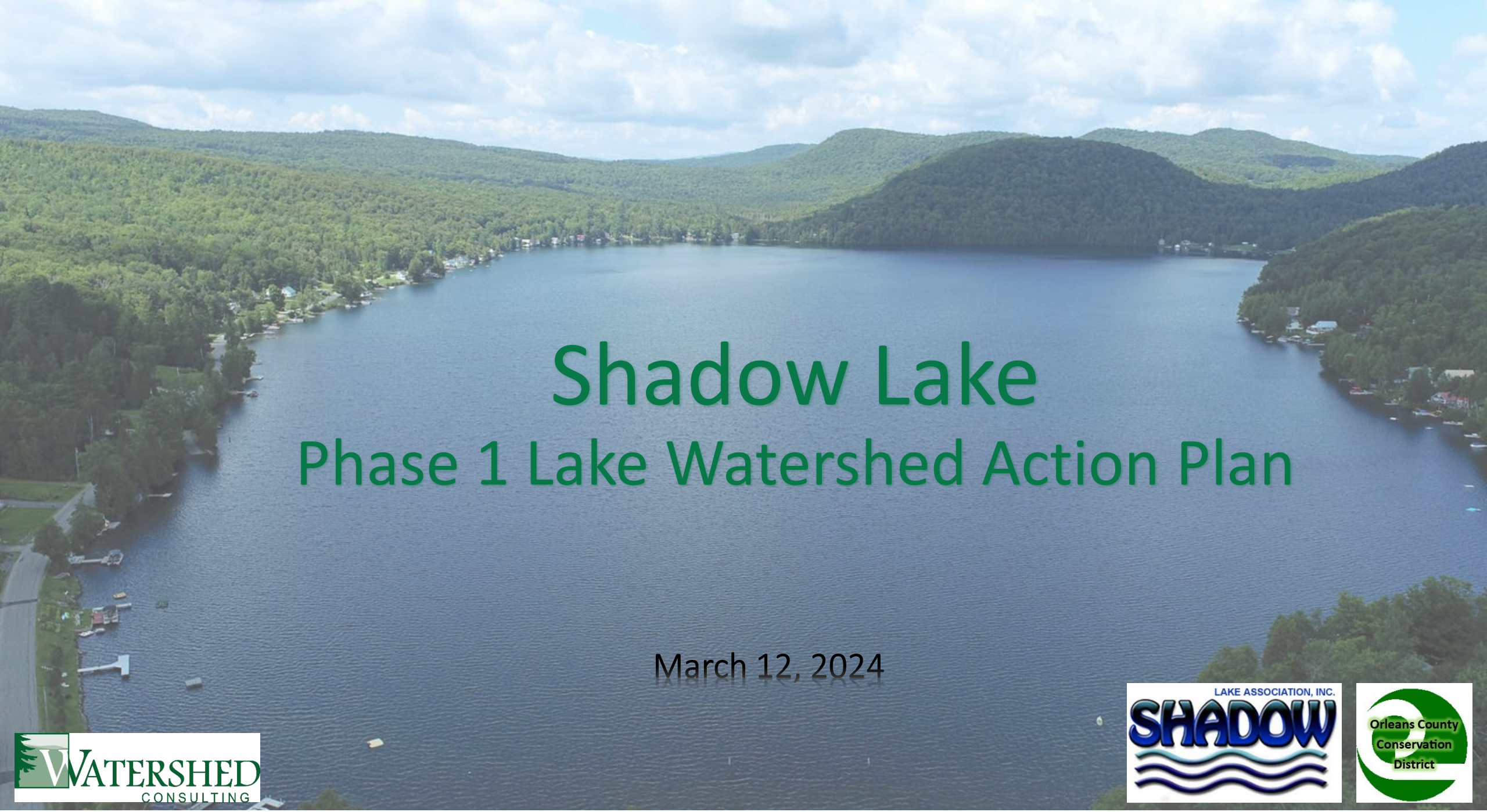

# Shadow Lake

## Phase 1 Lake Watershed Action Plan

March 12, 2024

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LAKE ASSOCIATION, INC. SHADOW

Orleans County Conservation District

# Shadow Lake Phase 1 LWAP

## Overview of Tasks:

- Data Review
- Stakeholder Input
- Desktop Assessment
- Field Assessments
  - Lakeshore Assessments
  - Terrestrial Assessments
  - Road Assessments
- Drone Flights
- Prioritized Project Recommendations
- Public Meeting
- 30 Summary Sheets
- Lake Wise Assessments
- Story Map
- Final Plan


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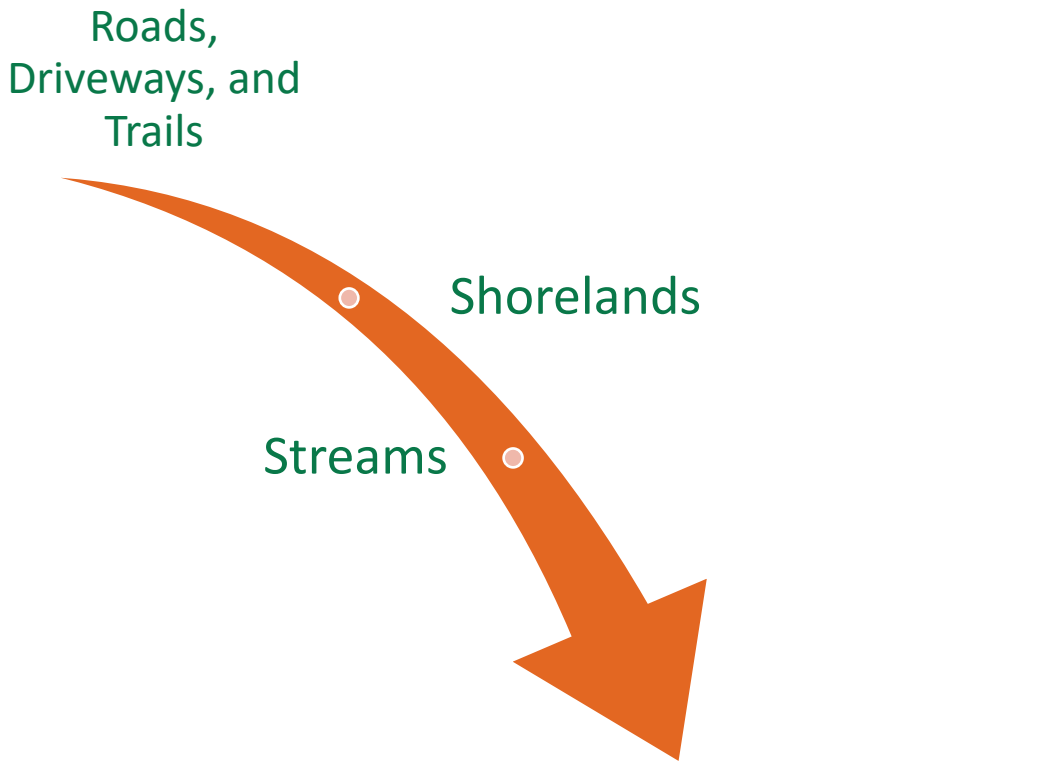
# Shadow Lake Phase 1 LWAP

