exportToJPEG(srcDir+'\\'+lName+'_'+msName,resolution
    else:
        layout.exportToJPEG(srcDir+'\\'+lName,resolution = 300,jpeg_quality

basins = set()
types = set()
for f in os.listdir(srcDir):
    if 'FigsByBasin' != f:
```

1483 CHAGRIN RIVER / LAKE ERIE DIRECT TRIBUTARIES STORMWATER MASTER PLAN (CHALET SWMP)

DE00030 (FOREST HILL PARK DAM #2) BASIN INSPECTION CONDITION ASSESSMENT

MEMORANDUM

REVISION NO. X

DRAFT

PREPARED FOR:

Northeast Ohio Regional Sewer District

NORTHEAST OHIO REGIONAL SEWER DISTRICT
REGIONAL STORMWATER MANAGEMENT PROGRAM

OCTOBER 2020

WADE TRIM

Figure 2: Ownership Map

2.1 INTERVIEWS AND RECORD DRAWINGS

Chagrin River Watershed Partners (CRWP) contacted Michael Smedley with the City of East Cleveland to conduct basin interviews and request any additional information available to define as-built, historical and current conditions. CRWP confirmed that this basin is owned by the City of East Cleveland and was installed in 1999. Plans for this basin were forwarded to the District 2016 and have also been provided to Wade Trim, where they are stored on the Project's Extranet Site.

2.2 SURVEY

A formal land survey was conducted by KS Associates between August and December of 2019, to obtain elevations of the basin's key components. The collected data has been uploaded to AGO in the "1483 – CHALET SWMP Survey and Crossings Map (KS)". **Figure 3** provides an overview of the basin's key

Unmanned Vehicles & Drones

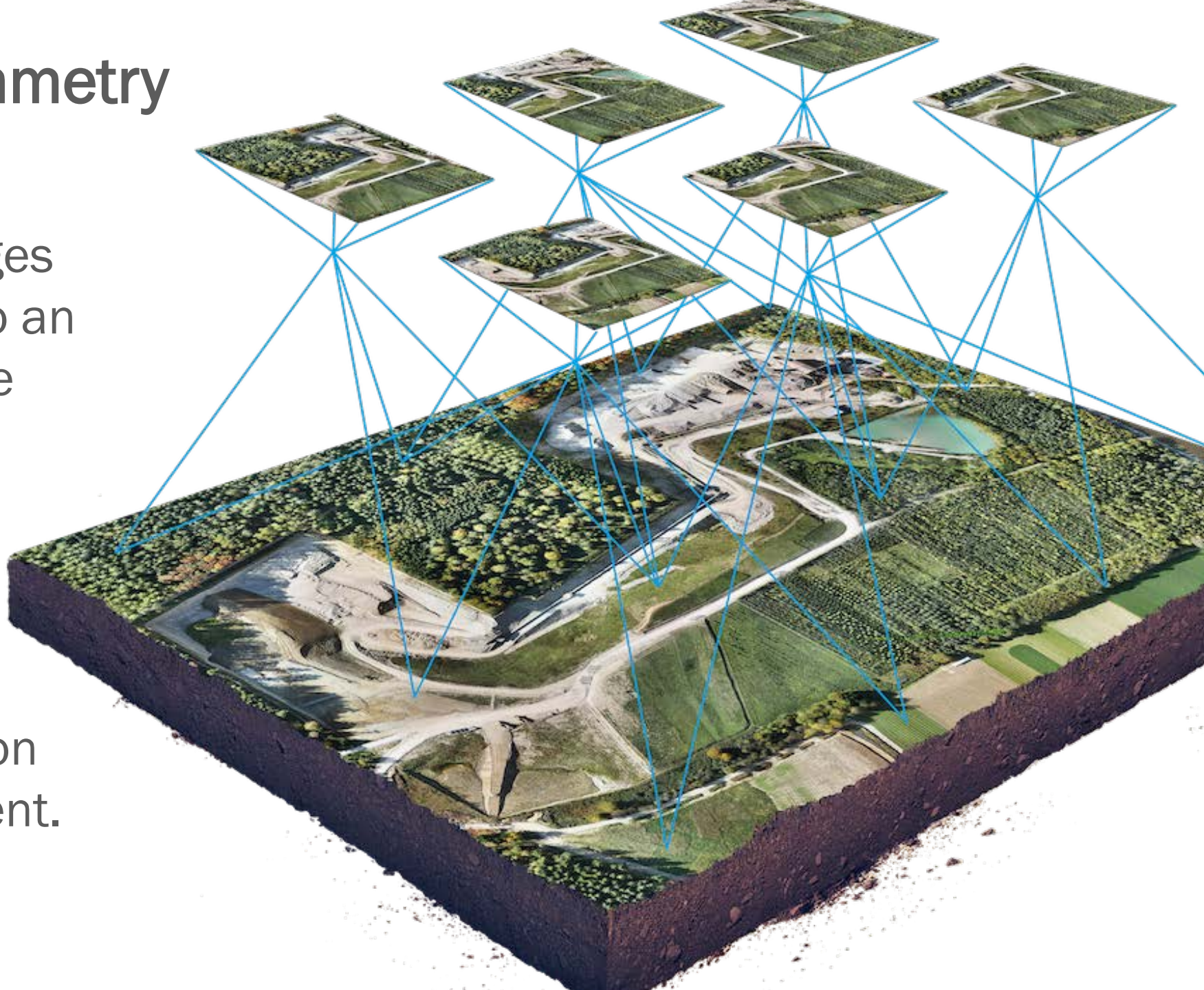
Drones and Unmanned Aerial Systems

Types: Aerial (UAV) and Nautical

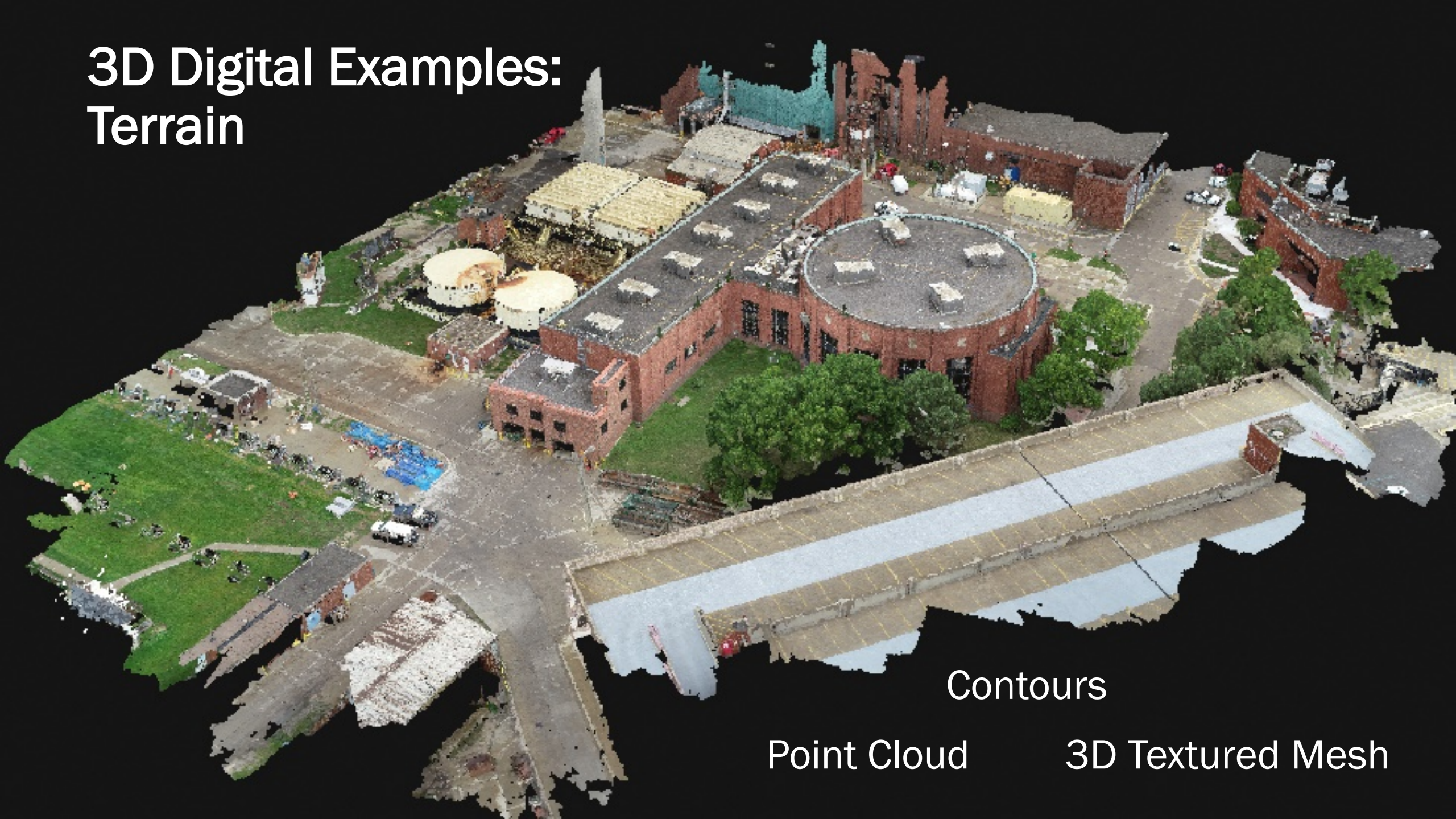
Uses: Inspection, design, mapping

Visual Photogrammetry

Typically uses a drone
to capture many images
stitched together into an
"Orthomosaic" image
correct in scale
and location.
This can be used
in BIM and GIS
mapping for
accurate depiction
and measurement.



