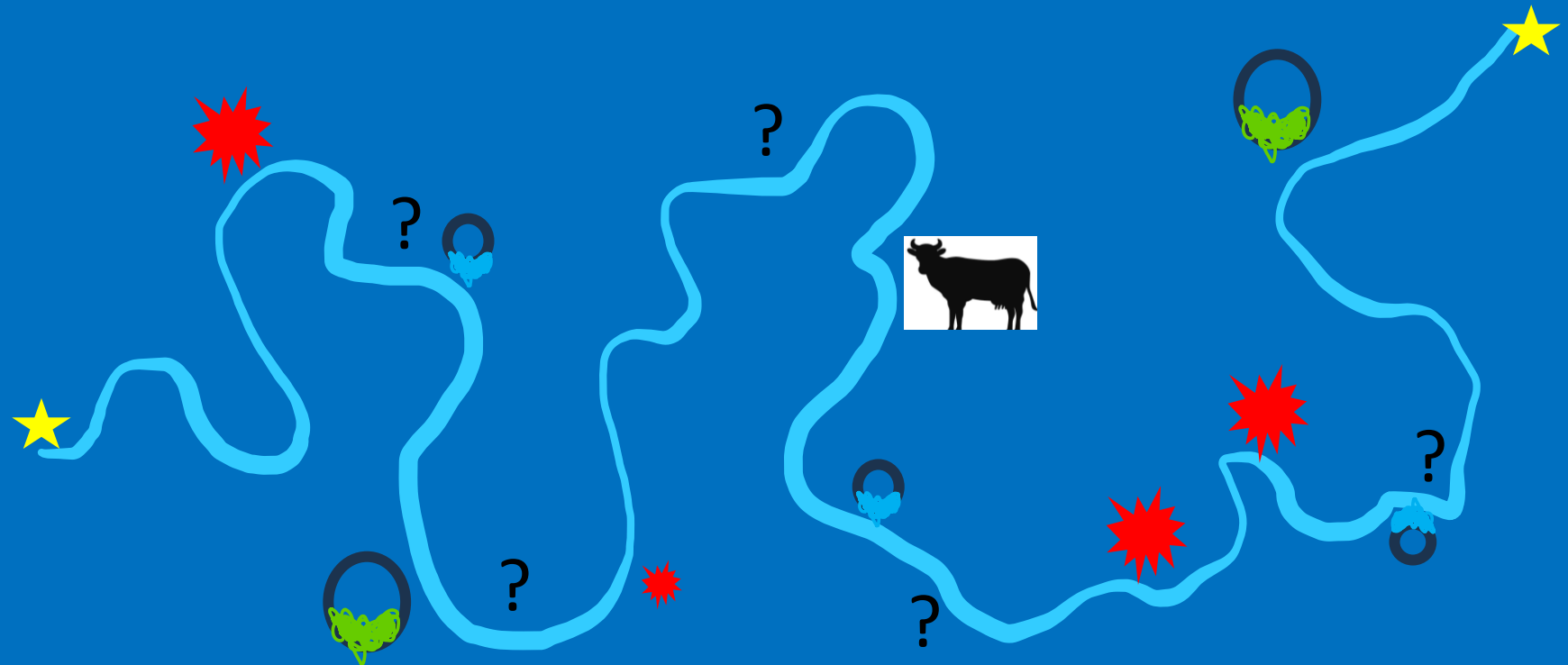
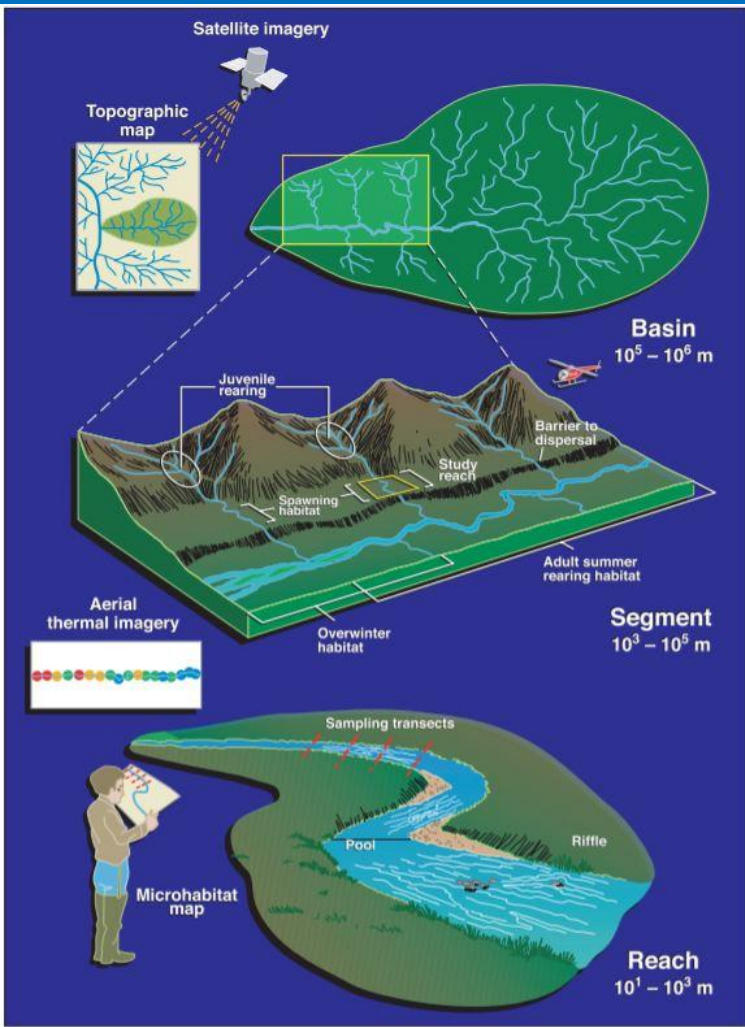




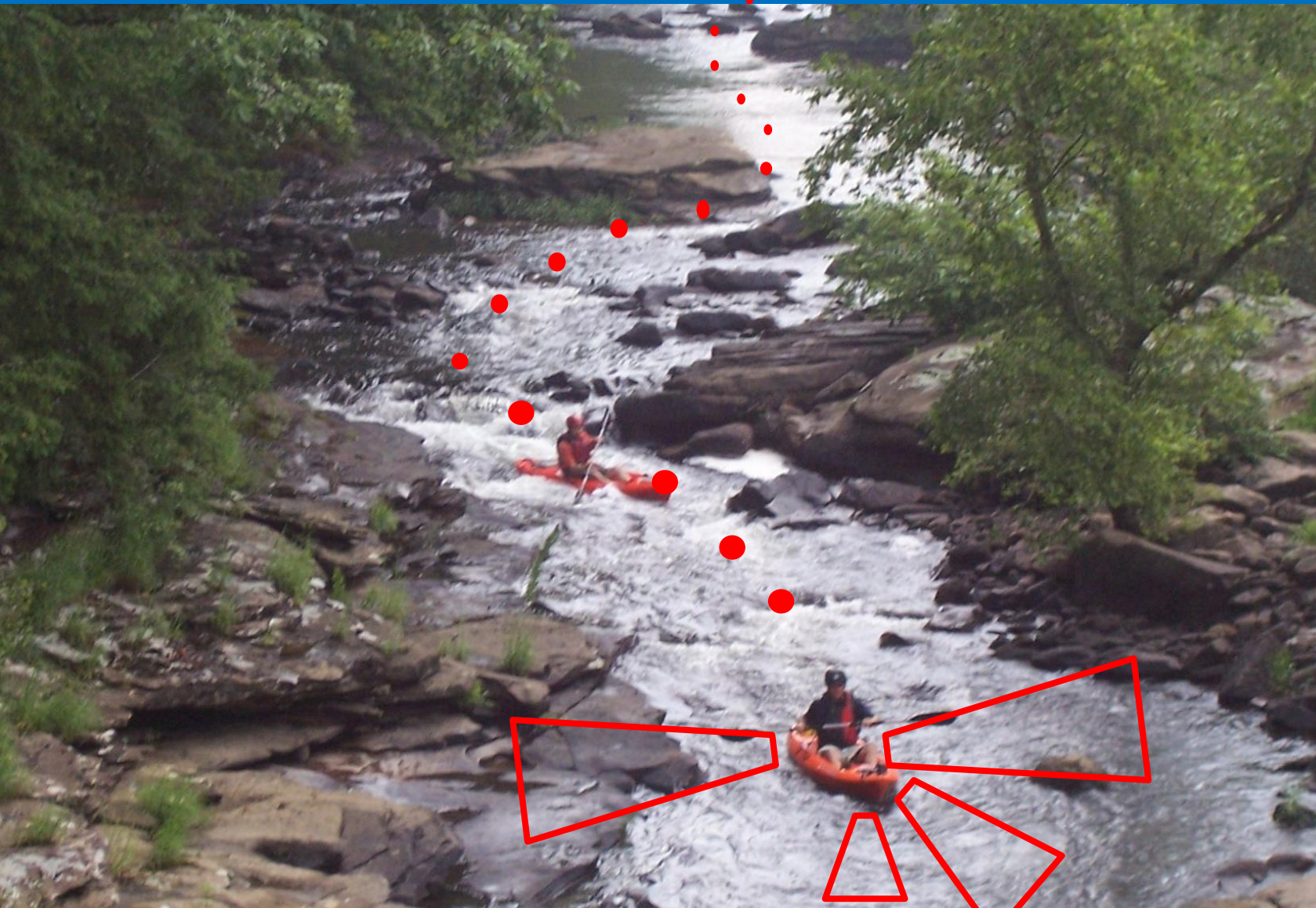
05/05/2025 🕒 13:48:02

Complete River & Stream Corridor Assessment

1. Rapid Inventory & Assessment
2. Understand the context, distribution and severity of the issues
3. Monitor change over time at 1m resolution



What Data Can We Collect?



Video

- Left & Right Streambank
- Riparian
- Infrastructure

Underwater Video

- Substrate Type

Side Scan Sonar

- Depth
- Side-scan imagery
- Substrate Type

Acoustic Doppler Current Profiler

- Bathymetry
- Discharge

Water Quality Sensor

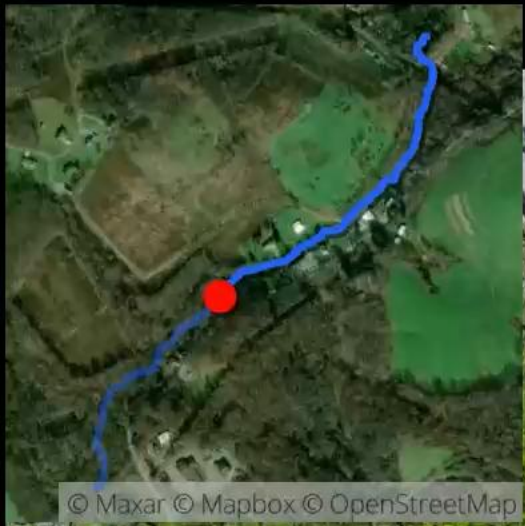
- DO, pH, Temp, etc.

Water Grab Samples

- Lab testing
- eDNA

GPS

Time
Location
Elevation



+39.481145
-79.662799

© Maxar © Mapbox © OpenStreetMap

High Definition Stream Survey Greens Run Watershed, WV

Track: GR_D1B1T2



Left



Front

05/05/2025 14:08:36



Down



Right

Segment: GR-Seg-504

HDSS Survey Platforms



BACKPACK



KAYAK



INFLATABLE BOAT



TABLETS



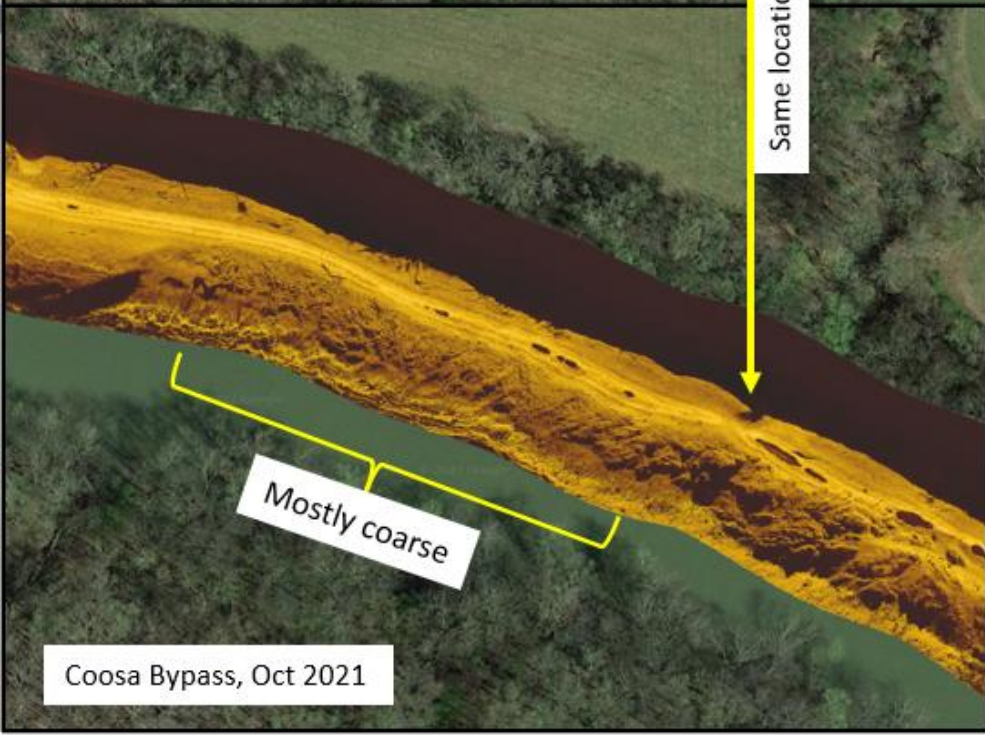
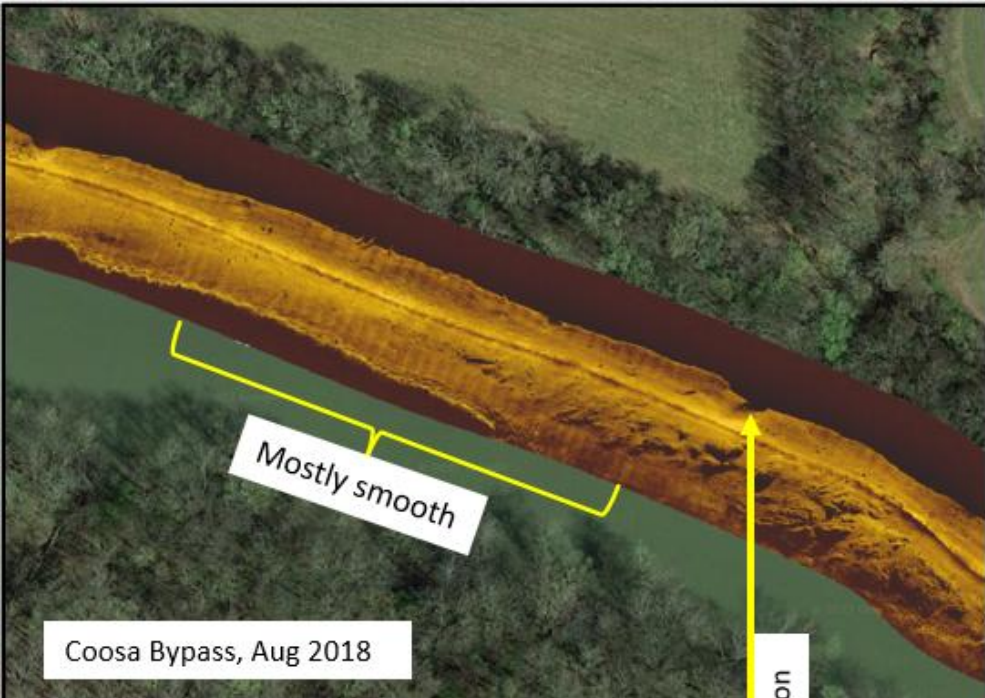
DRONE



