CASPIAN LAKE AND WATERSHED ACTION PLAN (LWAP)

Protecting and Preserving Caspian Lake Starts with a Plan

January 16, 2024

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Just water consulting

MSK ENGINEERS

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WHAT IS A LAKE AND WATERSHED ACTION PLAN?

*A Lake Watershed Action Plan (LWAP) is an **assessment** to **identify** the **greatest threats** to the lake ecosystem, including impacts on water quality and wildlife habitat from stormwater runoff and from altered, cleared, or converted shorelands.*

Site ID	Description	Potential BMP Type / Description	Water Quality Score	Cost Score	Additional Benefits Score	Landowner Score	Total Score	Normalized Score	Rank
Wet001/010	Perron/MacNeil Property	Wetland restoration: pond buffer, perennial stream buffer	4	4	13	1	21	100%	1
ST-32	Perron Property - Stream Buffer Restoration	Passive Stream and Riparian Buffer Restoration	3	4	11	1	18	86%	2
ST-31	Alley Property - Stream Buffer Restoration	Passive Stream and Riparian Buffer Restoration	4	4	9	1	17	81%	3
ST-2	Lotspeich Property - Stream Buffer Restoration	Passive Stream and Riparian Buffer Restoration	3	4	9	1	16	76%	4
ST-3	Barr Family, LLC - Stream Restoration	Passive Stream and Riparian Buffer Restoration	3	4	9	1	16	76%	5
ST-33	MacNeil Property - Stream Buffer Restoration	Passive Stream and Riparian Buffer Restoration	2	4	10	1	16	76%	6
Wet005	Barr Family, LLC	Wetland revegetation and perennial stream buffer	2	3	11	1	16	76%	7
ST-8	Barr Family, LLC - Stream Restoration	Passive Stream and Riparian Buffer Restoration	1	4	10	1	15	71%	8
ST-7	Clarke Property - Stream Buffer Restoration	Passive Stream and Riparian Buffer Restoration	2	4	8	1	14	67%	9
ST-6	Lotspeich Property - Stream Buffer Restoration	Passive Stream and Riparian Buffer Restoration	2	4	8	1	14	67%	10

A LWAP Final Report includes a list of **prioritized problems and solutions** and provides a table of projects.

Project Goals

Reduce Phosphorus to the Lake	148 lbs. Annually [37 tons algae]
Reduce Sediment to the Lake	~350 cu. Ft. Annually (Lakeshore)
Create Riparian Habitat	25 acres
Restore Lake Shoreline to More Natural Condition	780 linear feet @ 50' wide
Reduce Streambank Erosion	Unmodeled Specifically
Create More Resilient Roads	1.65 miles to MRGP standards

BASIC STEPS IN AN LWAP

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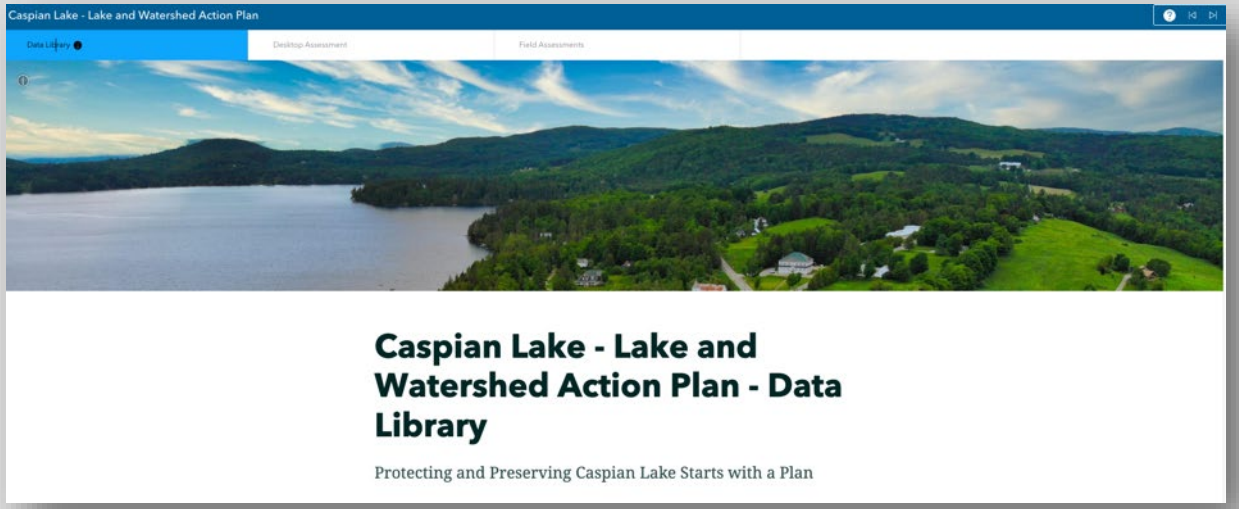
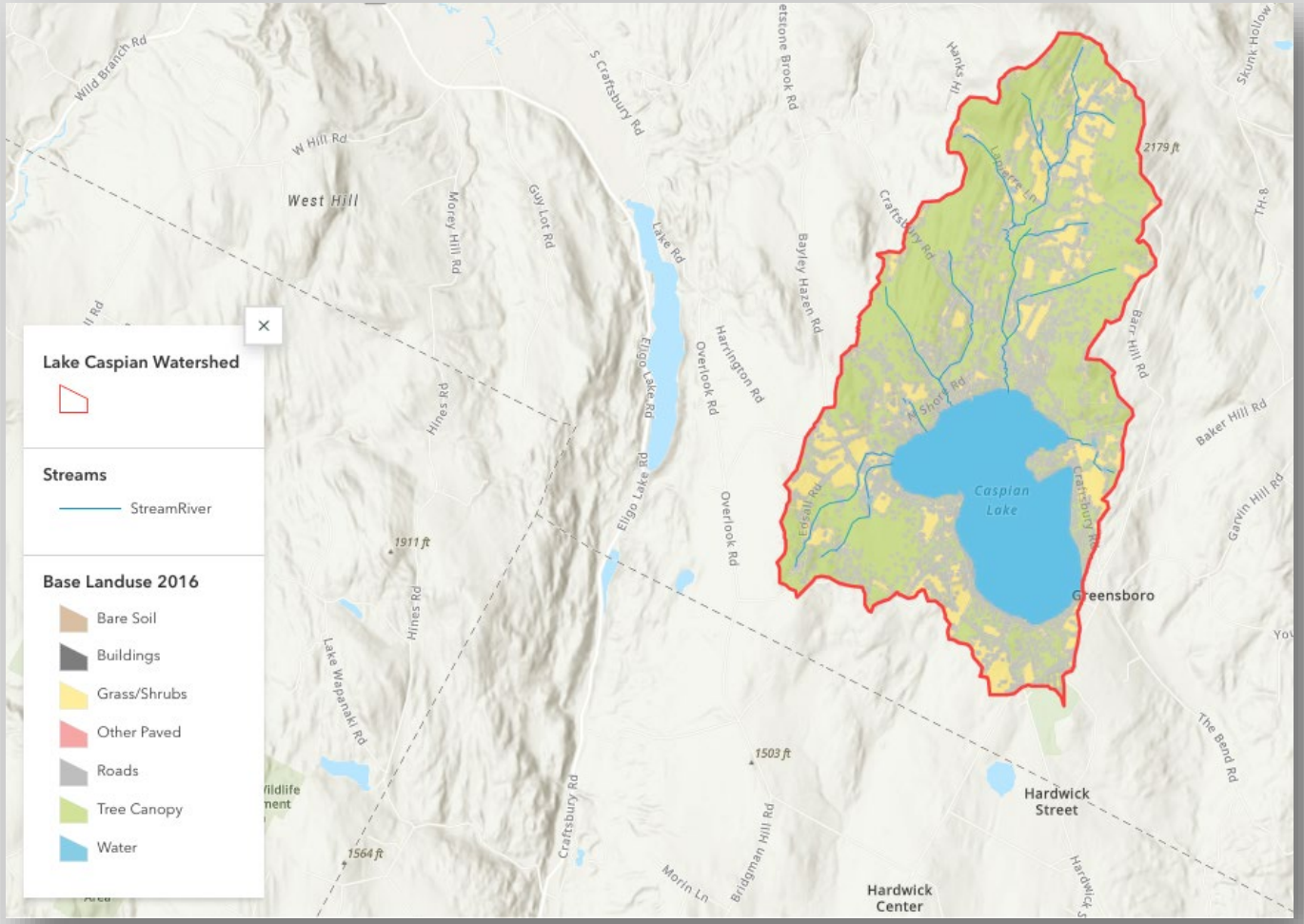
DATA LIBRARY

- Data Considered
- Landuse (2016 UVM SAL Data)
- Roads and Road Assessments (MRGP)
- Stream Assessments
- Water Quality Data (VT Lay Monitoring Program)



StoryMap Online

LANDUSE DATA



Takeaways:
Predominantly Forested – 54%
Tree Canopy, Grass/Shrubs, and Water = ~97% of all Landuse

