Memorandum

To:	Winooski Natural Resources Conservation District
From:	Jessica Louisos, PE and Alex Marcucci, SLR International Corporation
Date:	April 25, 2023, revised March 7, 2024
Subject:	Lake Iroquois-Patrick Brook Watershed Action Plan Watershed Resource Library SLR # 14439.00006

INTRODUCTION

The Winooski Natural Resources Conservation District with partners Lewis Creek Association and Lake Iroquois Association have contracted with SLR to create a Lake Watershed Action Plan (LWAP) for the Lake Iroquois-Patrick Brook watershed. The LWAP will combine existing data with newly collected data from 2023 to create a document for management activities and projects aimed at protecting and improving conditions in the watershed. The lake watershed planning process involves identification of sources of water quality and habitat degradation and greatest threats to the health of the lake, involvement of the community members in the planning process, identification of sediment and phosphorus sources to the lake from each of three sectors – streams, roads, and shorelands, and identification of projects that can be implemented to address lake and watershed stressors. This report details data sources reviewed for the watershed during the data collection phase of the project.

LAKE IROQUOIS WATERSHED DESCRIPTION

Lake Iroquois is a 247-acre lake located in Williston, Richmond, St. George, and Hinesburg, Vermont (Figure 1). The main tributary that flows into and out of Lake Iroquois is Patrick Brook, a tributary to the LaPlatte River. Watershed action planning efforts for Lake Iroquois focus on the whole Patrick Brook watershed, including lands downstream of Lake Iroquois and Lower Pond. The Patrick Brook watershed is approximately 8 square miles in size. The subwatershed draining directly to Lake Iroquois is 3.5 square miles in size.

Figure 1. Lake Iroquois Watershed Location Map

Patrick Brook originates in Williston and flows southerly into Lake Iroquois, which is outlet-regulated by a 7-foot-tall stone and concrete dam (VT ID-97.01) (VANR, Dams Inventory). The lake, formerly known as Hinesburg Pond, was formed as a glacial kettle pond after the last ice coverage in Vermont receded about 15,000 years ago. A dam built on the lake's outlet in the mid-1800s was used to control the water supply to mills downstream in Hinesburg. Milling declined in the 20th century and in the 1960s the dam was intentionally cemented in its top position, keeping the pond at its current level throughout the year. Before the dam was built, the smaller kettle pond was located on the southern end of the current lake. The dam raised the original water level and enlarged the lake.

Below the dam, a short section of the brook is free flowing before flowing into Lower Pond (also known as Sunset Lake), an approximately 61-acre water body created by a 12-foot tall earthen/stone dam built in 1867 (VT ID-97.02) (VANR, Dams Inventory). The brook flows over a series of smaller dams before flowing under Mechanicsville Road in Hinesburg. During the 1800s, there were numerous mills situated along Patrick Brook from Richmond Road to Mechanicsville Road. A map showing the locations of dams within the watershed is provided in the attachment.

Downstream, a portion of flow is diverted southerly to a canal through Hinesburg Village to the LaPlatte River. The natural brook flows westerly to meet the LaPlatte River, along an altered path with flow to this

channel controlled by a failing concrete block wall diversion structure along Mechanicsville Road. The diverted flow path, known as the Patrick Brook Canal, was hand dug in the early 1800s parallel to Mechanicsville Road to power a mill that was situated near where the canal crosses Route 116. Dredging and maintenance of the canal occurred until the 1980s and kept the majority of the water from Patrick Brook flowing through the canal, with little in the natural channel to the west. Since then, deterioration of upstream diversion structures and reduced canal maintenance have led to most of the water from Patrick Brook flowing through the natural channel and diversion channel toward the Route 116 culvert at Hinesburg Center, which is not adequately sized to handle the increased proportion of flow now reaching it (Patrick Brook Canal History). Both the natural flow path and the canal flow into the LaPlatte River, which is a direct tributary to Lake Champlain, flowing into Lake Champlain near Shelburne Bay (Basin 5).

The Patrick Brook watershed is primarily forested, with concentrated areas of agriculture and development (Table 1, attached map). There are nearly 40 miles of road within the watershed, with a relatively even split of town-owned and private roads (Table 2). A short section of State Route 116 passes through the lower watershed. Private roads are concentrated around the shores of Lake Iroquois and Lower Pond.

