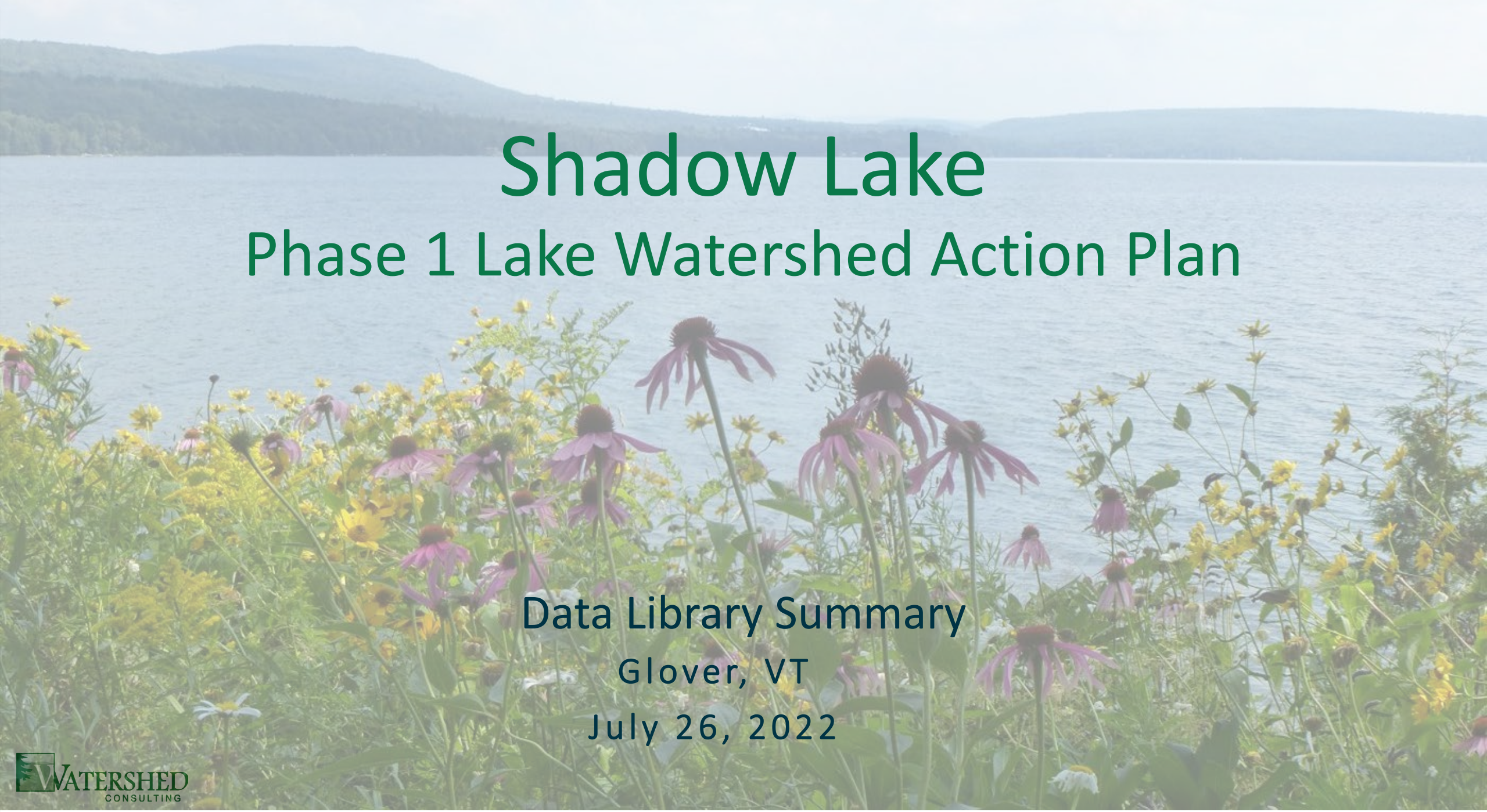


Shadow Lake

Phase 1 Lake Watershed Action Plan

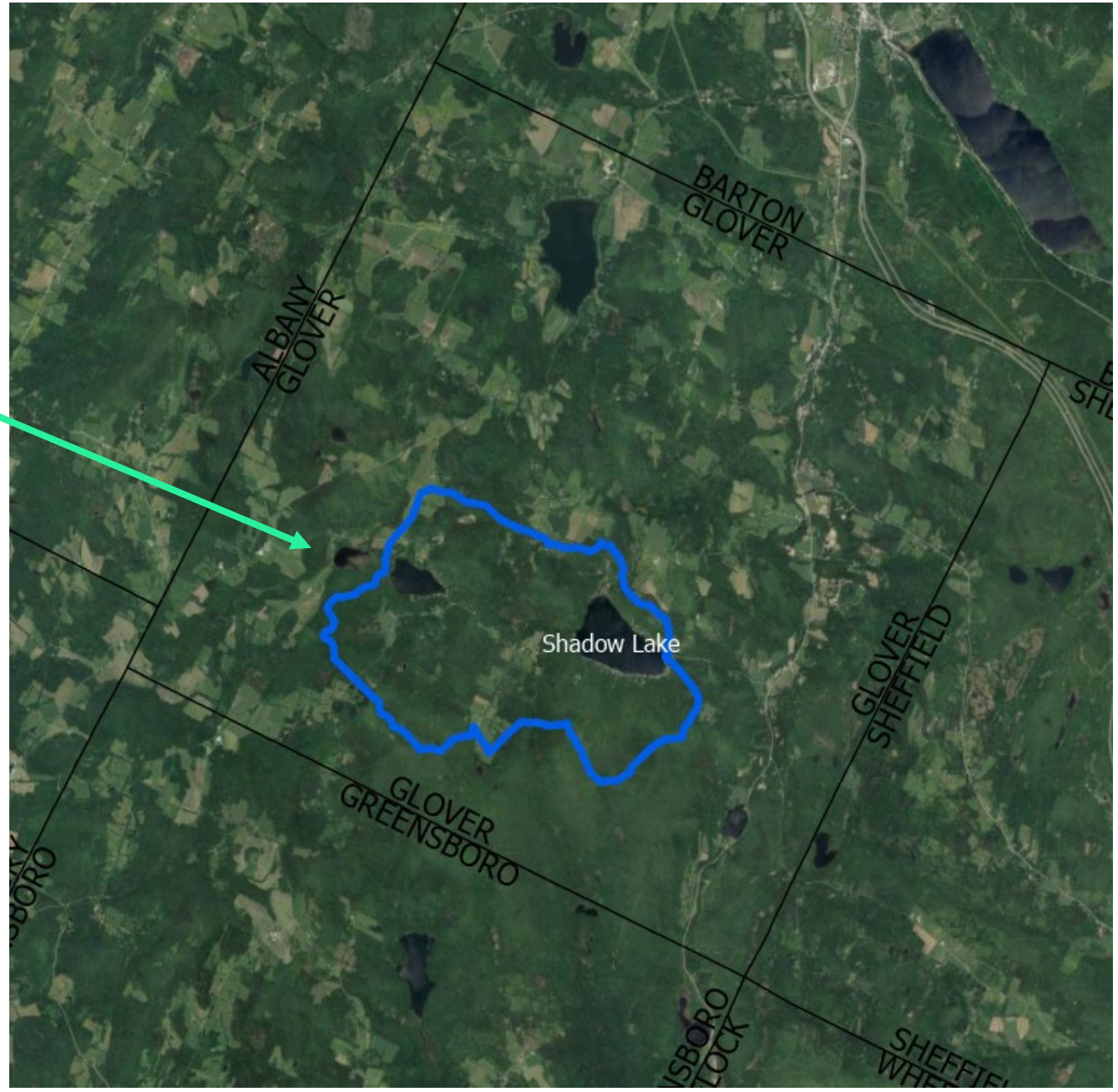
Data Library Summary

Glover, VT

July 26, 2022

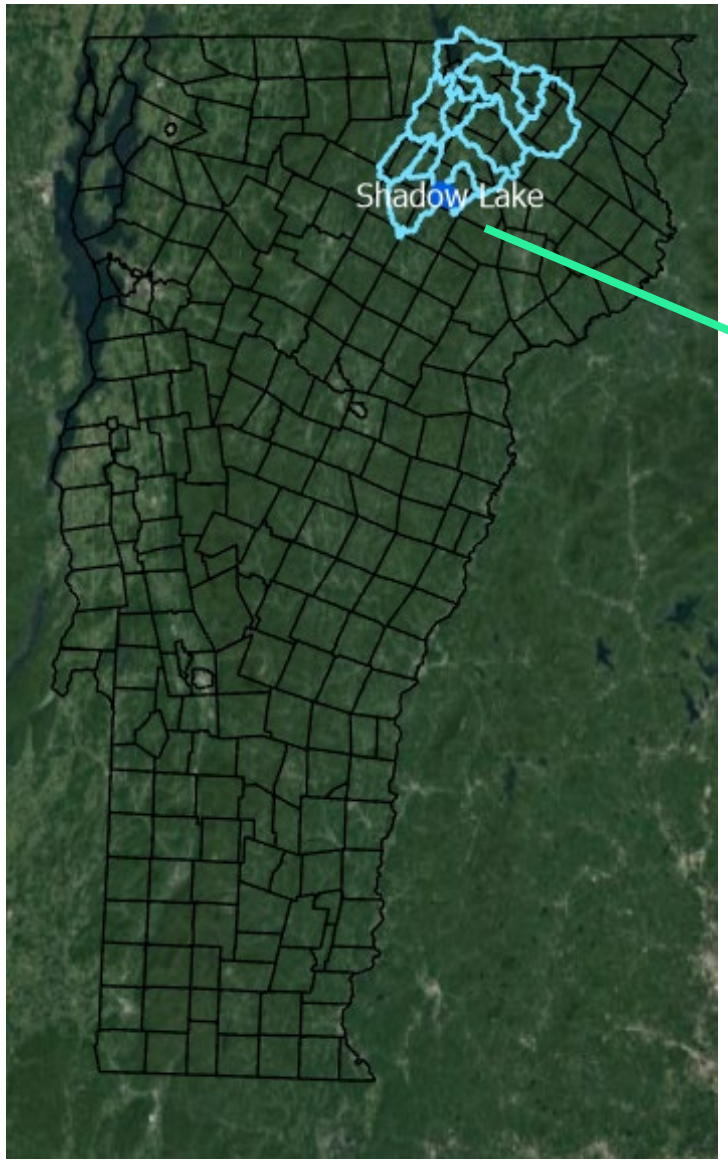
VWATERSHED CONSULTING

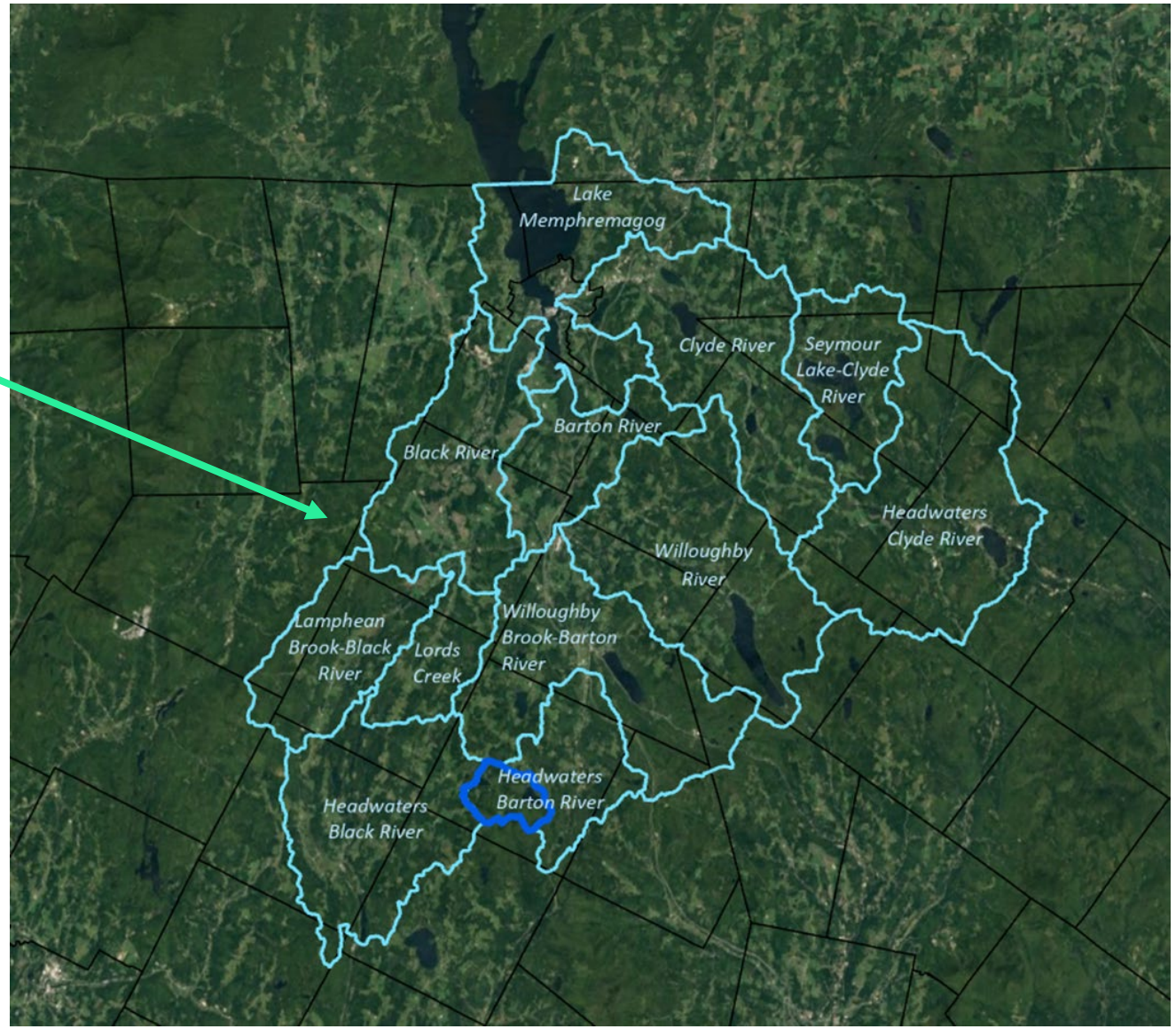
Shadow Lake



WATERSHED CONSULTING

Shadow Lake





WATERSHED CONSULTING

Shadow Lake is within the Lake Memphremagog watershed

Shadow Lake

217-acre lake area

3,413-acre drainage area (dark blue line)