3D Digital Examples: Terrain



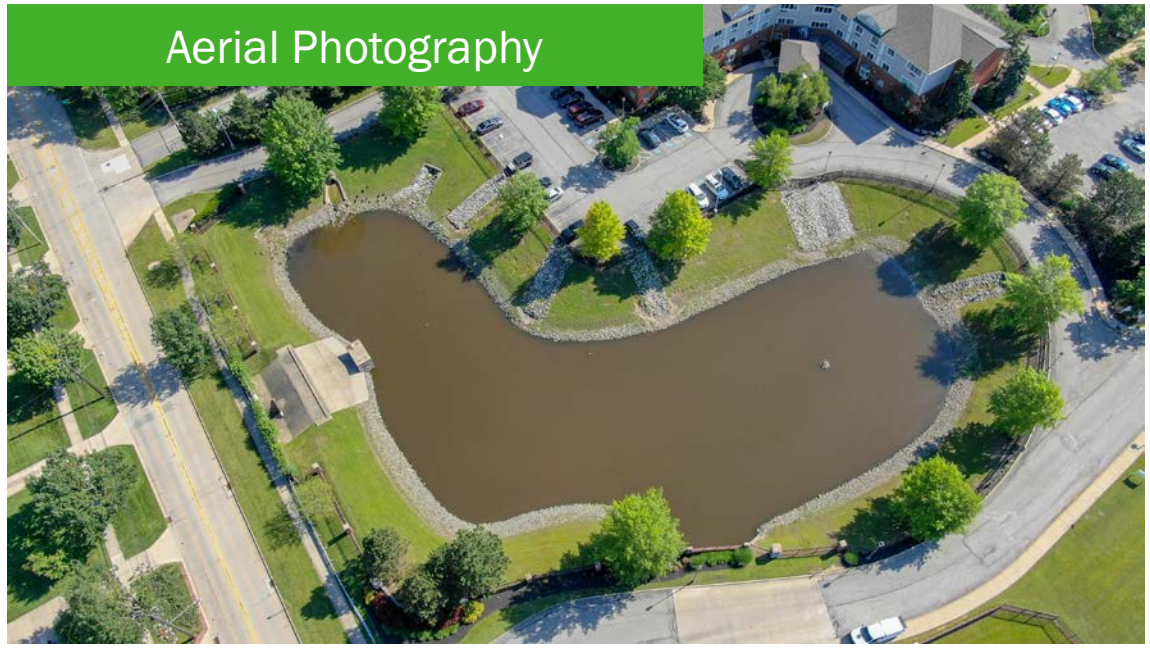
Aerial Drone Equipment

DJI Phantom 4 Pro RTK

Propeller Aeropoints

Basins – Drone Imagery

Aerial Photography



Aerial Photography

Orthomosaic

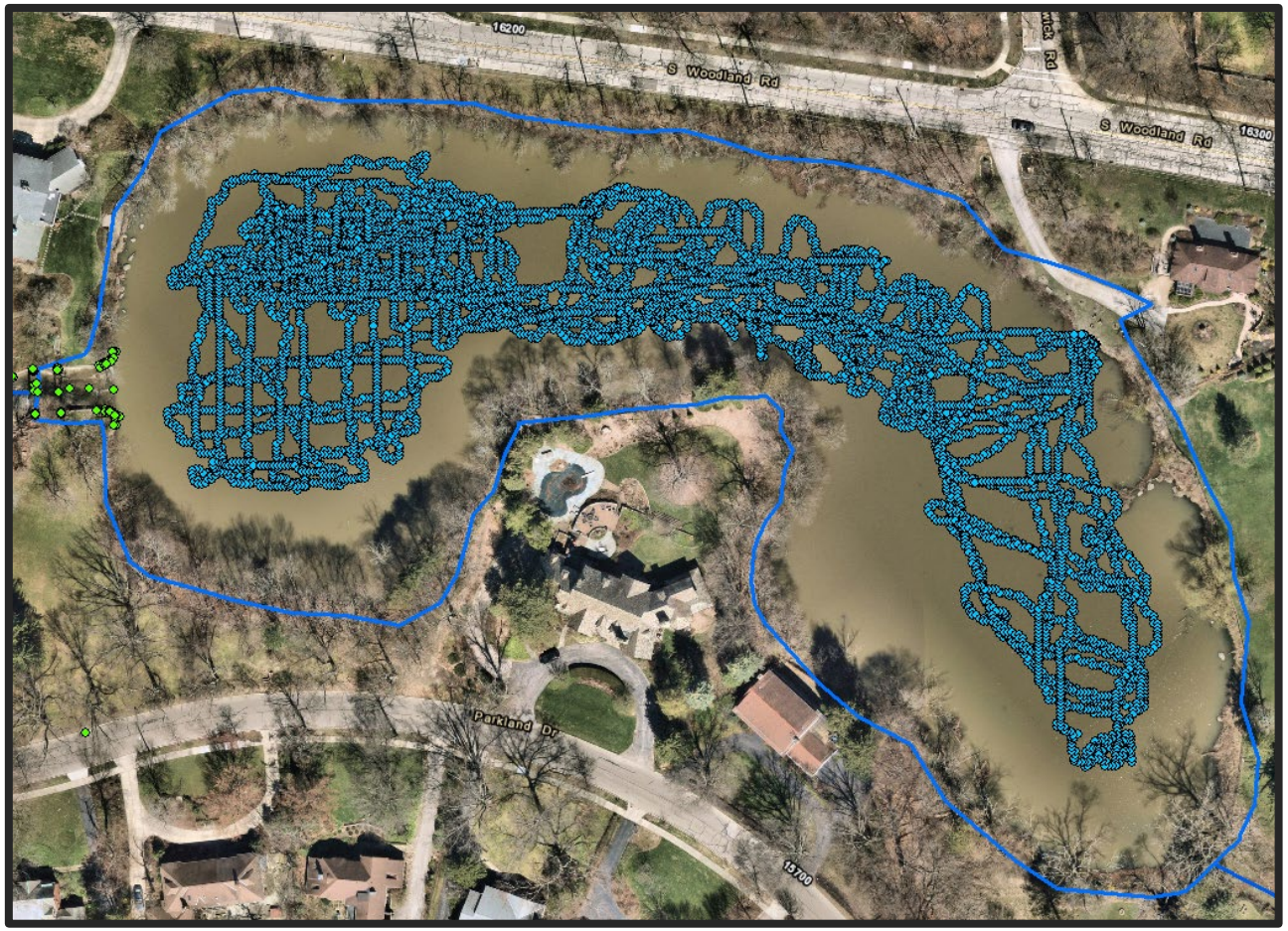
https://cloud.pix4d.com/pro/project/510968/map?shareToken=d1ad2fda-9810-4111-a856-12fbf7e999c1