Table 1. Land Cover Summary for Patrick Brook Watershed

Land Cover Class (2016)	Percentage of Watershed Coverage
Tree Canopy	62%
Grass/Shrub	27%
Bare Earth	0.1%
Water	6%
Buildings	1%
Roads	1%
Other Paved Surfaces	2%

Table 2. Roads Summary for Patrick Brook Watershed

Road Type	Mileage	Percent of Total Road Mileage
Class 2 Town Highway	11.4	30%
Class 3 Town Highway	8.0	21%
Class 4 Town Highway	0.4	1%
State Highway	1.2	3%
Private Road	17.6	46%

SPATIAL DATA

Numerous spatial data sources were used during data collection for Lake Iroquois-Patrick Brook watershed action planning. The VANR Natural Resources Atlas is a useful mapping tool hosting over 150 map layers and was used during data collection (VANR, 2020). Spatial data were obtained from various sources, including the Vermont Open Geodata Portal (VCGI). Key datasets are highlighted below.

Municipal Roads General Permit Scoring (segments)
Available here, data shown on attached map, https://geodata.vermont.gov/datasets/VTANR::municipal-roads-general-permit-scoring-segments/explore?location=43.858183%2C-72.455050%2C9.00

This dataset published by the VANR contains the results of road erosion inventory data collection across Vermont. The layer is based on an analysis conducted in 2017 and updated in 2018 and 2019 that divided the state's road network into segments and evaluated hydrologic connectivity of each individual segment. Hydrologic connectivity is defined as being located within 100 feet of a river corridor, perennial or intermittent stream, wetland, lake, or pond. As part of the Municipal Roads General Permit, municipalities have been required to conduct road erosion inventories for all hydrologically connected segments on municipality-owned roads. The Chittenden County RPC has led the effort to assess roads in its member municipalities. This dataset provides scoring data for each road segment in the state. Segments are assigned one of the following scores: not connected, fully meets, partially meets, does not meet, or incomplete data.

Stream Geomorphic Assessment Data
Available here, data shown on attached map,
https://anrweb.vt.gov/DEC/SGA/projects/phase1/themes.aspx?pid=75

A Phase 1 Stream Geomorphic Assessment of the LaPlatte River watershed was conducted in 2004. A Phase 2 Stream Geomorphic Assessment of Patrick Brook was conducted for the reaches between Lake Iroquois and Lower Pond and downstream of Lower Pond to the confluence with the LaPlatte shortly thereafter. Several layers containing stream geomorphic assessment data were used. All data were obtained through the Vermont Stream Geomorphic Assessment Data Management System (DMS).

- Reach points (s06rpts) – reach points dividing sections of stream for evaluation
- Segment centerlines (seg01swseg) – stream centerline divided by Phase 2 segment points
- Segment line impacts (fit01lnimpactseg) – feature indexing tool (FIT) line impact data
- Segment point impacts (fit01ptimpactseg) – feature indexing tool (FIT) point impact data

LiDAR Data
Available here, https://maps.vcgi.vermont.gov/LidarFinder/

Several LiDAR products published by the Vermont Center for Geographic Information were used including digital elevation model, contours, and hillshade layers. LiDAR data were collected in 2014 for the area. Raster data have a resolution of 0.7 meters.

VSWI Wetlands Class Layer
Available here, https://geodata.vermont.gov/datasets/VTANR::vswi-wetlands-class-layer/explore?location=43.858794%2C-72.459550%2C9.00

The Vermont Significant Wetlands Inventory (VSWI) dataset is based on 2010 mapping that combined National Wetland Inventory maps with wetlands hand digitized from 1:24,000 topographic maps. The layer represents Vermont's regulatory wetlands.

VT Hydrography Dataset – High Resolution NHD
Available here, https://geodata.vermont.gov/documents/vt-hydrography-dataset-high-resolution-nhd/about

The Vermont Hydrography Dataset (VHD) is a local resolution component of the National Hydrography Dataset (NHD). The VHD provides a database of stream segments within Vermont and is based on the following components: Vermont Mapping Program (VMP) digital orthophotos (1994-2000), vmp "break line" features, historical surface water data, NAPP cir multi-spectral aerial photography and CIR satellite imagery.