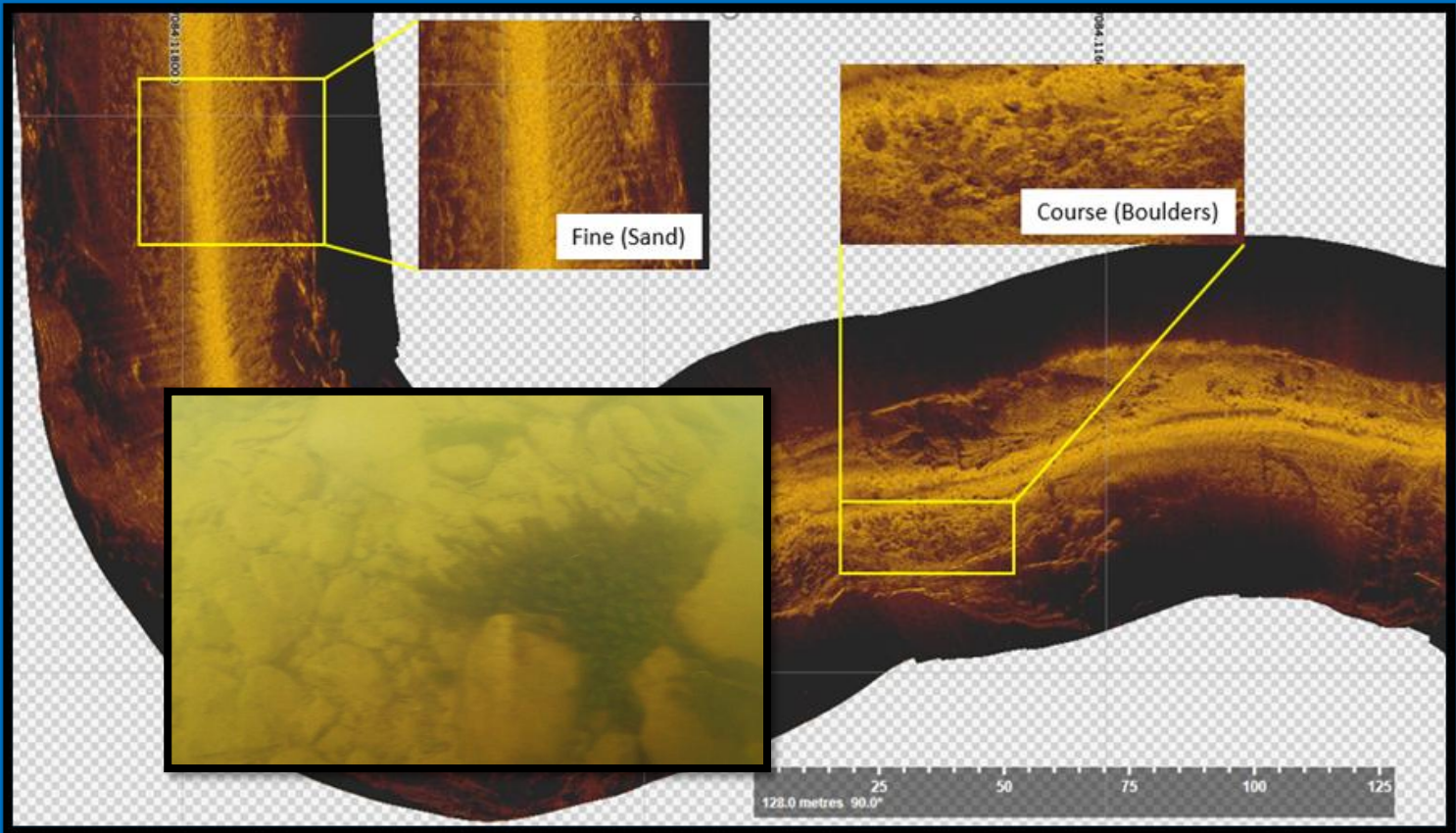
AUTONOMOUS BOAT

Change Over Time

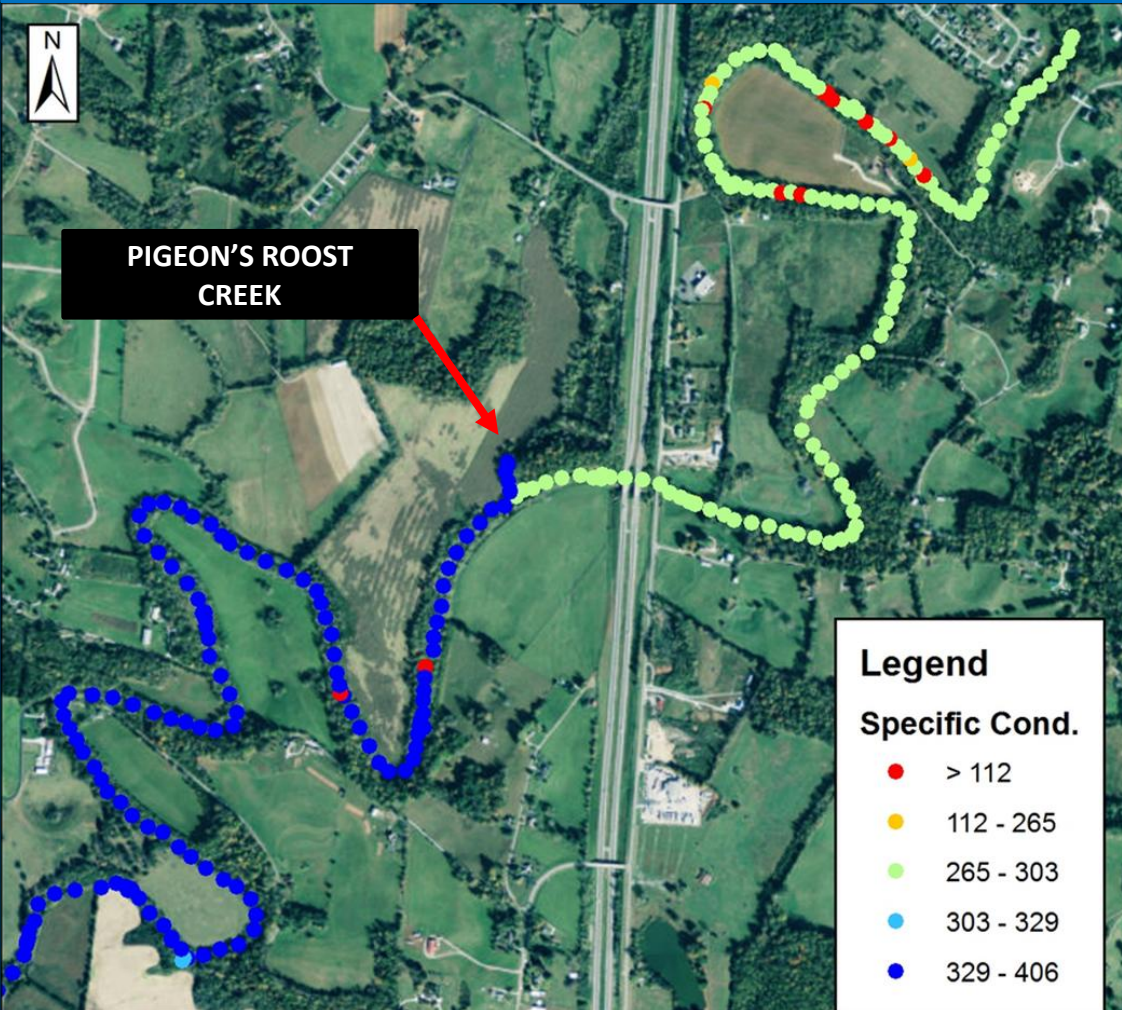
Side-scan Sonar & Video



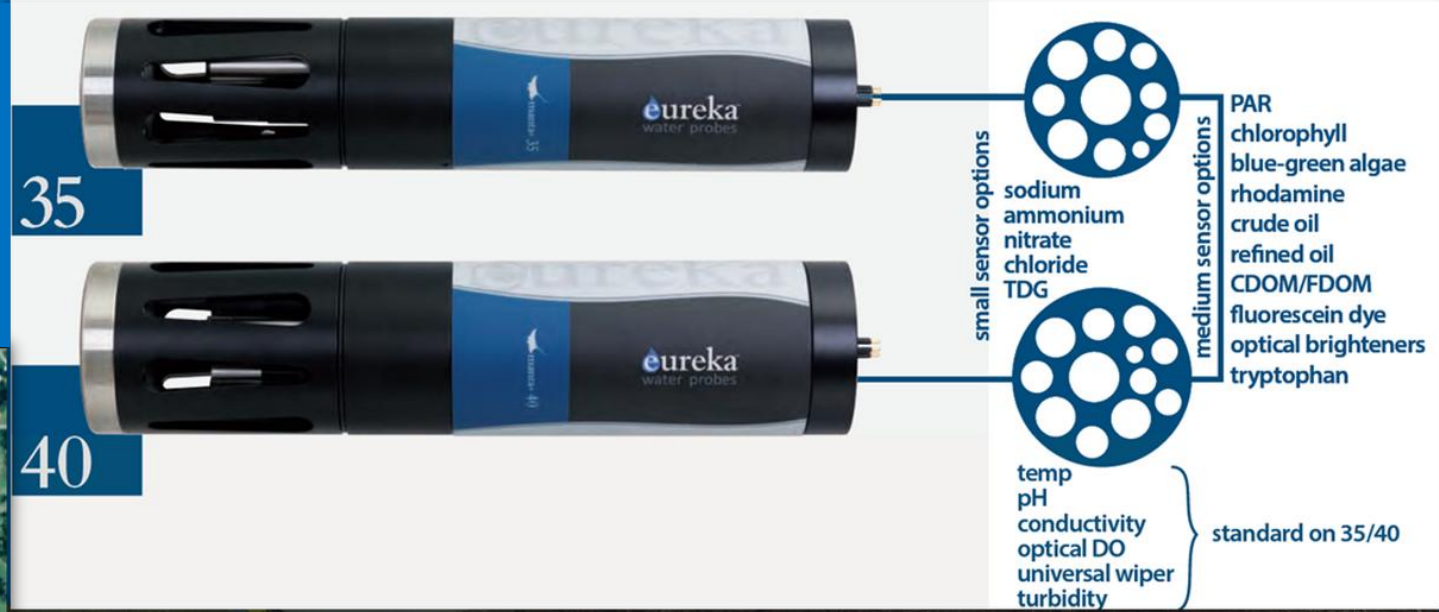
Same location



Water Quality



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

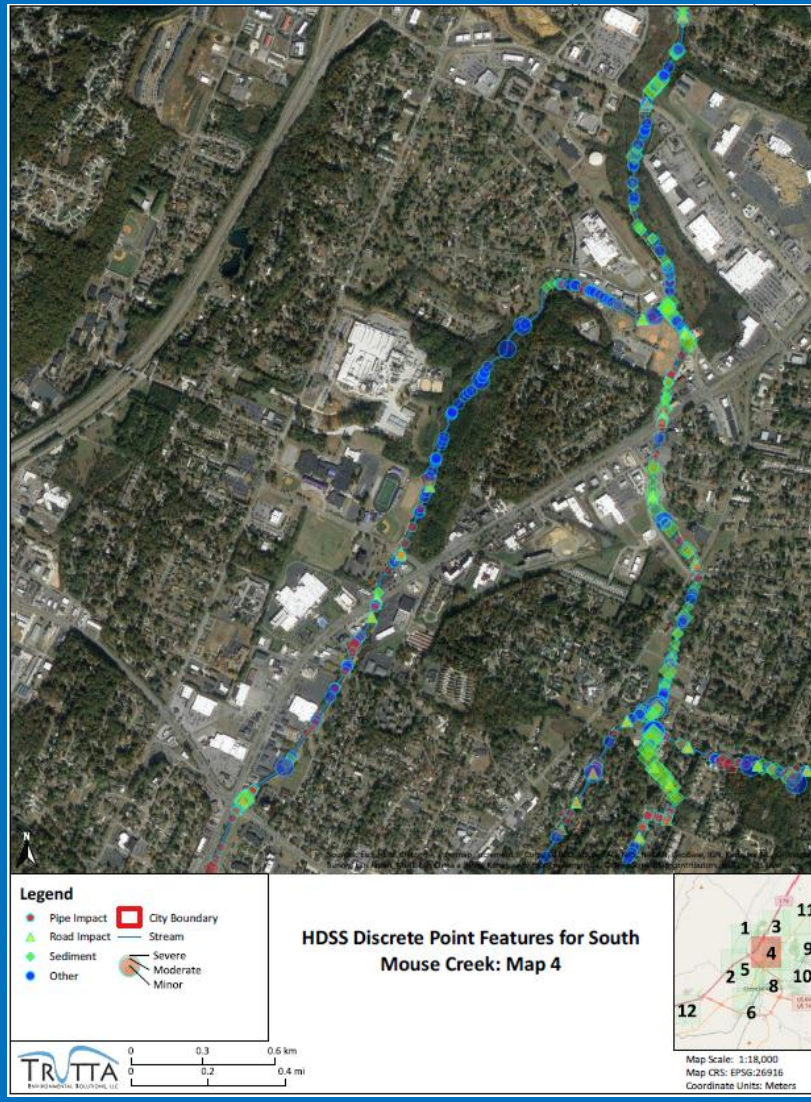


Habitat Data Linked in GIS

Time, Location & Condition Scores

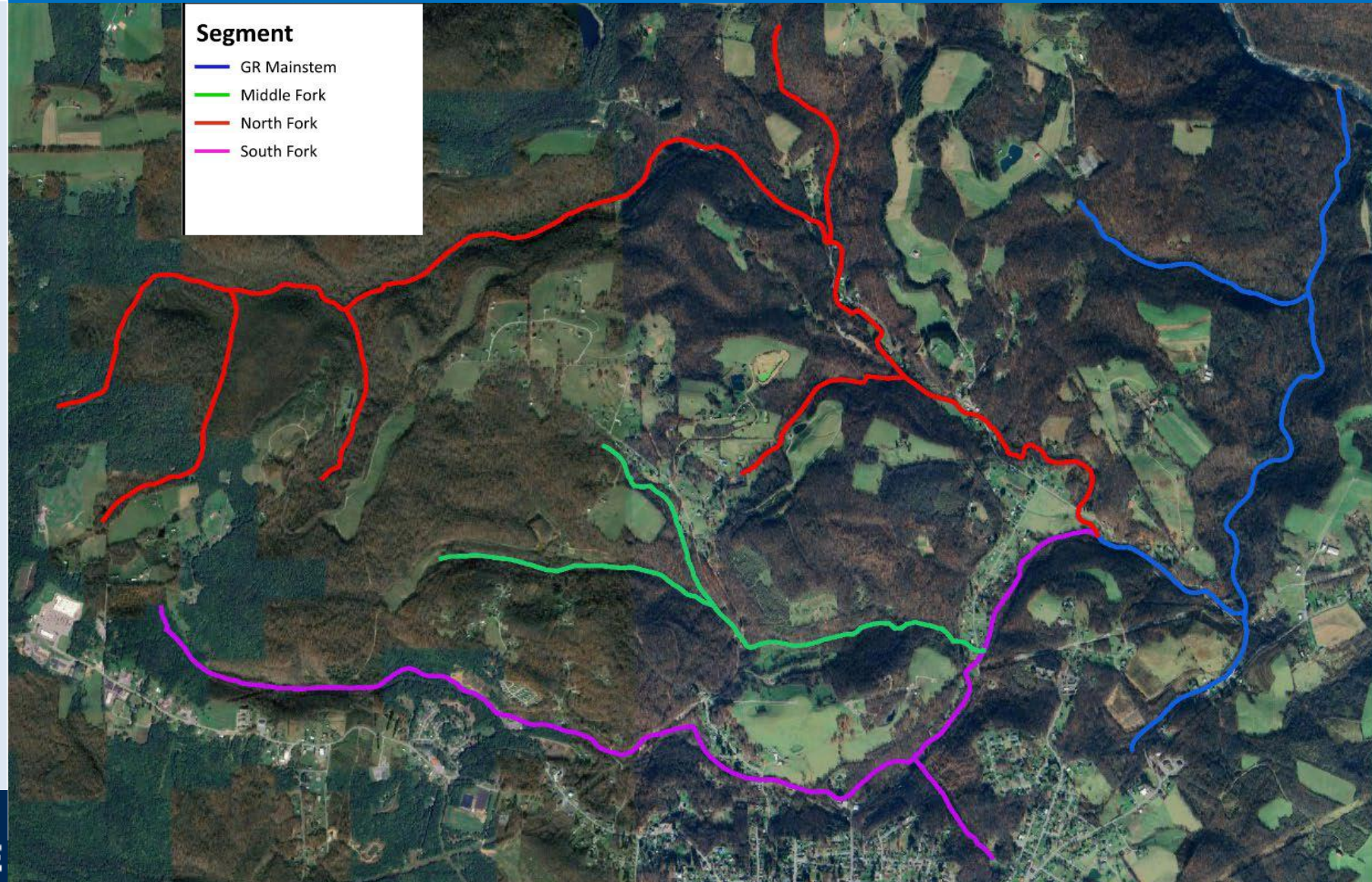


Maps Showing Conditions Combined Data, Point Data & Prioritized Data



Problem: Acid Mine Drainage

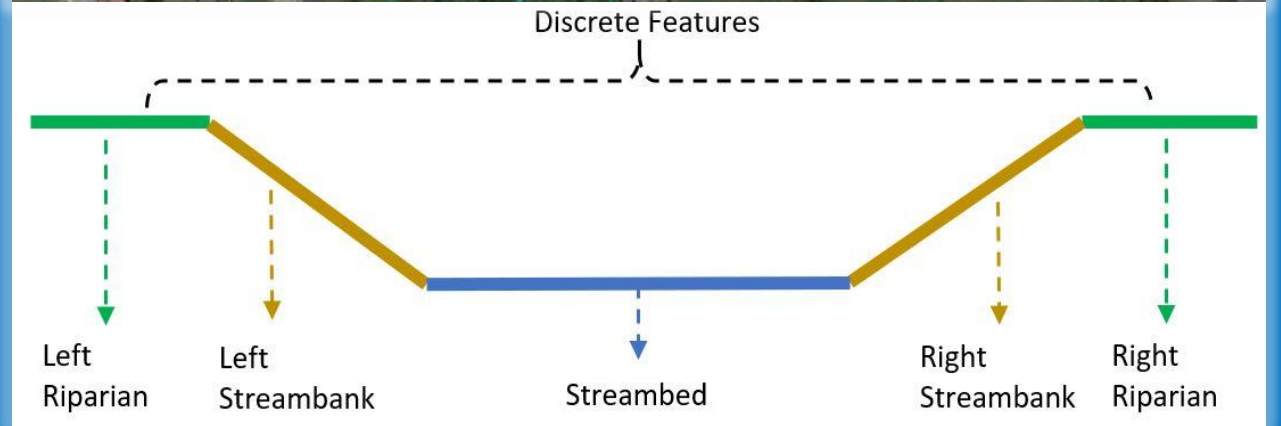
- Source and intensity of the impacts is unclear.
- Prioritize location for active treatment facility.