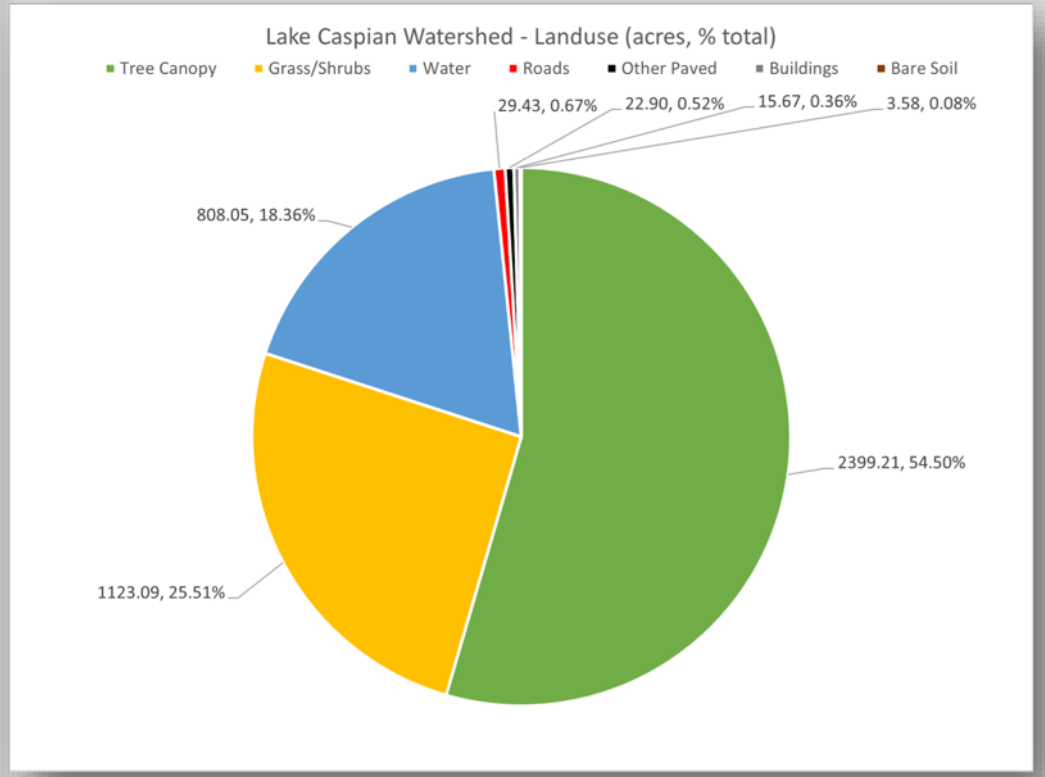


Figure 4: Land use summary - UVM SAL data 2016

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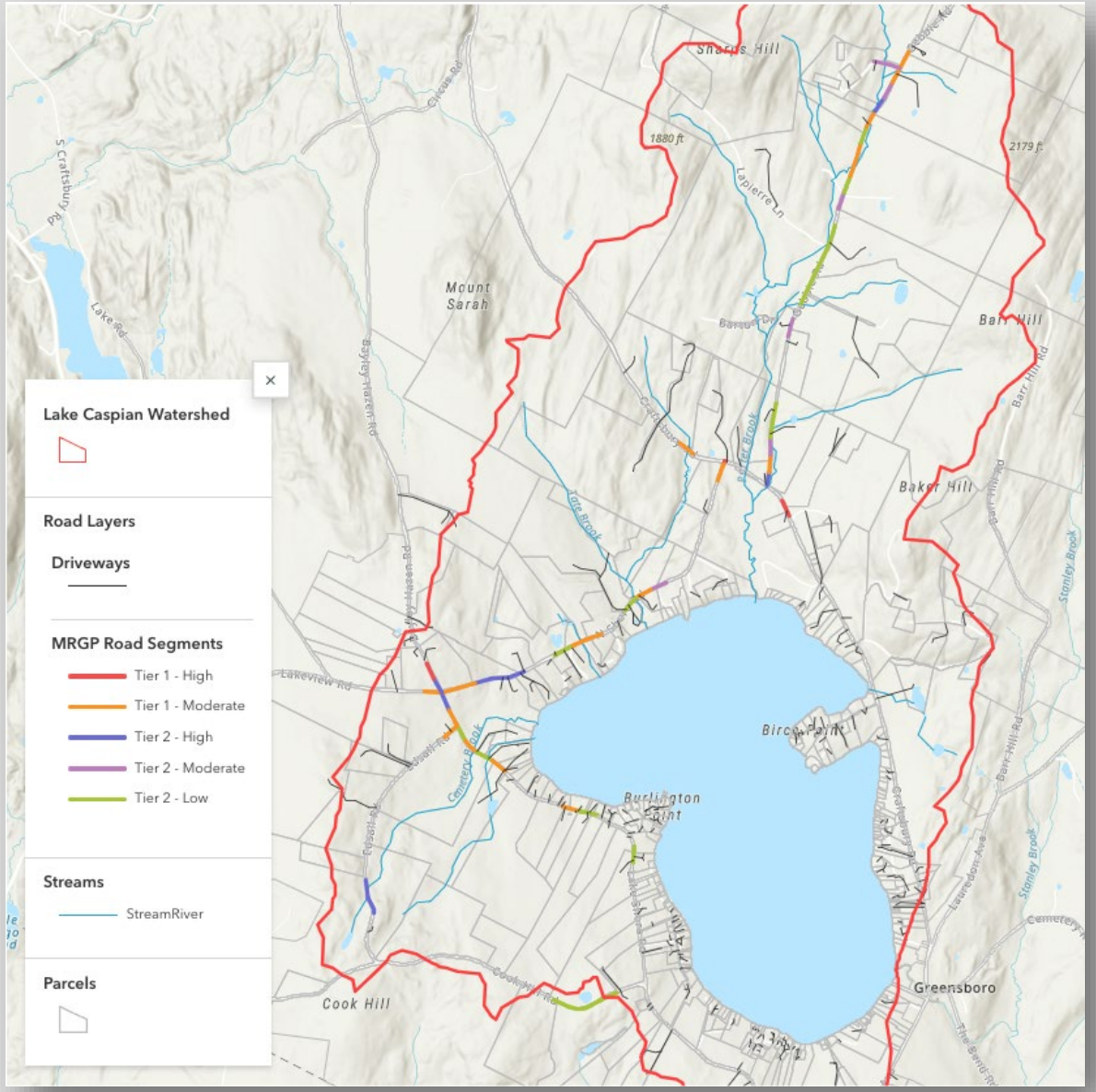
ROAD DATA ANALYSIS



Takeaways:
Mostly Town Roads (~60%) - ~34% Driveways
Mostly Gravel (33%)

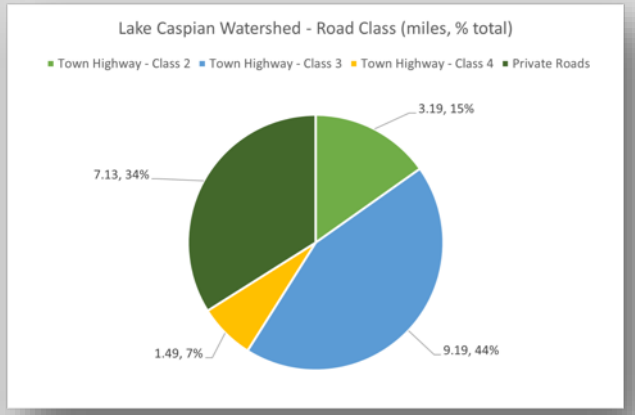


Figure 2: Roads by Road Class

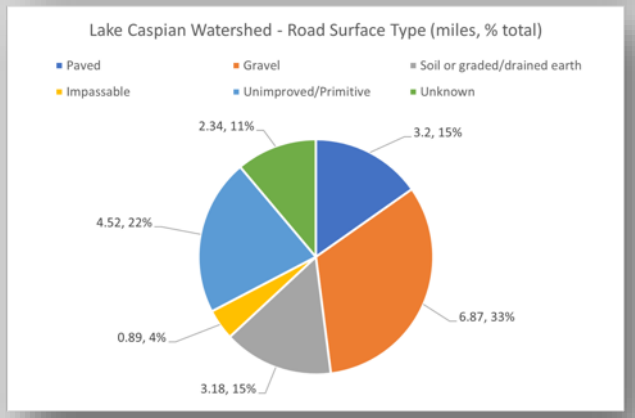


Figure 3: Roads by Surface Type

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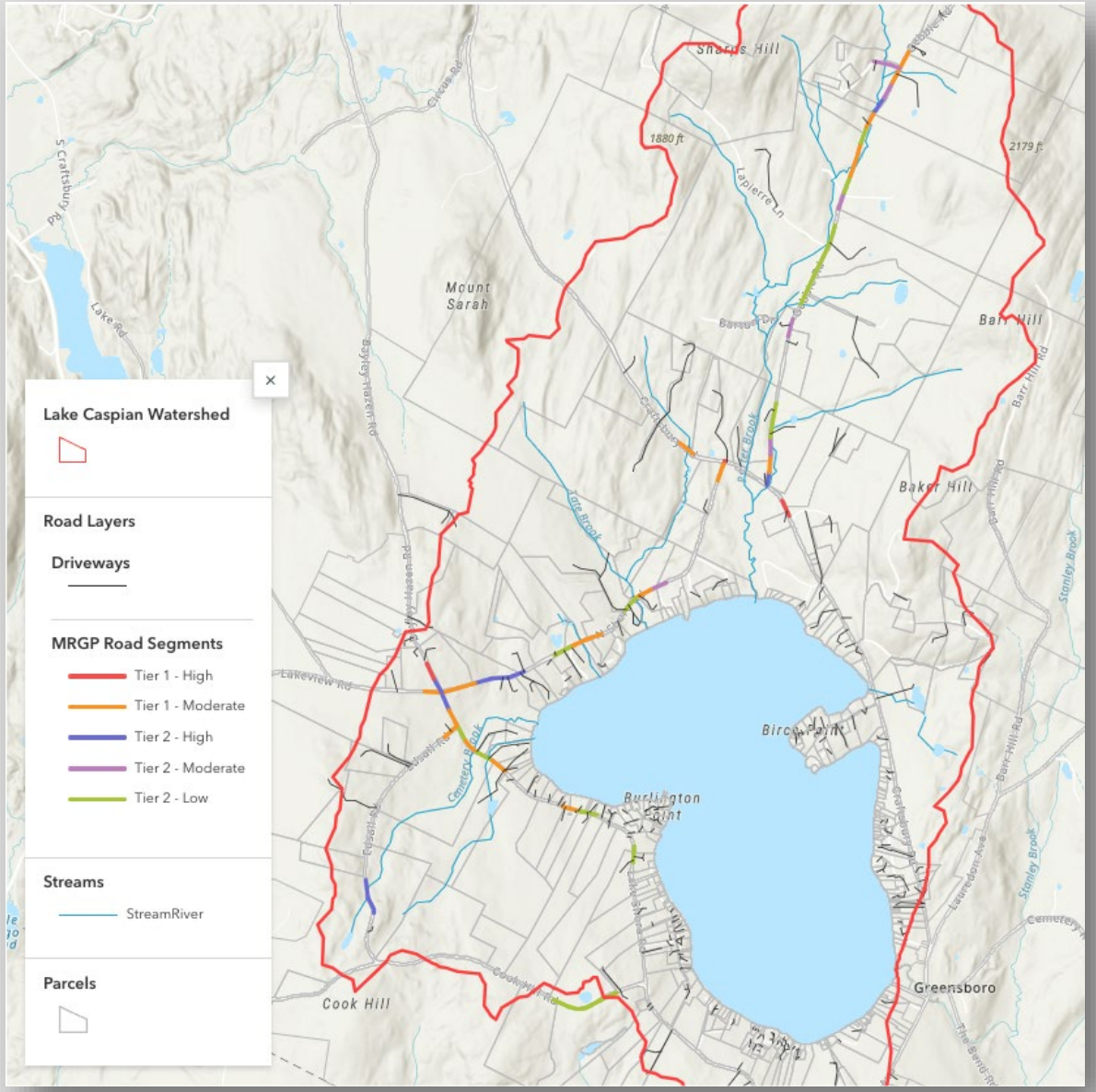
ROAD DATA ANALYSIS



