

Aerial and Bathymetric Drones Aid Detention Basin Inspections

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Acknowledgements

Mike Blair, Project Manager



NORTHEAST OHIO REGIONAL SEWER DISTRICT



Jason Yoscovits, Drone Pilot
Allison Tierney, Professional Engineer



Agenda

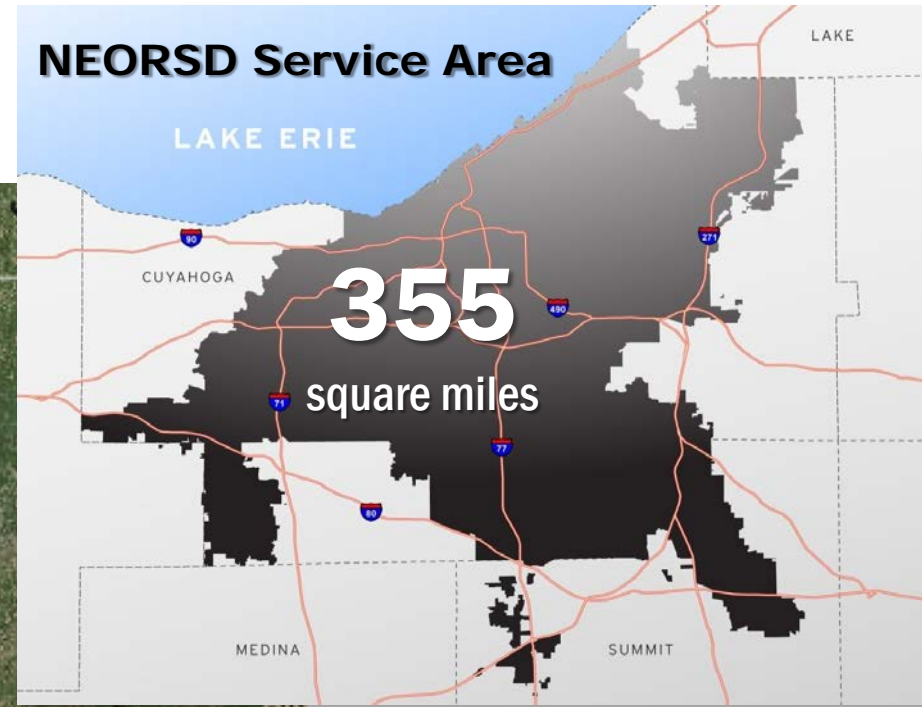
- Introduction
- Project Overview
- Drone Data Acquisition
- Drone Data Use
- Comments & Observations
- Conclusions



Introduction

The image features a decorative graphic on the left side. It consists of a large green trapezoidal shape at the top, which transitions into a dark grey trapezoidal shape below it. The right edge of both shapes is slanted. Three thin green lines are scattered around the graphic: one at the top right, one at the bottom left, and one in the middle left.

Northeast Ohio Regional Sewer District



NORTHEAST OHIO REGIONAL SEWER DISTRICT

REGIONAL
STORMWATER
MANAGEMENT
PROGRAM

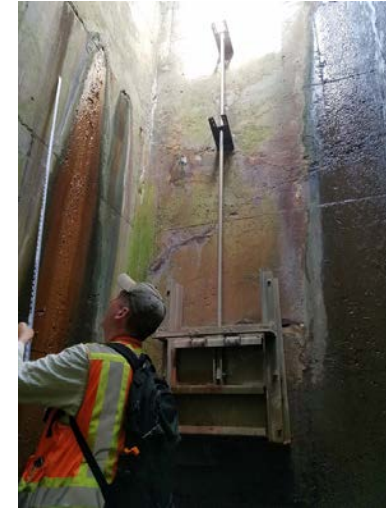
PROJECT CLEAN LAKE
25-year Combined Sewer Overflow
control program

Serves:
62 municipalities
>1M residents
Maintains & Operates:
Interceptor Sewers
3 WWTPs