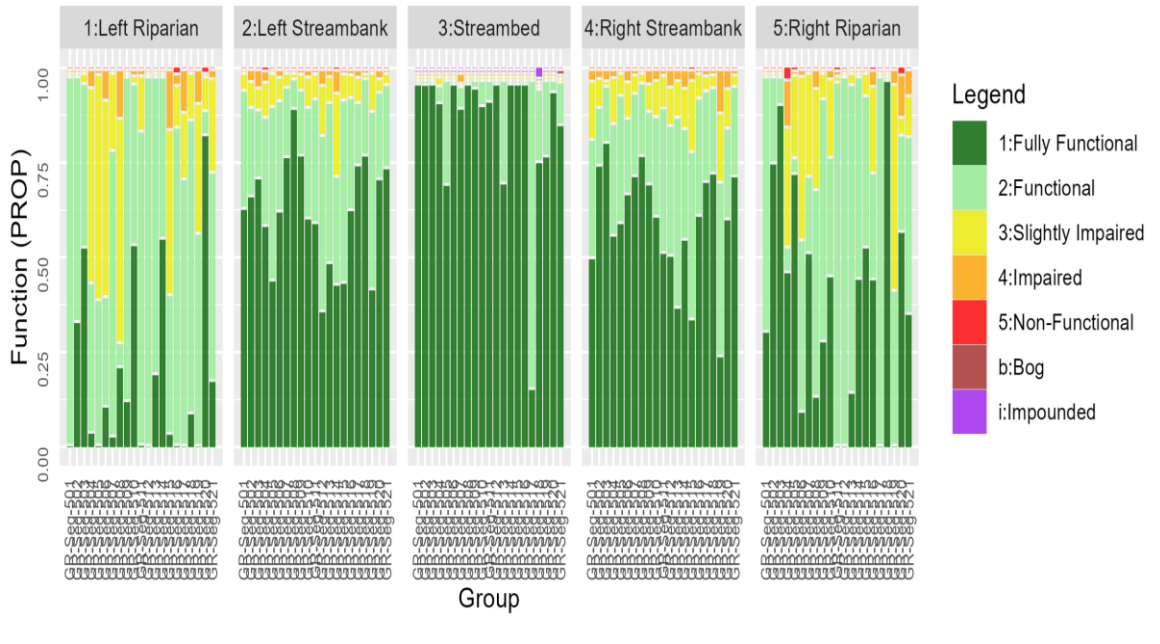
Stream Corridor Assessment

For Impact Assessment & Project Prioritization

- Riparian zones
- Streambank
- Streambed
- Discrete features



Stream Corridor Inventory and Assessment

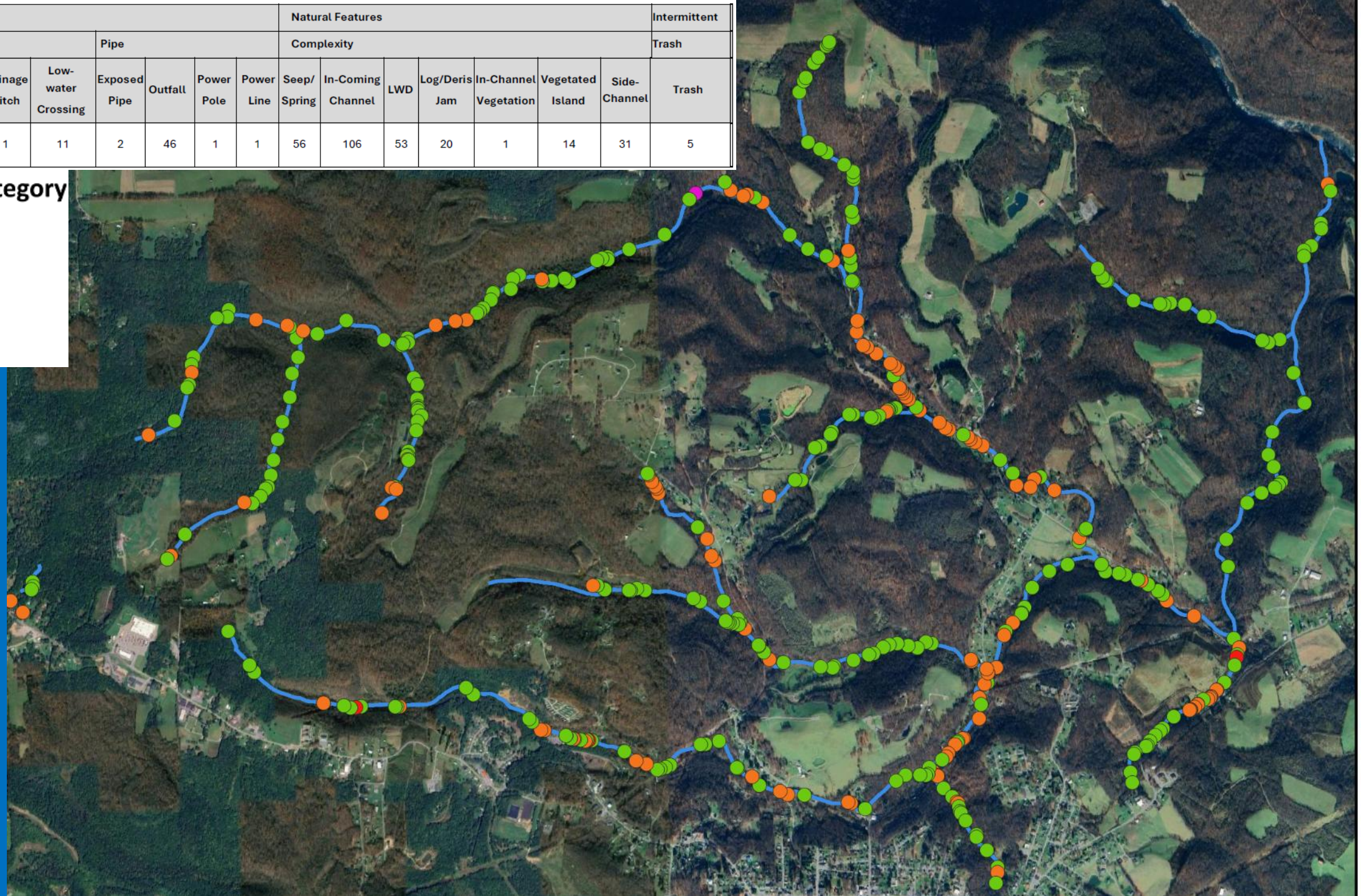


Category		Infrastructure								Natural Features							Intermittent
Class		Road				Pipe				Complexity							Trash
Project	Total	Overhead Bridge	Culvert	Drainage Ditch	Low-water Crossing	Exposed Pipe	Outfall	Power Pole	Power Line	Seep/Spring	In-Coming Channel	LWD	Log/Deris Jam	In-Channel Vegetation	Vegetated Island	Side-Channel	Trash
Greens Run	405	34	23	1	11	2	46	1	1	56	106	53	20	1	14	31	5

Discrete Feature Category

byCategory

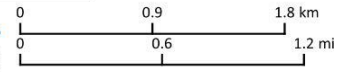
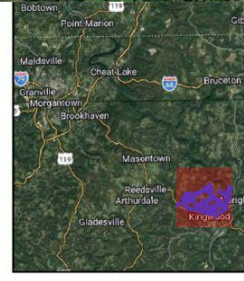
- Infrastructure
- Intermittent
- Natural Feature
- Powerline



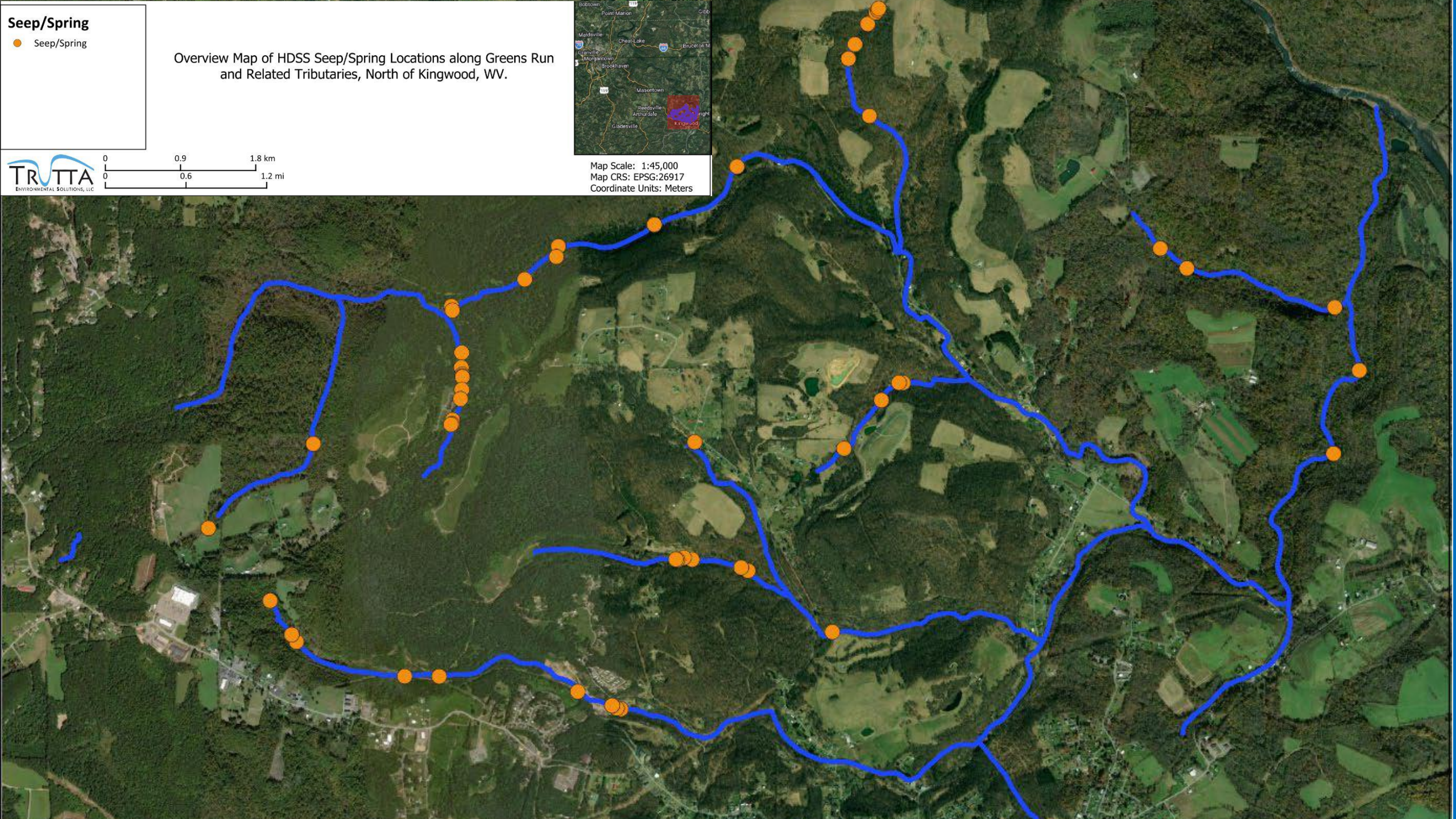
Seep/Spring

● Seep/Spring

Overview Map of HDSS Seep/Spring Locations along Greens Run and Related Tributaries, North of Kingwood, WV.



Map Scale: 1:45,000
Map CRS: EPSG:26917
Coordinate Units: Meters



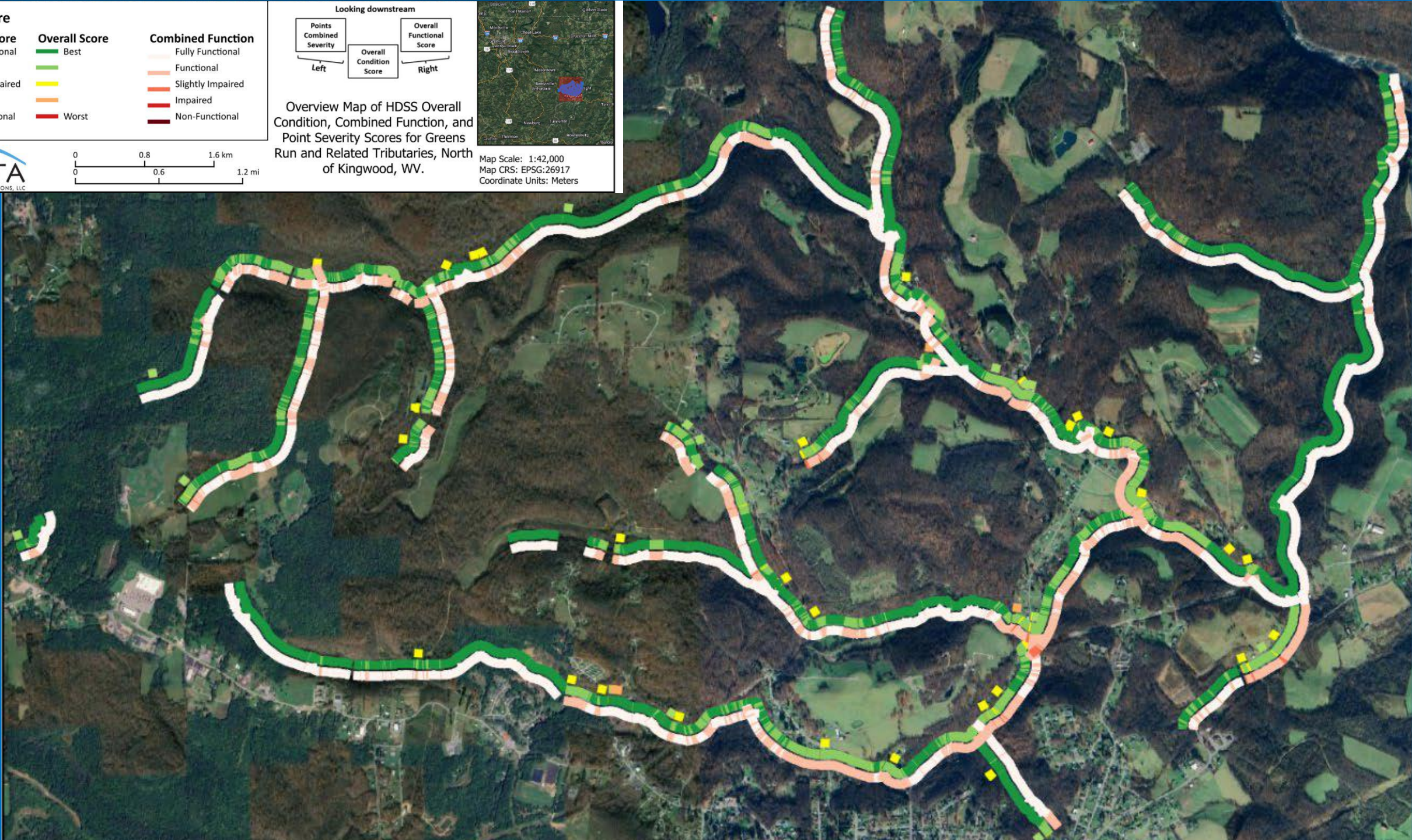
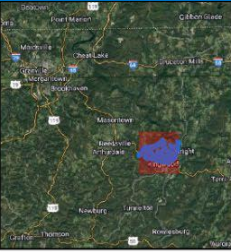
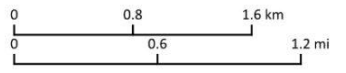
Overall Score

Pt Severity Score	Overall Score	Combined Function
Fully Functional	Best	Fully Functional
Functional	Good	Functional
Slightly Impaired	Fair	Slightly Impaired
Impaired	Poor	Impaired
Non-Functional	Worst	Non-Functional

Looking downstream

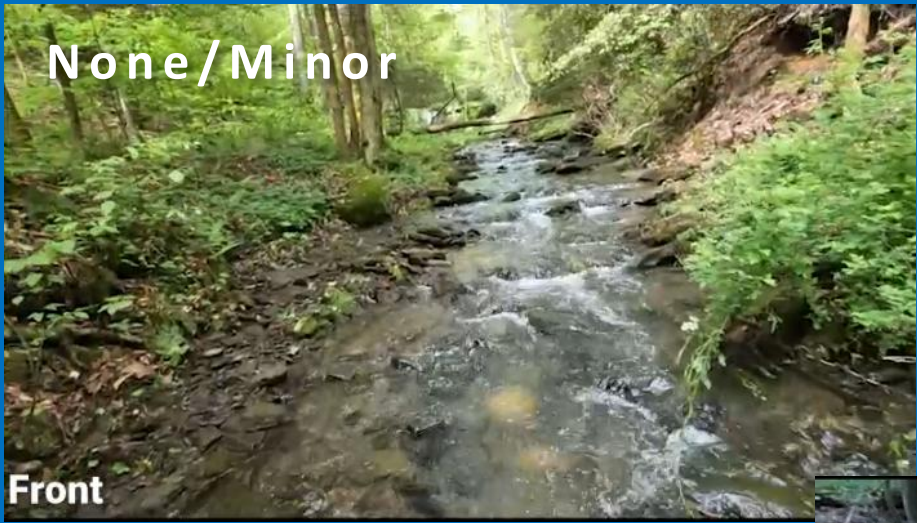
Overview Map of HDSS Overall Condition, Combined Function, and Point Severity Scores for Greens Run and Related Tributaries, North of Kingwood, WV.

Map Scale: 1:42,000
Map CRS: EPSG:26917
Coordinate Units: Meters



Stream Channel Modification

Iron-Oxidizing Bacteria



None/Minor

Front



Moderate

Front



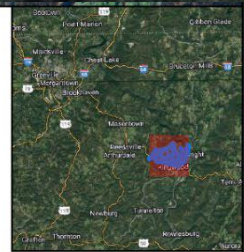
Intense

Front

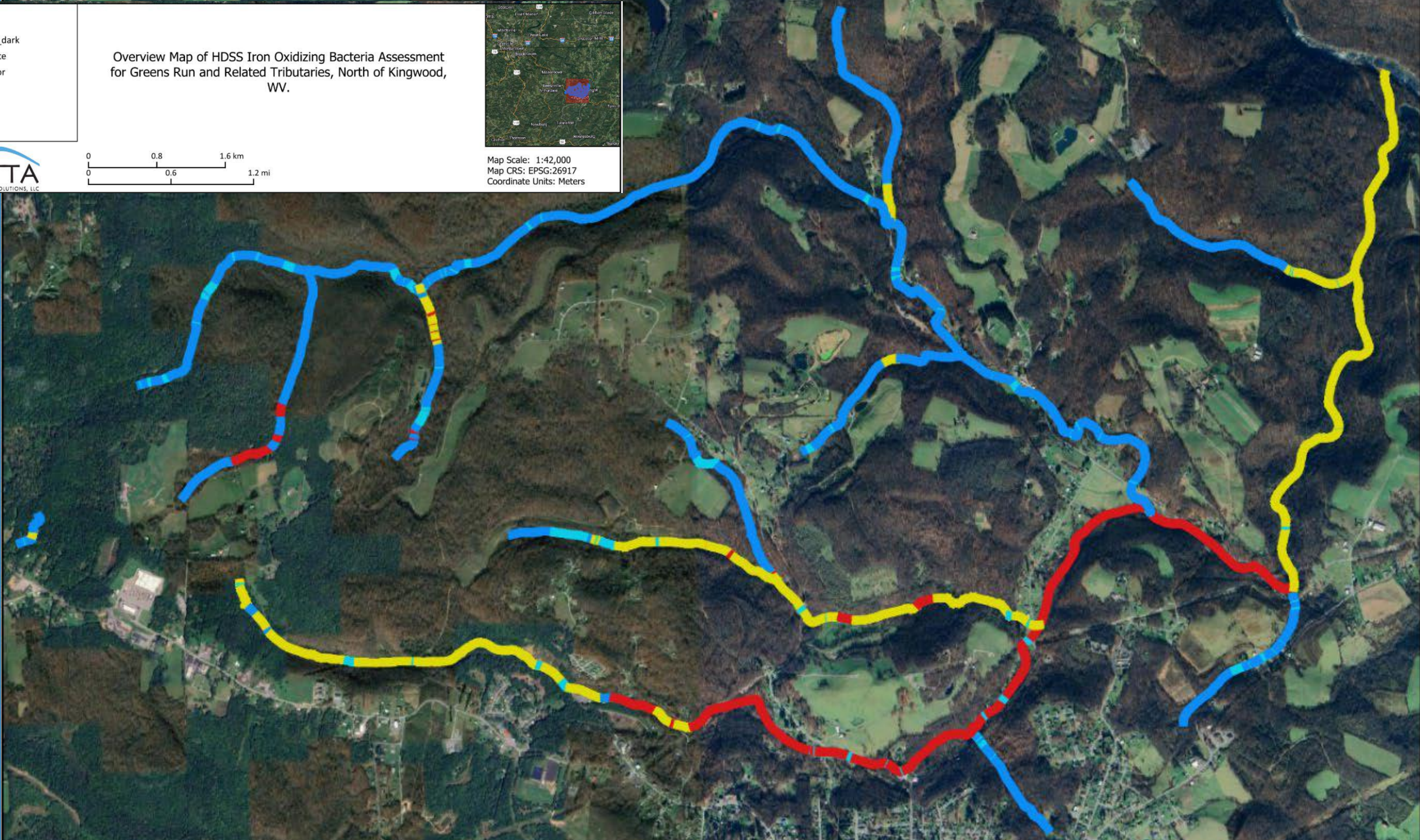
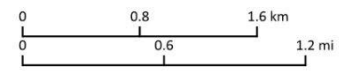
Intensity

- █ intense_dark
- █ moderate
- █ no/minor

Overview Map of HDSS Iron Oxidizing Bacteria Assessment for Greens Run and Related Tributaries, North of Kingwood, WV.



