Notice of Intent

BEFORE THE FEDERAL ENERGY REGULATORY COMMISSION
APPLICATION FOR AN EXEMPTION FOR A
10 MEGAWATT OR LESS WATER POWER PROJECT

Per 18 CFR §5.5, Stonecat Hydro, LLC (SCH) hereby notifies the Federal Energy Regulatory Commission (FERC) of its intent to file an Application for 10-MW or less Exemption from Licensing for the Swanton Hydroelectric Project.

1. *Applicant name and business address:*

Stonecat Hydro, LLC
c/o Mr. Peter Blanchfield, Manager
Stone Ridge Hydro, LLC
16 Harrogate Road
New Hartford, NY 13413
Phone: 650-644-6003
Email: peter.blanchfield@gmail.com

2. *Existing FERC Project No:*

There is no existing FERC Project number; this is a new development.

3. *License Expiration Date:*

Not applicable; new project development.

4. *Unequivocal statement of Applicant's intention to file for re-license:*

Stonecat Hydro, LLC states its ***unequivocal intent to file an application*** for a new 10-MW or less Exemption for the proposed Swanton Hydroelectric Project. Concurrently with this Notice of Intent (NOI), SCH is submitting a Pre-Application Document (PAD) to commence first stage consultation. The applicant will use the Traditional Licensing Process (TLP). For an exemption proceeding the TLP is the default process; therefore, a TLP request will not be required.

5. *The type of principal project works to be exempted, such as dam and reservoir, powerhouse, or transmission lines:*

The Project facilities are anticipated to consist of: (1) an existing dam approximately 360 feet long with a maximum height of 12 feet, crest elevation of 108.0 MSL and new flashboards resulting in a normal water surface elevation of 110.0 MSL; (2) an impoundment with a surface area of about 180 acres at a water surface elevation of 110.0 MSL; (3) a former concrete power canal approximately 300 feet long, 12 feet wide to be reutilized for new fish passage; (4) a new concrete intake structure approximately 100 feet wide and 60 feet long located on the right embankment; (5) a new concrete powerhouse approximately 60 feet wide and 100 feet long housing three turbines with a combined total capacity of 850 kW; (6) a new tailrace excavated from the existing bedrock about 60 feet wide and 150 feet long; (7) a new transmission line with a total length of approximately 200 feet at 12.47kV; and (8) other appurtenances.

6. *The location of the proposed project by state, county, and stream, and when appropriate, by city or nearby city:*

State or Territory:	Vermont
County:	Franklin County
City:	Village of Swanton
River:	Missisquoi River

7. *Proposed project capacity:* 850 kW

8. *Names and mailing address of:*

a. *Every County in which part of the project is located, and in which any Federal facility that is used or to be used by the project:*

The project is entirely located within Franklin County, Vermont.

Franklin County Vermont
Gerald H. Charboneau, Clerk
17 Church St. St Albans, VT 05478
TEL: 802-457-3863
jerry.charboneau@fcvtcourt.com

The project does not include any Federal lands or Federal facilities.

b. *Each city or town in which any part of the project is located and in which any federal facility that is used or to be used by the Project is located.*

The Project's principal features are located in the Village of Swanton, VT; however, the reservoir extends into the Town of Swanton, VT and the Town of Highgate Falls, VT.

Village of Swanton, VT
Clerk
120 First Street
Swanton, VT 05488
802-868-3397
dianneday@swanton.net

Town of Swanton, VT
Clerk / Treasurer
PO Box 711
1 Academy Street
Swanton, VT 05488
802-868-4421
townclerk@swantonvermont.org

Town of Highgate, VT
Clerk
PO Box 189
2996 VT Rte 78
Highgate Center, VT 05459
802-868-5002
wdusablon@highgatevt.org

The project does not include any Federal lands or Federal facilities.

c. *Each city or town that has a population of 5,000 or more people and is located within 15 miles of the existing or proposed project dam:*

Town of Saint Albans, VT
PO Box 37
597 Lake Road
St. Albans, VT 05478

Town of Saint Albans City, VT
PO Box 867
100 North Main Street
St. Albans, VT 05478

Town of Swanton, VT
PO Box 711
1 Academy Street
Swanton, VT 05488

Town of Bekmantown, NY
571 Spellman Road
West Chazy, NY 12992

City of Champlain, NY
PO Box 3114
10729 Route 9
Champlain, NY 12919

d. *Every Irrigation district or similar special purpose political subdivision:*

i. *In which any part of the project is or is proposed to be located and any federal facility that is or is proposed to be used by the project is located:*

The proposed project does not include any Federal lands or Federal facilities. There are no known irrigation districts or similar special purpose political subdivisions within the project boundary.

ii. *That owns, operates, maintains, or uses any project facility or any Federal facility that is or is proposed to be used by the project:*

The proposed project does not include any Federal lands or Federal facilities. There are no known irrigation districts or similar special purpose political subdivisions within the project boundary.

e. *Every other subdivision in the general area of the project or proposed project that there is reason to believe would be likely interested in, or affected by, the notification*

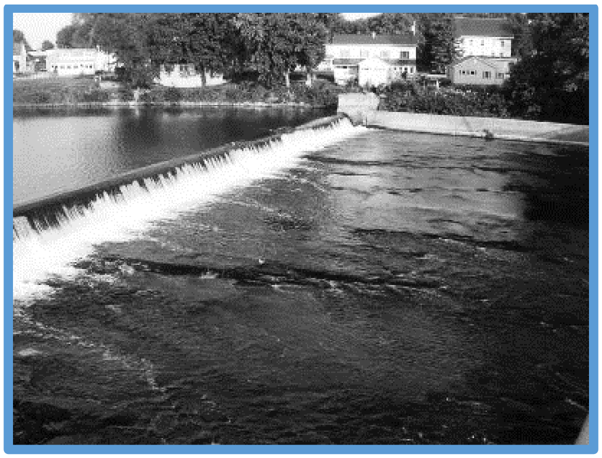
There are no known political subdivisions in the general area of the proposed project that would be interested or affected by this notice of intent.

f. *Affected Indian Tribes*

There are no federally recognized Indian tribes in the State of Vermont.

SCH is filing this Notice of Intent (NOI) concurrently with a Pre-Application Document (PAD). In accordance with 18 CFR § 5.5(c), SCH, as the proposed applicant, is sending notification of these filings to the Distribution list attached to this NOI. The list includes applicable resource agencies, local governments, Indian tribes, and non-government organizations.

In accordance with 18 CFR § 5.5(e), SCH is requesting designation as the non-federal representative for Endangered Species Act consultation and for consultation under Section 106 of the National Historic Preservation Act.



LOWER SWANTON DAM HYDROELECTRIC PROJECT

PRE-APPLICATION DOCUMENT

FOR

EXEMPTION FROM LICENSING

NEW DEVELOPMENT

JUNE 6, 2022

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1.0 Introduction

This Pre-Application Document (PAD) summarizes existing information relevant to the proposed Lower Swanton Dam Hydroelectric Project for the purposes of seeking a 10-MW or less exemption.

In accordance with federal regulations (18 C.F.R. § 5.6), the PAD summarizes existing, relevant, and reasonably available information to enable the Federal Energy Regulatory Commission (FERC or Commission) and interested stakeholders to identify issues and related information needs, develop study requests and study plans, and prepare documents analyzing any license application that may be filed with the Commission.

The PAD contains the following information:

- A process plan and schedule for consulting stakeholders, gathering information, developing and conducting studies, obtaining permits and completing all pre-filing licensing activities;
- A description of the Project's facilities and operation;
- A description of the existing environment and any known or potential project effects on specific resources including: geology and soils; water resources; fish and aquatic resources; wildlife and botanical resources; wetlands, riparian, and littoral habitats; rare, threatened, and endangered species; recreation and land use; aesthetic resources; cultural resources; socioeconomic resources; tribal resources; and a description of the river basin;
- A list of preliminary issues and studies that may be needed at the Project; and

The Lower Swanton Dam Hydropower Project development is proposed by Stonecat Hydro, LLC (SCH) (the "Applicant").

The Applicant will use the FERC Traditional Licensing Process (TLP), the default process for the 10-MW or less exemption.

This PAD has been filed electronically on the FERC E-Library. Printed copies can be requested using the contact information below. Please specify subject: Lower Swanton Dam Hydropower Project PAD.

2.0 Applicant Information / FERC Process Plan & Schedule

2.1 Contact Information

The name of the project applicant is as follows:

Stonecat Hydro, LLC
c/o Pete Blanchfield
16 Harrogate Road
New Hartford, NY 13413
PHONE: 650-644-6003
EMAIL: peter.blanchfield@gmail.com

2.2 Authorized Agents

Authorized Agents are as follows:

Stonecat Hydro, LLC
Pete Blanchfield
16 Harrogate Road
New Hartford, NY 13413
PHONE: 650-644-6003
EMAIL: peter.blanchfield@gmail.com

2.3 FERC Process Plan & Schedule

The Process Plan and Schedule outlines actions by FERC, Stonecat Hydro, LLC (Stonecat Hydro), and other participants during the pre-filing process for the 10-MW or less exemption. Table 1 provides a Process Plan and Schedule for pre-filing activities under the TLP. See Figure 1. Note that since the TLP is the default process for 10-MW or less exemption the TLP approval process is not applicable to this project.

Figure 1. Overview TLP Process (FERC 2020)

Table 1. Proposed TLP Licensing Process Plan and Schedule

Activity	Responsible Party	Regulation or timeframe	Proposed Date
Stage 1 Consultation			
File NOI and PAD with FERC, and distribute to stakeholders	Stonecat Hydro	18 CFR §5.3, 5.5, and 5.6	June 6, 2022
Hold Joint Agency/Public Meeting	Stonecat Hydro	18 CFR §4.38	Between July 6 and August 5, 2022
File comments on PAD and study requests With Stonecat Hydro	Stakeholders	18 CFR §4.38	Within 60 days of Joint Agency Meeting
Stage 2 Consultation			
Conduct studies	Stonecat Hydro	18 CFR §4.38	Summer 2022 & 2023
Issue study report(s) to stakeholders	Stonecat Hydro	18 CFR §4.38	When completed

Activity	Responsible Party	Regulation or timeframe	Proposed Date
Issue Draft Exemption Application to stakeholders	Stonecat Hydro	18 CFR §4.38	April 1, 2024
File comments on Draft Exemption Application	Stakeholders	18 CFR §4.38	May 15, 2024
File Final Exemption Application with FERC	Stonecat Hydro	18 CFR §4.38	August 1, 2024

The process plan and schedule include a Joint Agency Meeting (JAM) anticipated to be held around July-August 2022. The actual date will be scheduled subsequent to this filing. Further information will be distributed to interested stakeholders concurrent with Applicant's public notice of the meeting.

