Do you s what I see?

Tools for Stormwater Assessments

May 11, 2018

Vicky McCauley

Ron Maichle

Nick Barille

Northeast Ohio Regional Sewer District

NORTHEAST OHIO REGIONAL SEWER DISTRICT
REGIONAL STORMWATER MANAGEMENT PROGRAM

@neorsd

Our Business Opportunity Program will be hosting a Stormwater Design Preview in July



SAVE THE DATE

Stormwater Design Preview





Tuesday, July 10, 2018 10 a.m.–Noon

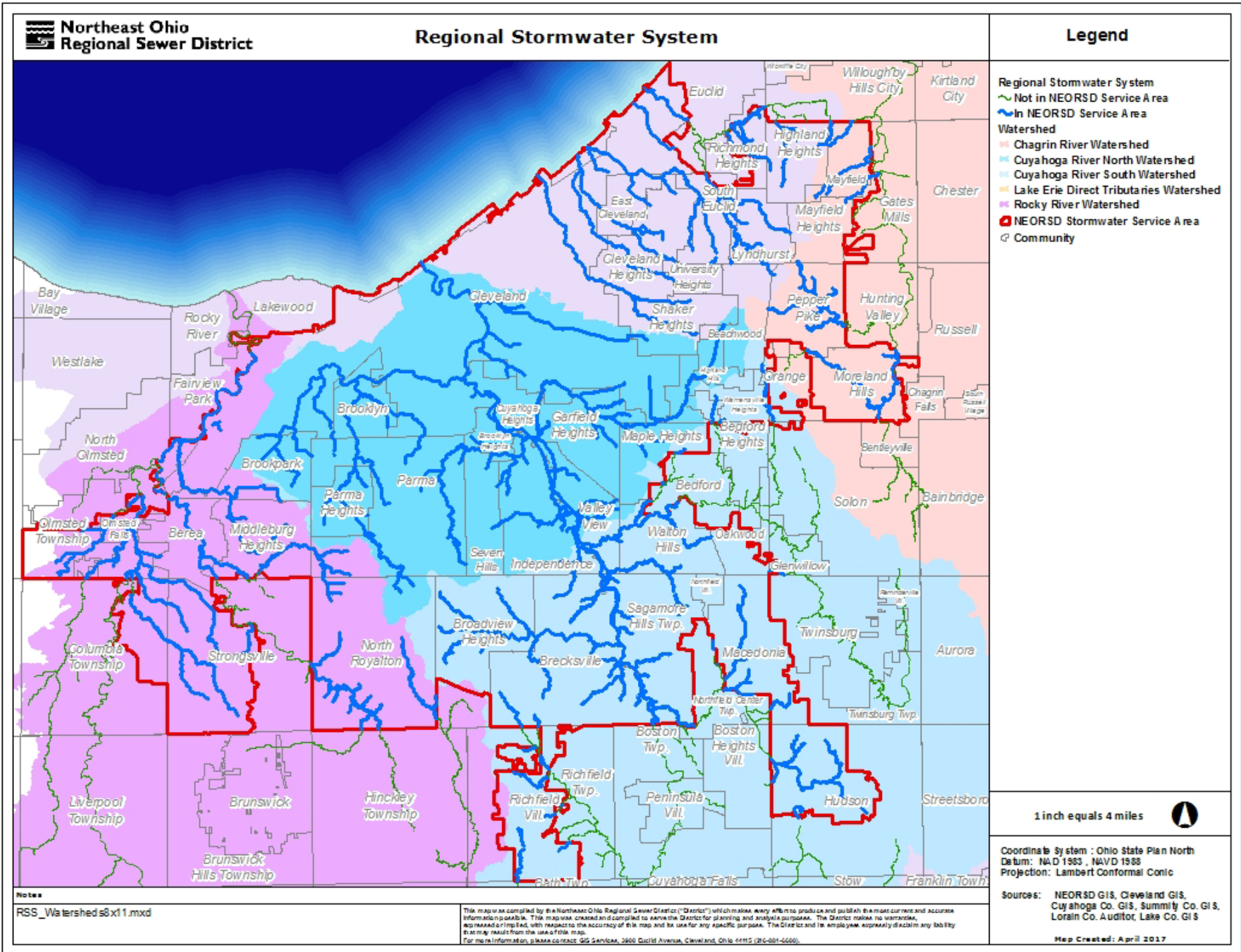
Watershed Stewardship Center in Parma

Join us for an advance look at upcoming Regional Stormwater Management Program projects, expectations, and opportunities. Details and additional resources available at *neorsd.org/opportunity*

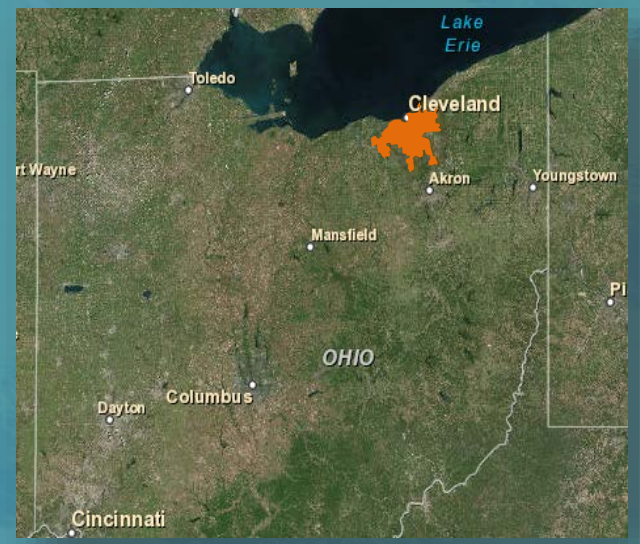


BUSINESS Opportunity PROGRAM

Northeast Ohio Regional Sewer District



- 20.0 miles of Regional Streams
- 15.25 miles open stream channels;
- 4.75 miles culverted





Inspect & Maintain



SW Master Plans



Construct Projects



Encourage Good Practices

Program Components

NORTHEAST OHIO REGIONAL SEWER DISTRICT

REGIONAL STORMWATER MANAGEMENT PROGRAM

Northeast Ohio Regional Sewer District

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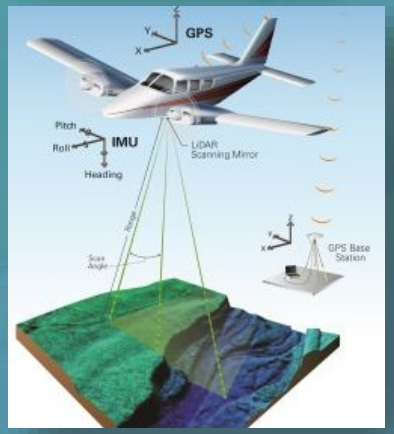

bing™ maps










GPS
IMU
Pitch
Roll
Heading
LiDAR Scanning Mirror
GPS Base Station






Google earth





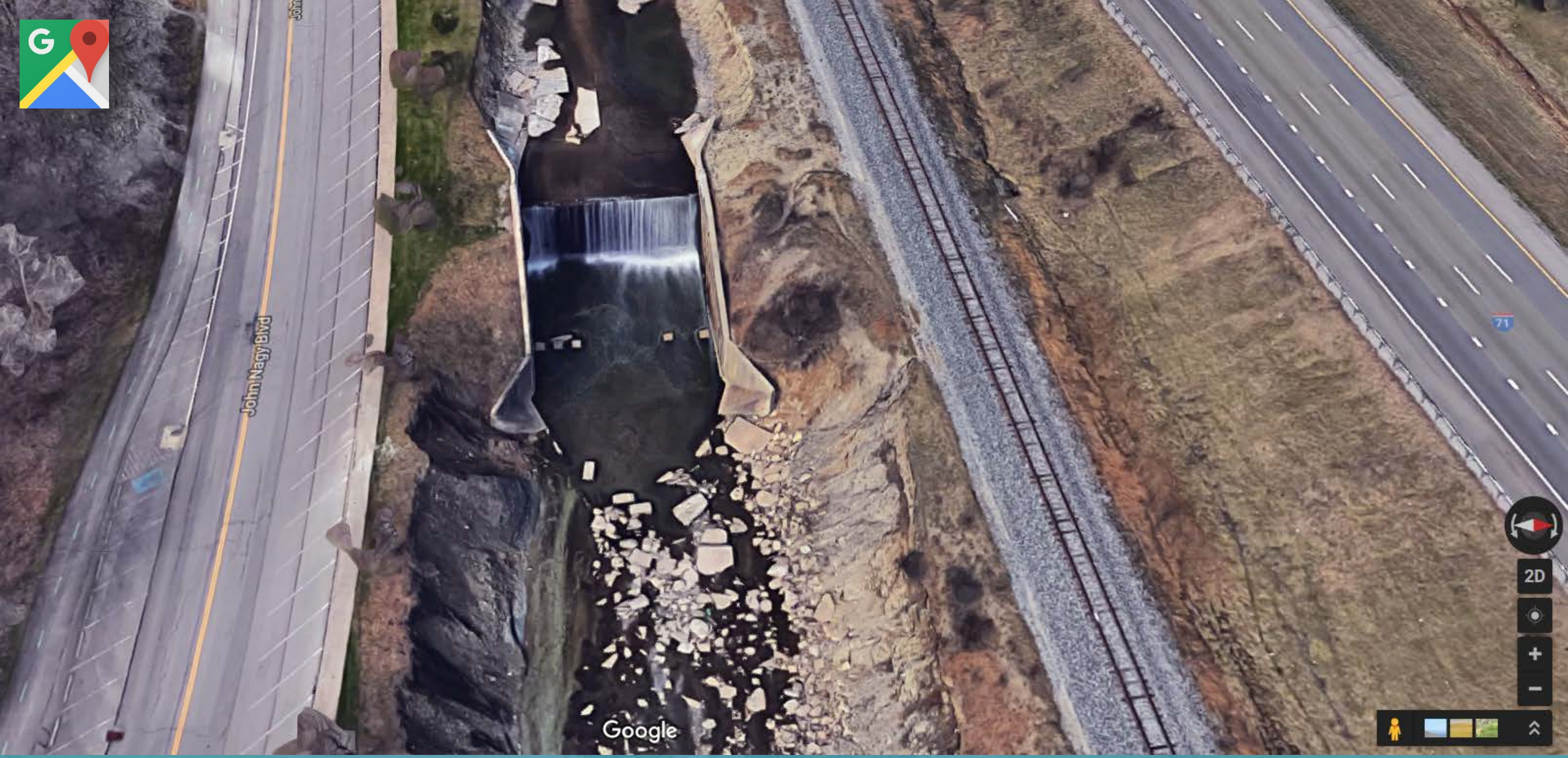

nearmap.com



- Which tool is right for you?
- Common Desktop
- Spherical Imagery
- Trail Cameras
- Drones

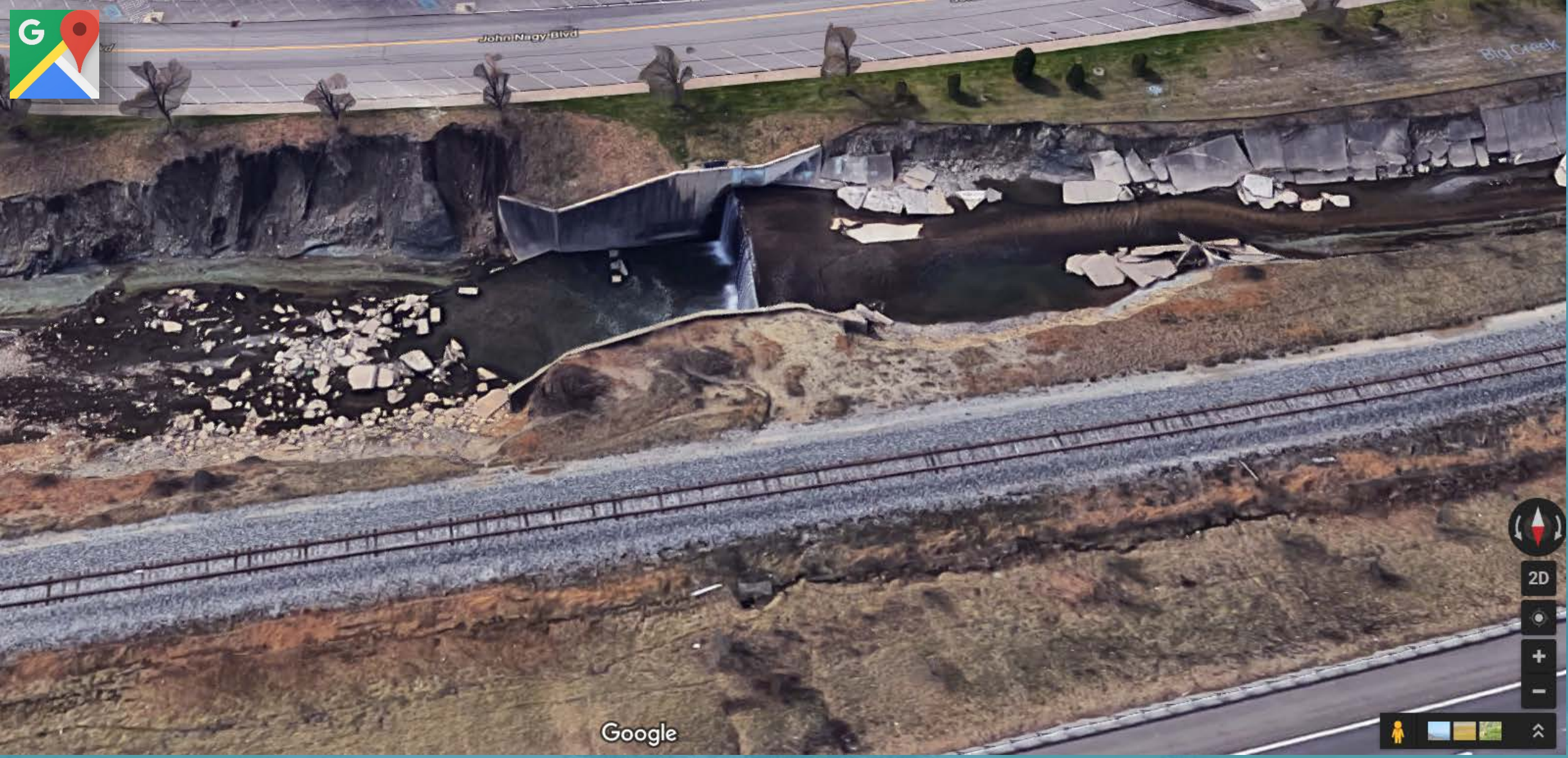
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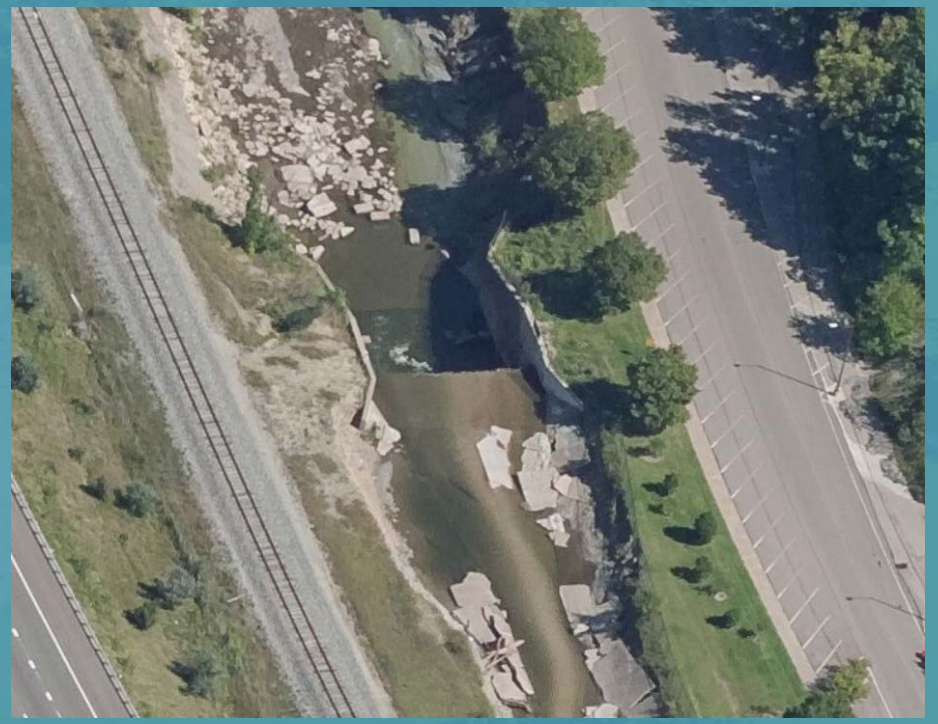
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bing maps