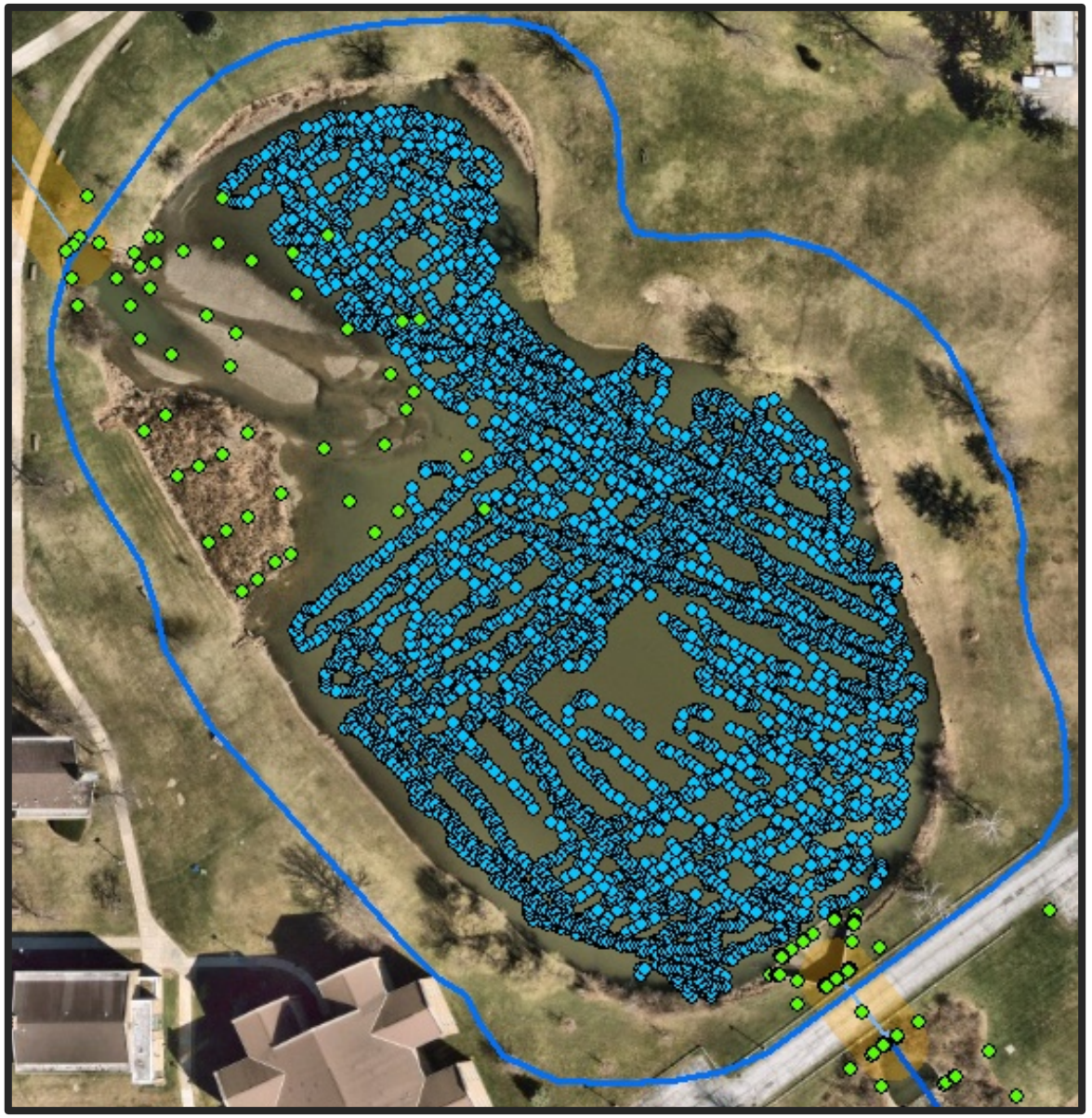
Nautical Drones

USV Harbor Scout

Basin Inspection with Nautical Drone

Bathymetry Data Collection





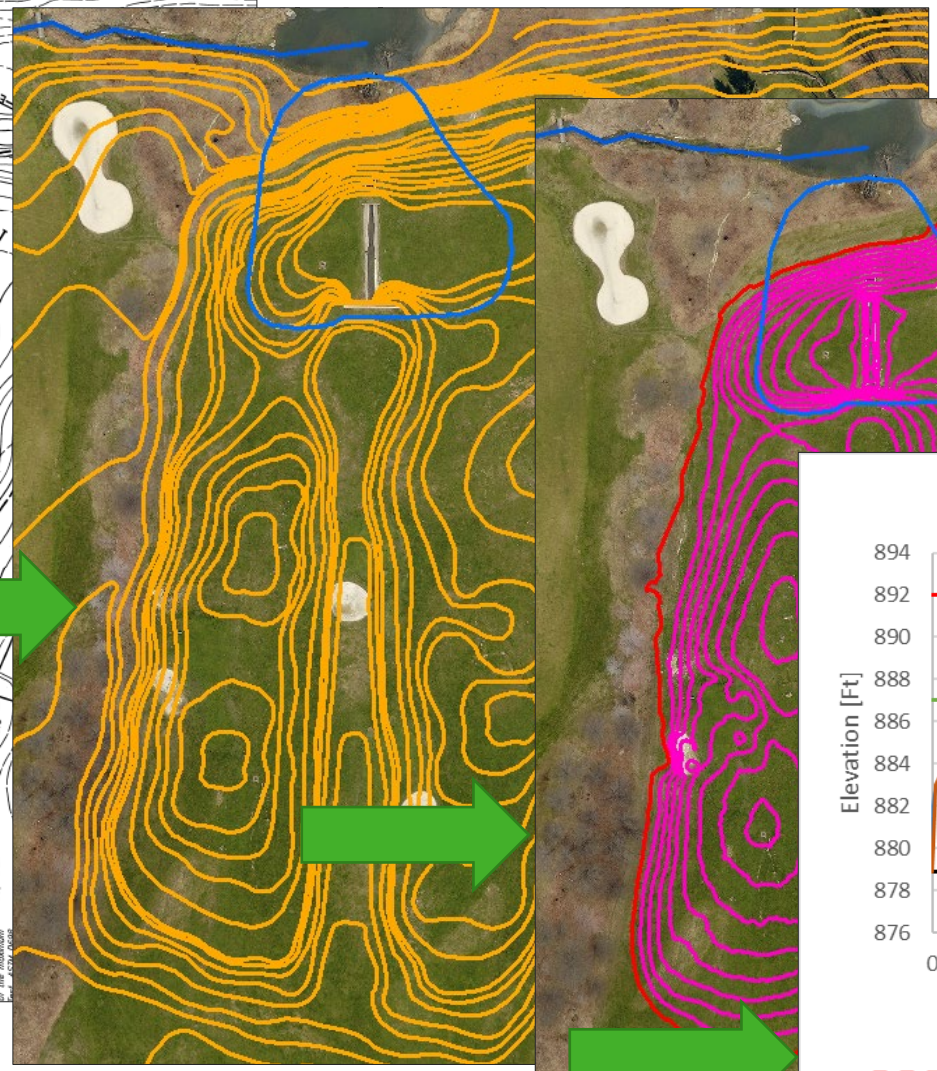
Bathymetry

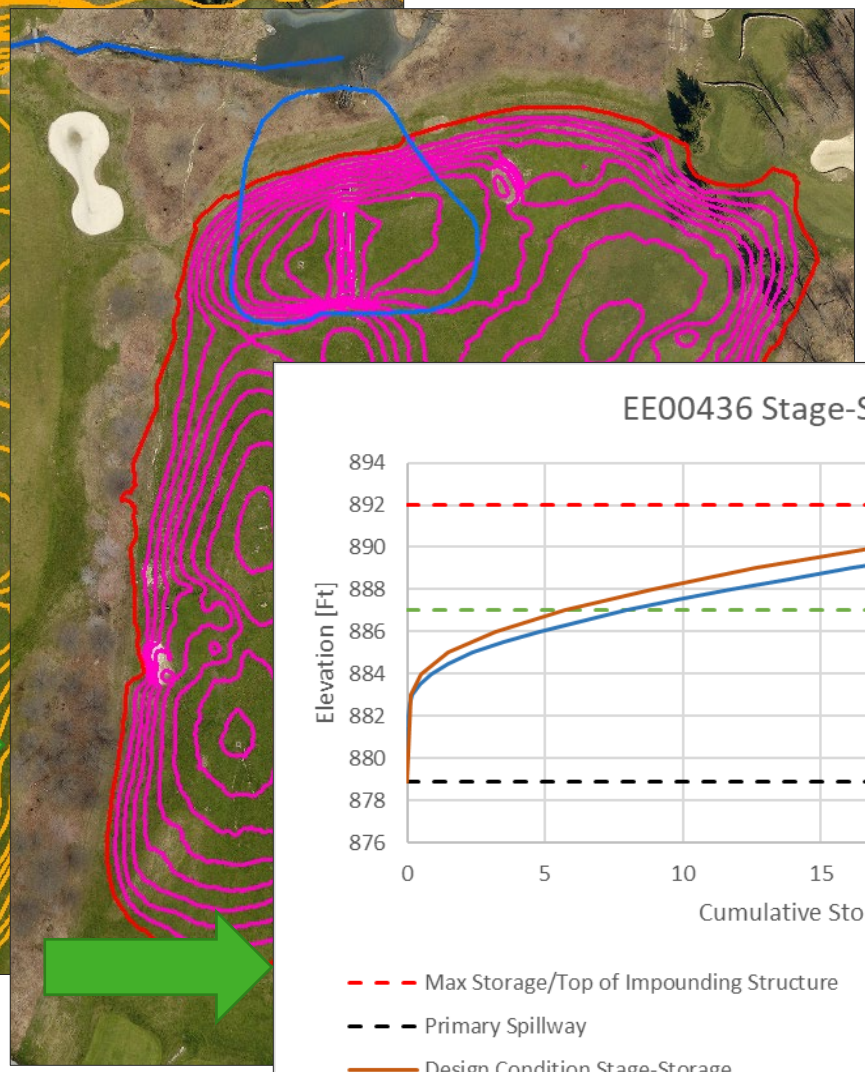
Depth in feet 8.0

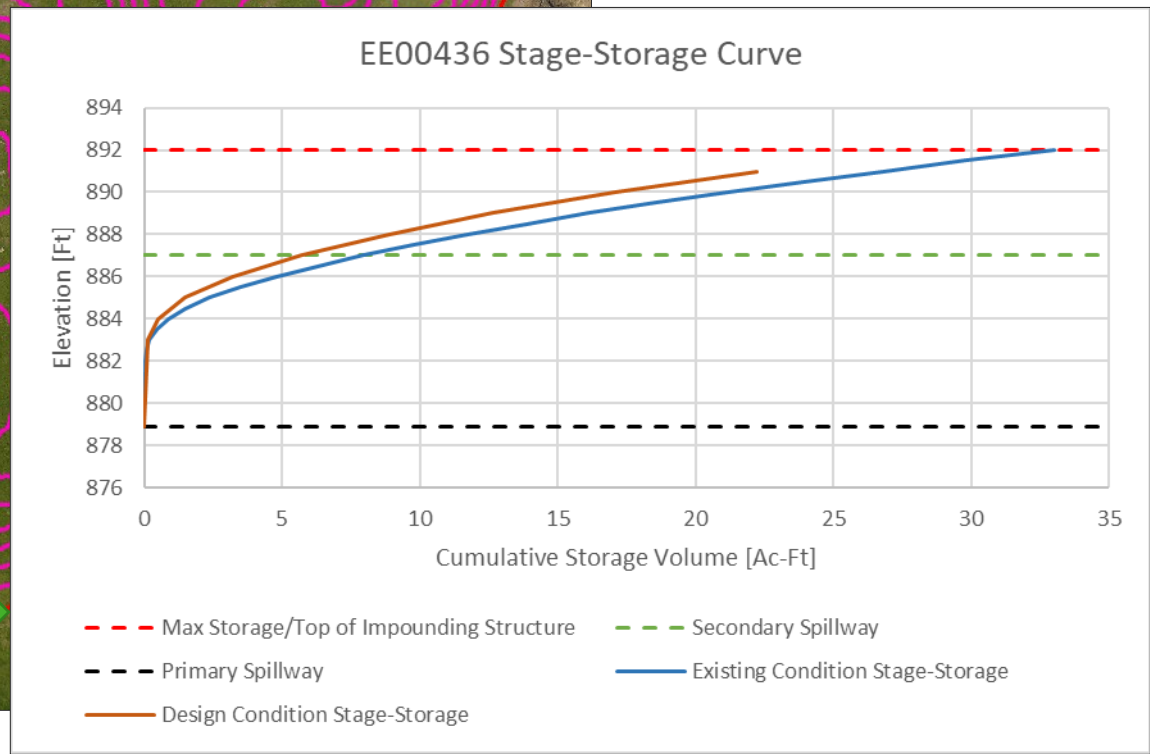