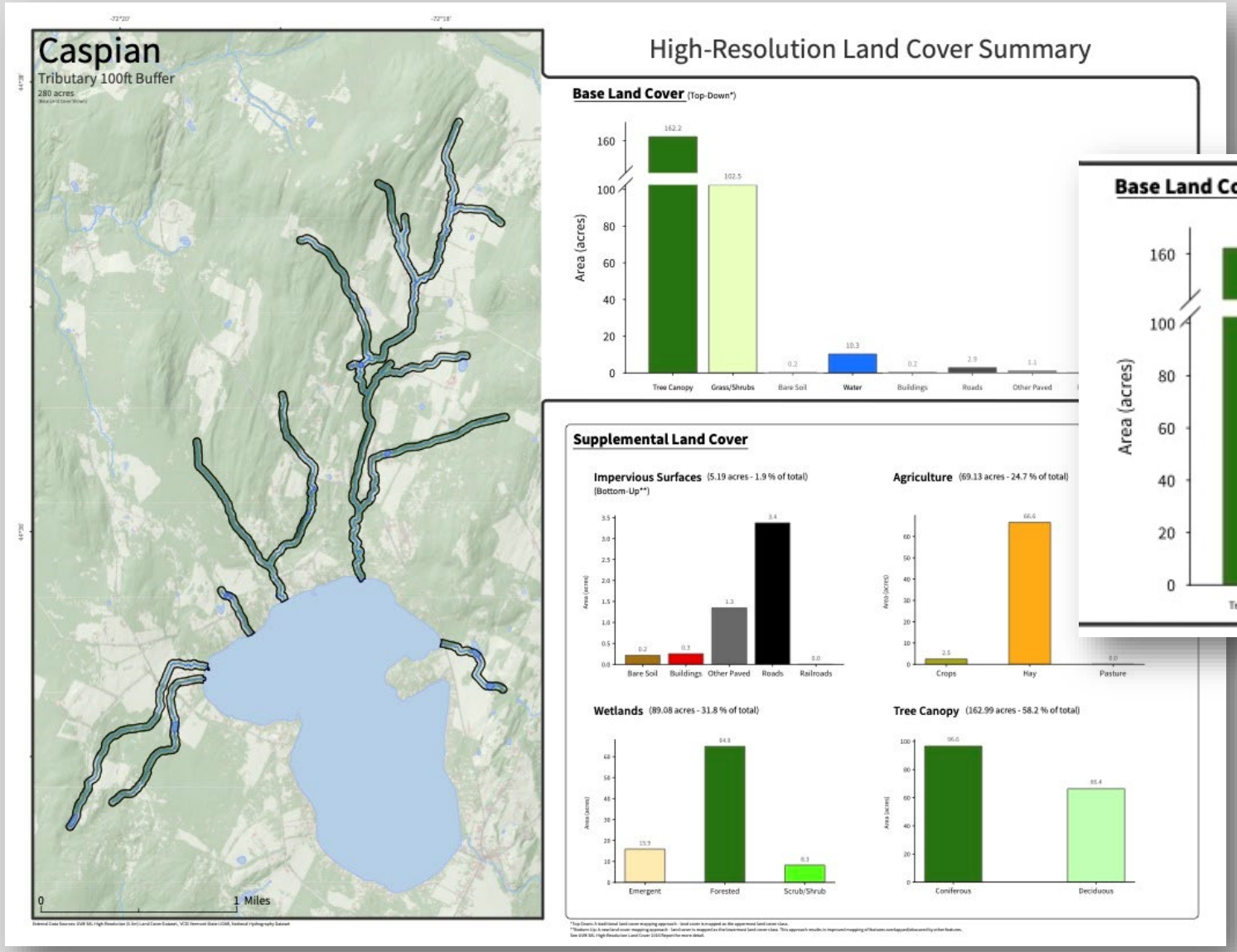
Municipal Roads General Permit:

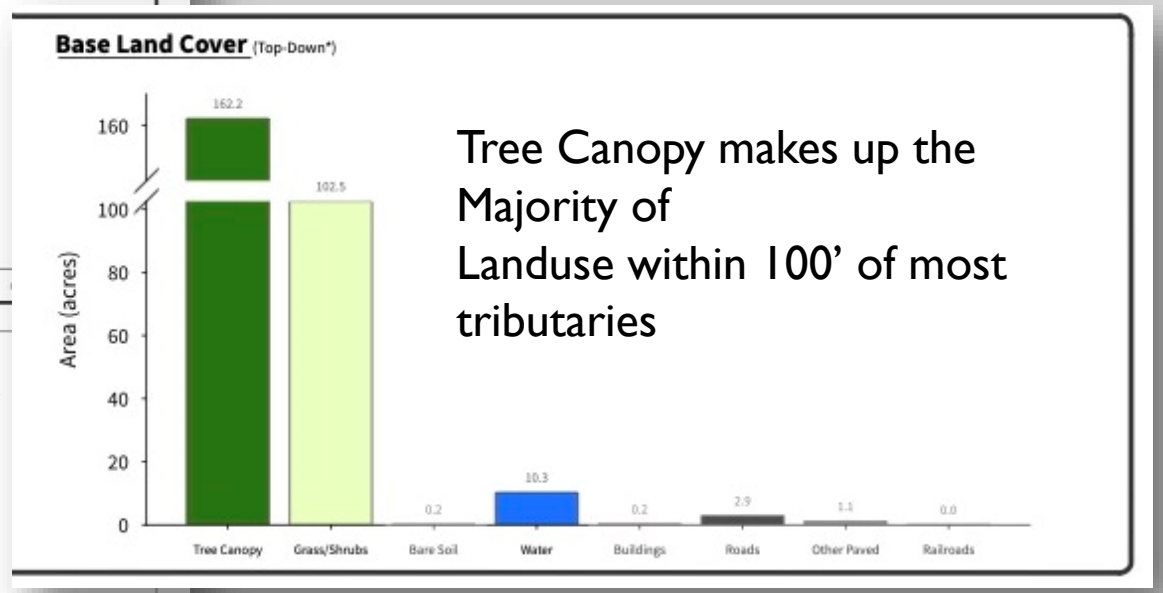
Within the Caspian Lake watershed there are 247 road segments (not inclusive of private driveways). Of these, 158 are not connected. Of the remaining 89 segments, the designations are as follows:

Segment Status
- Does Not Meet - 31 Segments
- Partially Meets - 26 Segments
- Fully Meets - 30 Segments
- Incomplete Data - 1 Segment

Link to StoryMap

STREAMS ANALYSIS





Tree Canopy makes up the Majority of
Landuse within 100' of most tributaries

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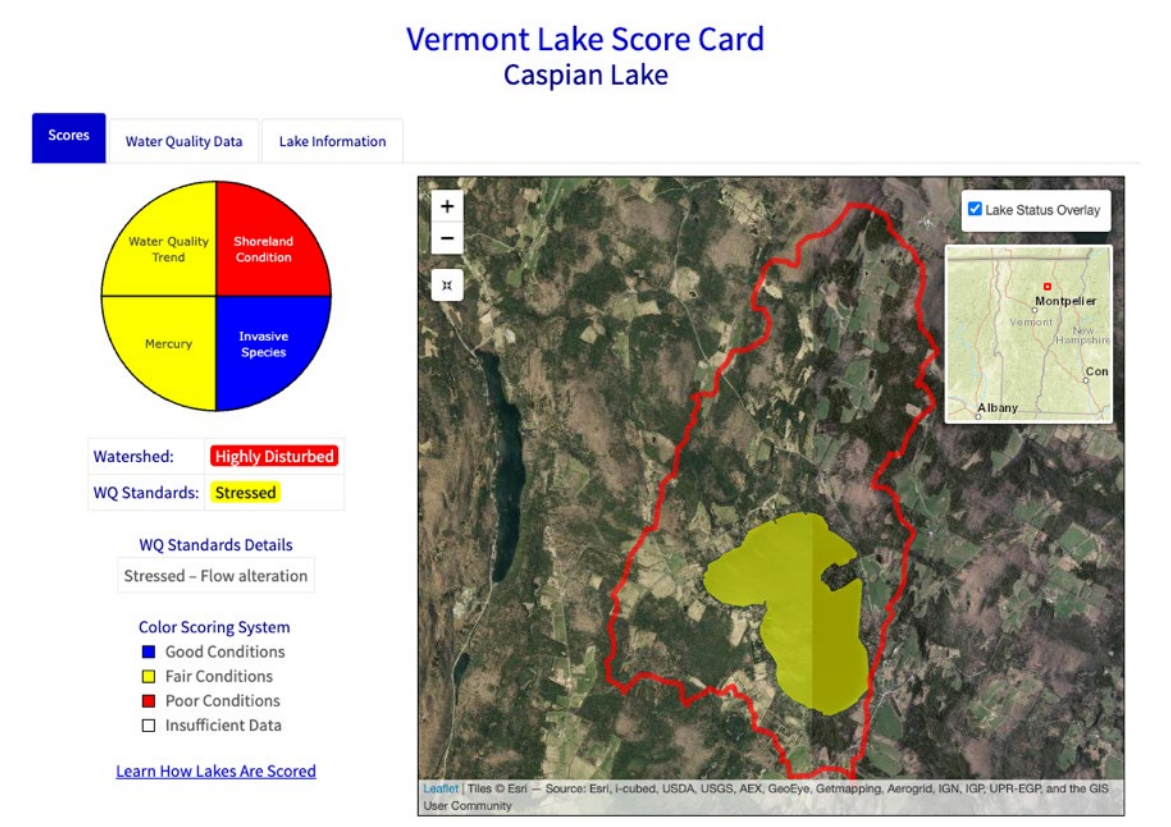
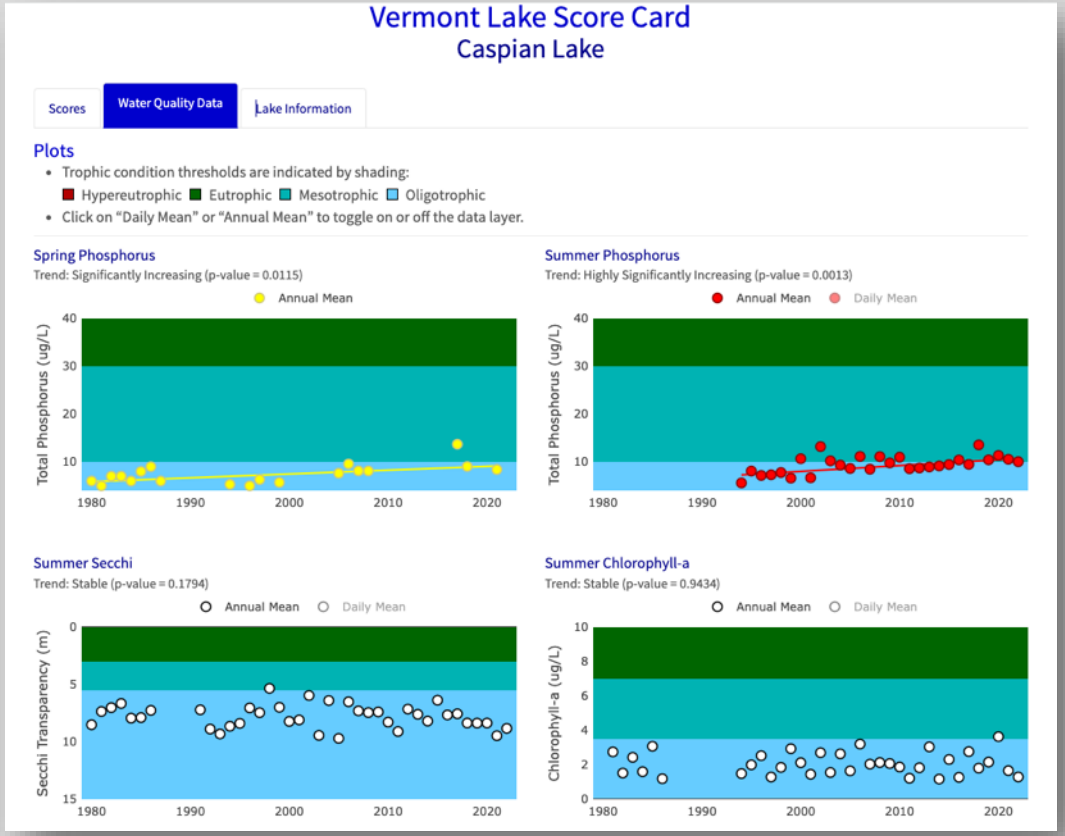
STREAMS ANALYSIS