50 feet
10 m





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PRODUCTS INDUSTRIES RESOURCES COVERAGE ABOUT US CONTACT LOG IN TRY NEARMAP USA

CURRENT, HIGH RESOLUTION AERIAL MAPS

PORT HURON, MI | CAPTURED: MAR. 26, 2018



Engineering



Landscaping



Public Safety



Real Estate



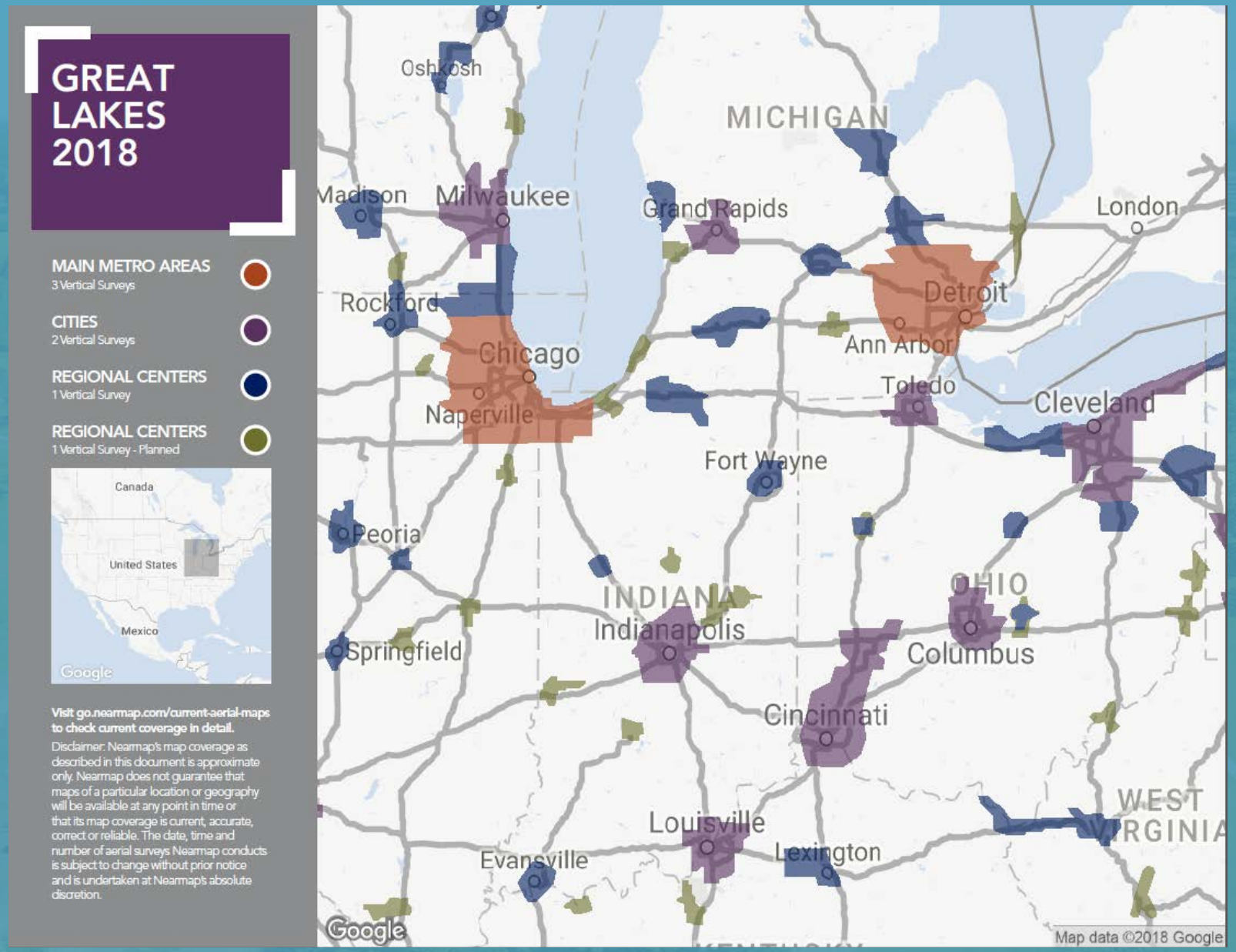
Roofing



Solar

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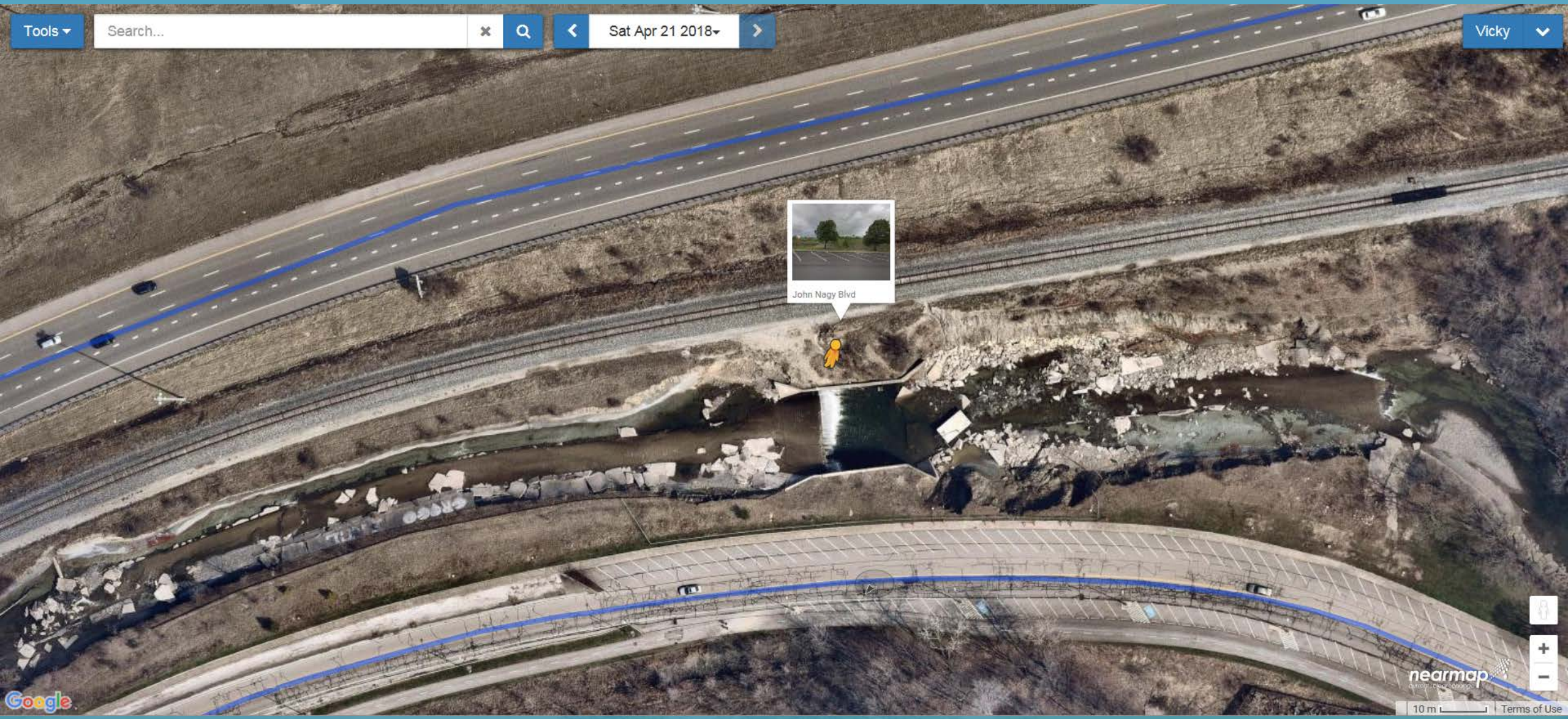


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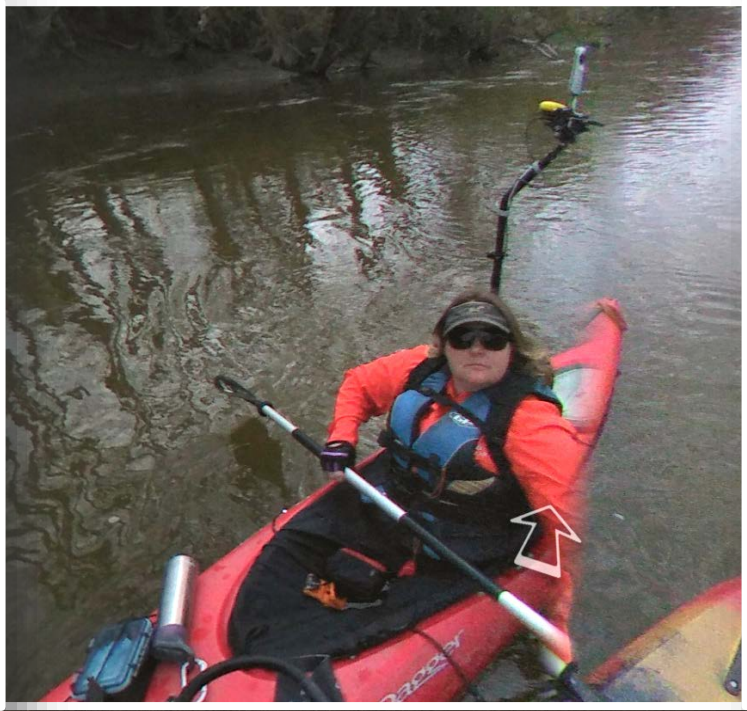
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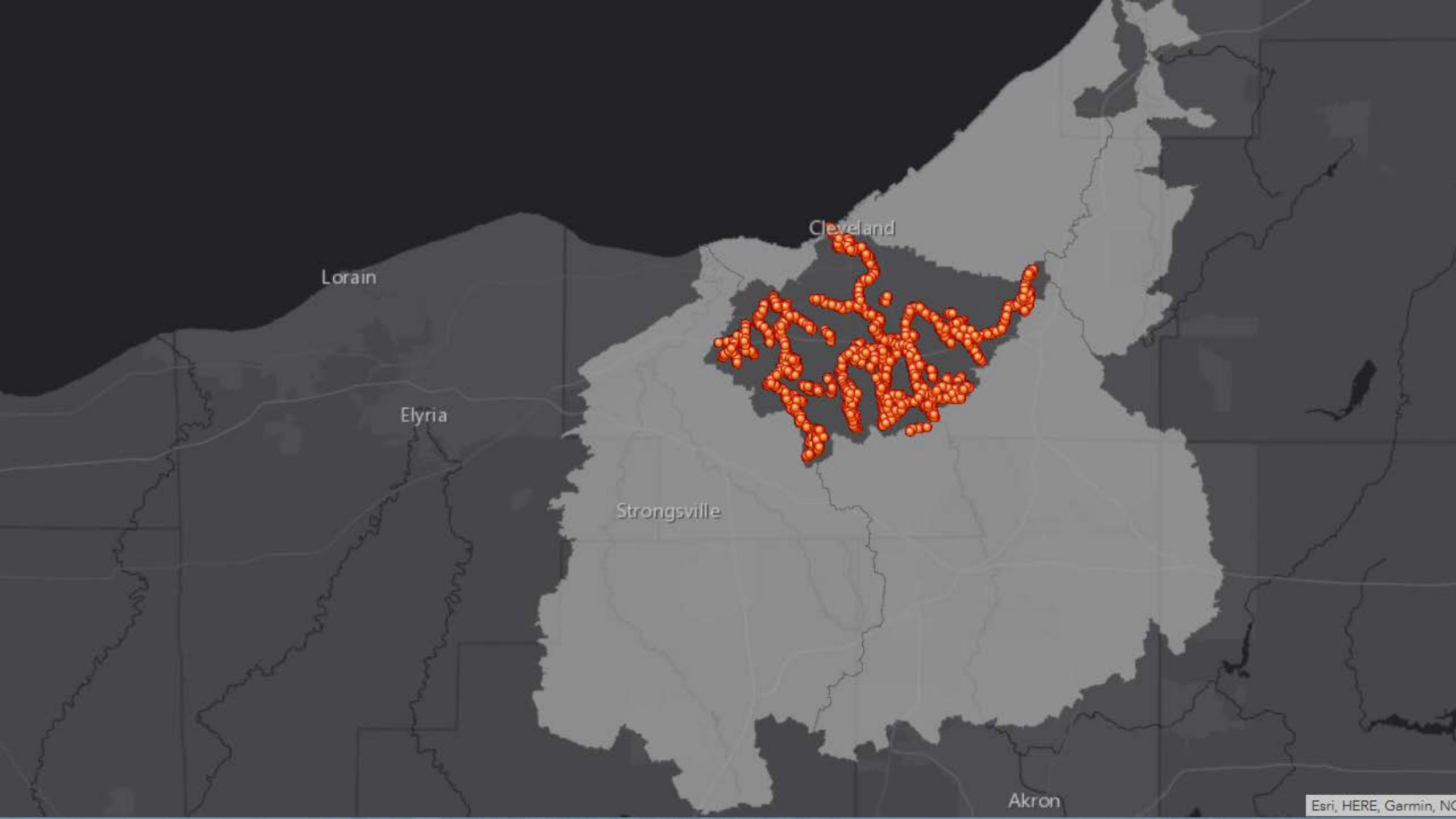




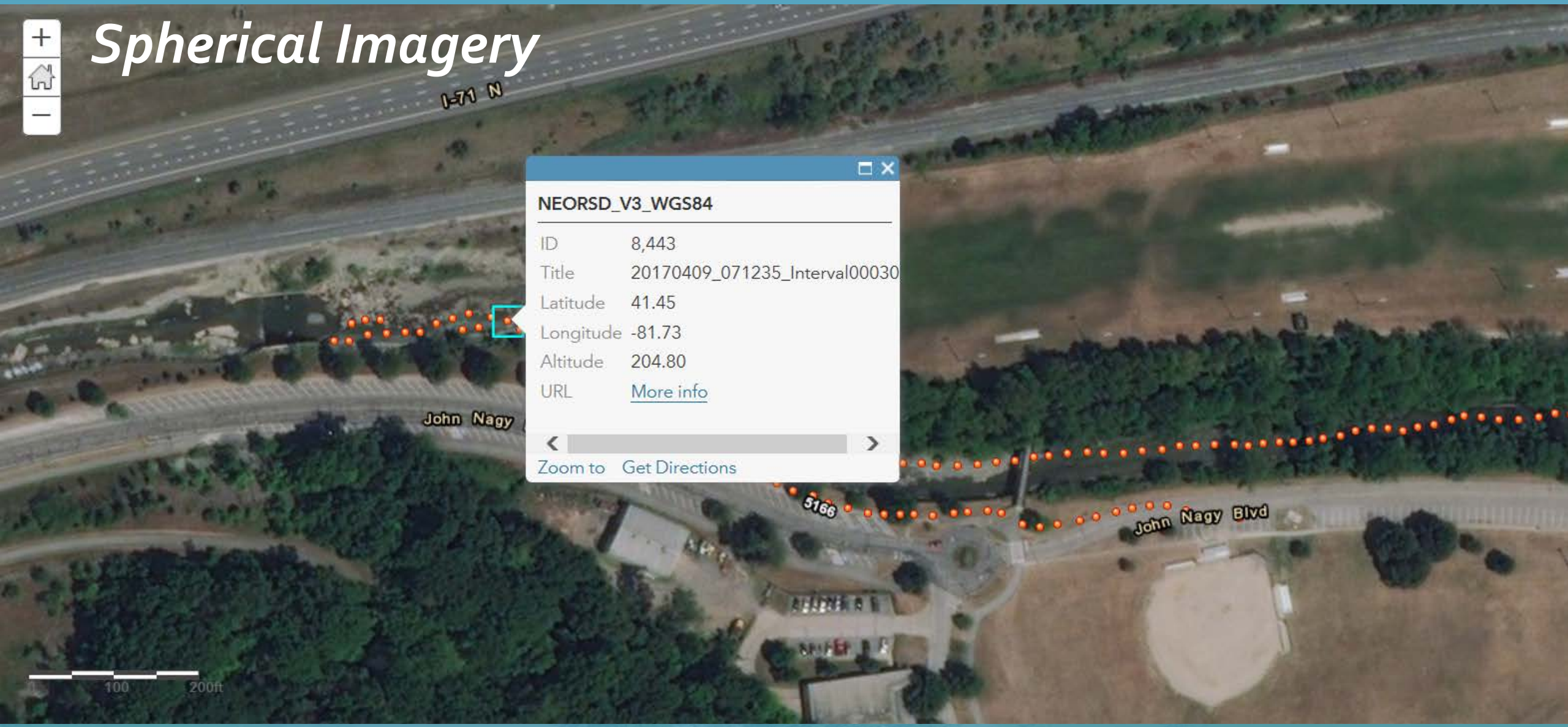


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Cleveland
Lorain
Elyria
Strongsville
Akron
Esri, HERE, Garmin, NC