Map Scale: 1:42,000
Map CRS: EPSG:26917
Coordinate Units: Meters

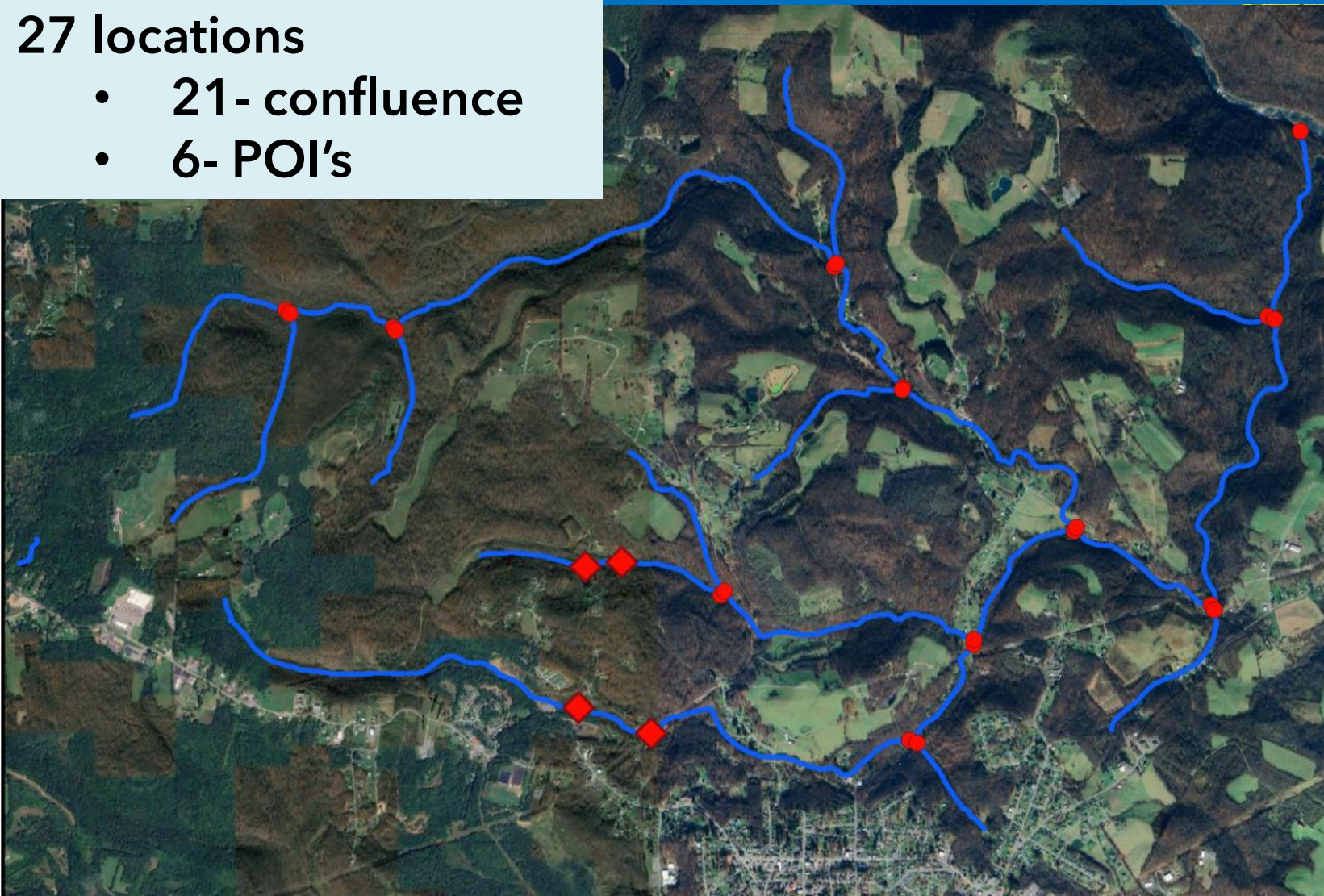


Site Specific Sampling

- Discharge Measurements

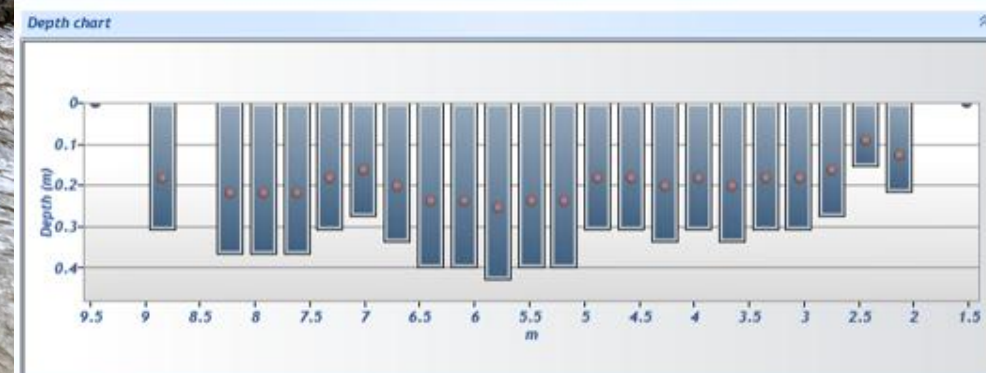
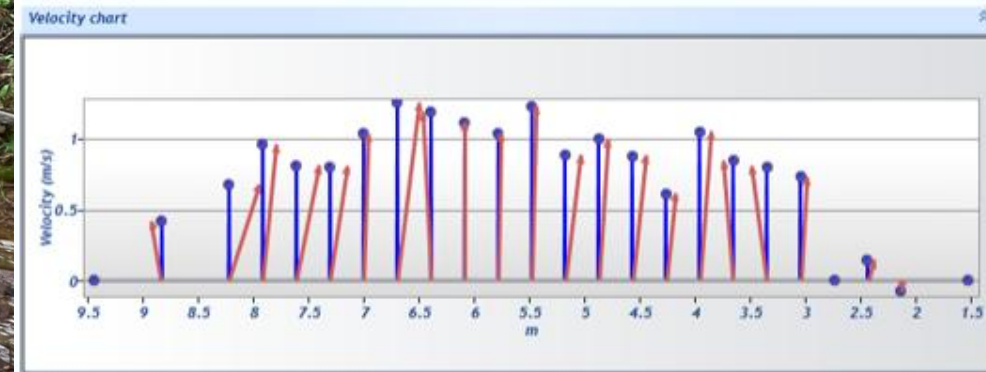
27 locations

- 21- confluence
- 6- POI's



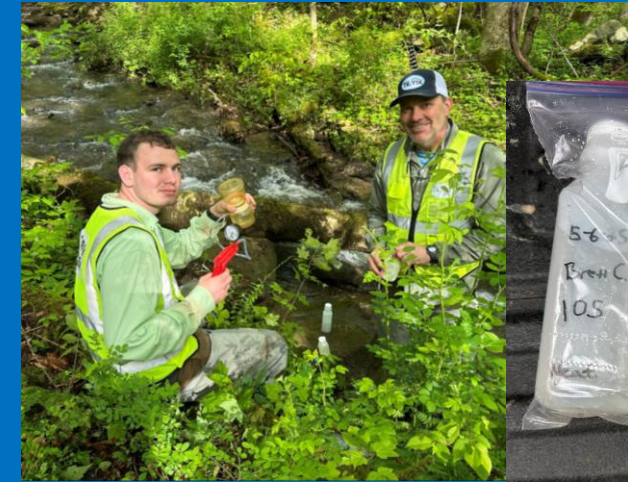
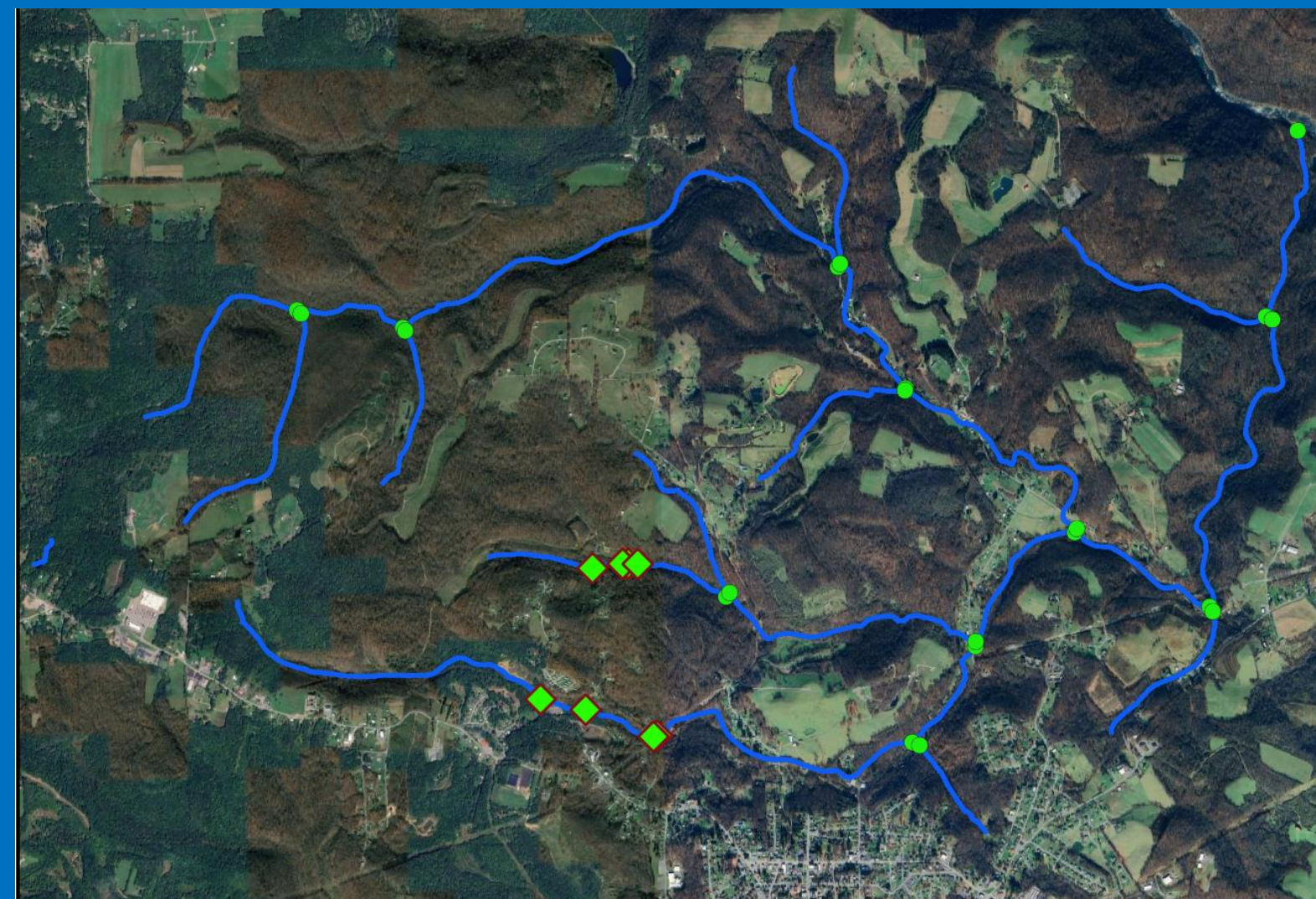
Site Specific Sampling

- Discharge Measurements



Site Specific Sampling

- Water Quality Grab Samples



29 locations

- 21- confluence
- 8- POI's

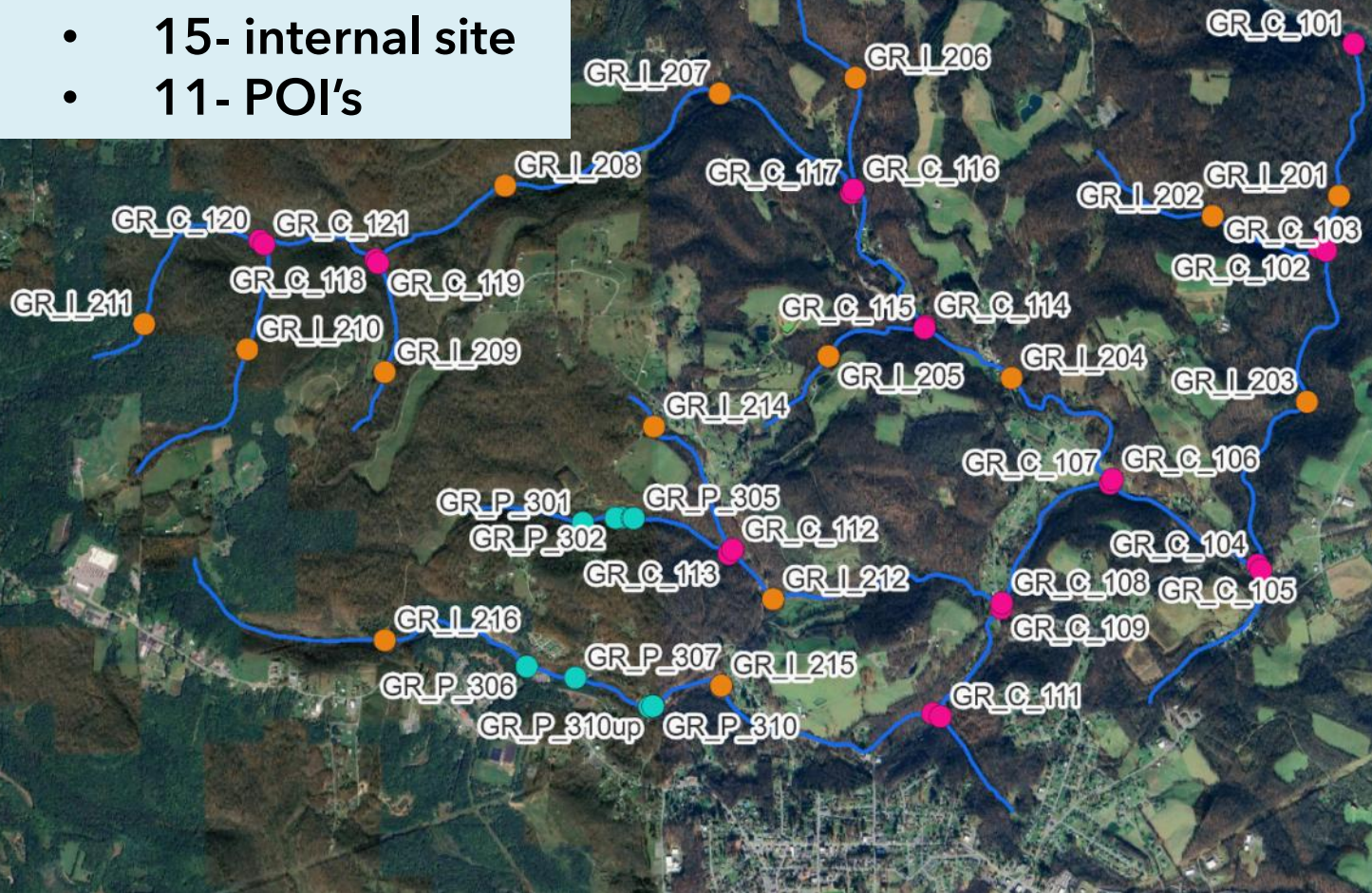
WVWRI Protocols
Chain of Custody

Site Specific Sampling

- Water Quality Sonde Sample

47 locations

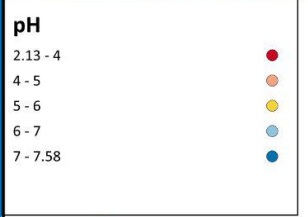
- 21- confluence
- 15- internal site
- 11- POI's



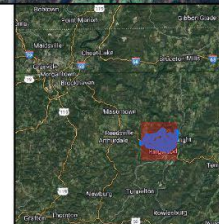
- ≥ 3 subsamples / site
- pH
- Dissolved Oxygen
- Temperature
- Turbidity
- Specific Conductivity
- Ammonia
- Nitrate
- CDOM



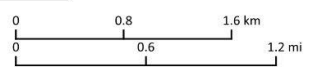
Sources: Esri, HERE, DeLorme, Intermap, increment IP Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGM, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, mapmyIndia, ©OpenStreetMap contributors, and the GIS User Community



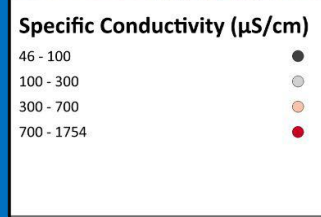
Mean pH Among Sites for the Greens Run Project Area, North of Kingwood, WV.



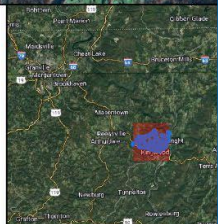
Map Scale: 1:42,000
Map CRS: EPSG:26917
Coordinate Units: Meters



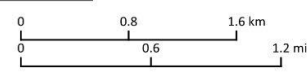
Sources: Esri, HERE, DeLorme, Intermap, increment IP Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGM, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, mapmyIndia, ©OpenStreetMap contributors, and the GIS User Community

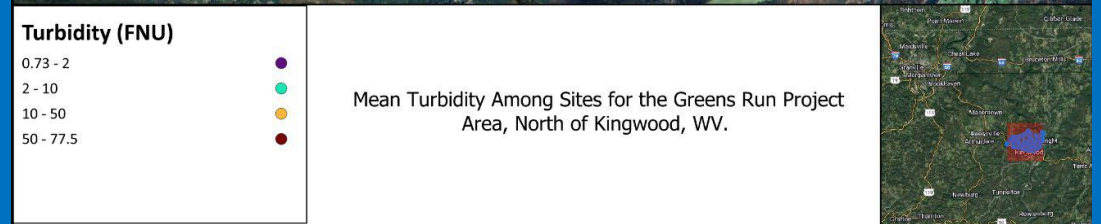
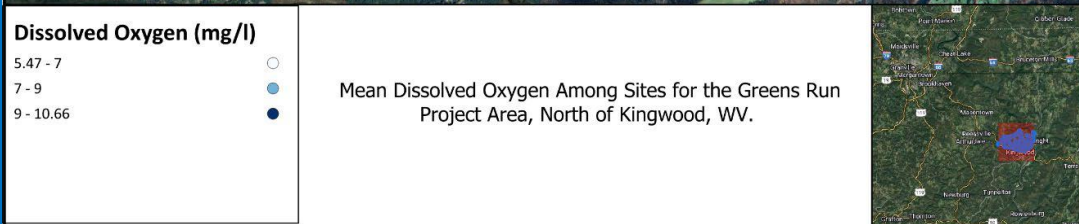


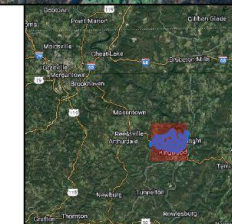
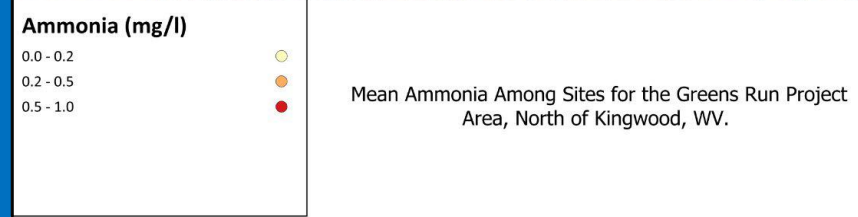
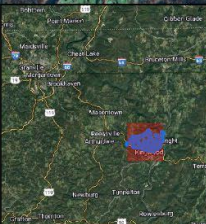
Mean Specific Conductivity Among Sites for the Greens Run Project Area, North of Kingwood, WV.