VT Lay Monitoring Program Data





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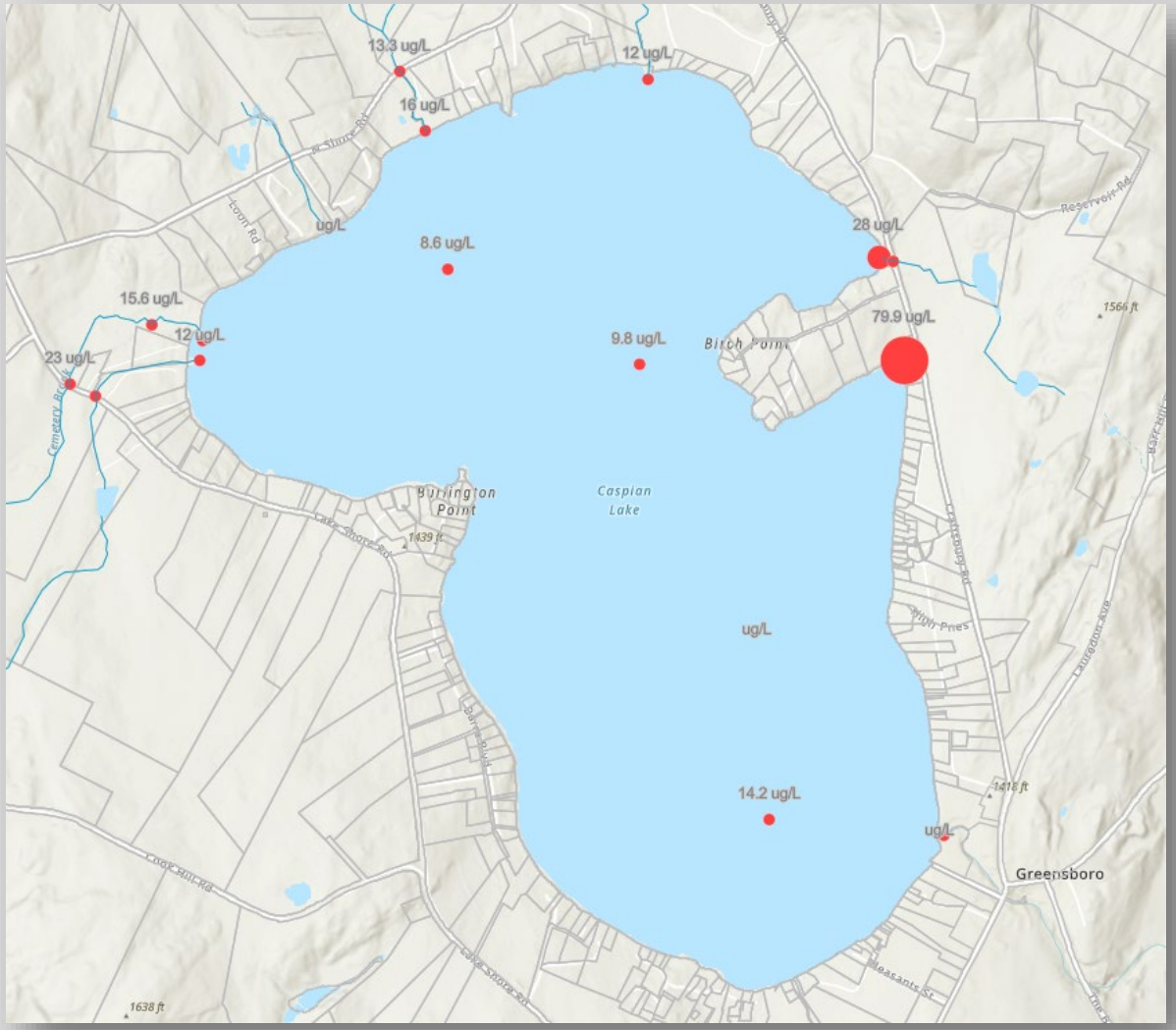
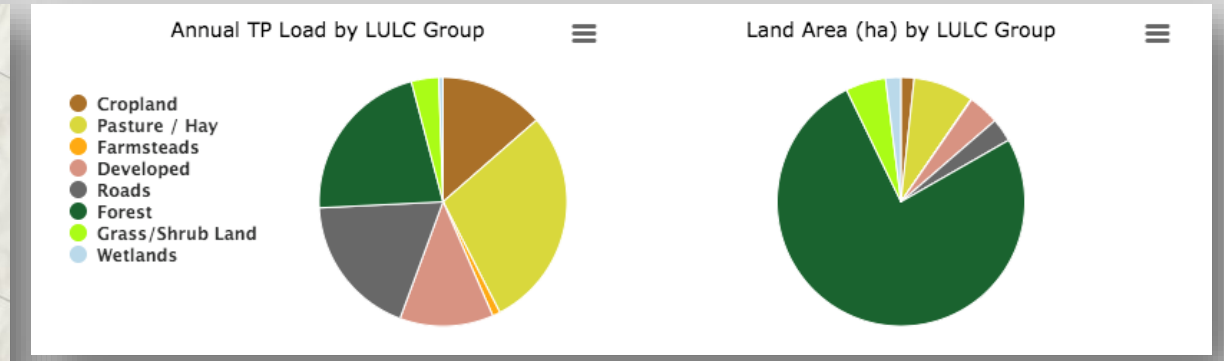
WATER QUALITY ANALYSIS

VT Lay Monitoring Program Data





Porter Brook – Annual TP Load by Landuse – Takeaways:

- Most land is forested - associated TP load is ~15-20%
- Roads are small percentage of landuse – associated TP load is ~15%
- Cropland + Pasture/Hay is ~30% of TP load – small percent of landuse
- Developed land is ~15% of TP load – small percent of landuse

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STREAMS ANALYSIS

Other Data Considered

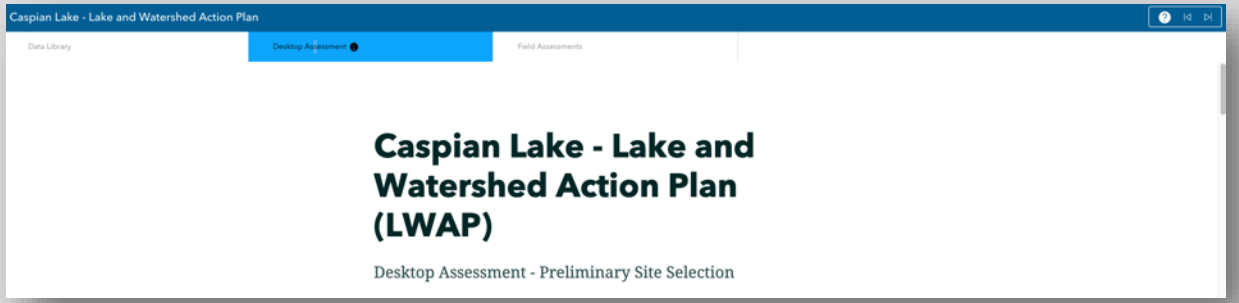
- Caspian Lake Protection Committee Annual Reports
- Caspian Lake Feeder Stream Study (2014)
- Caspian Lake Tributaries Walk (2013)
- Water Quality Data (VT Lay Monitoring Program)

Other Data Considered

- Soils (Hydrologic Soil Group, Erodibility)
- Topography (Slope)
- Wetlands Data

DESKTOP ASSESSMENT

- Four Core Areas
- Shoreland
- Streams
- Wetlands
- Roads



StoryMap Online

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DESKTOP ASSESSMENT - SHORELAND

- **87 Sites Total**

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DESKTOP ASSESSMENT - STREAMS

- **33 Sites Total**

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DESKTOP ASSESSMENT - WETLANDS