Spherical Imagery



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Spherical Imagery



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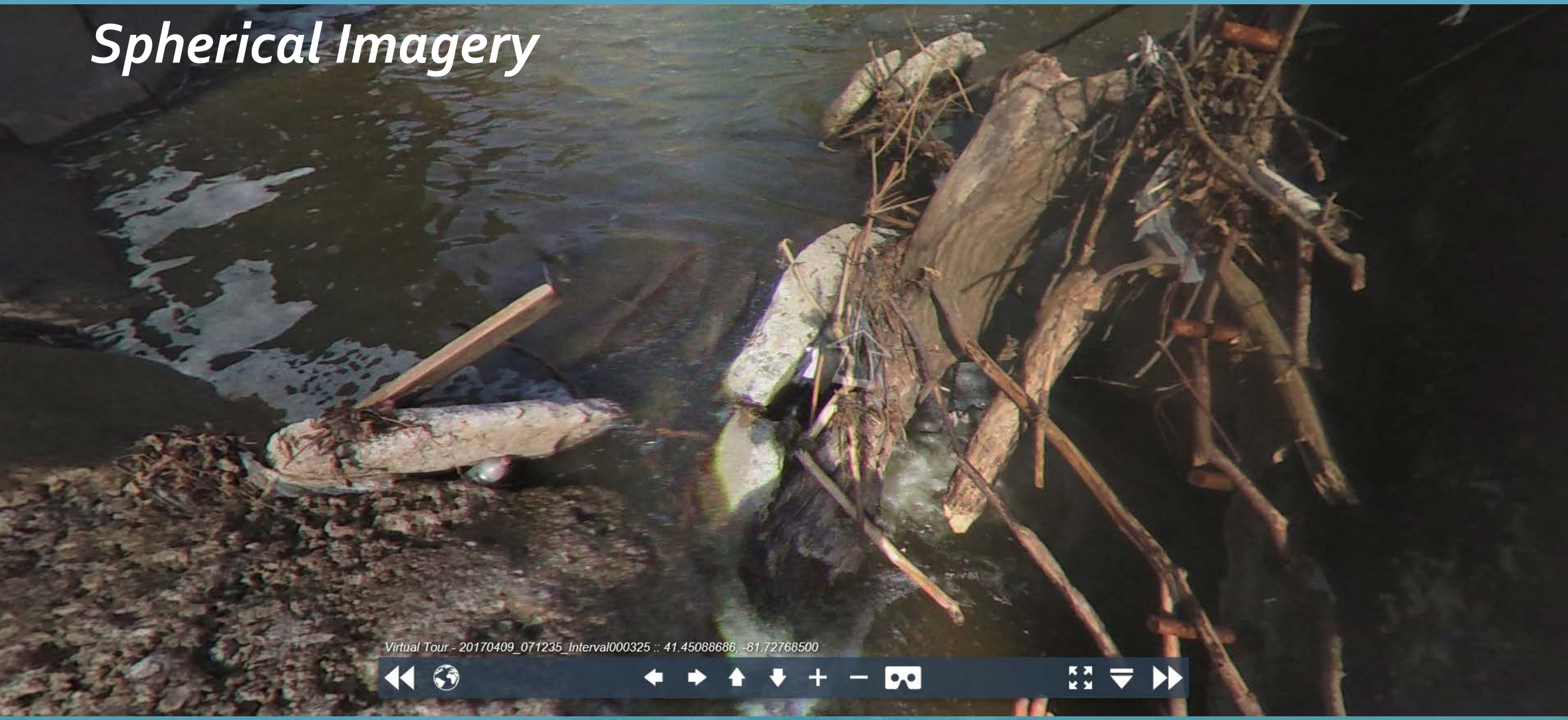
Spherical Imagery



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Spherical Imagery



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Trail Cameras







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Time stamped peak WSE, enables calculation of time of concentration and assists with model validation

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Drones



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Nick Barille
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barillen@neorsd.org

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Drone's as Tools

- Getting Started with Drones
- Background on Drone Operations
- Projects
- Lessons Learned
- Future Plans

How NEORSD got into Drone's

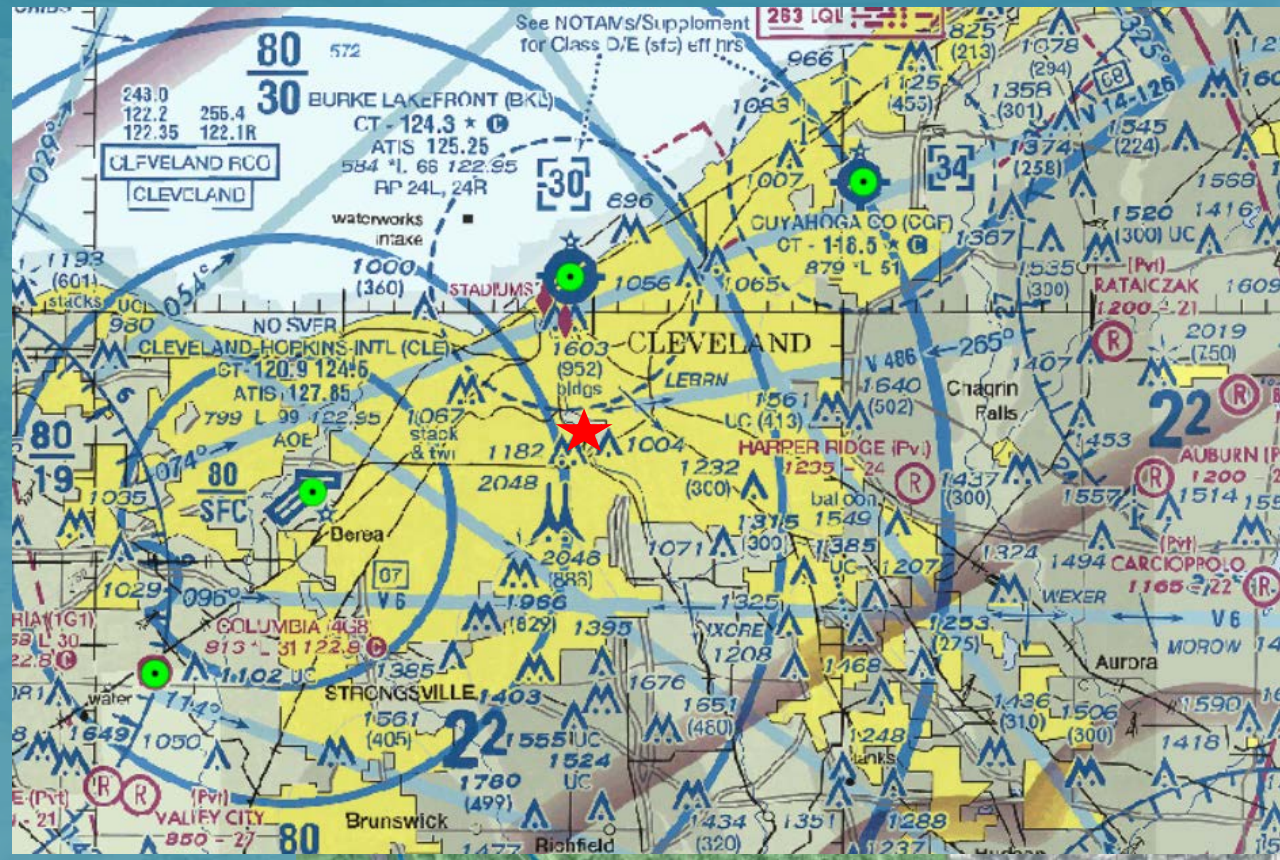
- Created a 2015 budget for drone's use in Emergency Response
- During purchasing found strict FAA regulations on use
- Took 2015-2016 to get FAA authorization to fly (Public COA)
  - Difficult to Fly under requirements
- In late 2016 new way to fly under 14 CFR Part 107
- In 2017 sent 2 employees to training
  - Cuyahoga Community College – Drone Academy
    - Covered a lot of the material for Part 107
- Two Part 107 pilots mid-2017
- 3 additional employees being trained in 2018



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14 CFR Part 107

- Majority of all commercial operations operate under this part
- Major Rules
  - Operate within G airspace
  - 5 miles from airports
  - Follow any community, state, or federal postings.
    - Individual Communities, Metroparks, and National Parks
- Certificate of Authorization
  - Fly near airports



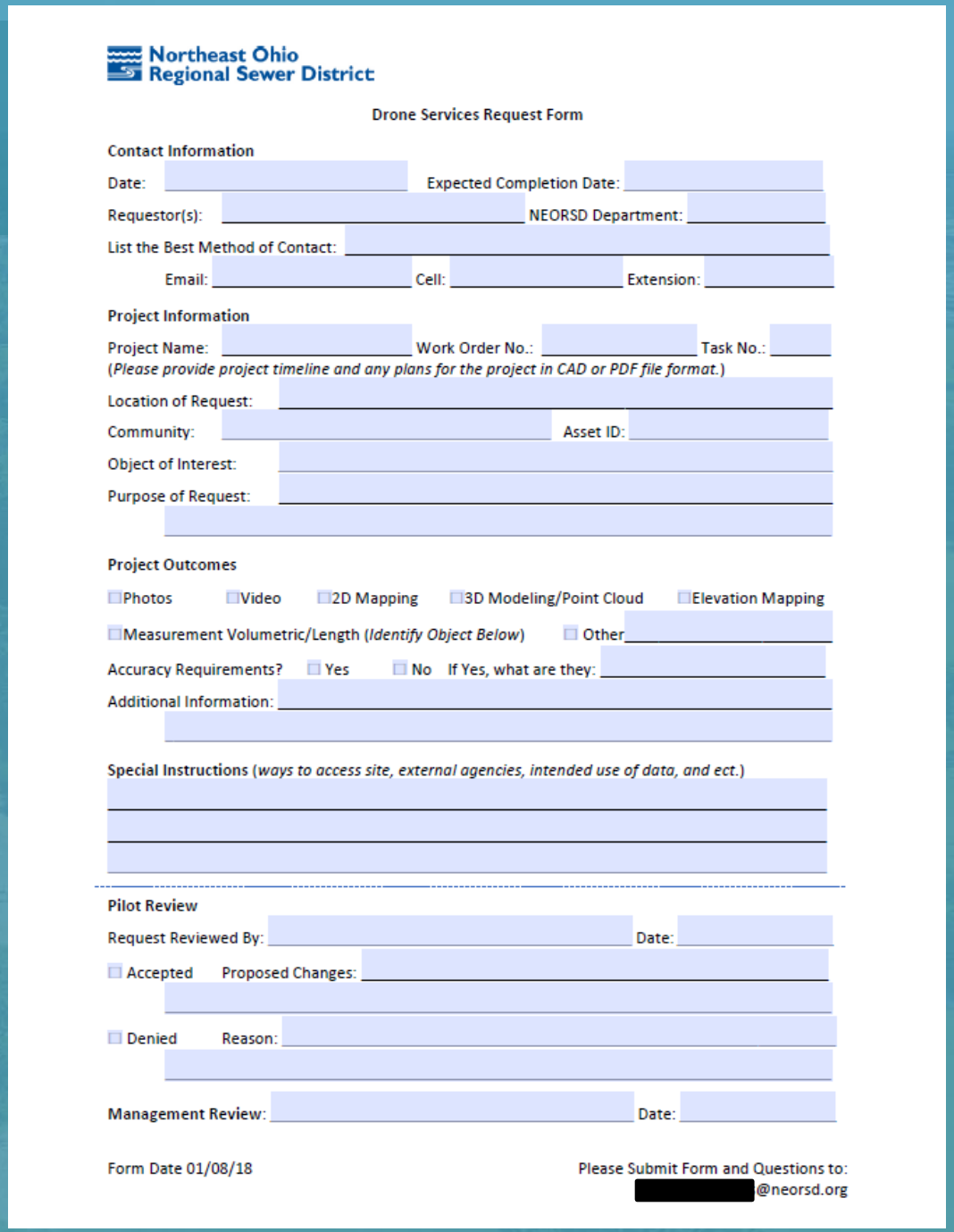


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Keeping up with Drones

- Getting Buy In
  - Meetings with Upper Management Staff
  - Demonstrate Cost and Time Benefit
  - Evaluate who would use the program
    - What are their needs
- How to handle work load
  - Drone Request form
  - Established a shared internal Email Box
  - Drone Work is about 15% of our total time

Northeast Ohio Regional Sewer District



Northeast Ohio Regional Sewer District

Drone Services Request Form

Contact Information

Date: _____ Expected Completion Date: _____

Requestor(s): _____ NEORSD Department: _____

List the Best Method of Contact: _____

Email: _____ Cell: _____ Extension: _____

Project Information

Project Name: _____ Work Order No.: _____ Task No.: _____

(Please provide project timeline and any plans for the project in CAD or PDF file format.)