Bathymetry & Aerial Data Delivery

- Bathymetry – .csv File
  - Comma (or character) separated value
- Aerial – LAS converted to Raster file format
  - Examples of Raster file formats can include JPEG and TIFF
- Lots of data generated
  - Consider “cloud” storage
  - Example: www.Pix4d.com

Basin Performance “Time History”



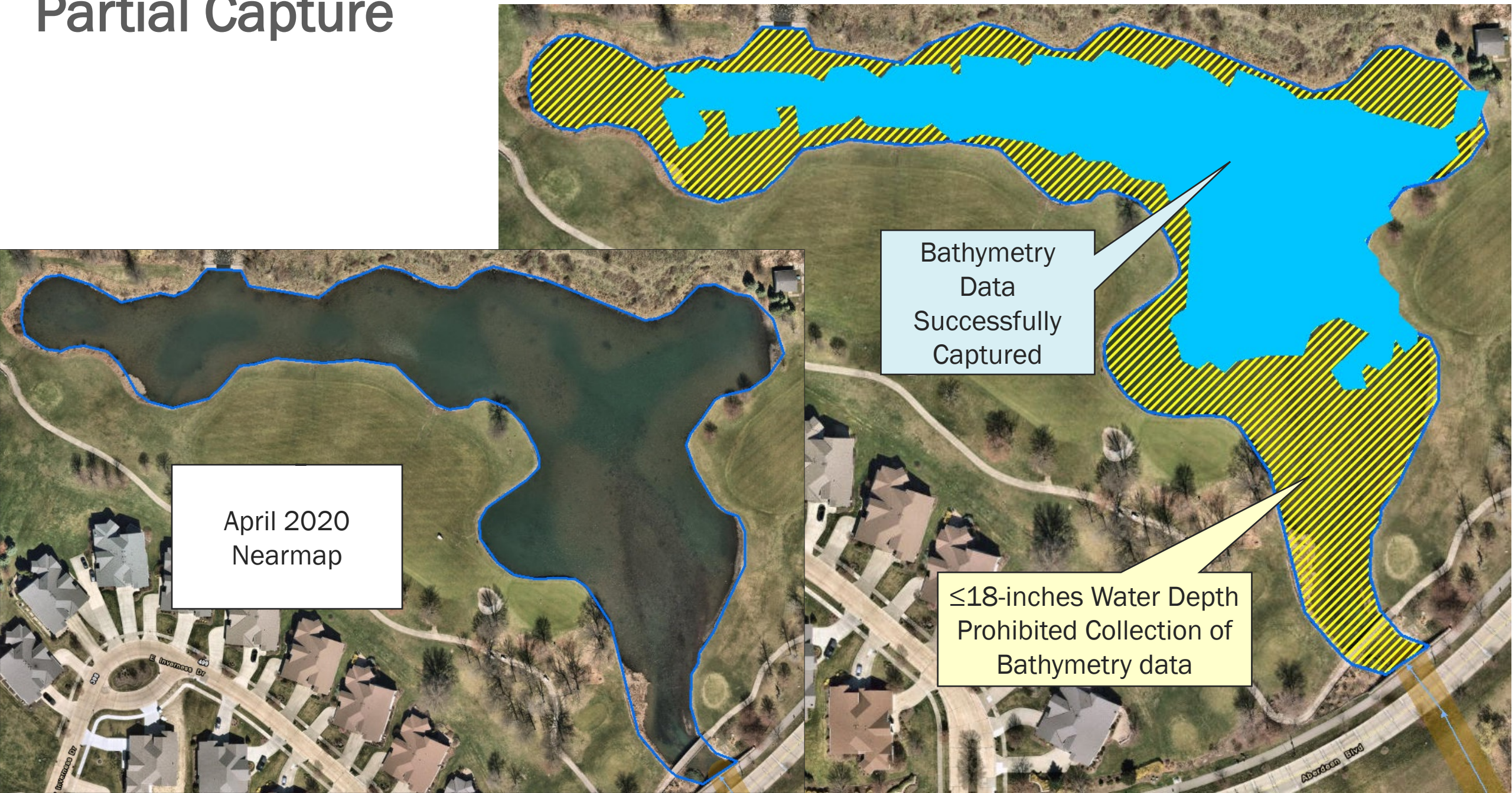


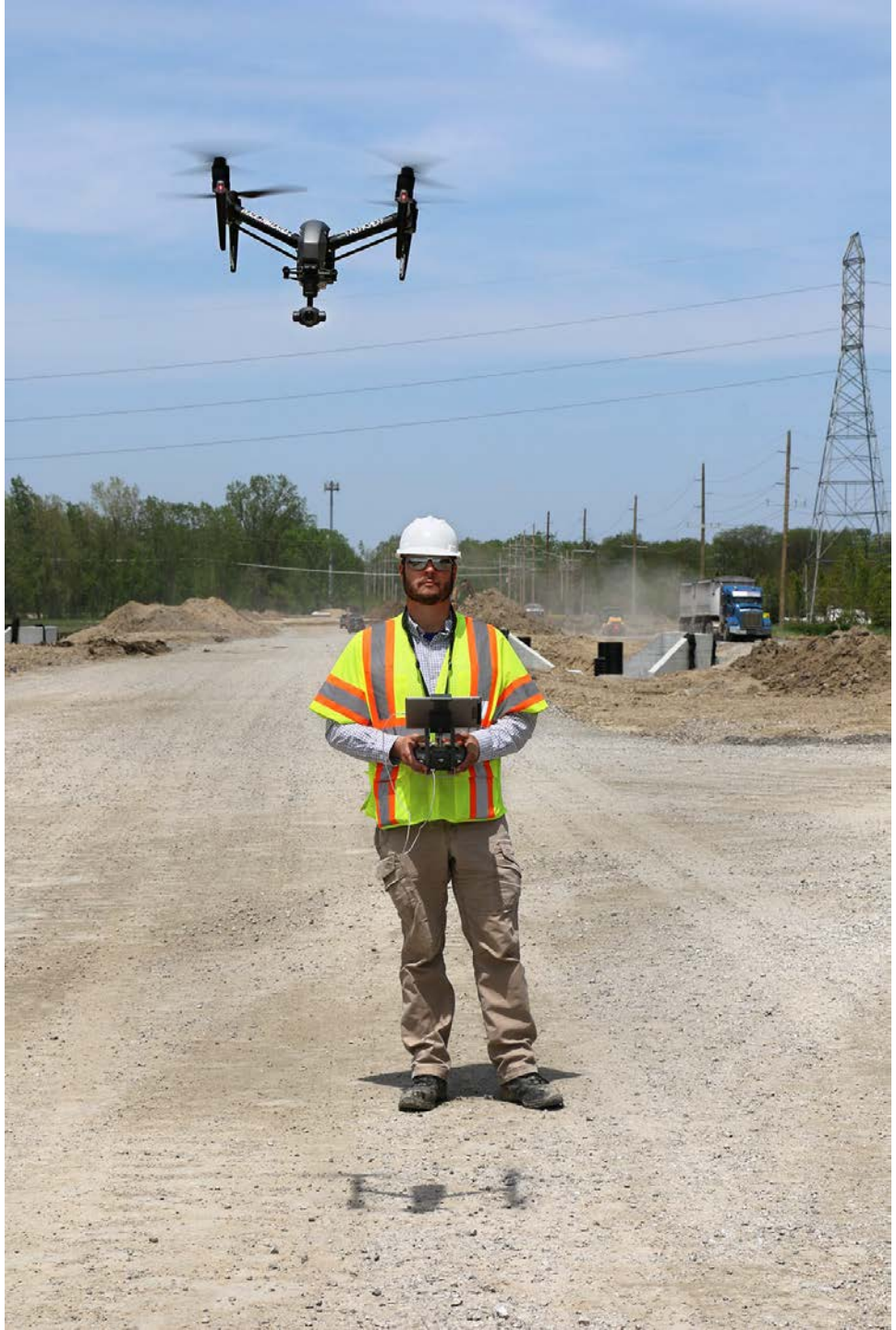


Comments & Observations

- Good planning improves results
  - Applies to all aspects – acquiring, managing/storing, and using the data
- Fieldwork requires planning and flexibility
  - Weather
  - Access
- Data can have limitations
  - Drone boat draft for example