NORTHEAST OHIO REGIONAL SEWER DISTRICT

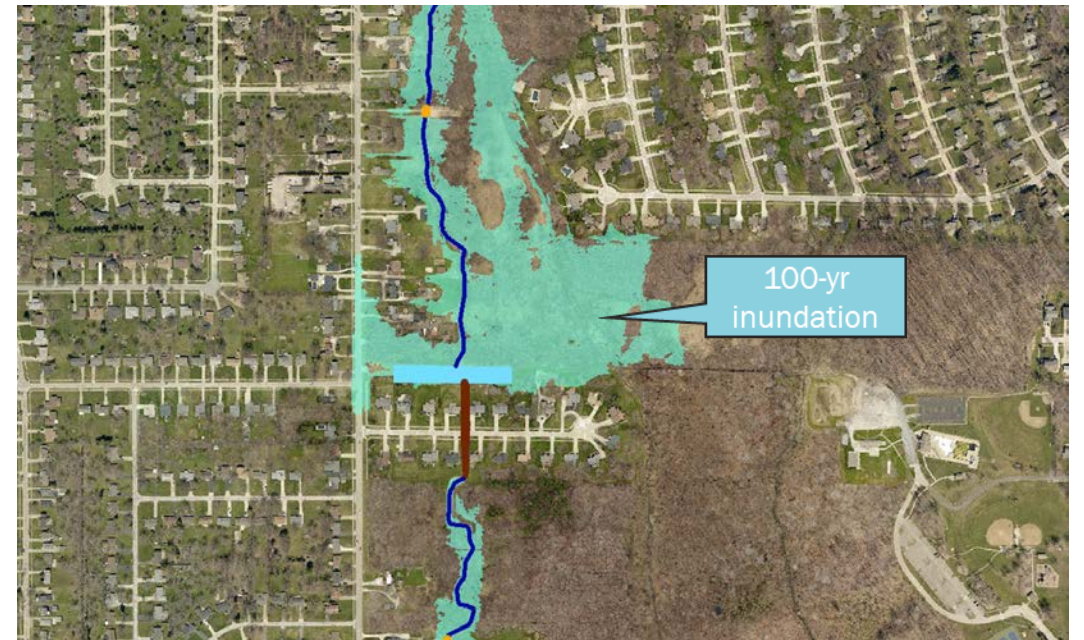


REGIONAL
STORMWATER
MANAGEMENT
PROGRAM

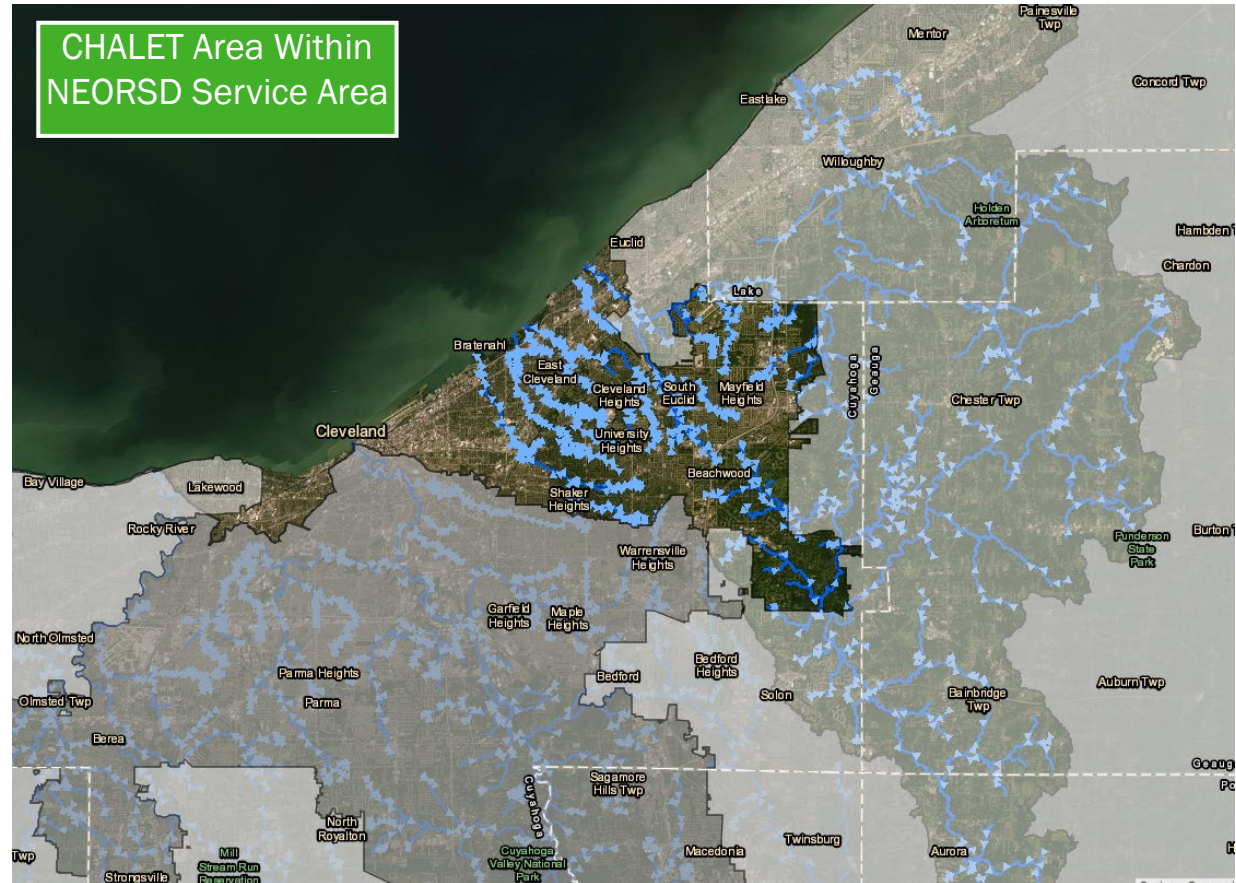
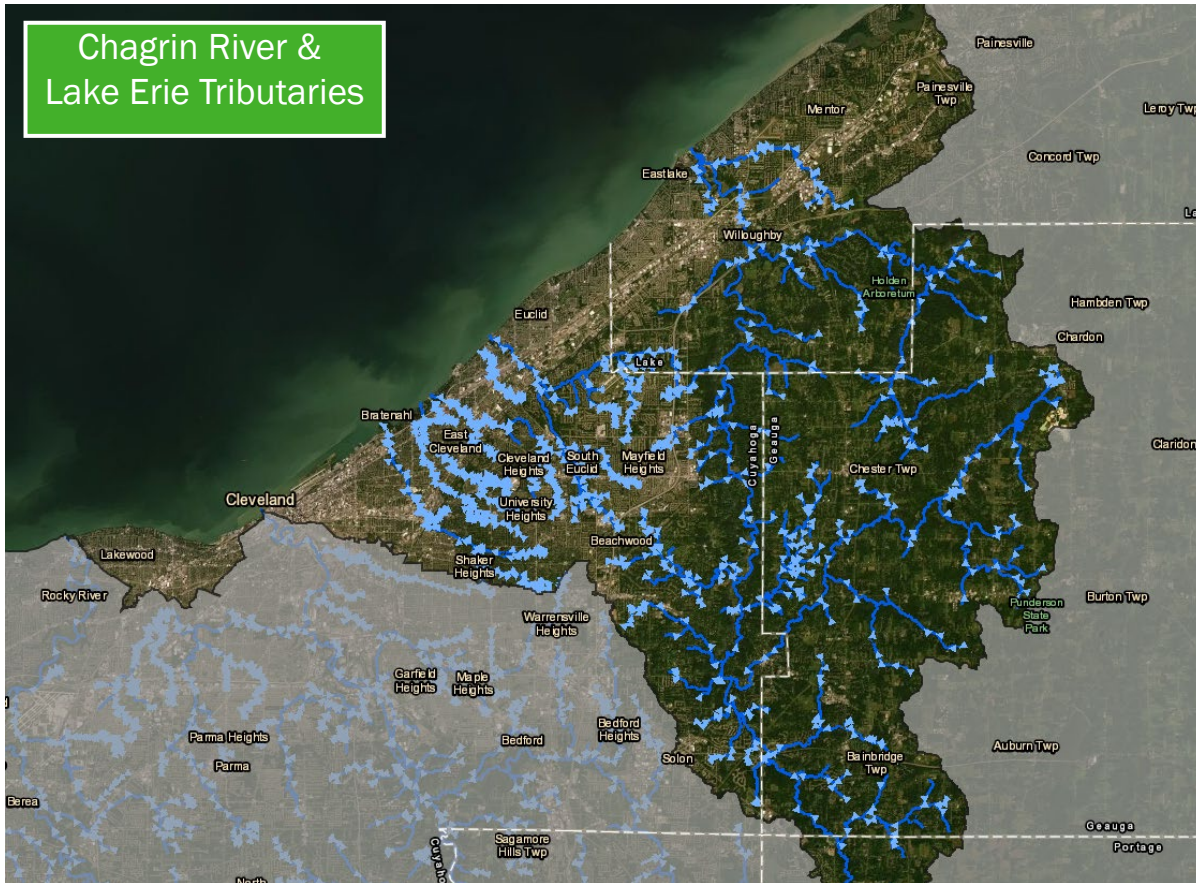