- **10 Sites Total**

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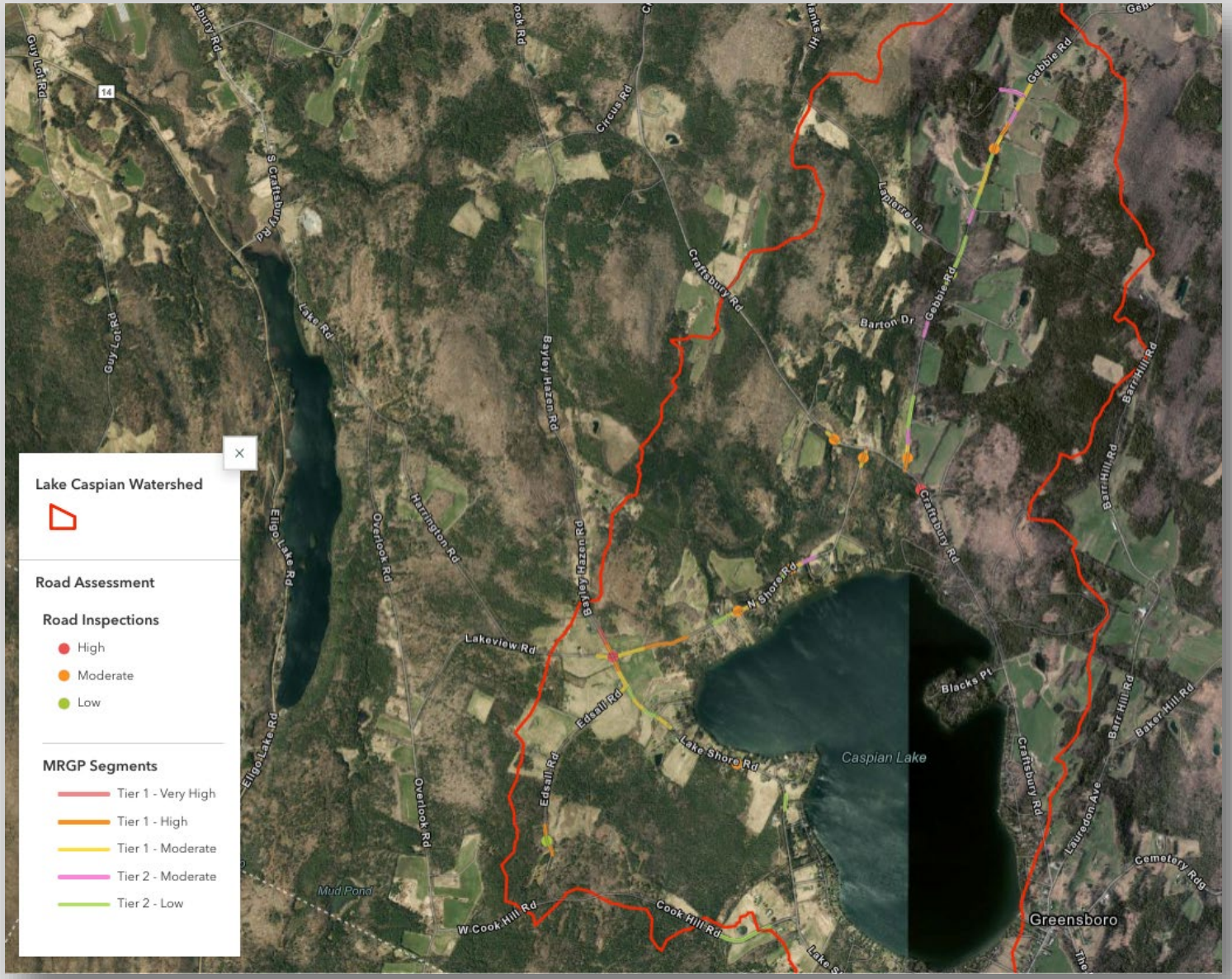
DESKTOP ASSESSMENT - ROADS



ID and Preliminary Ranking Process:

- Selected using Road Erosion Inventory (REI) results from Municipal Roads General Permit (MRGP)
- Priority Score is as outlined in chart below:

LWAP Priority Score	Combined Score	Segment Priority
Tier 1 – Very High	Does Not Meet	Very High
Tier 1 – High	Does Not Meet	High
Tier 1 – Moderate	Does Not Meet	Moderate
Tier 2 – Moderate	Partially Meets	Moderate
Tier 2 – Low	Partially Meets	Low

DESKTOP ASSESSMENT - ROADS

- **11 Total Sites**
- **57 MRGP Segments (18,200’ – 3.45 miles)**

FIELD ASSESSMENT

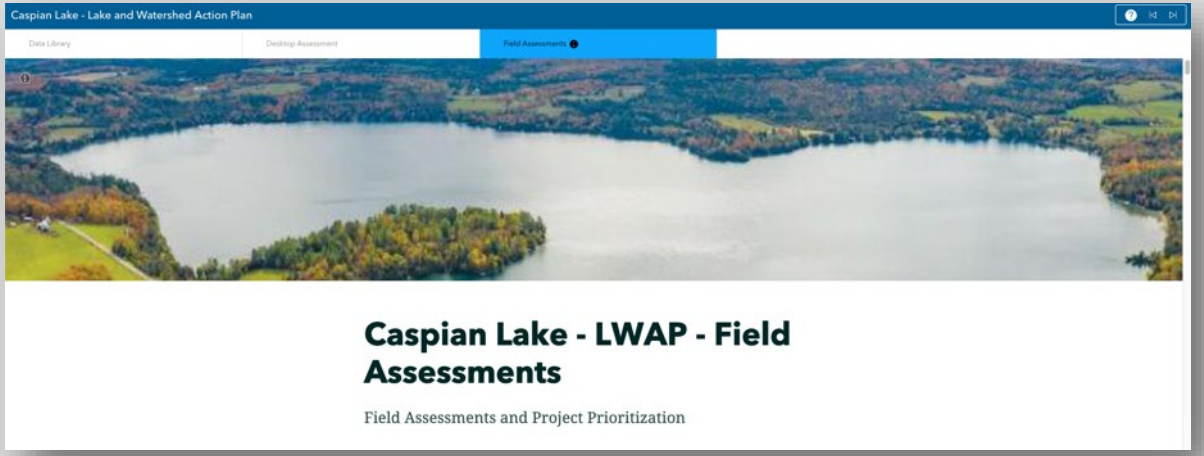
Four Core Areas

Shoreland - ~98 Sites Assessed → 17 Prioritized

Streams – 33 Sites Assessed → 10 Sites Prioritized

Wetlands – 10 Sites Assessed → 3 Sites Prioritized

Roads – 11 Sites Assessed → 5 Sites Prioritized



StoryMap Online

SCORING

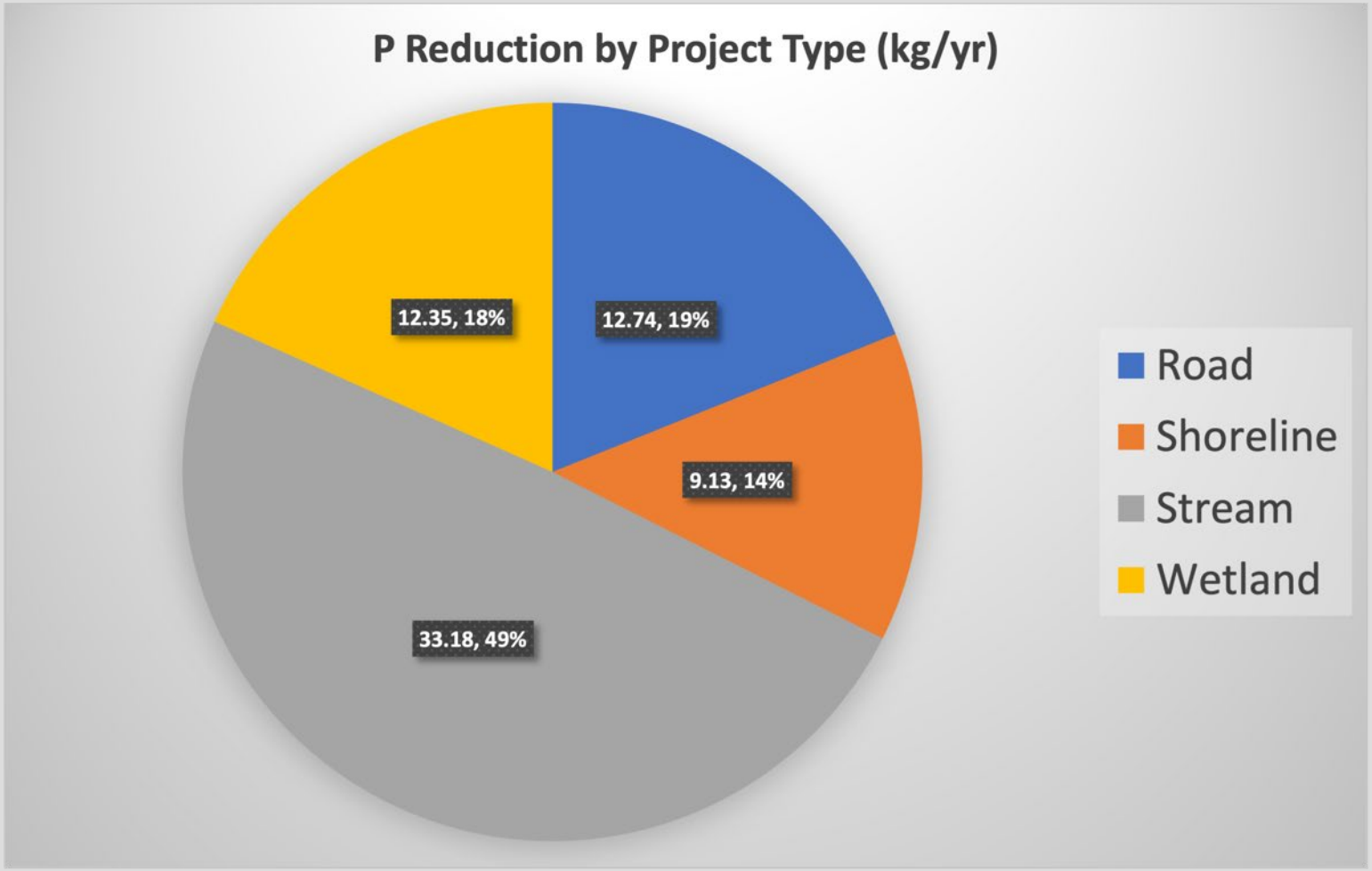
Water Quality Score		Cost Score				Additional Benefits Score								Landowner Score
P Reduction (kg / year)		Efficiency ($ / kg P removed)		O&M Requirements	Geomorphic Benefits	Addressed Chronic Problem?	Mitigates Flooding?	Educational - Public Demonstration	Infrastructure Conflicts	Reduces Thermal Pollution	Peak Flow Reduction	Enhances /Creates Habitat	Easy Access for Construction	Landowner Support
Additive		*Additive*		*Additive*	*Additive*	*Additive*	*Additive*	*Additive*	*Additive*	*Additive*	*Additive*	*Additive*	*Additive*	*Multiplicative*
0 - 1.21	1	$0 - 4,183	4	Low - 3	Low - 1	Yes - 1	Yes - 1	Yes - 1	Yes - 0	Yes - 1	Yes - 1	Yes - 1	Yes - 1	Yes - 1
1.22 - 2.93	2	$4,184 - 14,139	3	Medium - 2	Medium - 2	No - 0	No - 0	No - 0	No - 1	No - 0	No - 0	No - 0	No - 0	No - 0
2.94 - 4.97	3	$14,140 - 23,157	2	High - 1	High - 3									Unknown - 0
4.98 - 9.55	4	$23,158 - 40,000	1		No / N/A - 0									