- Road sector: 49% of projects (including driveways, private roads, and public roads)
  - Most common issues: unstable road shoulders, erodible and unstable ditches, lack of adequate cross drainage (clogged, undersized, or absent culverts), poor grading and grader berms, and direct connection of unmanaged runoff to the lake.
- Shoreline sector: 39% of projects
  - Most common issues: Lack of vegetated buffers, shoreline erosion, and hardscaped retaining walls.
- Stream sector: 12% of the projects
  - Most common issues: lack of floodplain access, lack of riparian buffers, and unmanaged stormwater inputs to streams, which can increase stream power and erosive capacity and increase sediment transport and deposition in the lake.

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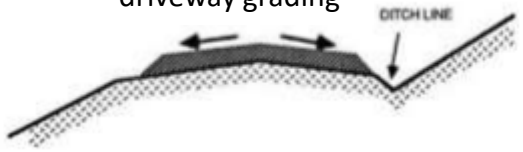
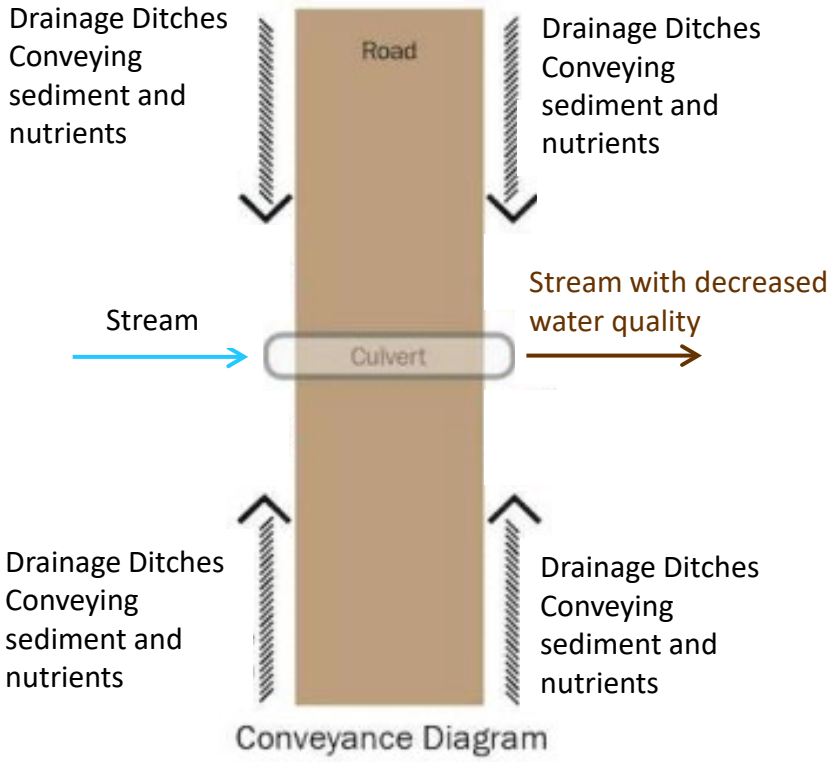
# Roadways (including driveways, roads, other travel areas)

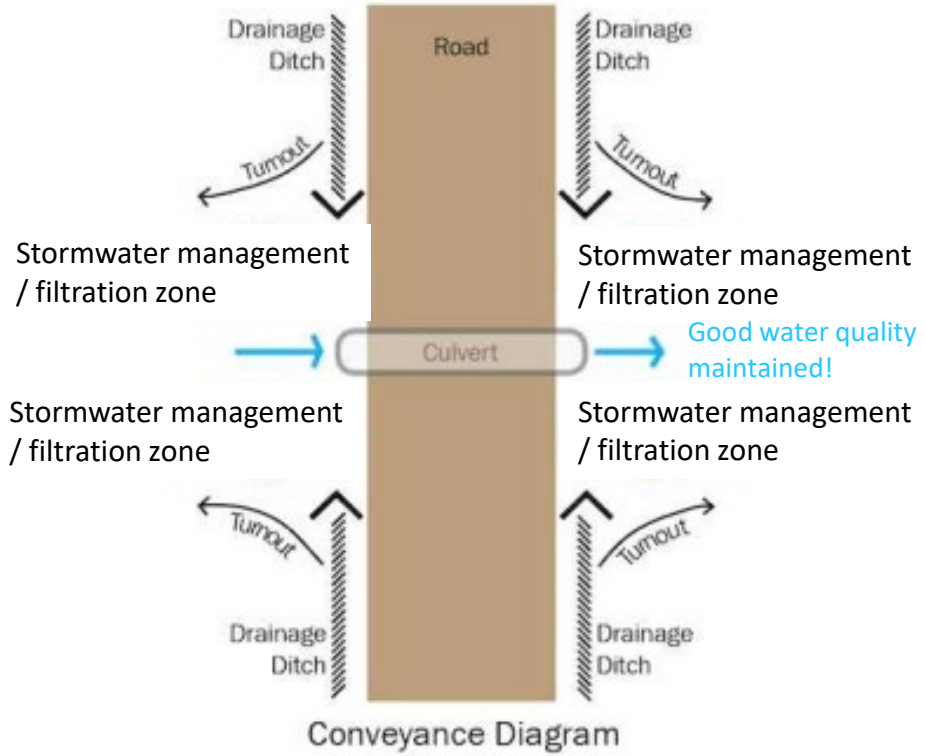
Key concepts for stormwater:

- Slow it down
- Spread it out
- Sink into the ground
- Keep it clean

Unpaved road and driveway grading




https://dec.vermont.gov/sites/dec/files/wsm/stormwater/docs/Permitinformation/MunicipalRoads/Roads%20with%20Open%20Drainages%20REI%20Supplement-%20MRGP%202023.pdf

# Roadways (including driveways, roads, other travel areas)

**Issues observed:**

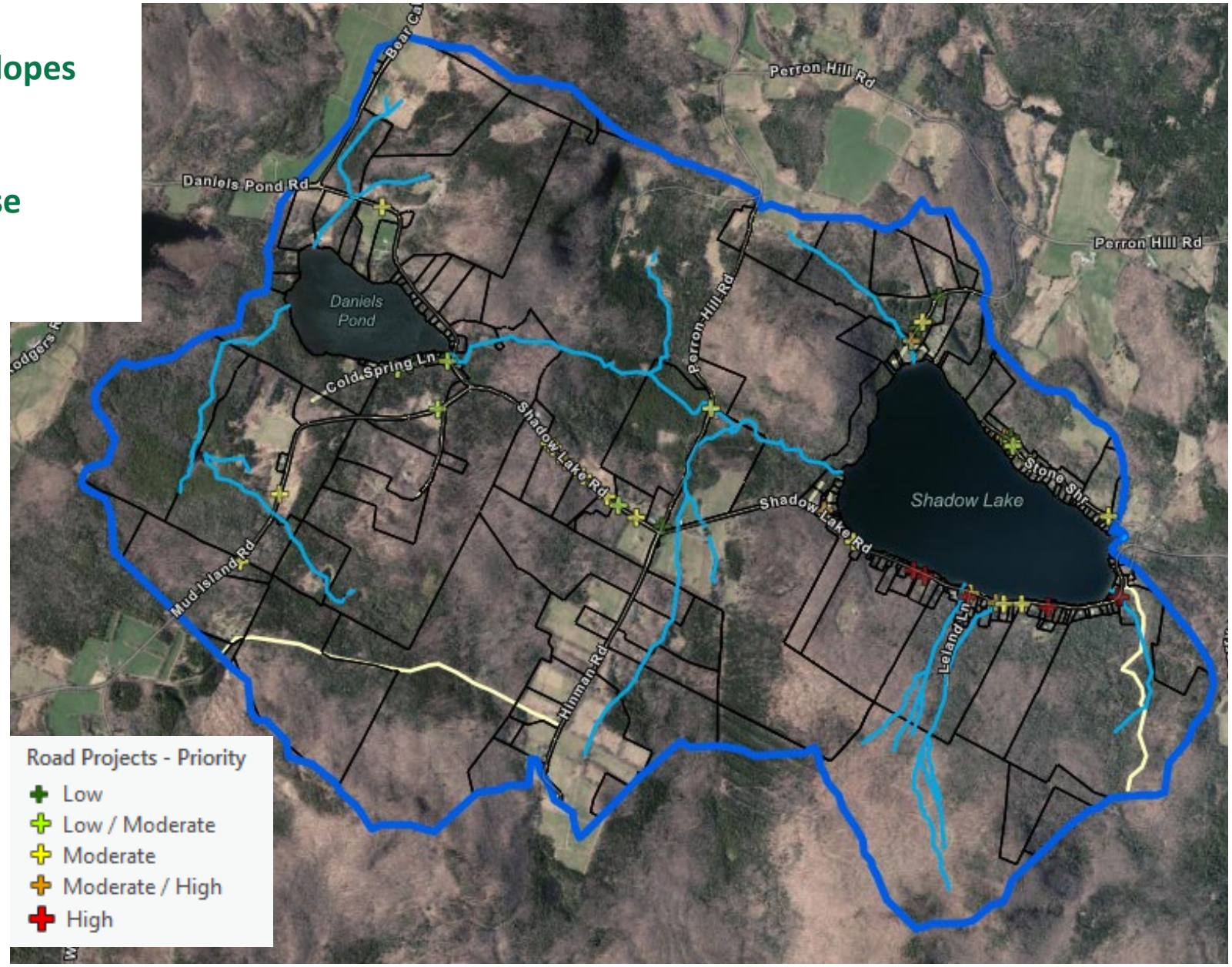
- **Unstable ditches and uncompacted ditch slopes leading to sediment transport**
- **Undersized, absent, or clogged culverts**
- **Improper grading, grader berms, piled loose materials near culverts and streams**
- **Off-road vehicle-related erosion**

40 projects identified

- 7 high priority
- 5 moderate / high priority
- 18 moderate priority
- 5 moderate / low priority
- 5 low priority

Project types:

- Slow and filter stormwater runoff with best management practices (BMPs)
- Improve grading
- Ditch stabilization
- Culvert improvements