5 tributaries (light blue lines)
9.46 miles of tributaries

Daniels Pond flows to Shadow Lake

Residence Time: 1.758 years

Lake Volume: 115.5 acre-feet

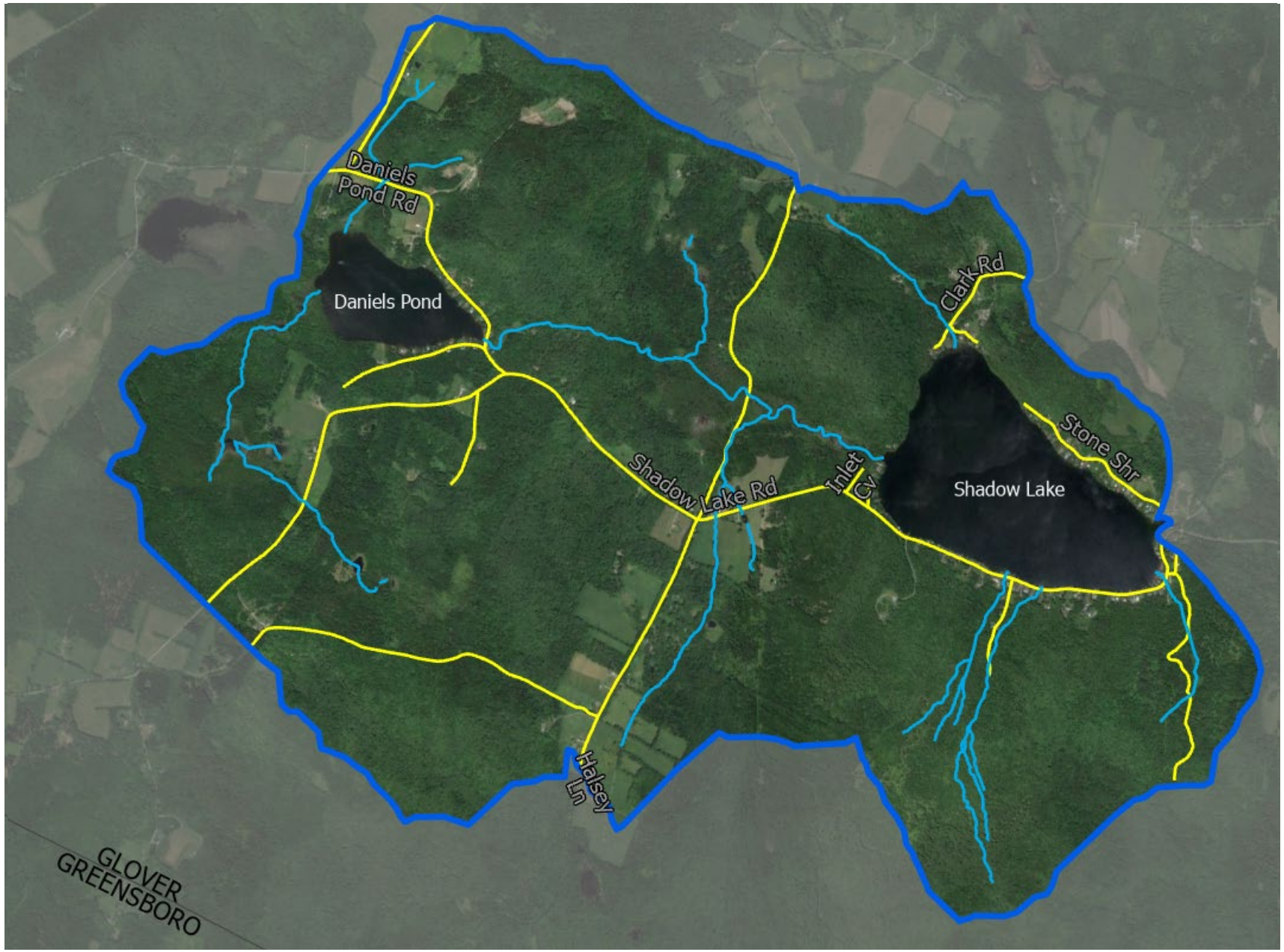
WATERSHED CONSULTING

Shadow Lake

217-acre lake area

3,413-acre drainage area

Main roads shown in yellow

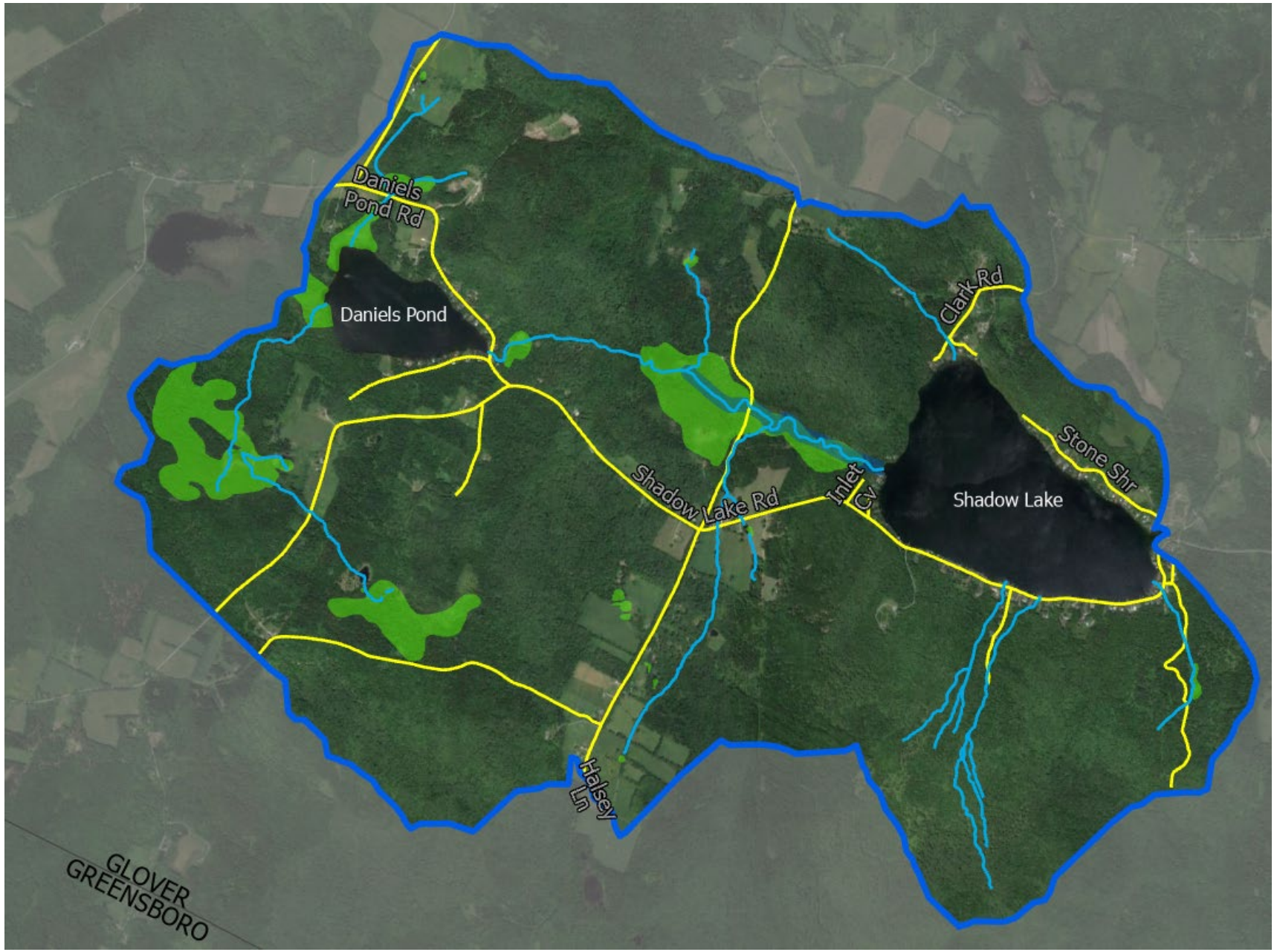


WATERSHED CONSULTING

Shadow Lake

217-acre lake area

178 acres of mapped wetlands (green)



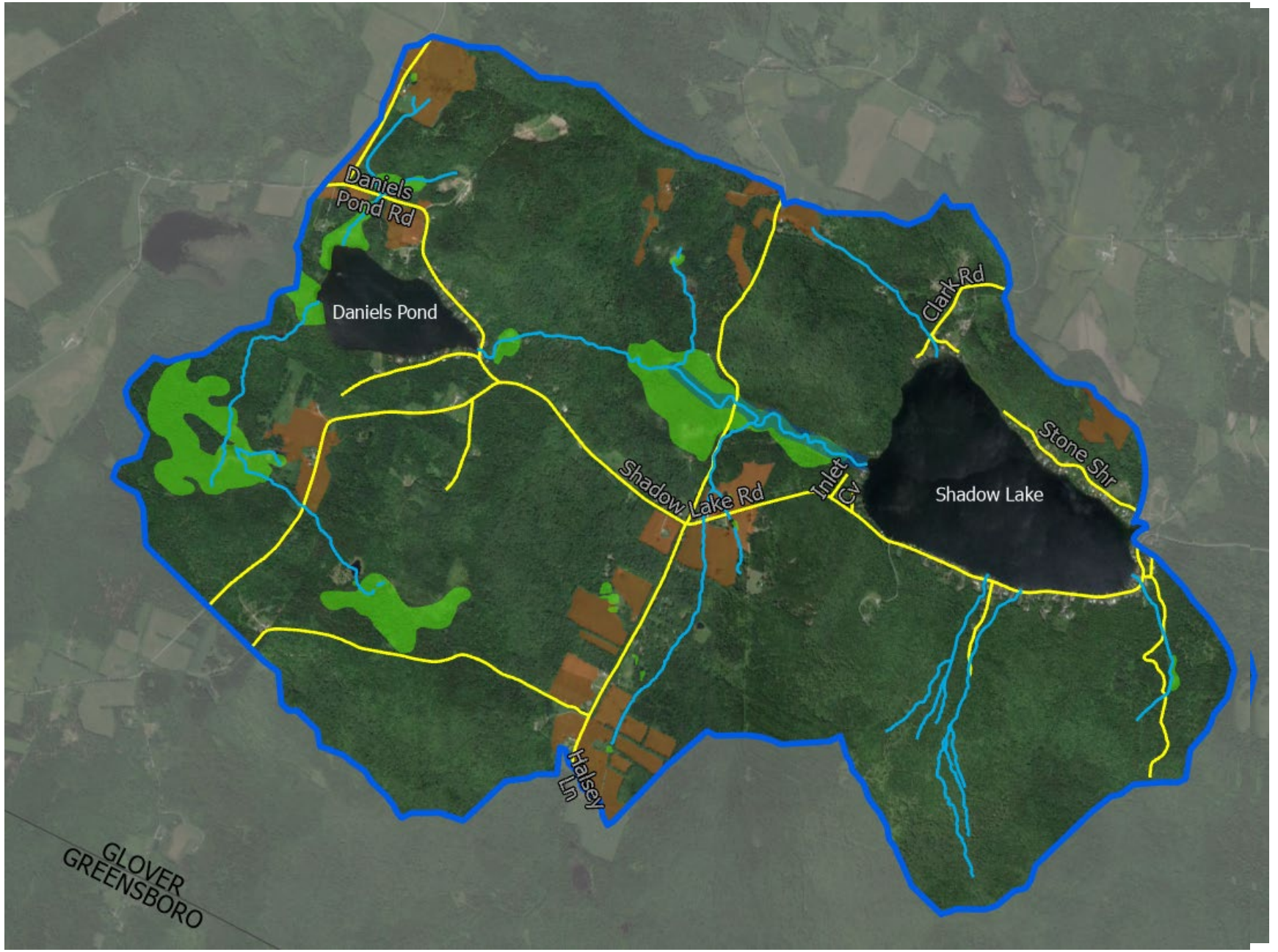
WATERSHED CONSULTING

Shadow Lake

217-acre lake area

178 acres of mapped wetlands (green)

200 acres of agricultural lands (brown)