- Stormwater Master Planning Effort

- 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

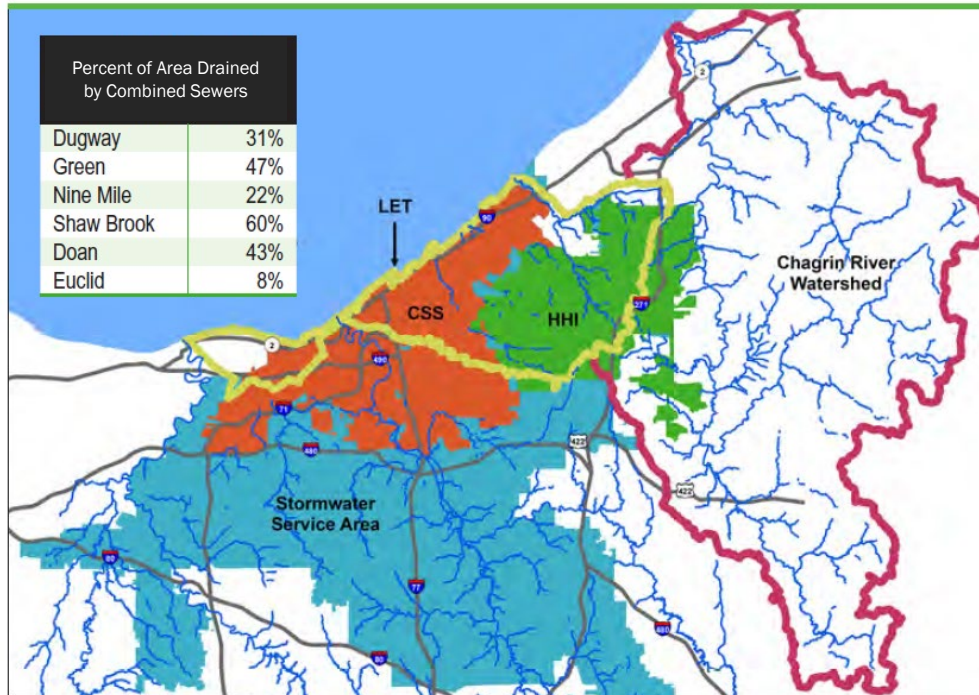


CHALET Stormwater Master Plan



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

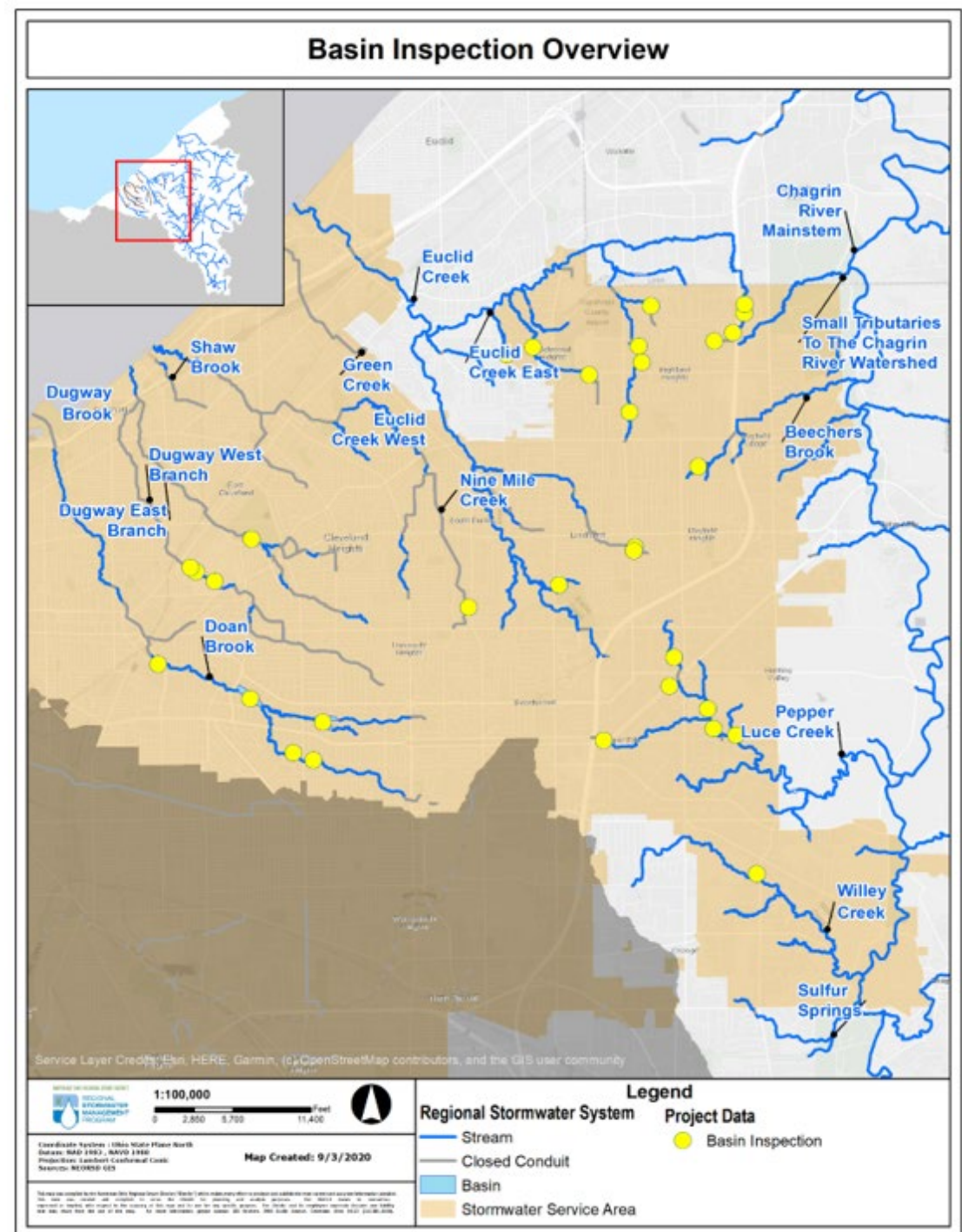
- HWM data collection
- USGS stream gage data collection
- Recommendations on additional monitoring required

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 - NEORS

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	<input type="checkbox"/>
5. Secondary Inlet Type		6. Secondary Inlet Condition	
7. Inlet Scour Condition	<input type="checkbox"/>	8. Forebay Condition	

BASIN INTERIOR (Section 1.2)

9. Interior Slope Gen Erosion / Stability Condition	<input type="checkbox"/>	10. Rodent Activity	<input type="checkbox"/>
11. Interior Basin Floor Vegetation Condition			

IMPOUNDING STRUCTURE (DAM) (Section 1.3)

12. Material Type:			
Upstream Face			
13. Interior Slope Seepage Condition	<input type="checkbox"/>	14. Gen Erosion / Stability Condition	<input type="checkbox"/>
15. Rodent Activity	<input type="checkbox"/>	16. Vegetation Condition (Earthen)	<input type="checkbox"/>
17. Joint / Alignment Condition (Concrete/Masonry)	<input type="checkbox"/>		

Downstream Face

18. Interior Slope Seepage Condition	<input type="checkbox"/>	19. Gen Erosion / Stability Condition	<input type="checkbox"/>
20. Rodent Activity	<input type="checkbox"/>	21. Vegetation Condition (Earthen)	<input type="checkbox"/>
22. Joint / Alignment Condition (Concrete/Masonry)	<input type="checkbox"/>		

Crest

23. Gen Erosion Condition (Earthen)	<input type="checkbox"/>	24. Rodent Activity	<input type="checkbox"/>
25. Vegetation Condition (Earthen)	<input type="checkbox"/>	26. Joint / Alignment Condition (Concrete/Masonry)	<input type="checkbox"/>

OUTLET WORKS (Section 1.4)

Primary Outlet Condition	<input type="checkbox"/>	28. Primary Outlet Stilling Basin Condition	<input type="checkbox"/>
Primary Outlet Trash Rack Condition	<input type="checkbox"/>	30. Primary Outlet Scour Condition	<input type="checkbox"/>
Secondary Outlet Condition	<input type="checkbox"/>	32. Secondary Outlet Stilling Basin Condition	<input type="checkbox"/>
Secondary Outlet Trash Rack Condition	<input type="checkbox"/>	34. Secondary Outlet Scour Condition	<input type="checkbox"/>
Lake Drain Condition		36. Emergency Spillway Rodent Activity (Earthen)	<input type="checkbox"/>
Emergency Spillway Vegetation Cond. (Earthen)	<input type="checkbox"/>	38. Emergency Spillway Gen Condition (Concrete)	<input type="checkbox"/>
Emergency Spillway Gen Condition (Earthen)	<input type="checkbox"/>		

MISCELLANEOUS (Section 1.5)

Fencing / Gates		41. Aesthetics	
Sediment Condition		43. Debris Condition	

COMMENTS

INSPECTED BY: _____ DATE: _____

REVIEWED BY: _____ DATE: _____

Basin Inspection

Populate Survey123 forms on iPad

12:07 AM Fri Mar 19

CHALET Basin Inlet Inspection Form V2

INSPECTION METADATA

Inspection Date: *
Thursday, April 4, 2019

Inspection Company: *
Wade Trim

Inspector Initials: *
AT, IN

Weather: *
Sunny Cloudy Rain Snow

GENERAL INFORMATION

RSS Asset?
 Yes
 No

Basin Asset ID:
PC00223

Inlet Asset ID:
PC00223-LI001
Use RSS asset ID if RSS asset. If local, suggest initial value of [BASINID-]+*LI*+*00x* where LI is Local Inlet and x is the sequence of local inlets.

Inlet Type:
 Stream inlet (natural or channelized)
 Pipe inlet

Inlet Priority:
1 = primary, 2 = secondary, etc
2

1:20 AM Fri Mar 19


CHALET Basin Inspection Form V2

0

Impounding Structure Length (ft): *
0

Impounding Structure Description: *
in dam with a combination of grass, shrubs and tree growing on the crest and u/s and d/s slopes.


Photo of Impounding Structure (from US): *



is_img_us-a88b8852caf1417da6577814f8604fbc.jpg

Impounding Structure US Photo Description/Notes:
right side of the outlet drop structure looking d/s at the u/s face time f the impounding structure.

Photo of Impounding Structure (from DS): *



is_img_ds-ec77acf7d3094cd38028e101de39b491.jpg

12:09 AM Fri Mar 19

CHALET Basin Outlet Form V2

INSPECTION METADATA

Inspection Date: *
Thursday, April 4, 2019

Inspection Company: *
Wade Trim

Inspector Initials: *
ANT, IN, SM

Weather: *
Sunny Cloudy Rain Snow

ASSET INFORMATION

RSS Asset?
 Yes
 No

Basin Asset ID:
PC00133

Outlet Asset ID:
PC00133_OUT
Use RSS asset ID if RSS asset. If local, suggest initial value of [BASINID-]+*LO*+*00x* where LO is Local Outlet and x is the sequence of local outlets.