Location of Request: _____

Community: _____ Asset ID: _____

Object of Interest: _____

Purpose of Request: _____

Project Outcomes

☐ Photos ☐ Video ☐ 2D Mapping ☐ 3D Modeling/Point Cloud ☐ Elevation Mapping

☐ Measurement Volumetric/Length (*Identify Object Below*) ☐ Other _____

Accuracy Requirements? ☐ Yes ☐ No If Yes, what are they: _____

Additional Information: _____

Special Instructions (*ways to access site, external agencies, intended use of data, and ect.*)

_____

_____

_____

Pilot Review

Request Reviewed By: _____ Date: _____

☐ Accepted Proposed Changes: _____

☐ Denied Reason: _____

Management Review: _____ Date: _____

Form Date 01/08/18

Please Submit Form and Questions to: [redacted]@neorsd.org

NEORSD Drones

Phantom 3 Advanced

- August 2015
  - Good learning aircraft
  - Good Video quality
- Other Equipment
  - Batteries
  - Props



Matrice 200

- December 2017
  - Flexible payloads
  - Stability
  - Safety features
- Other Equipment
  - Batteries
  - Props
  - Additional Payload



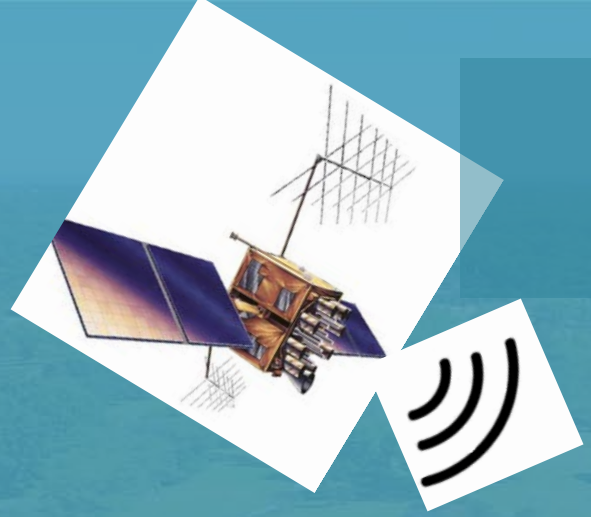
Hardware and Software

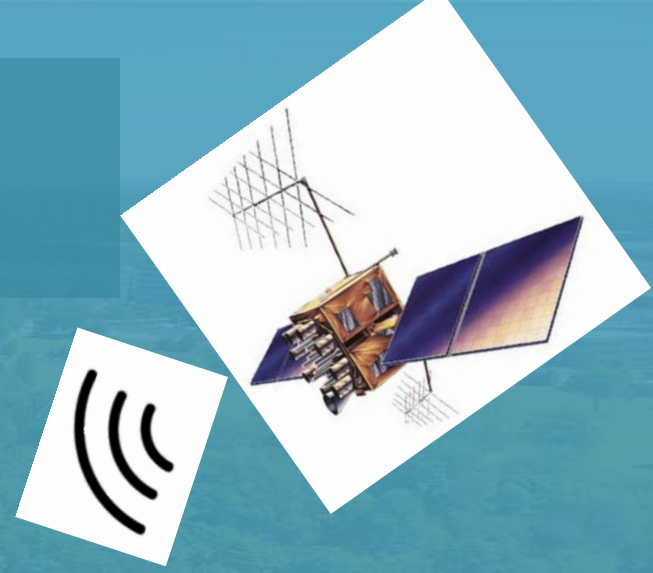
- iPad and Applications
  - 3DR Site Scan (data acquisition and image processing software)
  - DJI GO and the DJI GO 4
  - Weather and Restrictions
- Video Editing Software
- Handling data, transfer and storage
  - 5 GB/video (about ¼ mile of stream)
  - 1 GB/100 Photos
    - Typical autonomous flight yields 200 - 500 photos
  - Policy for data retention in place
- Computer Upgrades
  - Video Cards, Processor Upgrades, Additional RAM

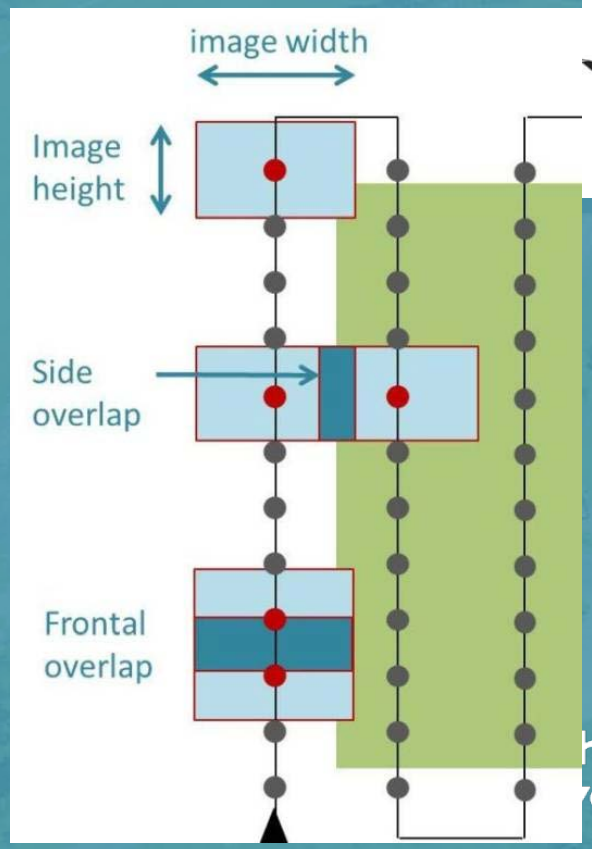


Northeast Ohio Regional Sewer District

Imaging Software









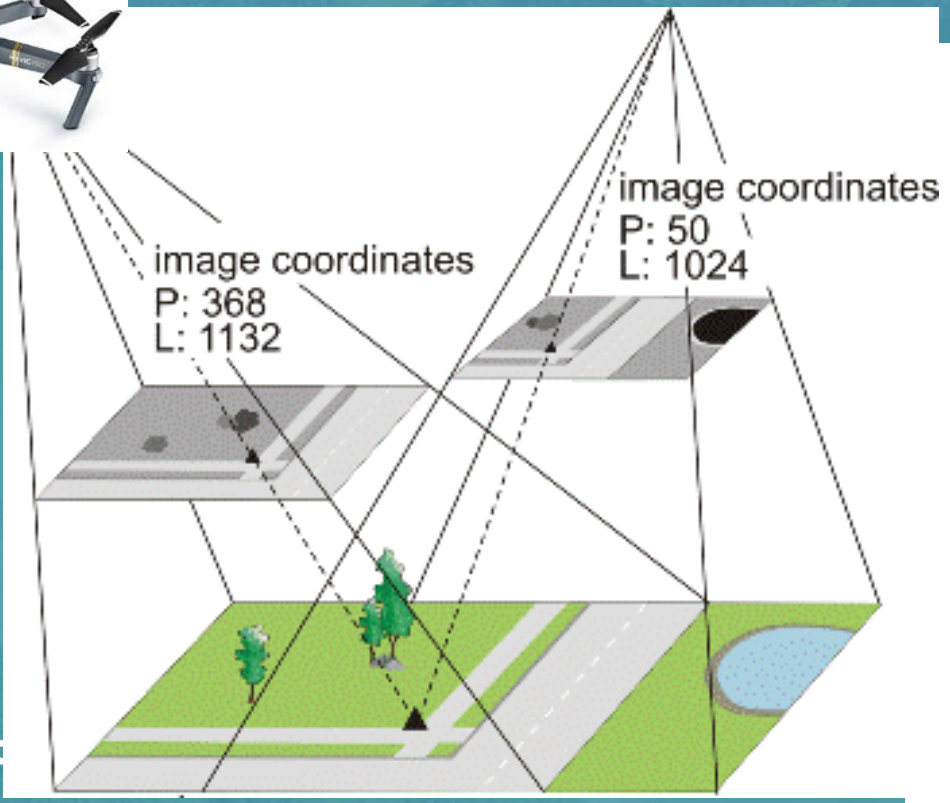
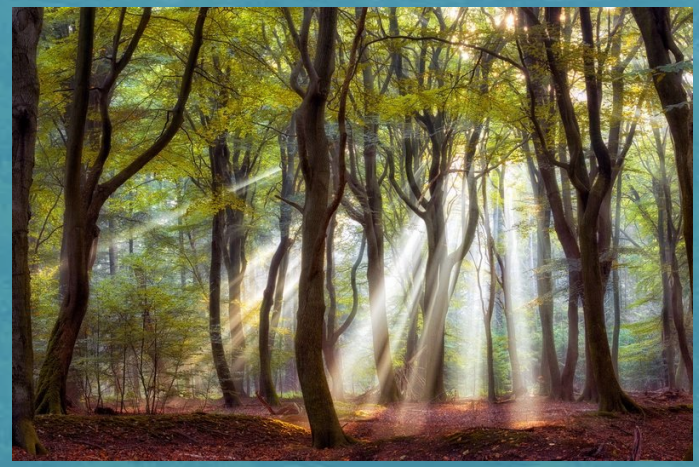


Photo Information

- Description
- Origin
- Image
  - Size
  - Resolution
- Camera
  - Make and Model
  - Angle
  - Exposure and ISO
- Advanced Photo
  - filters/zoom/light
- GPS
  - Coordinates
  - Altitude
- File

Photogrammetry vs LiDAR

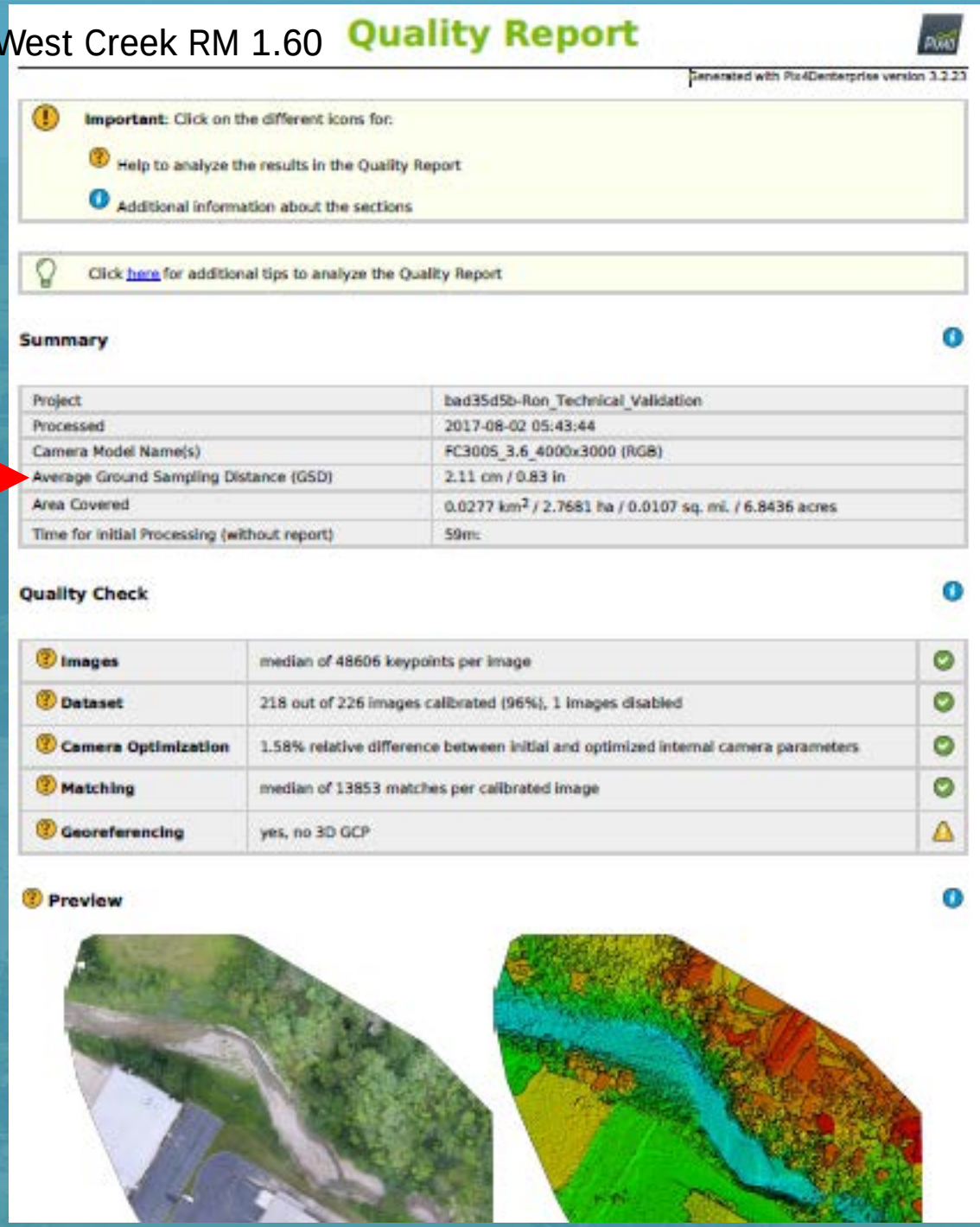
- LiDar, Light Detection and Ranging (lasers)
  - Extremely accurate, faster
  - Sunlight shinning through in a forest
  - More expensive
- Photogrammetry (pictures stitched together)
  - Uses pictures and common points between pictures
  - More time surveying and processing
  - Significant use of GCP, uses traditional surveying to be accurate



Accuracy

- Relative Accuracy
  - Measurement of how objects are positioned relative to each other in a reconstructed model
  - Allows for measure distances, volumes and heights differences
  - Relative has an error of 1-3 times pixel size both horizontal and vertical
- Absolute Accuracy
  - Difference between the location of objects on the model and the true position on Earth
  - Required for combing data (GIS) layers, by using Ground Control Points
  - Absolute has an error of 1-2 times pixel size horizontally and 1-3 times vertically
- This is not a certified Survey, still require surveys

Pixel Size or GSD Error Range (2.11 - 6.33 cm)


West Creek RM 1.60 Quality Report

Generated with Pix4Denterprise version 3.2.23

Important: Click on the different icons for:

Help to analyze the results in the Quality Report

Additional information about the sections

Click here for additional tips to analyze the Quality Report

Summary

Project	bad35d5b-Ron_Technical_Validation
Processed	2017-08-02 05:43:44
Camera Model Name(s)	FC3005_3.6_4000x3000 (RGB)
Average Ground Sampling Distance (GSD)	2.11 cm / 0.83 in
Area Covered	0.0277 km² / 2.7681 ha / 0.0107 sq. mi. / 6.8436 acres
Time for initial Processing (without report)	59m:

Quality Check

Images	median of 48606 keypoints per image	✓
Dataset	218 out of 226 images calibrated (96%), 1 images disabled	✓
Camera Optimization	1.58% relative difference between initial and optimized internal camera parameters	✓
Matching	median of 13853 matches per calibrated image	✓
Georeferencing	yes, no 3D GCP	⚠

Preview

Northeast Ohio Regional Sewer District

Projects

April 16, 2018, at 1457 hours

Cuyahoga River: gauge 19.6 feet; discharge 12,100 cfs



Cuyahoga River USGS 04208000, note NWS Flood Stage 16 feet



April 20, 2018, at 1158 hours

Cuyahoga River: gauge 8.0 feet; discharge 3,340 cfs

Kerruish Basin

- **City:** Cleveland and Warrenville Heights, Ohio
- **Purpose:** Dredging of "Dry" Basin
- **Drone Function:** Take aerial photos to track progress of dredging and conditions





Kerruish Basin

Draining Basin (Flight: March 15, 2018)



Kerruish Basin

- Starting Dredging
- Opening outlet
- Flight: March 22, 2018





Kerruish Basin

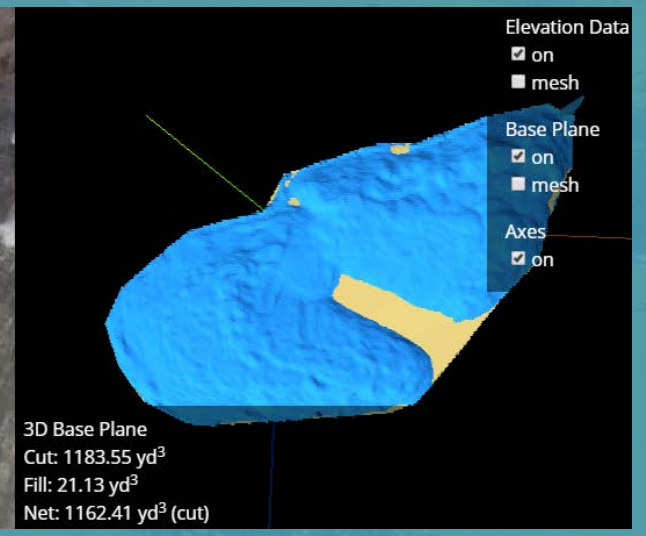
Basin Dredging (Flight: April 5, 2018)