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# Roadways

## Unstable ditches and uncompacted ditch slopes leading to sediment transport

# Roadways

## Undersized, absent, or clogged culverts

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# Roadways

## Improper grading, grader berms, piled loose materials near culverts and streams

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# Shoreland Issues

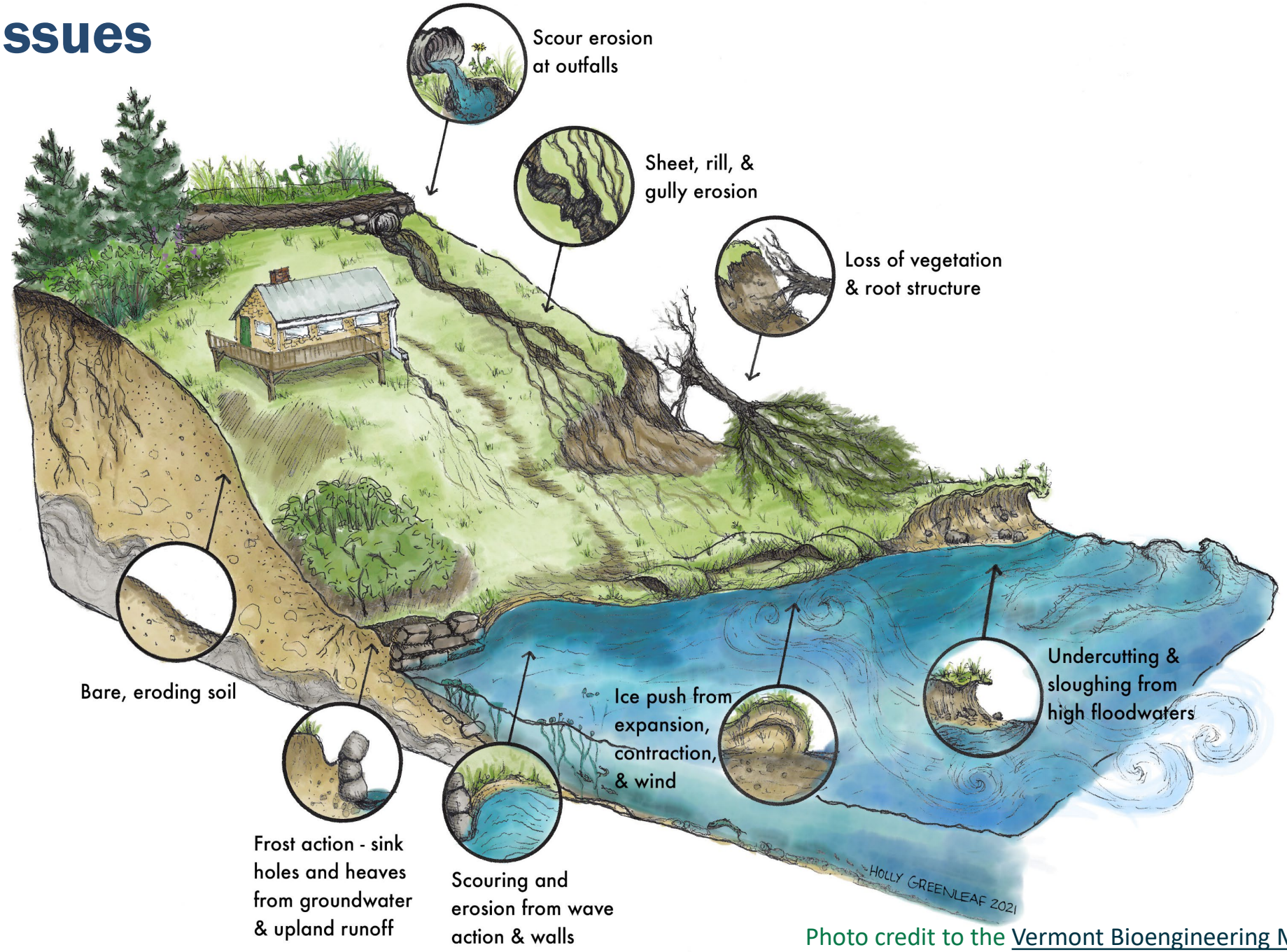



Photo credit to the Vermont Bioengineering Manual, 2022

# Shoreland

Assessed via boat.
Identified issues along lake segments.

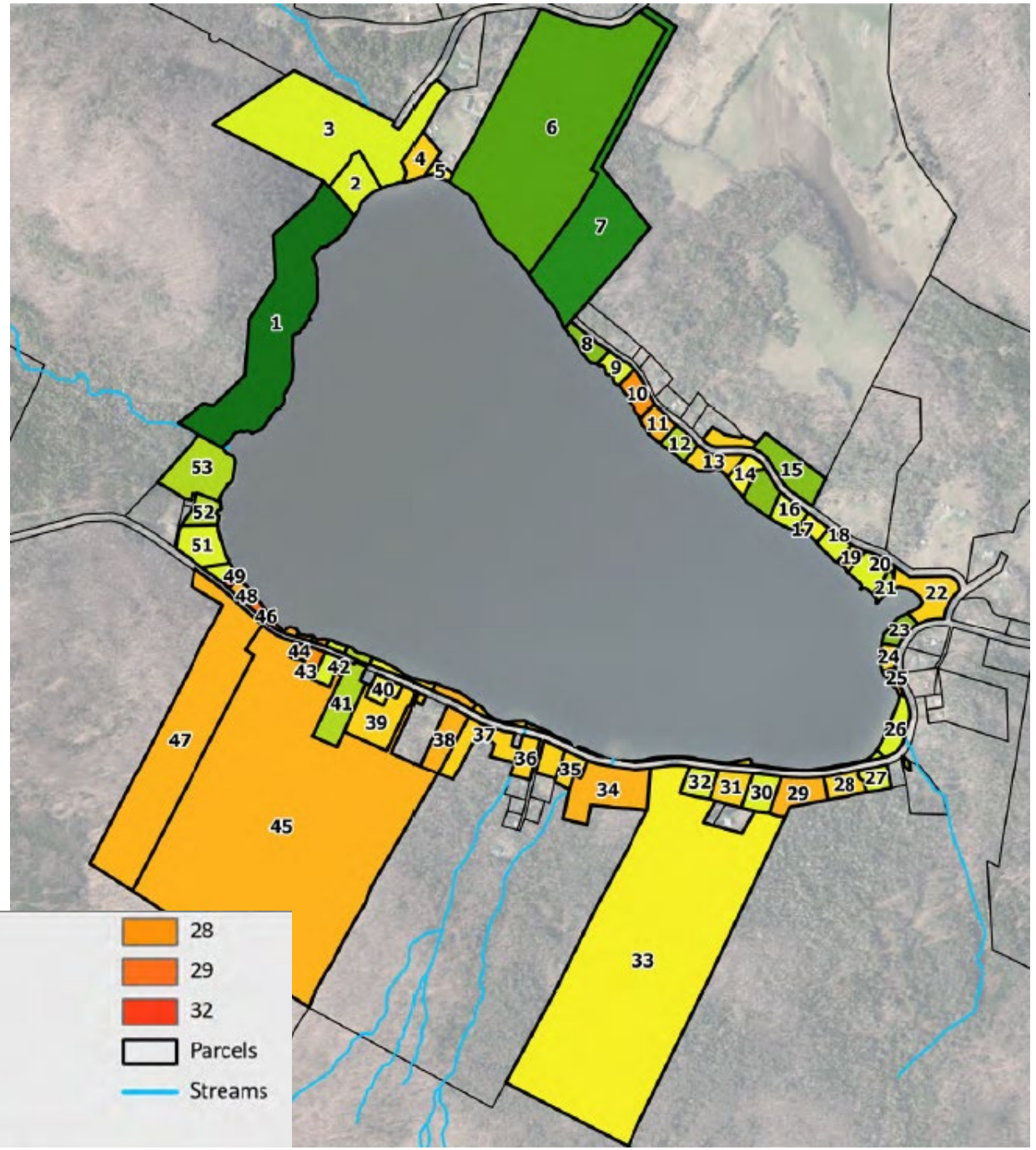
Segments are defined as areas they have similar characteristics.