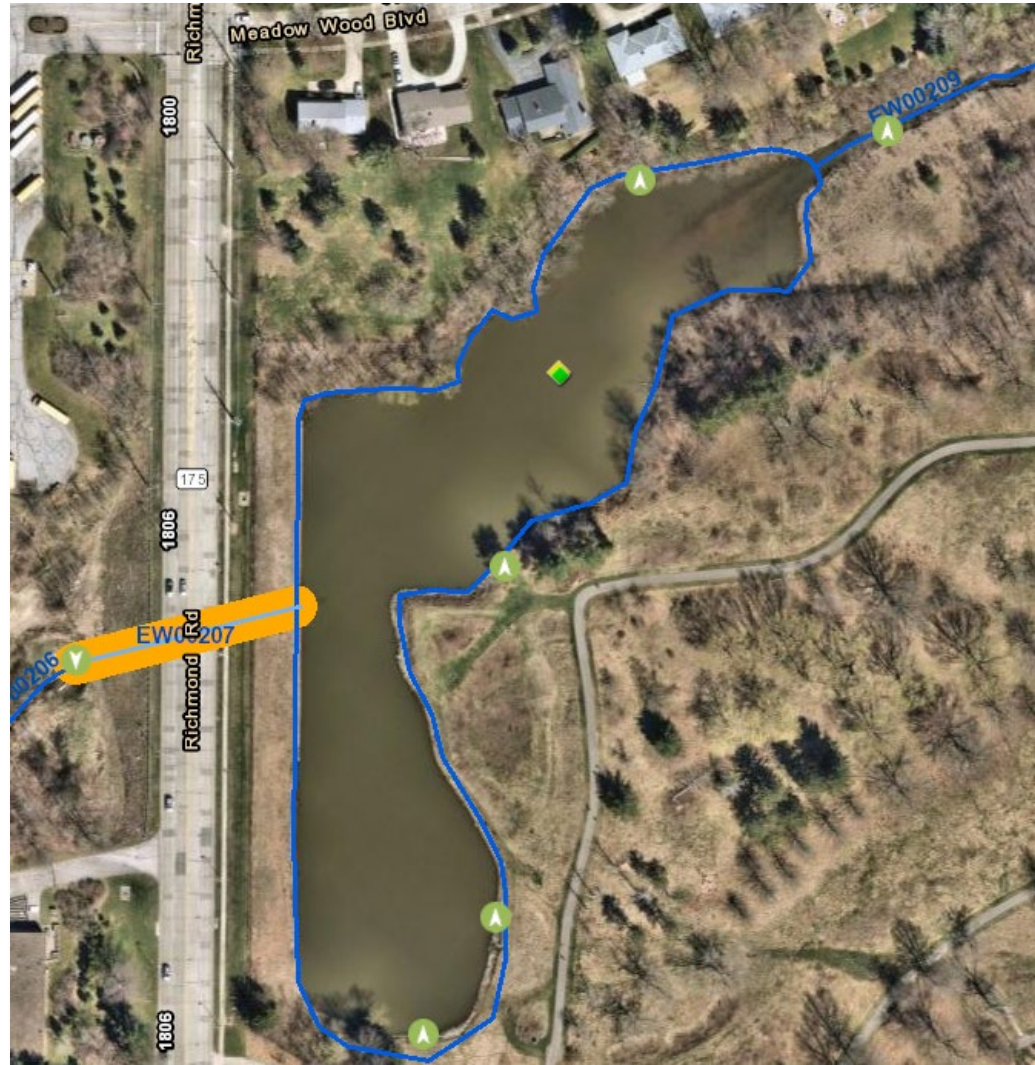
OUTLET

Outlet Type: *
Weir

Outlet Shape (Weir): *
Rectangular

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 Report Figures\Figures')
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, 'page'+str(pNum)+'Name')
                layout.exportToJPEG(srcDir+'\\'+lName+'_'+msName, resolution = 300, jpeg_quality = 90)
        else:
            layout.exportToJPEG(srcDir+'\\'+lName, resolution = 300, jpeg_quality = 90)

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



OCTOBER 2020



1483 CHALET SWMP

DRAFT

October 2020

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

The slide features a large green trapezoidal shape on the left side, which tapers to the right. Below this green shape is a dark grey trapezoidal shape, also tapering to the right. Three thin green lines are scattered across the slide: one starts at the top edge of the green shape and extends upwards and to the right; another starts at the top edge of the green shape and extends upwards and to the right, slightly further to the right than the first; and a third starts at the bottom edge of the dark grey shape and extends downwards and to the left.