Volume Estimates



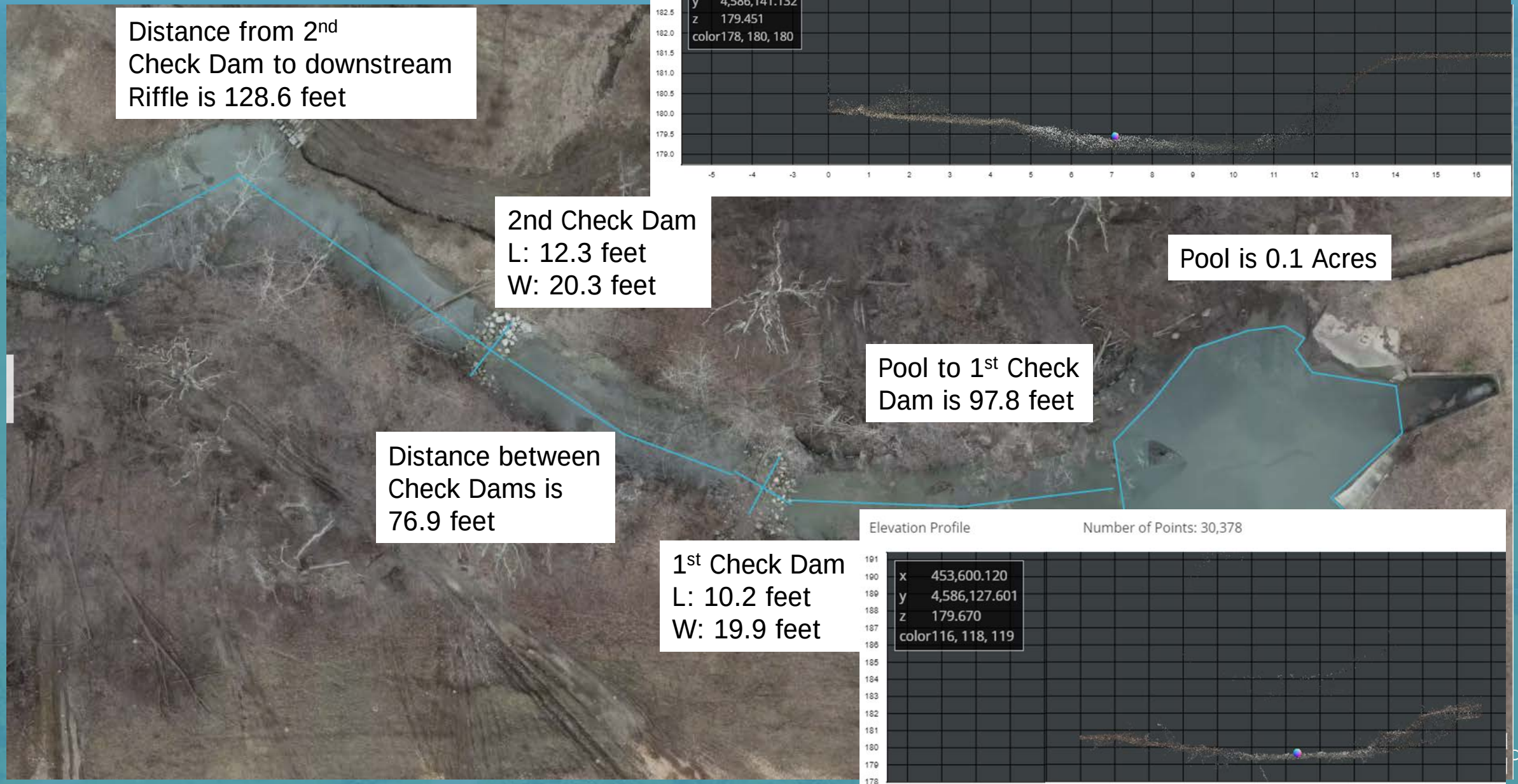


Kerruish Basin

- Dredging Continued
- Flight: April 10, 2018



Drone Flight 04/10/18
(ground sampling distance of 0.91 inch)

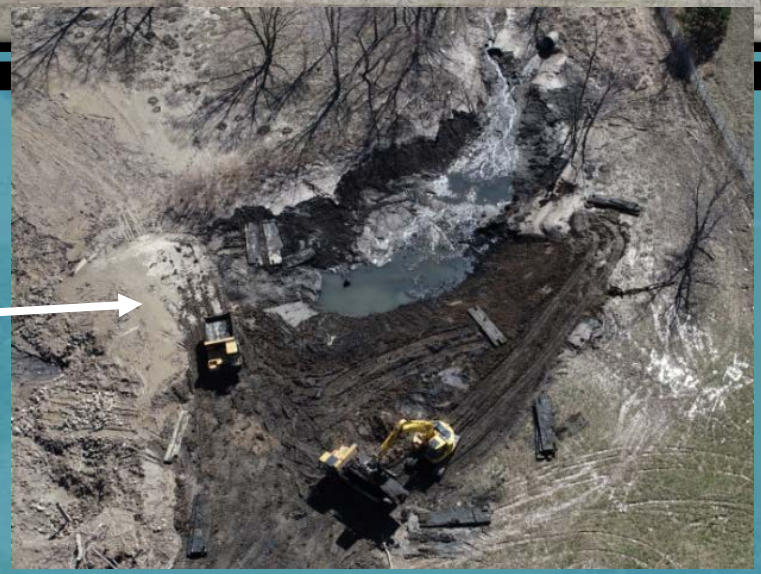


Kerruish Basin

Forebay Dredging (Flight: April 20, 2018)

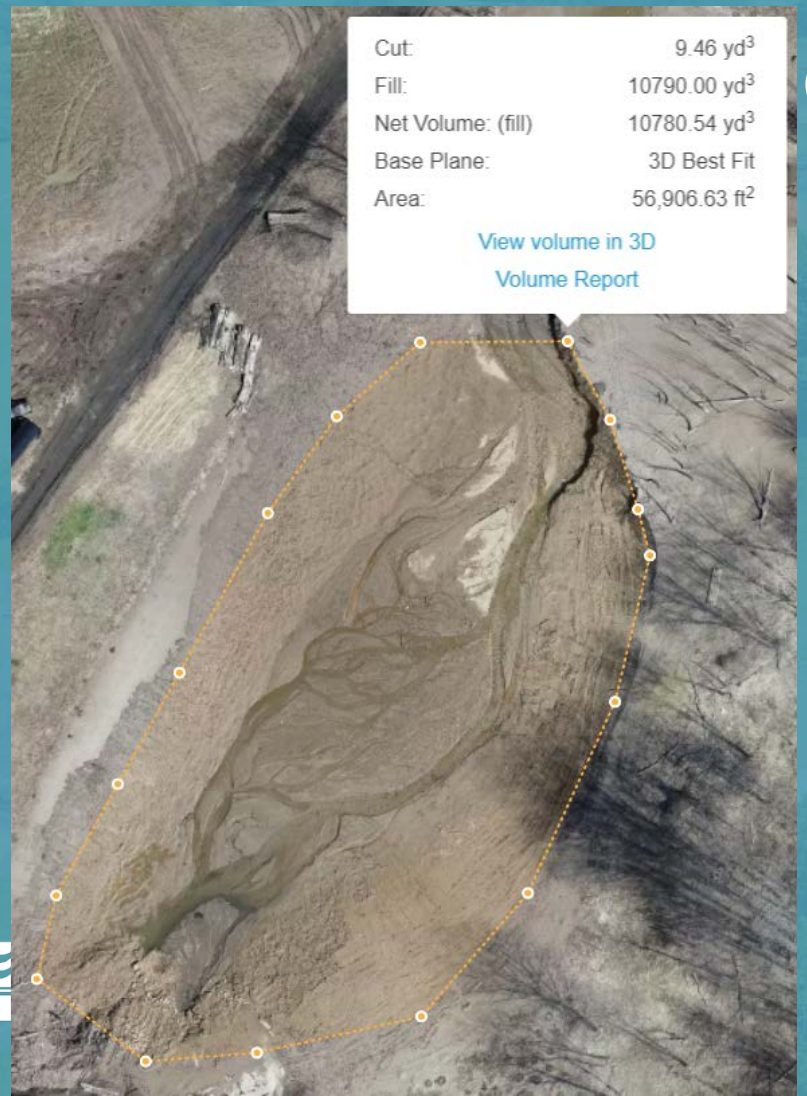






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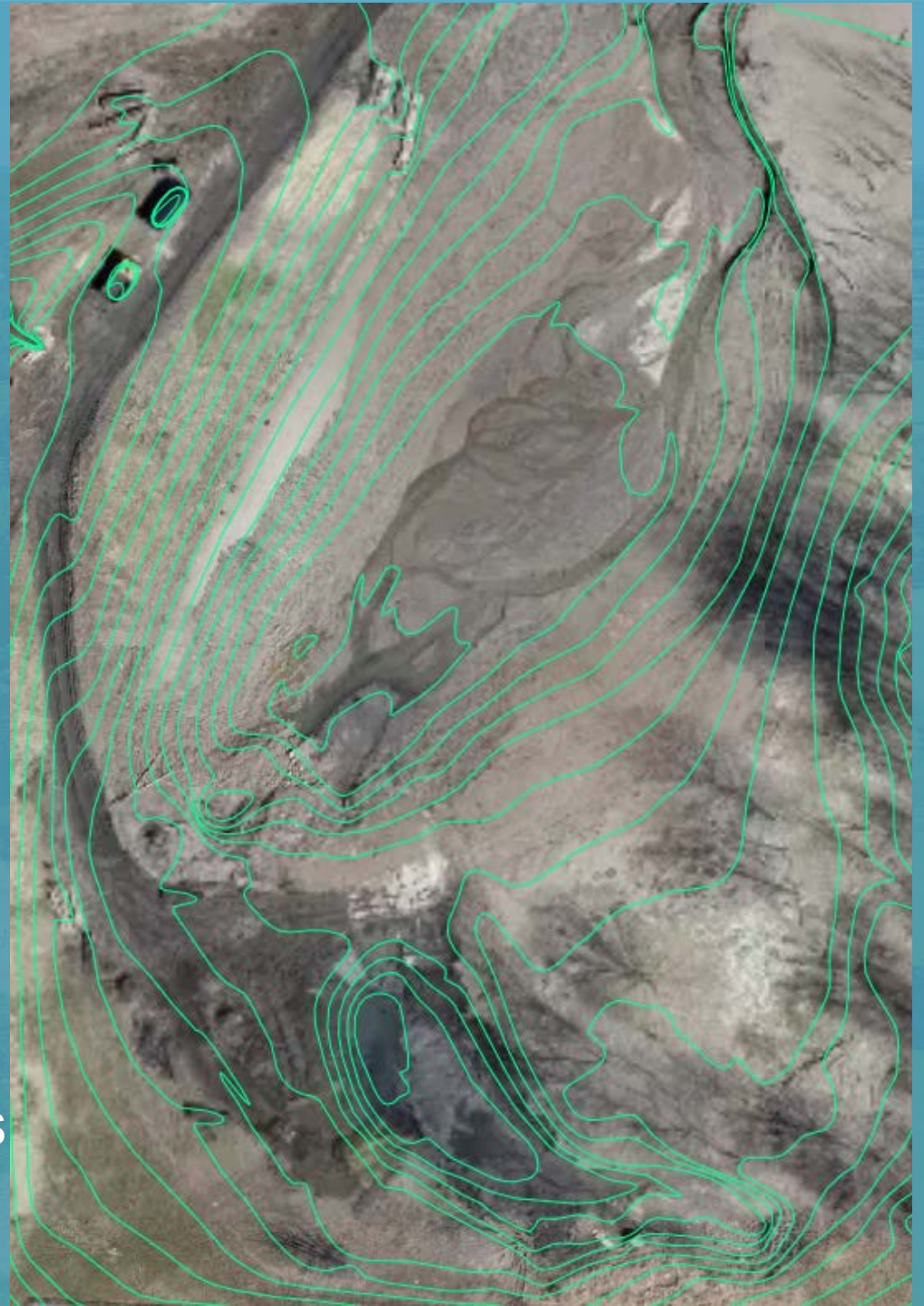
Kerruish Basin



Quick Fill Measurement (est 12,000)

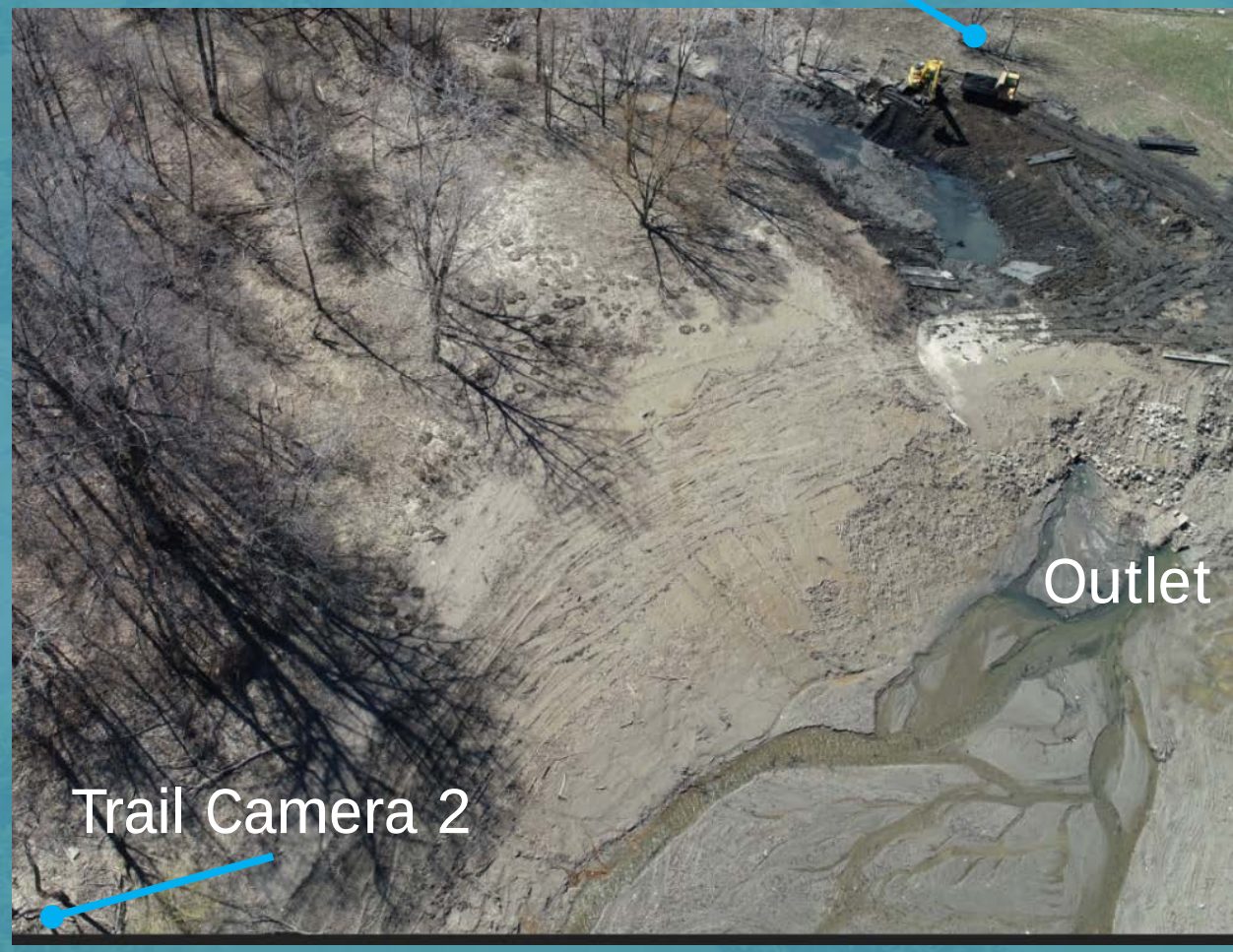
Flight:
April 20, 2018

2 ft Contours



Kerruish Basin

- Importance of using multiple tools
- Note: Mill Creek drainage 13.0 mi^2
- Heavy Rain Event
  - Average Rainfall from 26 stations in and around the NEORSD service area
    - April 14 was 0.20 inches
    - April 15 was 2.70 inches



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Kerruish Basin

Major Rain Event 04-14-18 to 04-15-18
Trail Camera 1 (SWIM Team)

04-14 at 1616 hrs



04-14 at 1917 hrs



04-15 at 0745 hrs



04-15 at 1317 hrs



04-15 at 1548 hrs



04-15 at 1848 hrs



Kerruish Basin

Major Rain Event 04-14-18 to 04-15-18
Trail Camera 2 (SWIM Team)













West Creek (River Mile 0.2)

- **City:** Independence, Ohio
- **Purpose:** Follow up on 2013 Restoration Project (West Creek Conservancy)
- **Drone Function:** Take aerial photos to show existing conditions



West Creek Flooding
North of Granger Road
February 21, 2002

Northeast Ohio Regional Sewer District

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West Creek

Google Maps 2007



Flight: September 11, 2017



West Creek (River Mile 0.2)

Flight: September 11, 2017

Project Plan Overlays (2013)



Measurements



West Creek (River Mile 0.2)