E911 Road Centerlines
Available here, https://geodata.vermont.gov/datasets/vt-data-e911-road-centerlines-1/explore?location=43.864817%2C-72.455244%2C9.14

This layer contains Enhanced 9-1-1 road centerline locations statewide. The base data contained in this dataset were originally manually digitized using a combination of paper and RC Kodak RF 5000 orthophotos. VTrans highway maps and state forest maps were also used to locate additional road segments. The dataset provides unique coding to filter roads by town and county and has field to locate riad segments by address.

Stormwater Infrastructure
Available here & here (VANR data), https://geodata.vermont.gov/datasets/VTANR::stormwater-infrastructure-line-features/explore?location=43.891236%2C-72.403850%2C9.00 , https://geodata.vermont.gov/datasets/VTANR::stormwater-infrastructure-point-features/explore?location=43.906164%2C-72.414150%2C9.00

Both public data from the VANR and in-house data from previous SLR mapping were used to identify the locations and types of stormwater infrastructure within the Patrick Brook watershed. The majority of mapped stormwater infrastructure is concentrated in Hinesburg Village, near Champlain Valley Union School, and in some small subdivisions. Stormwater infrastructure mapping was completed by this project team for Lewis Creek Association (MMI, 2010).

Parcel data
Available here,
https://maps.vcgi.vermont.gov/opendata/tileselect_opendata.html?IndexLayerName=Index_CadastralParcels_VTPARCELS&FolderURL=https://maps.vcgi.vermont.gov/gisdata/vcgi/packaged_zips/CadastralParcels_VTPARCELS/&cdownload=-1&InputLayerName=CadastralParcels_VTPARCELS&InputFtype=Parcels

Parcel boundary data were obtained from VCGI and downloaded for the towns of interest. The parcel data are standardized and joined with grandlist data. Parcel layers used are listed below by town and date.

- VTPARCELS_WILLISTON – 2022
- VTPARCELS_RICHMOND – 2018
- VTPARCELS_HINESBURG – 2021
- VTPARCELS_STGEORGE – 2021

Water Quality Monitoring Stations
Available here (VANR data), data shown on attached map,
https://geodata.vermont.gov/datasets/VTANR::water-quality-monitoring-sites/explore?location=43.923594%2C-70.839400%2C7.89

Spatial data for water quality monitoring programs within the Lake Iroquois watershed were obtained from multiple sources. Several organizations conduct water quality sampling within the watershed and include the following:

- Vermont Department of Environmental Conservation biomonitoring (BASS)
- Lake Iroquois Association
- Lewis Creek Association
- South Chittenden Riverwatch

2016 Land Cover
Available here, https://geodata.vermont.gov/pages/land-cover

Land cover was mapped statewide for Vermont in 2016 by the University of Vermont based on 2013-2017 LiDAR data and 2016 NAIP imagery using object-based image analysis (OBIA). Eight land cover classes were mapped: (1) tree canopy, (2) grass/shrub, (3) bare earth, (4) water, (5) buildings, (6) roads, (7) other paved surfaces, and (8) railroads.

REPORTS

Water Quality Monitoring – LaRosa Program
Tributary Water Quality Monitoring – 2019, Lake Iroquois Association
Available here,
https://www.lakeiroquois.org/fileadmin/files/Tributary_Sampling/2019_LaRosa_Report.pdf?0baa84e91259dc2949b5319d596a197f7150d354

This report outlines water quality monitoring efforts and results for 2019 in the Lake Iroquois watershed. Monitoring was carried out through the LaRosa Partnership Program, funded by the Vermont Department of Environmental Conservation. Monitoring also occurred during 2020 and 2021, but no report was prepared for those years. The 2019 report highlights a couple of locations with elevated phosphorus results (tributaries from the north and west of the lake). Water quality monitoring has been carried out in the watershed by Lake Iroquois Association since 2011.

Water Quality Monitoring – South Chittenden River Watch
Summary Report: 2019 Water Quality Sampling Results

The South Chittenden River Watch (SCRW) has been monitoring water quality in four watersheds in Chittenden County since 2004. SCRW has several stations located on Patrick Brook, all downstream of Lake Iroquois and Lower Pond.