WATERSHED CONSULTING

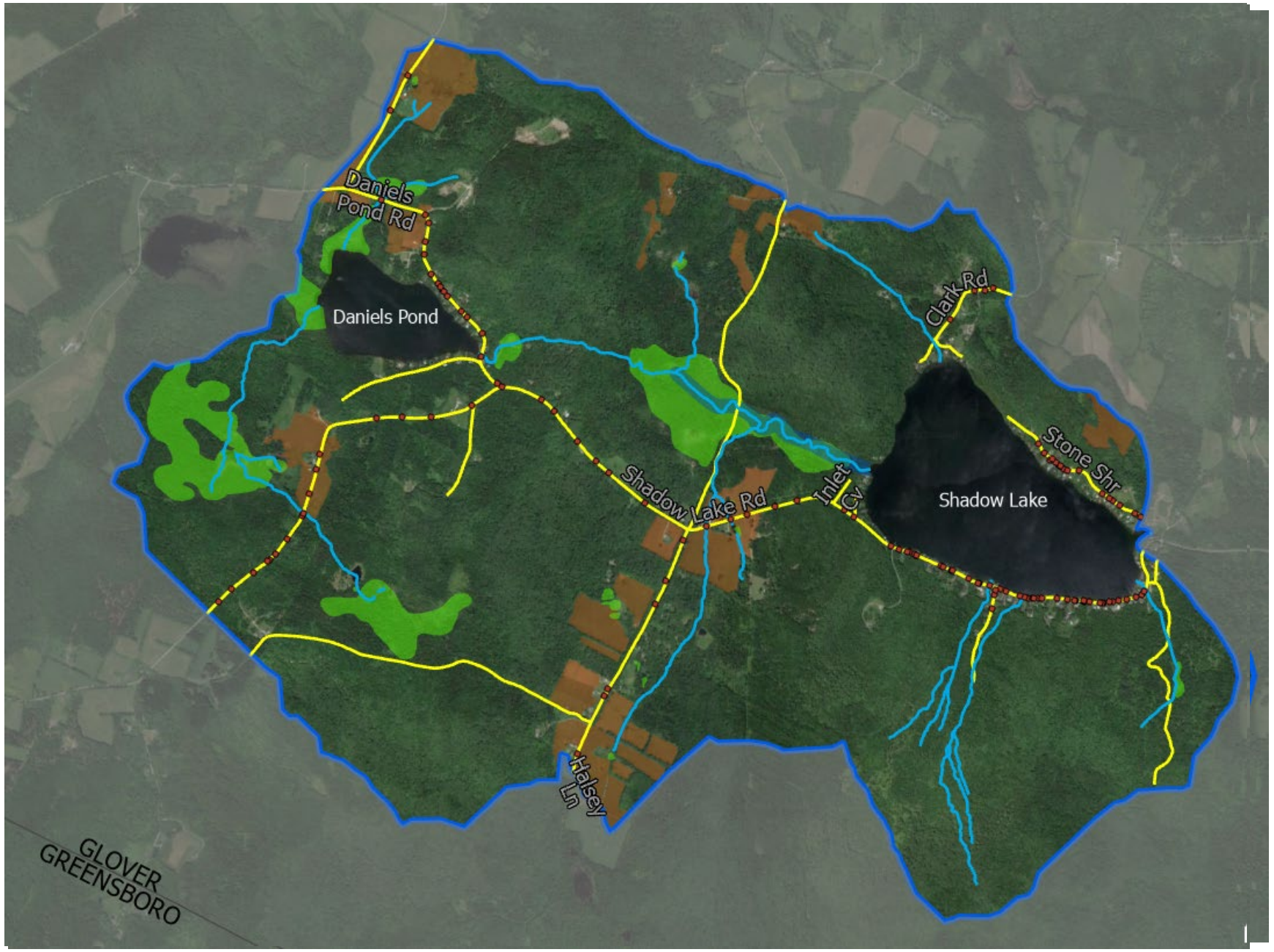
Shadow Lake

217-acre lake area

178 acres of mapped wetlands

200 acres of agricultural lands (brown)

121 mapped culverts, conveying water across roads or driveways (red dots)



WATERSHED CONSULTING

Shadow Lake

10 mapped stream crossing culverts, scored for Aquatic Organism Passage (AOP)

Red = No AOP for all aquatic organisms including adult salmonids
Grey = Reduced AOP for all aquatic organisms

See the Vermont Culvert Aquatic Passage Screening Tool for more info

WATERSHED CONSULTING

Shadow Lake

10 mapped stream crossing culverts, scored for Geomorphic Compatibility

Teal = Mostly Compatible

Yellow = Partially Compatible

Orange= Mostly Incompatible

Red = Fully Incompatible

- Structure fully incompatible with channel and high risk of failure.
- Re-design and replacement performed ASAP

See the Vermont Culvert Geomorphic Compatibility Screening Tool for more info

WATERSHED CONSULTING

Shadow Lake

Parcel boundaries in white

106 lakeshore properties (red property boundary lines)

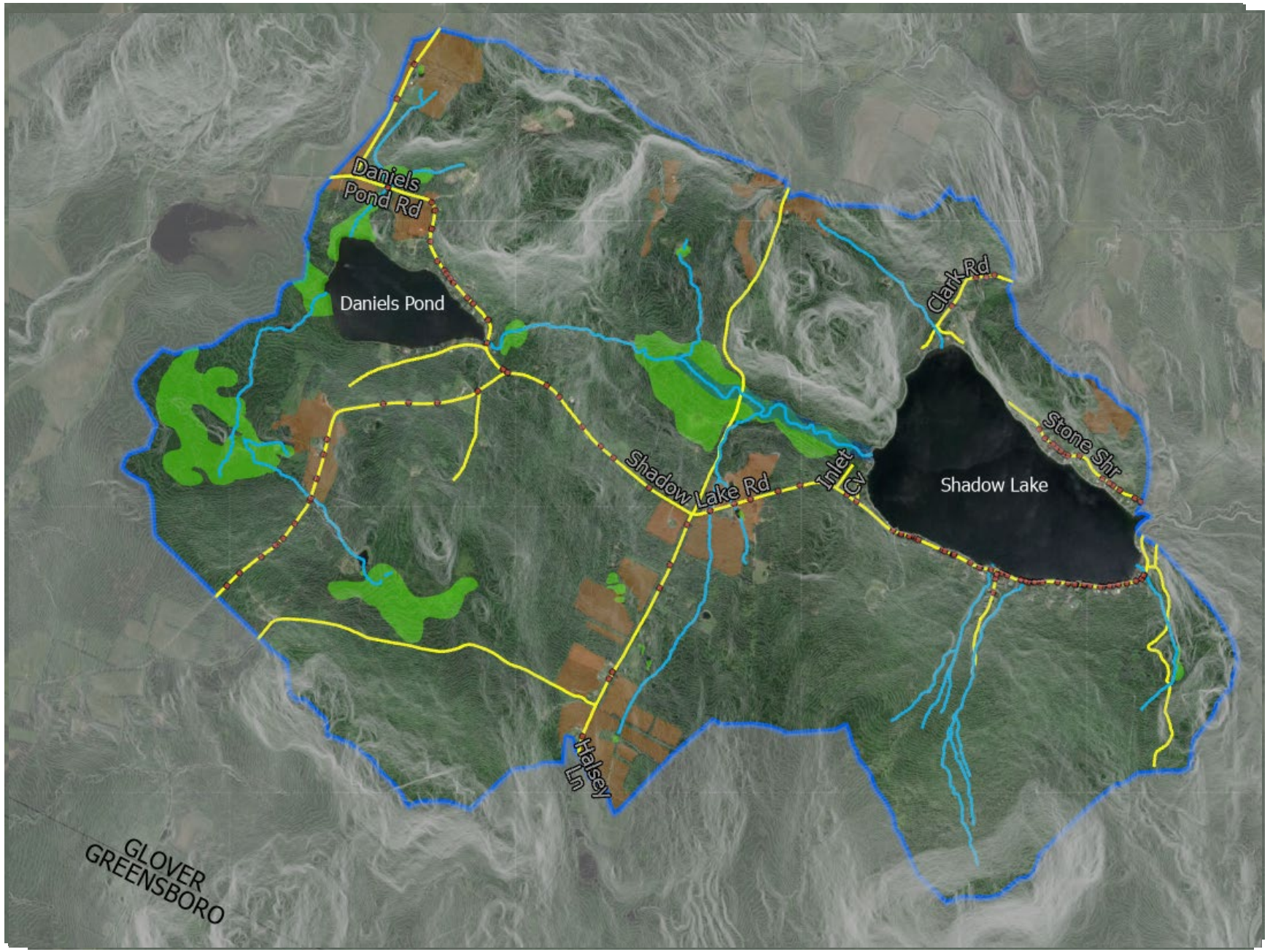
WATERSHED CONSULTING

Shadow Lake

Shadow Lake is in a low point, steeper to the northwest

Grey lines show contours

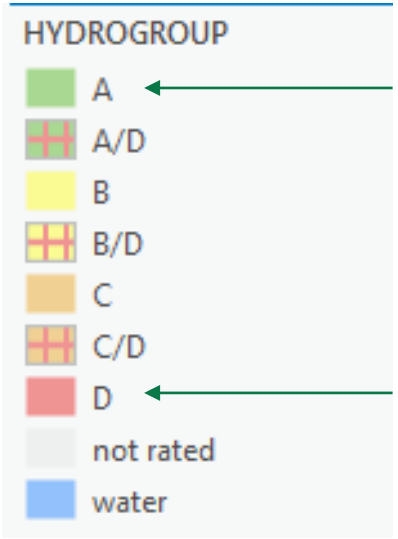
Closer together = steeper slopes



WATERSHED CONSULTING

Shadow Lake

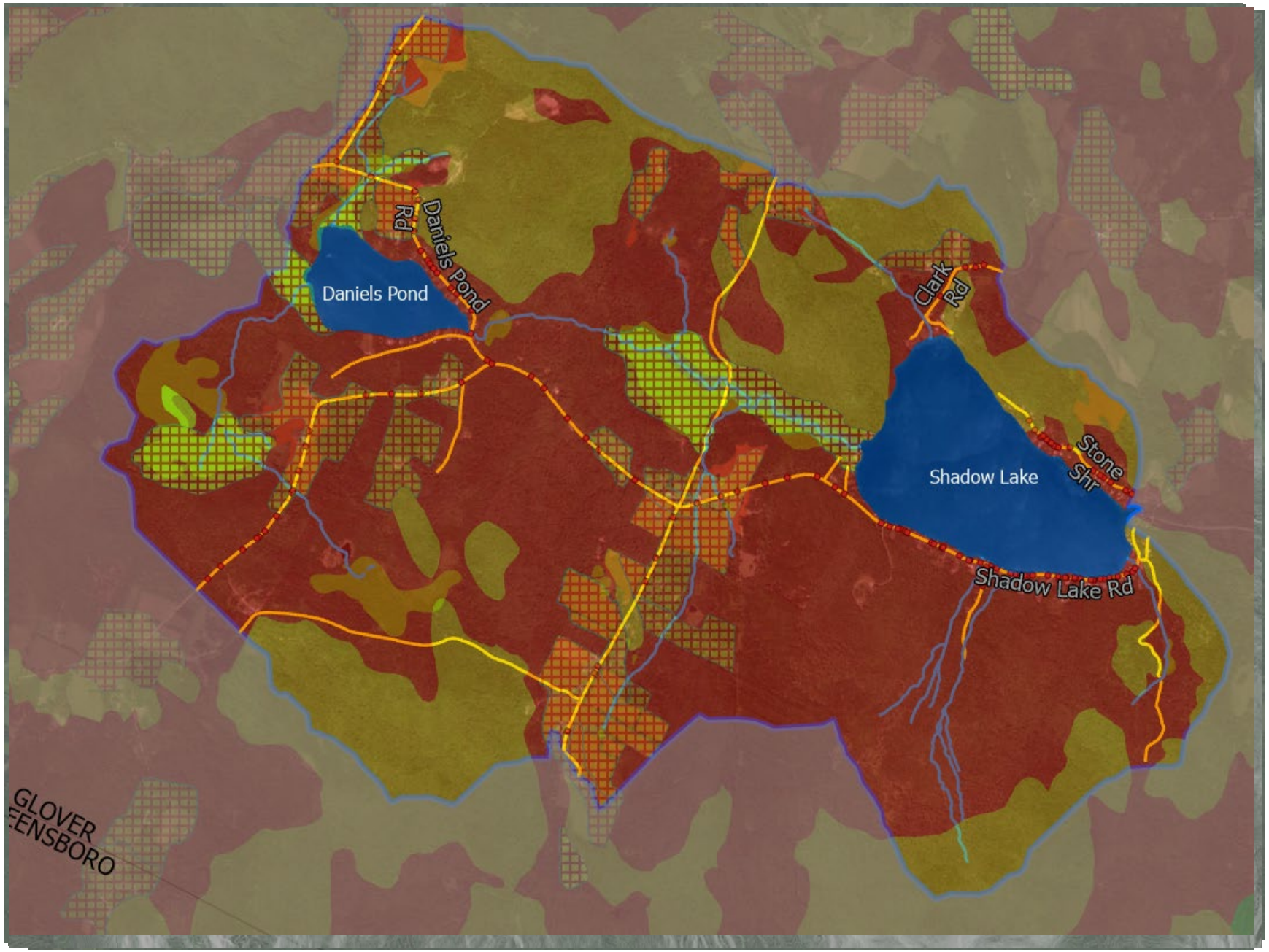
178 acres of mapped wetlands



Sandy Soil

Clayey Soil

More D (Clay Soil) = more runoff



WATERSHED CONSULTING

Shadow Lake

34.8-acre Significant Natural Community (green)