Drones and Unmanned Aerial Systems

Types: Aerial (UAV) and Nautical

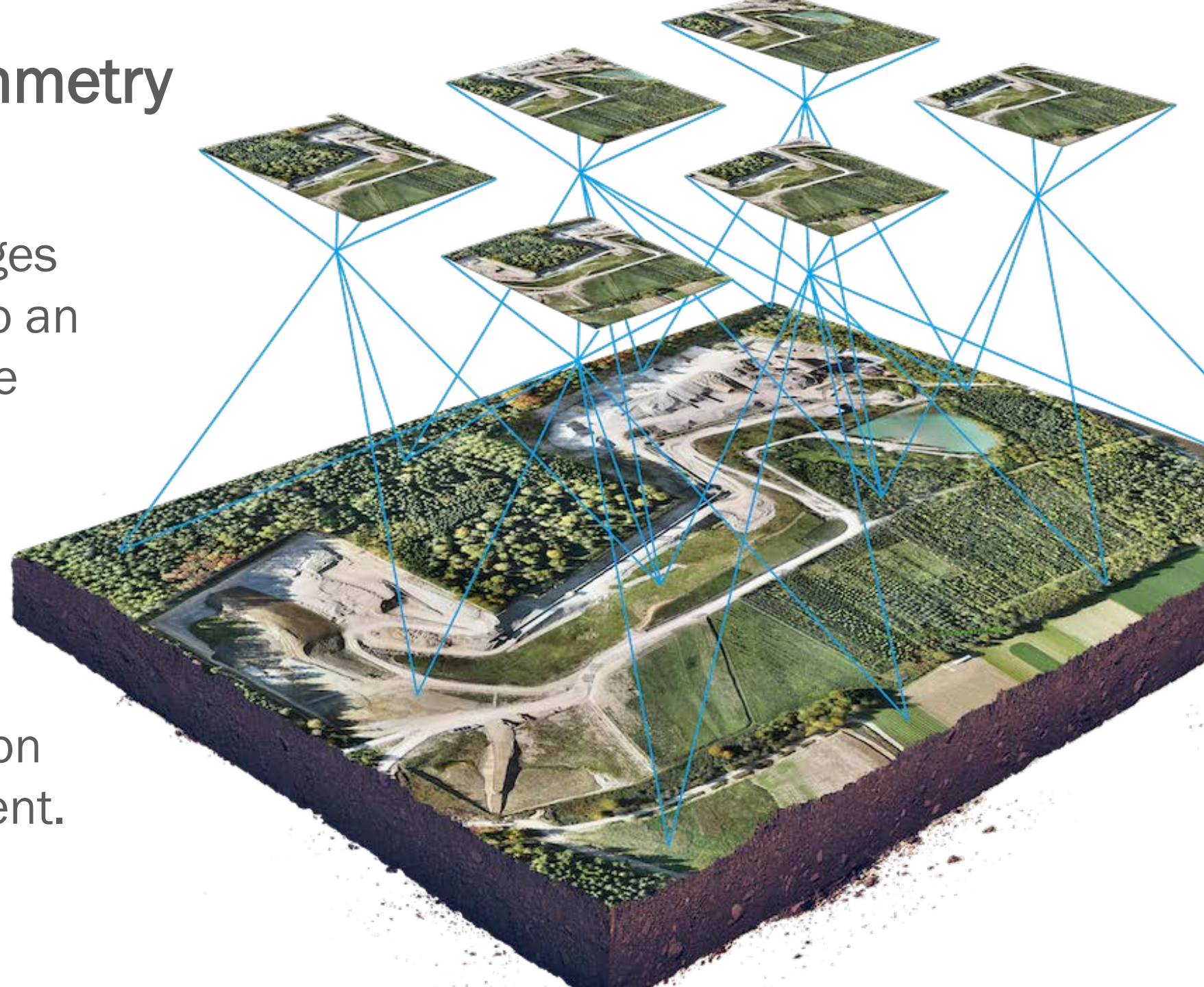
Uses: Inspection, design, mapping



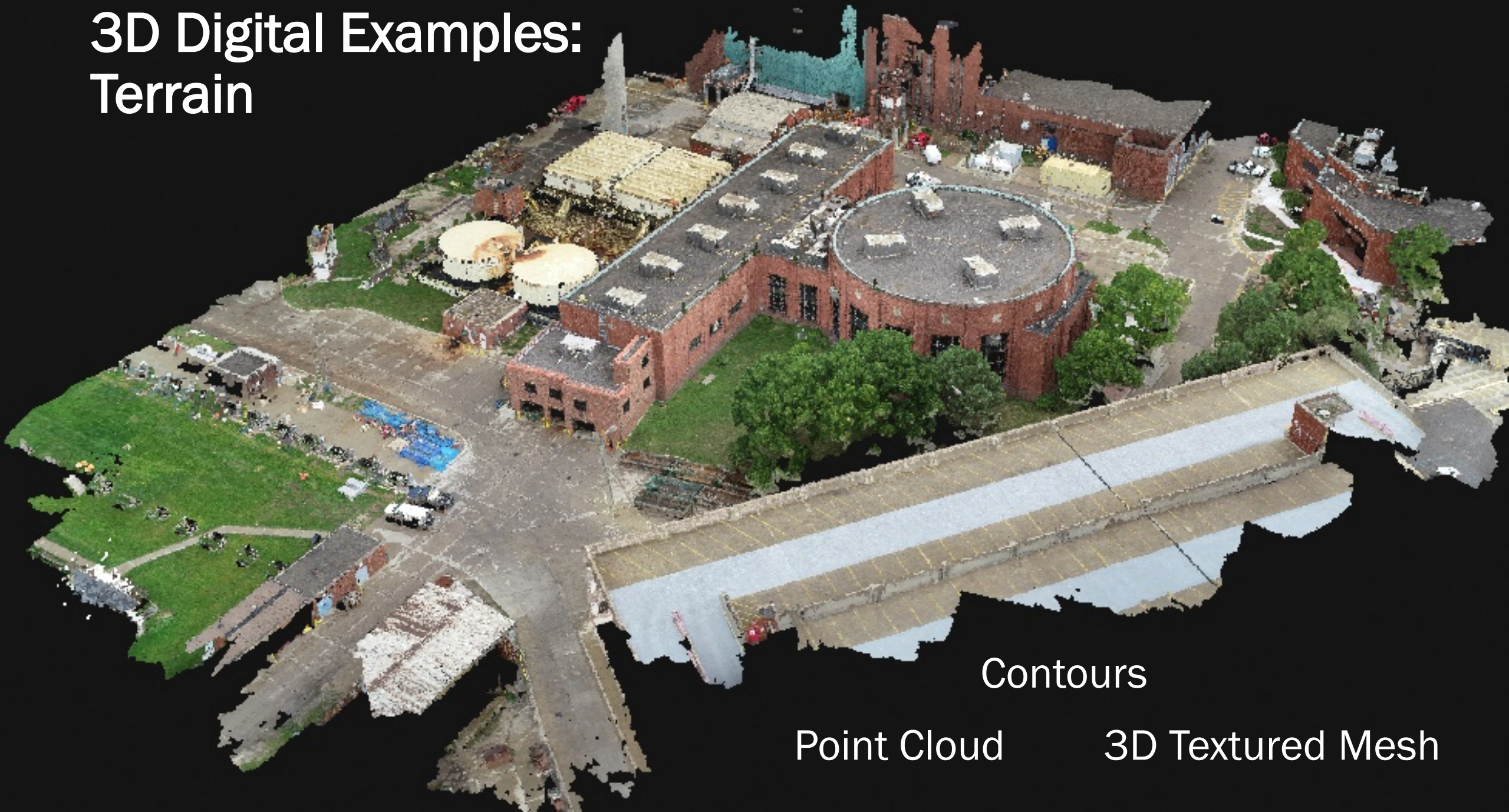
Visual Photogrammetry

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



Contours

