High Definition Stream Survey: SESWA

Brett Connell

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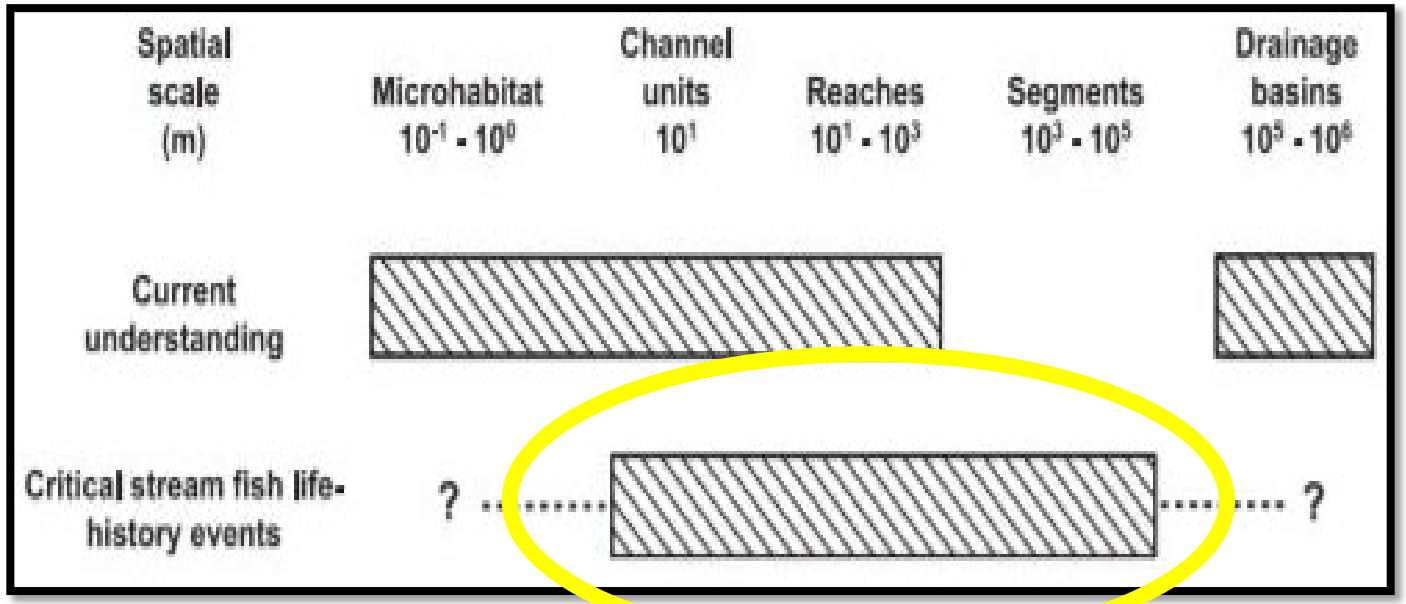
TruttaSolutions.com

Drawbacks of Traditional Sampling

- Access
- Area
- Time
- Flow/depth limits

TRUTTA Environmental Solutions

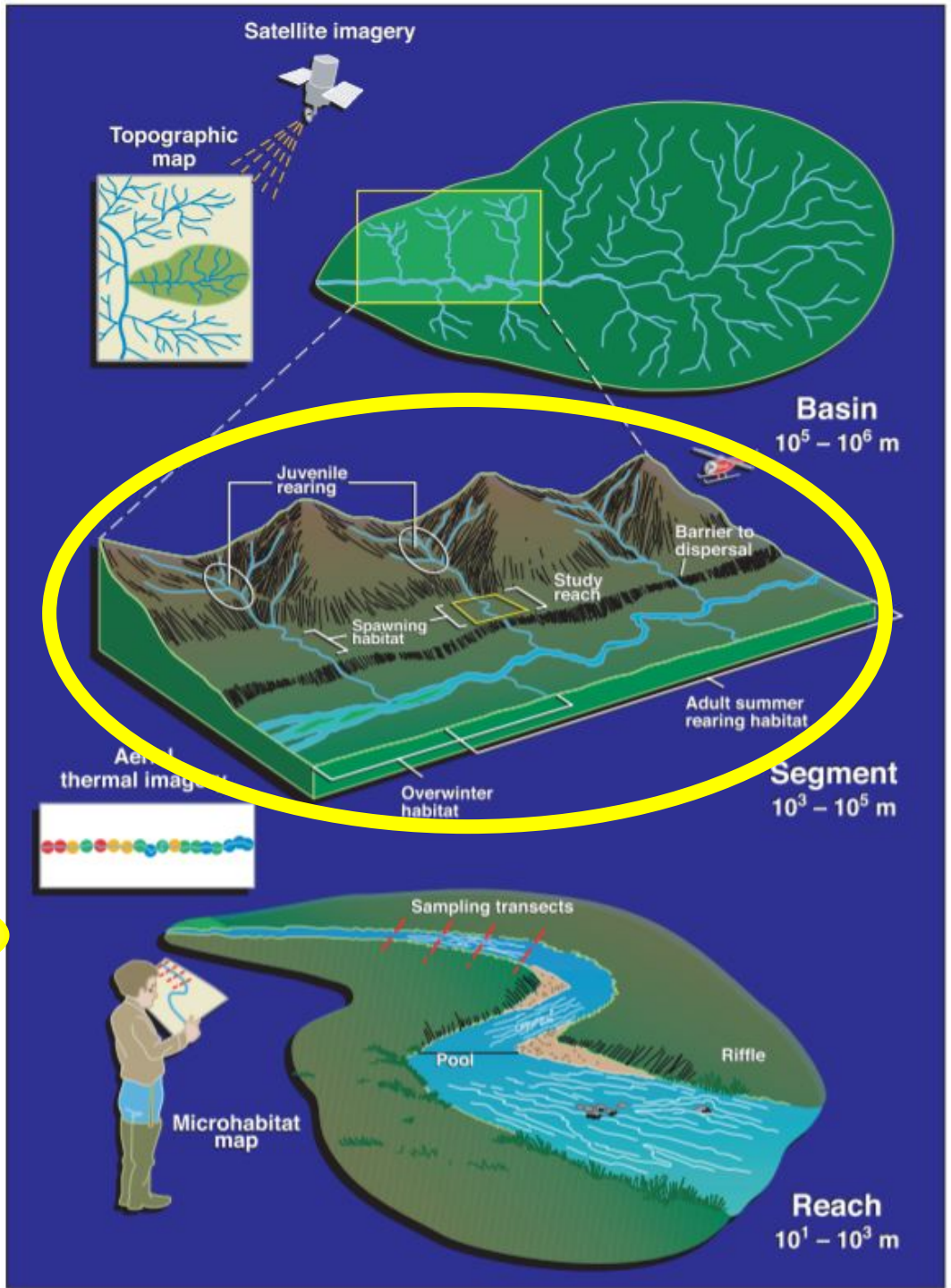
Landscape Modeling

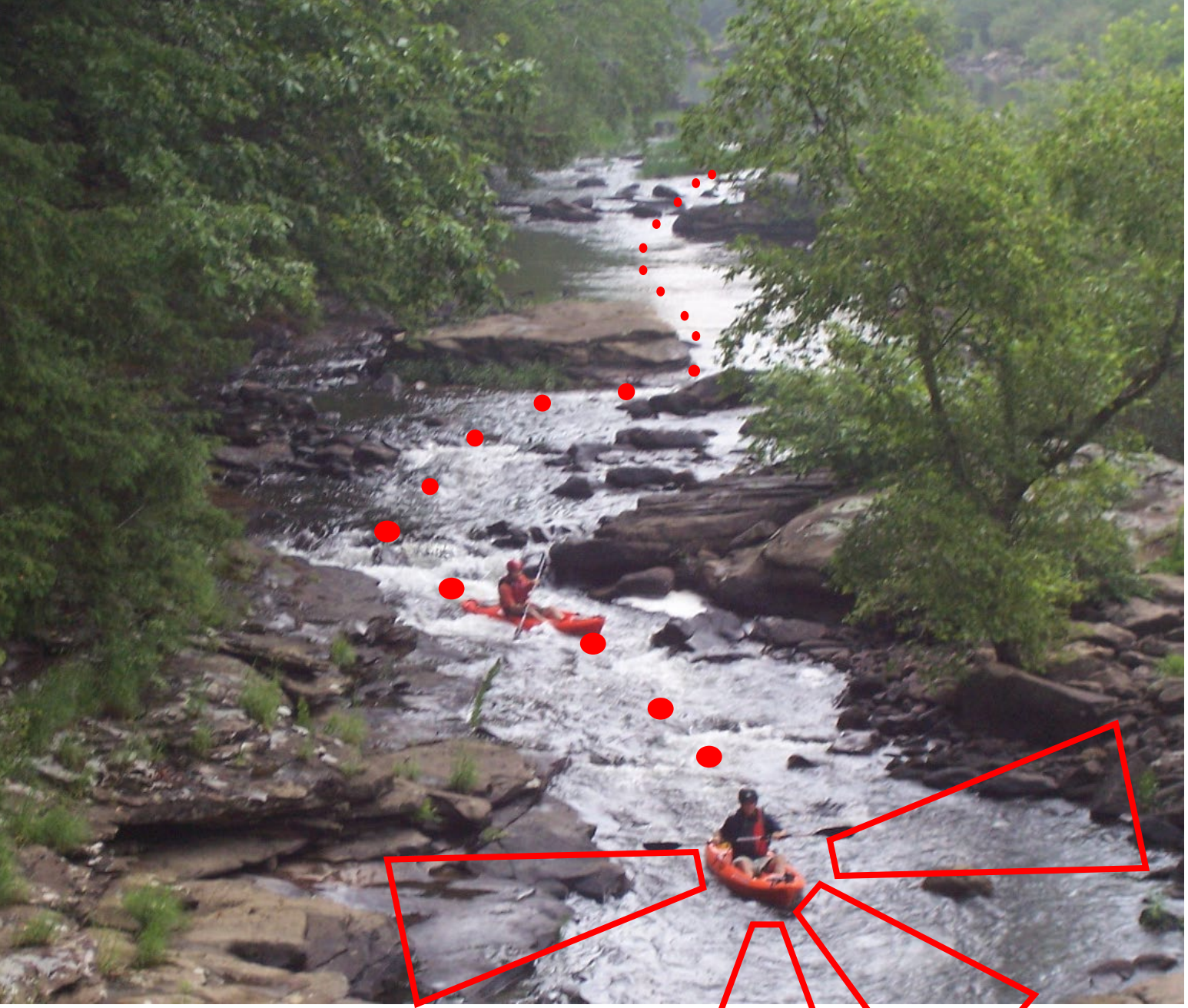


Fausch et al. 2002. Landscapes to Riverscapes: Bridging the Gap between Research and Conservation of Stream Fishes. BioScience

Intermediate scale = 1 to 100 km

Traditional Sampling





Side video / LiDar
- Left and Right Streambank
- Riparian
- Floodplain Access
- Infrastructure

Front video
- Habitat type
- Canopy cover

Down video
- Substrate type
- Embeddedness

Water quality sensor
- DO, pH, Temp, etc

Side scan sonar
- Depth
- Side scan imagery

Acoustic Doppler Current Profiler
- Bathymetry
- Discharge
- Transects

Water Grab Samples
- eDNA

GPS
- Time
- Location
- Elevation

High Definition Stream Survey

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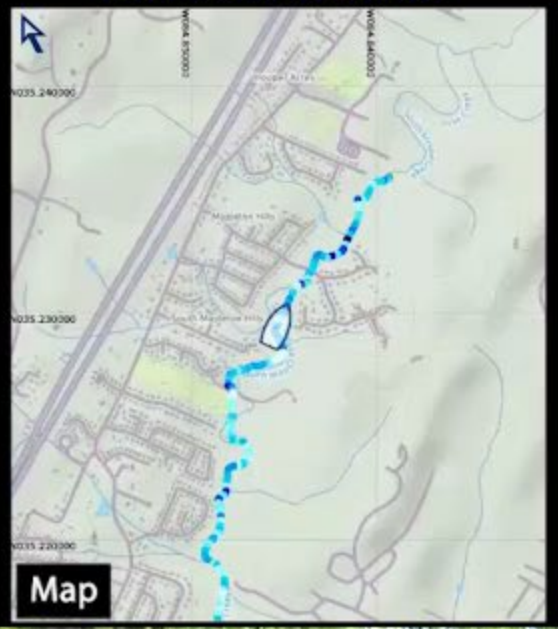
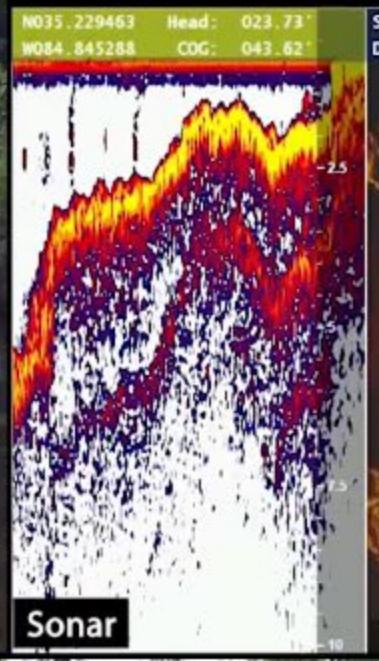
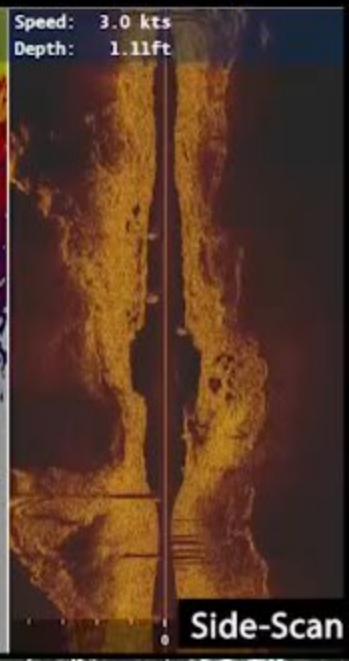