3.0 Description of River Basin

Major Land and Water Uses

The project is located within Franklin County, Vermont which has lands of approximately 633 square miles according to the US Census Bureau (Census 2021a). Franklin County is located in the northwest corner of Vermont and borders the Canadian province of Quebec. Adjacent counties in Vermont include Grand Isle, Chittenden, Lamoille and Orleans.

One of the New Hampshire grants, the town of Swanton was chartered in 1763 by Governor Benning Wentworth. It was named for Captain William Swanton, an officer in the British Army who had traveled thought the area during the French and Indian War. The Village of Swanton is located within the Town of Swanton as shown in Figure 2.

Figure 2. Swanton Town & Village Zoning Map (Swanton 2021)

The Town and Village of Swanton have a long history of industrial activity including sawmills, wood factories, linen production and quarrying. In 1894, the hydroelectric plant was installed at Highgate Falls and Swanton was the first town in Vermont to adopt municipal electric lighting.

The Missisquoi Basin has numerous water features and mountain ranges with approximately 66% of the acreage within the Missisquoi Drainage area being forested and an additional 25% being used for agricultural purposes. (VANR 2013, NRCS 2008). Although the area is generally rural, there are about 729 farms totaling 189,699 acres of farmland in Franklin County (USDA 2017).

The percentage of urban developed area within the Missisquoi drainage area is approximately 3.5 percent with an average percent impervious area of 0.76 percent. The drainage basin includes about 2.8 percent of waterbodies and wetlands. (USGS 2022a).

The Missisquoi River provides access for recreation including boating, fishing and swimming. Numerous access sites exist on the Missisquoi River that allow swimming with some areas having natural features such as waterfalls, cascades, and gorges that can enhance recreational activities. Other water-based recreation activities (i.e., fishing, tubing, wildlife viewing, etc.) are also widely experienced by visitors to the Missisquoi River (VANR 2013).

There are 18 public water supplies located in the greater Missisquoi River Basin. A majority of these systems (16) access groundwater for their supplies, with the remaining two systems drawing from surface water sources including the one in Swanton (VANR 2013).

There are 7 dams on the Missisquoi River as shown in Table 2 (VANR 2013).

Table 2. Missisquoi River Dams

Dam Name	Notes
Swanton	Undeveloped
Highgate Falls	FERC Regulated Hydropower
East Highgate	Breached
Enosburg Falls	FERC Regulated Hydropower
Sheldon Springs	FERC Regulated Hydropower
North Troy	FERC Regulated Hydropower
Bakers Fall	FERC Regulated Hydropower

Project Impoundment and Storage

The existing impoundment has a normal water surface area of approximately 170 acres at a normal water surface elevation of 108 feet MSL. The reservoir volume is approximately 850 acre-feet which assumes an average impoundment depth of about 5 feet. The existing reservoir extends approximately 6.5 miles upstream.

The proposed project will include two feet of flashboards on the crest of the existing dam which will elevate the normal water surface elevation of the impoundment to 110 feet MSL. The proposed reservoir surface area is 180 acres with a reservoir volume of approximately 900 acre-feet.

Both the existing reservoir and proposed reservoir at elevation 110 feet MSL have no storage utilized for the purpose of power generation or flood control.

Climate

The project region experiences warm muggy summers and cold winters with moderate amounts of snowfall. Average monthly climatic data for the previous ten years is shown below in Table 3.

Table 3. Summary Climate Information Swanton, VT Based on Previous Ten Years Data (Weather 2022)

Month	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Avg. Temperatures (°F)	Hi 23 Lo 11	Hi 26 Lo 12	Hi 36 Lo 22	Hi 50 Lo 34	Hi 65 Lo 45	Hi 72 Lo 52	Hi 78 Lo 58	Hi 77 Lo 57	Hi 70 Lo 50	Hi 56 Lo 41	Hi 42 Lo 30	Hi 30 Lo 20
Avg. Wind Speed (MPH)	7	7	8	8	7	6	6	6	6	7	8	7
Avg. Precipitation (in)	4	4.3	4.7	5.5	6.6	7.7	6.1	5.8	4.2	5.6	4.2	4.5

4.0 Project Location, Facilities and Operations

4.1 Project Description

The summary of the Project description is:

> *The Project facilities are anticipated to consist of: (1) an existing dam approximately 360 feet long with a maximum height of 12 feet, crest elevation of 108.0 MSL and new flashboards resulting in a normal water surface elevation of 110.0 MSL; (2) an impoundment with a surface area of about 180 acres at a water surface elevation of 110.0 MSL; (3) a former concrete power canal approximately 300 feet long, 12 feet wide to be reutilized for new fish passage; (4) a new concrete intake structure approximately 100 feet wide and 60 feet long located on the right embankment; (5) a new concrete powerhouse approximately 60 feet wide and 100 feet long housing three turbines with a combined total capacity of 850 kW; (6) a new tailrace excavated from the existing bedrock about 60 feet wide and 150 feet long; (7) a new transmission line with a total length of approximately 200 feet at 12.47kV; and (8) other appurtenances.*

The existing project consists of an existing 170 acre impoundment with an average depth of 5 feet, an approximately 8 foot tall concrete overflow spillway and a former concrete power canal approximately 300 feet long and 12 feet wide. The proposed project will utilize the existing dam but add two feet of flashboards to the crest of the existing dam to raise the elevation of the reservoir from 108 feet MSL to 110 feet MSL. The former concrete power canal will be reconstructed to house a new fish passage structure which will be designed and specified in consultation with resource Agencies. The proposed project will include the construction of a new intake structure, powerhouse and tailrace on the right side intake. The design process is still in progress; however, it is anticipated that three horizontal Kaplan turbines with a total combined capacity of 850 kW will be installed in the powerhouse. The powerhouse and intake structure will be constructed of reinforced concrete. The intake structure will be 100 feet wide and 60 feet long and transition flow into a 60 feet wide 100 feet long powerhouse. It is anticipated that the powerhouse will displace approximately 55 feet of spillway length resulting in a spillway about 275 feet in length. The intake structure will include a trashracks adequate for downstream fish protection and an adjacent downstream fish bypass. The fish bypass will be designed in consultation with resource agencies.

Table 4 includes information on the proposed turbine/generator system. Table 5 includes project information.

Table 4. Existing Equipment Information

Parameter	Unit # 1	Unit # 2	Unit # 3
Turbine Type	Full Kaplan	Full Kaplan	Full Kaplan
Orientation	Horizontal	Horizontal	Horizontal
Maximum Hydraulic Capacity (cfs)	460	460	460
Minimum Hydraulic Capacity (cfs)	70	70	70
Generator Voltage	600VAC	600VAC	600VAC
Generator Type	Induction	Induction	Induction
Generator Rating (kW)	283.3	283.3	283.3

Table 5. Project Information Table

Information Type	Variable Description	Value
Name of the Facility	Facility Name	Swanton Dam
Location	River name (USGS proper name)	Missisquoi River
	River basin name	Missisquoi
	Nearest town, county, and state	Swanton, Franklin County, Vermont
	River mile of dam above next major river or Ocean	+/- 8 miles to Connecticut River
	Geographic latitude	44°55'00.32"N
	Geographic longitude	73°07'7.49"W
Regulatory Status	FERC Project Number, issuance and expiration dates	No Project # Issued Yet
	FERC license type	10-Mw or less Exemption
	Water Quality Certificate issuance date, plus source agency name	None existing; will need to apply
Power Plant Characteristics	Average annual generation (kWh)	+/- 3,580,000/yr
	Number, type, and size of turbines, including maximum and minimum hydraulic capacity of each unit	All 3 units the same. Hydraulic range 70-460 cfs each. 283.3 kW each.
	Modes of operation (run-of-river, peaking, pulsing, seasonal storage, etc.)	Run-of-river
	Operations Type	Automatic Operation with PLC
Characteristics of Dam, Diversion, or Conduit	Date of construction	Unknown. Late 1800s
	Dam height	12 feet
	Impoundment Elevation	Existing 108 MSL Proposed 110 MSL
	Average Tailwater elevation	+/- 98 feet MSL
	Length and type of all penstocks and water conveyance structures between reservoir and powerhouse	Forebay within intake structure connects directly to powerhouse. Forebay 100 feet wide, 60 feet long.

Information Type	Variable Description	Value
	Water source	Missisquoi River
	Water discharge location or facility	Missisquoi River
Characteristics of Reservoir and Watershed	Gross volume and surface area at normal pool	Existing Elevation 108 MSL 170 acres; 850 acre-feet Proposed Elevation 110 MSL 180 acres;900 acre-feet
	Maximum water surface elevation (feet MSL)	Not Available
	Maximum and minimum volume and water surface elevations for designated power pool, if available	No storage utilized, same as normal pool.
	Upstream dam(s)	See Table 2
	Downstream dam(s)	See Table 2
Hydrologic Setting	Average annual flow at the dam	1,912 cfs
	Average monthly flows	See Section 4.4 Operations
	Location and name of relevant stream gauging stations above and below the facility	USGS Gage No. 04294000, Missisquoi River at Swanton, VT. The gage is located immediately upstream of the dam. Period of record for all analysis is 20 years; 2002-2021
	Watershed area at the dam	Drainage area: 852 square miles

4.2 Proposed Project Facilities

Except for the dam and former canal structure (river left); all project facilities are proposed.

4.3 Project Boundary

The proposed project boundary is located in Appendix A.

4.4 Project Operations

The existing dam is not currently operating. There are no outlets or gates for dam operation purposes. There is a gate structure that controlled water into the former power canal. The gate is in disrepair and does not appear operable.