Northern Lake Champlain Direct Drainages Tactical Basin Plan
Available here,
https://www.lakeiroquois.org/fileadmin/files/Tributary_Sampling/2019_LaRosa_Report.pdf?0baa84e91259dc2949b5319d596a197f7150d354

The basin plan for all direct tributaries to Lake Champlain was published in 2020 by the Vermont Agency of Natural Resources. The plan covers all direct drainages from Ferrisburgh to Swanton including the Lake Champlain Islands. The plan outlines water quality issues in the basin, strategies to protect and restore waterways, and funding opportunities for watershed projects.

Stream Geomorphic Assessment
Stream Corridor Plan – LaPlatte River and Tributaries
Available here, https://anrweb.vt.gov/DEC/SGA/finalReports.aspx

A river corridor plan was prepared for the Hinesburg section of the LaPlatte River watershed in 2007. The study area includes Patrick Brook downstream of Lake Iroquois. The plan identifies several potential projects that could be implemented for the protection and restoration of Patrick Brook, including removal of obsolete dams and river corridor protection.

ADDITIONAL RESOURCES

Lake Iroquois Report Card
Available here,
https://anrweb.vt.gov/DEC/IWIS/ReportViewer3.aspx?Report=LakeScoreCard_Current_TrendsAndStatus&ViewParms=True&LakeID=IROQUOIS

The Lake Iroquois Report card summarizes long term later quality monitoring data within Lake Iroquois from 1980 through 2020. The report card classifies Lake Iroquois with the following scores: trend score – good, water quality standards status – stressed, and watershed score – highly disturbed. It identifies phosphorus as a stressor.

Vermont Integrated Watershed Information System
Available here,
https://anrweb.vt.gov/DEC/IWIS/ReportViewer3.aspx?Report=LakeScoreCard_Current_TrendsAndStatus&ViewParms=True&LakeID=IROQUOIS

The Vermont Integrated Watershed Information System (IWIS) provides an online portal for water quality data across the state. Raw data for sampling from a variety of sources are hosted here, including monitoring data for Lake Iroquois and its tributaries.

Lewis Creek Association 2021 Water Quality Monitoring Data
Available here, https://storymaps.arcgis.com/stories/8ab94a52bc4447308f5bd6a326d15cfa

Water quality monitoring data for the 2021 season are presented in a story map. Only one station in the Patrick Brook watershed was monitored in 2021, located in the lower reaches well downstream of the two lakes.

CITATIONS

MMI, 2010. LaPlatte River Watershed Stormwater Infrastructure Study. Prepared for the LaPlatte Watershed Partnership/ Lewis Creek Association by Milone & MacBroom, Inc., Chittenden County, Vermont.

Morgante, Andrea and Town of Hinesburg. Patrick Brook and Canal History. Available at: https://anrweb.vt.gov/ANR/Act250/ViewFile.aspx?filename=Patrick%20Brook%20and%20Canal%20History.pdf&fileid=248413