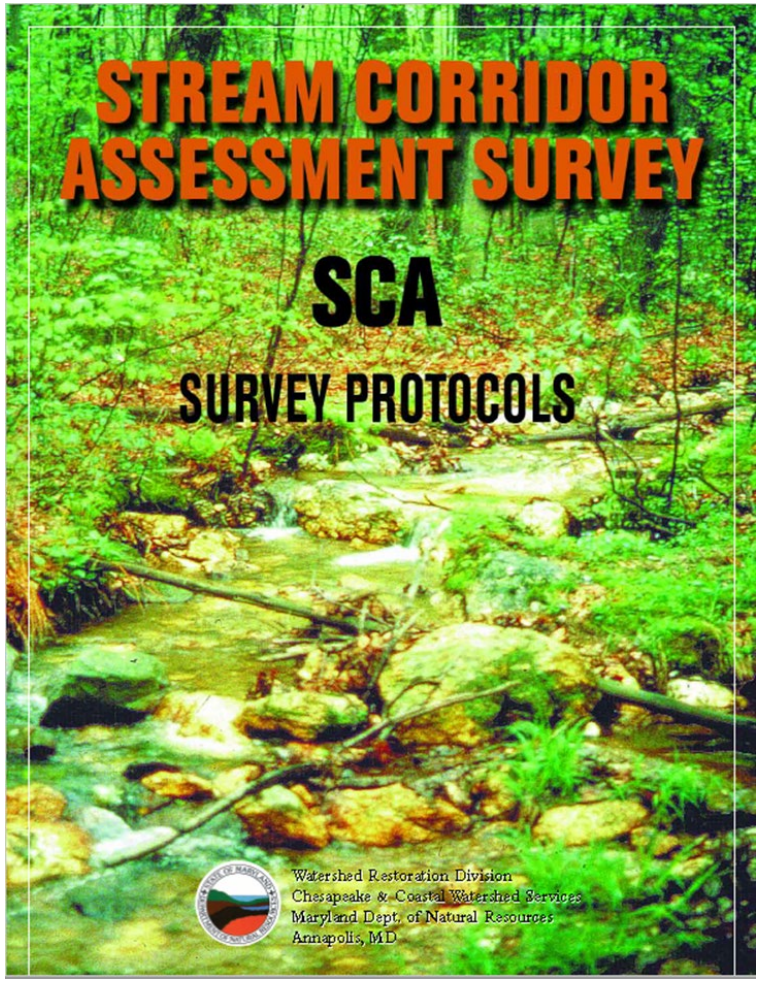
South Mouse Creek - Track 101

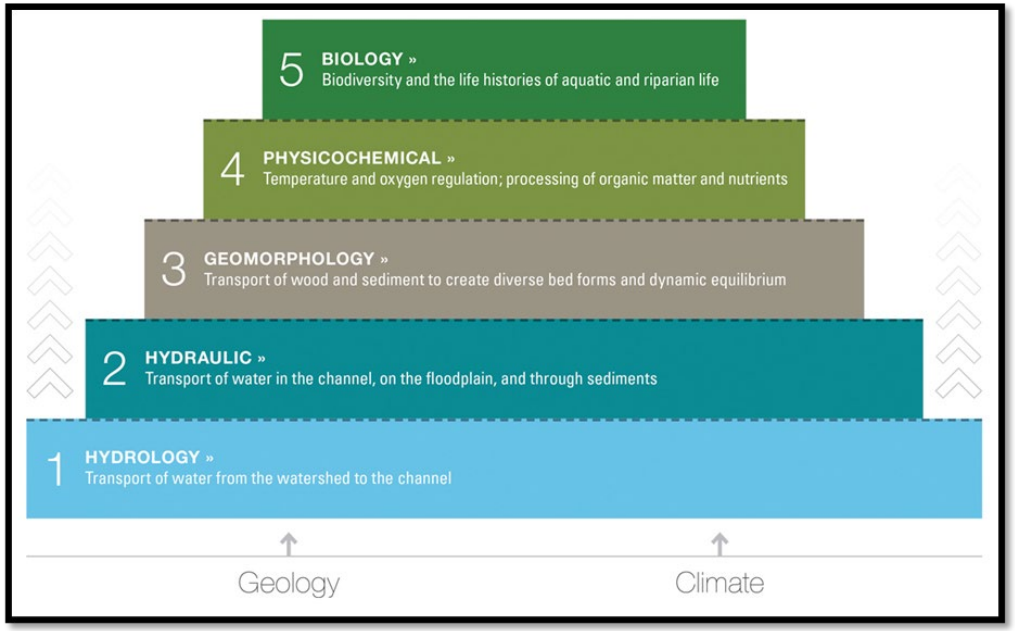


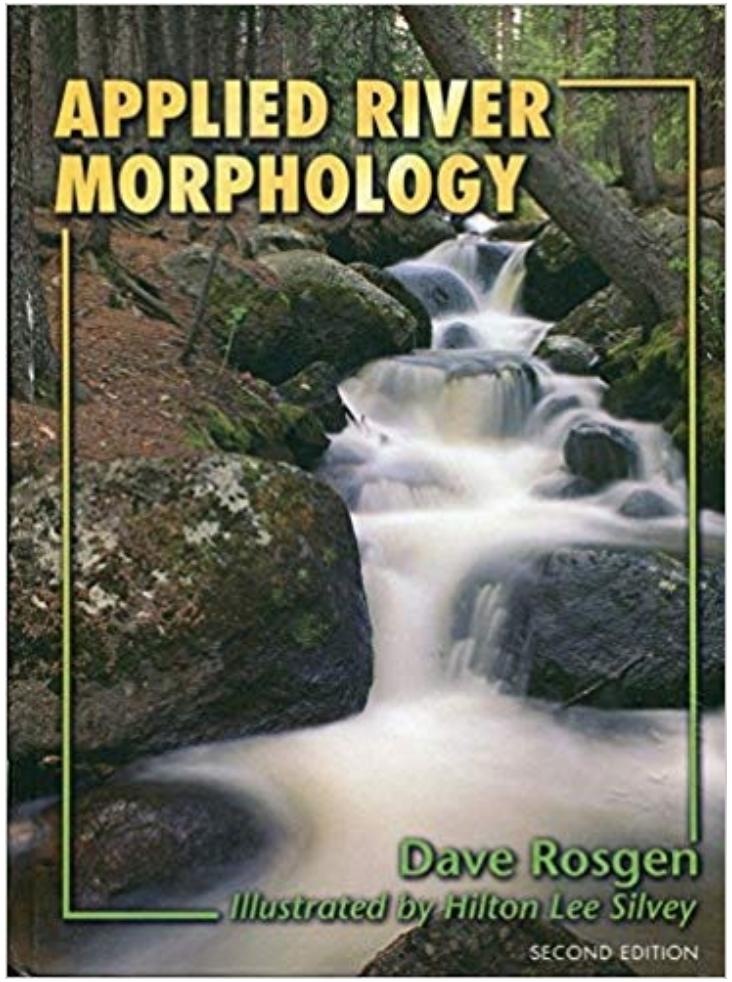


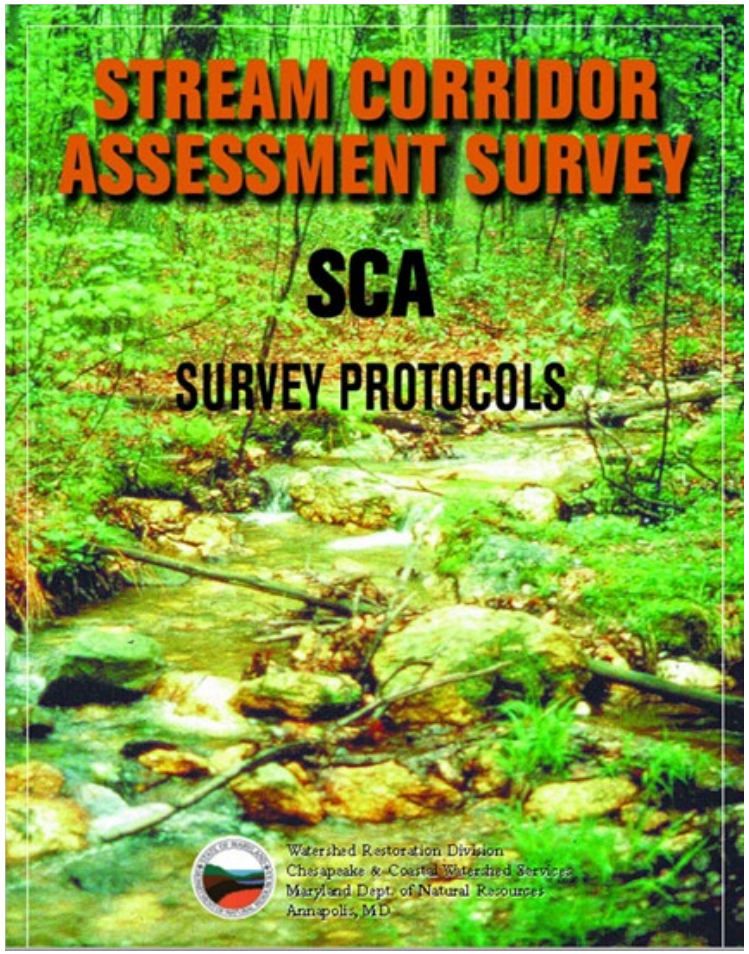

SATURN

Flexible Data Classification

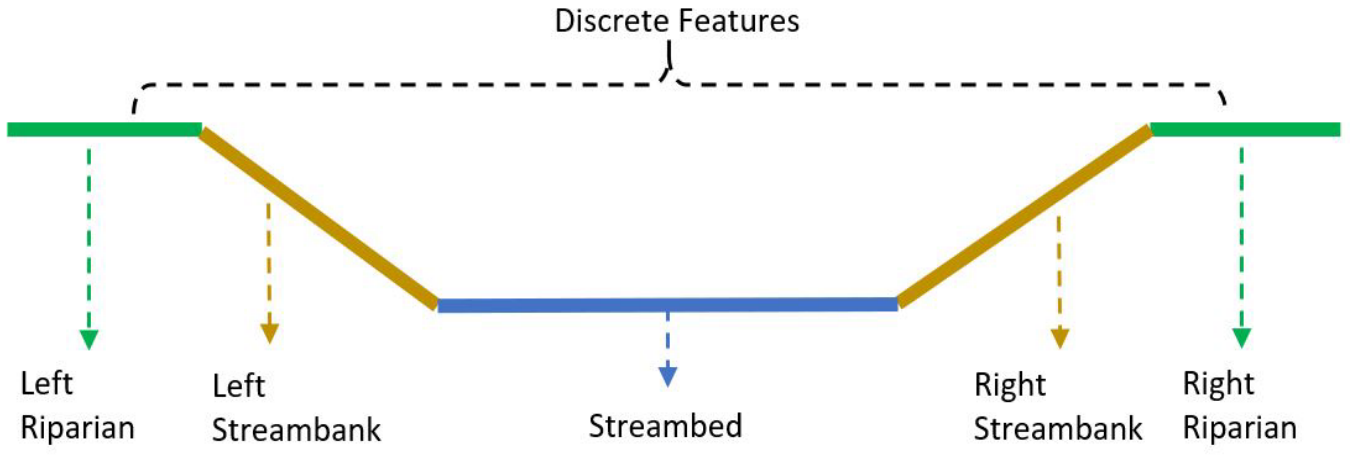




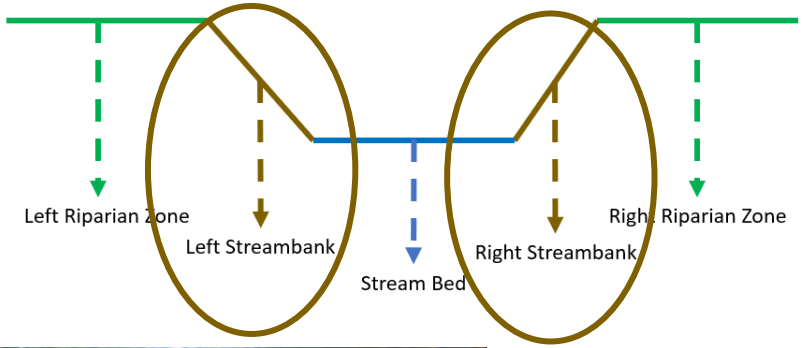




- Riparian
- Streambank
- Streambed
- Discrete features

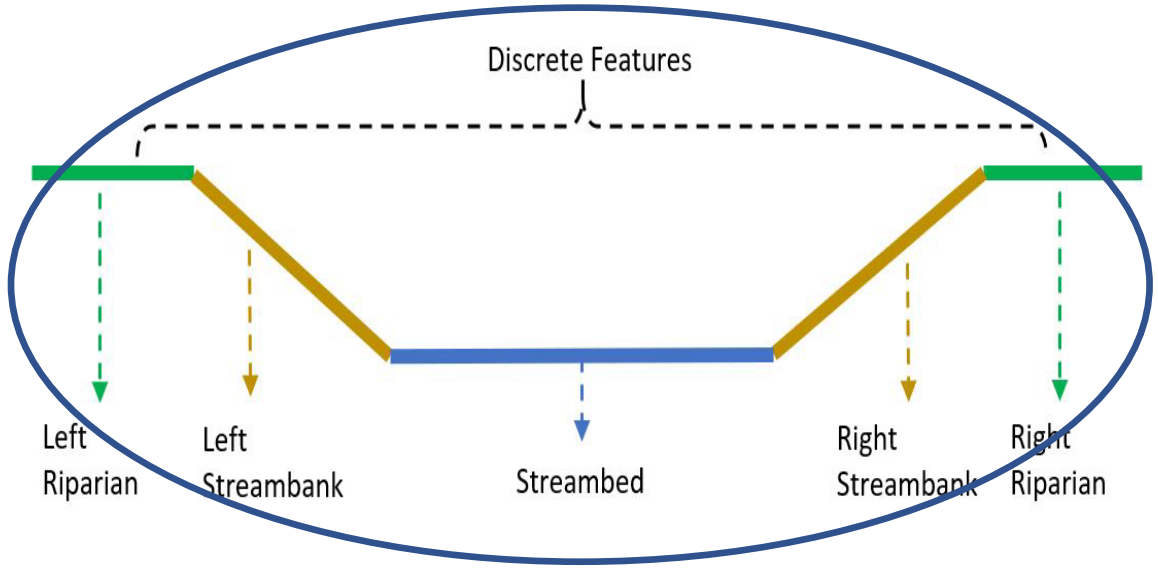


Streambank Condition Scoring



Functional ← → Impaired

Discrete Feature Scoring - Outfalls



Clean Outfall ← → **Illicit Discharge**


Front
Front
Front
Front

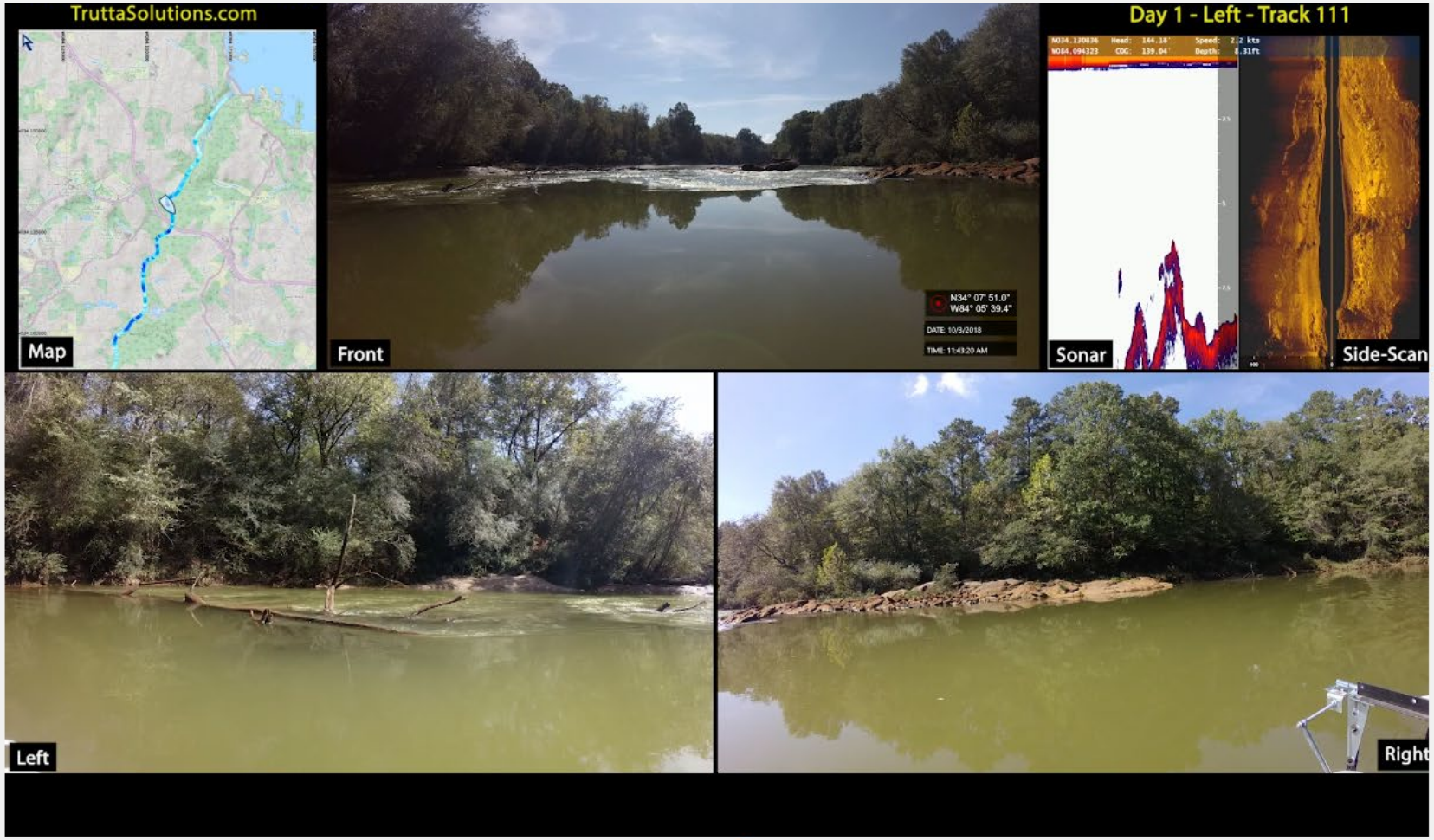
Classification Software

Ethogram

	Key	Code	Type	Description
1	u	u:SD-VI	Point event	Sedimentation - Vegetated Islands
2	p	p:SD-OH	Point event	Sedimentation - Other
3	e	e:VEG	Point event	Sedimentation - Inchannel vegetatior
4	i	i:SD-CB	Point event	Sedimentation - In channel Bars
5	o	o:SD-EF	Point event	Sedimentation - Excess Fines
6	z	z:RD-OH	Point event	Road Crossing - Overhead Bridge
7	c	c:RD-4D	Point event	Road Crossing - Low Water Crossing,
8	x	x:RD-LW	Point event	Road Crossing - Low Water Crossing,
9	v	v:RD-CV	Point event	Road Crossing - Culvert
10	r	r:revisit	Point event	revisit
11	d	d:PI-OF	Point event	Pipe - Outfall
12	g	g:PI-OH	Point event	Pipe - Other
13	n	n:PI-Dch	Point event	Pipe - manmade drainage ditch
14	f	f:PI-MS	Point event	Pipe - Manhole Stack
15	s	s:PI-IN	Point event	Pipe - Intake
16	a	a:PI-EX	Point event	Pipe - Exposed
17	t	t:TR	Point event	Other - Trash
18	h	h:OH-O2	Point event	Other - Other
19	m	m:LS	Point event	Other - Live Stock
20	l	l:OH-LW	Point event	Other - Large Woody Debris