The proposed Project's mode of operation is run-of-river mode. The hydraulic capacity of the units range from a minimum of 70 cfs to a maximum of 1,380 cfs. All three proposed units have a hydraulic range of 70-460 cfs each. Project flows which pass through the turbines will discharge back into the Missisquoi River immediately at the toe of the dam. Since the tailwater will backwater the toe of the dam, environmental bypass flows are not anticipated. However, it is anticipated that an aesthetic flow of 1" will be required over the flashboards, as is typically required by the State of Vermont. For a post construction spillway length of 275 feet, the aesthetic flow will be about 20 cfs. In addition, it is anticipated that there will be seasonal flow requirements for the upstream and downstream fish passage. USFWS Region 5 Fish Passage Engineering Design Criteria (USFWS 2016) require a minimum of 4-5% station capacity which would be 55-70 cfs. Upstream fish passage will need both operational and attraction flows. These cannot be estimated at this time as flow will vary widely with design. The applicant will work with fisheries' Agencies on all fish passage designs.

There is a USGS Gage located in the project impoundment in close proximity to the dam. The gage's period of record is 1990 to present. For project flows and flow duration curves, a 20 year period of record was utilized (2002-2021). According to the USGS gage website, the drainage area of the gage is 850 square miles and according to a stream stats analysis the drainage area of the project is 852 square miles. Since these values are within less than 1% of each other, no drainage area ratio was applied.

An analysis of the USGS Gage 04294000 was completed for a period of record of January 1, 2002 through December 31, 2021. See Table 6.

Table 6. Project Flows 2010-2020

Month	Maximum Recorded Flow (cfs)	Average Recorded Flow (cfs)	Minimum Recorded Flow (cfs)
All	26,200	1,912	79
Jan	19,400	1,668	360
Feb	21,100	1,177	261
Mar	14,600	2,705	258
Apr	25,500	4,799	712
May	25,800	2,369	245
Jun	23,100	1,654	91
Jul	8,720	946	114
Aug	19,800	886	79
Sep	12,300	692	82
Oct	16,800	1,770	90
Nov	26,200	2,130	435
Dec	16,500	2,140	256

During normal operations, it is anticipated that the first 20 cfs in the river will go to the aesthetic flow. The minimum operating flow of a single turbine is 70 cfs. Therefore a minimum of 90 cfs in the river is required to operate the turbines. At river flows between 1-89 cfs, all flows are discharged from the dam. At river flows between 90-1,400 cfs, 20 cfs spills for aesthetic flows and 70-1,380 cfs is discharged from the turbines. At river flows above 1,400 cfs, 1,380 cfs is discharged from the turbines, and all remaining flows are discharged over the spillway.

Table 7 for the project flow dispatch as a function of total river flow.

Table 7. Project Flow Dispatch as a Function of Total River Flow

River Flow (cfs)	Dam Flow (cfs)	Turbines (cfs)
1-89	1-89	0
90-1,400	20	70-1,380
1,400+	20+	1,380

In addition, it is anticipated that between April 1 and June 15, the project may pass an additional 55-70 cfs through the downstream fish passage facility. During this period, the minimum turbine operating flow is between 145-160 cfs. The project will be operated as run-of-river; and therefore, has no storage capacity or ability to provide flood control measures. During high water operations or flood conditions, the headgate to the turbines will be closed to protect the powerhouse and all water will be discharged over the spillway.

4.5 Other Project Information

Current license requirements

The project does not currently have FERC authorization and therefore does not have any current FERC requirements.

Compliance History

The project does not currently have FERC authorization and therefore does not have any current FERC compliance history.

Safety

It is anticipated that the project will be visited by staff daily.

The applicant understands that a Public Safety Plan (PSP), Dam Safety Surveillance Monitoring Plan (DSSMP) and downstream hazard assessment will be required for public safety.

Delivery of Water for Non-Power Uses

The Village of Swanton public water supply system is based on surface water withdrawals. The maximum daily demand is 725,000 Gallons per day (VANR 2013). The exact location of the system is unknown.

Current net investment

The current investment in the project is less than $100,000.

Average Annual Energy and Dependable Capacity

The average annual energy generation is anticipated to be approximately 3,580,000 kWh. The project will operate as run-of-river and therefore will not have dependable capacity throughout the year.

5.0 Facility Maps

Project maps can be found in Appendix A.

6.0 Environmental Analysis

6.1 Water Resources

Drainage Area

The Missisquoi River is approximately 80 miles long and winds through northern Vermont in the United States and southern Quebec in Canada. The south branch rises in Vermont, running southeast to northwest, while the north branch lies in Quebec, running north to south. The two branches join in Highwater, Quebec and then flow in a generally westerly direction until the confluence with Lake Champlain. Over its length, the river drops 715 feet (WIKI 2020).

The Missisquoi River is the largest tributary of the Missisquoi Bay, followed by the Rock and Pike Rivers. The basin is divided into five sub watersheds; Hungerford Brook, Black Creek, Tyler Branch, Trout River, and Mud Creek (VANR 2016).

The total drainage area of the Missisquoi River is estimated to be 862 square miles based on a USGS StreamStats analysis (USGS 2022a - See Appendix B for the full USGS StreamStats Report). The drainage area contributing to the project is estimated to be 852 square miles based on a USGS StreamStats analysis. The Swanton Dam is located at about RM 8 of the Missisquoi River, and creates an impoundment with a surface area of about 170 acres and a volume of approximately 850 acre feet at an estimated average impoundment depth of 5 feet. Figure 3 provides an overview of the drainage area contributing to the project location (USGS 2022b). The full StreamStats Report can be found in Appendix B.

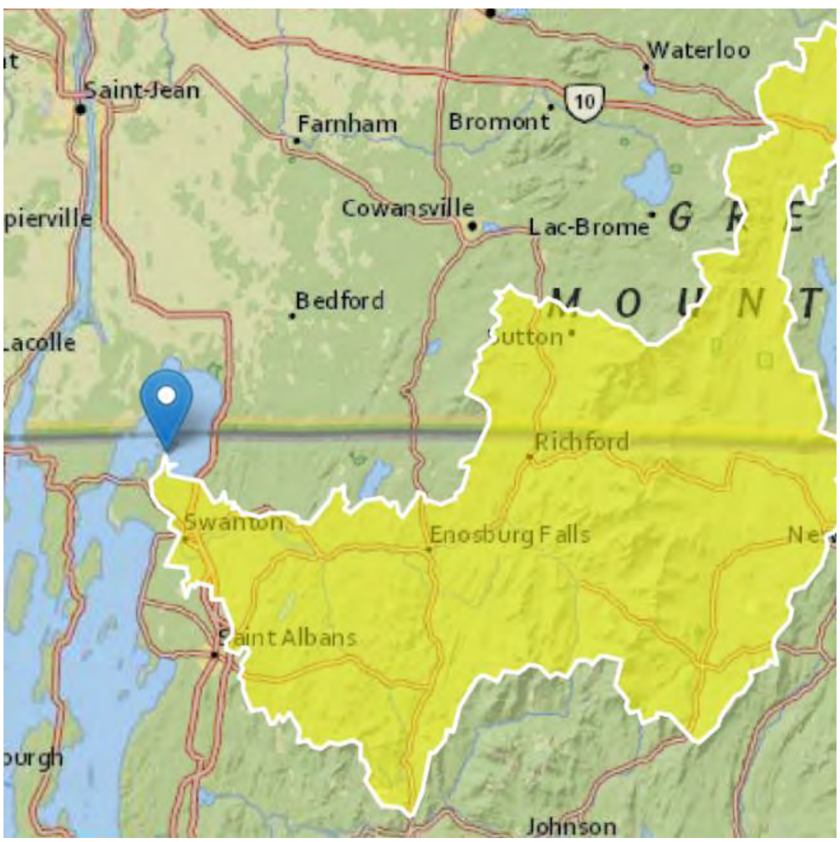


Figure 3. Project Drainage Area (USGS 2022a)

Streamflow, Gage Data

USGS Gage No. 04294000 is located on the Missisquoi River in the project impoundment. The gage has a total period of record of February 7, 1991 to present. The gage and site have a very close drainage area; 850 square miles and 852 square miles; therefore, no drainage area ratio was applied to the flow values.

Monthly flow duration curves as well as a combined curve for all data are completed in tabular form (Table 8) and are plotted in Figure 4. Individual monthly flow duration curves can be found in Appendix C. All flow analysis was completed based on the previous 20 years of whole year data (January 1, 2002 – December 31, 2021).

Table 8. Flow Exceedance at Swanton Dam - Based on USGS Gage No. 04294000 January 1, 2002 through December 31, 2021

% Exceedance	ALL Data	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1%	6947	5,827	3,521	8,860	11,400	7,126	5,687	2,788	3,028	2,507	6,645	5,699	6,010
5%	4724	3,289	2,104	7,017	9,458	5,431	3,815	2,080	1,690	1,508	4,138	4,219	4,462
10%	3430	2,304	1,471	5,394	8,217	3,999	2,880	1,667	1,220	1,017	3,289	3,427	3,469
15%	2640	1,888	1,200	4,594	7,198	3,150	2,174	1,360	1,000	752	2,418	2,816	2,770
20%	2170	1,648	1,070	3,598	6,443	2,645	1,900	1,098	766	594	2,030	2,378	2,495
25%	1840	1,420	978	3,064	5,889	2,320	1,654	916	665	486	1,614	2,160	2,180
30%	1580	1,320	907	2,567	5,270	2,057	1,410	781	567	418	1,407	1,977	2,000
35%	1360	1,230	840	2,104	4,742	1,840	1,248	706	503	370	1,220	1,820	1,746
40%	1200	1,130	796	1,800	4,161	1,650	1,046	621	439	329	1,020	1,680	1,580
45%	1050	1,030	741	1,620	3,730	1,495	917	566	373	301	881	1,530	1,460
50%	921	967	690	1,440	3,320	1,340	810	504	332	273	762	1,385	1,335
55%	811	899	637	1,258	3,000	1,210	714	451	293	255	664	1,274	1,260
60%	715	832	590	1,060	2,728	1,100	628	391	270	233	580	1,180	1,180
65%	617	779	545	947	2,440	981	544	347	252	213	499	1,063	1,073
70%	522	740	500	760	2,173	886	480	309	218	192	418	997	1,010

% Exceedance	ALL Data	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
75%	435	676	460	639	1,890	793	418	285	191	174	356	890	904
80%	349	611	430	521	1,650	719	360	244	162	153	307	777	835
85%	268	546	389	430	1,491	611	273	193	146	136	253	701	776
90%	182	494	349	362	1,241	456	175	154	118	115	166	594	692
95%	117	407	293	285	862	315	122	124	100	97	107	454	500
99%	117	407	293	285	862	315	122	124	100	97	107	454	500