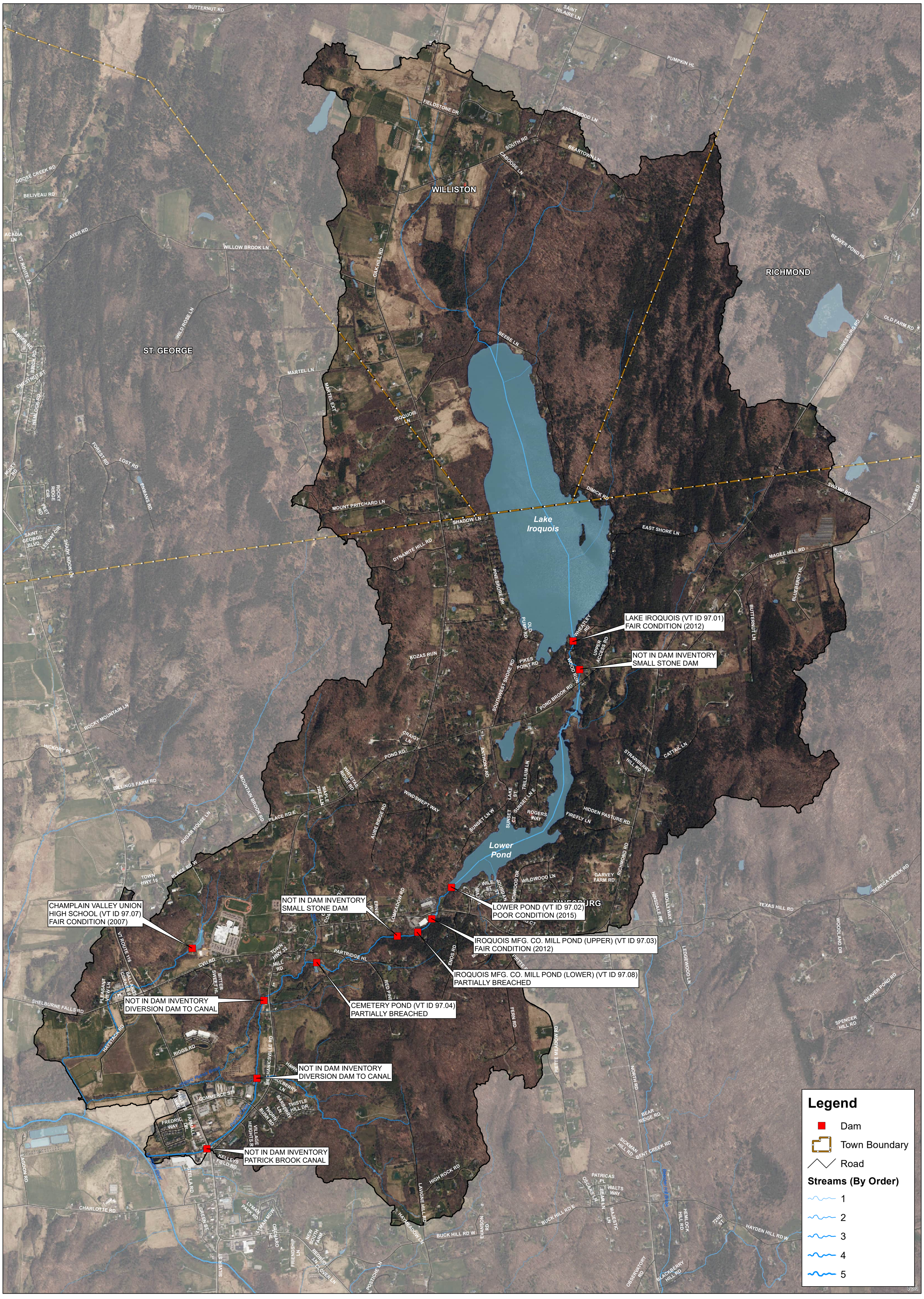
Vermont Agency of Natural Resources (VANR). Dams Inventory. Available at: https://anrweb.vt.gov/DEC/DamsInventory/ListDams.aspx

Vermont Agency of Natural Resources (VANR). 2020. Natural Resources Atlas. Available at: https://anrmaps.vermont.gov/websites/anra5/

Vermont Center for Geographic Information (VCGI). Vermont Open Geodata Portal. Available at: https://geodata.vermont.gov/