21	k	k:IC	Point event	Other - Incoming Channel
22	b	b:FB	Point event	Other - Fish Barrier

Subjects

	Key	Name	Description	Current sta
1		No focal subject		
2	1	1:Left Bank	impact only on ...	
3	3	3:Right Bank	impact only on ...	
4	2	2:Both Banks	impact on both...	
5	5	5:in channel	impacts only in...	
6	0	0:all	impacts in cha...	



Events for "Chat_Left_D1T111_Boat_Point_...

	time	subject	code
41	00:48:31.068	1:Left Bank	l:OH-LW
42	00:48:54.748	1:Left Bank	l:OH-LW
43	00:49:16.514	5:in channel	l:OH-LW
44	00:51:40.748	1:Left Bank	l:OH-LW
45	00:52:16.518	1:Left Bank	l:OH-LW
46	00:52:44.958	1:Left Bank	l:OH-LW
47	00:53:42.426	1:Left Bank	l:OH-LW
48	00:53:56.223	5:in channel	l:OH-LW
49	00:54:10.712	1:Left Bank	l:OH-LW
50	00:54:37.605	1:Left Bank	l:OH-LW
51	00:54:58.118	1:Left Bank	l:OH-LW
52	00:55:13.376	1:Left Bank	l:OH-LW
53	00:56:13.087	1:Left Bank	k:IC
54	00:56:27.089	0:all	z:RD-OH
55	00:57:28.844	1:Left Bank	l:OH-LW
56	00:58:52.725	1:Left Bank	e:VEG
57	01:00:31.241	1:Left Bank	l:OH-LW
58	01:01:20.447	1:Left Bank	l:OH-LW
59	01:03:19.858	1:Left Bank	l:OH-LW
60	01:03:50.736	1:Left Bank	l:OH-LW
61	01:04:17.372	1:Left Bank	l:OH-LW
62	01:06:18.109	1:Left Bank	l:OH-LW
63	01:07:07.313	1:Left Bank	l:OH-LW
64	01:07:32.447	1:Left Bank	l:OH-LW
65	01:10:39.996	1:Left Bank	l:OH-LW
66	01:11:52.788	5:in channel	l:OH-LW
67	01:12:43.575	1:Left Bank	l:OH-LW
68	01:12:56.150	1:Left Bank	l:OH-LW
69	01:13:12.320	1:Left Bank	l:OH-LW

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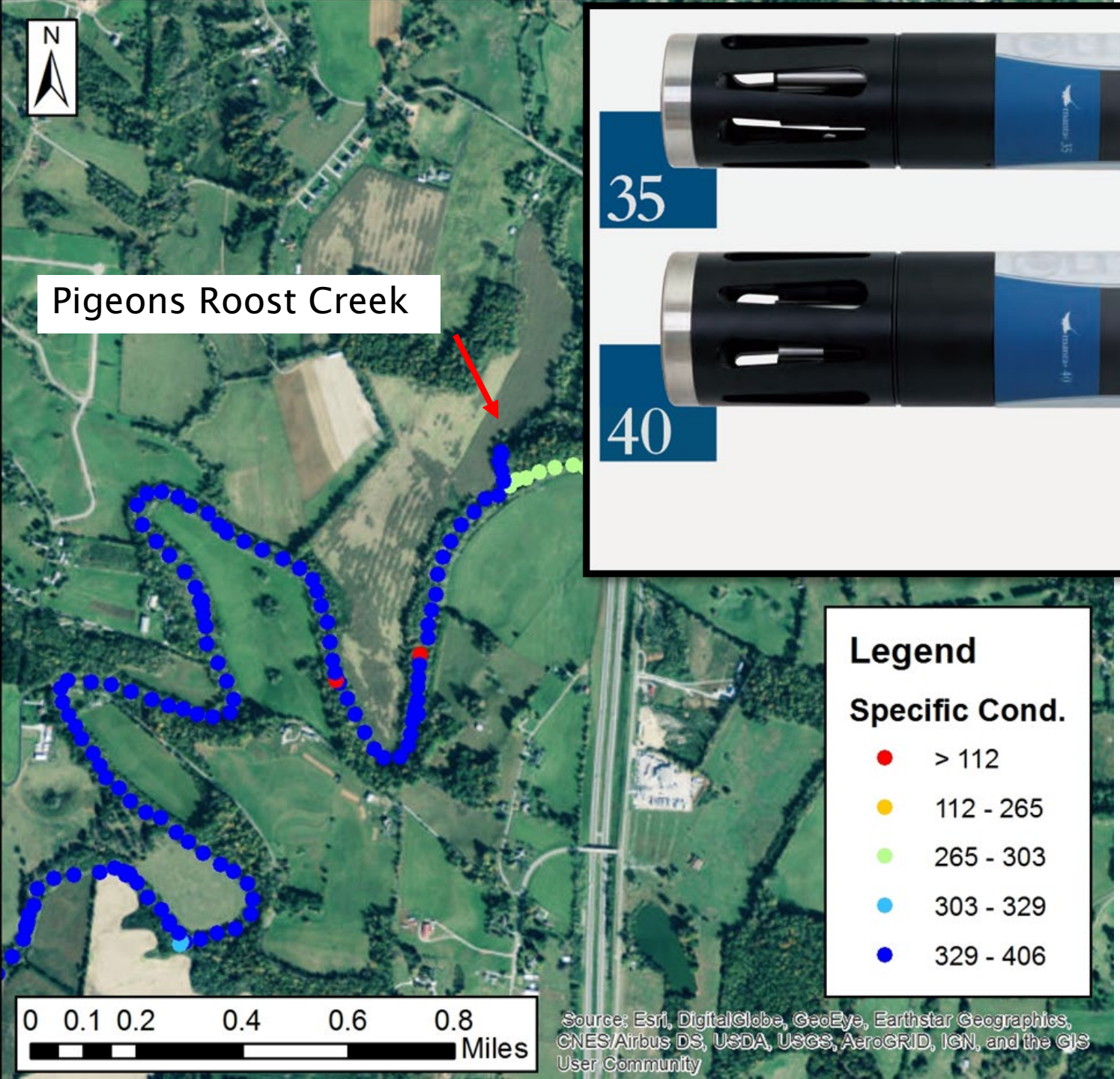
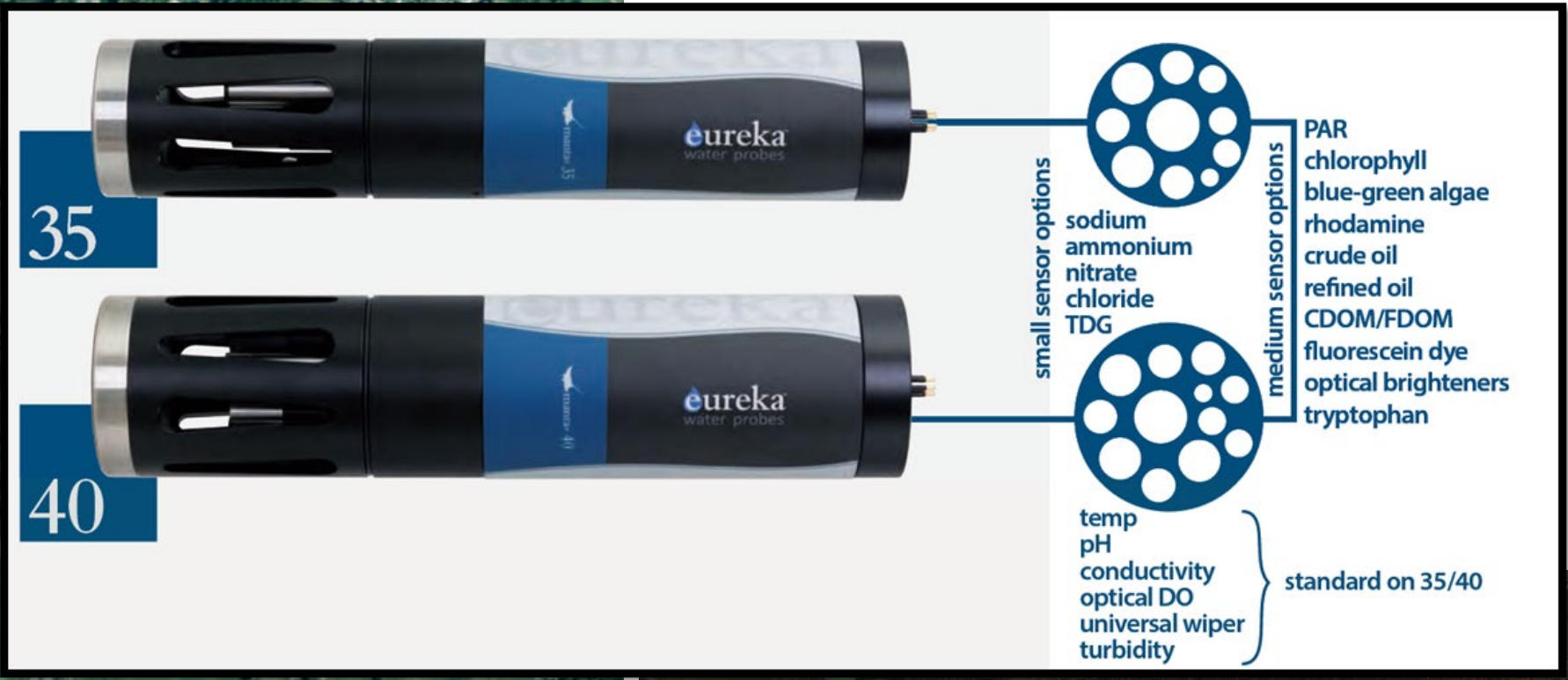
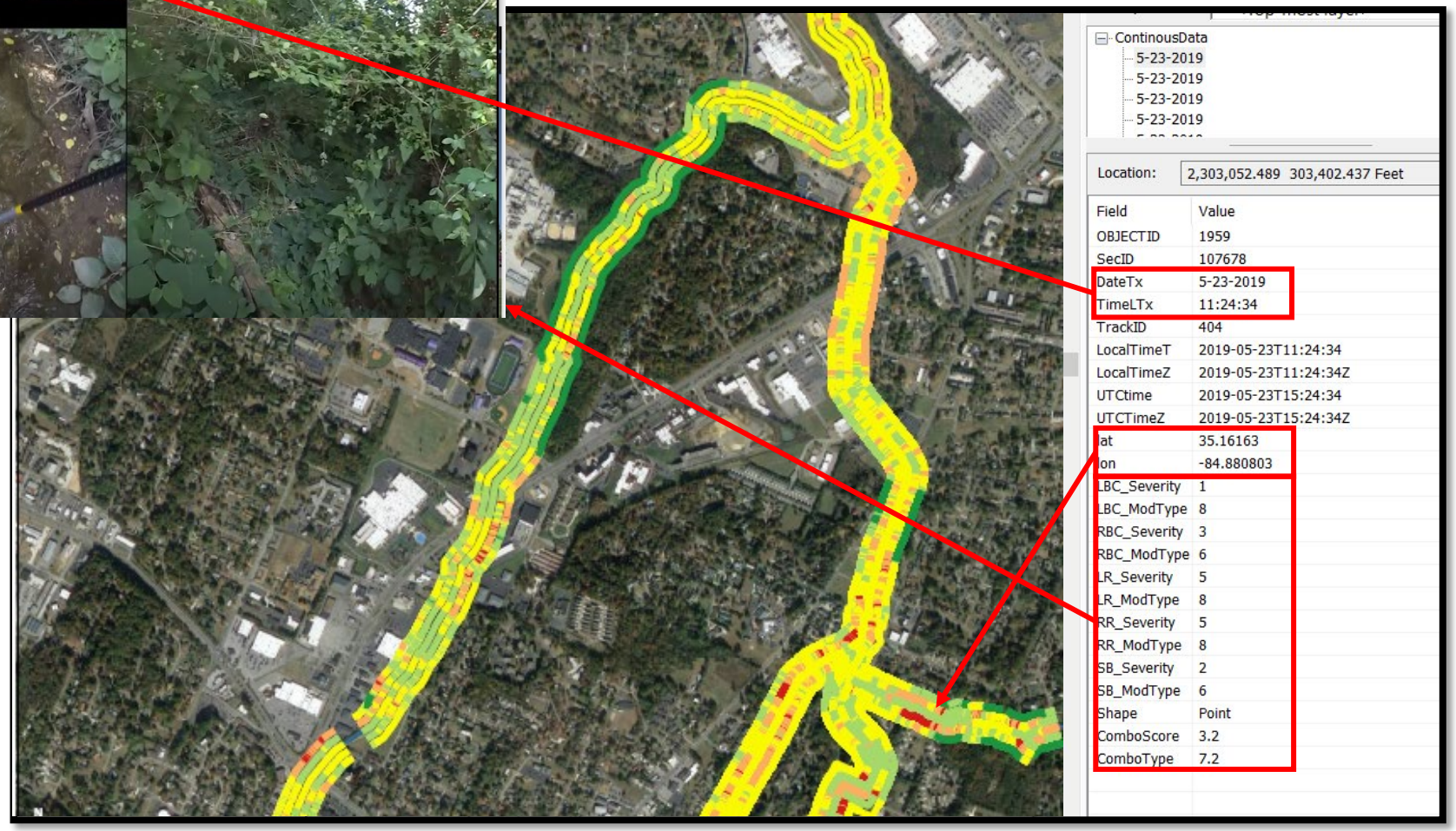