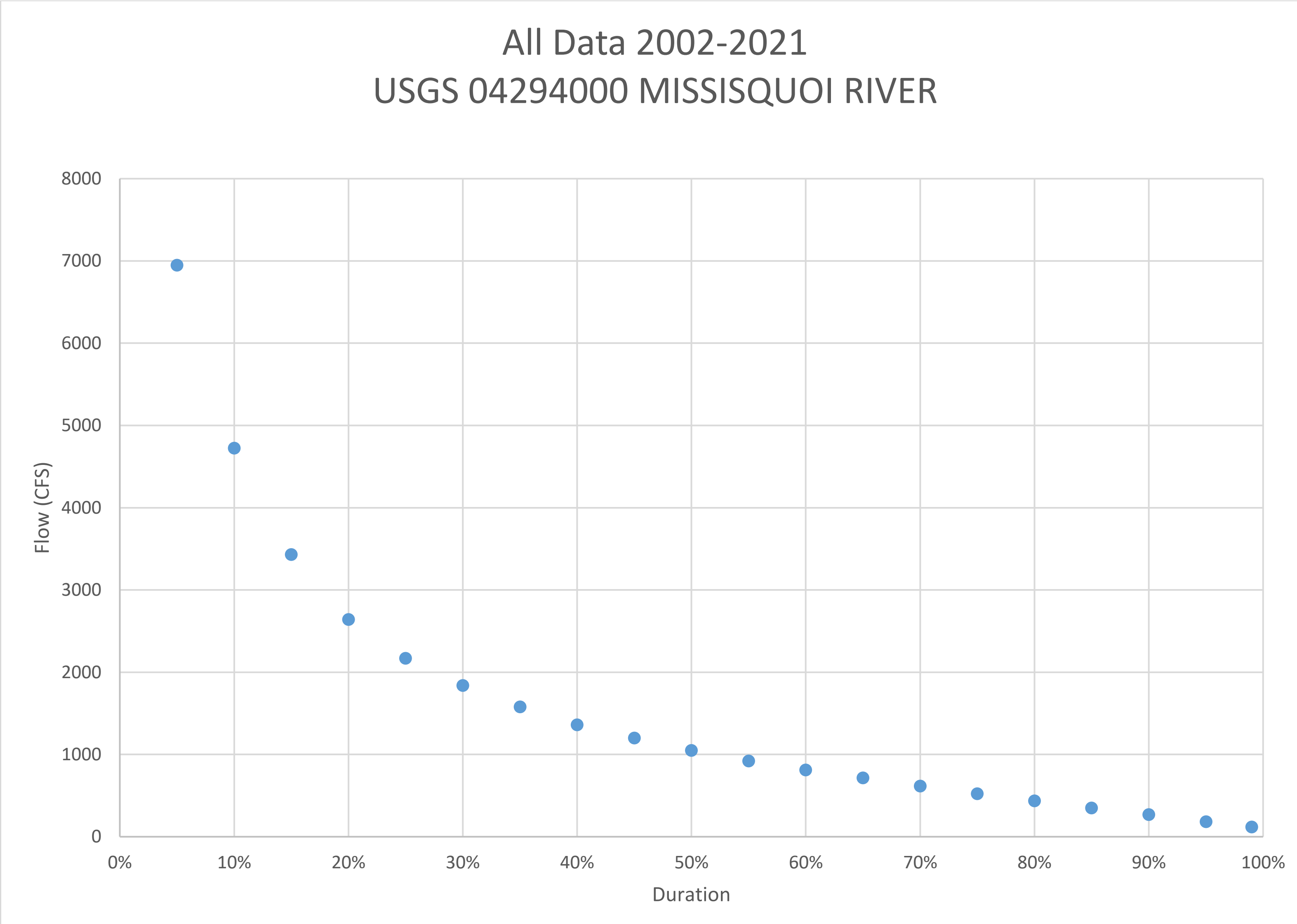


Figure 4. Swanton Dam Flow Duration Curves. Based on USGS Gage No. 04294000 January 1, 2002 through December 31, 2021

The minimum, maximum and average recorded flow at the project are shown in Table 9.

Table 9. Minimum, Maximum and Average Recorded Flows by Month at Swanton Dam. Based on USGS Gage No. 04294000 January 1, 2002 through December 31, 2021

	Max Recorded Flow (cfs)	Average Recorded Flow (cfs)	Min Recorded Flow (cfs)
All	26,200	1,912	79
Jan	19,400	1,668	360
Feb	21,100	1,177	261
Mar	14,600	2,705	258
Apr	25,500	4,799	712
May	25,800	2,369	245
Jun	23,100	1,654	91
Jul	8,720	946	114
Aug	19,800	886	79
Sep	12,300	692	82
Oct	16,800	1,770	90
Nov	26,200	2,130	435
Dec	16,500	2,140	256

Existing and Proposed Water Uses and Upstream or Downstream Requirements

There is one surface water supply withdrawal within the project area; however, the exact location is unknown. There is a water treatment plant downstream of the proposed project.

Existing Instream Flow Uses

Other than the above mentioned water supply and water treatment, the only other known instream flow use is recreation.

Existing Water Rights

The applicant will possess all water rights needed for operation of the project.

Water Quality Standards

Water quality standards for the State of Vermont are contained in Title V. S. A. Chapter 47. Inland surface waters of Vermont are classified by appropriate use Class (A1, A2, B1, or B2) as defined in V. S. A. Chapter 47. (VANR 2017) The State of Vermont assigns different classifications to waters by use. A body of water may be assigned different classifications for different uses. Designated uses are as follows (VANR 2017):

- Aquatic biota and wildlife that may utilize or are present in the waters;
- Aquatic habitat to support aquatic biota, wildlife, or plant life;
- The use of waters for swimming and other primary contact recreation;
- The use of waters for boating and related recreation uses;
- The use of waters for fishing and related recreational uses;
- The use of waters for the enjoyment of aesthetic conditions;

- The use of water for public water source; and
- The use of water for irrigation of crops and other agricultural uses.

According to the State of Vermont's water quality classification, all waters at or below 2,500 feet altitude, National Geodetic Vertical Datum, are designated Class B(2) for all uses, unless specifically designated as Class A(1), A(2), or B(1) for any use (VANR 2017). The project area is well below 2,500 feet in elevation. A review of the specific use classification designations (other than B(2)) do not include any waters in or near the project (VANR 2017). As such, the project waters are classified as B(2) for all uses.

The water quality data for Class B(2) waters is summarized in Table 10 and Table 11.

Table 10. Management Objectives and Criteria for Class B(2) by Use

Use	Management Objective and Criteria for B(2)
Aquatic Biota and Wildlife	*Management Objectives*: Manage to achieve and maintain good biological integrity *Biological Criteria*: Change from natural condition for aquatic macroinvertebrate and fish assemblages not exceeding moderate changes in the relative proportions of taxonomic, functional, tolerant and intolerant aquatic organisms. *Nutrient Criteria*.

	Class A(1)			Class B(1)			Classes A(2) and B(2)		
Stream Type[2]	Small, High-Gradient	Medium, High-Gradient	Warm-Water, Medium Gradient	Small, High-Gradient	Medium, High-Gradient	Warm-Water, Medium Gradient	Small, High-Gradient	Medium, High-Gradient	Warm-Water, Medium Gradien
Nutrient Concentrations									
Total Phosphorus (μg/L)[3]	10	9	18	10	9	21	12	15	27
Nutrient Response Conditions									
pH	Not to exceed 8.5 standard units.								
Turbidity	Consistent with the criteria in § 29A-302(4) of these rules.								
Dissolved Oxygen	Consistent with the criteria in § 29A-302(5) of these rules.								
Aquatic Biota	Consistent with the criteria under § 29A-305(a) of these rules.								

1. Compliance with nutrient criteria shall be achieved either by compliance with the nutrient concentration values specified above or by compliance with all nutrient response conditions. In situations where the applicable nutrient concentrations are achieved but the nutrient response conditions are not met as a result of nutrient enrichment, the Secretary may establish alternate nutrient concentration values on a site-specific basis, as necessary, to achieve compliance with the nutrient response conditions. All waters shall maintain a level of water quality that provides for the attainment and maintenance of the water quality standards of downstream waters.

2. Stream type determinations made by the Secretary are based on biological community types that relate to stream size, gradient, and elevation.

3. Not to be exceeded at low median monthly flow during June through October in a section of the stream representative of well-mixed flow.

Use	Management Objective and Criteria for B(2)
Aquatic Habitat	*Management Objectives*: Manage to achieve and maintain high quality aquatic habitat. Physical habitat structure, stream processes, and flow characteristics of rivers and streams and physical character and water level of lakes and pond necessary to fully support all life-cycle functions of aquatic biota and wildlife,

	including overwintering and reproductive requirements, are maintained and protected. *Criteria*: Rivers/streams – Changes to flow characteristics, physical habitat structure, and stream processes limited to moderate differences from the natural condition and consistent with the full support of high quality aquatic habitat Lake/Pond/Reservoir – Changes in aquatic habitat limited to moderate differences from the natural condition and consistent with high quality aquatic habitat. When such habitat changes are the result of water level fluctuation, compliance may be determined on the basis of aquatic habitat studies.
Aesthetics	*Management Objectives*: Waters shall be managed to achieve and maintain good aesthetic quality. *Criteria*: Rivers/Streams – Water character, flow, water level, bed and cannel characteristics and flowing and falling water of good aesthetic value. Lake/Pond/Reservoir – (1) Not to exceed 18 µg/L total phosphorus (June- September mean not to be exceeded in the photosynthetic depth (euphotic) zone at a central location in the lake). (2) Secchi Disk Depth 2.6 meters (June through September mean not to be less at a central location in the lake). (3) Chlorophyll-a 7.0 (µg/L)[3] (June-September mean not to be exceeded in the photosynthetic depth (euphotic) zone at a central location in the lake). (4) pH not to exceed 8.5 standard units. (5) Turbidity levels not to exceed 10 NTU as an annual average under dry weather base-flow conditions (6) DO Not less than 6 mg/l and 70% saturation at all times
Recreation Boating	*Management Objective* – Waters shall be managed to achieve and maintain a level of water quality compatible with good quality fishing. *Criteria*- (1) Measures of wild salmonid densities, biomass and age composition indicative of good population levels. (2) Waters that are designated cold water fish habitat shall comply with the following temperature criteria: total increase from the ambient temperature due to all discharges and activities shall not exceed 1.0 degree Fahrenheit.
Recreation – Swimming and other primary Contact Recreation	*Management Objective* - Where sustained direct contact with the water occurs, waters shall be managed to achieve and maintain a level of water quality compatible with good quality swimming and other primary contact recreation with very little risk of illness or injury from conditions that are a result of human activities. *Criteria* - Not to exceed a geometric mean of 126 organisms/100ml obtained over a representative period of 60 days, and no more than 10% of samples above 235 organisms/100 ml. In waters receiving combined sewer overflows, the representative period shall be 30 days. Secretary may waive some compliance requirements.
Public Water Sources	*Management Objective* – Waters shall be managed to achieve and maintain a level of quality that is suitable for use as a public water source with filtration and disinfection or other required treatment.