Point Cloud

3D Textured Mesh

Aerial Drone Equipment



DJI Phantom 4 Pro RTK

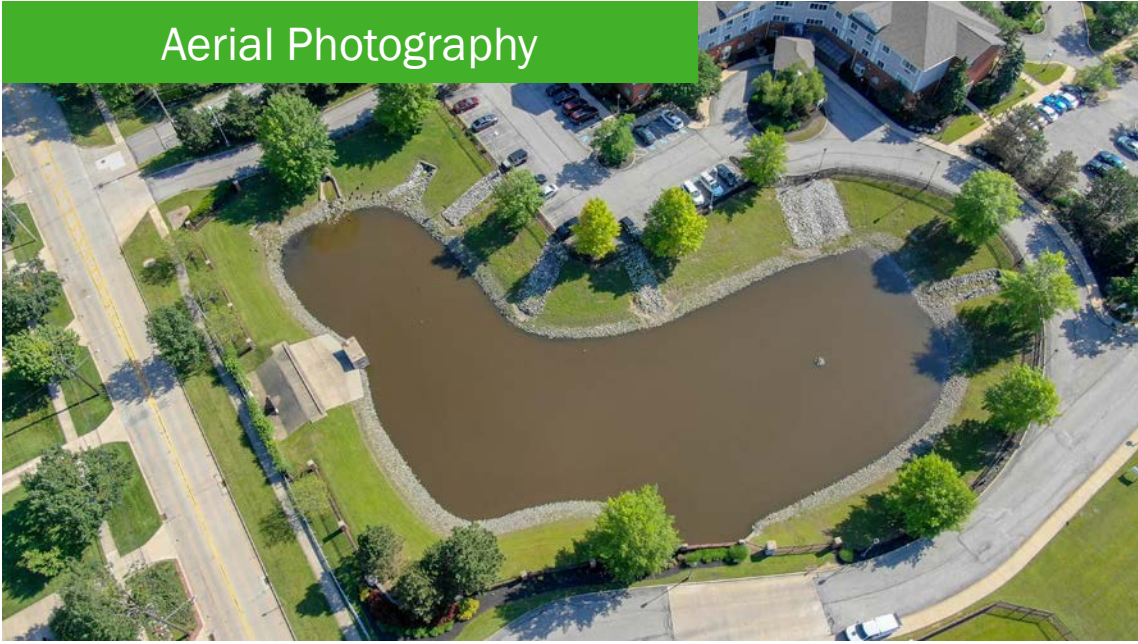


Propeller Aeropoints



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

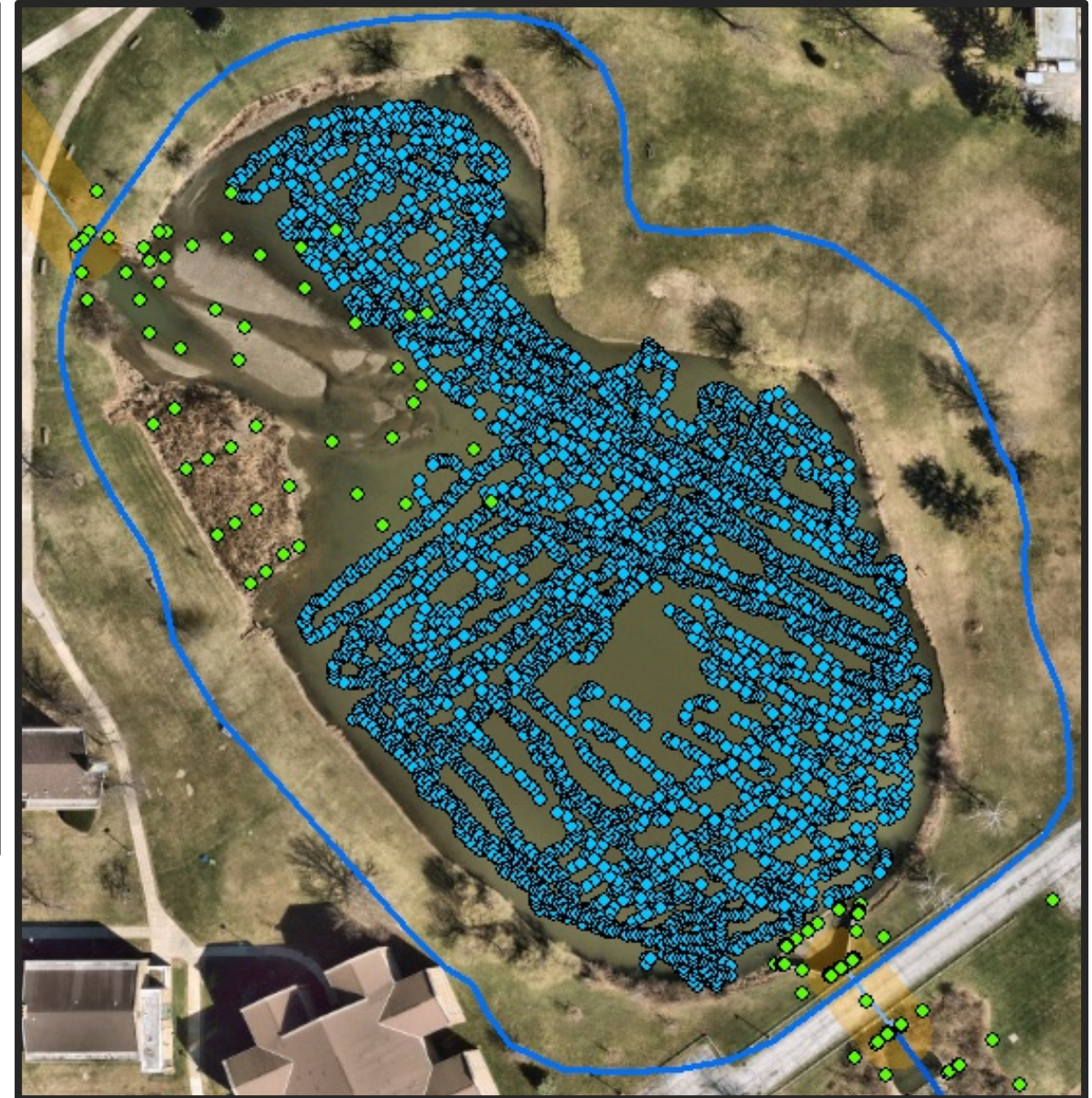
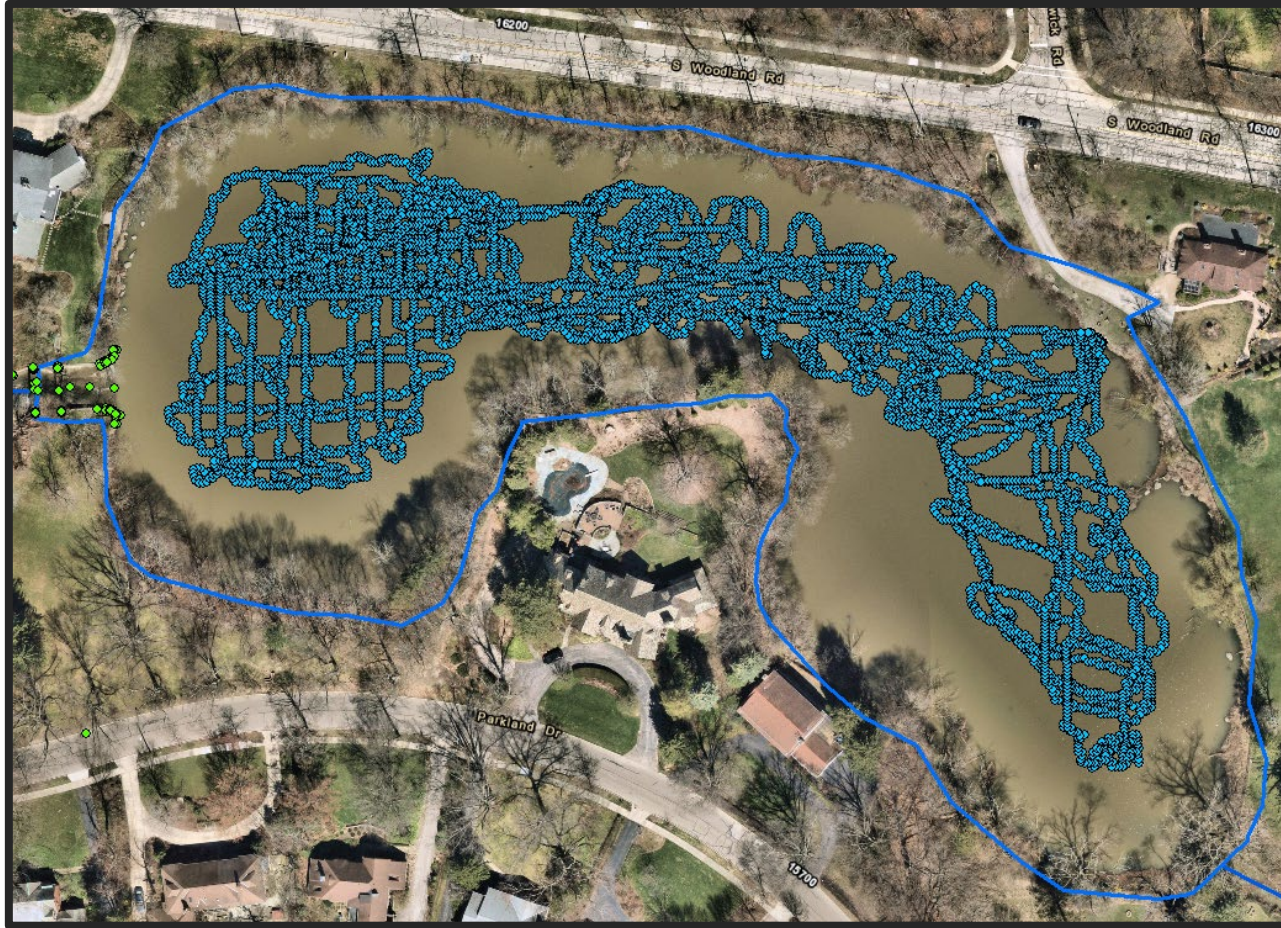