ATTACHMENT

WATERSHED MAPS



LAKE IROQUOIS & PATRICK BROOK WATERSHED DAM LOCATIONS

LAKE IROQUOIS-PATRICK BROOK WATERSHED ACTION PLAN

WINOOSKI NATURAL RESOURCES CONSERVATION DISTRICT

0 1,800 3,600

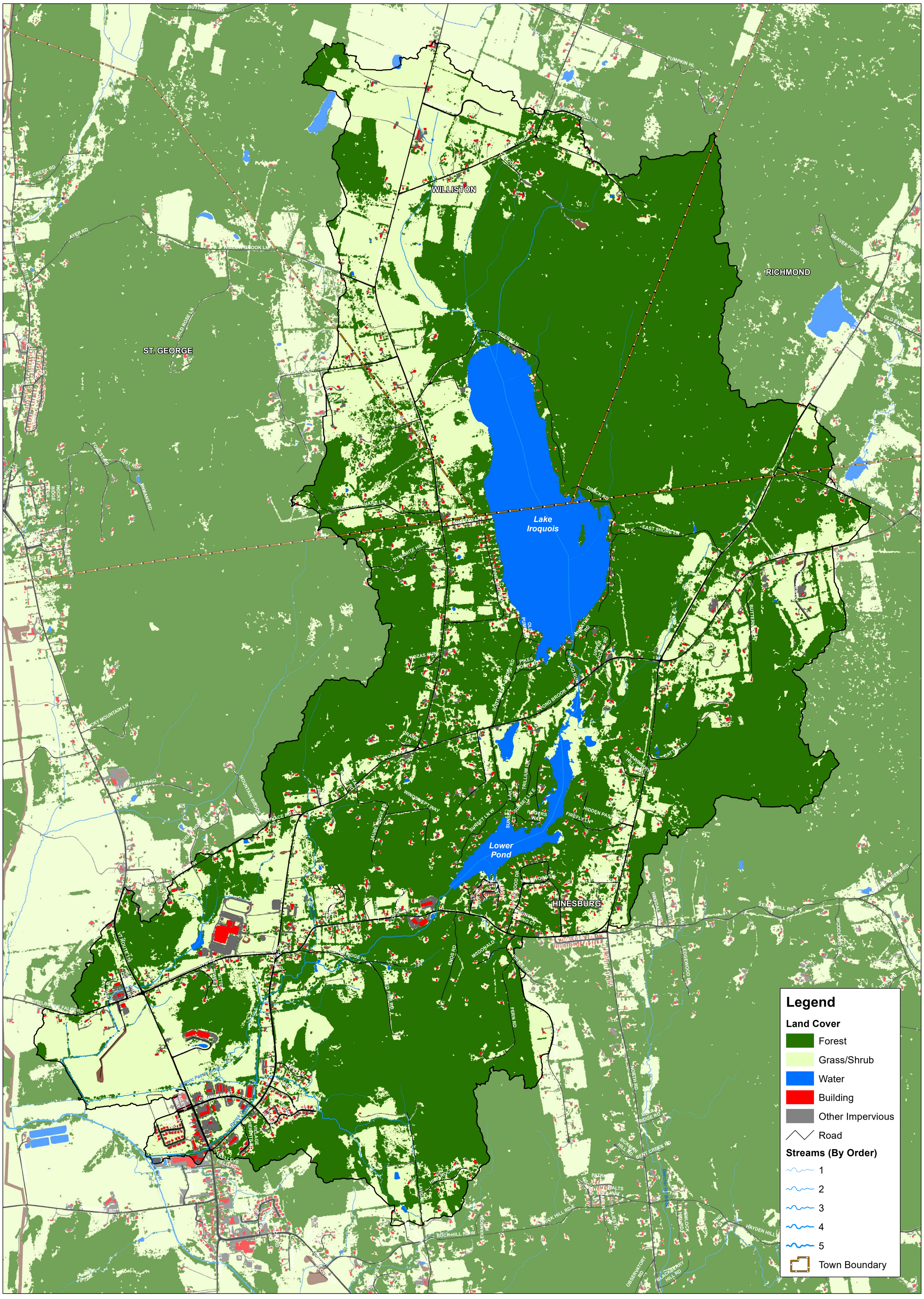
Feet

1 in = 900 feet

N

SLR

1 SOUTH MAIN ST
WATERBURY, VT 05676
802.882.8335



Legend

Land Cover

- Forest
- Grass/Shrub
- Water
- Building
- Other Impervious
- Road

Streams (By Order)

- 1
- 2
- 3
- 4
- 5
- Town Boundary

LAKE IROQUOIS & PATRICK BROOK WATERSHED LAND COVER (2016)