	Criteria - Waters shall comply with the Escherichia coli Criteria in subsection (f)(2)(B) of this section.
Irrigation of Crops and Other Agricultural Uses	*Management Objective* - Waters shall be managed to achieve and maintain a level of quality that is suitable, without treatment, for irrigation of crops used for human consumption without cooking and suitable for other agricultural uses.

Table 11. Water Quality Criteria for Class B(2) Waters

Parameter	Criteria (Use)
Biological	Change from natural condition for aquatic macroinvertebrate and fish assemblages for not exceeding moderate changes in the relative proportions of taxonomic, functional, tolerant, and intolerant organisms. (Aquatic Biota & Wildlife)
Turbidity	≤ 10 NTU as an average annual average under dry weather base flow conditions (Aesthetics) (Aquatic Habitat)
Dissolved Oxygen	Instantaneous minimum values ≥ 6 mg/L or 70% saturation (Aesthetics) (Aquatic Habitat non Salmonid) ≥7 mg/L and 75-95% saturation depending on spawning, nursery, egg maturation, larval development timing. (Aquatic Habitat Salmonid)
pH	≤8.5 standard units (aesthetics) (Aquatic Biota & Wildlife)
Nitrates (NO_3-N)	≤5.0 mg/L at flows exceeding low median monthly flows (Aquatic Biota)
Phosphorus	<12-27 µg/L at low median monthly flow during June to October (Aquatic Biota & Wildlife) <18 µg/L mean not to be exceeded in the photosynthetic depth (euphotic) zone at a central location in the lake (Pond/Lake/Reservoir Aesthetics)
Escherichia coli	Not to exceed a geometric mean of 126 organisms/100 m. obtained over a representative period of 60 days, and no more than 10% of samples above 235 organisms/100 ml. In waters receiving combined sewer overflows, the representative period shall be 30 days. (Recreation primary contact)
Chlorophyll-a	≤ 7.0 (µg/L)[3] (June- September mean not to be exceeded in the photosynthetic depth (euphotic) zone at a central location in the lake (Pond/Lake/Reservoir Aesthetics)
Temperature	Increase from ambient temperature ≤ 1.0°F (Recreation Boating)

Using VT ANR's Natural Resource Atlas, multiple sampling sites for water quality data were found along the lower Missisquoi River. The sampling sites are summarized in Table 12 and copies of the printed sampling details are located in Appendix D.

Table 12. Summary VANR Sampling Site Data Type –Lower Missisquoi River

Sampling Site Number	Location Missisquoi River	Type of Data	
		Macroinvertebrate	Chemistry
500505	Rt 78 Bridge, Swanton		X
500964	John's Bridge, Rt 7, Swanton		X

500965	Immediately below Swanton Dam		X
500966	Swanton Monument Road, Swanton		X
500963	Swanton, not specified		X
501688	Near bridge on Machia Rd, Highgate	X	X

Macroinvertebrate Data

One of the sampling locations on the lower Missisquoi River included data on macroinvertebrate populations. The site is above the Highgate project at about river mile 18.

During assessment, VANR uses several population characteristics to determine the health of the species inhabiting the stream bottom. Metrics are measured against those that would be expected in a naturally occurring population in a stream of similar size and location. The following metrics are utilized in evaluation (VANR 2021):

- Density – Relative abundance of macroinvertebrates
- Richness – number of distinct taxa
- EPT Richness – Number of distinct taxa from the general more environmentally sensitive orders Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptra (caddisfishes).
- PMA-O – Percent Model Affinity of Orders – Measure of order-level similarity to a model based on the reference streams and in an indicator of taxonomic structure
- B. I. – Hilsenhoff Biotic Index – the BI is a measure of the macroinvertebrate assemblage tolerance toward organic (nutrient) enrichment and is an indicator of tolerance/intolerance.
- Percent Oligochaeta – Is a measure of the percent of the macroinvertebrate community made up of the order of Oligochaeta and is an indicator of tolerance/intolerance.
- EPT/EPT+Chironomida – Is a measure of the ratio of the abundance of the intolerant EPT orders to the generally tolerant Diptera family of Chironomidae and is an indicator of taxonomic structure and tolerance/intolerance.
- PPCS-F – Pinkham-Pearson Coefficient of Similarity – Functional Groups – Is a measure of functional feeding group similarity to a model based on the reference streams and is an indicator of functional structure.

Using these criteria VANR has completed a Macroinvertebrate assessment at the location shown in Table 13.

Table 13. Sampling Site 501305 Macroinvertebrate Data

VERMONT DEPARTMENT OF ENVIRONMENTAL CONSERVATION
WATERSHED MANAGEMENT DIVISION

Macroinvertebrate Site Summary - River/Stream

Missisquoi River

Upstream of bridge on Machia Rd.
Highgate, VT (44.92700, -72.98800)
Stream Type: Warm Water Medium Gradient

Macroinvertebrate Community Metrics

Macroinvertebrate Community Assessments are based primarily on eight metrics of the Macroinvertebrate community. These include metrics of abundance, species richness, and indexes of Sensitive to tolerant species ratios. (For More Details)

Date	Density	Richness	EPT Richness	PMA-O	B.I.	Oligo.	EPT/EPT + Chiro	PPCS-F	Community Assessment
9/24/2009	4744	46.0	26.0	77.7	3.76	0.34	0.94	0.42	Good
9/24/2018	4020	42.0	26.0	79.6	3.82	0.00	0.99	0.32	Good
Scoring Guideline for a WWMG Stream of Water Quality Class B(2)									
	≥ 300	≥ 30	≥ 16	≥ 45	≤ 5.4	≤ 12	≥ 0.45	≥ 0.4	Full Support
	≥ 250	≥ 28	≥ 15	≥ 40	≤ 5.65	≤ 14.5	≥ 0.43	≥ 0.35	Indeterminate
	< 250	< 28	< 15	< 40	> 5.65	> 14.5	< 0.43	< 0.35	Non-Support

The data in Table 13 shows that the river is fully supporting macroinvertebrates at this location. However, the 2015 Missisquoi River Basin Assessment Report (VANR 2015) states the following:

> "The Missisquoi River biological community assessment has gone from "excellent" in 1999 down to "very good" in 2004 to "good" in 2009 and to "fair" in 2013. The notes from the 2013 community analysis summarized that "the macroinvertebrate fingerprint of lower density, richness and EPT present, and low BI/high EPT/EPTc, along with an altered PPCS-f due to filter feeders, point to a high flow event with scour issues, and non-point [source] particulates. Most other water quality parameters seem to be very similar to previous sampling, including slightly elevated Fe, and Al, and somewhat low DO." (VANR 2015)

Data sheets including raw data for all sampling locations can be found in Appendix D.

<u>Water Quality Chemistry</u>

Six of the sampling locations on the lower Missisquoi River included data on water quality chemistry. The following metrics are utilized in evaluation (VANR 2022):

- Chloride – Used to determine impacts from deicing products like road salt, and wastewater discharges
- Conductivity – Measure of the ability of water to carry electrical current. Higher Levels of conductivity suggest the presence of chlorides or other toxic metals.
- Dissolved oxygen – Used by aquatic organisms to breathe
- Nitrogen Nitrates – Nutrient that may fuel algae blooms
- pH (acidity) – A measure of the acidity of waters
- Phosphorus – A nutrient that may fuel algae blooms
- Turbidity – A measure of the suspended fine materials in waters that result in a cloudy or murky appearance.

Data sheets can be found in Appendix D.

Hydroelectric generation utilizes non-consumptive, once-through use of water without chemicals, nutrients or other non-water discharges. Therefore, it does not contribute to the levels of Chloride, Nitrates/Nitrogen, phosphorus or E. Coli in rivers. The primary concern regarding hydropower generation and water quality is temperature and dissolved oxygen (DO). Although there is data for water quality in the lower Missisquoi River, it did not include DO. No parameters outside the water quality standards were identified. However, since DO data was not available and the impact of new generation is not known it is assumed that additional DO & temperature data will be needed.

Existing impoundment Data

The existing impoundment is approximately 170 acres with an estimated average depth of about 5 feet and a volume of about 850 acre-feet. The impoundment extends upstream to the riffles below Highgate Falls Dam.

Bypass Reach

The project will not have a bypass reach. Water from the turbines will be discharged into the pool at the toe of the dam.