Basin Inspection with Nautical Drone

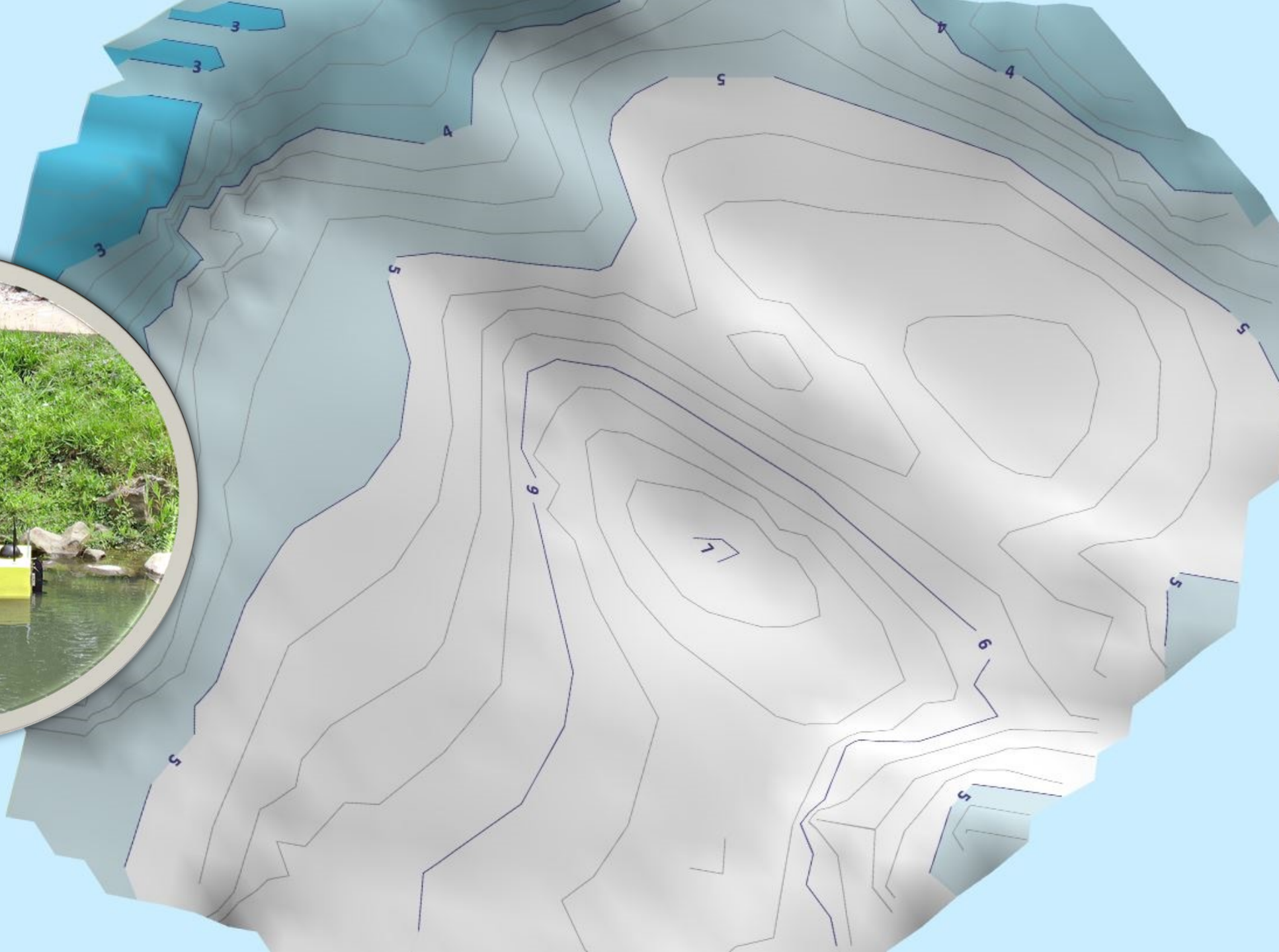




Bathymetry Data Collection



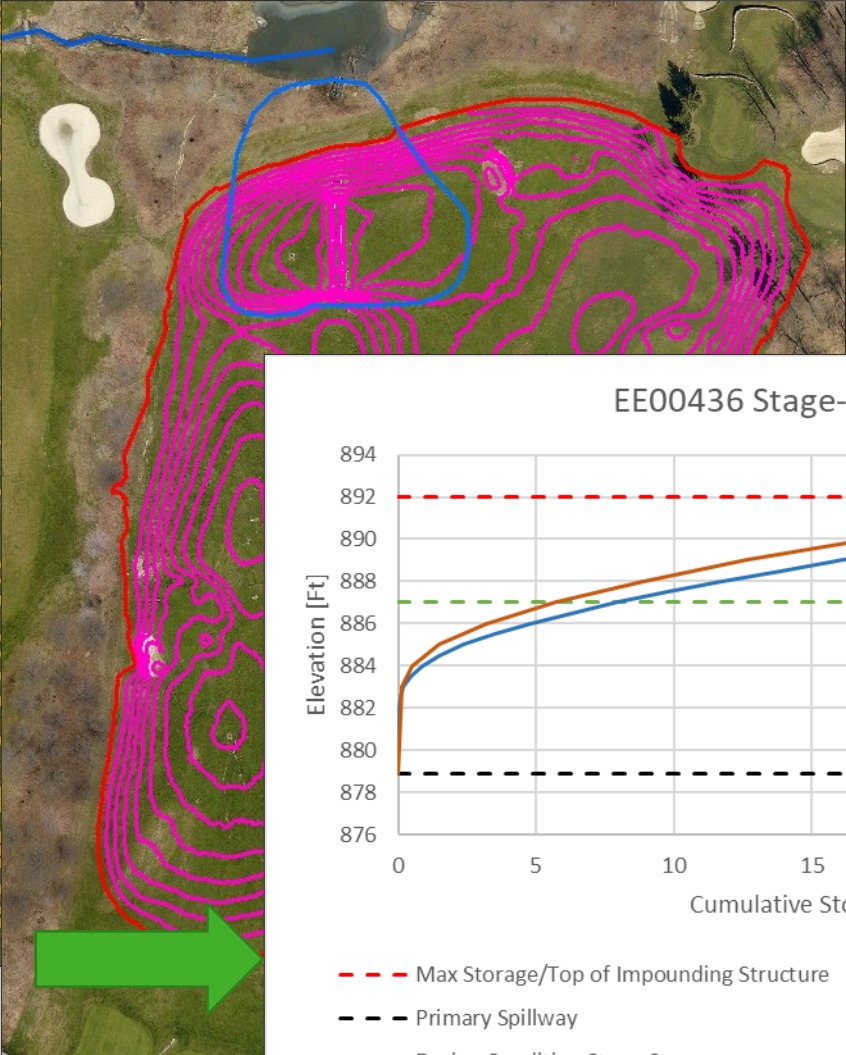
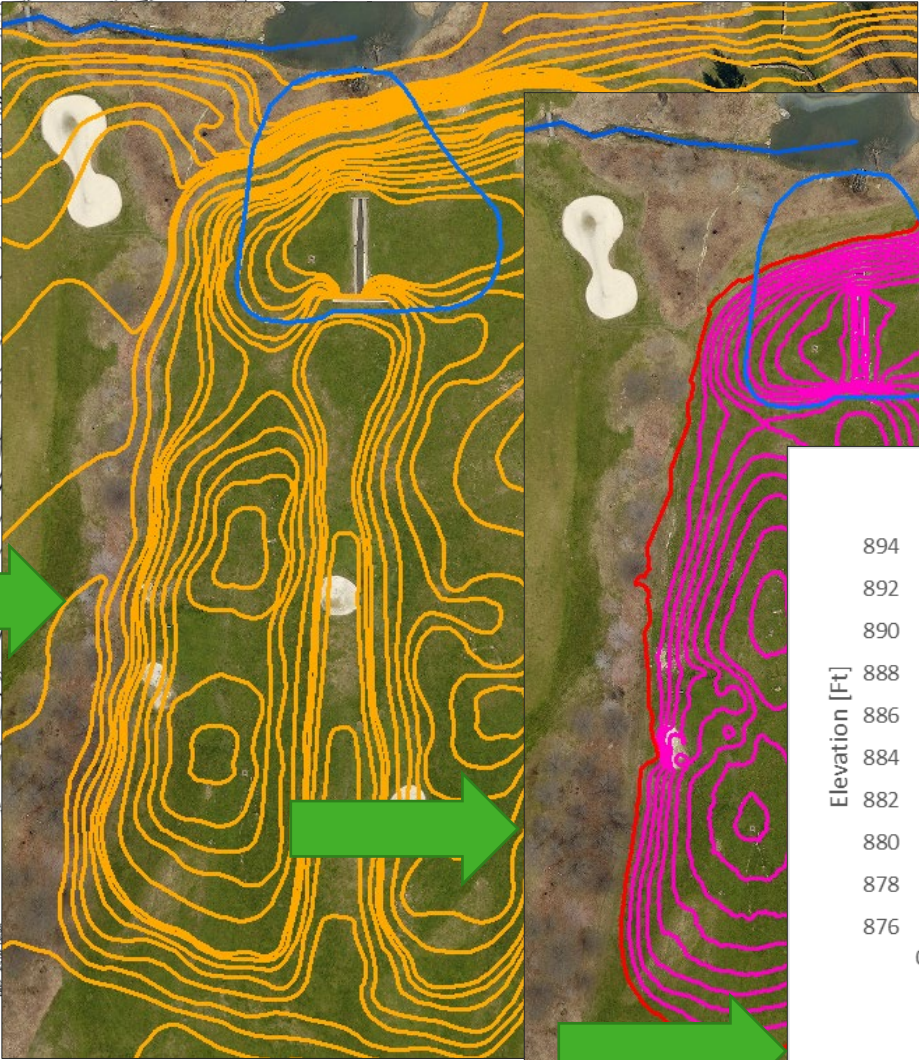
Bathymetry



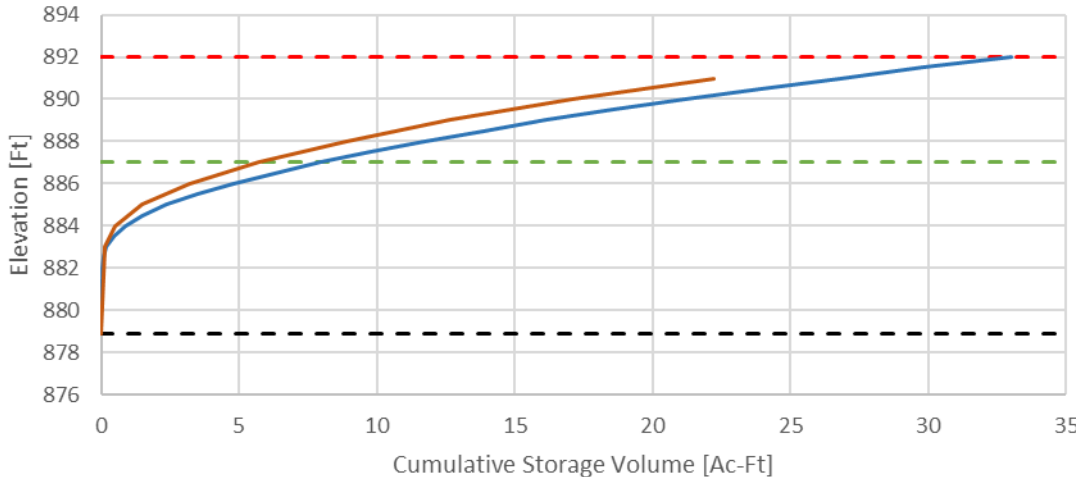
Bathymetry & Aerial Data Delivery

- 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”



EE00436 Stage-Storage Curve



- - - Max Storage/Top of Impounding Structure
- - - Secondary Spillway
- - - Primary Spillway
- - - Existing Condition Stage-Storage
- - - Design Condition Stage-Storage

Comments & Observations

The image features a decorative graphic on a white background. It consists of a large green trapezoidal shape on the left and top, and a grey trapezoidal shape below it. Three thin green diagonal lines are scattered across the composition: one at the top right, one at the bottom left, and one in the middle left.