N
Pigeons Roost Creek
Legend
Specific Cond.
> 112
112 - 265
265 - 303
303 - 329
329 - 406
0 0.1 0.2 0.4 0.6 0.8
Miles
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

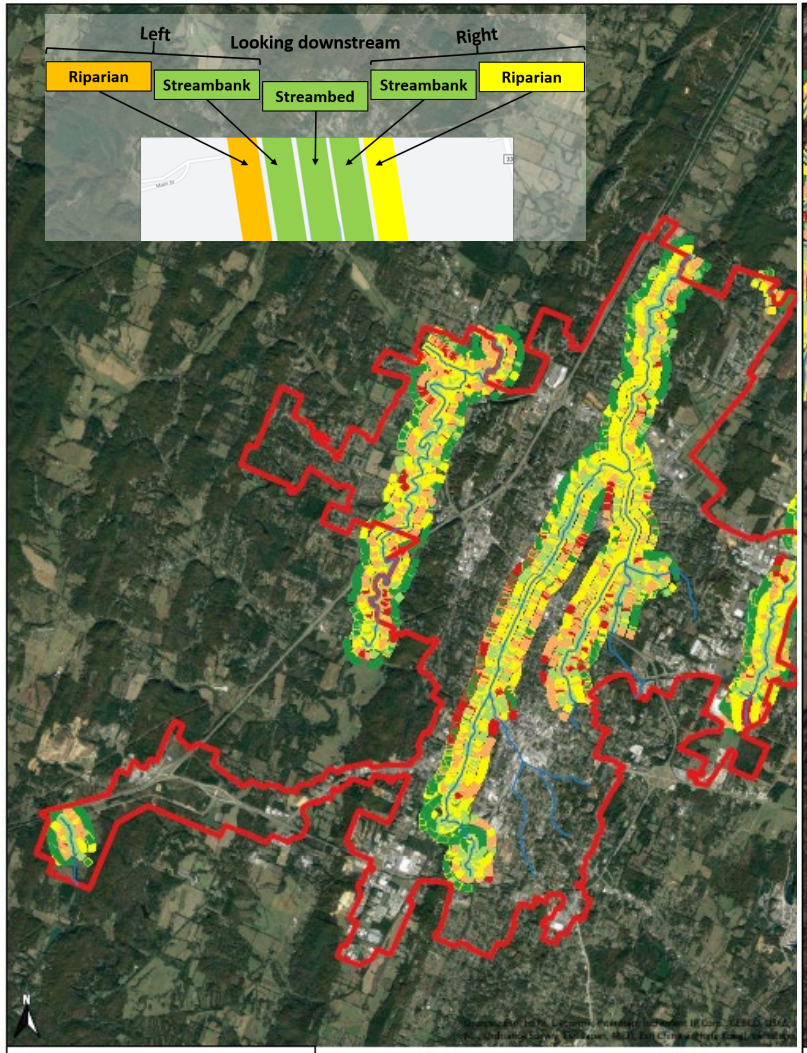

35
40
eureka
water probes
small sensor options
sodium
ammonium
nitrate
chloride
TDG
medium sensor options
PAR
chlorophyll
blue-green algae
rhodamine
crude oil
refined oil
CDOM/FDOM
fluorescein dye
optical brighteners
tryptophan
temp
pH
conductivity
optical DO
universal wiper
turbidity
standard on 35/40

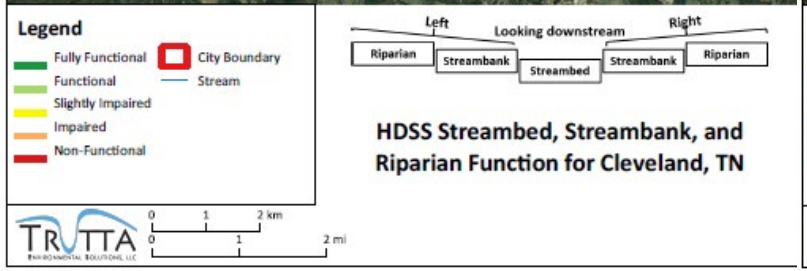


ContinousData
- 5-23-2019
- 5-23-2019
- 5-23-2019
- 5-23-2019

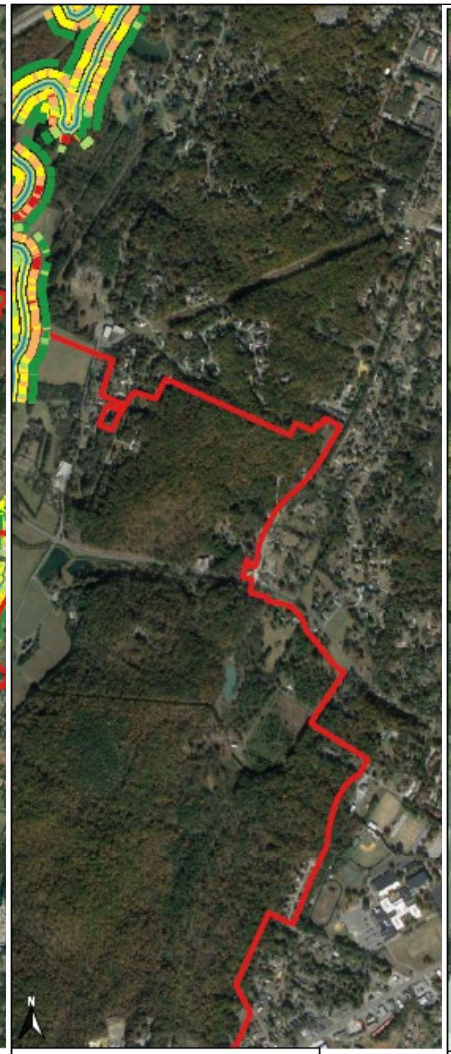
Location: 2,303,052.489 303,402.437 Feet

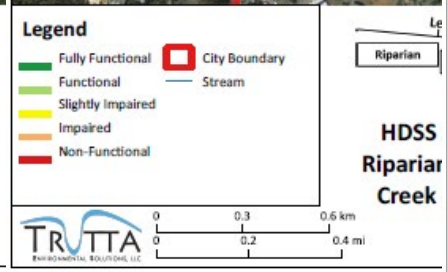
Field	Value
OBJECTID	1959
SecID	107678
DateTx	5-23-2019
TimeLTx	11:24:34
TrackID	404
LocalTimeT	2019-05-23T11:24:34
LocalTimeZ	2019-05-23T11:24:34Z
UTCtime	2019-05-23T15:24:34
UTCTimeZ	2019-05-23T15:24:34Z
lat	35.16163
lon	-84.880803
LBC_Severity	1
LBC_ModType	8
RBC_Severity	3
RBC_ModType	6
LR_Severity	5
LR_ModType	8
RR_Severity	5
RR_ModType	8
SB_Severity	2
SB_ModType	6
Shape	Point
ComboScore	3.2
ComboType	7.2



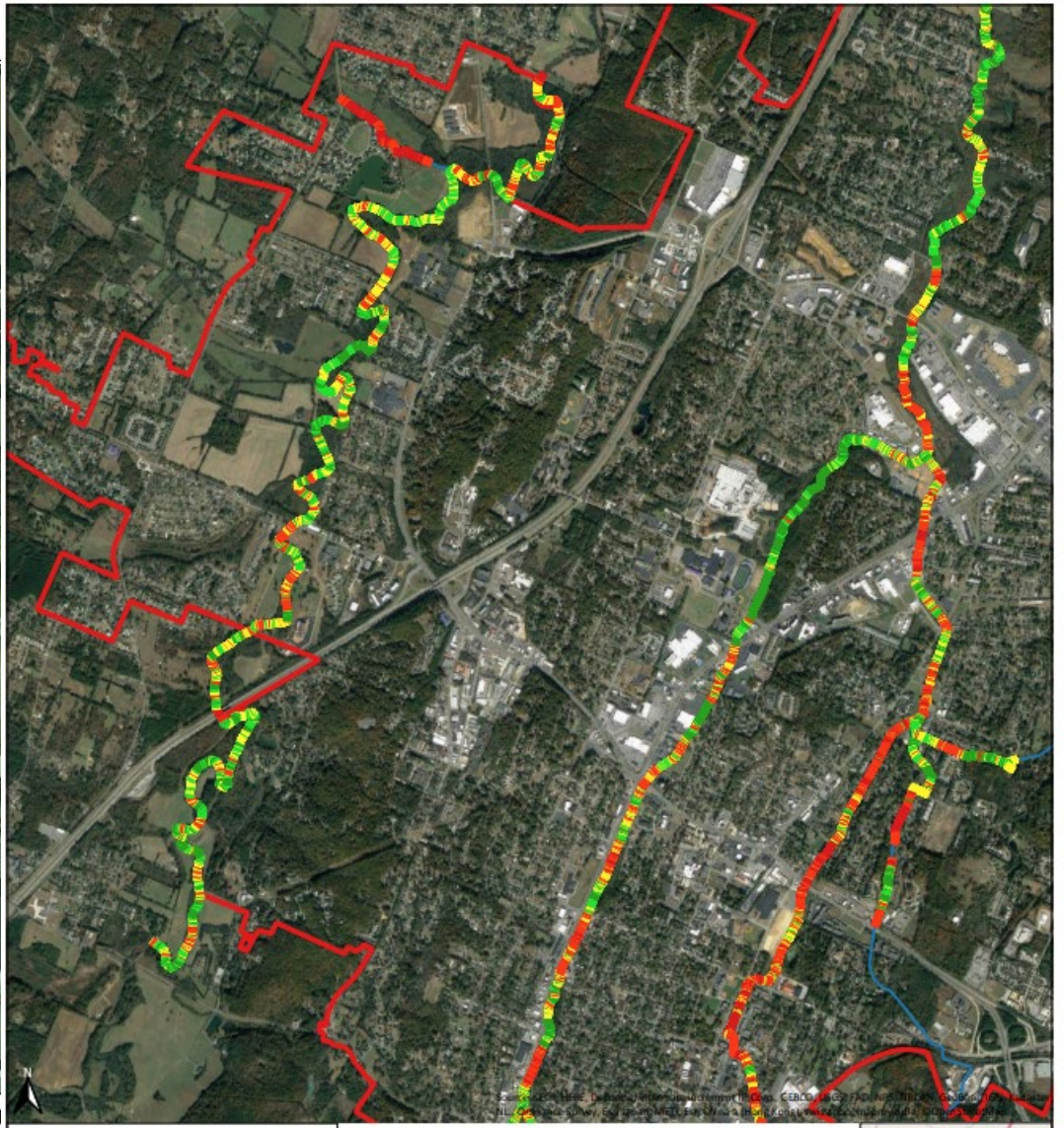


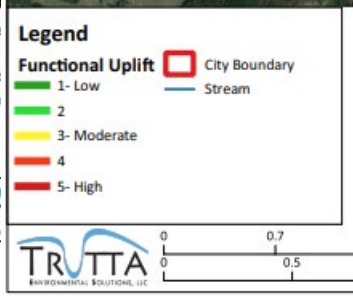
HDSS Streambed, Streambank, and Riparian Function for Cleveland, TN



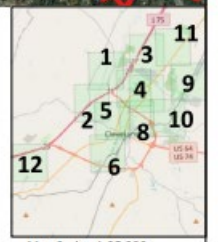


HDSS Riparian Creek





HDSS Functional Uplift for the majority of streams within Cleveland, TN.