Project Effects

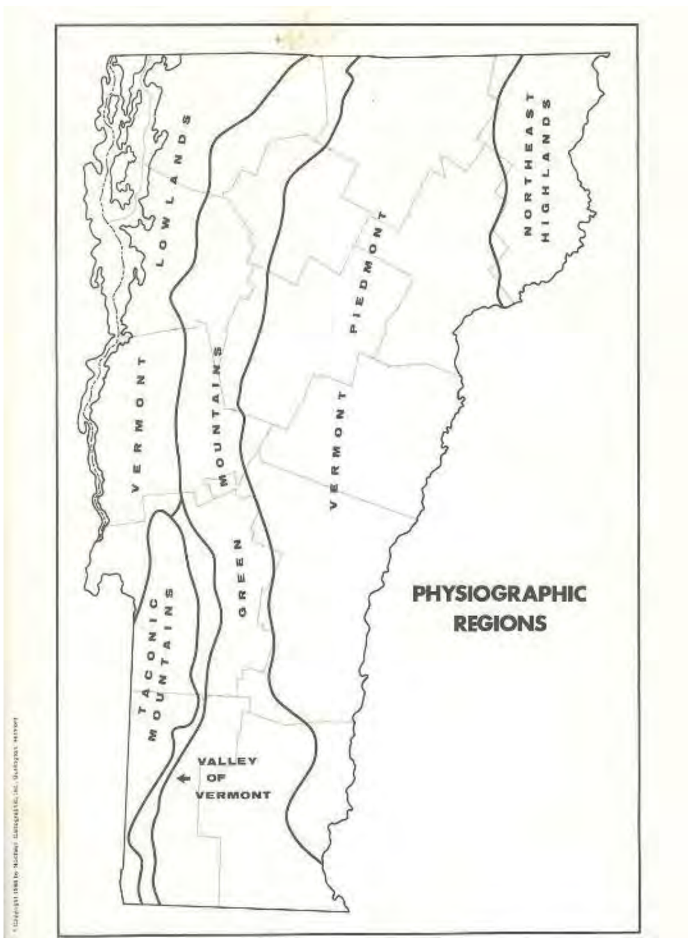
The applicant does not anticipate that the project will have any effect on water quality. The proposed project will be operated in a run-of-river mode while maintaining the existing hydrograph and minimizing project related fluctuations to the water surface in the impoundment. The project's use of river water includes once-through non-contact energy harnessing. When passing through the turbines, the water does not interact with any chemicals nor is it processed in any way. The applicant acknowledges that due to the limited data available on dissolved oxygen upstream and downstream of the dam that collection of additional data may be needed. The applicant will work with VANR and USFWS to confirm whether there is a need for additional data.

6.2 Geology & Soils

Geology

There are five distinct physiographic regions of Vermont. Categorized by geological and physical attributes, they are the Northeastern Highlands, the Green Mountains, the Taconic Mountains, the Champlain Lowlands, and the Vermont Piedmont. (SMC 2011) (Wiki 2022) The Swanton Project is located in the Vermont Lowlands.

The Vermont Lowlands are on the western side of the state. The region extends from the Canadian border in the north to the Poultney River and the Brandon area. The Adirondack Mountains to the west in New York, and the Green Mountains to the east rise high enough to protect the area from storms. This factor, along with the low average elevation of the valley area, helps keep the climate milder than the rest of the state. This region contains the largest amount of flat and gently rolling land in the state. Most of the land lies below 1,500 feet in elevation. Agriculture is important in this region. There is a long growing season and the soil is fertile. Franklin and Addison counties are the most important farming areas. (SMC 2011)



[1]

Figure 5. Geologic Regions of Vermont

[1] https://sites.google.com/site/physiographicregionsofvermont/process

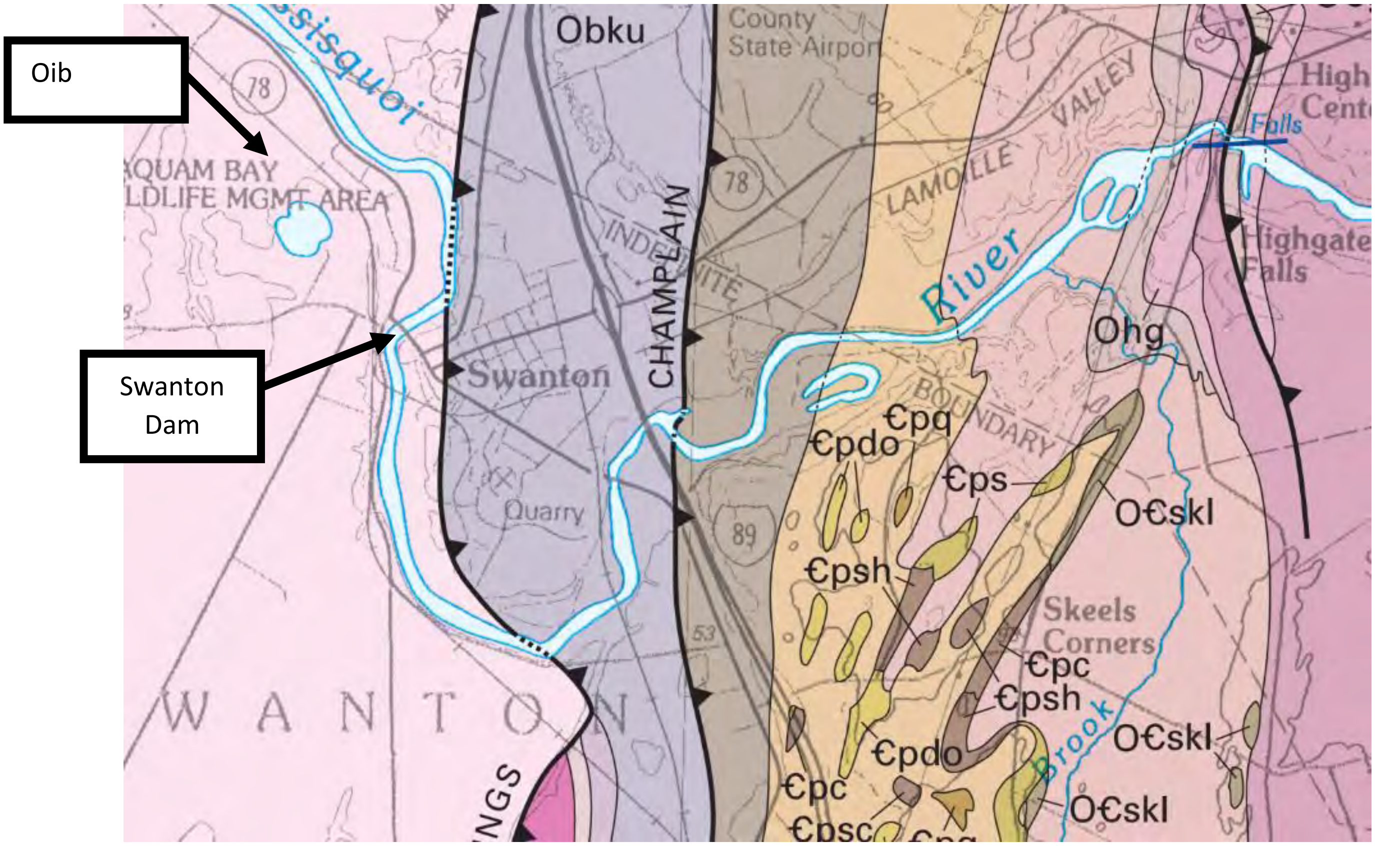


Figure 6. Screenshot. Bedrock Geologic Map of Vermont (USGS 2011)

The dam is constructed in an Iberville Formation (Upper Ordovician) consisting of dark-gray shale with thin discontinuous beds of cross bedded and graded siltstone.

Soils

The NRCS Soils Online Interactive Soils Mapper was utilized to evaluate soils in the project area as shown in Figure 7 and Table 14. The full NRCS report can be found in Appendix E.

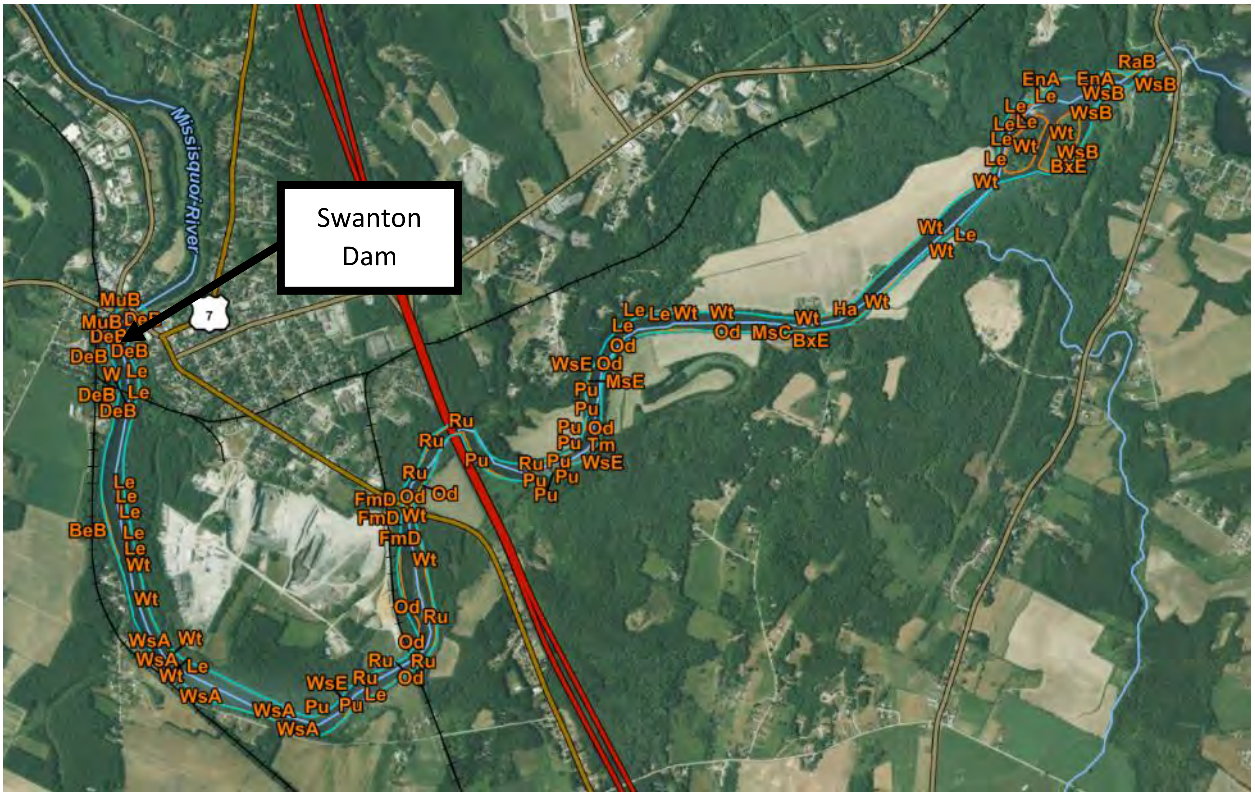


Figure 7. NRCS Soils Mapper Project Area

Table 14. Summary NRCS Soil Information for Project Area – Correlates to Figure 7