LAKE IROQUOIS-PATRICK BROOK WATERSHED ACTION PLAN

WINOOSKI NATURAL RESOURCES CONSERVATION DISTRICT

0 1,800 3,600

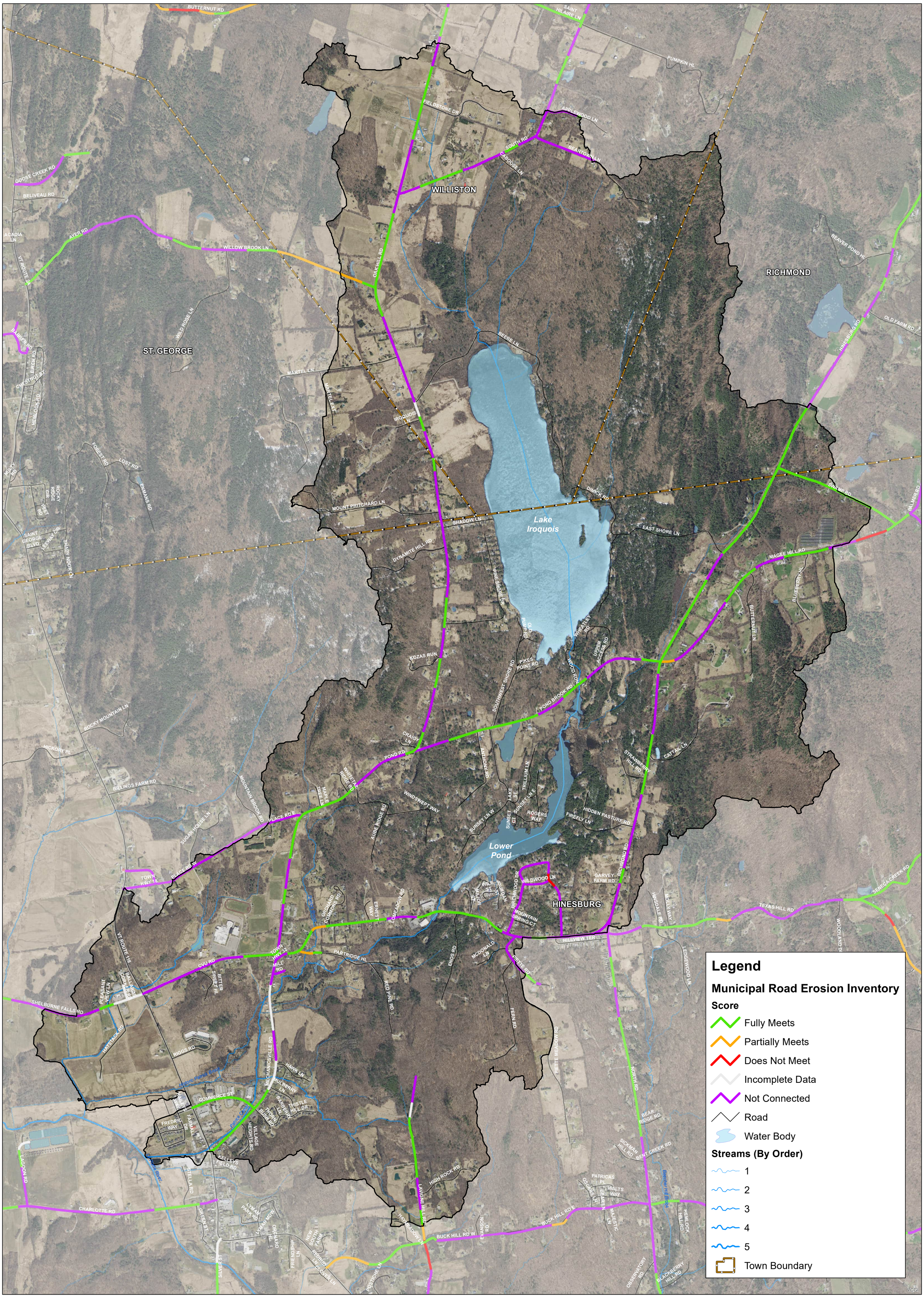
Feet

1 in = 900 feet

N

SLR

1 SOUTH MAIN ST
WATERBURY, VT 05676
802.882.8335



LAKE IROQUOIS & PATRICK BROOK WATERSHED MUNICIPAL ROAD EROSION INVENTORY

LAKE IROQUOIS-PATRICK BROOK WATERSHED ACTION PLAN

WINOOSKI NATURAL RESOURCES CONSERVATION DISTRICT

0 1,800 3,600

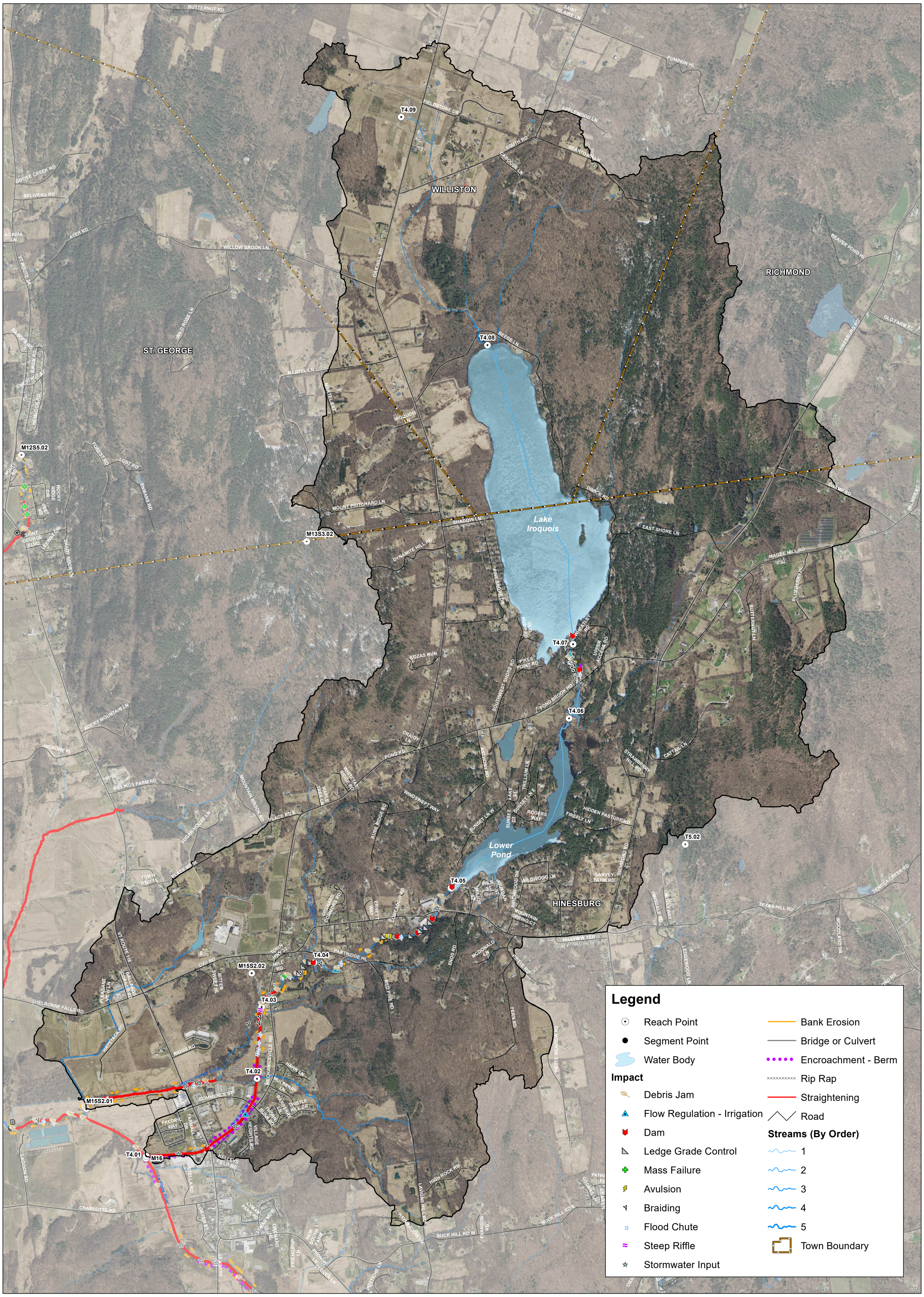
Feet

1 in = 900 feet

N

SLR

1 SOUTH MAIN ST
WATERBURY, VT 05676
802.882.8335



LAKE IROQUOIS & PATRICK BROOK WATERSHED
PHASE 2 STREAM GEOMORPHIC ASSESSMENT DATA

LAKE IROQUOIS-PATRICK BROOK WATERSHED ACTION PLAN

WINOOSKI NATURAL RESOURCES CONSERVATION DISTRICT

0 1,800 3,600

Feet

1 in = 900 feet

N

SLR

1 SOUTH MAIN ST
WATERBURY, VT 05676
802.882.8335

LAKE IROQUOIS & PATRICK BROOK WATERSHED WATER QUALITY MONITORING

LAKE IROQUOIS-PATRICK BROOK WATERSHED ACTION PLAN

WINOOSKI NATURAL RESOURCES CONSERVATION DISTRICT

0 1,800 3,600

Feet

1 in = 900 feet

N

SLR

1 SOUTH MAIN ST
WATERBURY, VT 05676
802.882.8335

Legend

Water Quality Monitoring Station

- LaRosa 2022
- BASS WQ Site
- Previous Site - LCA
- LaRosa 2021
- Previous Site - LIA
- Water Body
- VT Significant Wetland Inventory
- Road

Streams (By Order)

- 1
- 2
- 3
- 4
- 5
- Impervious Surface
- Town Boundary

VCGI