Segments were scored for indicators of potential water quality issues.

53 scored segments

Used to guide outreach and prioritization for Lakewise assessments

| |
|---|
| Shoreline Natural Condition: |
| Shoreline Stability: |
| Shoreline Vegetation Width: |
| Shoreline Erosion: |
| Stormwater Flow Type: |
| Percent Lawn/Cleared Area: |
| Lake Access Stability: |
| Slope to Lake: |
| Bedrock Controls: |
| Constructed Stabilization: |




Shoreline Assessments
Total Score
15
16
17
22
23
24
25
26
27
28
29
32
Parcels
Streams

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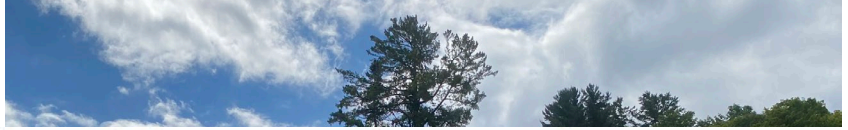
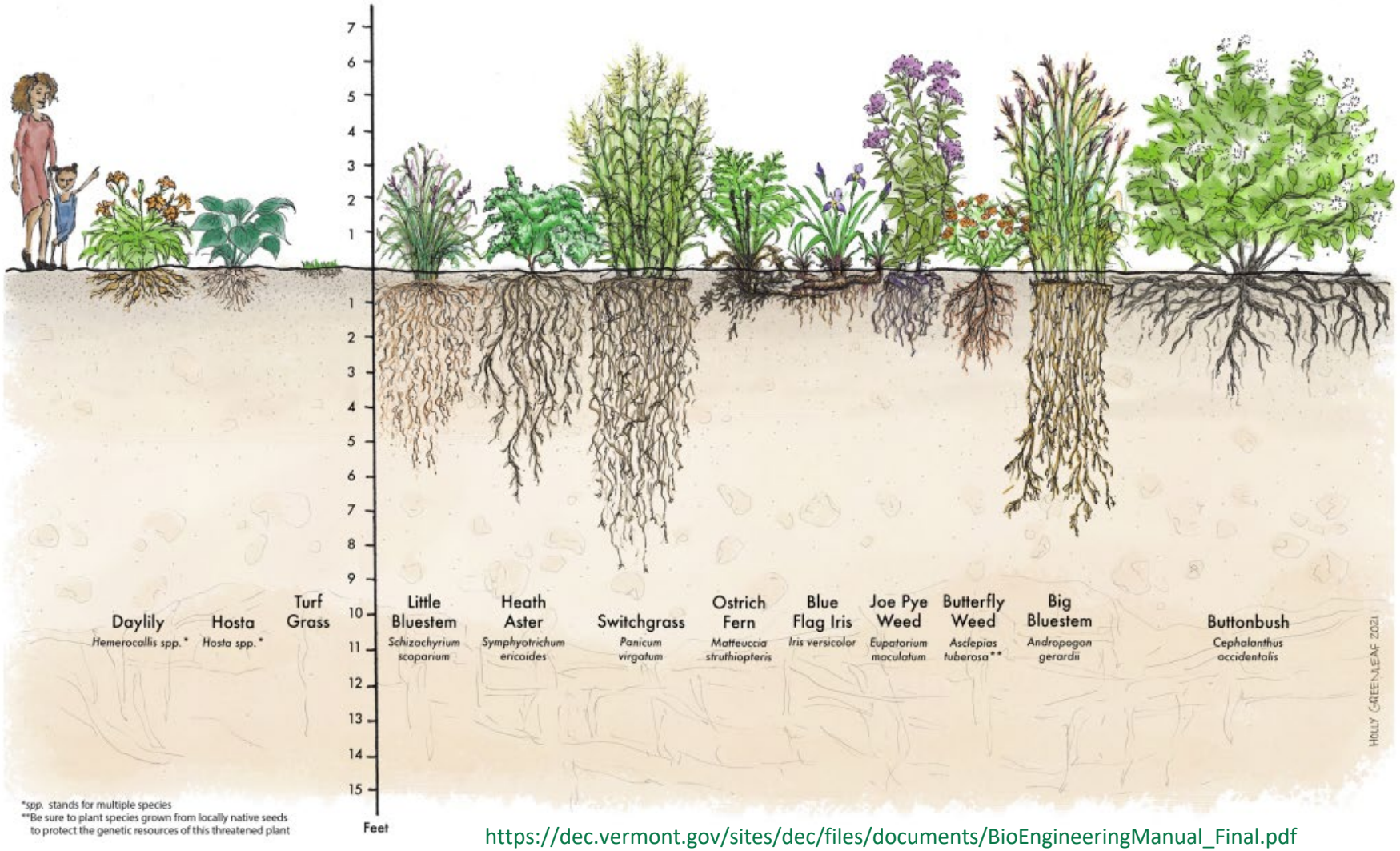
# Shoreland - Lacking Buffers