- **Northern White Cedar Swamp**

WATERSHED CONSULTING

Shadow Lake

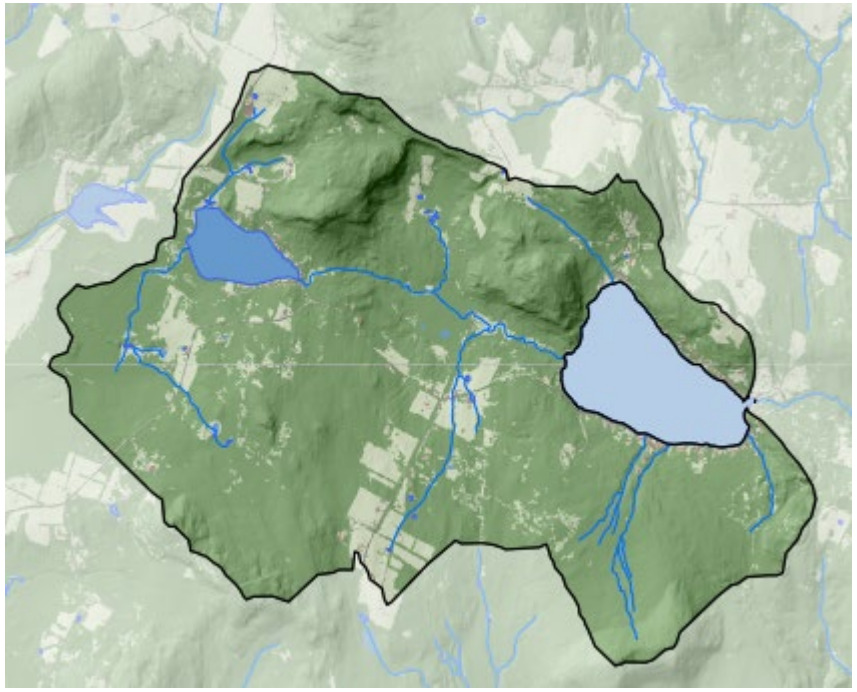
393 Potentially Erosive Features (red)

5.99 acres

Data generated by UVM Spatial Analysis lab

WATERSHED CONSULTING

Land Cover: Watershed

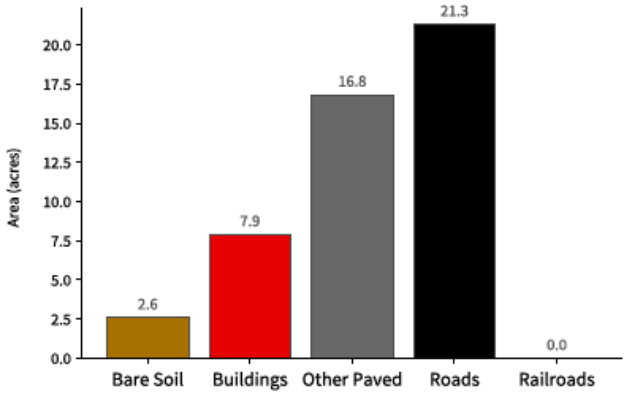


- 85% of the watershed is forested
- 15% is wetlands
- 1.5% impervious
- Agriculture is 6.3%

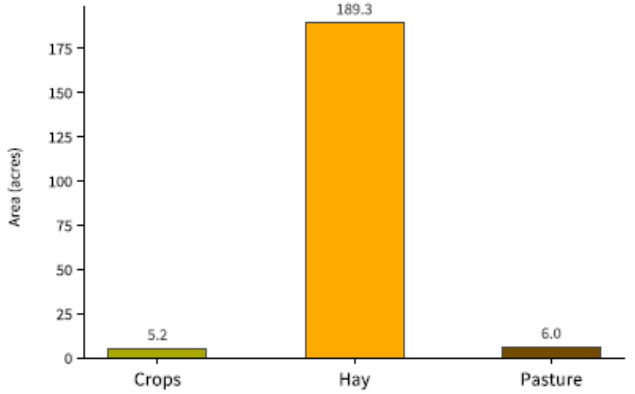
- See UVM SAL High-Resolution Land Cover 2016 Report for more detailed explanation of methodologies

Supplemental Land Cover

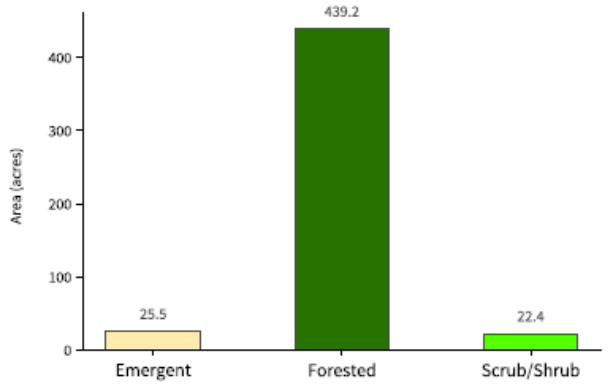
Impervious Surfaces (48.64 acres - 1.5 % of total)
(Bottom-Up**)



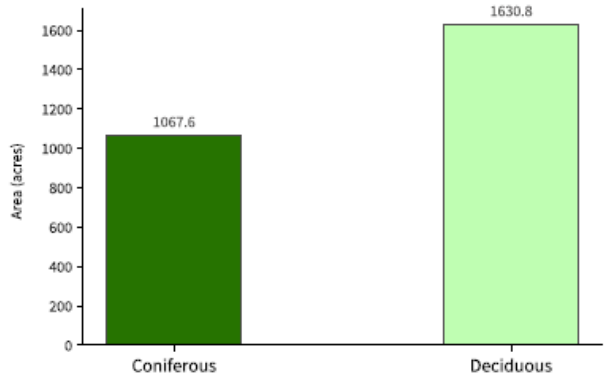
Agriculture (200.6 acres - 6.3 % of total)



Wetlands (487.09 acres - 15.2 % of total)



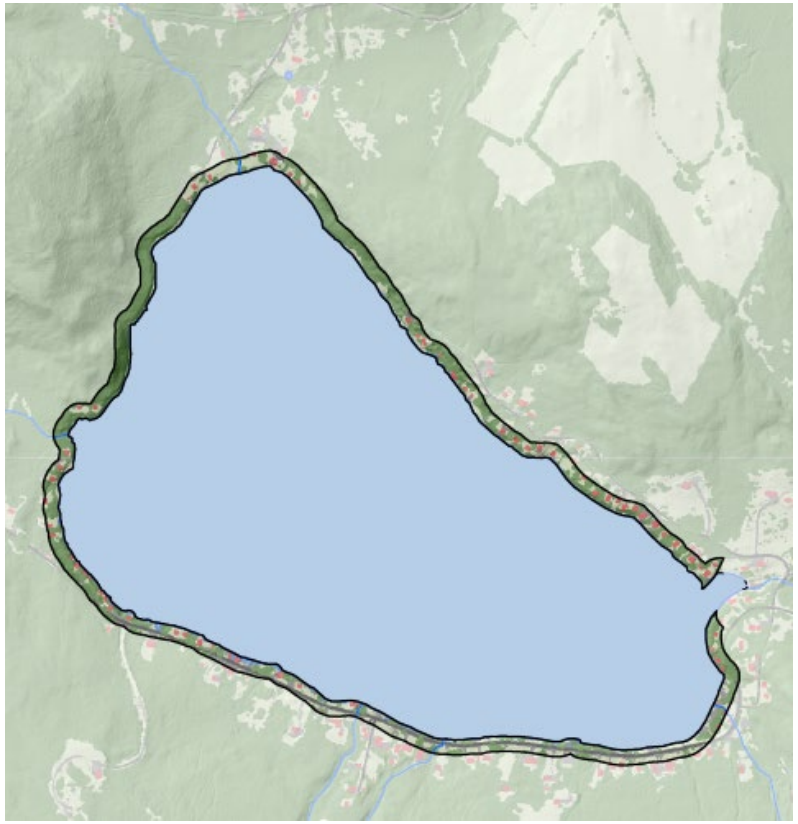
Tree Canopy (2,698.34 acres - 84.4 % of total)



*Top-Down: A traditional land cover mapping approach - land cover is mapped as the uppermost land cover class.
**Bottom-Up: A new land cover mapping approach - land cover is mapped as the lowermost land cover class. This approach results in improved mapping of features overlapped/obscured by other features.
See UVM SAL High-Resolution Land Cover 2016 Report for more detail.

WATERSHED CONSULTING

Land Cover: Lake 100ft buffer

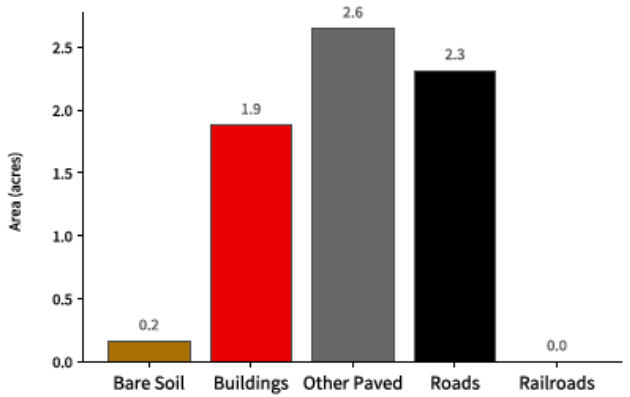


Greater percentage of impervious surface within the 100 ft buffer than in the entire watershed

Supplemental Land Cover

Impervious Surfaces (7.01 acres - 22.6 % of total)

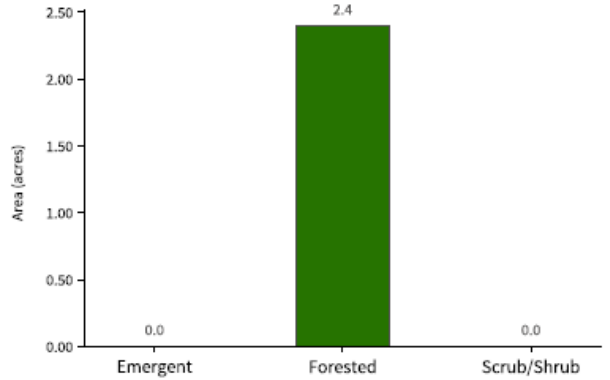
(Bottom-Up**)



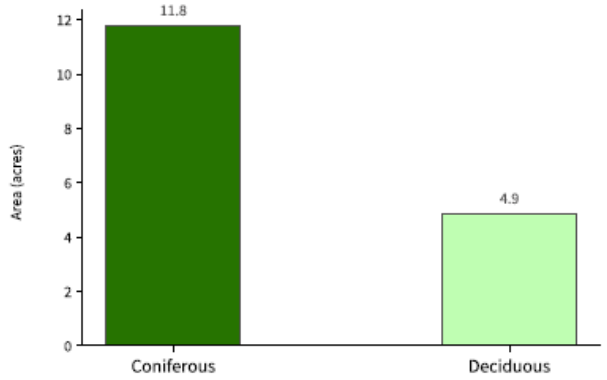
Agriculture (0 acres - 0 % of total)

No Agricultural Land Cover Mapped in this Area

Wetlands (2.4 acres - 7.7 % of total)



Tree Canopy (16.66 acres - 53.8 % of total)



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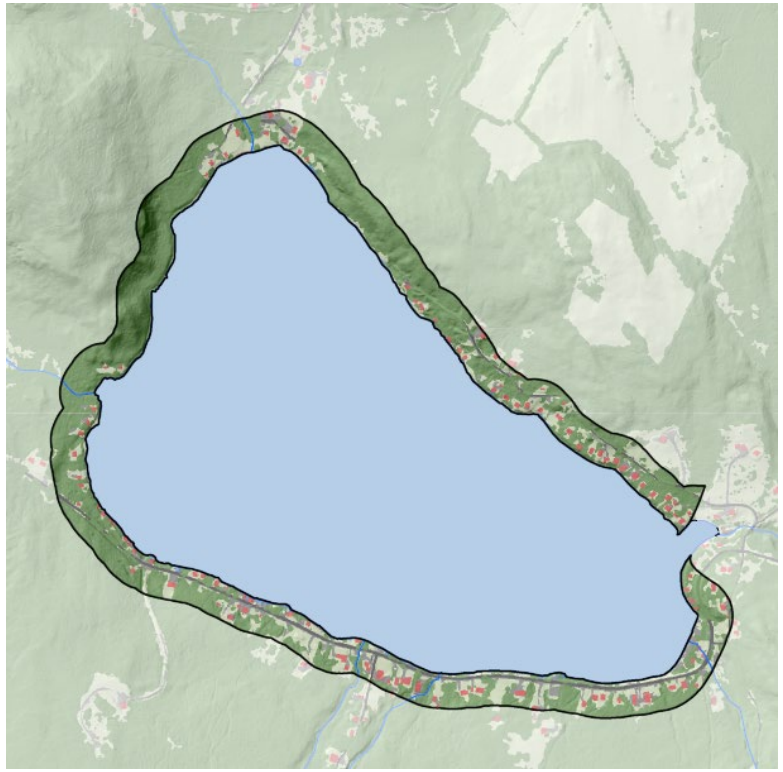
WATERSHED CONSULTING