Profile View



Appearance

Point Budget: 9,000,000

Point Size: 1

Elevation Profile

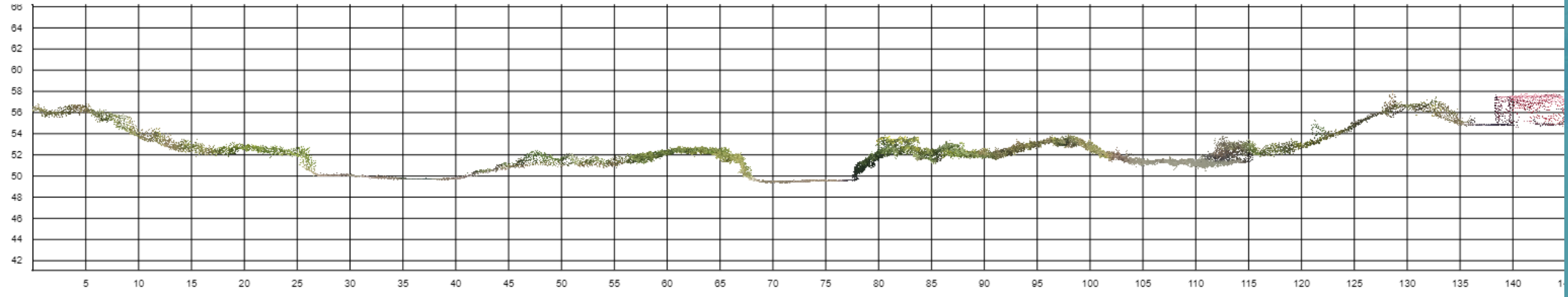
Show Profile Graph

Elevation Profile

Line Width 10 ft

Units

Standard Foot



West Creek

Unnamed Trib – South of I-480



Main Branch RM 0.30



West Creek (River Mile 1.10)

Inspection: May 7, 2002



Stream Inspection: July 2017

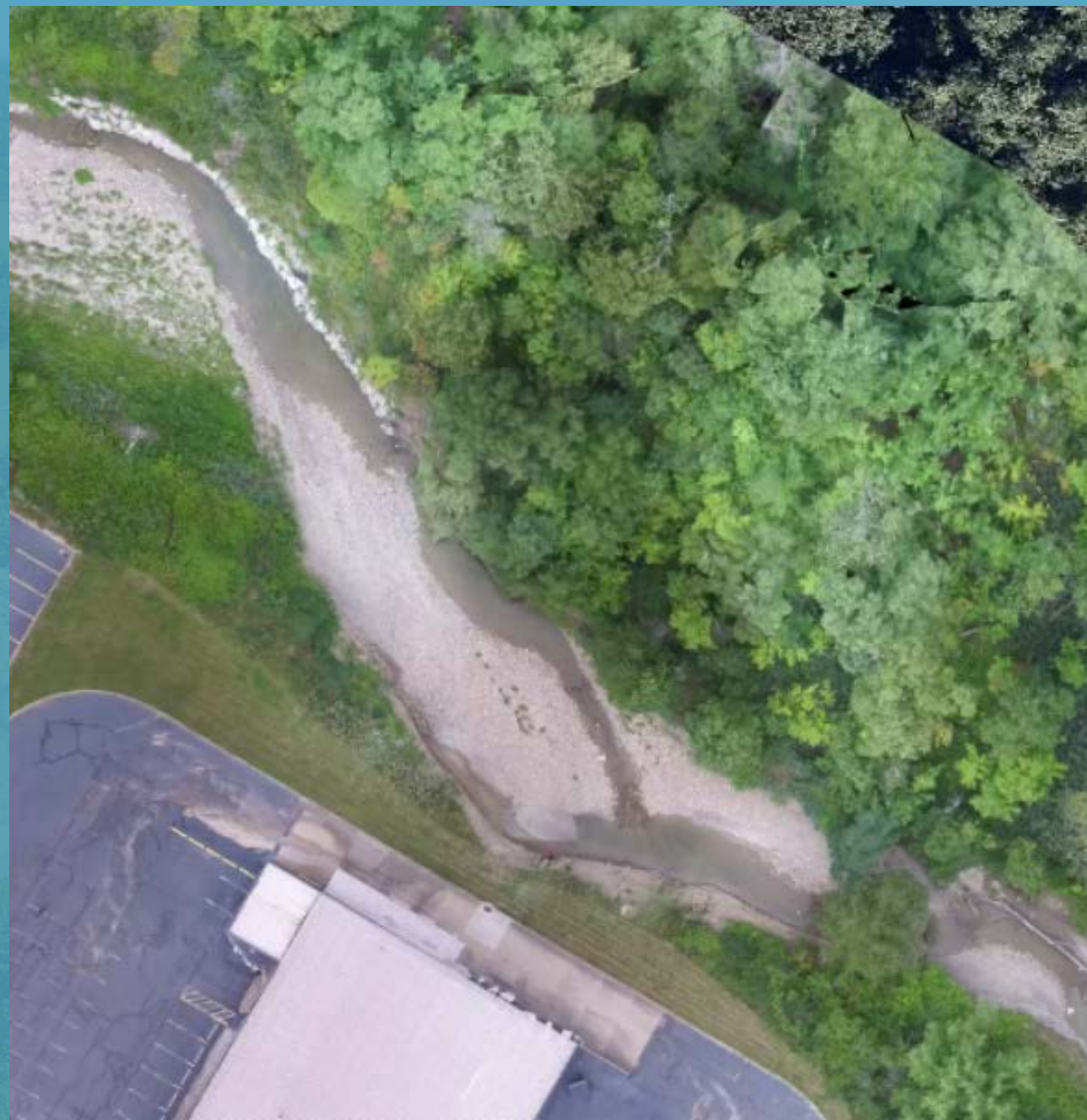


Drone Flight: March 5, 2018



West Creek (River Mile 1.60)

- **City:** Brooklyn Heights, Ohio
- **Purpose:** Follow up on Historical Erosion known issue
- **Drone Function:** Take aerial photos to show existing conditions



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West Creek (River Mile 1.60)

Pictures July, 24, 2013

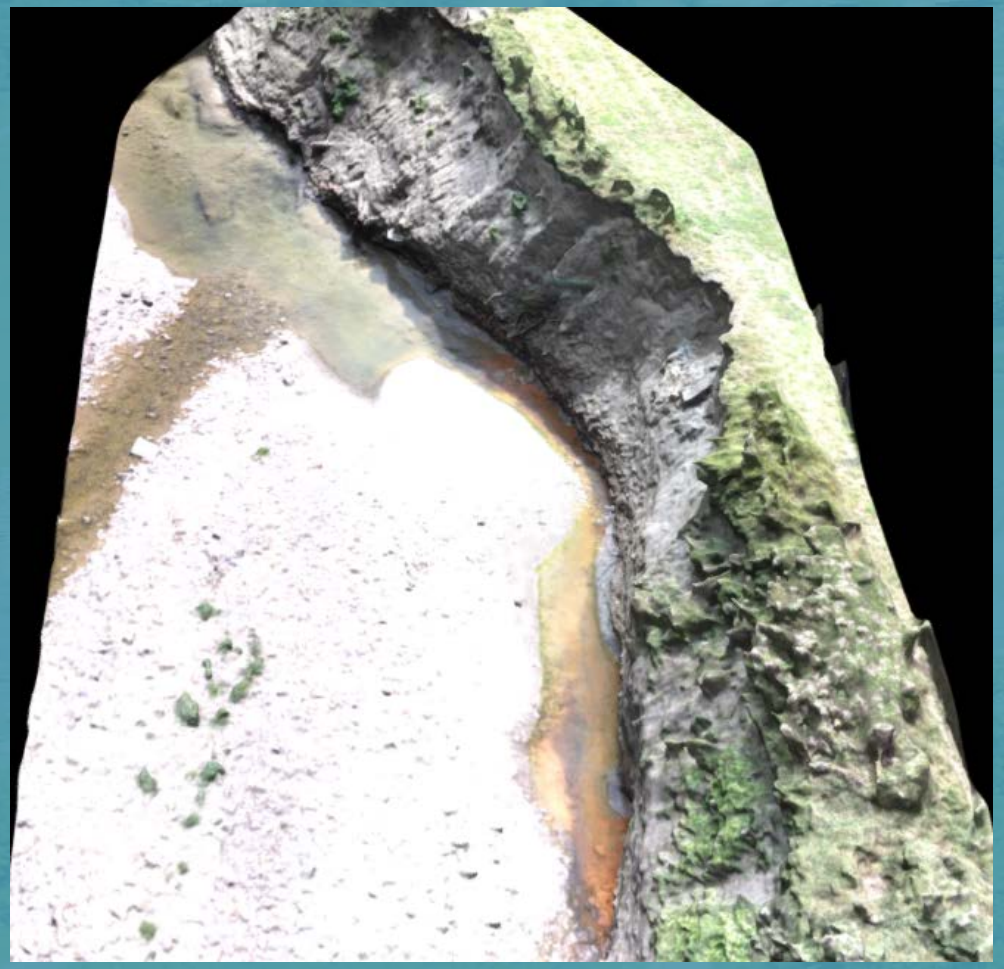




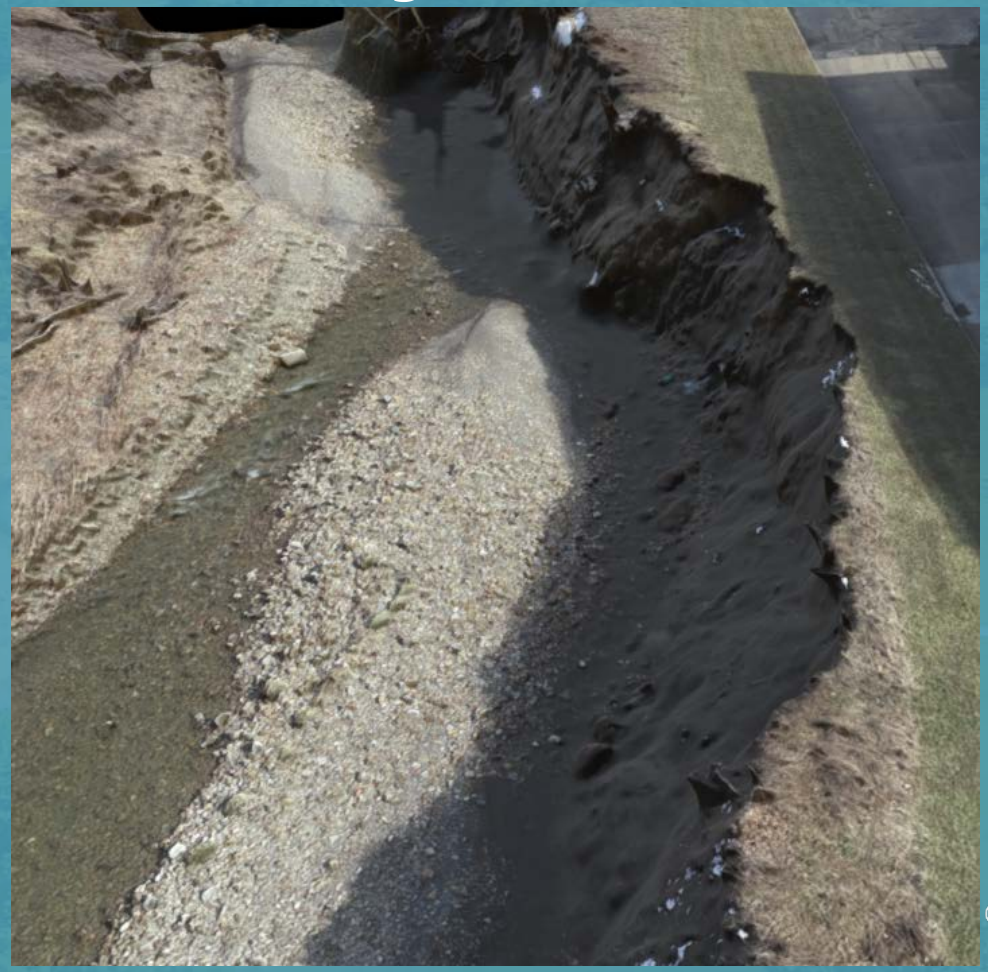
@neorsd

West Creek (River Mile 1.60)

3D Model (Flight: December 1, 2017)



3D Model (Flight: March 5, 2018)

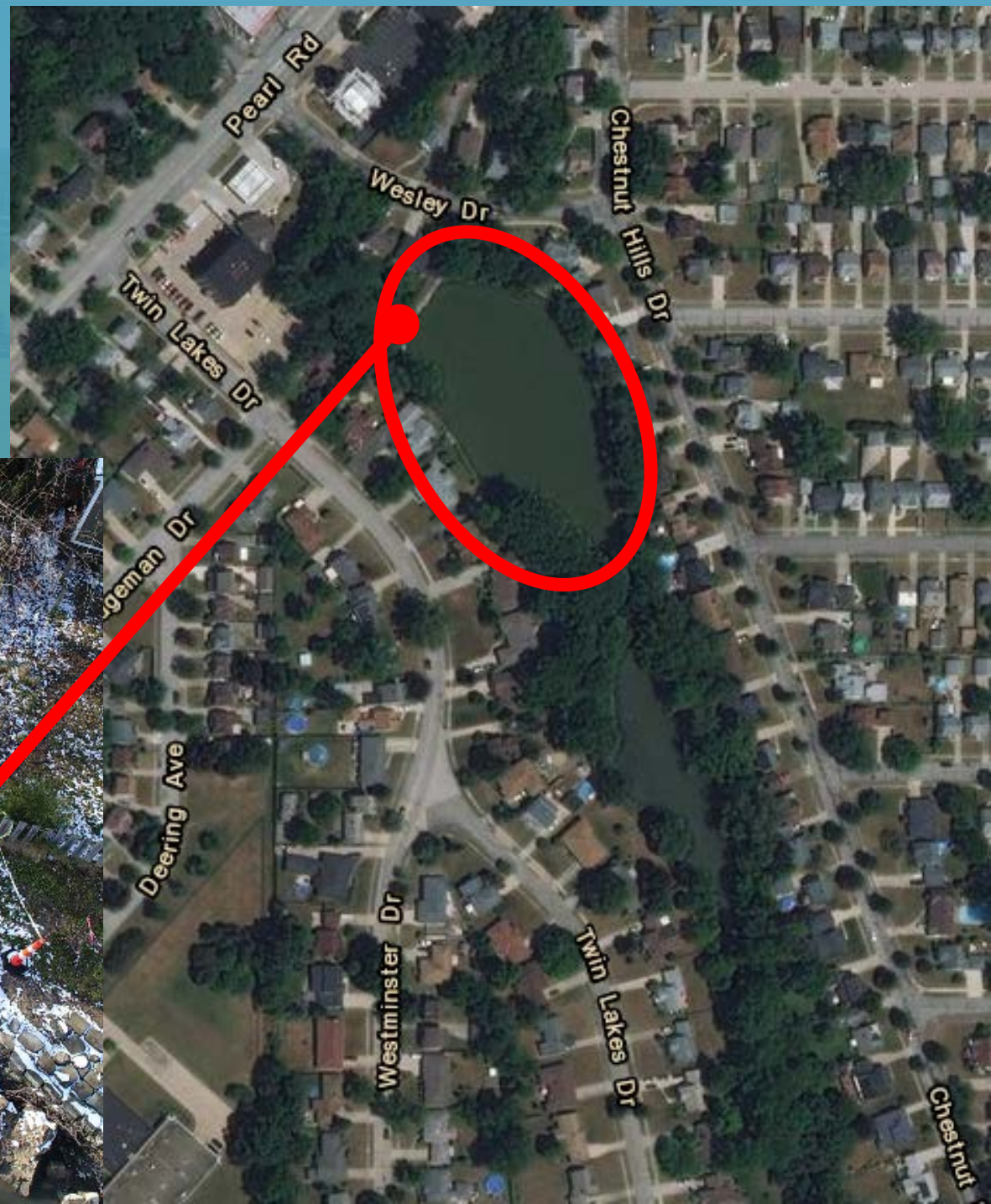


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Lower Twin Lake

- **City:** Parma, Ohio
- **Purpose:** Dam is failing, would like HOA add flood plain
- **Drone Function:** Take aerial photos so consultant can create concept art





Lower Twin Lake - By the Numbers

Number of Photos = 281



Flight Date:
January 21, 2018

Number of Boats Counted = 7



Lower Twin Lake



Twin Lakes Parma
Existing



Concept Art “Riparian Corridor” by
Environmental Design Group
(Akron, Ohio)

Shaker Wetland

City: Beachwood, Ohio

Purpose: Invasive Species recently removed from degraded 1.1-acre wetland, City wanted conceptual design and cost

Drone Function: Take new aerial photos for concept design



Figure 2 Existing Conditions.