TOTAL = (Water Quality + Cost + Additional Benefits) X Landowner

- Acre of Buffer Created: $7,214.00
- Linear Foot of Shoreline Restored: $150.00
- Mile of Road Brought to MRGP Standard (Median, Not Scaled): $67,689.00

P Reduction: VT DEC's Phosphorus Reduction Calculator Tool
Cost: Water Quality Restoration Formula Grant Target and Fund Allocation Methodology

EFFECTIVENESS



For the 34 Prioritized Projects:

- **67.4 kg/year (148.59 lbs/year)**

LANDOWNER WILLINGNESS IS KEY

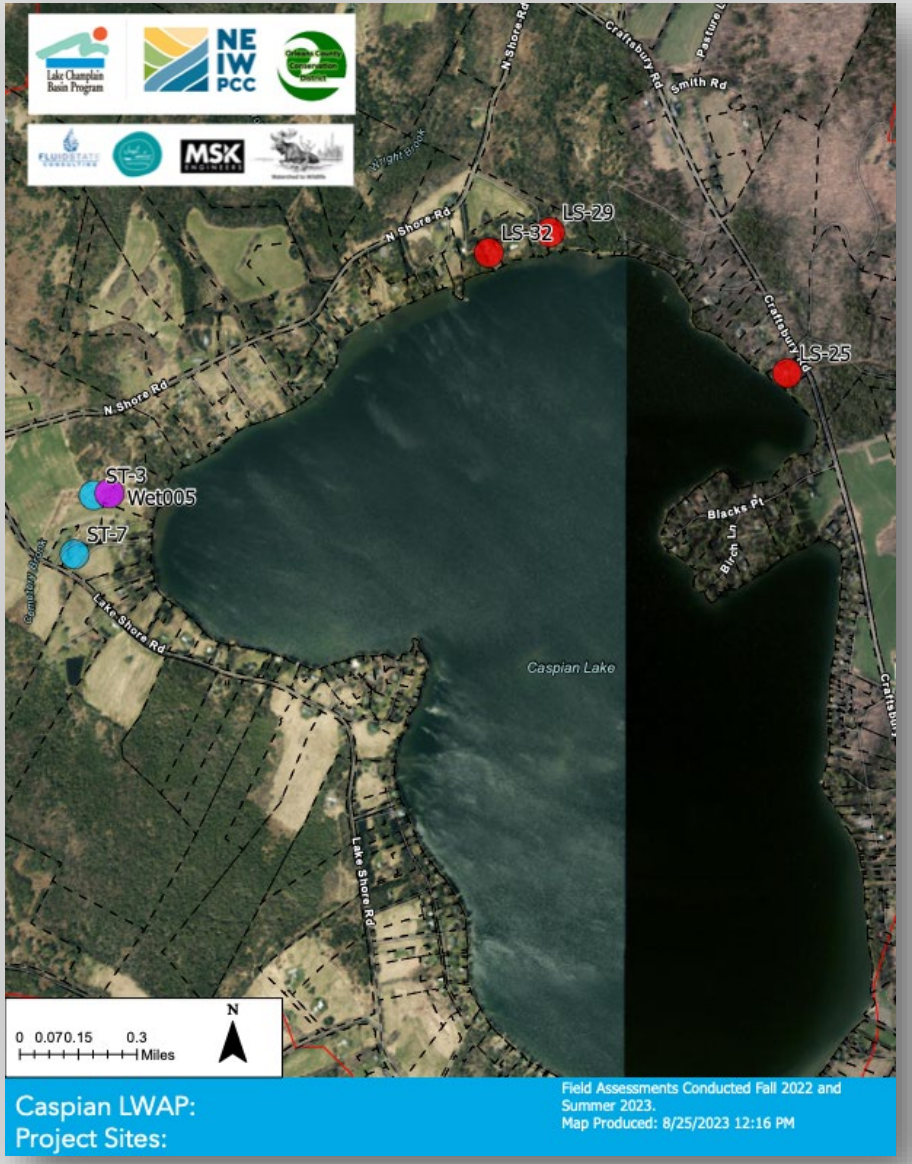
RESULTS

Project Groupings:

Multiples 'Sites' Per Project

Projects Are:

1. Wet005/ST-3
2. LS-25
3. LS-32
4. ST-7
5. LS-29



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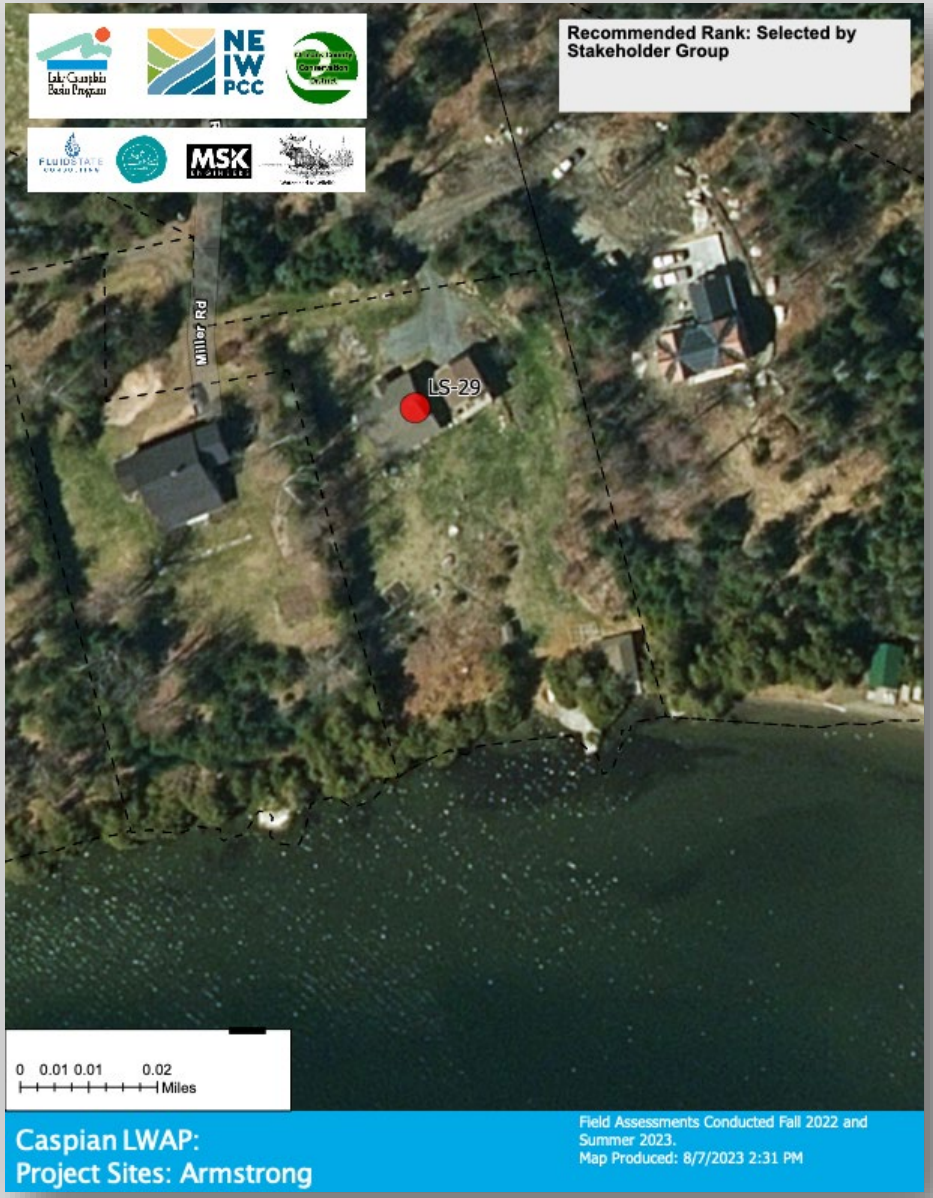
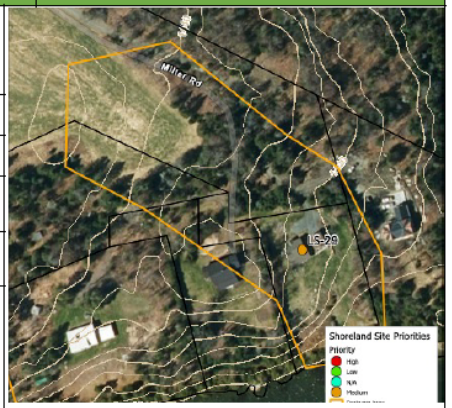
CONCEPT DESIGN SITE 5 – LS-29



Caspian Lake – Lake & Watershed Action Plan
Field Assessment Summary Sheets

RANK: 16

Site ID: LS-29	**Project Type: Lakeshore**
Location:	155 MILLER ROAD – Armstrong-Newhouse
Drainage Area (Acres)	3.26
Impervious Managed (Acres)	0.26
Sediment Reduction (cu. Ft / year)	Low
Phosphorus Reduction (kg / year)	0.33
Cost ($)	$3,600.00



Description:
Large lawn, bank somewhat unstable underneath boathouse, will likely earn Lake Wise award if addressed, plans on replacing structure

Recommendations:
Plant riparian buffer to 50' (approximately 0.5 acres total across parcel). Manage shoreline under boathouse (length unknown – costs and benefits could increase depending on length).