Symbol / Soil Type	Approximate Area (AC) / % Aare of Interest
Belgrade silt loam, 2 to 8 percent slopes	0.8/0.3%
Buxton silt loam, 25 to 45 percent slopes	0.2/0.1%
Deerfield loamy fine sand, 0 to 8 percent slopes	1.4/0.4%
Enosburg loamy fine sand, 0 to 3 percent slopes	0.5/0.2%
Farmington-Rock outcrop complex, 15 to 60 percent slopes	0.2/0.1%
Hadley silt loam	0.7/0.2%
Limerick silt loam	4.3/1.3%
Missisquoi loamy sand, 8 to 15 percent slopes	0.2/0.1%
Missisquoi loamy sand, 15 to 25 percent slopes	0.2/0.1%
Missisquoi loamy sand, 25 to 60 percent slopes	0.4/0.1%
Munson silt loam, 3 to 8 percent slopes	0.1/0%
Ondawa variant silt loam	4.1/1.3%

Podunk variant silt loam	2.3/0.7%
Raynham silt loam, 3 to 8 percent slopes	0.5/0.1%
Rumney variant silt loam	1.8/0.6%
Terric Medisaprists	0.1/0%
Water	276.7 / 85.6%
Windsor loamy fine sand, 0 to 3 percent slopes	0.8/0.2%
Windsor loamy fine sand, 3 to 8 percent slopes	0.4/0.1%
Windsor loamy fine sand, 25 to 60 percent slopes	0.4/0.1%
Winooski silt loam	27.3/8.4%
Total	323.2/100%

Project Effects

The project does not include any new dam construction. The proposed mode of operation is run-of-river. Development of a hydropower project is not anticipated to have any effect on soils or geology within the project area.

6.3 Fish & Aquatic Resources

The fish resources

Fish resources in the lower Missisquoi River are complex and controversial. There are resident species, migratory species, RTE species, stocked species and invasive species. There are concurrent efforts to improve access to spawning habitat for certain species while implementing population control methods for others. A clear understanding of the biological and ecological goals and management efforts are key. At the same time, there have been ongoing discussions for many years regarding the Lower Swanton Dam, including possible removal and improving power generation. There was a time when VFWD Commissioner Laroche circulated a well written document titled “Remove the Swanton Dam: Bring Back the Fish” (Laroache Undated). The document provided various justifications for the removal of the dam and pledged funds for removal with “no cost to the Village or Community”. It further stated that “the only known obstacle to removing this old dam is approval by the Village of Swanton.” The Village feels as strongly about keeping the dam in place. In a response to the Missisquoi Bay Basin Plan (VOS 2008), the Village outlines a variety of arguments as to the dam’s public benefit; including, but not limited to: historic significance, recreation, sources of water for fire suppression and a survey of the populous indicating more than 75% want to keep the dam in place. Separately, we are in a climate crisis and once again the world is strained over energy resources. Through a collaborative effort, it is absolutely possible for everyone to meet their goals at this project. The Village of Swanton has made it clear that the dam will not be removed. The Fisheries Agencies have made it clear that there is a need to support the regional biology and ecology. Development of the proposed hydropower project provides an opportunity to utilize the dam for its intended purpose; while at the same time, provide environmental enhancements such as fish passage. The applicant has a reasonable expectation that both upstream and downstream passage will be necessary at the project. At this point, the applicant is assuming a standard downstream bypass structure in accordance with USFWS Region 5 Design Guidelines (USFWS 2016). There are a variety of options for upstream passage including a denil ladder, natural channel, etc. Although the dam has blocked important species from passing upstream for more than 100 years, it has also blocked the passage of unwanted species. The upstream passage must consider how prevent the introduction of invasive such as lamprey. This is particularly complicated but the applicant will work with Agencies to find a solution that will meet all science based, clear and reasonable goals.

Migratory Species

The Missisquoi River is a major tributary to Lake Champlain and is used by numerous fish species that enter the river seasonally because they require riverine habitat to reproduce. According to VANR, one of the primary spawning areas is the habitat immediately downstream of the Swanton Dam, which has a steeper gradient and habitat used by numerous lake-run fish species for spawning, including walleye, esocids (pike species), redhorse suckers, white suckers, brown bullhead, smallmouth bass, freshwater drum, longnose gar, yellow perch, white perch and minnow species (for example, common shiner, creek chub, fallfish, eastern silvery minnow). In addition to these lake-run species, there are several state listed threatened and endangered species found in the lower Missisquoi, including lake sturgeon, stonecat, eastern sand darter and various mussel species. (VANR 2015)

Lake Champlain supported indigenous populations of landlocked and/or sea-run Atlantic salmon Salmo salar and lake trout Salvelinus namaycush during its early settlement. Both species were rapidly depleted as development in the area progressed during the 1800s. In the late 1950s and early 1960s, New York and Vermont began stocking lake trout and landlocked Atlantic salmon that produced a limited fishery. Encouraged by this success, the Vermont Fish and Game Department (now Fish and Wildlife Department), New York State Department of Environmental Conservation (NYSDEC), and the U.S. Fish & Wildlife Service (USFWS) formed the Lake Champlain Fish and Wildlife Management Cooperative in 1973. A major goal of this Cooperative is to develop and maintain a salmonid fishery focusing on restoration of landlocked salmon and lake trout, and stocking steelhead Oncorhynchus mykiss and brown trout Salmo trutta to diversify fishing opportunities. The States of Vermont and New York and the USFWS annually stock approximately 500,000 salmonid yearling equivalents in Lake Champlain. VFDW publishes an annual report on the Cooperative Lake Champlain salmonid sampling which includes the Missisquoi River. In 2019, 11 Landlocked Atlantic Salmon were collected of which 2 were male and 9 were female. (VFWD 2020a)

Lake Champlain walleye anglers reported their perception that walleye fisheries declined during the latter part of the 20th century in Lake Champlain. As late as the 1970's there was a large angler interest in fishing for walleye, and it was the primary game fish in the Inland Sea. Sound management techniques are needed to continue restoration and management efforts for this popular fishery, within the bounds of the lake's ability to supply the proper habitat and forage. Walleye management activities on Lake Champlain included monitoring adult walleye returning to spawn in the major tributaries, collection of brood stock for the fish culture and stocking program, and evaluation of the contribution of stocked walleye to spawning populations. The collection of brood stock for the fish culture program rotates between the Poultney, Winooski, and Missisquoi Rivers on a 3-year cycle. The objectives and goals of the project are to protect and enhance existing walleye populations to a level that will provide a self-sustaining population capable of supporting a fishery as described in the Lake Champlain Walleye Management Plan. (VFWD 2020b). A summary of the age structure of the Walleye collected during VFWD's 2019 Spring electrofishing efforts can be seen in Figure 8.

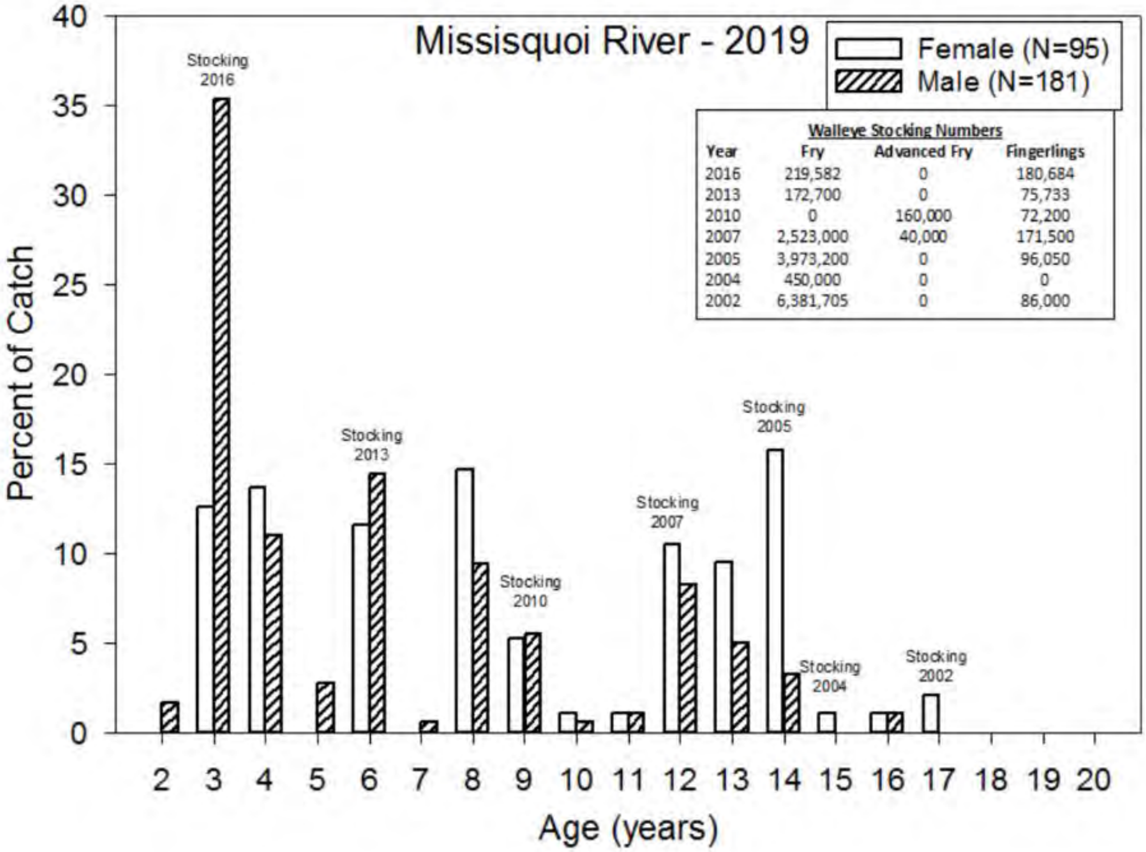


Figure 8. Age structure of Missisquoi River walleye collected in 2019 during spring electrofishing. (VFWD 2020b)

Vermont is the only New England state to which muskellunge are native, and its native distribution within the state was restricted to the central and northern portions of Lake Champlain and its various tributaries, including the Missisquoi River. The population once supported a popular recreational fishery; however, beginning in the late 1970's it slowly declined to where they became a rare occurrence in the lake. Genetic analysis of incidental muskellunge caught by anglers in recent years indicate these fish originated from stocking on the New York side of Lake Champlain, or from stocking conducted in the 1980's by the VFWD in Otter Creek (Wilson and Good 2010). These stockings were conducted using non-endemic strain muskellunge from Chautauqua Lake (NY) and a Pennsylvania reservoir. Recent studies indicate native Lake Champlain strain muskellunge are most likely extirpated from the state (Good 2008). Muskellunge objectives for the Esocid Management study are to 1) restore a naturally reproducing and self-sustaining population of muskellunge to Lake Champlain and its tributaries, focusing on its native range, and 2) provide recreational muskellunge angling opportunities (VFWD 2019).