Draft Concepts by NEORSD Paul Kovalcik

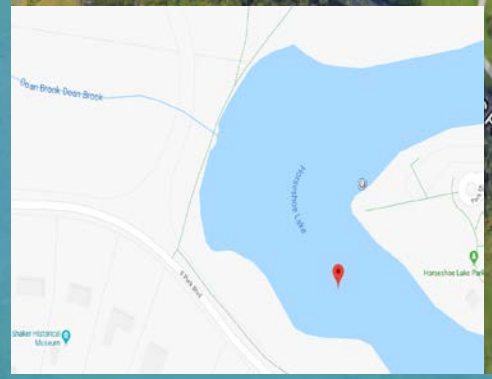
Northeast Ohio Regional Sewer District



Figure 3 Recommended restoration concept.

Horseshoe Lake

- City: Shaker Heights, Ohio
- Purpose: Dam rehabilitation
- Drone Function: Aerial images to monitor progress of project, videos for public outreach and project planning





Northeast Ohio Regional Sewer District

@neorsd

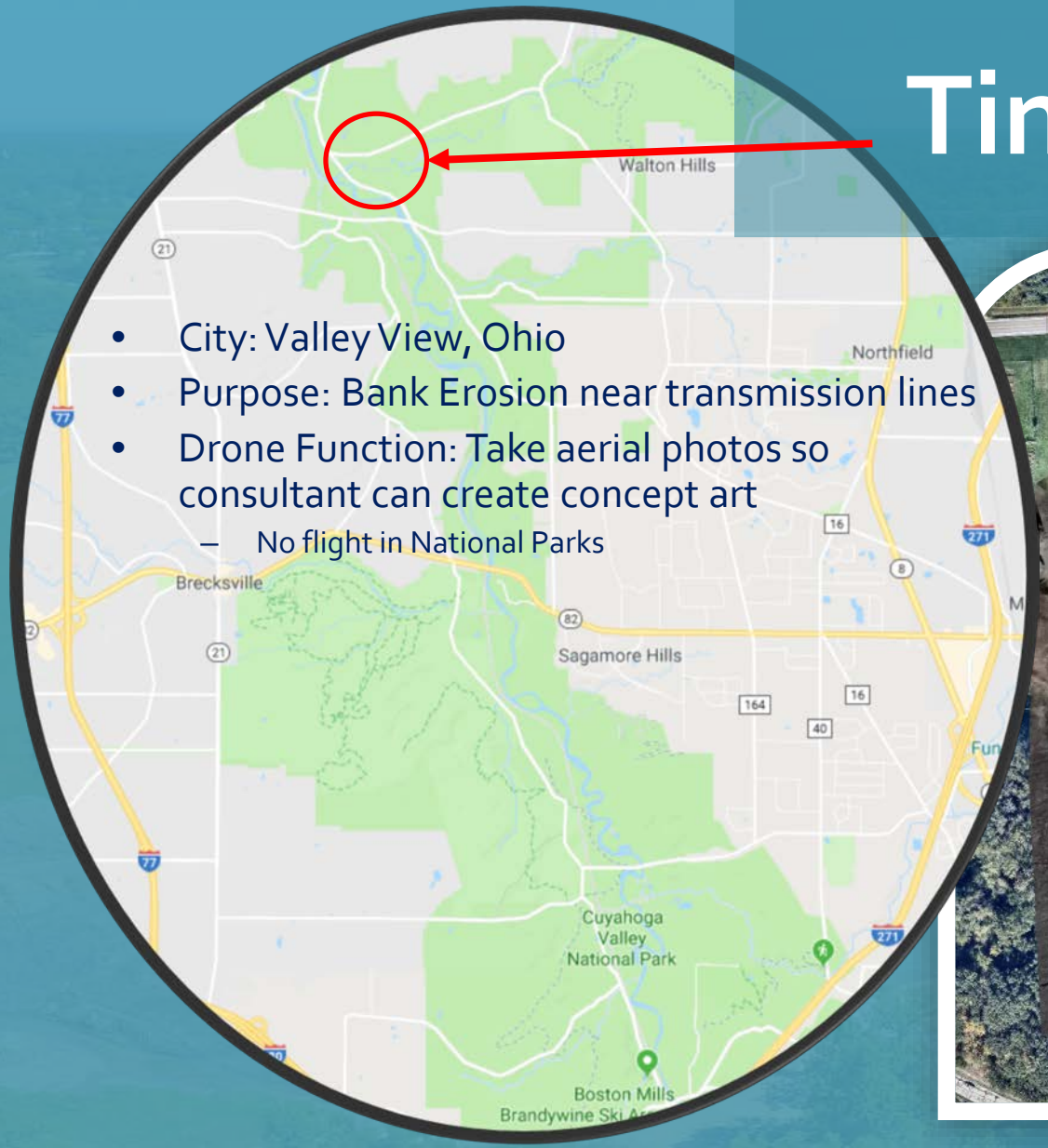
Horseshoe Lake Video Footage



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Tinkers Creek Erosion



- City: Valley View, Ohio
- Purpose: Bank Erosion near transmission lines
- Drone Function: Take aerial photos so consultant can create concept art
  - No flight in National Parks



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Compare Flights





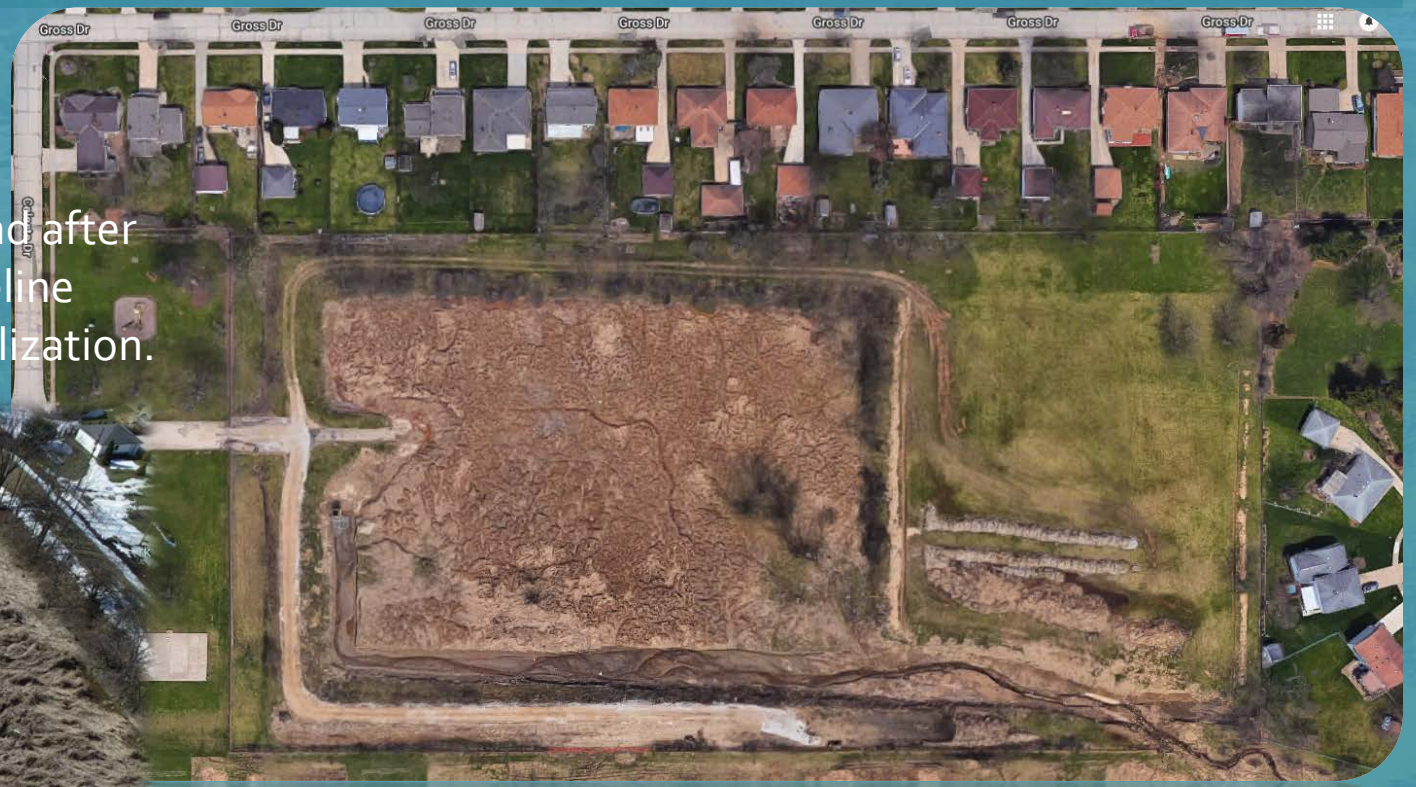
Northeast Ohio Regional Sewer District

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Bonnie Banks Basin

- City: Parma, Ohio
- Purpose: Dam rehabilitation
- Drone Function: Aerial images of before and after dredging maintenance. Evaluation of baseline conditions to assess potential stream stabilization.

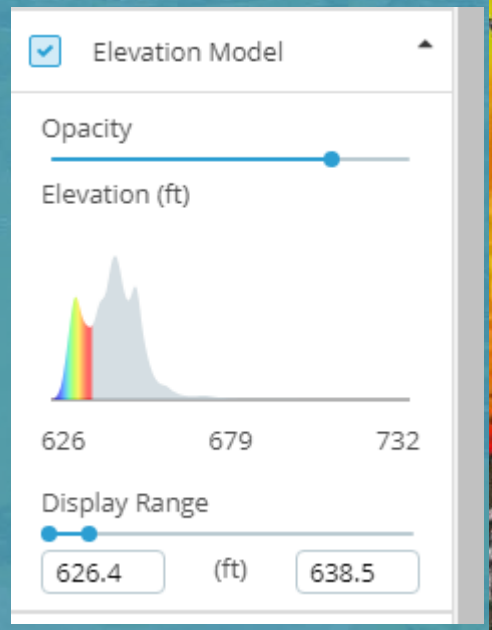


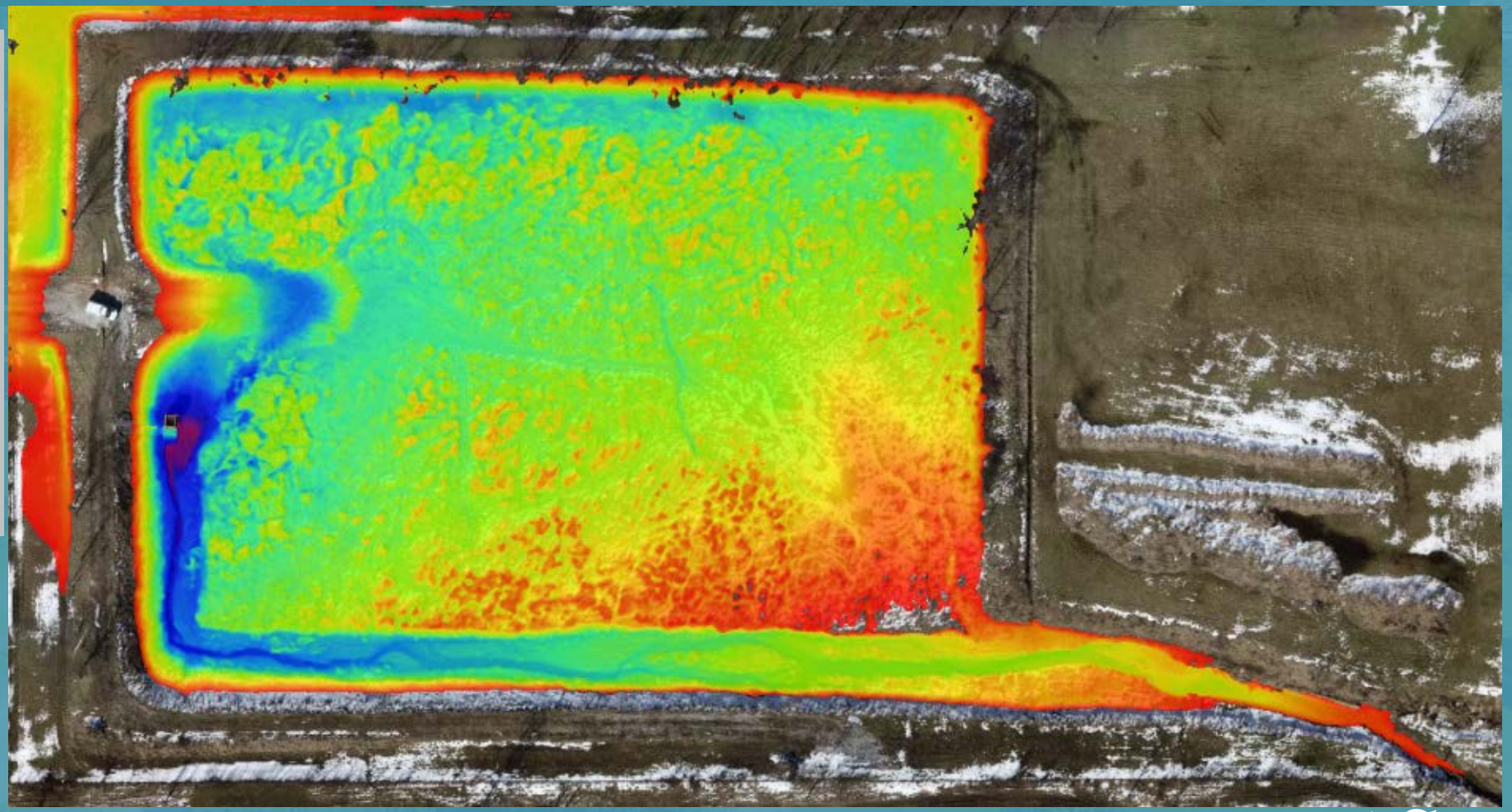


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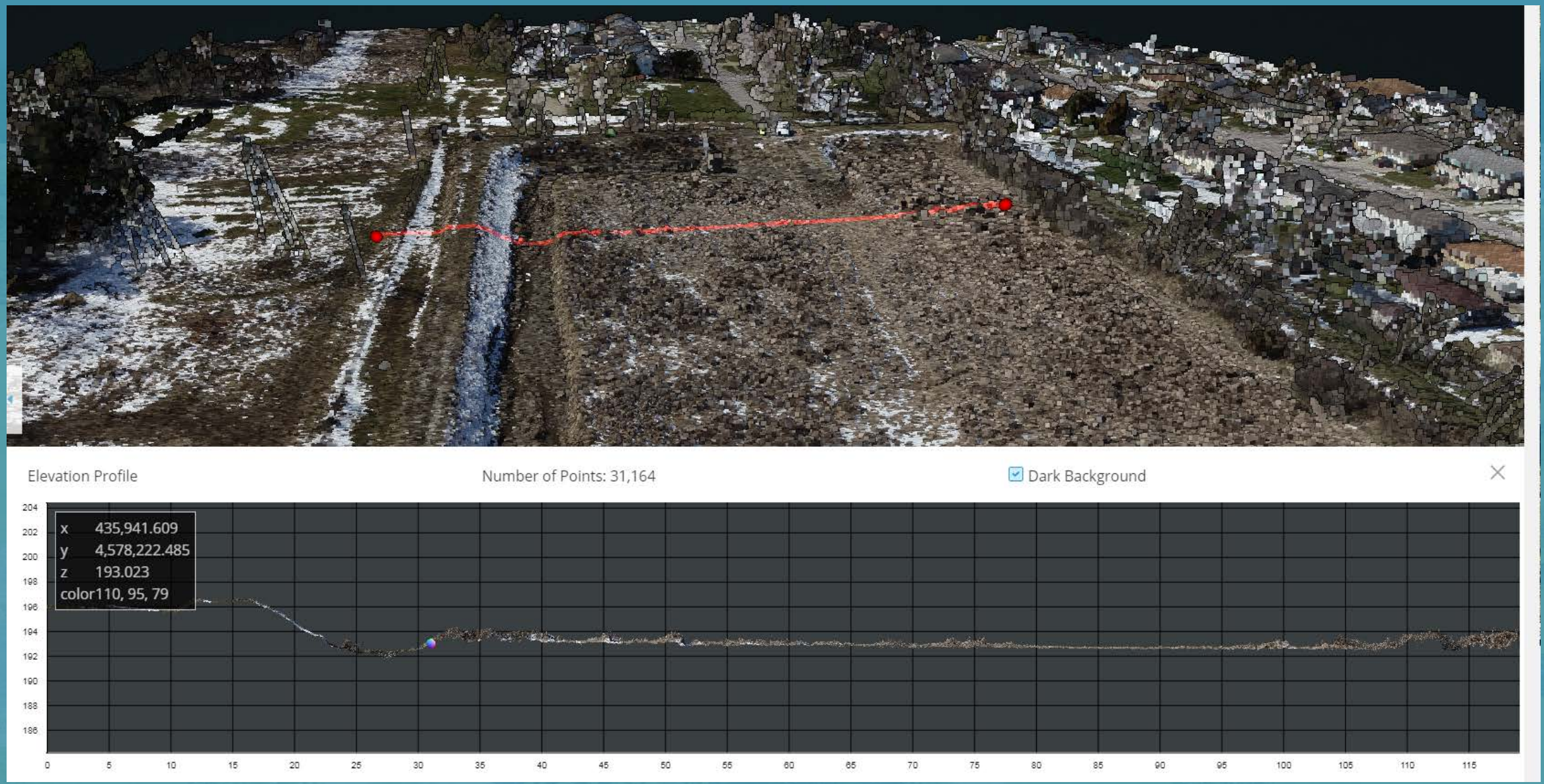
Bonnie Banks Basin