Water Quality Score	Cost Scoring	Additional Benefits Score	TOTAL Score
1	3	7	11 (52%)

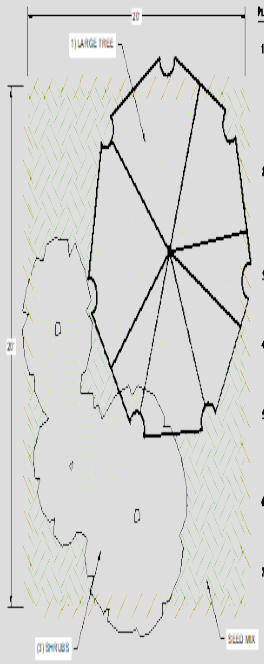
Additional Project Benefits: Low O&M, Addressed Chronic Problem, Enhances Habitat, No Infrastructure Conflict, Easy Access for Construction, Landowner Support	Comments:

LS29

Estimated Cost: $17,993
P Removed / Year: 1.19 lbs.
Efficiency: $15,120 / lbs. P

LS29

PARCEL ID: 208-0155
LOCATION: 155 MILLER ROAD

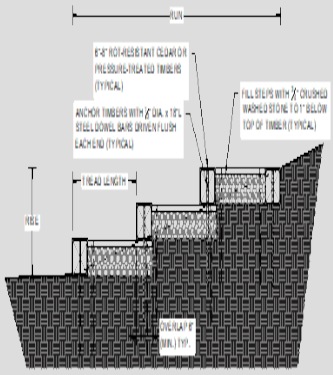


PLANTING GUIDANCE FOR THE REVEGETATION OF NATIVE SPECIES

1. WITHIN 50 FEET OF THE SHORELINE, THE GOAL SHOULD BE TO PLANT A MINIMUM OF ONE WOODY STEM PER PLANTING UNIT OR EQUALS APPROXIMATELY ONE (1) LARGE TREE AND THREE (3) LARGE AND SMALL SHRUBS FOR EVERY 20' x 20' AREA.
   A SIMILAR DENSITY OF NATIVE SEED MIX SHOULD BE APPLIED TO EACH 20' x 20' AREA.
2. FROM 50 FEET TO 100 FEET FROM THE SHORELINE, AT MINIMUM, APPLY A SIMILAR DENSITY OF PLANTINGS AS DESCRIBED THAT MATCHES THE SITE'S SOILS AND MOISTURE REQUIREMENTS. ADDITIONAL NATIVE, NON-INVASIVE, TREES AND SHRUBS MAY BE PLANTED IN THE UPLAND AREA.
3. FOR EACH 20 FEET OF SHORE, FIVE (5) DIFFERENT SPECIES OF NATIVE TREES AND SHRUBS SHOULD BE PROVIDED AS CHOSEN FROM APPROVED SPECIES.
4. FOR MAINTENANCE, NATIVE PLANTINGS AND SHRUBS, (5 - 6) PLANTS OF THE SAME SPECIES SHOULD BE PLANTED IN PROXIMITY TO ONE ANOTHER.
5. WHEN CHOOSING OR PURCHASING PLANT MATERIAL, IT IS IMPORTANT TO PROVIDE COMPLETE SCIENTIFIC NAMES INCLUDING SUBSPECIES IF APPROPRIATE, TO ENSURE WHICH NATIVE AND NON-INVASIVE SPECIES ARE NOT INTRODUCED UNINTENTIONALLY.
6. RE-VEGETATION AREAS ARE DESIGNED TO ACHIEVE THE GOAL OF NATURALIZATION, NO ADDITIONAL MAINTENANCE OR MOWING IS REQUIRED.
7. USE OF FERTILIZER MATERIAL OR STRAW IS NOT PERMITTED OVER THE LOT OF MAY AS MULCH OR NEEDED AREAS. HAY CAUSES WEED SEEDS AND SHOULD BE AVOIDED.
   - SEEDLINGS AND BARE ROOT TREES (minimum 36" TALL STOCK)
   - TREES SHOULD BE PLACED 6-8' APART
   - SHRUB MATERIAL SHOULD BE NO LESS THAN 36"
   - SHRUBS SHOULD BE PLANTED 3-5' APART AND CLUSTERED IN GROUPS.

20 FT x 20 FT PLANTING UNIT (PLANT LAYOUT MAY VARY)
ONE LARGE TREE, THREE SHRUBS (+/- 5% STEMS PER ACRE)

1 TYPICAL PLANTING UNIT DETAIL
Scale: NTS

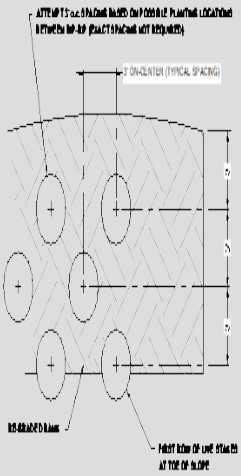


NUMBER OF STEPS: RISE (FT) ÷ DEPTH OF TIMBER (FT)
TREAD LENGTH (FT): RUN (FT) ÷ NUMBER OF STEPS

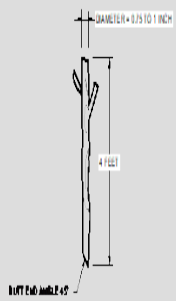
2 TYPICAL INFILTRATION STEP DETAIL
Scale: NTS

LS-29				
	UNITS	TOTAL	UNIT COST	TOTAL COST
General Conditions				
Mobilization	LS			$ 1,000.00
Traffic Controls	LS	0	$ 5,000.00	$ -
Erosion and Sediment Control	LS	1	$ 1,000.00	$ 1,000.00
Earthwork				
Common Excavation	CY	15	$ 30.00	$ 450.00
Topsoil	CY	10	$ 80.00	$ 800.00
Seed	SF	350	$ 0.50	$ 175.00
Planting Areas	EA	7	$ 500.00	$ 3,500.00
Stormwater Systems				
Infiltration Steps	LF	48	$ 15.00	$ 720.00
Live Staking Area	EACH	7	$ 250.00	$ 1,750.00
Other				
Boathouse Move	LS	1	$ 5,000.00	$ 5,000.00
LS-29 SUB TOTAL				$ 13,395.00
TOTAL WITH MOBILIZATION AND 20% CONTINGENCY				$17,999.76

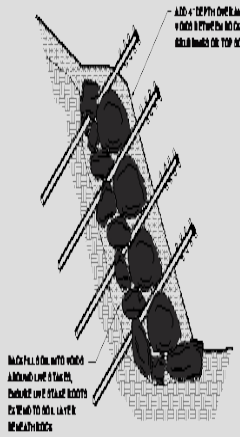
PLANT LIST			
ID	COMMON NAME	BOTANIC NAME	PLANTING LOCATION
TREES			
	CONIFEROUS		
AB	BALSAM FIR	ABIES BALSAMEA	RIPARIAN < 50 FT FROM OHW, UPLAND
PS	WHITE PINE	PINUS STROBUS	UPLAND
TO	EASTERN WHITE CEDAR (ARBORVITAE)	THUJA OCCIDENTALIS	RIPARIAN < 50 FT FROM OHW, UPLAND
	DECIDUOUS		
AR	RED MAPLE	ACER RUBRUM	RIPARIAN < 50 FT FROM OHW, UPLAND
AS	SILVER MAPLE	ACER SACCHARINUM	RIPARIAN < 50 FT FROM OHW
ASU	SUGAR MAPLE	ACER SACCHARUM	UPLAND
BP	GREY BIRCH	BETULA POPULIFOLIA	RIPARIAN < 50 FT FROM OHW, UPLAND
PT	QUAKING ASPEN	POPULUS TREMULOIDES	UPLAND
LR	LARCH	LARIX LARICINA	RIPARIAN <50 FT FROM OHW
SN	BLACK WILLOW	SALIX NIGRA	RIPARIAN < 50 FT FROM OHW
SHRUBS			
VN	WILD RAISIN	VIBURNUM NUDUM	RIPARIAN < 50 FT FROM OHW, UPLAND
CS	RED TWIG DOGWOOD	CORNUS SERICEA	RIPARIAN < 50 FT FROM OHW
SA	MEADOW SWEET	SPIRAEA ALBA	RIPARIAN < 50 FT FROM OHW
PV	CHOKECHERRY	PRUNUS VIRGINIANA	RIPARIAN < 50 FT FROM OHW, UPLAND
SC	ELDERBERRY	SAMBUCUS CANADENSIS	RIPARIAN < 50 FT FROM OHW, UPLAND
SD	COMMON PUSSY WILLOW	SALIX DISCOLOR	RIPARIAN < 50 FT FROM OHW
VA	LOWBUSH BLUEBERRY	VACCINIUM ANGUSTIFOLIUM	UPLAND
VO	HIGH-BUSH CRANBERRY	VIBURNAM OPULUS VAR. AMERICANUM	RIPARIAN < 50 FT FROM OHW, UPLAND
SEED MIXES			
	NEW ENGLAND WETMIX	WETLAND SEED MIX	RIPARIAN < 50 FT FROM OHW
	VERMONT WET MEADOW & DETENTION BASIN	WETLAND SEED MIX	RIPARIAN < 50 FT FROM OHW
			OHW: ORDINARY HIGH WATER LEVEL



PLAN VIEW



LIVE STAKE



SECTION VIEW

LIVE STAKE PLANTING NOTES

1. STAKE WILLOW AND DOGWOOD BRANCHES MUST BE HARVESTED DORMANT. COLD STORAGE MUST BE MAINTAINED BEFORE PLANTING.
2. INSTALL RIP-RAP PER PLAN, AND PLACE STAKES AT TOP OF BANK TO FULL WIDTH, AND 4 INCHES OF COVER OVER BUDS AT MINIMUM DEPTH.
3. INSTALLATION SHALL BE COMPLETED USING THE "STAKE" TOOL, PILE DRIVER, OR SIMILAR METHOD TO CREATE HOLES IN SOIL.
4. INSTALL 4 FT LONG LIVE WILLOW STAKES (CLUMPS OF SIMILAR NATIVE WILLOW SPECIES) SPACED 5 FT ON CENTER. THE STAKE TO BE INSERTED INTO PREPARED PILOT HOLES SLIGHTLY LARGER THAN THE STAKE DIAMETER AND BACKFILLED. STAKES SHOULD BE INSERTED TO 36 INCH DEPTH.
5. LIGHTLY TAMP TOP SOIL AROUND EACH STAKE AND WATER WITH WATER.
6. SEED BANK WITH EROSION AREA SEED MIX PER SPECIFICATIONS. THE SLOPE SHOULD BE HAND-RAKED TO SLIGHTLY THE SOIL SURFACE, THEN HAND-SEEDED, HYDROMULCHED OR HAND-SPREAD WITH A STRAW MULCH, AND RAKED LIGHTLY TO ENSURE SOIL CONTACT.
7. PLANT MATERIALS SHOULD BE PLANTED THE DAY THEY ARRIVE ON SITE. PLANTS AND CUTTINGS THAT CANNOT BE PLANTED THE DAY THEY ARRIVE SHALL BE STORED ON SITE UNDER A WET TARP TO PROTECT THEM FROM WIND, DIRECT SUNLIGHT, DRYING OR OTHER DAMAGE. CUTTINGS OR UNROOTED STOCK THAT IS NOT PLANTED WITHIN TWO DAYS AFTER ARRIVAL ON THE SITE SHALL BE DECLARED DEAD AND REMOVED FROM AT 40 TO 50 DEGREES FAHRENHEIT.
8. WILLOW CUTTINGS FOR BIOENGINEERING SHOULD BE OBTAINED 8-48 HOURS PRIOR TO INSTALLATION.