- Staff will need some tutoring on the lingo
- Proper curating of the information will foster current and future use

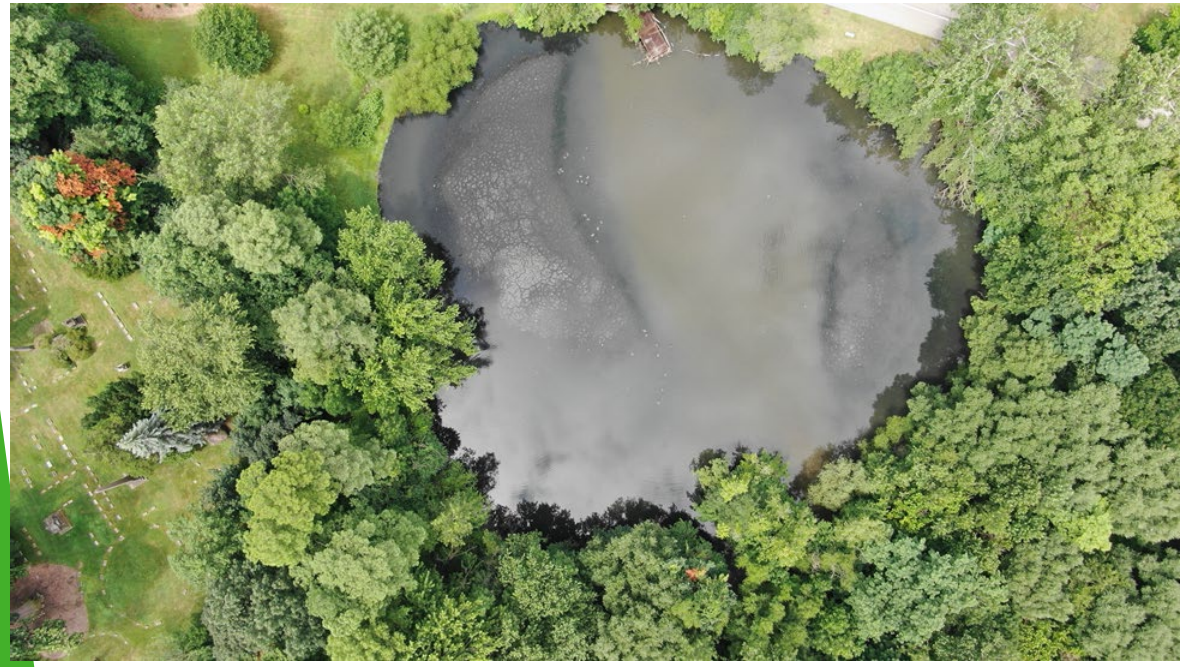
Partial Capture





Thank you!

Alan Stadler, PhD, PE, Senior Project Manager
astadler@wadetrim.com
216.363.0300 office
216.317.6662 cell



Comments

- The CHALET project area includes 18 wet basins
  - Successfully captured bathymetry data for 6 basins
  - Partially captured bathymetry data for 7 basins
  - Unsuccessfully captured bathymetry data for 5 basins
    - Sediment depth at or near water surface

  - Need at least 18-inches of water depth to successfully capture bathymetry data with current vessel