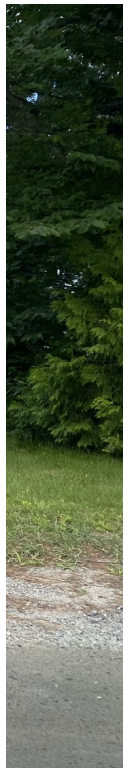


Lakeshores lack
buffers can con
loads. Shoreline
unstable.

Turf grass has v
does not stabili

## The Role of Plants in Bioengineering



https://dec.vermont.gov/sites/dec/files/documents/BioEngineeringManual_Final.pdf

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# Shoreland - Erosion

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

Bare soils, especially on a slope, are very prone to erosion.

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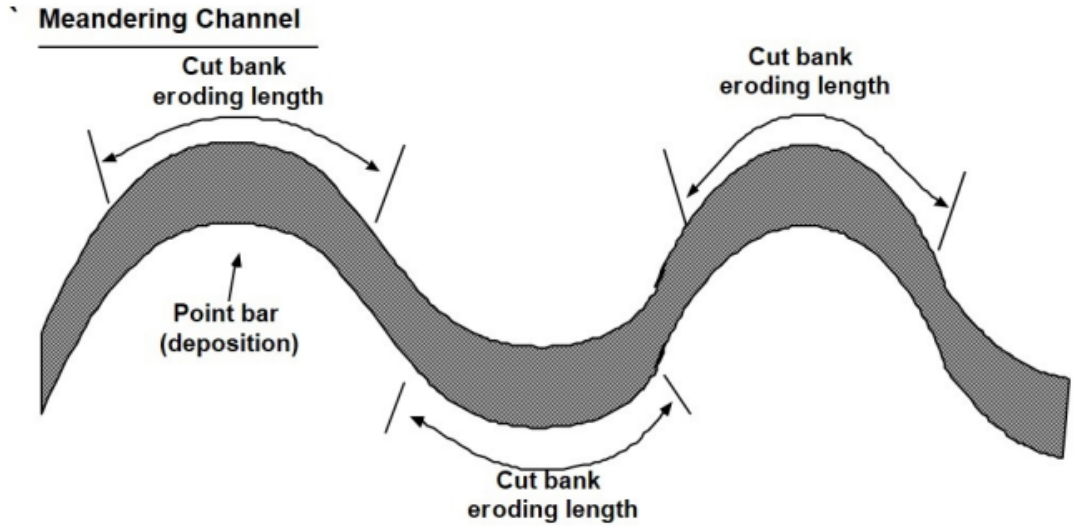
# Streams

Healthy streams have:

- Robust vegetated buffers
- Stable banks
- Transport water and base loads of sediment
- Have culverts large enough not to constrict flows, which can cause scour and erosion
- Stormwater inputs that are not transporting large pollutant loads

***A STREAM IN "DYNAMIC EQUILIBRIUM"***

- Erosion and deposition are roughly equal
- Meanders migrate over time but the stream does not widen
- High flows are able to access the floodplain




https://www.nrcs.usda.gov/sites/default/files/2022-09/Stream_in_dynamic_equilibrium_%28graphic%29.pdf

# Streams

**Issues observed:**

- **Unstable streambanks**
- **Scour / erosion near stream culverts**
- **Lack of robust vegetated buffer**
- **Unfiltered channelized stormwater inputs into streams**

17 projects identified

- 5 high priority
- 10 moderate priority
- 2 low priority

Project types:

- Floodplain restoration
- Buffering and stabilization
- Slow and filter stormwater runoff to streams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# Streams

**Issues observed:**

- Unstable streambanks
- Scour / erosion near stream culverts
- Lack of robust vegetated buffer
- Unfiltered channelized stormwater inputs into streams

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# Streams

**Issues observed:**

- Unstable streambanks
- Scour / erosion near stream culverts
- Lack of robust vegetated buffer
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# Project Summary Sheets

- 30 sheets were developed to help move projects towards implementation
  - Based on survey completed at the August 2023 public meeting

| Category | Average %* | Number of Project Sheets to be Developed |
|---|---|---|
| Public Hydrologically Connected Roads; Fish and Wildlife Access | 41% | 13 |
| Private Lakeshores | 26% | 8 |
| Private Driveways | 18% | 5 |
| Stream buffers, bank erosion, and floodplain access | 14% | 4 |
| **Total** | **99%** | **30** |

* Note that not all survey responses totaled 100%, so the total average percent is slightly lower than 100%

| Shadow Lake LWAP Phase 1 – Public Roads Summary Sheet | | Project rank by sector: 1 |
|---|---|---|
| **Site name:** | Ditches by Public Beach | |
| Approximate address: | 1189 Shadow Lake Rd, Glover, VT 05839 | |
| Sector type(s): | Public Areas including Roads | |

**Proposed BMP Description:**

It is recommended that the ditches in this area are stabilized, road edges compacted, excess sediment removed, culverts cleaned out, and check dams installed in ditches where slope allows. The remainder of ditches should be well vegetated to prevent further erosion. Floodplain restoration project also recommended in this area.