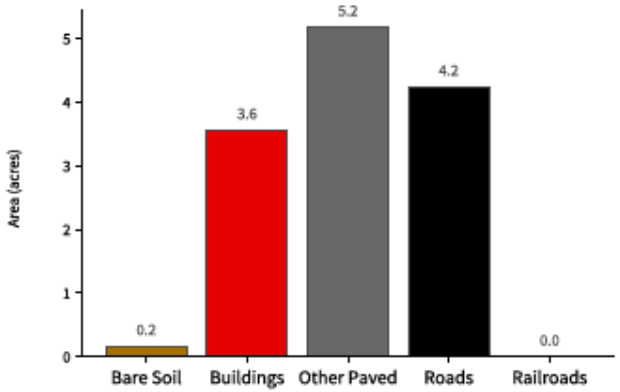
Land Cover: Lake 250ft buffer



More forested percentage of land cover within 250 ft of Shadow Lake than 100 ft, but still much higher percent impervious than overall watershed

Supplemental Land Cover

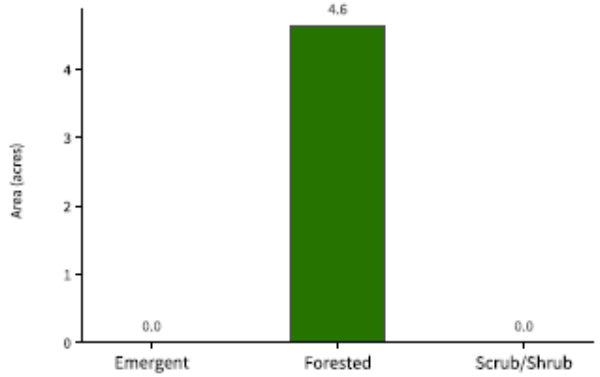
Impervious Surfaces (13.15 acres - 16.9 % of total)
(Bottom-Up**)



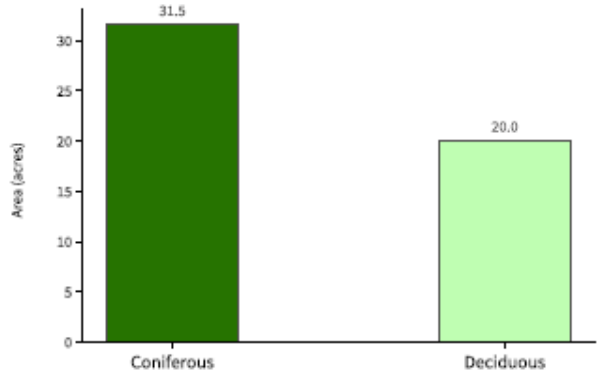
Agriculture (0 acres - 0 % of total)

No Agricultural Land Cover Mapped in this Area

Wetlands (4.64 acres - 5.9 % of total)



Tree Canopy (51.53 acres - 66.1 % of total)



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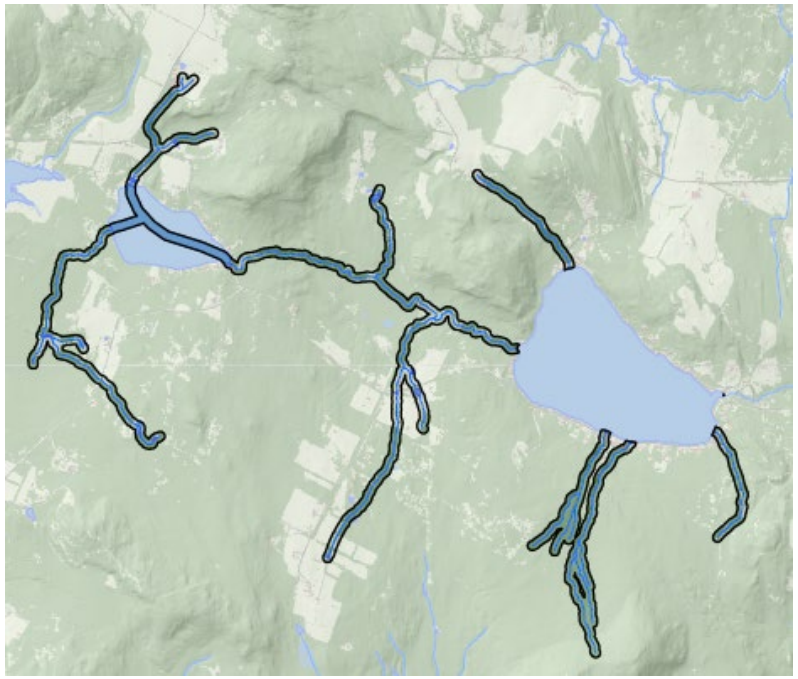
WATERSHED CONSULTING

Land Cover: Tributary 100ft buffer

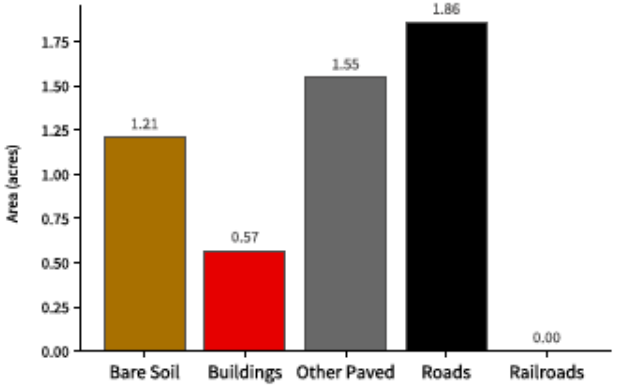


The impervious and agricultural percentages are slightly higher within 100ft of the tributaries than in the overall lake's watershed

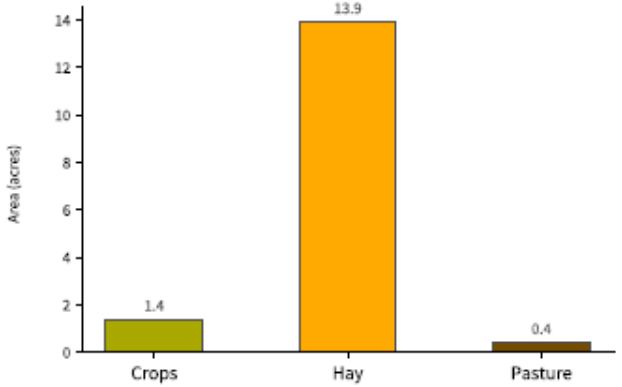
Supplemental Land Cover

Impervious Surfaces (5.18 acres - 2.1 % of total)

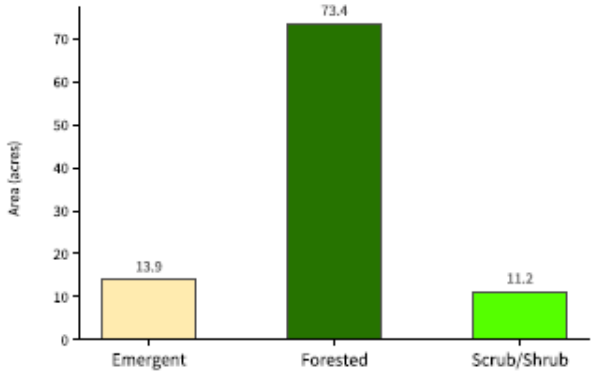
(Bottom-Up**)



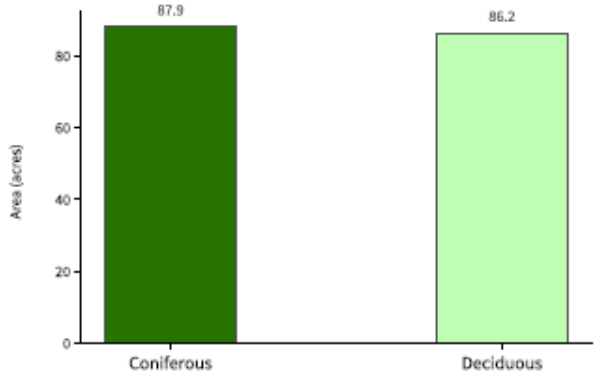
Agriculture (15.62 acres - 6.5 % of total)



Wetlands (98.52 acres - 40.7 % of total)



Tree Canopy (174.13 acres - 72 % of total)



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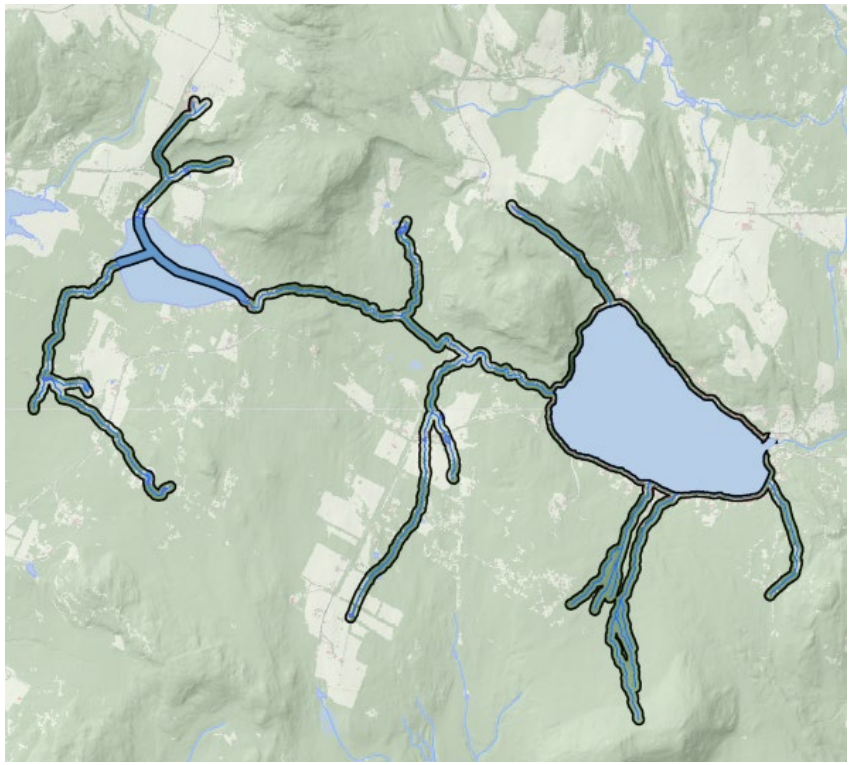
WATERSHED CONSULTING

Land Cover: Lake and Tributary 100ft buffer

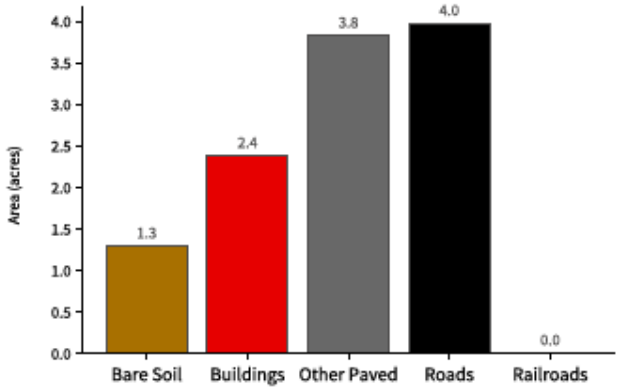


The impervious percentages are higher within 100ft of the tributaries and lake than in the overall lake's watershed

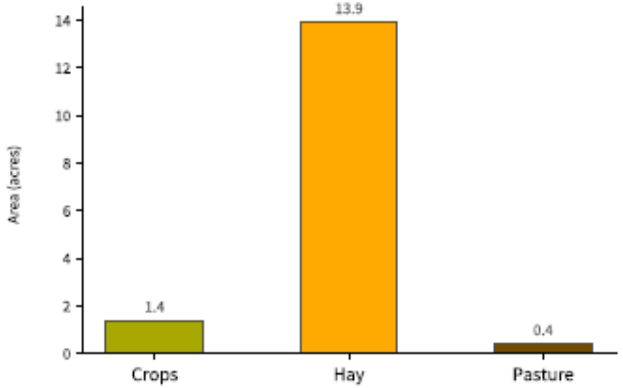
Supplemental Land Cover

Impervious Surfaces (11.46 acres - 4.2 % of total)

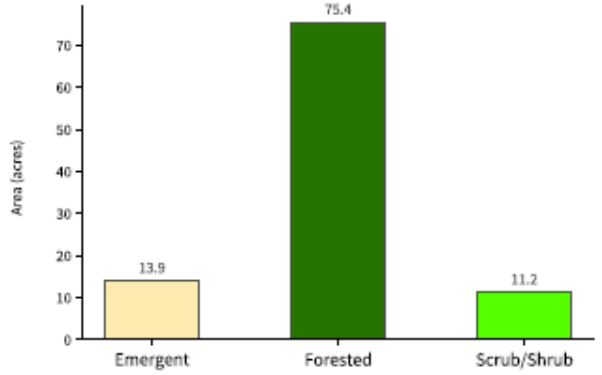
(Bottom-Up**)



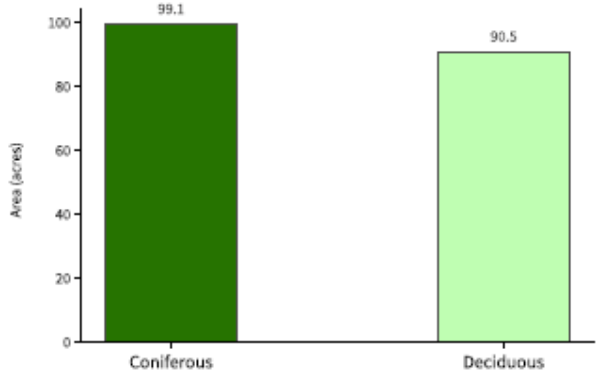
Agriculture (15.62 acres - 5.8 % of total)



Wetlands (100.45 acres - 37.2 % of total)



Tree Canopy (189.68 acres - 70.3 % of total)