Map Scale: 1:35,200
Map CRS: EPSG:26916
Coordinate Units: Meters

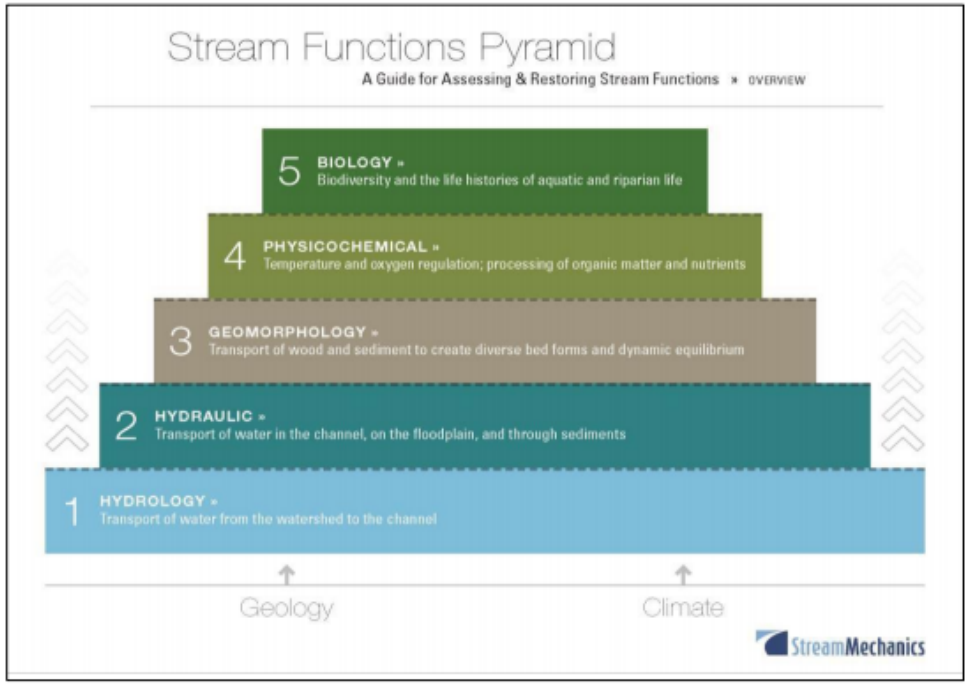


Figure 1. Stream Functions Pyramid (Harman et al., 2012)

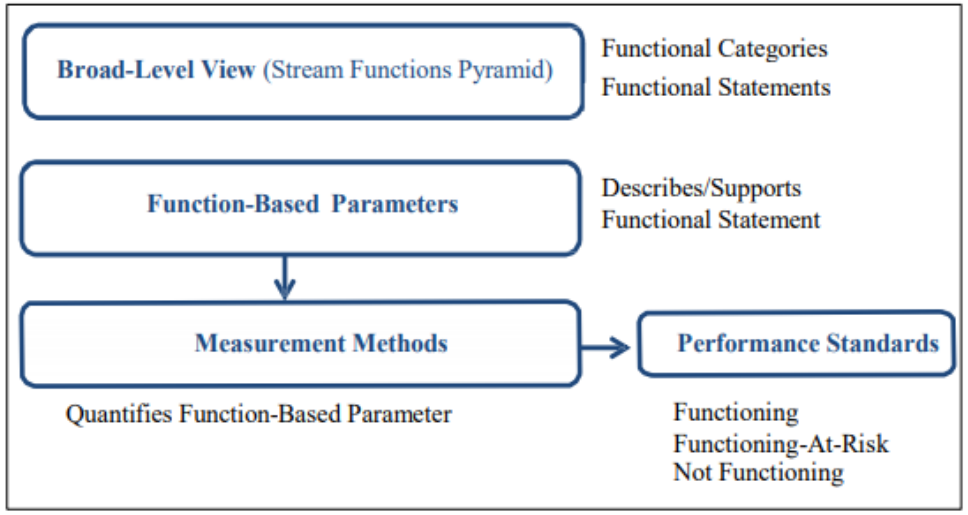
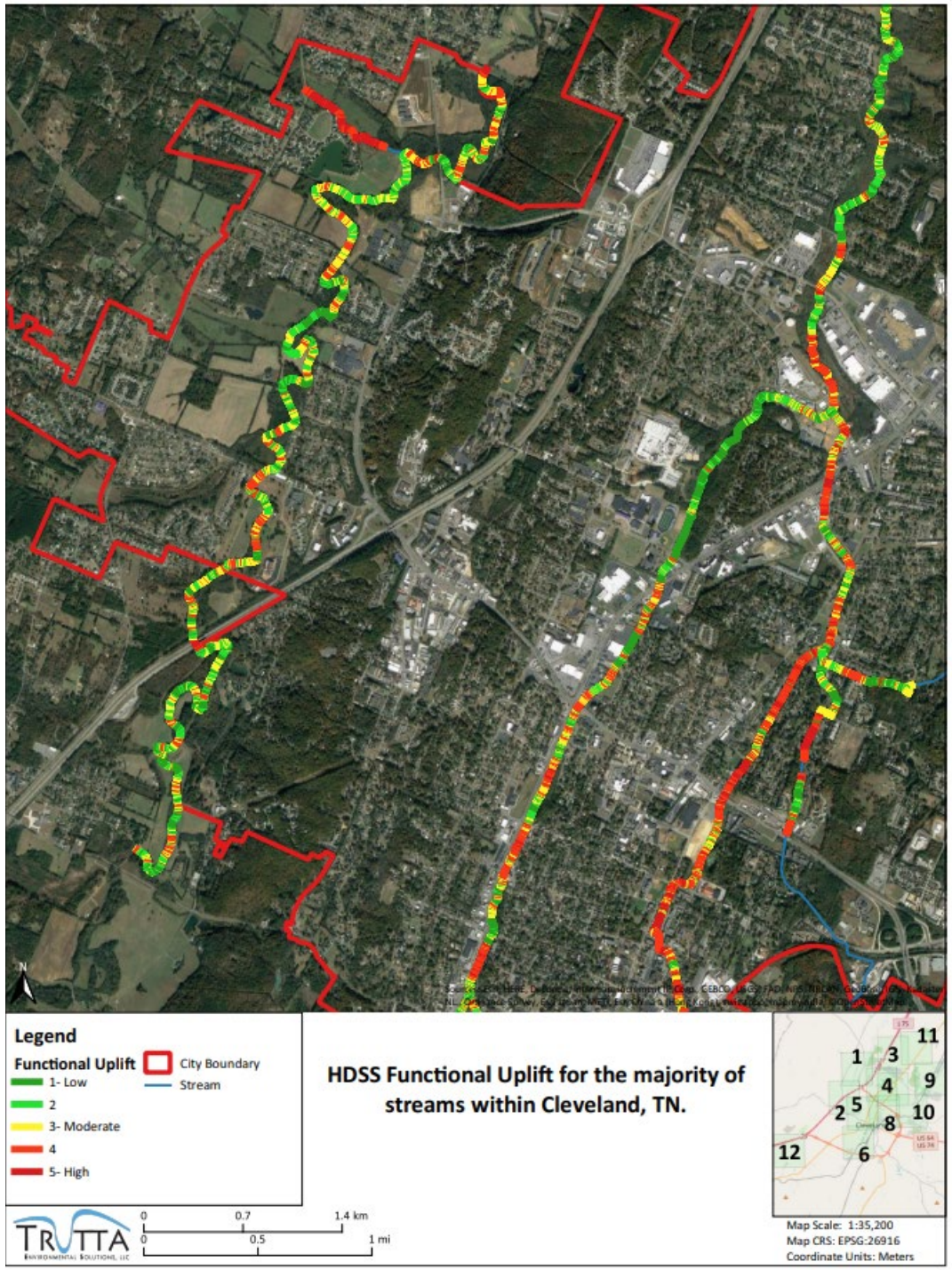
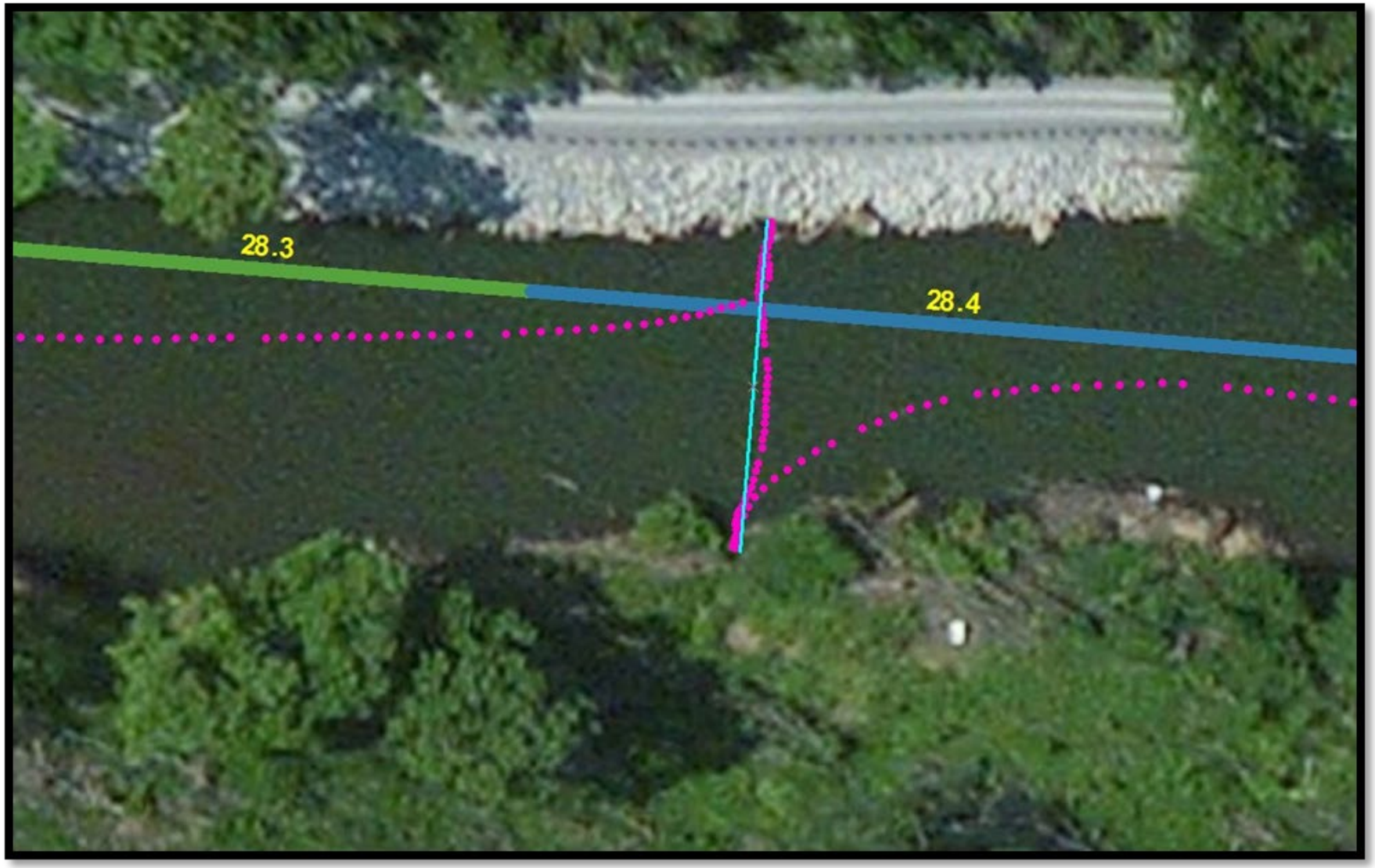


Figure 2. Stream Functions Pyramid Framework (Harman et al., 2012)