**Site Description**

Public road including ditches and culverts. Stream has jumped banks in July storm; area is depressed so there was significant sediment deposition.

**Feasibility concerns:**

Constrained area

| Proposed BMP details | |
|---|---|
| Current site type | Public road |
| Drainage area size | High |
| Water Quality Concern | High |
| Pollutant reduction potential | High |
| Design required | Medium |
| Hydrologic soil group | D |
| Hydrologic connectivity | Yes |
| Ownership of Site | Public |
| Relative project cost | Medium |
| Auxiliary Benefits | Lower repair and cleanout frequency |
| Landowner Participation: | Public |
| | |
| **Retrofit Priority** | **High** |

**Site map**

**Site photo**

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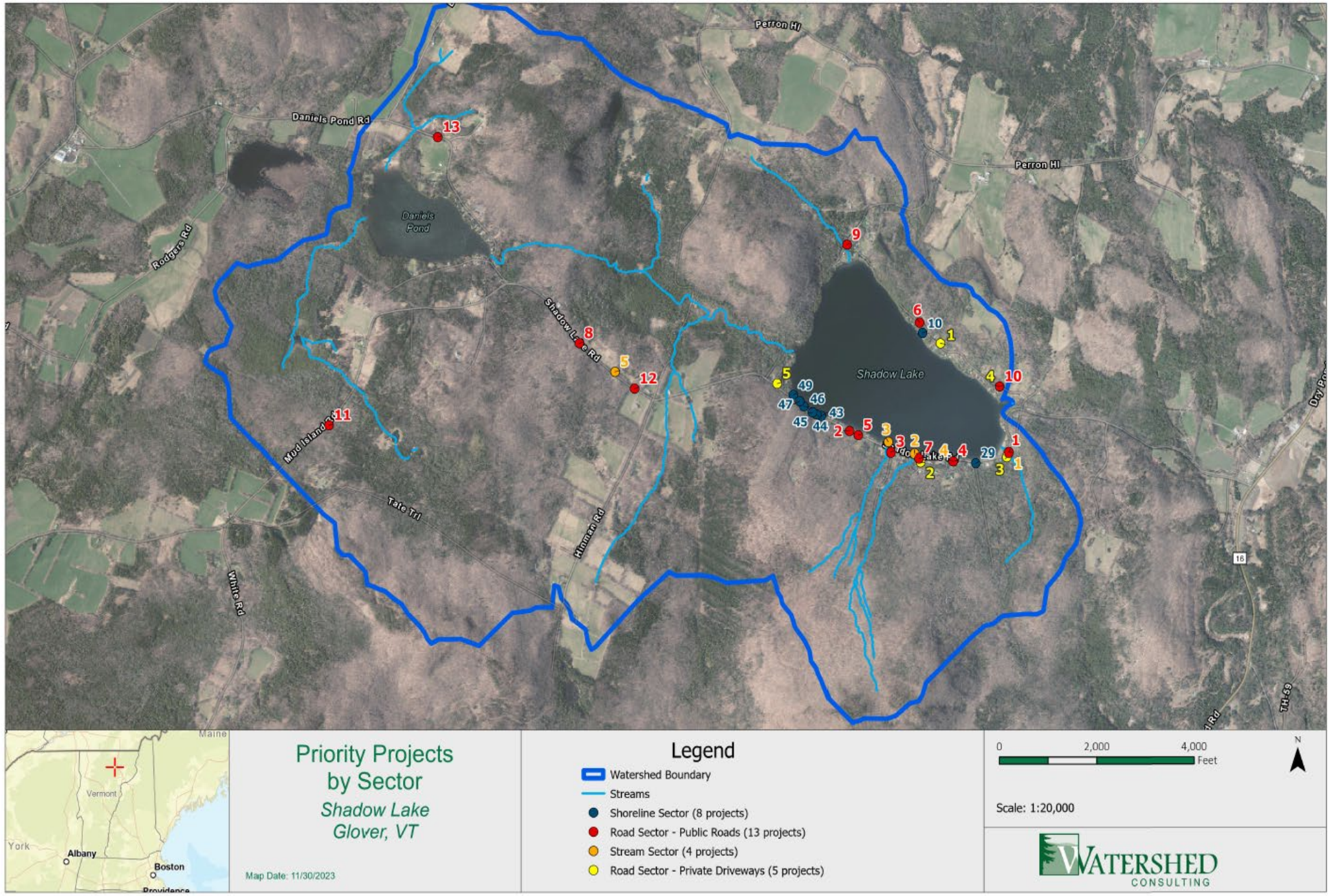
# Priority Projects

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# Project Example

Project recommendations example:
The Fish and Wildlife Access area - stormwater is flowing c
vegetated and eroding shoreline and depositing sediment

| Shadow Lake LWAP Phase 1 – Public Roads Summary Sheet | | Project rank by sector: 4 |
|---|---|---|
| **Site name:** | Fish and Wildlife Parking | |
| **Approximate address:** | 1504 Shadow Lake Rd, Glover, VT 05839 | |
| **Sector type(s):** | Public Areas including Roads | |

**Proposed BMP Description:**

Provide a vegetated buffer along stream; upsize stream culvert and improve drainage in this area; culvert undersized; culvert by Shadow Lake Rd is partially clogged with sediment. This area should be stabilized and cleaned of sediment. A bioretention is recommended in low area of parking lot. Add vegetated buffer along lake side of boat ramp and stabilize area around existing bench.

**Site Description**

Stream jumped banks and eroded parking area in July storm. Benefits: water quality improvements, stormwater management, and shoreline improvements (habitat, shading, stabilization).