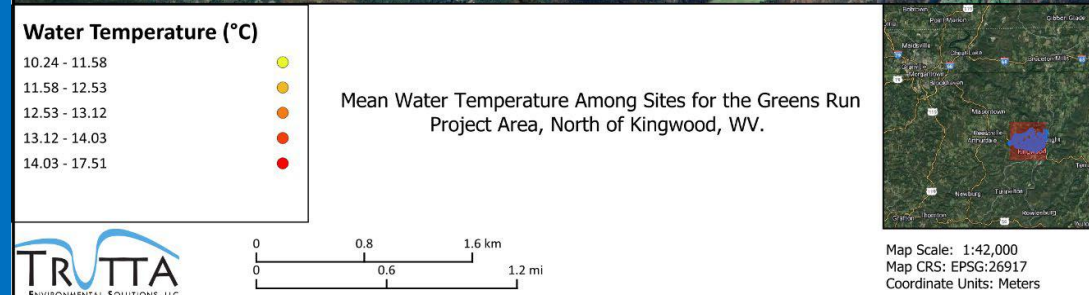
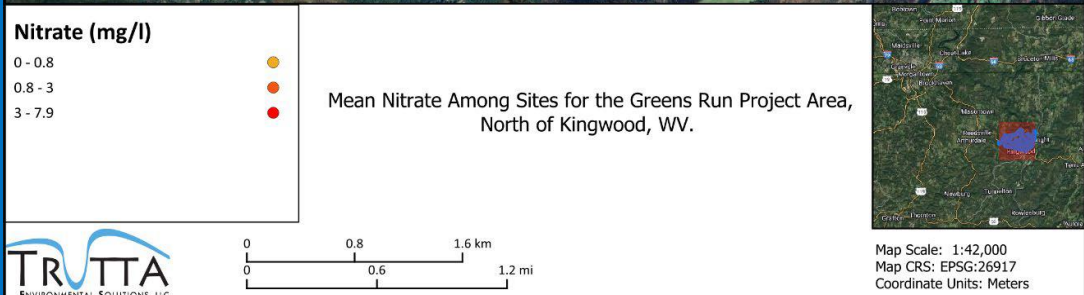


Map Scale: 1:42,000
Map CRS: EPSG:26917
Coordinate Units: Meters

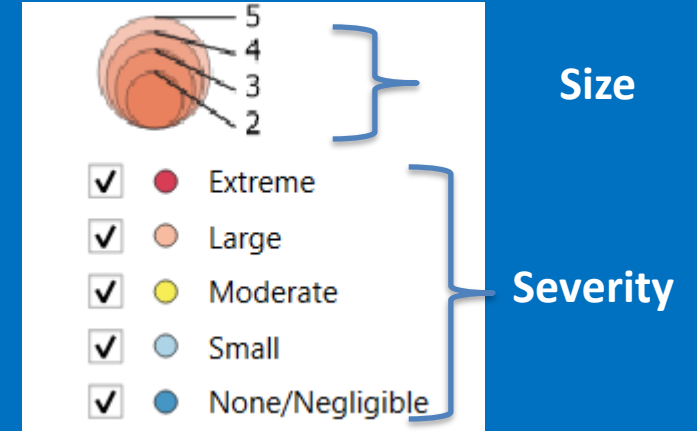




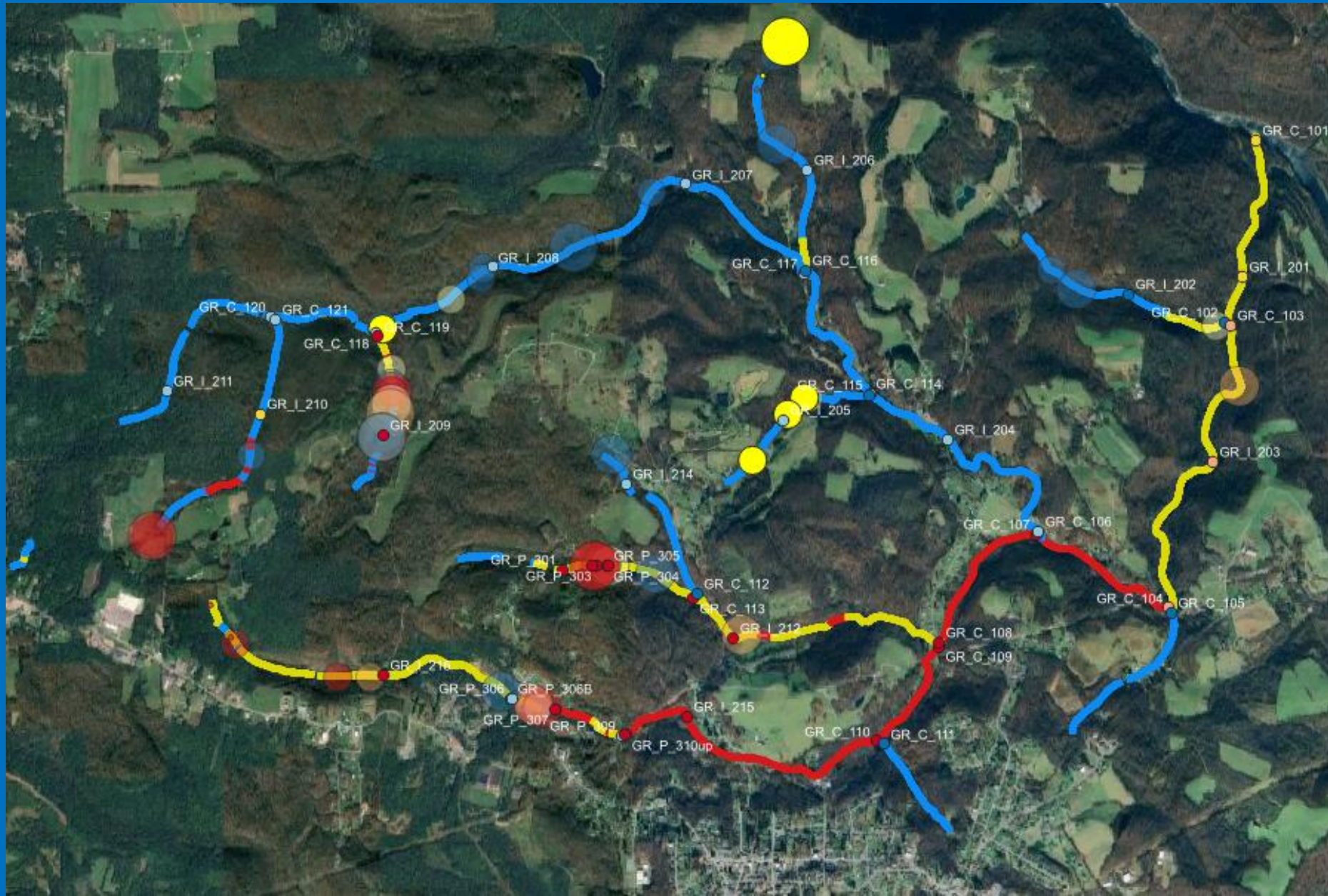




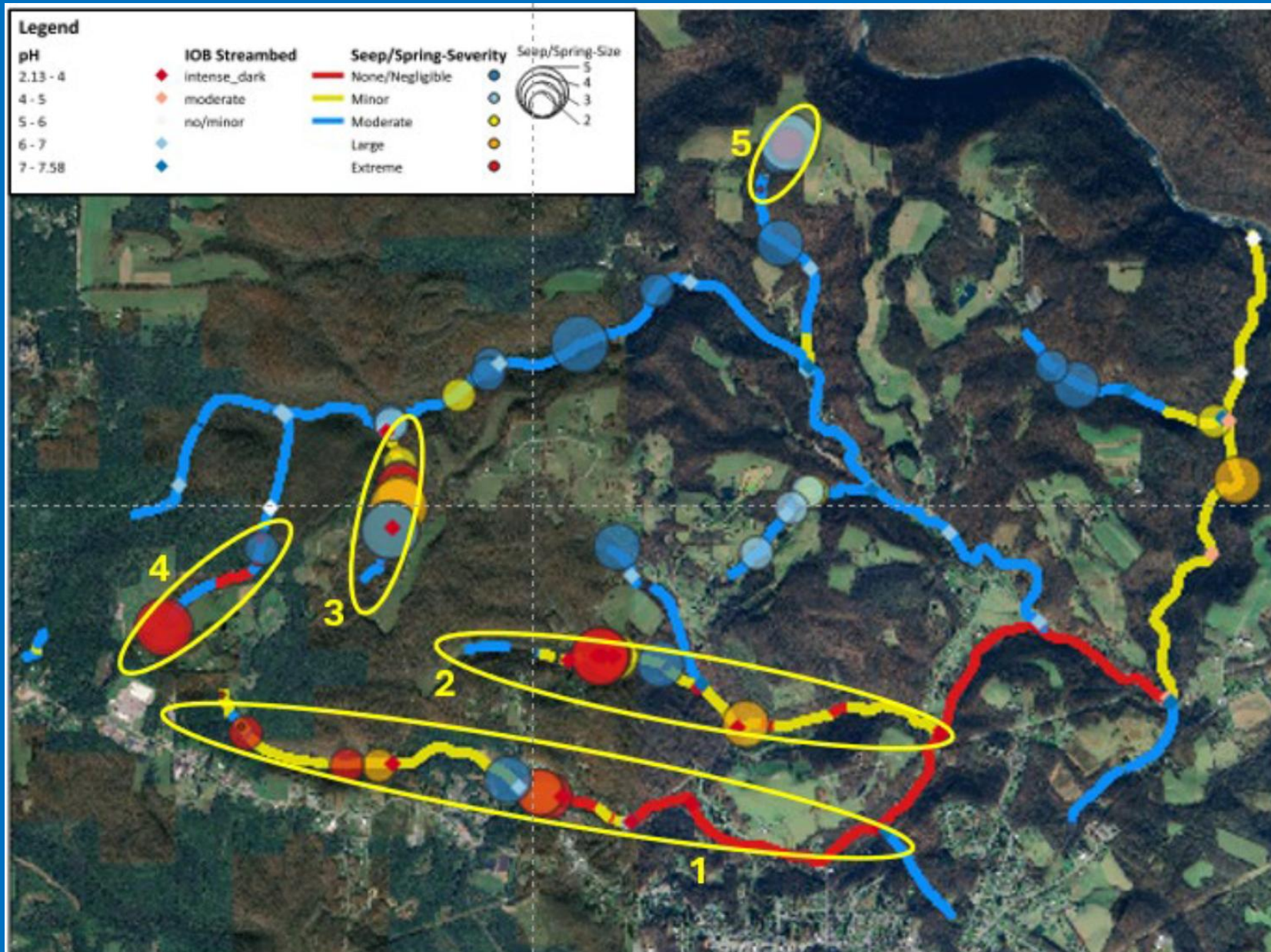
Discrete Features - Seeps/Springs



Combined Results – pH, IOB, & Seeps



Combined Results – pH, IOB, & Seeps

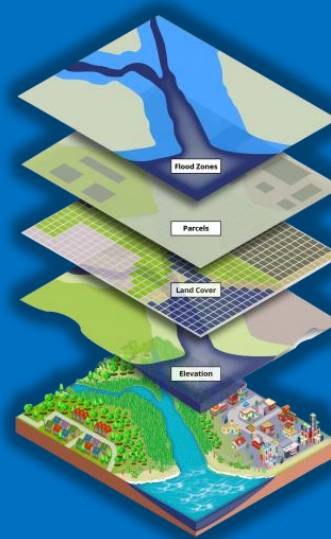


Project Deliverables

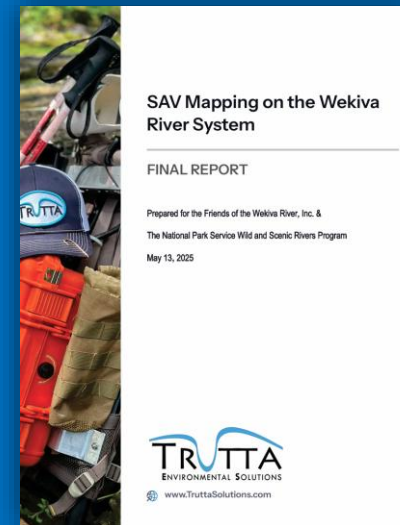
StreamView Video



GIS Data



Report

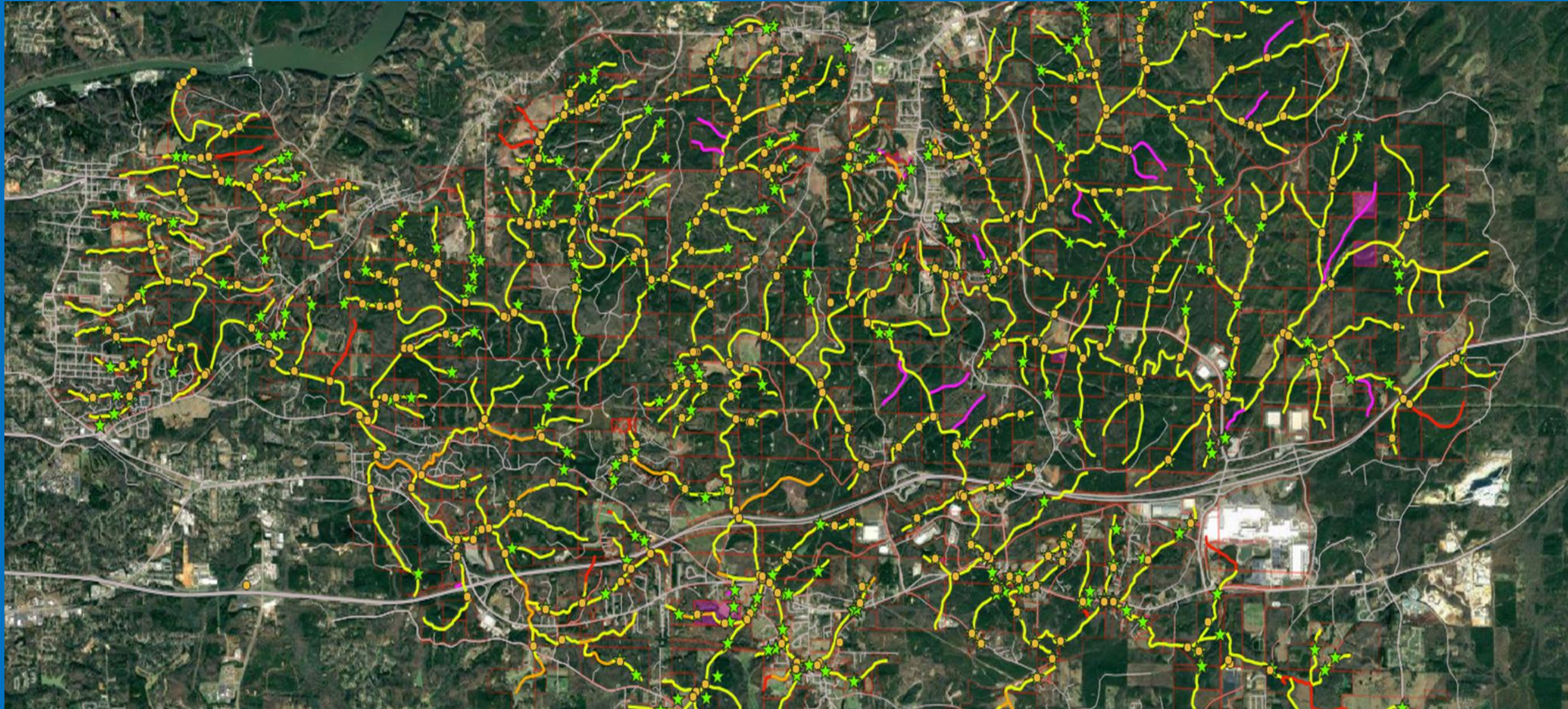


Training

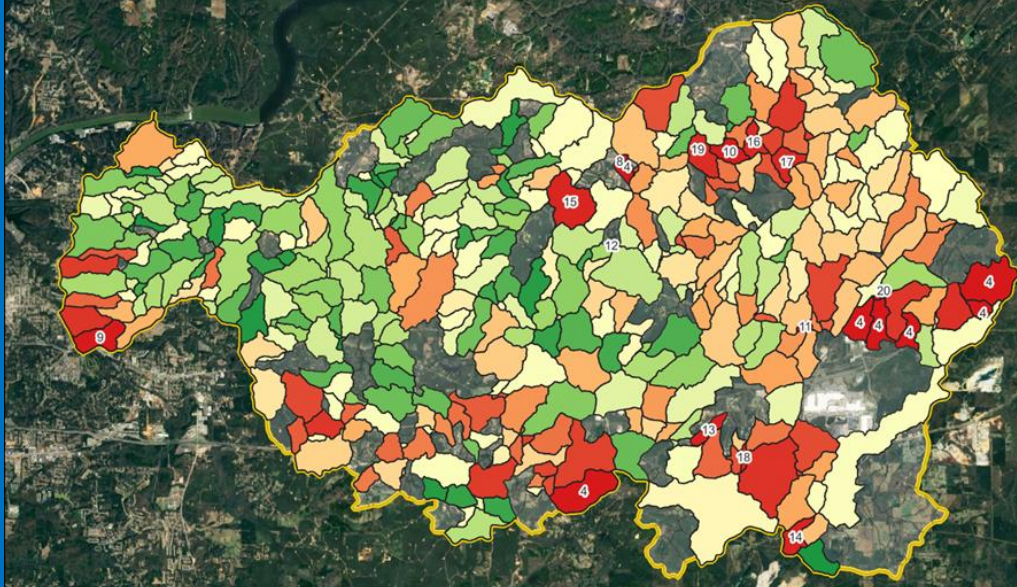


Hurricane Creek Watershed

250 Miles, 240 Confluences, 777 Water Quality Sites



Corridor Function



Sources: Esri, HERE, DeLorme, Intermap, increment IP Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, mapbox, mapbox, OpenStreetMap contributors, and the GIS User Community

Functional Ranking

- Worst
-
-
-
- Best
- No Data

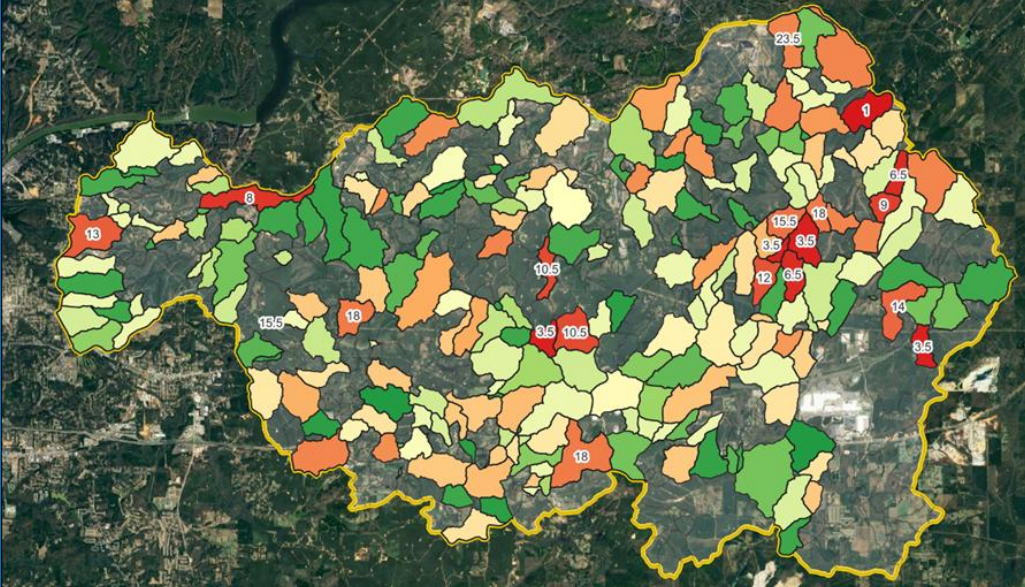
HDSS Overall Stream Corridor Functional Ranking by Catchment within the Hurricane Creek Watershed, East of Tuscaloosa, AL. Top 20 Ranking was also provided with ties receiving a similar number- the lower the number the worse the score.