- 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

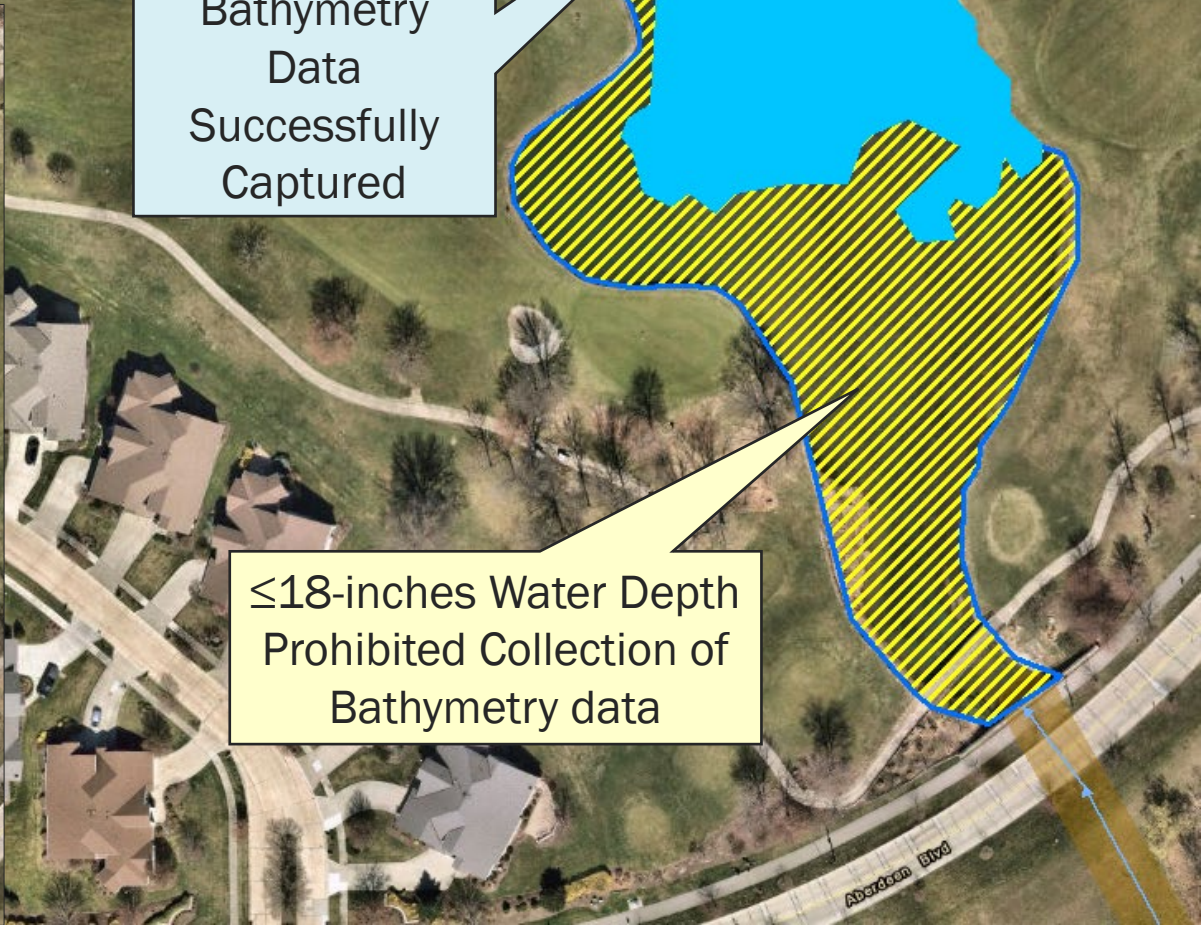
Partial Capture



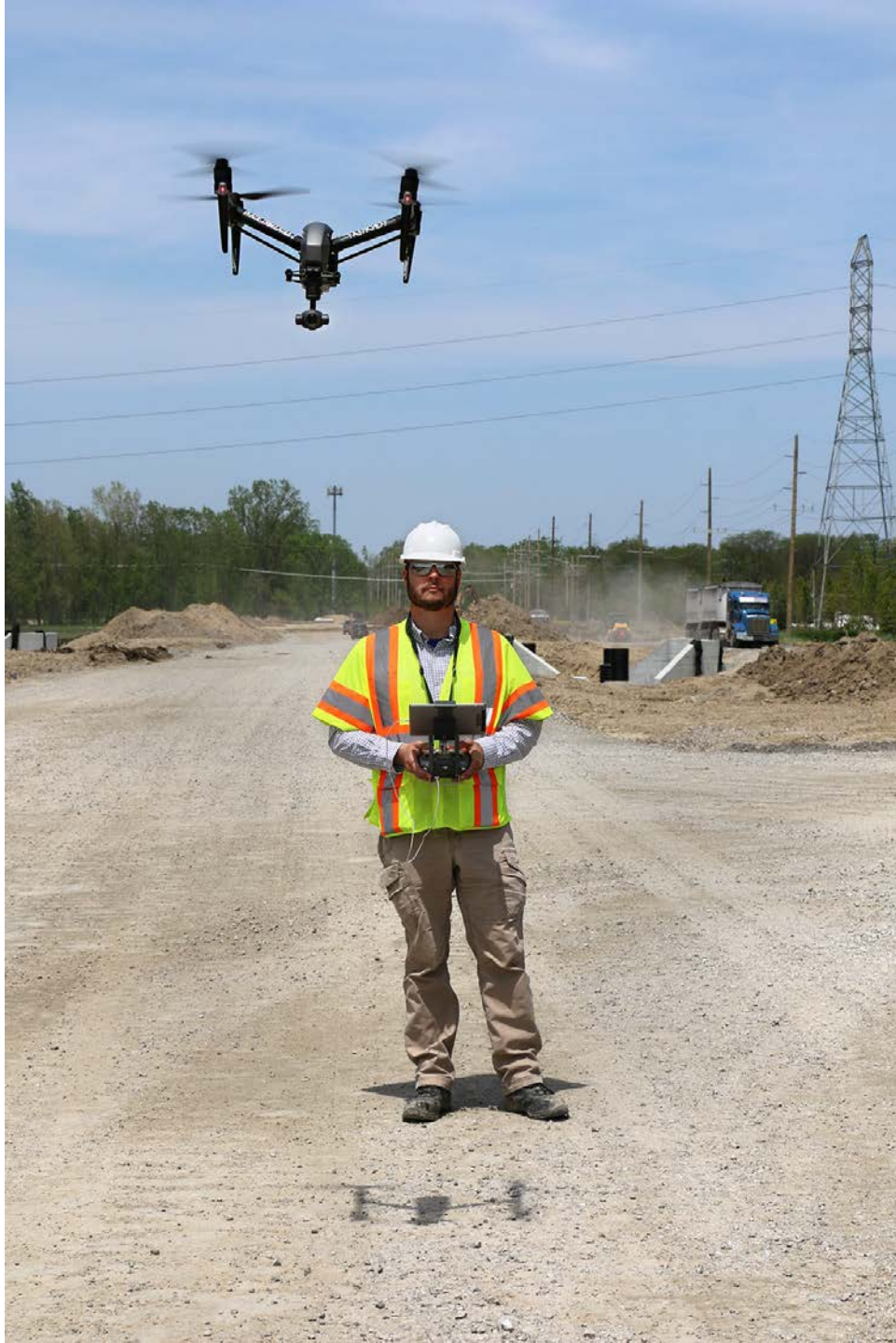
Bathymetry
Data
Successfully
Captured



April 2020
Nearmap



≤18-inches Water Depth
Prohibited Collection of
Bathymetry data





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