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WATERSHED CONSULTING

Lake Scorecard

Vermont
Inland Lake Score Card

SHADOW (GLOVER)

View Detailed Nutrient Trends and Status

View Plant List, Including Invasive Plants

View Fish List

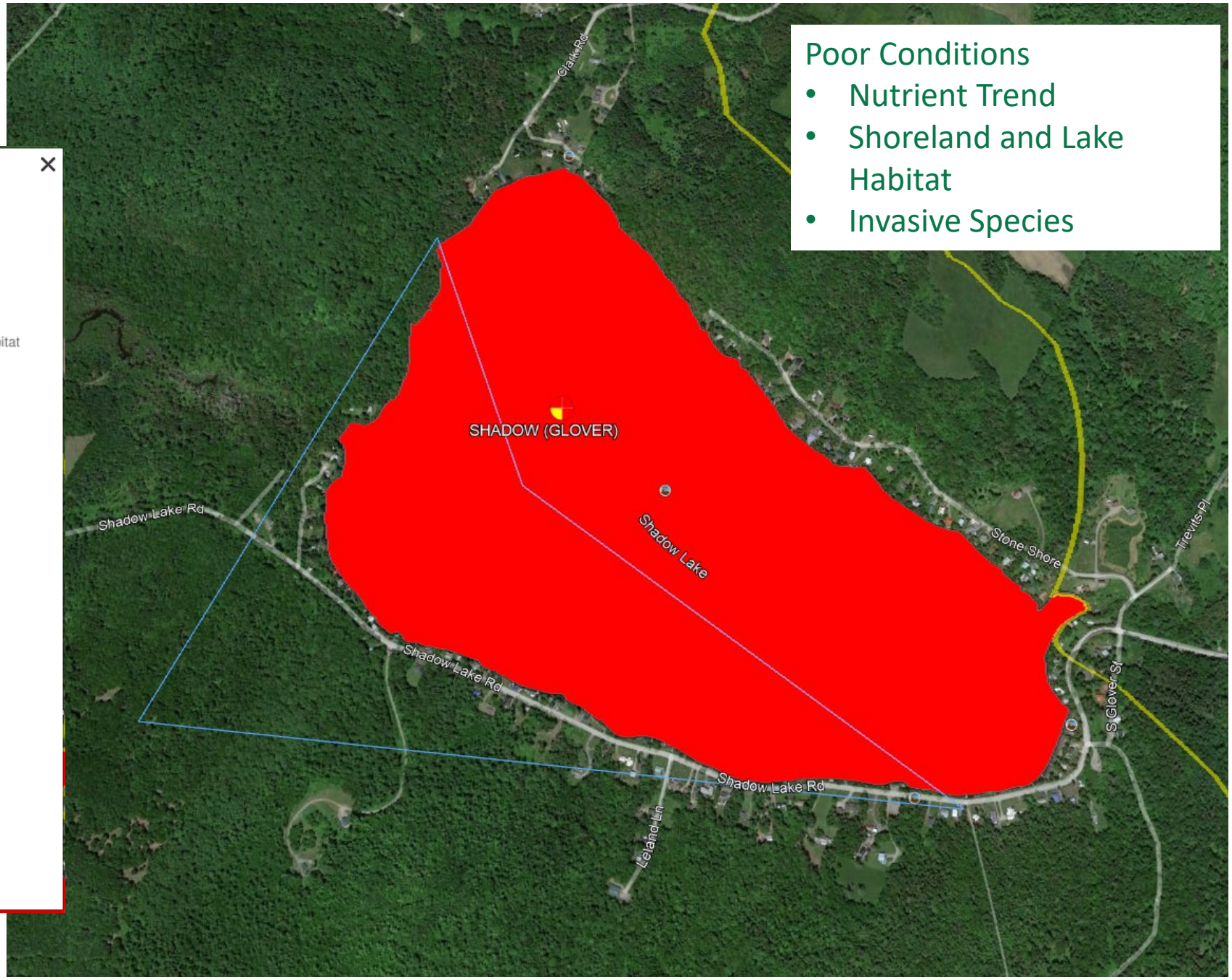
Scoring System

- Blue = Good Conditions
- Yellow = Fair Conditions
- Red = Poor Conditions
- Gray = Insufficient Data

Learn how lakes are scored

Learn how to maintain or improve a lake's score

VERMONT DEPARTMENT OF ENVIRONMENTAL CONSERVATION
WATERSHED MANAGEMENT DIVISION
LAKES & PONDS PROGRAM



Poor Conditions

- Nutrient Trend
- Shoreland and Lake Habitat
- Invasive Species

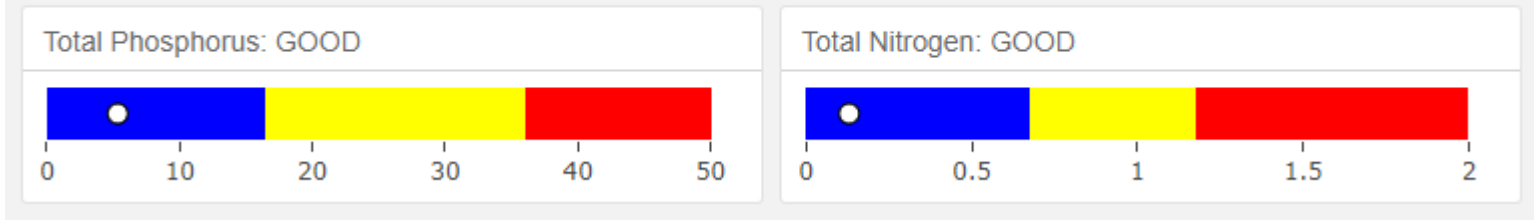
WATERSHED CONSULTING

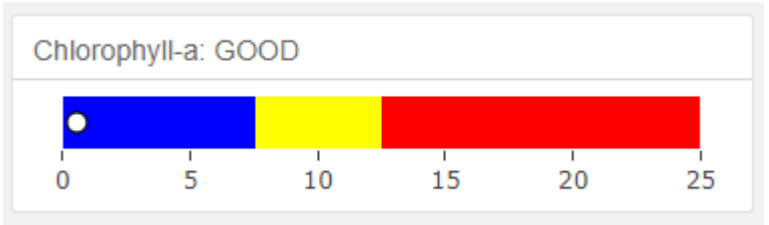
Lake Assessment

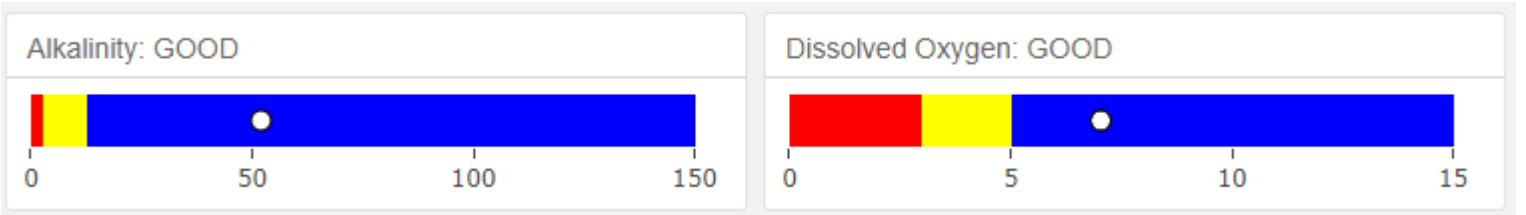
Assessment Report Card

Total Phosphorus	GOOD
Total Nitrogen	GOOD
Chlorophyll-a	GOOD
Alkalinity	GOOD
Dissolved Oxygen	GOOD
Lakeshore Disturbance	POOR
Lakeshore Habitat	POOR
Shallow Water Habitat	FAIR
Physical Complexity of Habitat	POOR

Condition Assessments



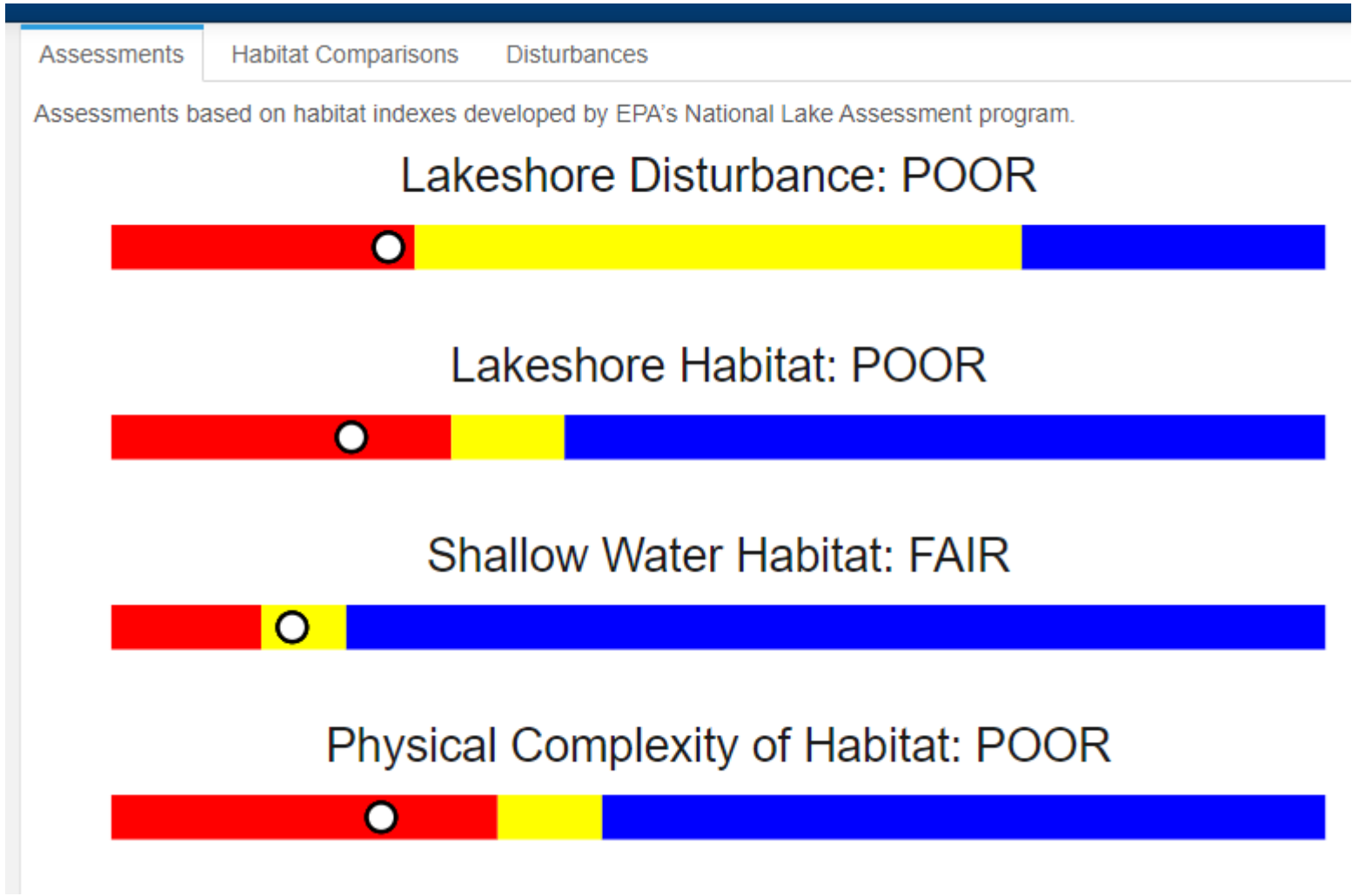




WATERSHED CONSULTING

Some parameters were ranked well, including nutrients (Phosphorus and Nitrogen) but are trending higher (see later slides)

Lake Assessment



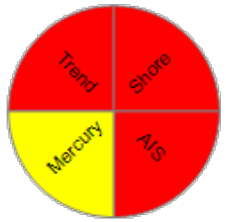
Other parameters were classified as fair (yellow) or poor (red)

WATERSHED CONSULTING

Lake Scorecard

SHADOW (GLOVER) - data through 2020

Learn How Lakes Are Scored



Lake Area:
217.3 acres

Basin Lake Area Ratio:
16

Max Depth:
42.4 meters

Mean Spring TP:
8.3 ug/L

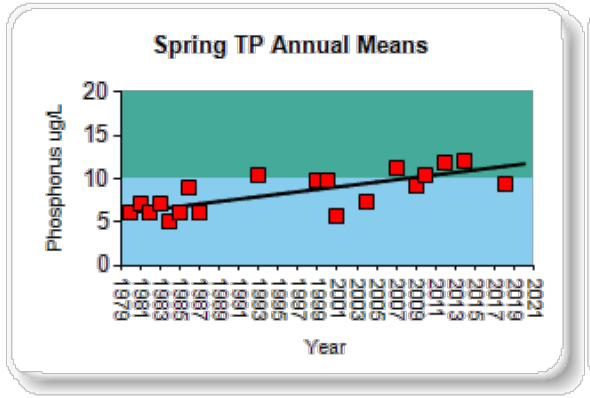
Mean Summer TP:
8.9 ug/L

Mean Summer Chla:
2.3 ug/L

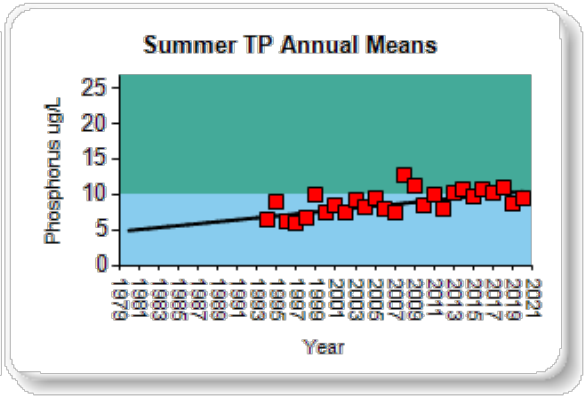
Mean Summer Secchi:
7.9 meters

Hypereutrophic
Eutrophic
Mesotrophic
Oligotrophic

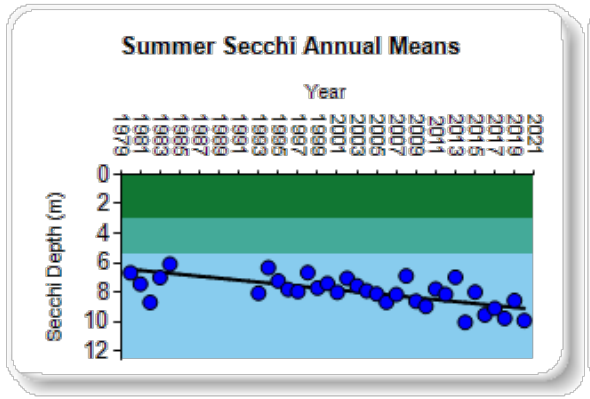
Spring TP Trend: p = 0.0024 | CV = 27
Highly significantly increasing