0 3 6 km
0 2 4 mi

Map Scale: 1:157,356
Map CRS: EPSG:26916
Coordinate Units: Meters

Point Impacts



Sources: Esri, HERE, DeLorme, Intermap, increment IP Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, mapbox, mapbox, OpenStreetMap contributors, and the GIS User Community

Point Ranking

- Worst
-
-
-
- Best
- No Data

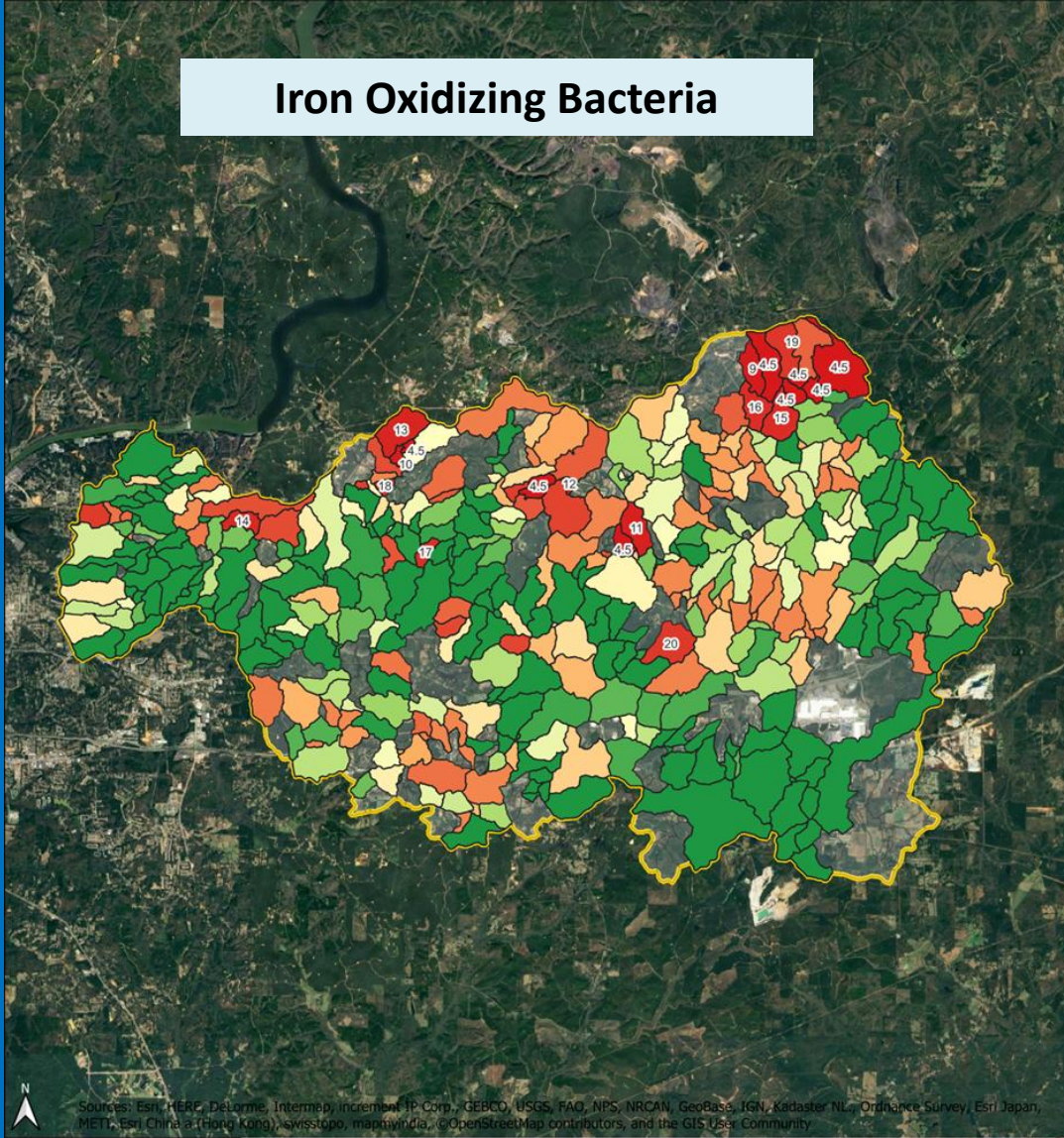
HDSS Overall Point Ranking by Catchment within the Hurricane Creek Watershed, East of Tuscaloosa, AL. Top 20 Ranking was also provided with ties receiving a similar number- the lower the number the worse the score.



0 3 6 km
0 2 4 mi

Map Scale: 1:157,356
Map CRS: EPSG:26916
Coordinate Units: Meters

Iron Oxidizing Bacteria



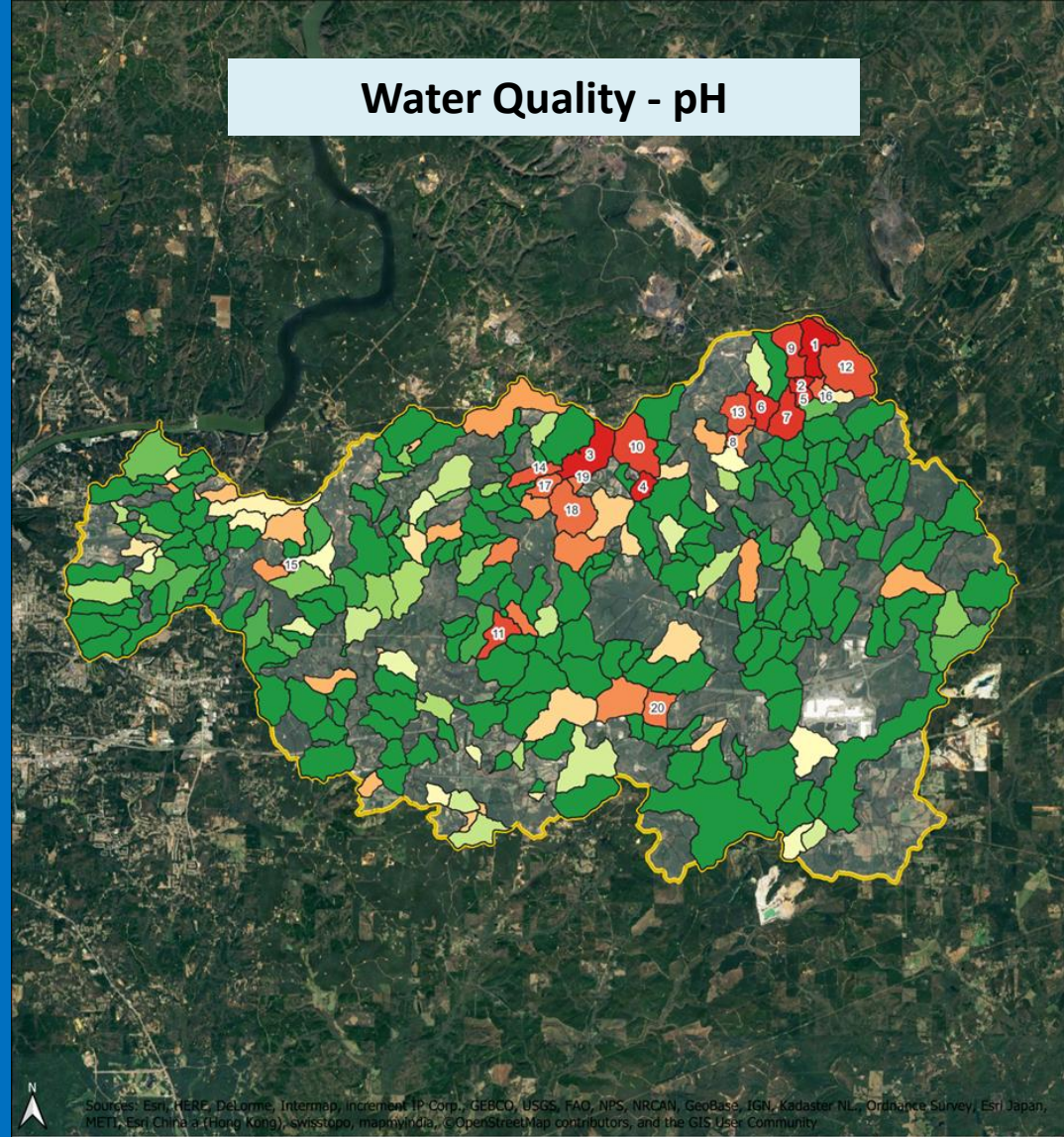
Iron Oxidizing Bacteria



HDSS Streambed Color Ranking by Catchment, Influenced by Iron Oxidizing Bacteria, within the Hurricane Creek Watershed, East of Tuscaloosa, AL. Top 20 Ranking was also provided with ties receiving a similar number- the lower the number the worse the score.



Water Quality - pH



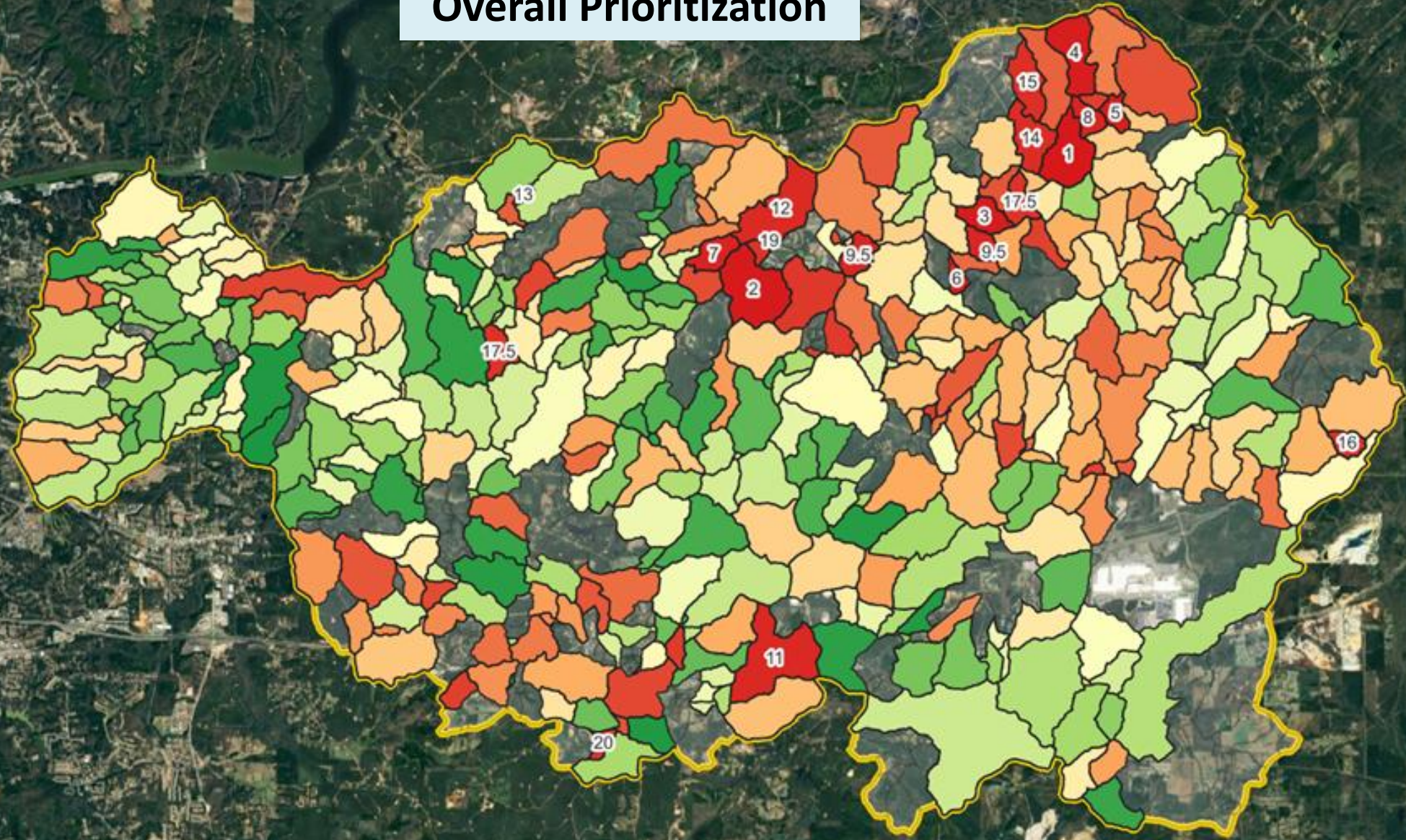
pH Ranking



HDSS Overall pH Ranking by Catchment within the Hurricane Creek Watershed, East of Tuscaloosa, AL. Top 20 Ranking was also provided with ties receiving a similar number- the lower the number the worse the score.



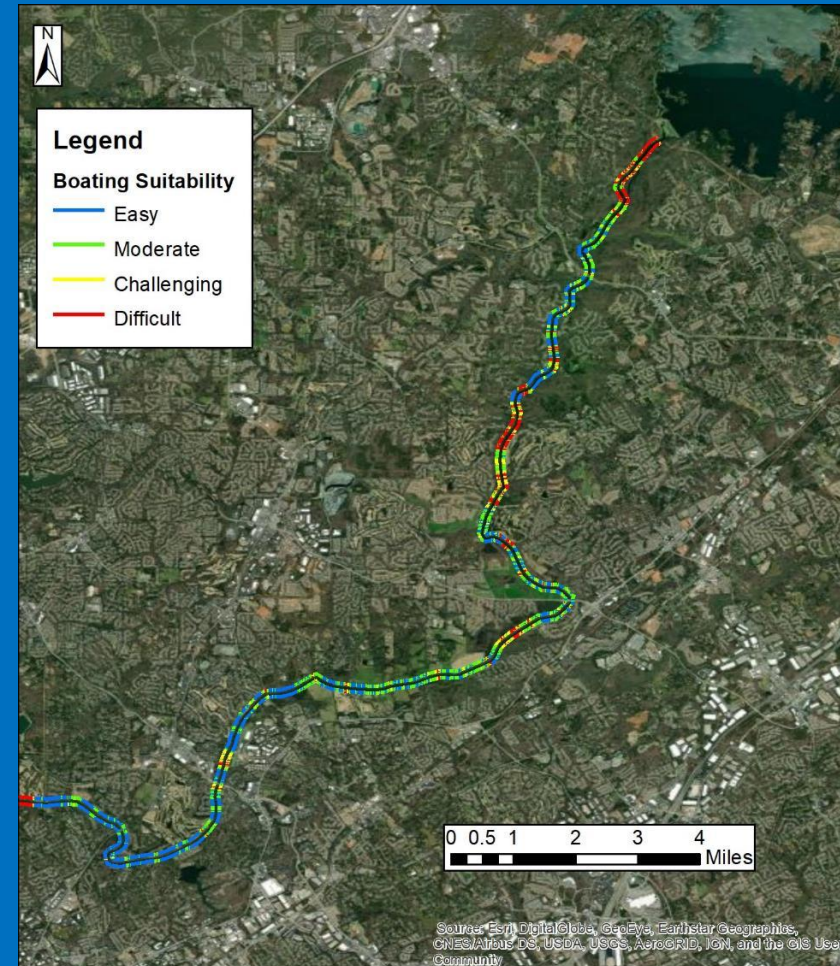
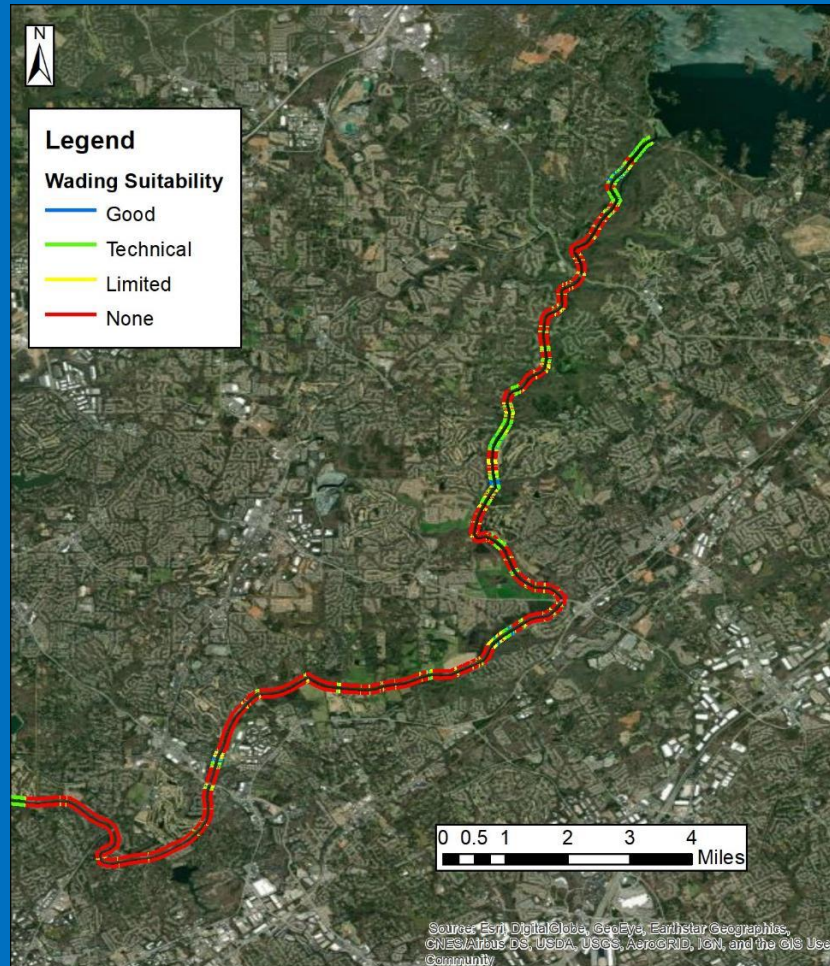
Overall Prioritization



General Public Suitability: Recreational Use

Find areas with suitable:

(1) Depth, (2) Roughness and (3) Velocity



+28.761233
-81.497507

Rock Springs Run
State Preserve

Wekiva Swamp

05/17/2024
09:29:31

High Definition Stream Survey

Wekiva Wild and Scenic River System, FL

Track: WK_B1D1T1
Segment: Rock Springs Run

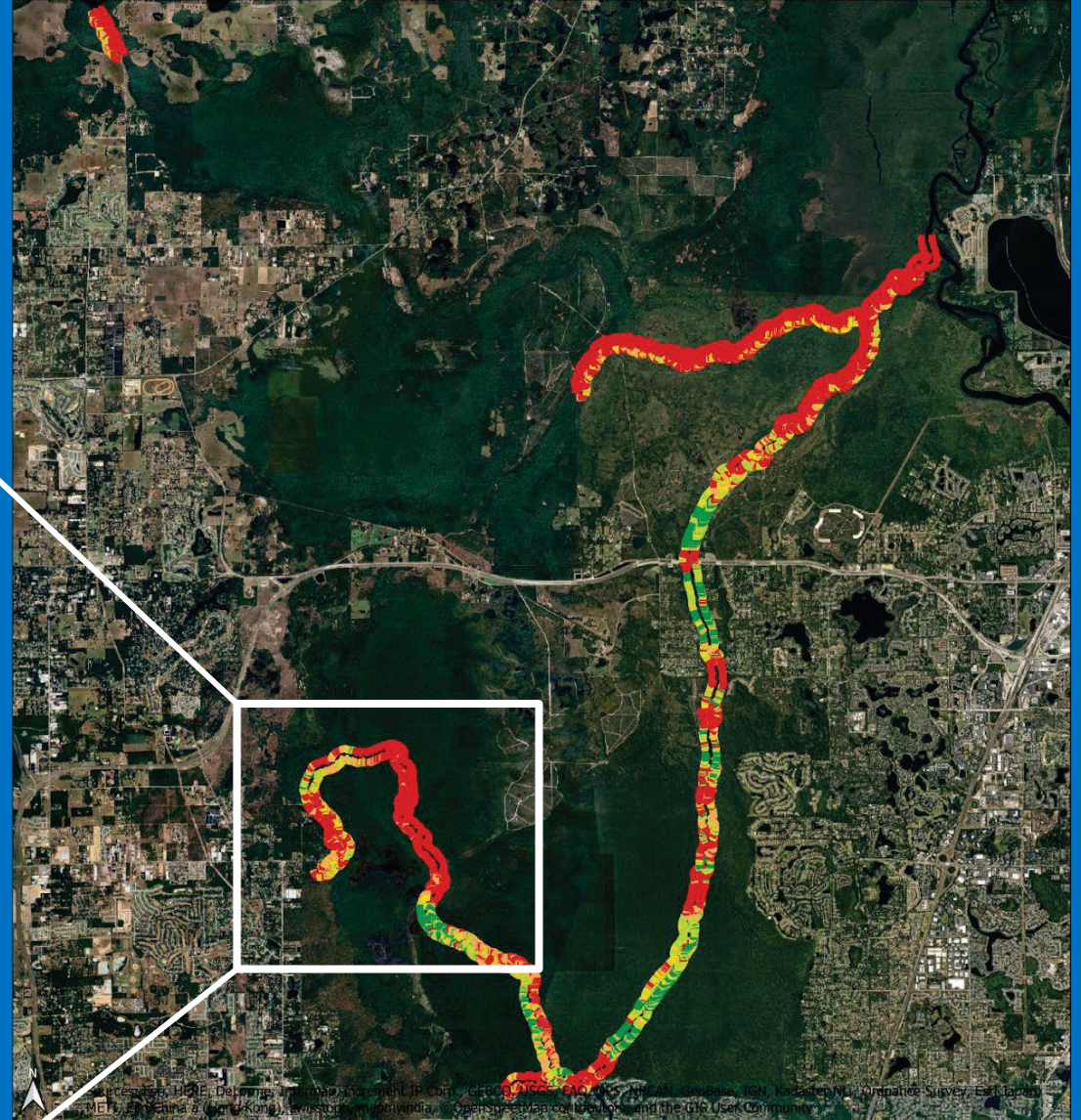
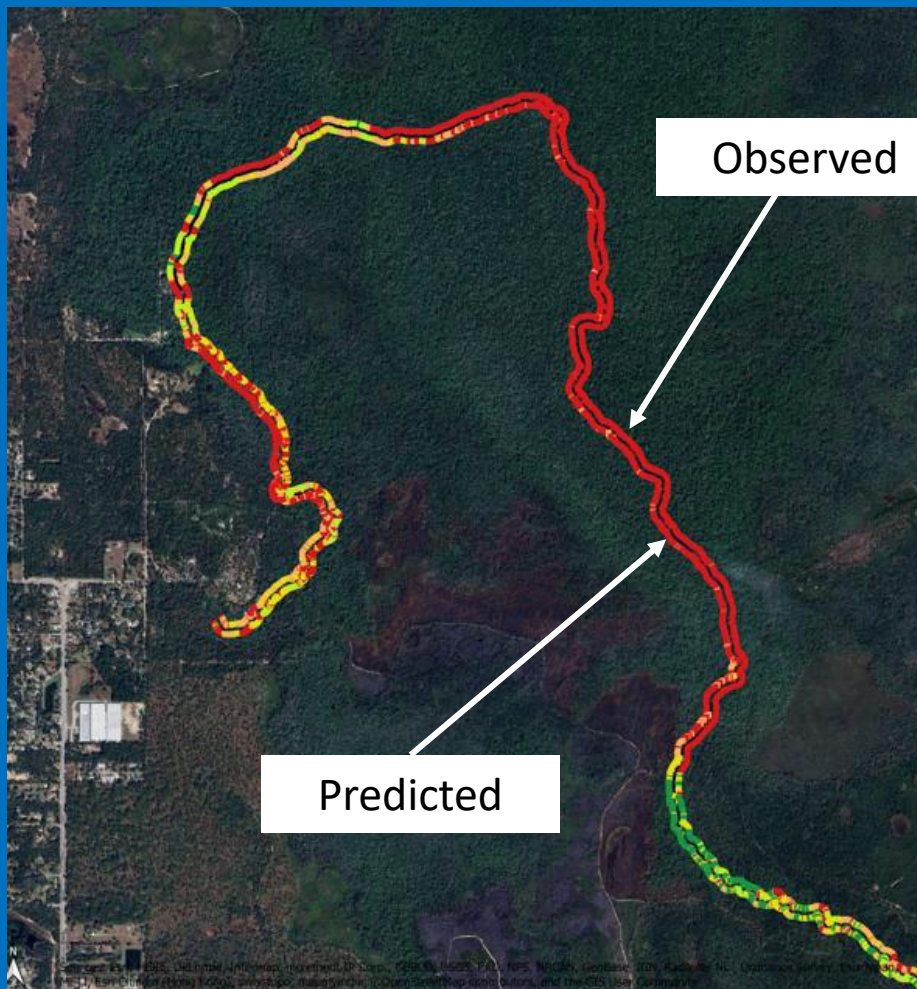
W061 497721 COG: 255.37 Depth: 2.23ft

2.5
5
7.5
10
12.5

25 0 25



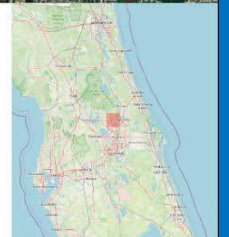
Eelgrass Observed vs. Predicted



Model vs. Observed

Model	Observed
Least Suitable (Red)	Not Observed (Red)
Rare (Orange)	Rare (Orange)
Common (Yellow)	Common (Yellow)
Dominant (Light Green)	Dominant (Light Green)
Most Suitable (Dark Green)	Complete (Dark Green)

Eelgrass Suitability Model Prediction vs Observed
 Model prediction on right and observed on left looking downstream



Habitat Suitability



- ◆ Where are they now?
- ◆ Where do we protect?
- ◆ Where do we restore?
- ◆ Where do we reintroduce?



Based on Depth, Velocity, Substrate & Cover

RIVER RESEARCH AND APPLICATIONS
River Res. Applic. 32: 1765–1775 (2016)
 Published online 31 March 2016 in Wiley Online Library
 (wileyonlinelibrary.com) DOI: 10.1002/rra.3025

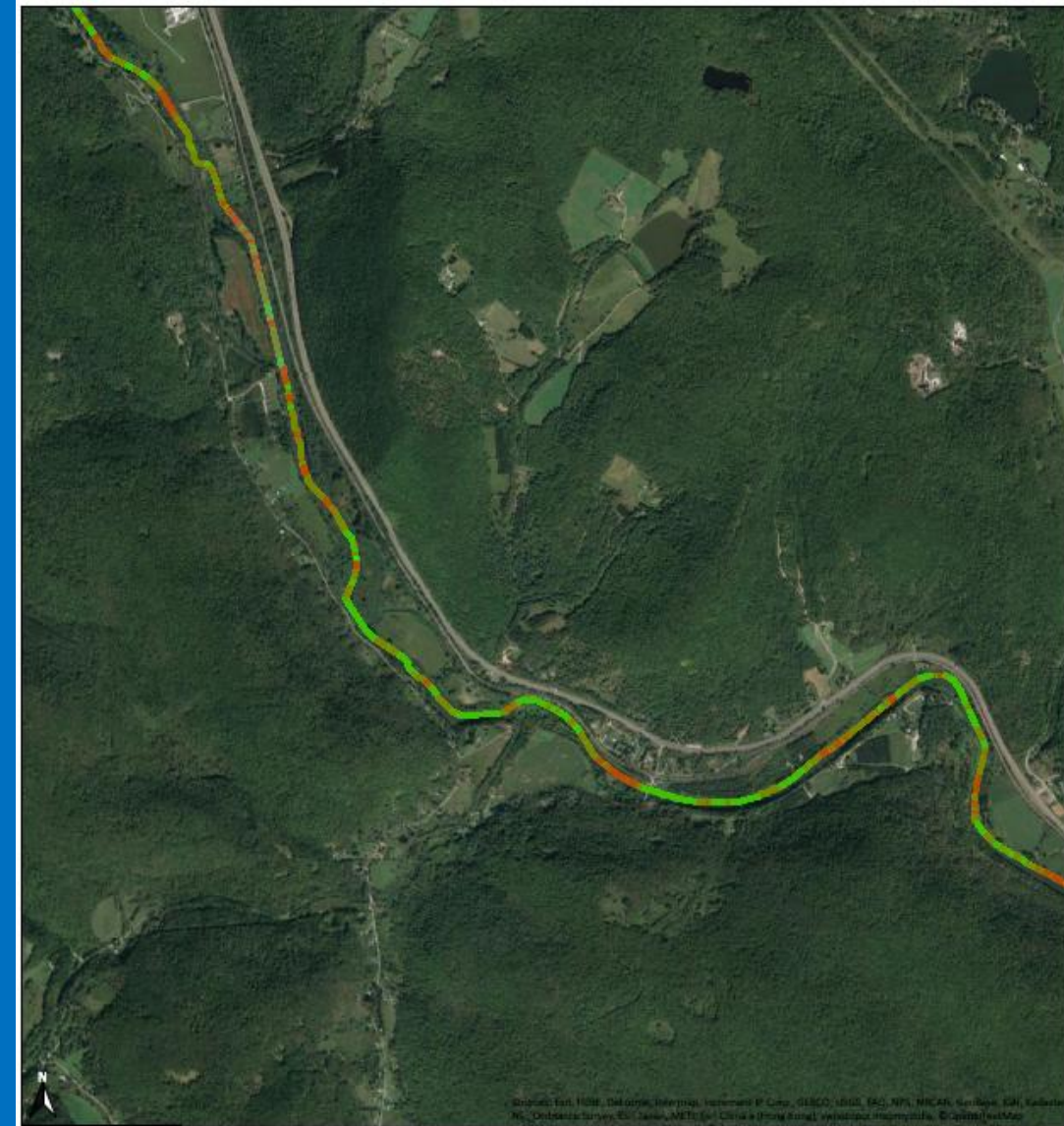
EVALUATING METHODS TO ESTABLISH HABITAT SUITABILITY CRITERIA: A CASE STUDY IN THE UPPER DELAWARE RIVER BASIN, USA

H. S. GALBRAITH^{a*}, C. J. BLAKESLEE^a, J. C. COLE^a, C. A. TALBERT^b AND K. O. MALONEY^a

^a USGS Leetown Science Center, Northern Appalachian Research Laboratory, Wellsboro, Pennsylvania USA

^b USGS Fort Collins Science Center, Fort Collins, Colorado USA

Segment	Brown Trout Adult	Brown Trout Juvenile	Brown Trout Spawning	Rainbow Trout Adult	Rainbow Trout Juvenile
West Branch	0.52	0.53	0.41	0.63	0.64
Upper East Branch	0.45	0.52	0.44	0.56	0.54
Lower East Branch	0.56	0.49	0.38	0.63	0.62
Delaware River	0.63	0.45	0.32	0.67	0.65

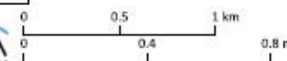


Legend

- 0 - 0.2
- 0.2 - 0.4
- 0.4 - 0.6
- 0.6 - 0.8
- 0.8 - 1

HDSS Adult Brown Trout (*Salmo trutta*) Habitat Suitability Along the West Branch: Map WB2

TRUTTA
 RESEARCH WITH RESOLUTION, LLC



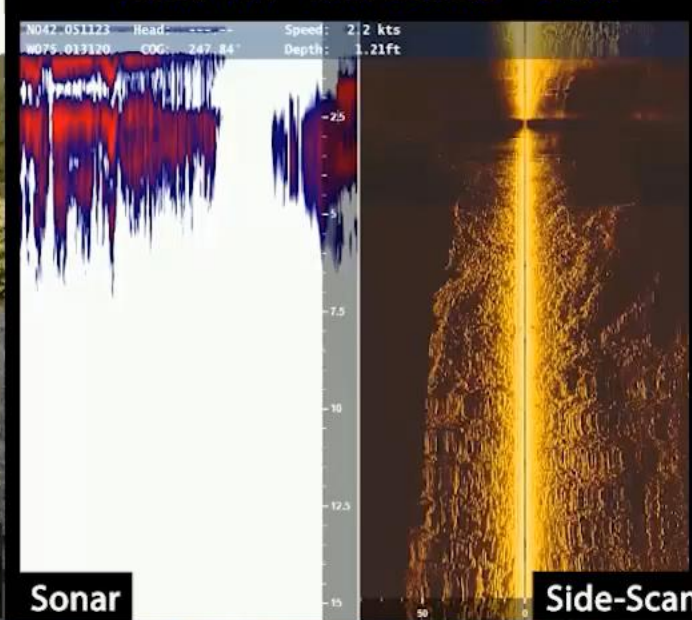
Map Scale: 1:29,508
 Map CRS: EPSG:6347
 Coordinate Units: Meters