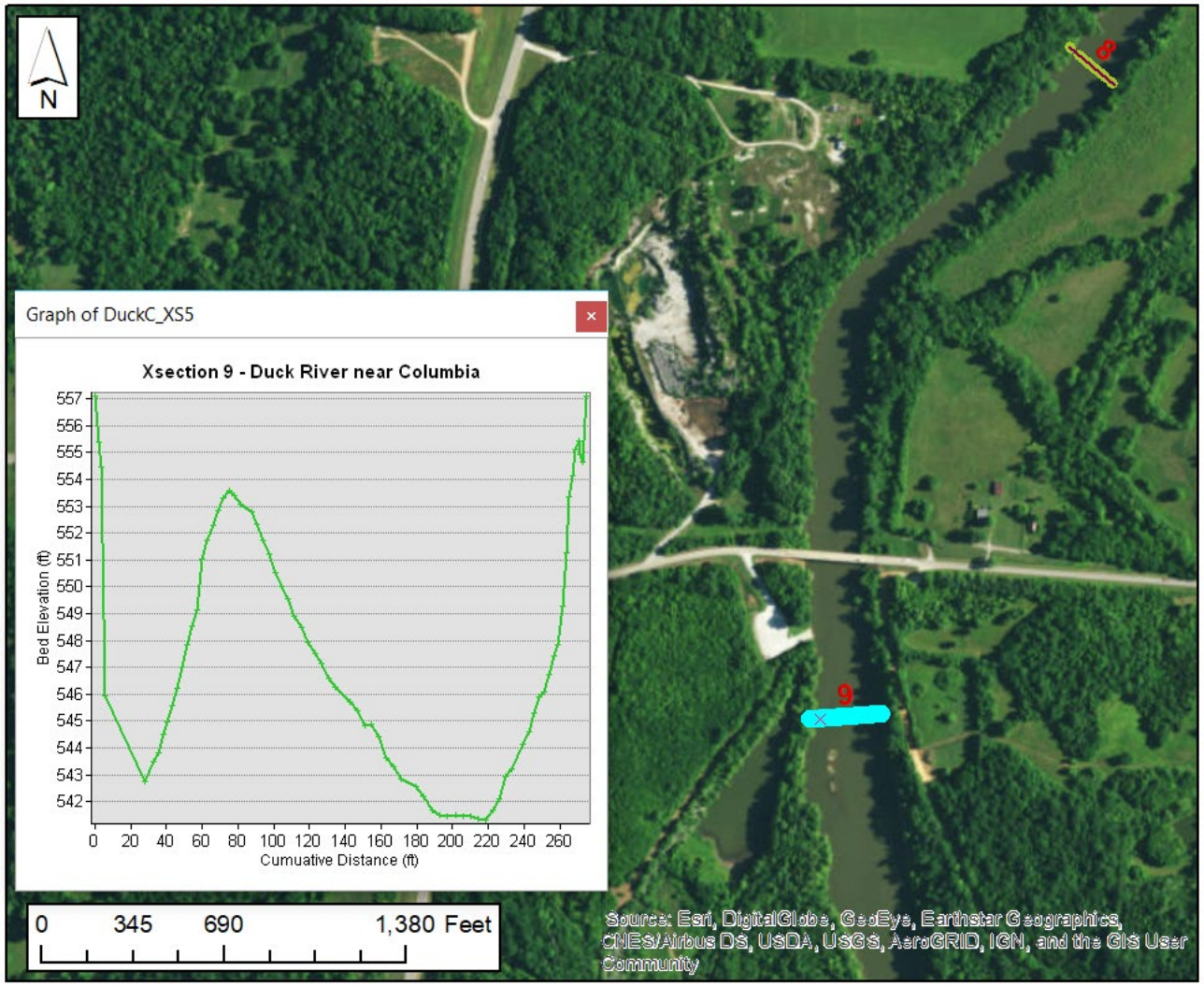
Cross Sections & Bathymetry

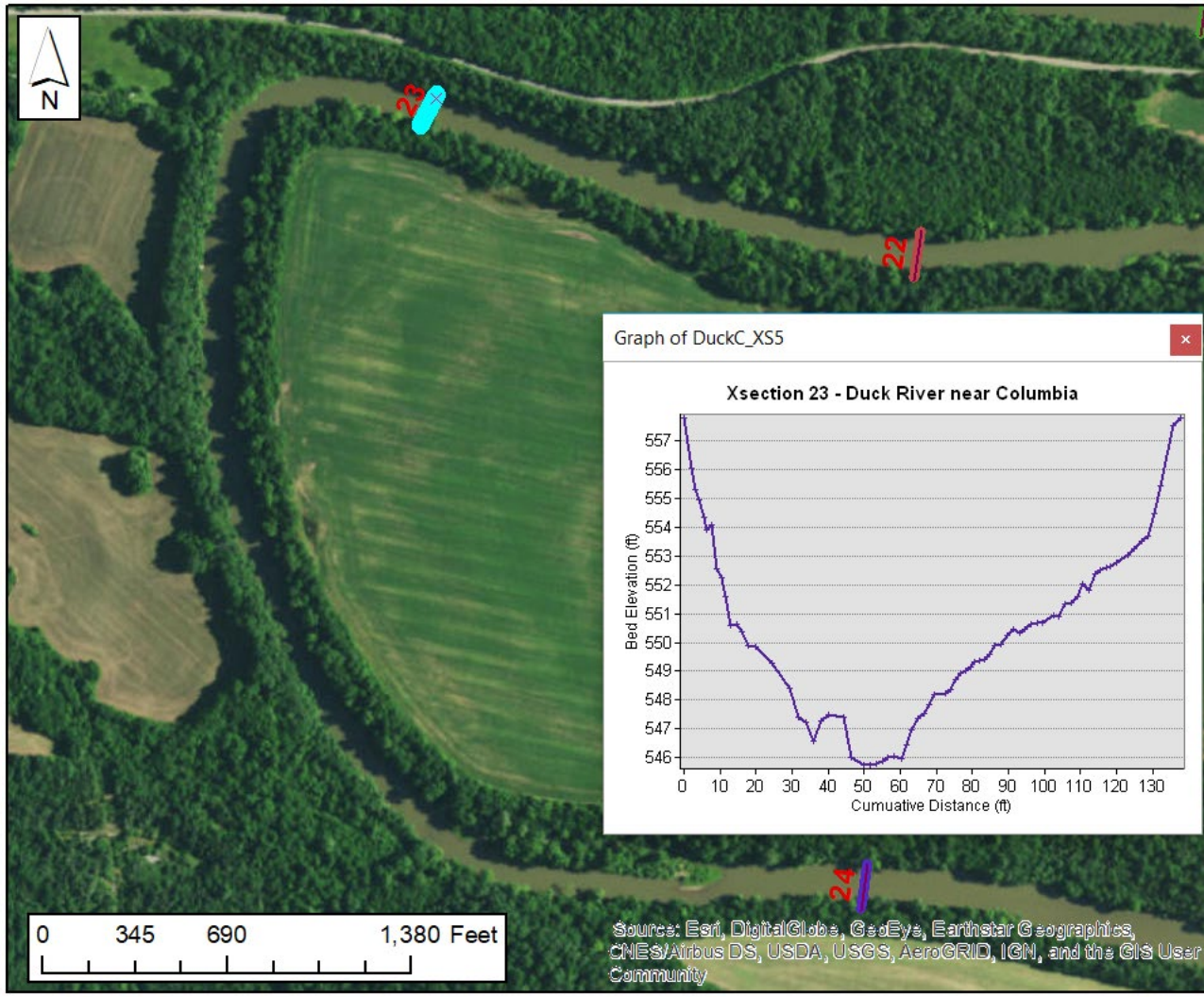
XS ID	Type	River Mile	XS Length (ft)	XS ID	Type	River Mile	XS Length (ft)
245	River	24.5	147.7	10687	Tributary	68.7	38.9
262	River	26.2	152.3	702	River	70.2	100.7
271	River	27.1	152.6	711	River	71.1	118.0
277	River	27.7	123.4	717	River	71.7	86.6
284	River	28.4	102.8	734	River	73.4	76.7
297	River	29.7	125.2	741	River	74.1	105.7
304	River	30.4	114.7	744	River	74.4	130.3
314	River	31.4	141.1	756	River	75.6	97.7
10352	Tributary	35.2	54.9	762	River	76.2	107.2
365	River	36.5	153.2	768	River	76.8	107.7
369	River	36.9	168.3	771	River	77.1	100.1
380	River	38	141.0	778	River	77.8	102.0
393	River	39.3	154.0	10789	Tributary	78.9	64.6
401	River	40.1	113.9	791	River	79.1	86.1
411	River	41.1	145.9	804	River	80.4	73.8
421	River	42.1	168.0	818	River	81.8	75.2
10433	Tributary	43.3	63.9	824	River	82.4	56.9
10436	Tributary	43.6	57.8	831	River	83.1	69.2
442	River	44.2	120.6	834	River	83.4	76.6
455	River	45.5	121.5	838	River	83.8	63.4
469	River	46.9	112.8	843	River	84.3	61.6
476	River	47.6	121.1	850	River	85	73.0
491	River	49.1	92.0	856	River	85.6	58.5
504	River	50.4	177.7	10857	Tributary	85.7	46.5
509	River	50.9	116.5	862	River	86.2	66.3
519	River	51.9	110.5	871	River	87.1	74.0
535	River	53.5	111.4	877	River	87.7	61.1
553	River	55.3	103.9	883	River	88.3	64.8
576	River	57.6	97.2	888	River	88.8	60.1
10581	Tributary	58.1	25.9	895	River	89.5	60.3
590	River	59	94.6	10895	Tributary	89.5	20.9
599	River	59.9	62.7	916	River	91.6	65.8
614	River	61.4	93.4	936	River	93.6	62.1
622	River	62.2	132.5	944	River	94.4	57.6
10623	Tributary	62.3	66.8	948	River	94.8	66.6
623	River	62.3	113.1	959	River	95.9	83.1
639	River	63.9	104.0	970	River	97	70.9
646	River	64.6	84.0	985	River	98.5	71.6
656	River	65.6	105.4	997	River	99.7	84.2
669	River	66.9	95.7	1006	River	100.6	55.6
683	River	68.3	108.9				



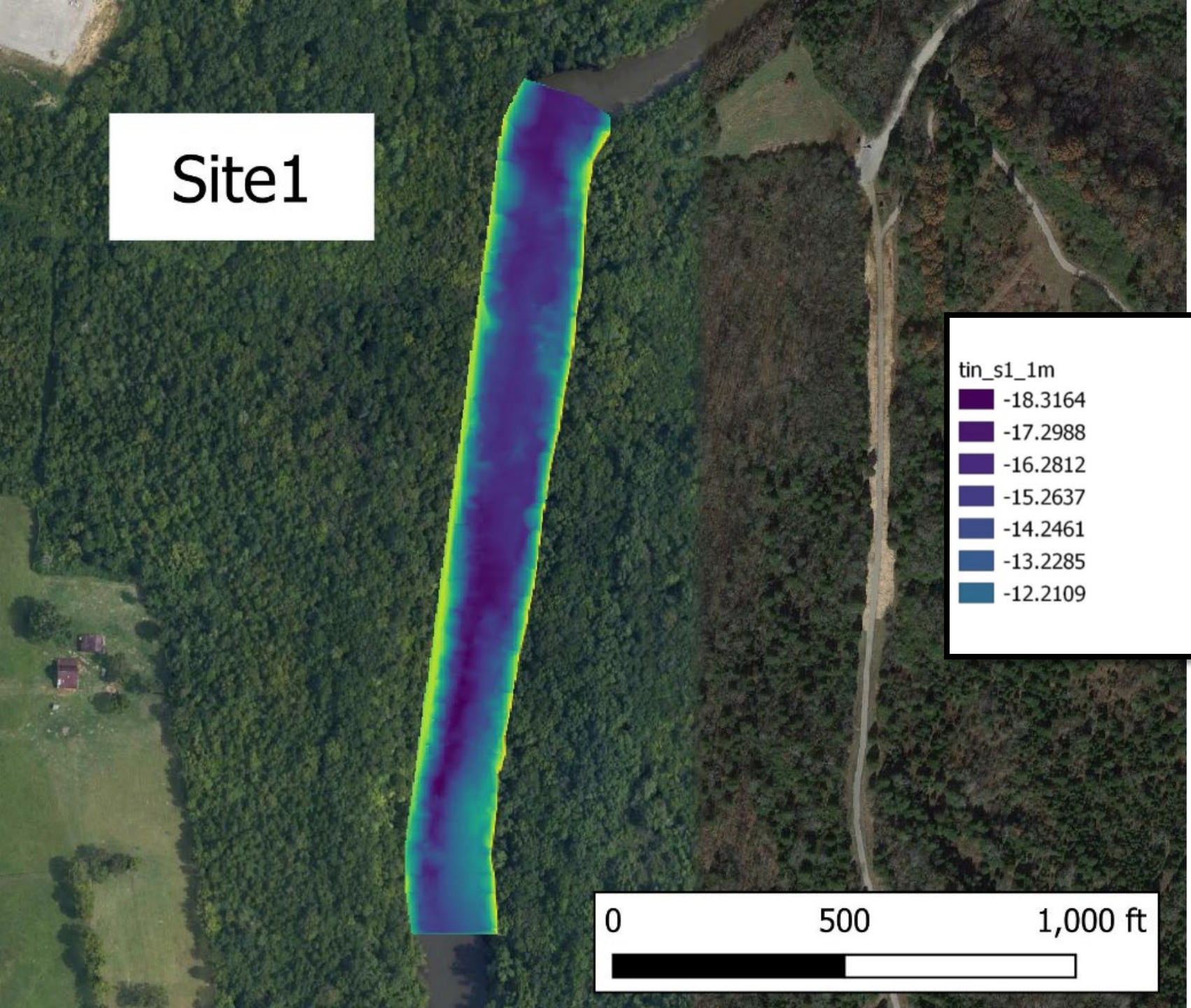
Cross Sections

- Survey grade GPS with Water Surface and Bed Elevations






9
10
11
12
Site 1
13
14
Site 2
15
16
17
18
19
20
21
22
23

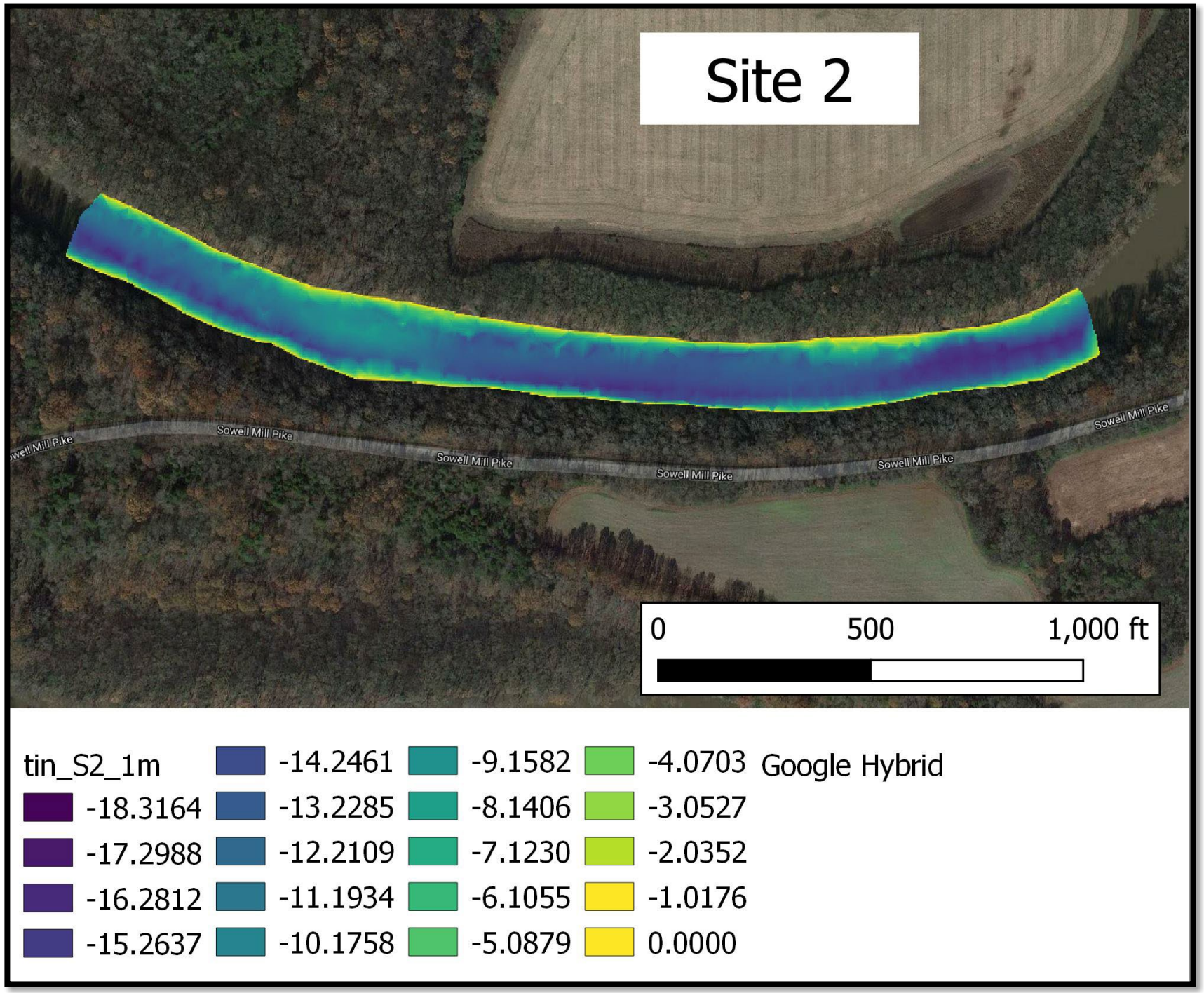


tin_s1_1m

-18.3164
-17.2988
-16.2812
-15.2637
-14.2461
-13.2285
-12.2109
-11.1934
-10.1758
-9.1582
-8.1406
-7.1230
-6.1055
-5.0879
-4.0703
-3.0527
-2.0352
-1.0176
0.0000