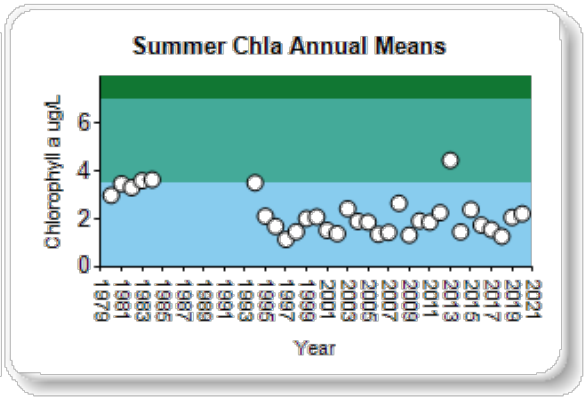
Summer TP Trend: p = 0.0015 | CV = 19
Highly significantly increasing



Summer Secchi Trend: p = 0 | CV = 13
Highly significantly increasing



Summer Chla Trend: p = 0.0717 | CV = 39
Stable



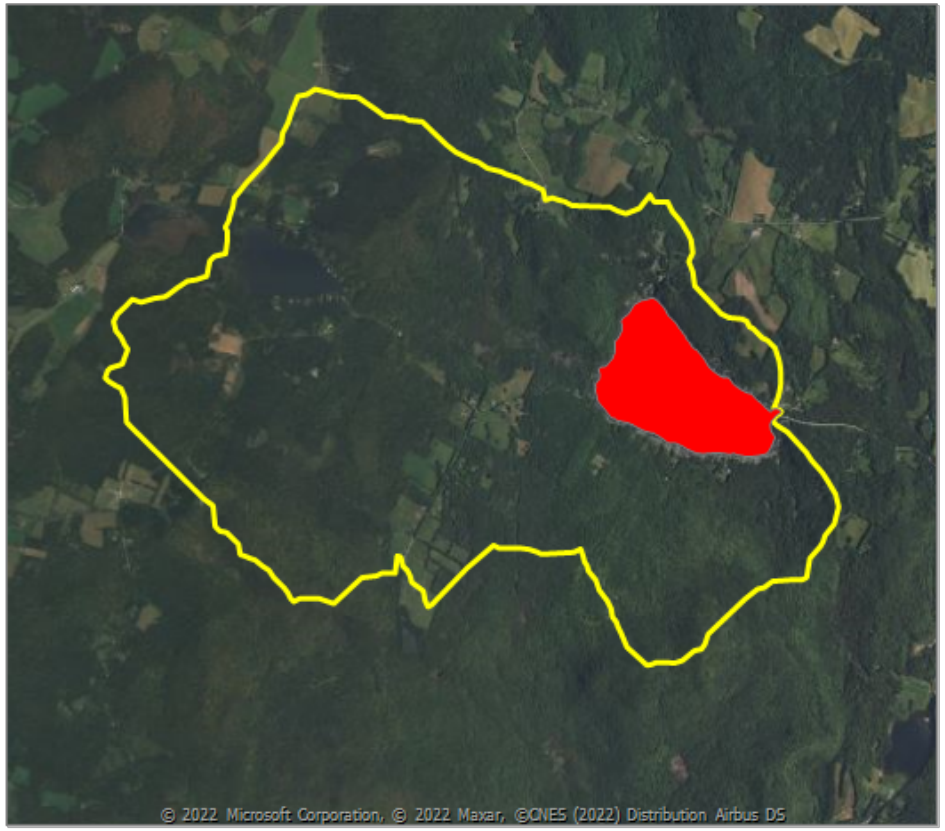
Stresses / Impairments

Altered -- Flow alteration

Trend Score: Poor

WQ Standards Status: Altered

Watershed Score: Moderately Disturbed



WATERSHED CONSULTING

While TP is still classified as good, the trends are showing increasing TP for annual means for spring and summer. These trends are pushing the lake out of oligotrophic status and into mesotrophic conditions.

Lake Scorecard

Eurasian watermilfoil may be taken off the states list of infested waters!

Milfoil has not been observed in several years!

IWIS

Lake ID SHADOW (GLOVER)

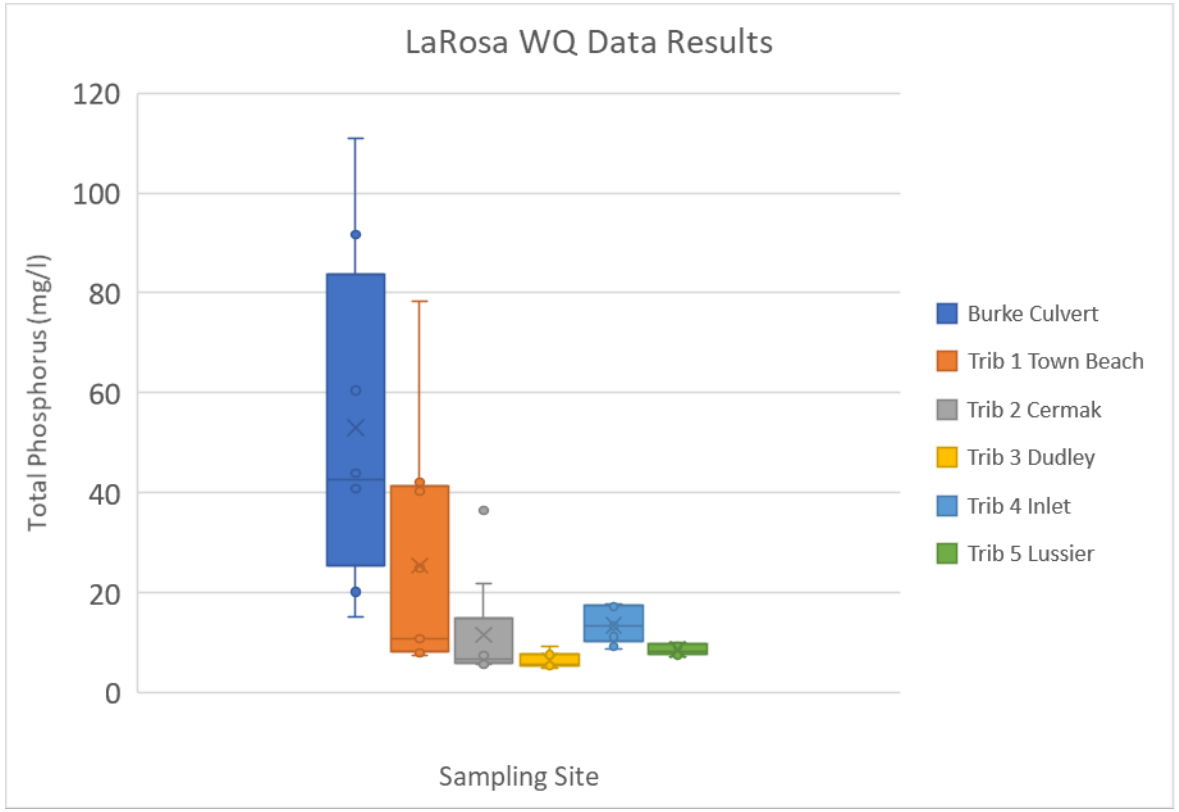
1 of 1 Find | Next

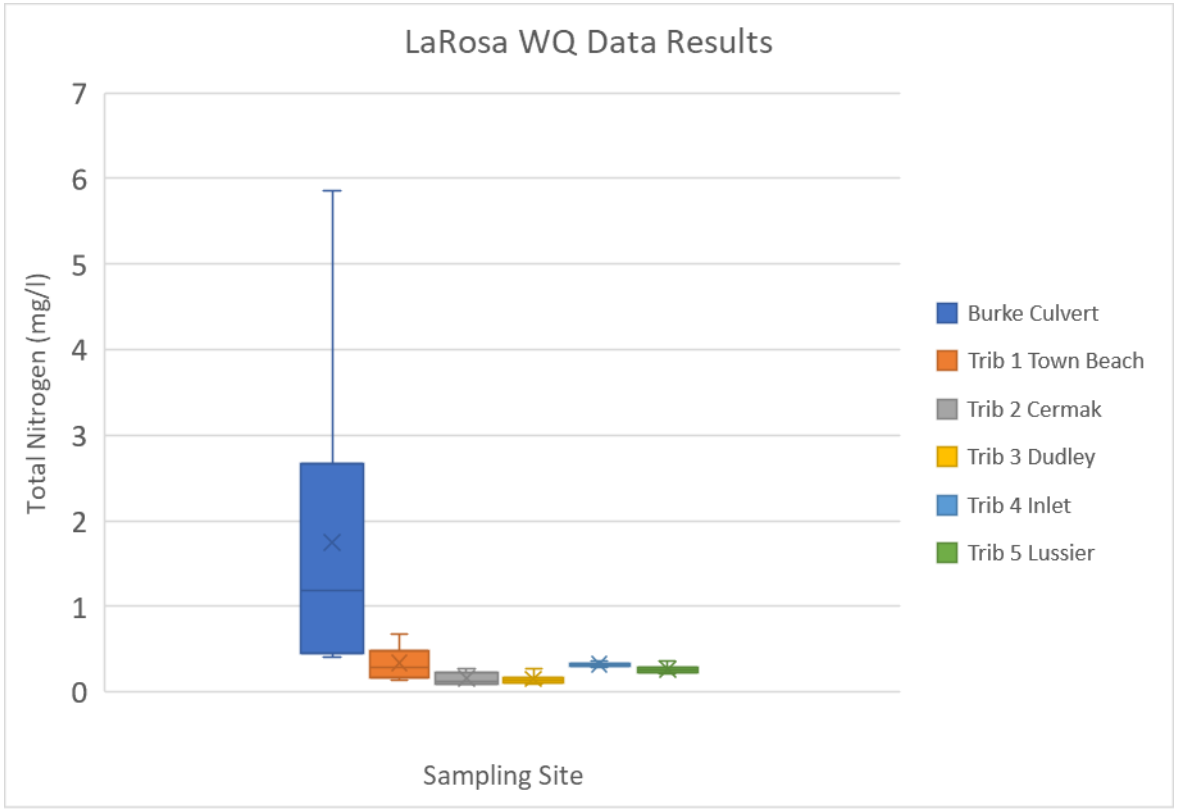
SHADOW (GLOVER) 21 Records

Lake Area = 217.3 acres

Species	Common Name	Earliest Record	Most Recent Record
Chara sp.	muskgrass or stonewort	8/28/1985	8/12/2019
Elodea canadensis	common elodea	9/17/1998	6/27/2013
Elodea sp.	waterweed	8/28/1985	9/17/1998
Equisetum sp.	horsetail	8/28/1985	8/28/1985
Fontinalis sp.	aquatic moss or brook moss	4/30/2013	6/27/2013
Myriophyllum spicatum	Eurasian watermilfoil	9/7/2011	10/11/2013
Najas flexilis	common naiad	9/7/2011	8/12/2019
Potamogeton amplifolius	big-leaf pondweed	8/28/1985	6/27/2013
Potamogeton epihydrus	ribbonleaf pondweed	9/17/1998	9/7/2011
Potamogeton gramineus	variable-leaf pondweed	9/17/1998	9/7/2011
Potamogeton illinoensis	Illinois pondweed	9/7/2011	9/7/2011
Potamogeton praelongus	boat-tipped pondweed	8/28/1985	8/12/2019
Potamogeton pusillus	small pondweed	9/17/1998	9/17/1998
Potamogeton pusillus ssp. Tenuissimus	small pondweed	9/7/2011	9/7/2011
Potamogeton sp.	pondweed	9/7/2011	9/7/2011
Potamogeton zosteriformis	flatstem pondweed	8/12/2019	8/12/2019
Ranunculus sp.	buttercup	4/30/2013	4/30/2013
Sagittaria sp.	arrowhead	8/28/1985	8/12/2019
Sparganium sp.	bur-reed	9/17/1998	9/7/2011
Vallisneria americana	wild celery or eelgrass	9/17/1998	9/17/1998
Zizania aquatica	wild rice	8/7/2012	8/7/2012

Water Quality Data





The Burke culvert and the Trib 1 Town beach will be areas of focus for this LWAP due to higher nutrient concentrations