3 LIVE STAKE PLANTING DETAILS
Scale: NTS

30% REVIEW: FOR PLANNING ONLY
NOT FOR CONSTRUCTION

MSK ENGINEERS
P.O. BOX 123, 120 DEPOT STREET
BENNINGTON, VERMONT 05201
PH: (802) 442-1822 FAX: (802) 445-1291

CASPIAN LAKE
WATERSHED ACTION PLAN
GREENSBORO, VERMONT

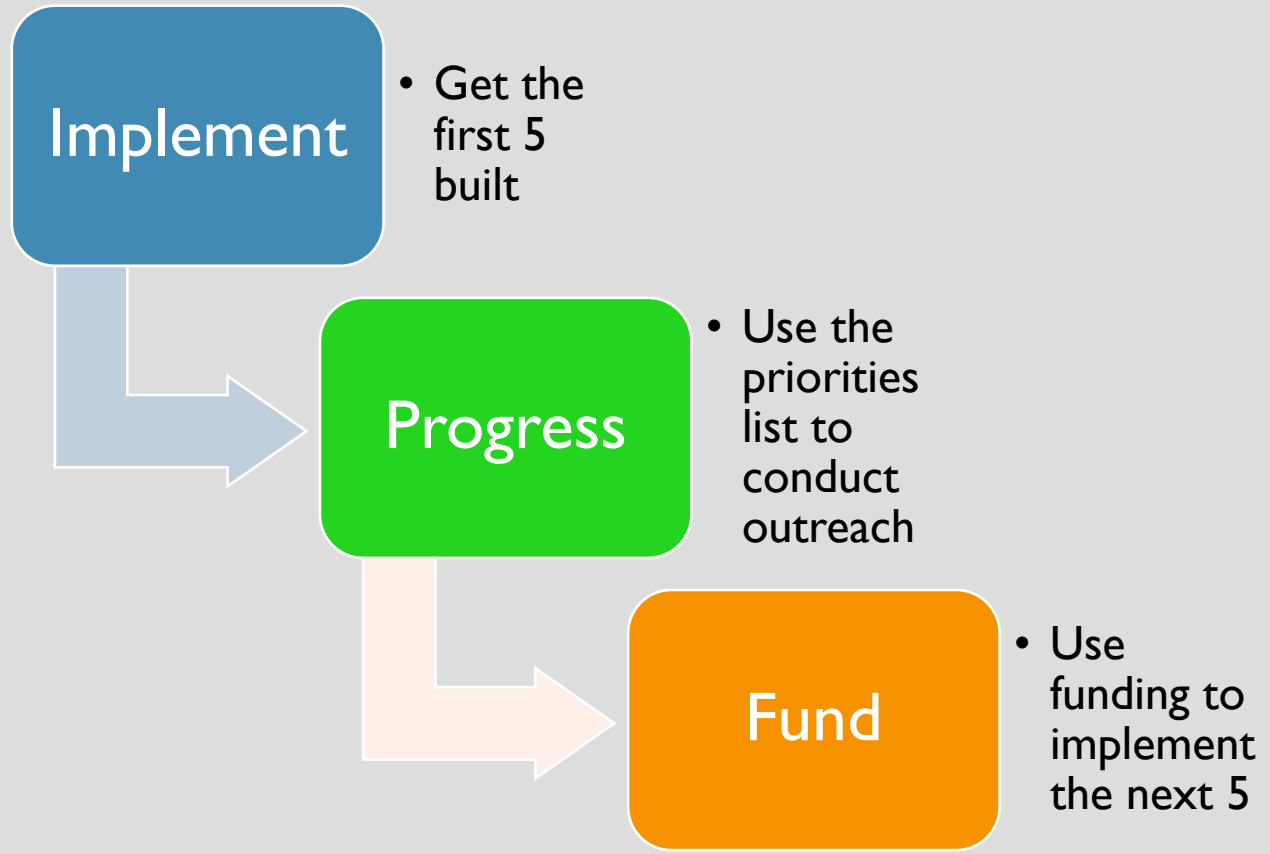
MSK NO.	DATE
1346.001	11-13-2020
DRAWN	CHECKED
MSK	AJK

CONCEPTUAL DESIGN
155 MILLER ROAD
SITE REMEDIATION DETAILS

SHEET NUMBER
LS-29

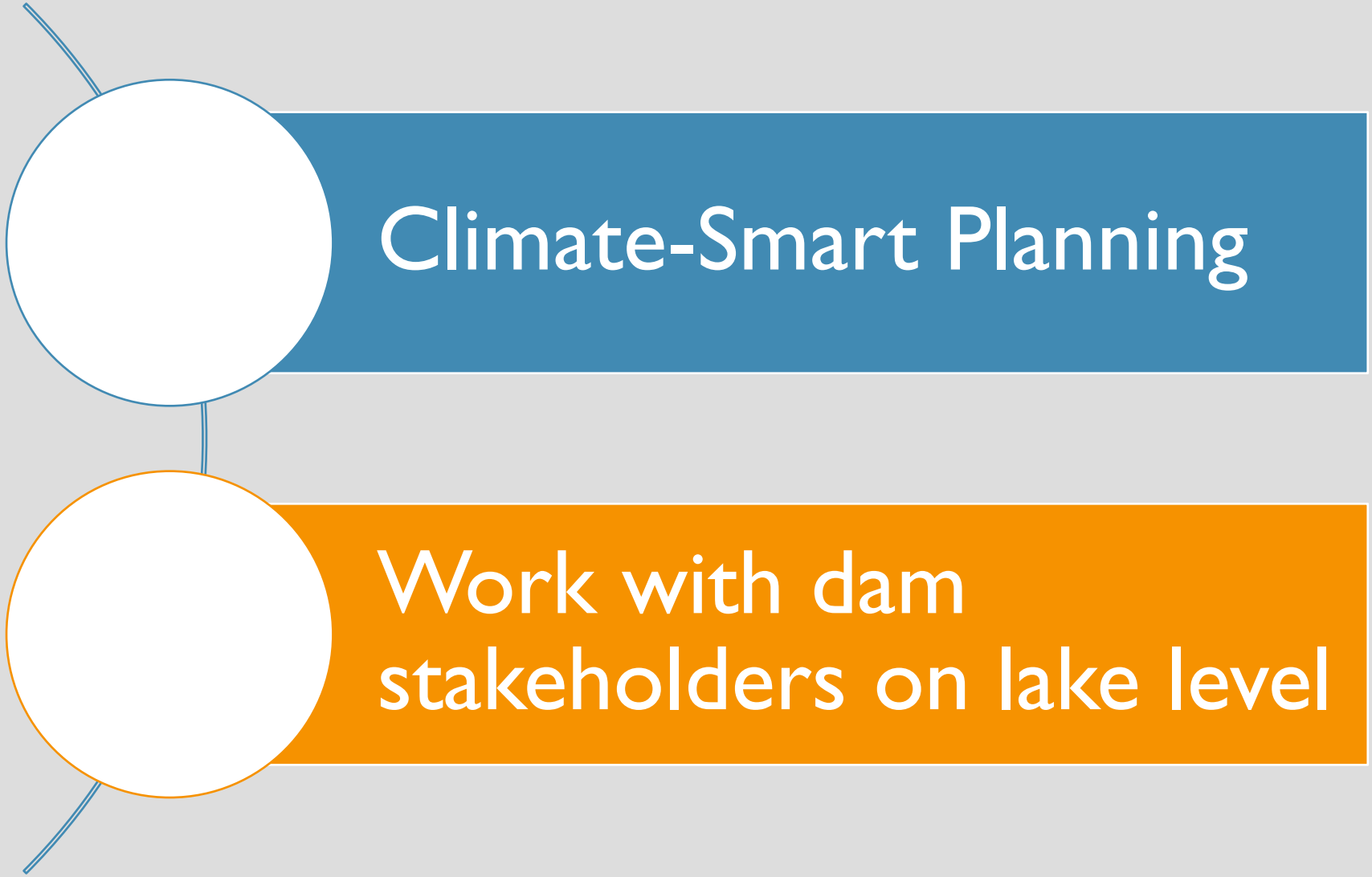
K:\DRAWING DATA\1346.001 CASPIAN LAKE\SHEETS\1346.001 CASPIAN LAKE_WATERSHED ACTION PLAN L029.DWG
13 November 2020 16:21:40

BEYOND THE CONCEPT SITES



FLUIDSTATE CONSULTING

GENERAL RECOMMENDATIONS - PROGRAMMATIC



GENERAL RECOMMENDATIONS - PROGRAMMATIC

- Social Marketing – Lake Wise & Stream Wise – better buffers
- Storm Smart Assessments – developed land runoff
- Extend Shoreland Protection Zone to Tributaries
- Adopt River Corridor Protection Bylaws
- Adopt VLCT Stormwater Bylaws
- Hold a Lake Wise Septic Social
- Support the Town's work with the MRGP

GENERAL RECOMMENDATIONS – INDIVIDUAL & DIY

- Adopt a No-Mow or Low-Mow Lawn on the Lake and streams
- Use the VT Guide to Stormwater for Homeowners to manage your house's runoff
- If you can, remove any development within 50' of the Lake or stream – it all helps!
- For hay/pasture – minimize the hayed area near streams or the Lake – outside 50' is great
- Look at your lakeshore retaining wall – could it be brought alive?
- Make sure you maintain your septic system – even if they're not broken, they might need TLC
- Encourage your neighbors (kindly!) to adopt similar practices – everyone loves the Lake!

Consider conserving your land

Join the Stewards of Greensboro Watershed

QUESTIONS?