Google Hybrid

0 500 1,000 ft


Site 2
Sowell Mill Pike
Sowell Mill Pike
Sowell Mill Pike
Sowell Mill Pike
Sowell Mill Pike
0
500
1,000 ft
tin_S2_1m
-18.3164
-17.2988
-16.2812
-15.2637
-14.2461
-13.2285
-12.2109
-11.1934
-10.1758
-9.1582
-8.1406
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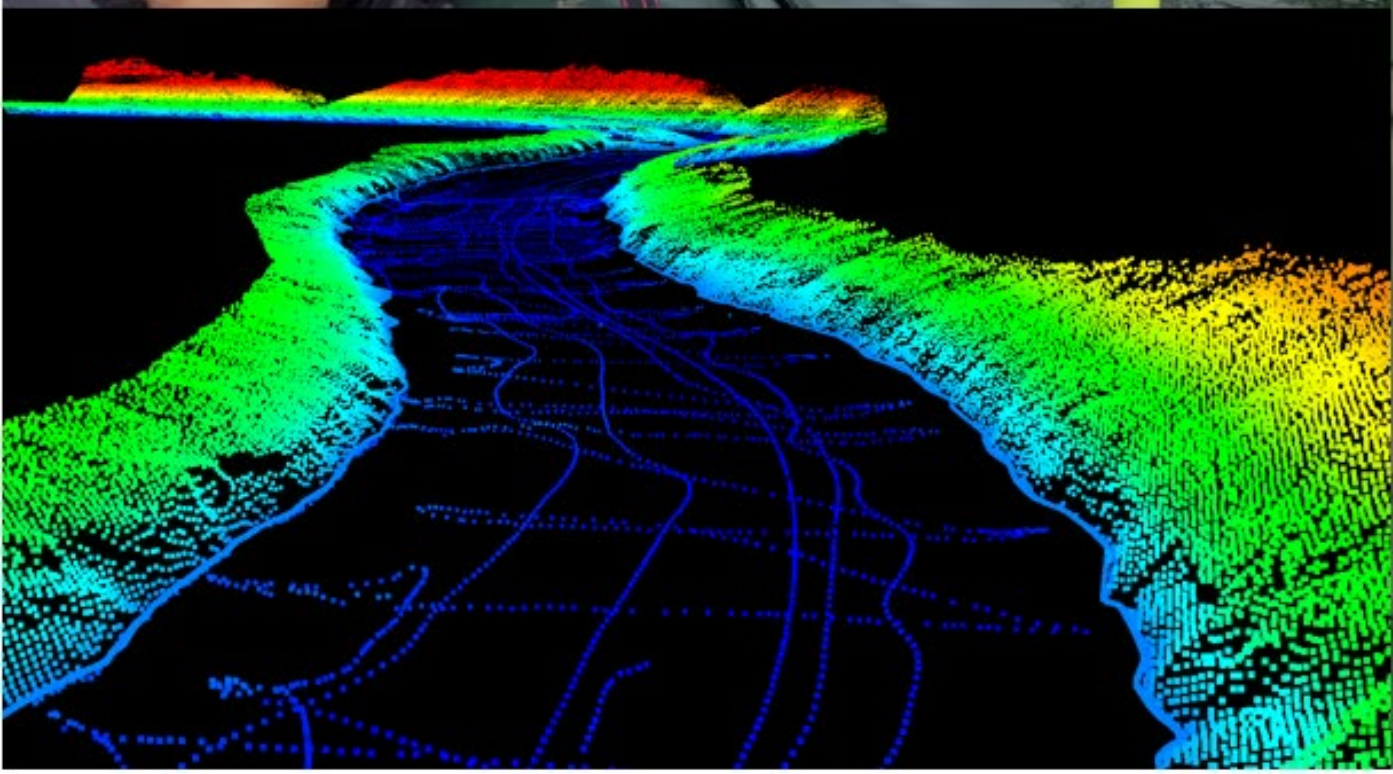
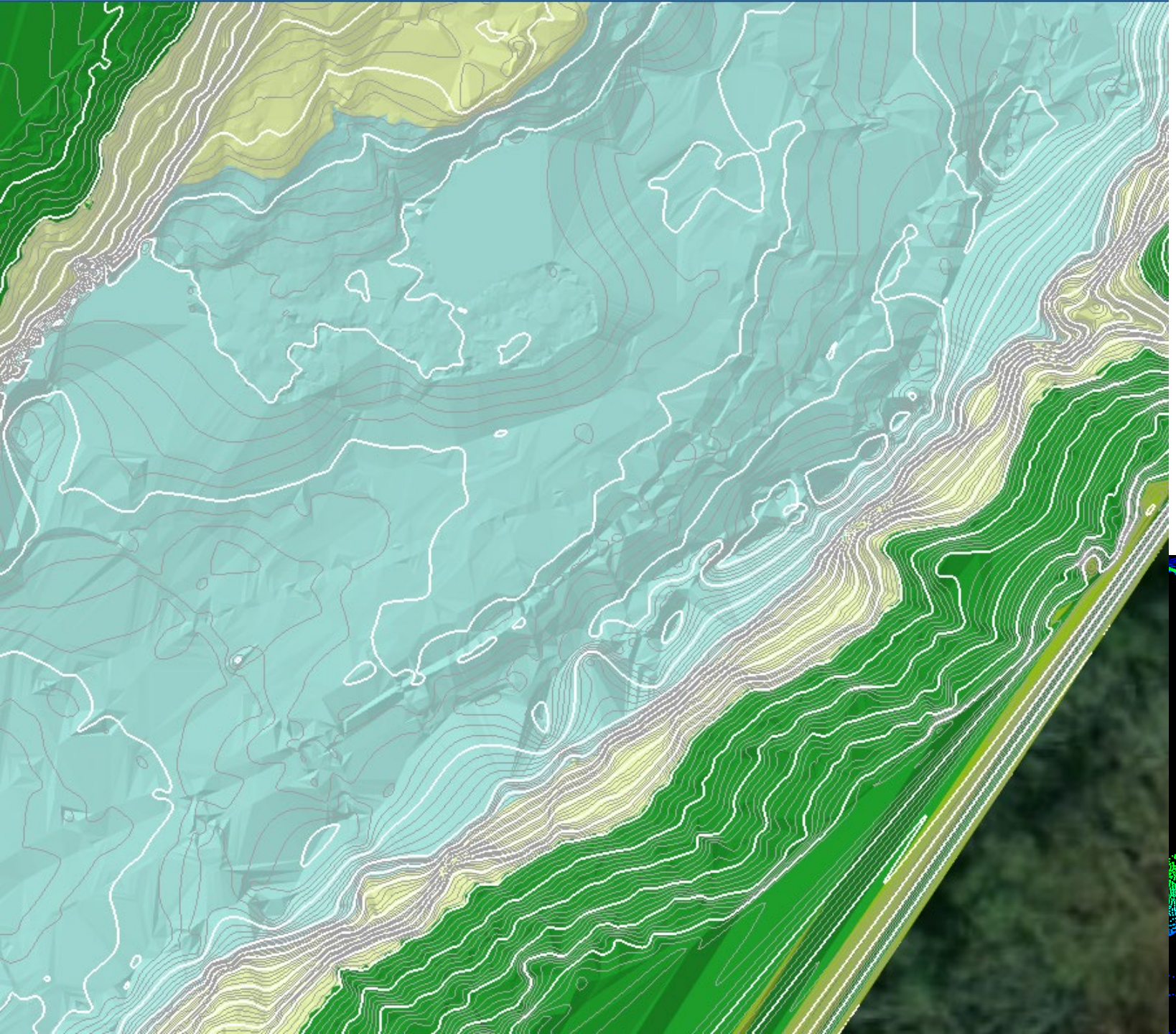
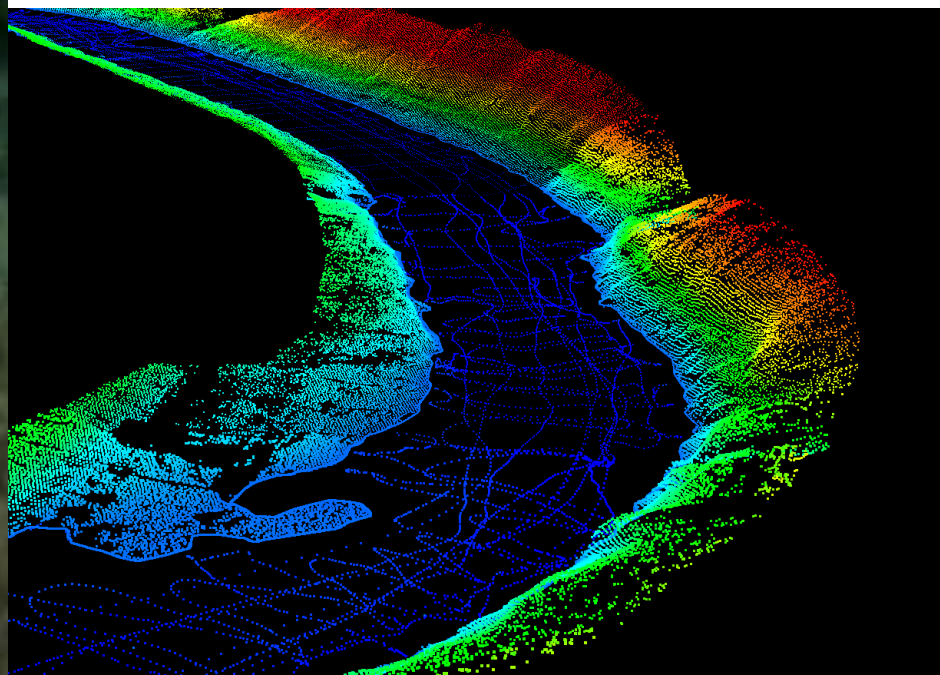
0.0000
Google Hybrid