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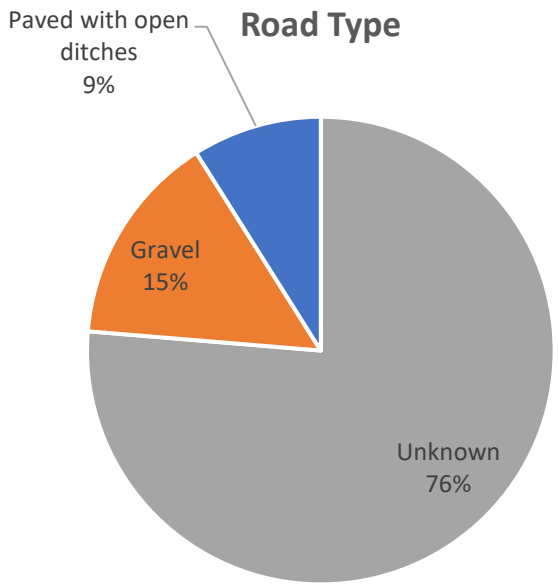
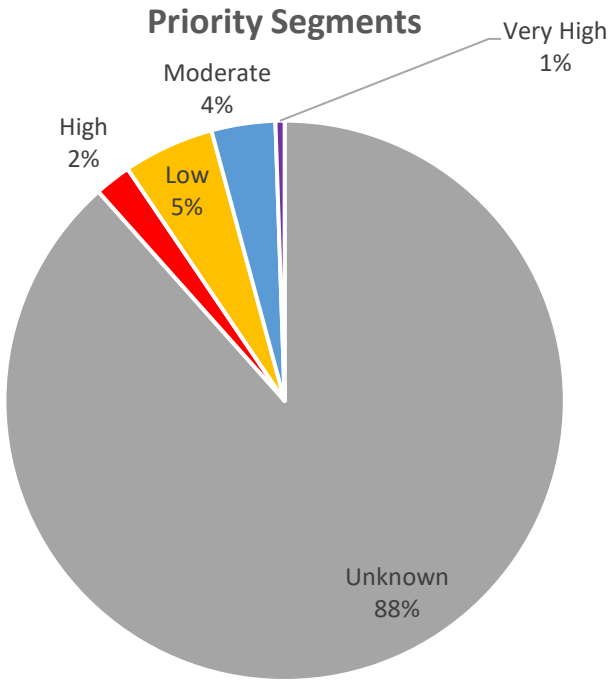
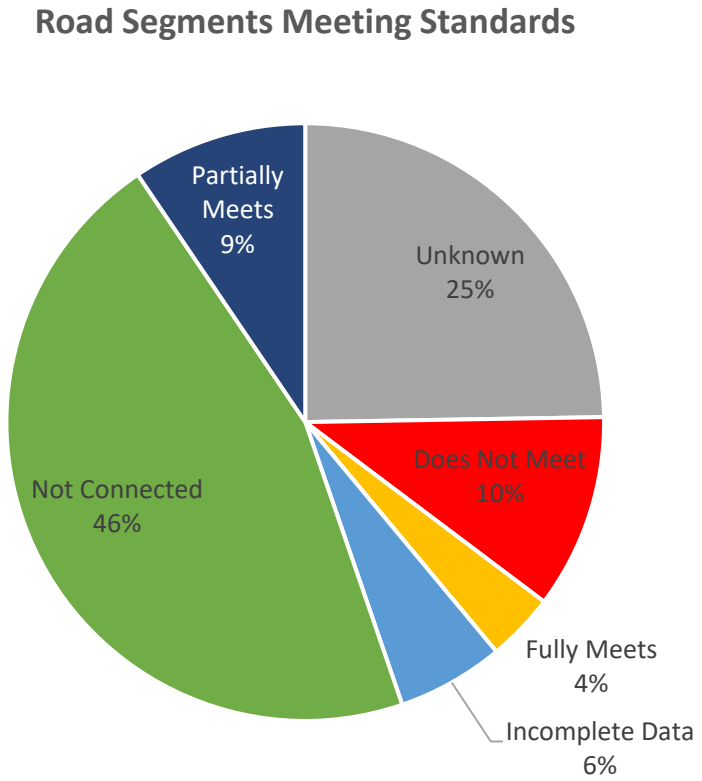
Shadow Lake Road Erosion Inventory

190 road segments in the watershed







Number of segments:

- 87 Not Connected
- 20 Does Not Meet
- 18 Partially Meeting
- 7 Fully Meets
- 11 Incomplete Data

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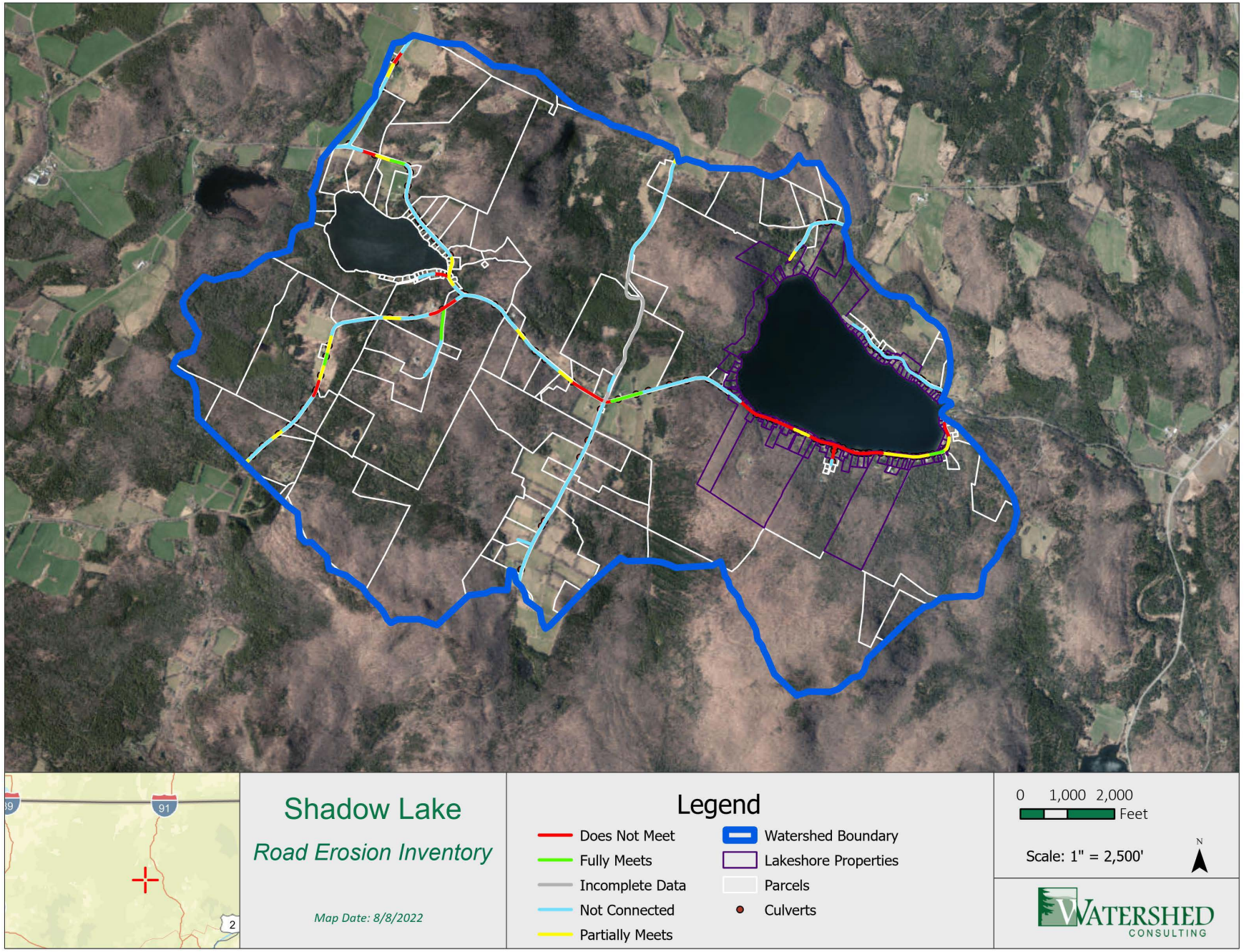

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Issues to Address

- Erosion
- Turbidity
- Nutrient loading

- The following slides show examples of these types of issues from other areas

Erosion: Outfalls and Downspouts

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Erosion: Roads

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Erosion: Streams and Agriculture

RUSLE

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Turbidity

Stormwater can carry sediment from roadways and eroded areas into tributaries to Shadow Lake. These contribute to increased turbidity

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Lakeshore Issues

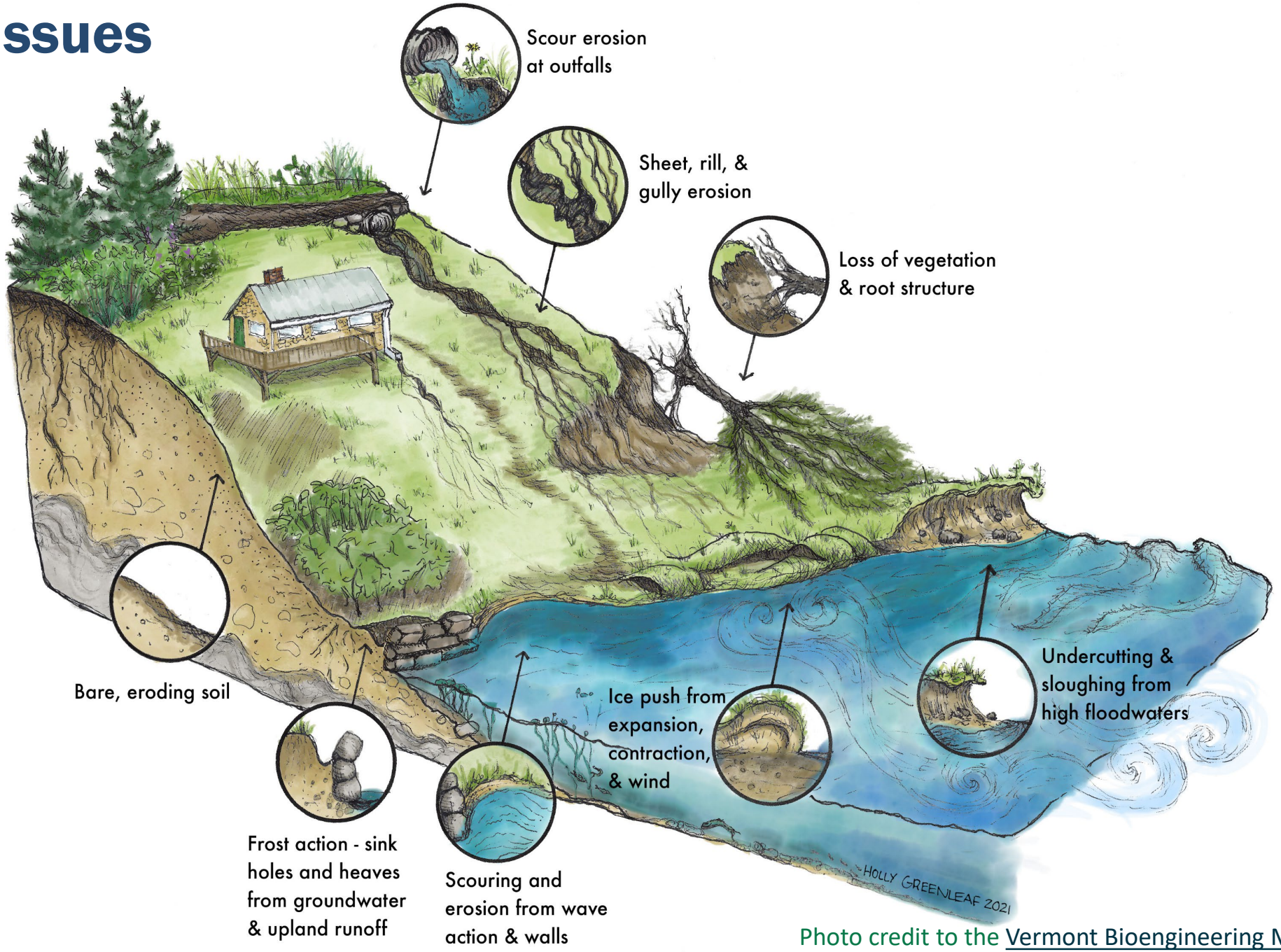

Photo credit to the Vermont Bioengineering Manual, 2022

Lacking Buffers

Lakeshores lacking robust native buffers can contribute higher nutrient loads. Shorelines can become unstable.

Turf grass has very shallow roots that does not stabilize the shoreline.

WATERSHED CONSULTING

Project Deliverables

Up to 30 one-page project description sheets will be developed.

This is an example of the type of project summary sheet that will be generated for this project.

Location:		**Site ID:**	
Town:		**BMP Category:**	
Site Description:			
Impervious Cover:		**Drainage Area Size:**	
Water Quality Benefits:		**Design Difficulty:**	
Risk Zone:		**Preliminary Ranking Score:**	
Top Site:	Yes		

Site Photo

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Potential Water Quality Stressors to Shadow Lake include but are not limited to:

- Shoreline erosion
- Stream erosion/channelization
- Agricultural inputs
- Roadway runoff
- Invasive species
- Development
- Forestry operations
- Off Road vehicle use
- Septic system failure
- Contamination
- Deicing chemicals
- Winter sand

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Thank you for your attention!

Contact:

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