High Definition Stream Survey

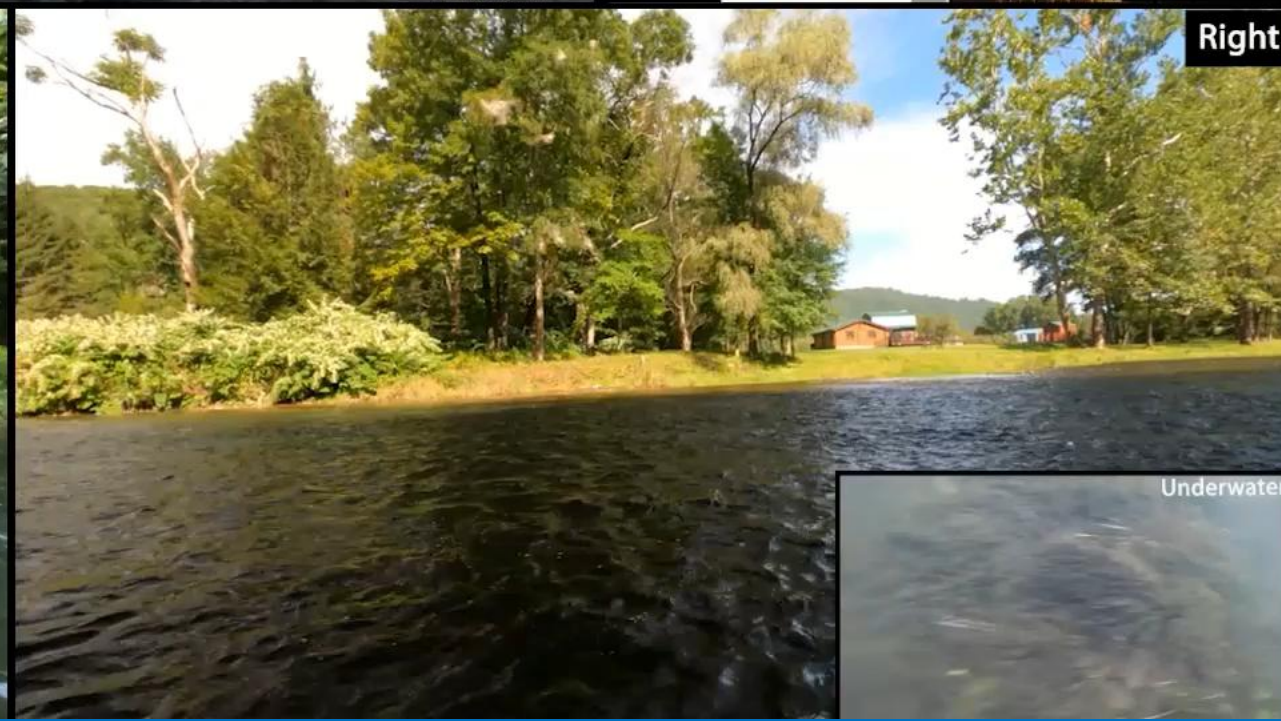
TruttaSolutions.com

East Branch Delaware River

Track 411 RM: E362.5 - E356



N42° 03' 04.1"
W75° 00' 47.1"
DATE: 9/3/2020
TIME: 10:55:09 AM



Invasive Plant Species

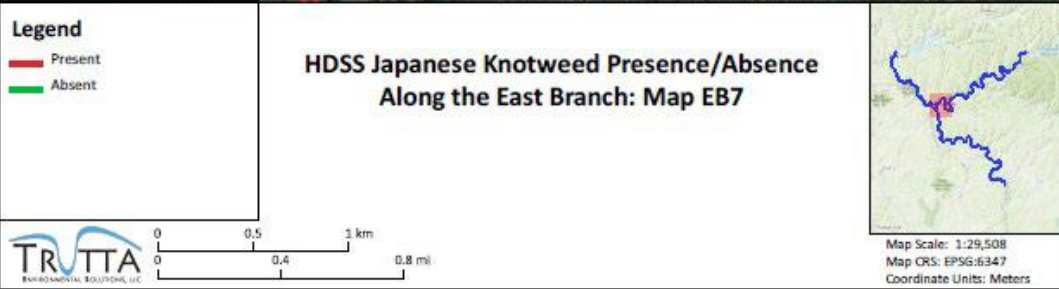
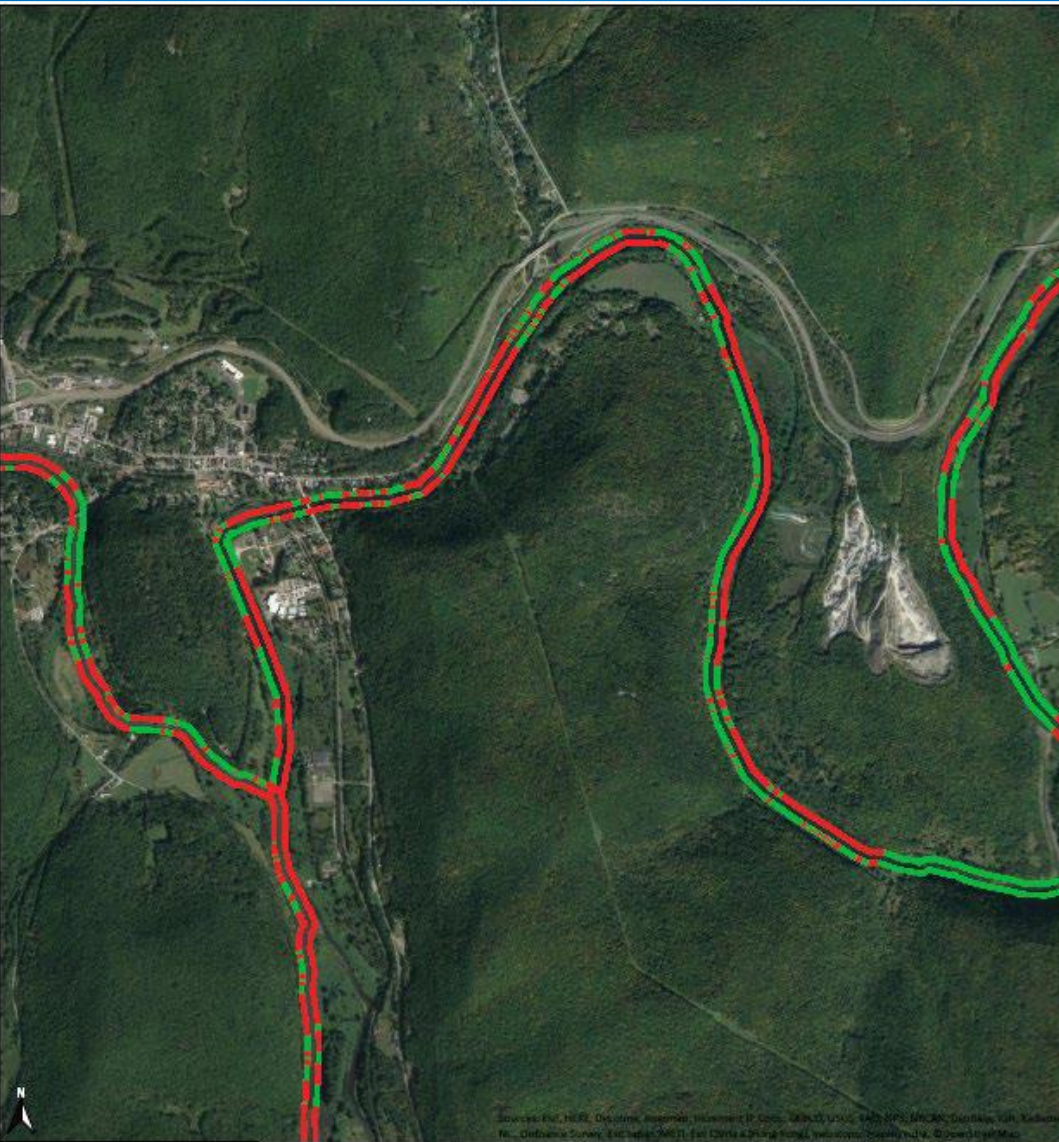


Table 16: Japanese Knotweed presence or absence in the Upper Delaware River survey area.

River	Knotweed Present	Knotweed Right bank (m)	Knotweed Left bank (m)	Knotweed Both banks (m)
Delaware River	Yes	21,436	23,931	45,367
Delaware River	No	24,212	21,717	45,929
East Branch	Yes	21,467	20,369	41,836
East Branch	No	31,050	32,148	63,198
West Branch	Yes	13,233	11,311	24,544
West Branch	No	12,792	14,714	27,506
Total	Yes	56,136	55,611	111,747
Total	No	68,054	68,579	136,633

Table 17: Percent Japanese Knotweed presence or absence in the Upper Delaware River survey area.

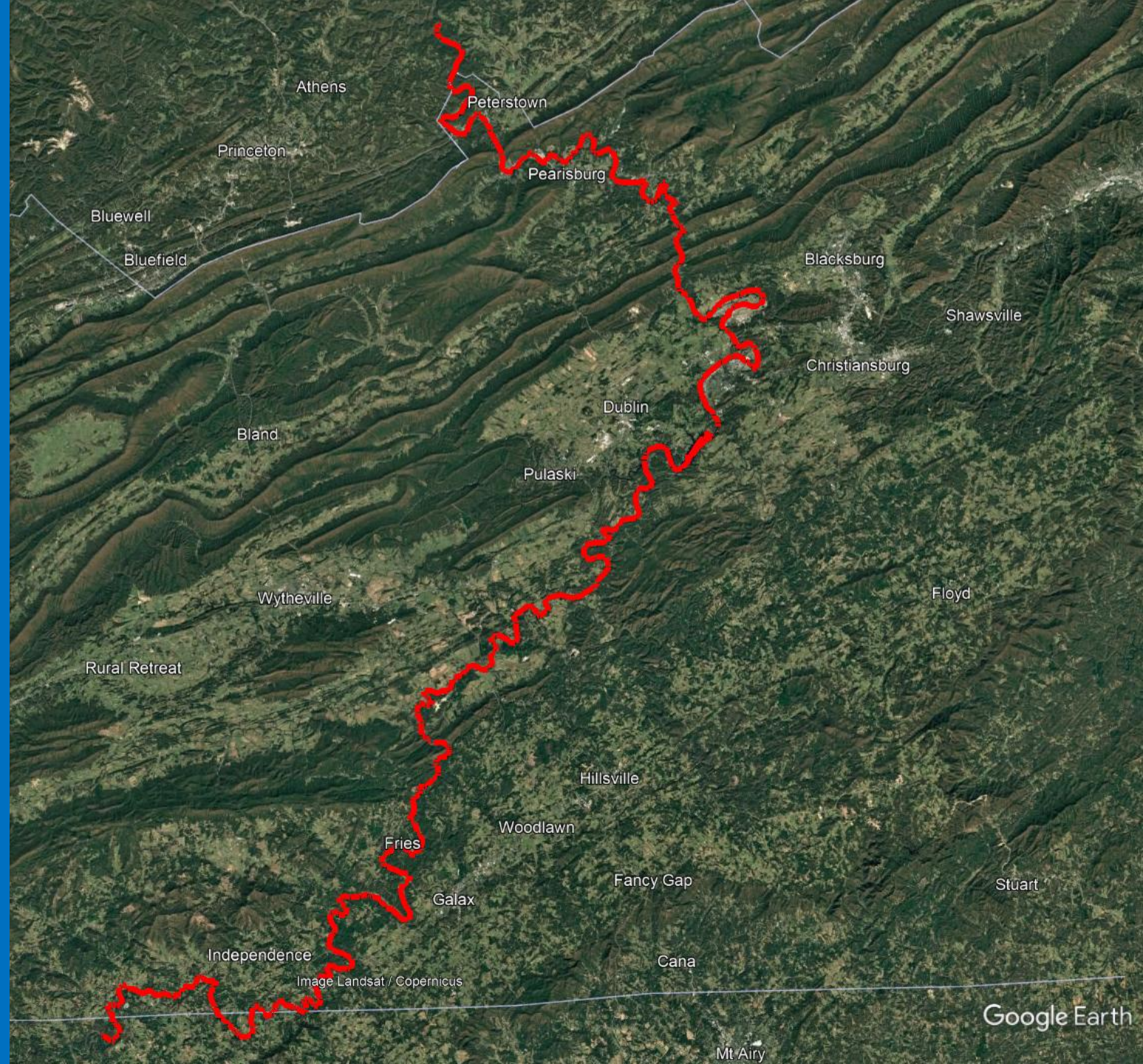
River	Knotweed Present	Knotweed Right bank (m)	Knotweed Left bank (m)	Knotweed Both banks (m)
Delaware River	Yes	47.0%	52.4%	49.7%
Delaware River	No	53.0%	47.6%	50.3%
East Branch	Yes	40.9%	38.8%	39.8%
East Branch	No	59.1%	61.2%	60.2%
West Branch	Yes	50.8%	43.5%	47.2%
West Branch	No	49.2%	56.5%	52.8%
Total	Yes	45.2%	44.8%	45.0%
Total	No	54.8%	55.2%	55.0%

Hurricane Helene Recovery

New River, Virginia: 160 Miles
12 days, 2 techs, 1 driver

Purpose:

- Document Baseline Conditions
- Recreational Infrastructure
- Monitor Restoration
- Prioritize Future Restoration
- Change Over Time





Sources: Esri, HERE, DeLorme, Intermap, increment IP Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeBCO, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, mapbox, OpenStreetMap contributors, and the GIS User Community

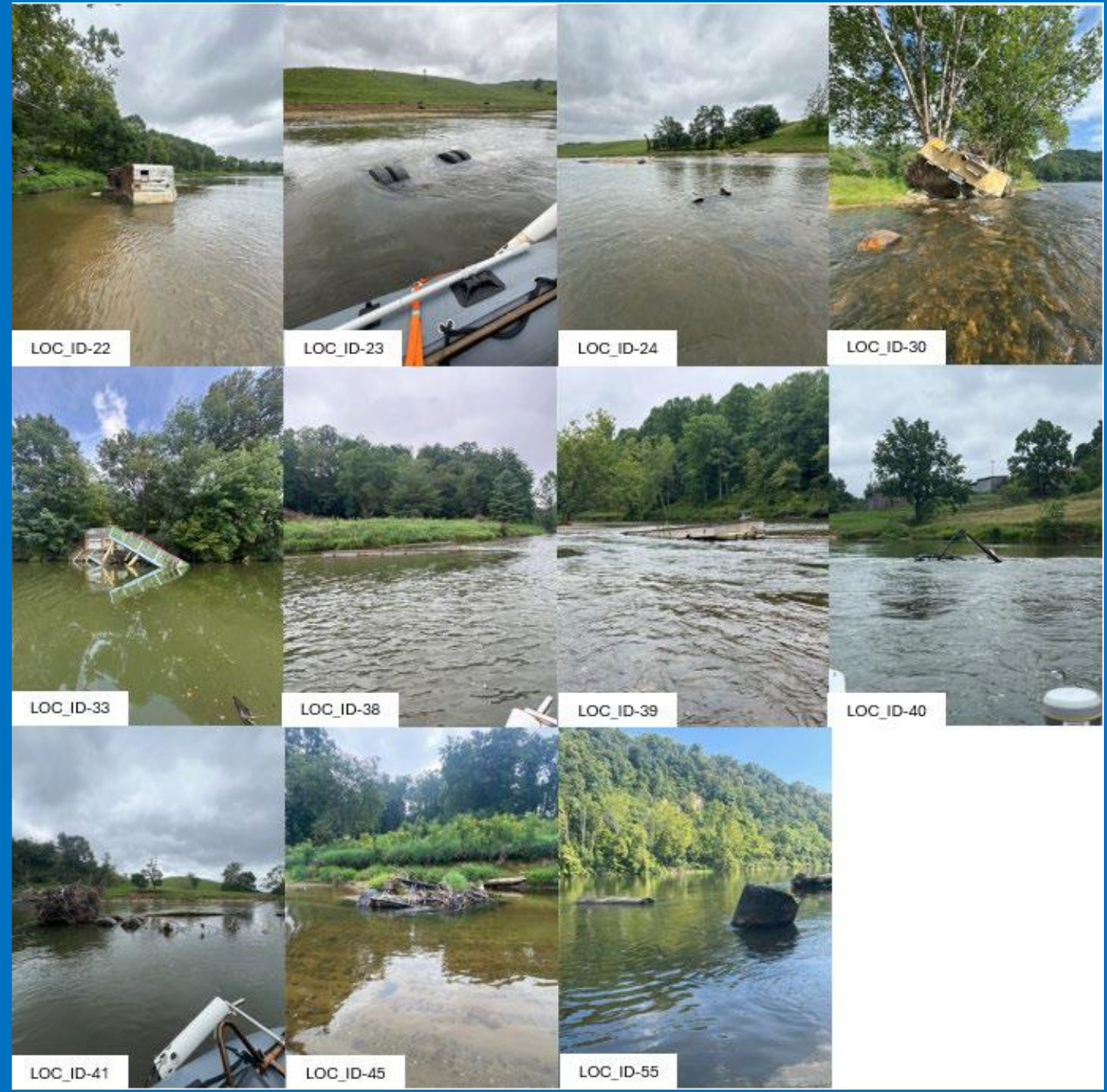
LOC by Type

- Dam
- Excess_Fines
- Livestock
- Log_Debris_Jam
- Powerline
- Ramp_Launch
- Trash

Locations of Concern by Type along the New River, VA.

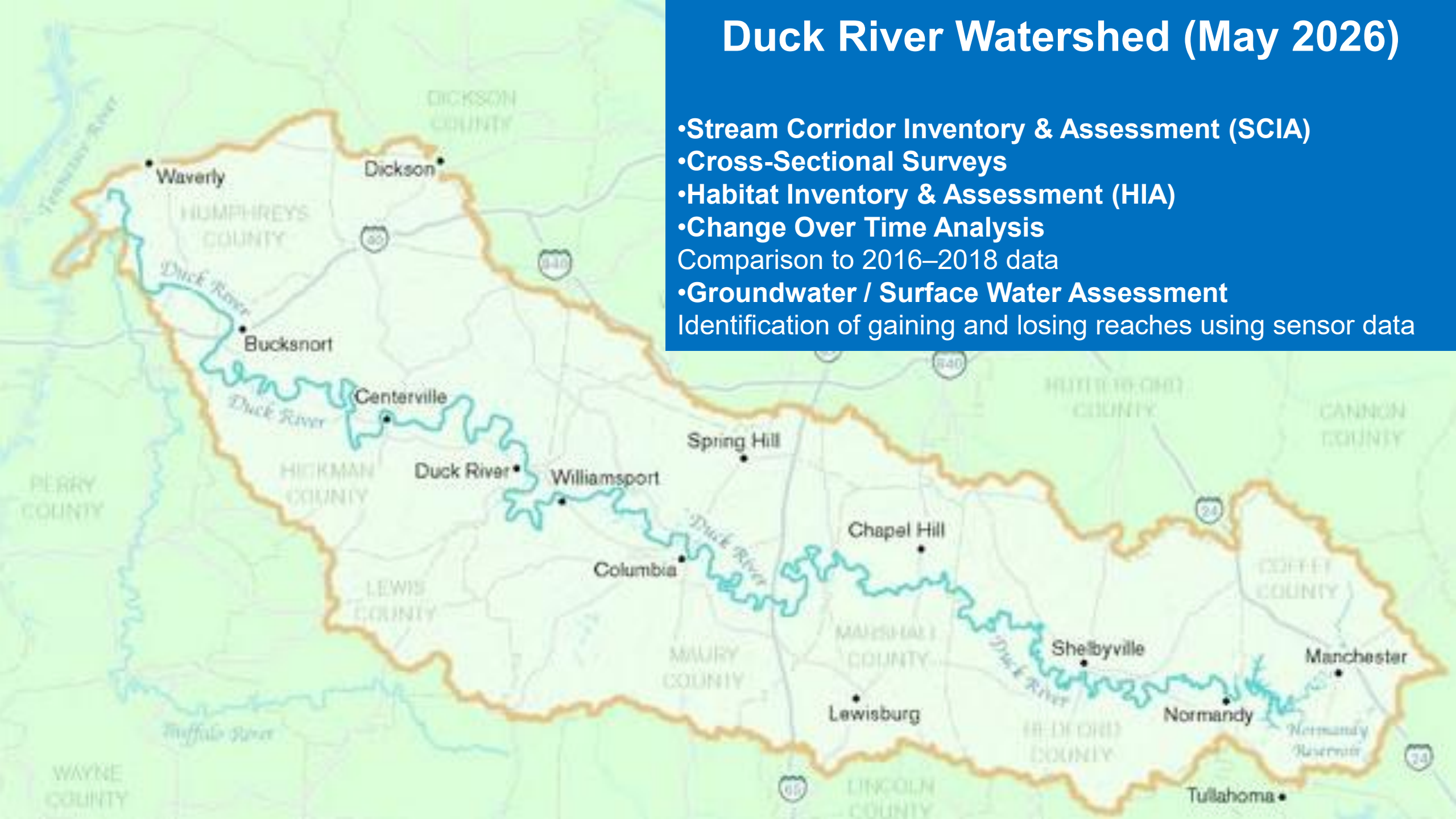


Map Scale: 1:550,000
 Map CRS: EPSG:32617
 Coordinate Units: Meters



Duck River Watershed (May 2026)

- Stream Corridor Inventory & Assessment (SCIA)
- Cross-Sectional Surveys
- Habitat Inventory & Assessment (HIA)
- Change Over Time Analysis
Comparison to 2016–2018 data
- Groundwater / Surface Water Assessment
Identification of gaining and losing reaches using sensor data





Hydropower

Water Quantity

- Channel Profiles
- Channel Capacity
- Flood Risk Models
- Drought impacts
- Instream Flow

Water Quality

- Longitudinal Profile
- Tributary input
- Sediment TMDLs
- Point & Non-Point Source Impacts

Wildlife

Habitat

- Riffle, Run, Pool Delineation
- Substrate Types
- Embeddedness
- Instream Cover
- Riparian Condition

HDSS

Cross-sectional Transects and Longitudinal Surveys

Transportation

Infrastructure

- Location, Extent & Condition of:
- Bridges
 - Intakes & Outfalls
 - Bank Stabilization
 - Dams, etc.

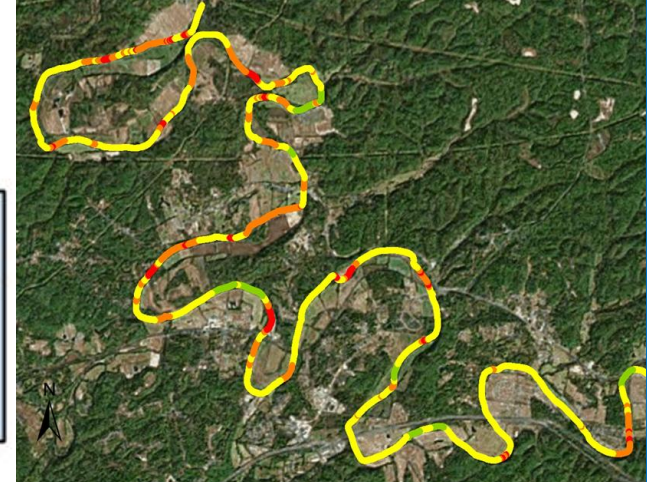
Environmental & Non-Profits

Outreach

- Virtual Stream Tours
- Integrates with Aerial Imagery
- StreamView Dashboards show data and stream conditions

Stream Corridor Assessment

- Current Conditions Archive
- Restoration Prioritization
- Mitigation Potential



Stormwater MS4

Stakeholders

Integrated Planning Framework

HDSS supports integrated planning by providing high-quality, multi-attribute, geo-referenced data of the entire stream channel



BETTER DATA. BETTER DECISIONS.

Brett.Connell@TruttaSolutions.com

TruttaSolutions.com



Factors of Cost

- Scale of Project: 2, 10, and 100 will have a different Cost/mile
- Number of Objectives
- # of parameters (WQ, Substrate, SQT, Stream Corridor Assessment, etc.)
- Cross sections / Discharge
- Backpack, Kayak, and/or Boat
- Single Track or Dual Track
- Extent of Access & portages
- Travel

Average Project Cost

- \$1,250-3,500 per mile