**Feasibility concerns:**

Stream proximity, space; Potential permits: shoreline, rivers, local zoning

| Proposed BMP details | |
|---|---|
| Current site type | Parking Lot |
| Drainage area size | Medium |
| Water Quality Concern | High |
| Pollutant reduction potential | High |
| Design required | Medium |
| Hydrologic soil group | D |
| Hydrologic connectivity | Yes |
| Ownership of Site | Public |
| Relative project cost | Medium ($25k-$75k) |
| Auxiliary Benefits | Lower repair and cleanout frequency, educational |
| Landowner Participation: | Public |
| | |
| **Retrofit Priority** | **High** |

**Site map**


**Site photo**

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# Shoreland Protection in Action


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# Glover Town Road and Culvert Work in Action

Note that there have been additional improvements completed after the last field assessments for this project (August 2023).

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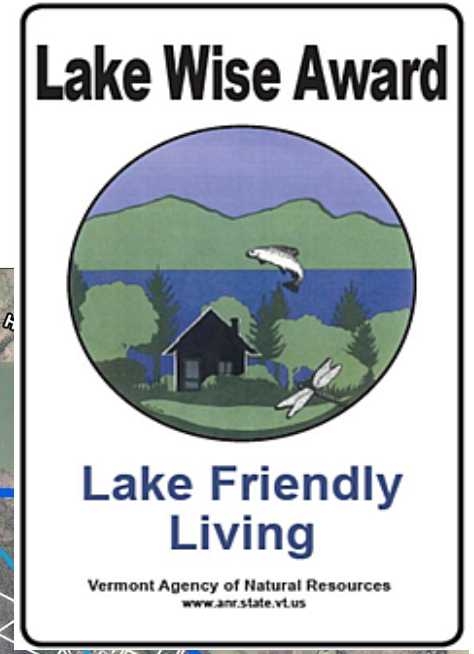
# Lake Wise

The Lake Wise program assesses four key areas:

- driveway,
- structure and septic,
- recreation area, and
- shoreline.

- 5 assessments completed
  - 80% passed the driveway portion, 60% passed the structures and septic portion, 40% passed the recreation area portion, **and 0% passed the shoreline portion**

| Property Assessed | Driveway | Structures and Septic | Recreation Area | Shoreline |
|---|---|---|---|---|
| Property 1 | ✓ | ✓ | ✓ | X |
| Property 2 | ✓ | X | X | X |
| Property 3 | ✓ | ✓ | ✓ | X |
| Property 4 | ✓ | X | X | X |
| Property 5 | X | ✓ | X | X |







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https://dec.vermont.gov/watershed/lakes-ponds/lakeshores-lake-wise/what

# Water Quality Stressors

Roads including:

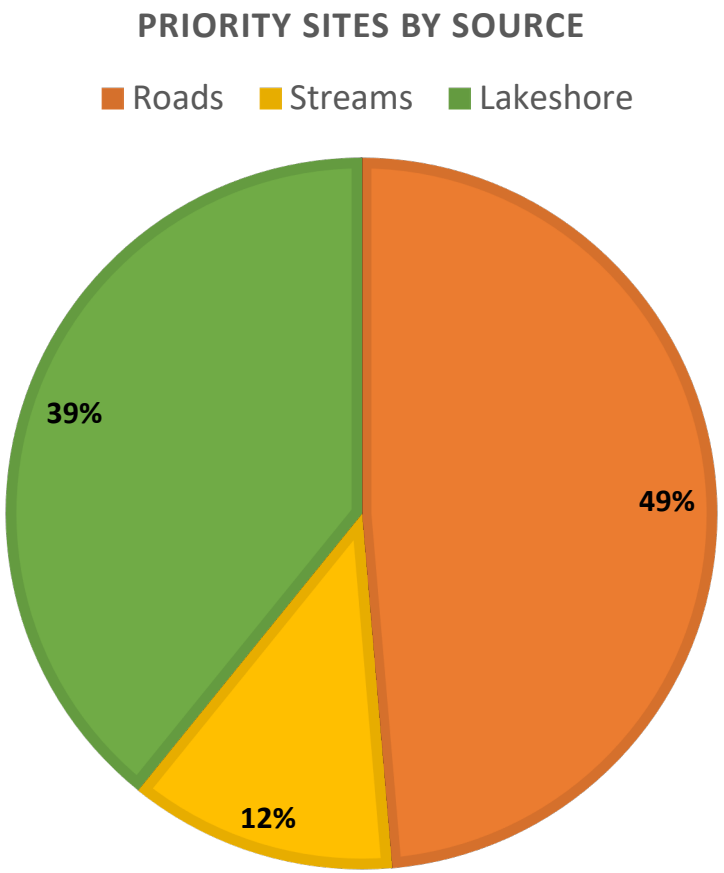
- Roadway runoff
- Development
- Off Road vehicle use
- Deicing chemicals
- Winter sand
- Undersized or absent culverts
- Clogged culverts
- Unstable ditches
- Poor grading / grader berms
- Direct connection for long ditch runs to streams

Lakeshore including:

- Lack of buffers
- Erosion
- Septic system failure / contamination

Streams including:

- Stream erosion / channelization
- Lack of buffers
- Lack of floodplain access

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# Recommendations:

- Further develop and implement site-specific BMPs to slow, filter, and infiltrate stormwater.
- Reassess road segments due to significant changes and in light of impacts due to climate change. Building resiliency will help protect infrastructure in the future.
- Stabilize roadside ditches and ensure they are maintained regularly
- Preserve and protect large undeveloped parcels within the watershed
- Complete stream walks and more comprehensive stream assessments (outside the scope of this study) focusing on key tributaries with high water quality monitoring results.
- Stabilize trails and prevent future damage from ATVs, particularly in wetland areas.
- Work with the VT DEC, SLA, and local partners such as the OCNRCD to complete additional Lake Wise assessments and implement site-specific recommendations
- Work with the OCNRCD, local partners, and private landowners to improve lake and stream buffers.
- Complete an Illicit discharge survey to identify and eliminate potential sources of contamination.
- Encourage adoption of residential green stormwater infrastructure.
- Work with the VT DEC stream flow protection program staff including the Streamflow Protection Coordinator and River Ecologist to improve dam functionality and reduce hazards.


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# Thank you for your attention!


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