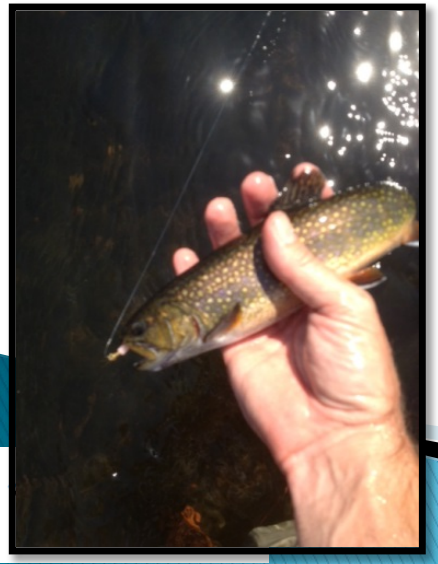


Organizations want to restore habitat and populations for Hellbenders, But…

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

TRUTTA Environmental Solutions

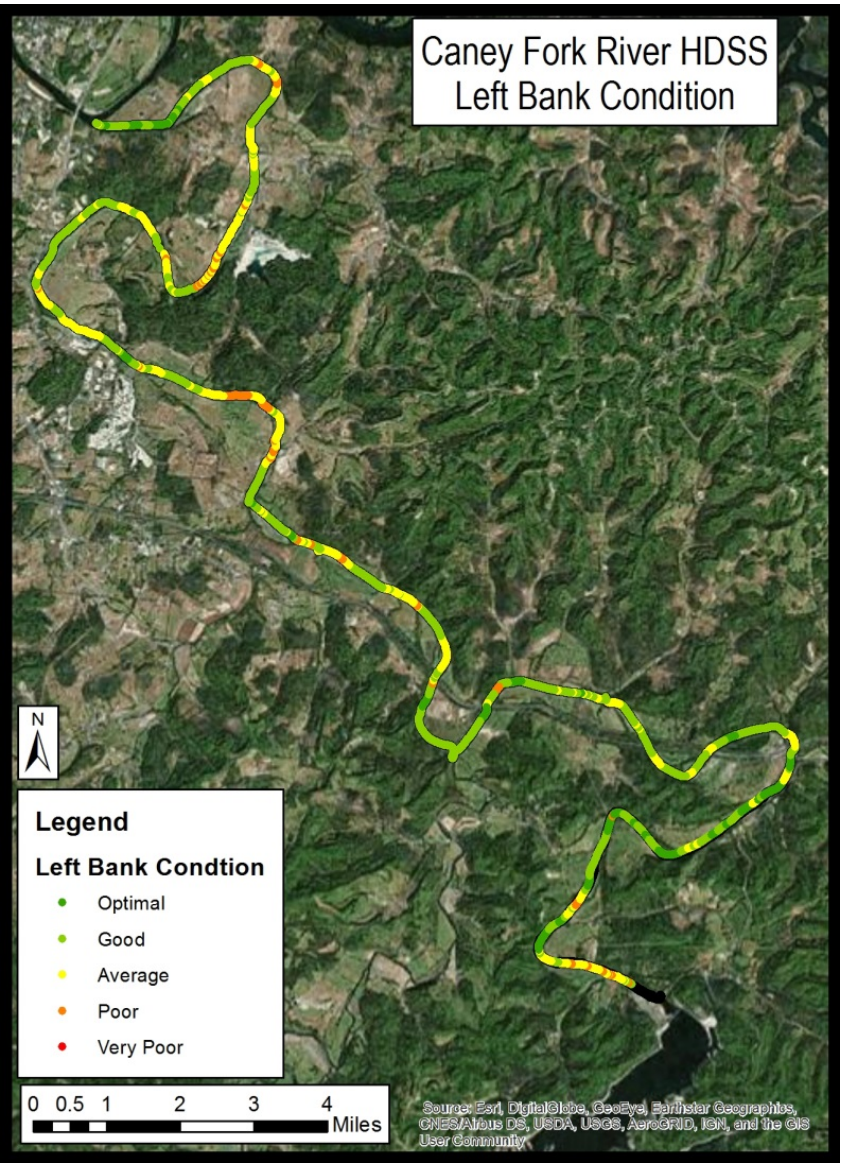
Caney Fork HDSS

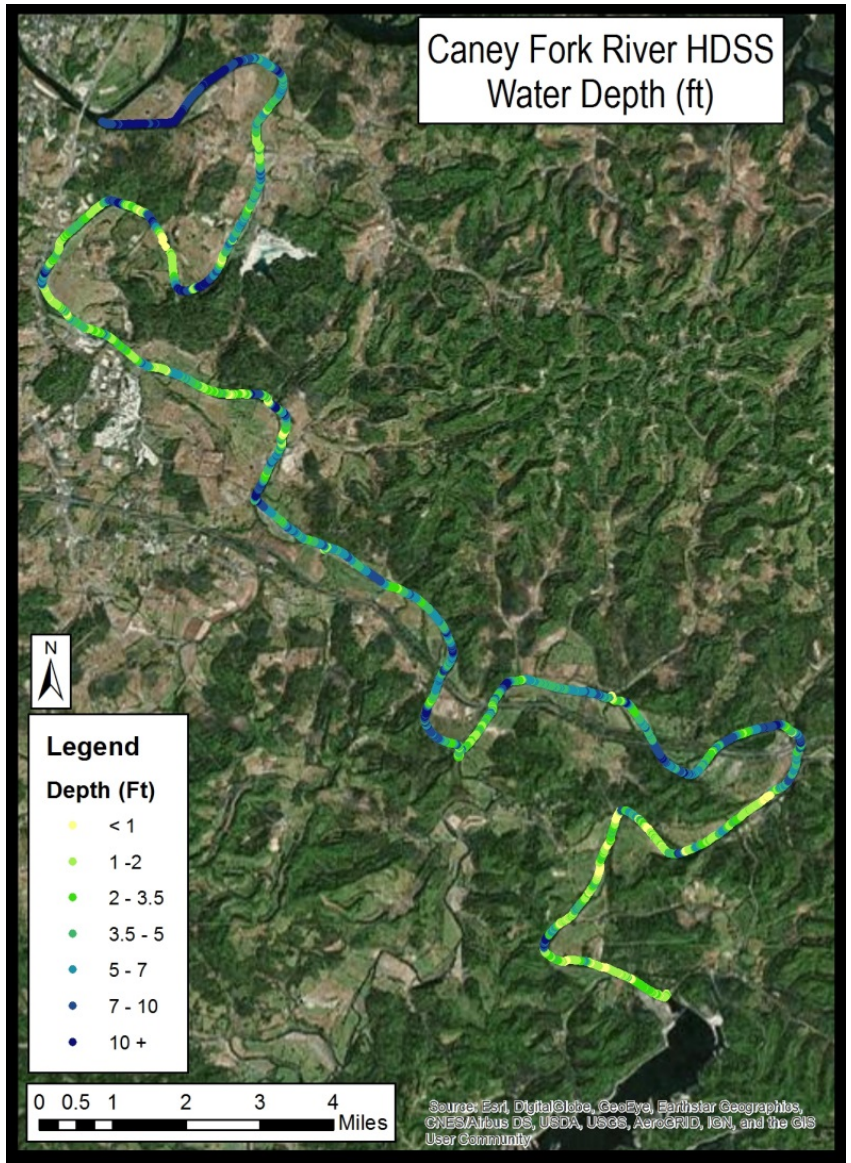


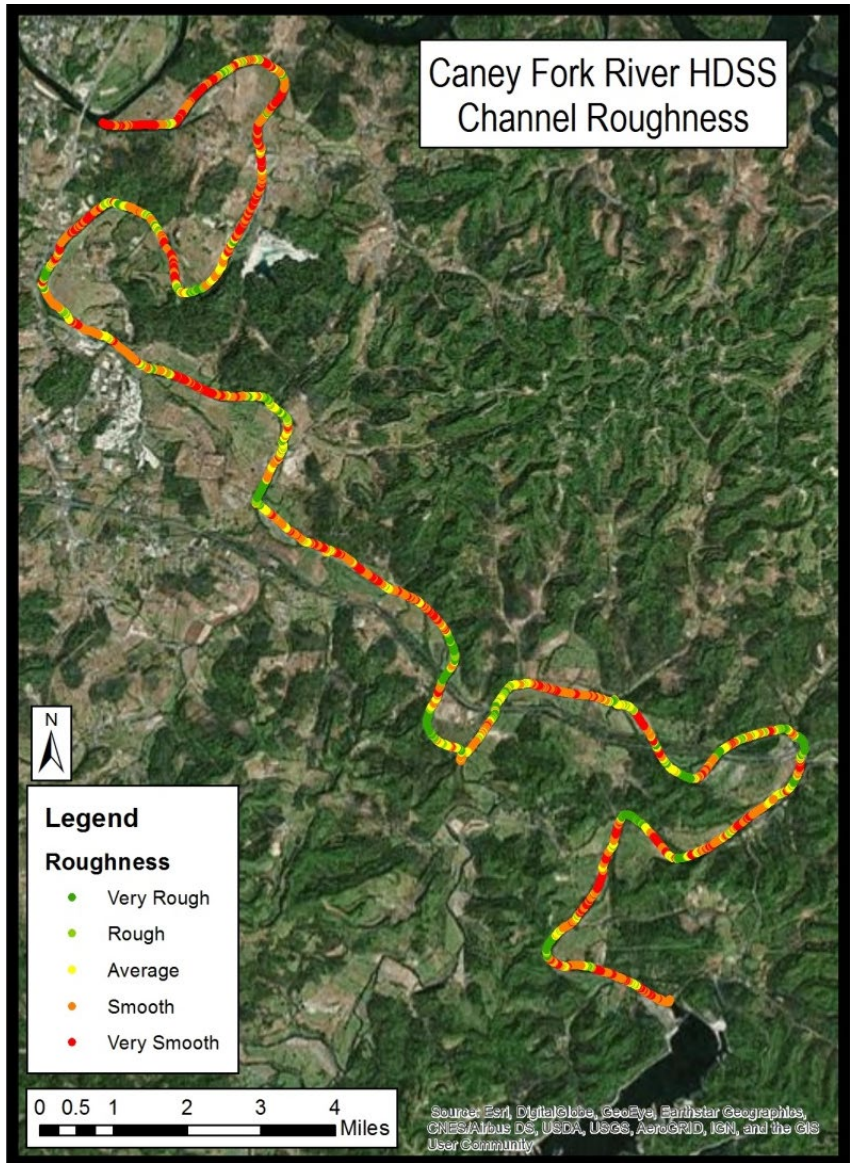
US Army Corps of Engineers®

TENNESSEE WILDLIFE RESOURCES AGENCY

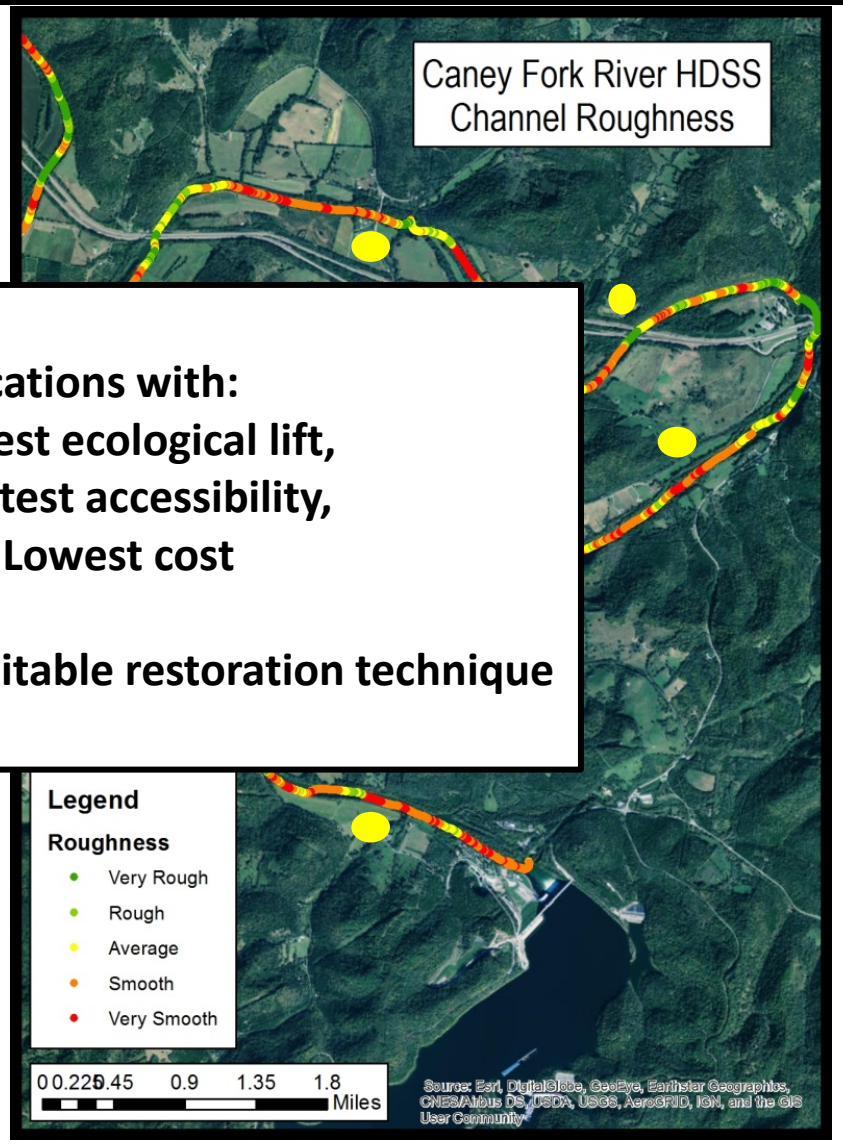
TROUT UNLIMITED


Caney Fork River HDSS
Left Bank Condition
N
Legend
Left Bank Condtion
Optimal
Good
Average
Poor
Very Poor
0 0.5 1 2 3 4
Miles
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community


Caney Fork River HDSS
Water Depth (ft)
N
Legend
Depth (Ft)
< 1
1 -2
2 - 3.5
3.5 - 5
5 - 7
7 - 10
10 +
0 0.5 1 2 3 4
Miles
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community


Caney Fork River HDSS
Channel Roughness
N
Legend
Roughness
Very Rough
Rough
Average
Smooth
Very Smooth
0 0.5 1 2 3 4
Miles
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

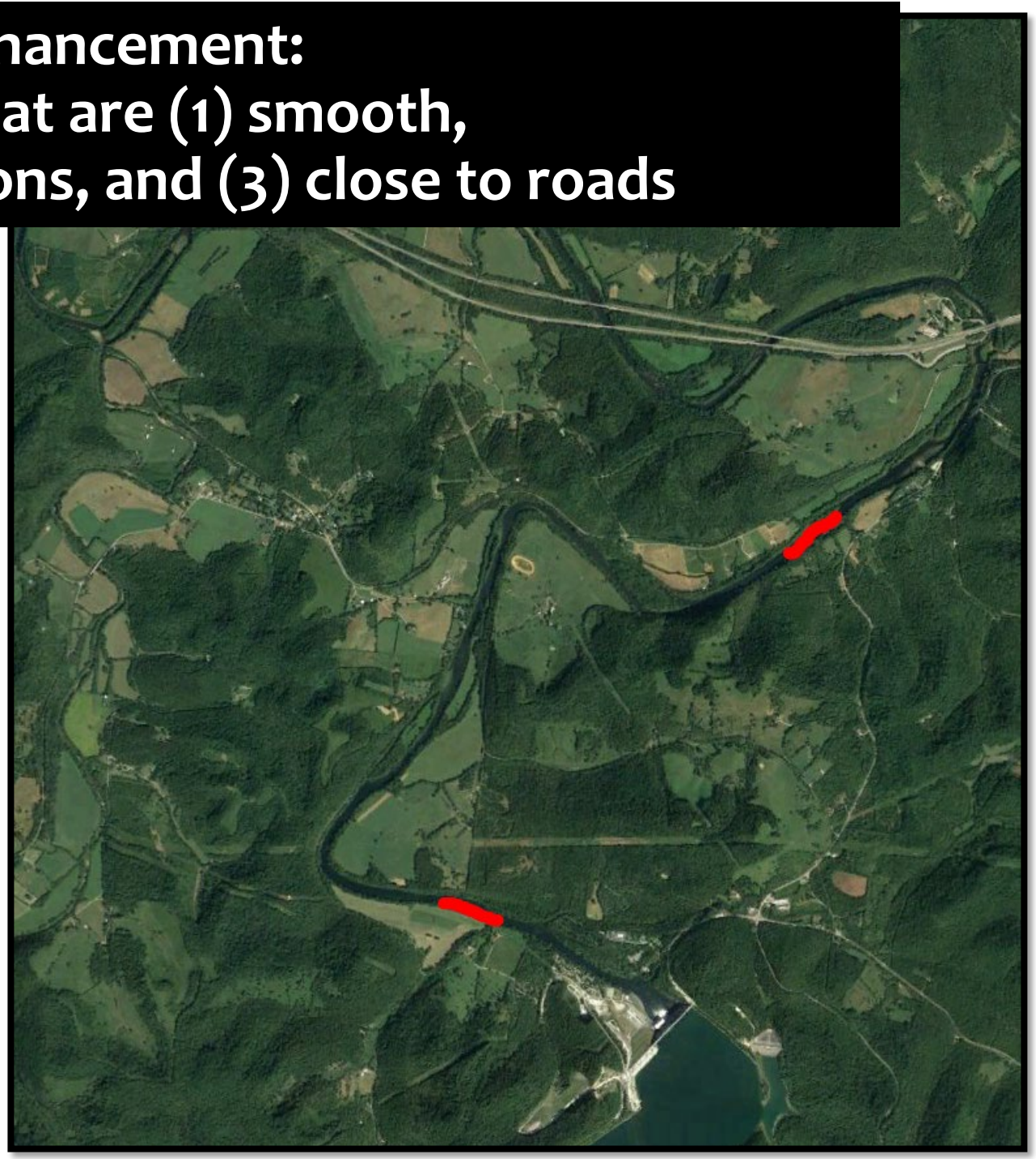
Habitat Enhancement:
Enhance areas that are (1) smooth, (2) close to access locations, and (3) close to roads



Locations with:

- **Highest ecological lift,**
- **Greatest accessibility,**
- **Lowest cost**

Determine most suitable restoration technique



Hydropower

Stormwater MS4

Transportation

Wildlife

Environmental & Non-Profits

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

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

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

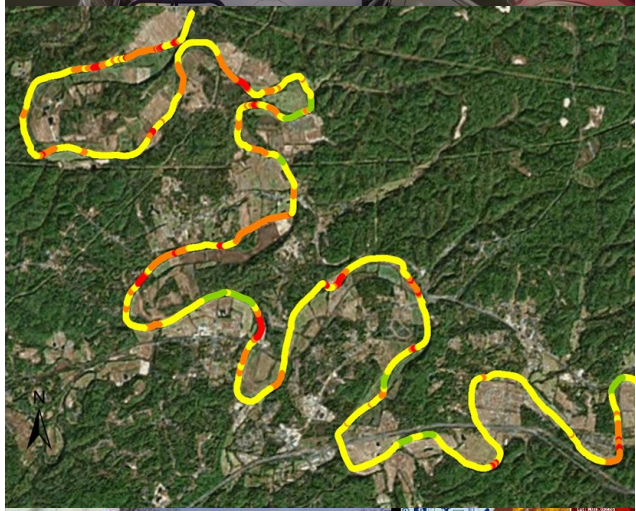
HDSS
Cross-sectional Transects and Longitudinal Surveys

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

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

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



Federal, State, and Local Acceptance

MORE DATA, HIGHER QUALITY, LOWER COST

Brett.Connell@TruttaSolutions.com

TruttaSolutions.com