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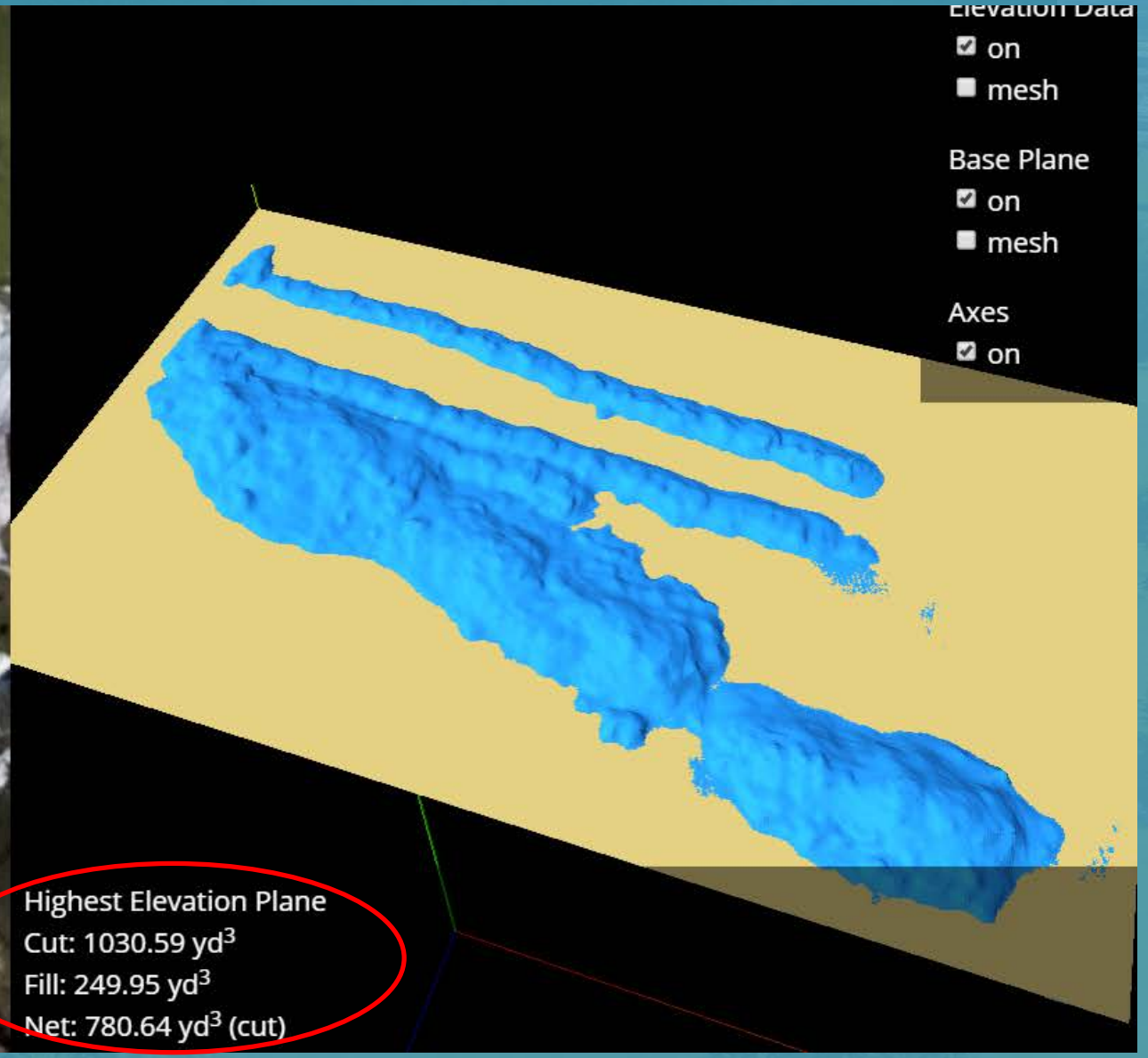


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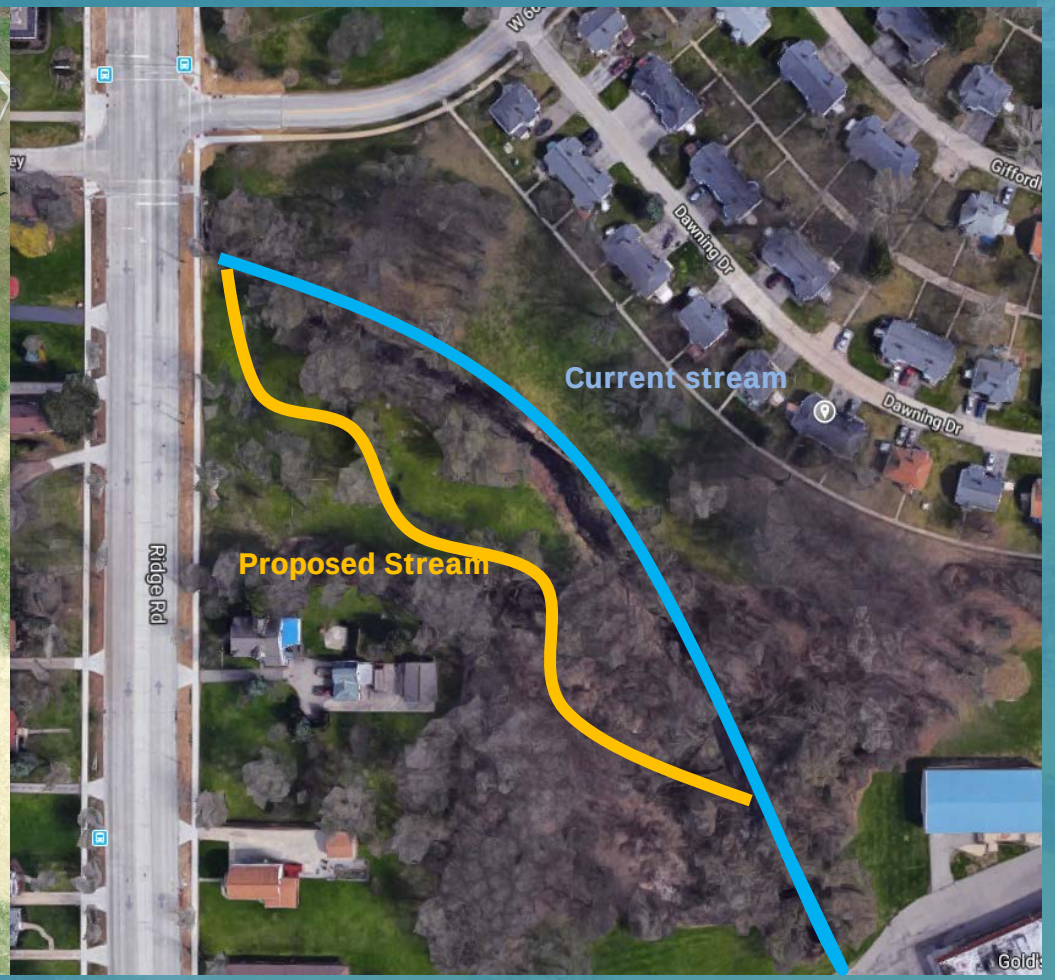
Bonnie Banks Basin





Stickney Creek

- City: Brooklyn, Ohio
- Purpose: Stream reroute
- Drone Function: Aerial images and video for public meetings with HOA and before/after documentation of project.



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Stickney Creek Video



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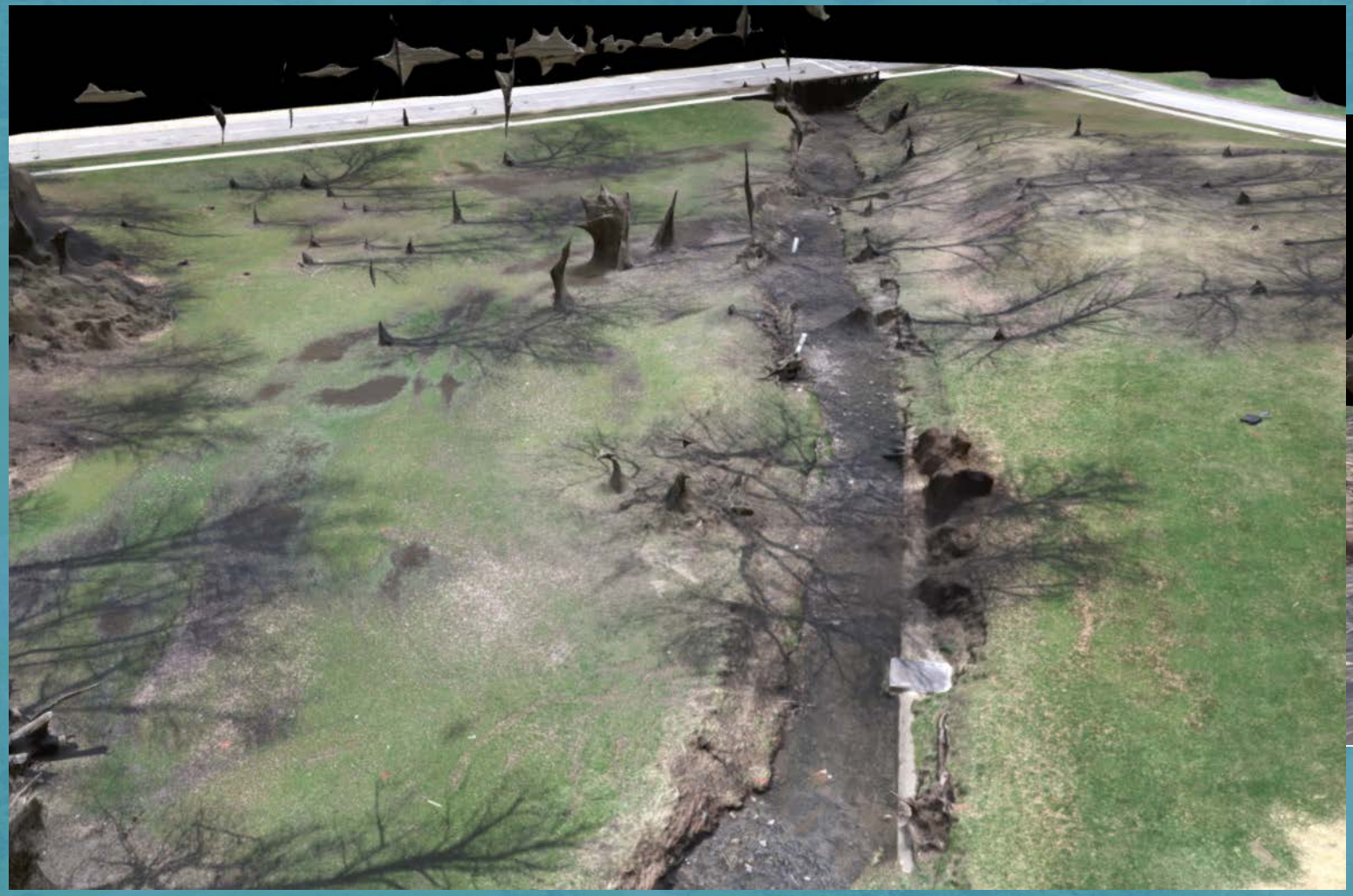
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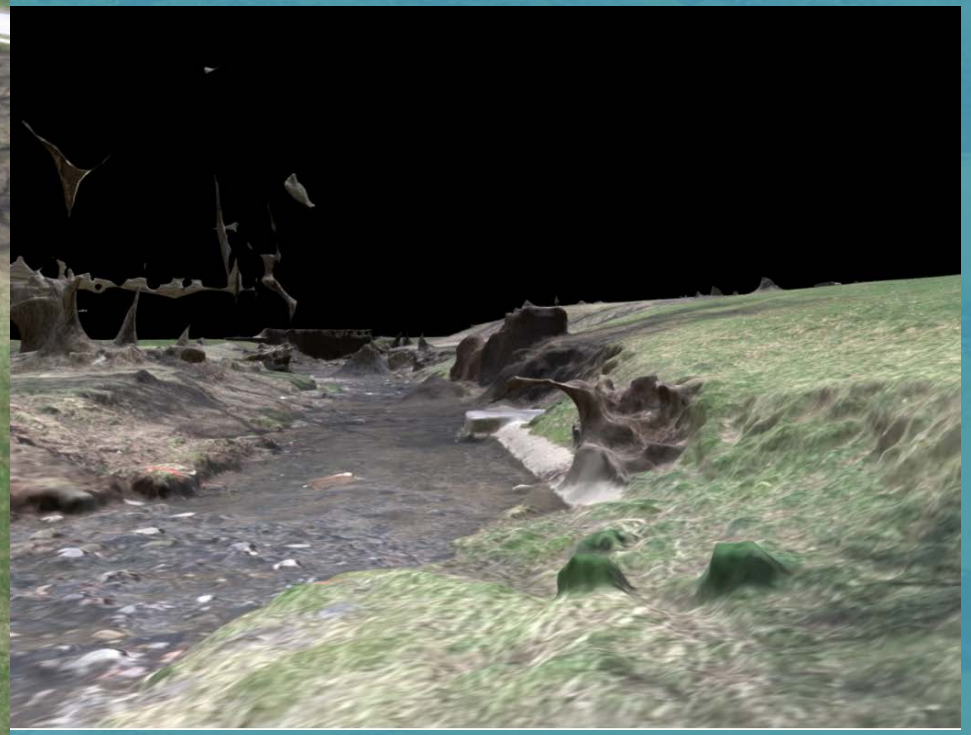
Stickney Creek Overlay



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Stickney Creek 3D Model





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Lessons Learned

- Leaves
- Gimble angle
- Auto flight
- GPS loss
- Overlap for Modeling
- Shadows
- Height of Flight



Future

- Pre-planning
- Progress inspections
- Modeling and flood simulations
- Continue to work toward data acquisition
- LiDAR

Questions

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NORTHEAST OHIO REGIONAL SEWER DISTRICT
REGIONAL STORMWATER MANAGEMENT PROGRAM