Date	Total Number Received	Avg. Length (Inches)	Total Wt. (Lbs)	Numbers Stocked by Location	
				Lower Missisquoi River & Bay	Above Swanton Dam
8/19/2008	250	6.1	4.35	250	0
8/19/2009	10,000	5.04	174	10,000	0
2010	0			0	0
8/18/2011	5,150	5.0	95.5	5,150	0
8/21/2012	8,800	5.36	185	8,800	0
8/26/2013	7,580	5.32	155	4,580	3,000
8/27/2014	7,000	5.24	137	5,000	2,000
8/25/2015	5,540	4.83	85	3,540	2,000
8/22/2016	6,300	5.31	128	3,800	2,500
8/21/2017	4,340	5.0	74	2,340	2,000
2018	0			0	0

Figure 9. Muskellunge stocking dates and numbers for Lake Champlain, 2008-2018 including above Swanton Dam. (VFWD 2019)

Lake sturgeon belong to an ancient family of fishes and have been described as living fossils. Lake sturgeon have life history traits that are unique when compared to more recently evolved fish species. They are long lived, slow to mature, spawn intermittently, and have high fecundity and low natural mortality. Lake sturgeon can live for 150 years and weigh up to 310 pounds. Lake sturgeon are the largest and longest living fish found in Vermont and are only present in Lake Champlain and its major tributaries (VFWD 2016).

Lake Champlain supported a small commercial fishery for lake sturgeon in the late 1800s and early 1900s. Annual harvest declined rapidly in the late 1940s and the commercial fishery was closed in 1967. The lake sturgeon was classified as endangered by Vermont in 1972. The decline in lake sturgeon abundance in Lake Champlain has been attributed to over fishing, habitat loss in the rivers that were used as spawning and nursery grounds, and the introduction of non-native species (VFWD 2016).

Lake sturgeon are now rarely seen during fisheries assessments on Lake Champlain and its tributaries. Sturgeon still migrate to the Missisquoi, Lamoille, and Winooski rivers to spawn although the number of spawning adults in each of the rivers is small. To ensure survival of Lake Champlain's lake sturgeon populations, the state has set a restoration goal of 2000 mature adults in the lake or 750 mature adults for each population spawning in the Missisquoi, Lamoille, and Winooski rivers (VFWD 2016).

Lake sturgeon are currently listed as endangered in Vermont and are rarely seen during fisheries assessments on the lake and its tributaries. In recent years increasing numbers of lake sturgeon are being caught by anglers fishing in tributaries to Lake Champlain. In 2012 more than twelve sturgeon were reported being caught by anglers fishing in the Winooski River. Most sturgeon have been caught by anglers fishing in the Winooski and Lamoille rivers but an occasional fish is reported from the Missisquoi River and Otter Creek. The Missisquoi River downstream of Swanton Dam is made up predominantly of low gradient, slow-flowing habitat with sand and silt substrate. Much of this portion of the river is seasonally backwatered by Lake Champlain. Only a steeper gradient segment of the river immediately downstream of Swanton Dam provides the coarse substrate and water velocities required by sturgeon and a number of other fish species for spawning. Estimated sturgeon spawning habitat below the Swanton Dam is about 56,400 square feet with 33 percent of this area rated as poor spawning habitat under typical spring flows (Moreau and Parrish 1994). A habitat study of the river upstream of the Swanton Dam and below Highgate Falls indicated there would be a 300-fold increase in available sturgeon spawning habitat if sturgeon had access to this reach (Lyttle 2004). Not only would the total area of spawning habitat increase but more quality spawning habitat would be available under a wider range of flows. Available nursery habitat for age-0 sturgeon would also be increased by providing access above the Swanton Dam (VFWD 2016).

Resident Species

While some fish species use the Missisquoi River only for spawning, others inhabit it for much of the year. Stonecat and eastern sand darters (both state listed species) reside in the river year round. Officials say Lake Champlain and its tributaries was the only place in New England that historically had muskellunge. The fish was native to the Missisquoi River and bay but the population that lived upstream of the Swanton Dam was wiped out by a toxic spill in the 1970s. Recently a program was undertaken to reintroduce muskellunge in the lower Missisquoi River and bay. Species like largemouth bass, northern pike, chain pickerel, yellow perch also reside in the river year round. The presence of the diverse fishery on Missisquoi River draws many anglers. During the spring, anglers in large numbers can be found targeting walleye, bullhead, white perch and yellow perch. In the summer and fall, the lower section of the river draws people for bass and pike fishing (VANR 2015).

Stocking

Vermont Fish and Wildlife Department raises and releases more than a million fish each year in the State of Vermont's waterways through its stocking programs. Since 2011 VANR has stocked approximately 100,000 fish in the lower Missisquoi River. According to VANR's Fish Stocking webpage there will be 8,800 fish stocked in 2022. Table 15 summarizes the species, numbers and location.

Table 15. Planned stocking efforts 2022 Lower Missisquoi River[2]

TOWN	SPECIES	PLANNED # STOCKED	AGE
Enosburg	RBT, Rainbow Trout	1000	2YR
Troy-Westfield	BNT, Brown Trout	3000	YR
CaBerekshire Richford	BNT, Brown Trout	2800	YR
Lowell	BKT, Brook	2000	YR

Brown Trout (*Salmo trutta*)– The Brown Trout is one of the trout species in Vermont that is not native. It was introduced to Vermont during the late 1800s, and now there are spawning populations in most of the drainage basins in the state. They are commonly found in rivers and streams. VANR personnel carefully choose the lakes and ponds in which they stock Brown Trout, as the fish tend to grow quite large in these habitats and eat many smaller fish, including other stocked trout.

The Brown Trout typically inhabits the lower reaches of cold-water streams, characterized by deep, slow-moving pools and runs. It also thrives in larger lakes of sufficient depth to maintain cool water temperatures year round. The Brown Trout is more tolerant of warm water temperatures and pollution

[2] https://anrweb.vt.gov/FWD/FW/FishStockingSearch.aspx

than other species of trout. As with other trout species, water temperature is a major limiting factor for Brown Trout. Optimum temperatures range from 53°F to 66°F, although they can tolerate temperatures near 80°F for short periods of time. Brown Trout tolerate pH levels from 5.0 to 9.5 but the optimal range is between 6.8 and 7.8 (VFWD 2022a).

Optimal brown trout habitat in streams is characterized by:

- 50% to 70% pools and 30% to 50% riffle runs;
- A rocky bottom in riffle-run areas with no silt;
- A gentle-sloping stream with slow, deep pools;
- Relatively constant stream flows;
- Stable banks with a lot of plant growth; and,
- Overhead cover where streams are wide and deep.

Brown Trout usually live for five to six years, although ages of eight and nine years are not uncommon in waters that are not frequently fished. They generally grow at faster rates and achieve larger sizes than Brook Trout or Rainbow Trout. In Vermont streams, Brown Trout tend to reach 5-9 inches after two years, 8-11 inches by their third year, and 9-14 inches by their fourth year. Growth rates in lakes are typically faster, with three-year-old Brown Trout reaching 11-18 inches and four-year-olds averaging 13-21 inches in length. Relatively few Brown Trout older than four years have been collected in fishery surveys, but every year anglers catch some very large fish. In Vermont streams, the male Brown Trout matures at two to three years of age and the female matures one year later. Some lake-dwelling strains may not mature until the fourth or fifth year. Spawning typically occurs from late October through December, when water temperatures reach an optimum range of 44°F to 48°F. Lake populations must have access to suitable tributary streams to reproduce. They sometimes migrate considerable distances to reach tributaries or headwaters with well-oxygenated gravel at the tail of pools (VFWD 2022a).

Brown trout are opportunistic feeders, but are perhaps more selective than other trout species. Aquatic and terrestrial insects make up the primary food source of brown trout that are less than ten inches in length. As they become larger, they shift more to fish and crustaceans. Mature brown trout in streams feed primarily at night, while those in lakes are more likely to feed during daylight hours (VFWD 2022a).

The brown trout was introduced to Vermont during the late 1800s and the species soon established a firm foothold in all the major drainage basins. It frequents many of the streams and rivers also occupied by brook trout and rainbow trout. Brown trout prefer deeper, slower and more fertile downstream river areas. Natural spawning populations are common to most drainage basins in the state, nevertheless, many of these waters are also stocked with catchable-sized brown trout to supplement the wild resource and improve fishing opportunities. The establishment of wild brown trout populations in a large number of waters has often been at the expense of the native brook trout. For example, the Batten Kill in the southwestern region of the state was historically a brook trout stream, but the brown trout, introduced around 1926, have largely replaced the native species. On the other hand, the establishment of brown trout populations has given anglers another type of trout to catch in Vermont. The brown trout is also well adapted to many lowland river areas, to which brook trout are not well suited. Brown trout often grow to trophy sizes in these waters. Brown Trout populations in lakes and ponds are relatively limited in Vermont. Even though Brown Trout adapt well to certain pond and lake habitats, Vermont Fish & Wildlife Department has decided to only stock rivers and streams. Brown Trout tend to accumulate in abundance in lakes and ponds because they out compete other trout species and withstand fishing so well. They also tend to grow larger than other trout species and feed heavily on other fish, including recently stocked smaller trout. Brook and Rainbow Trout do not pose such problems when stocked in lakes and ponds (VFWD 2022a).

Rainbow Trout (*Oncorhynchus mykiss)* - Native to the West Coast and introduced to Vermont in the late 1800s, Rainbow Trout are the most habitat-sensitive of the trout species and are stocked and bred extensively in state fisheries. Rainbow Trout will live in high- to moderate-gradient streams and rivers, as well as cold lakes. They are very sensitive to water pH levels and do not do well in acidic conditions (VFWD 2022b).

The Rainbow Trout inhabit moderate- to high-gradient cold-water streams with swift riffles and deep, clear pools, often overlapping portions of upstream Brook Trout habitat and downstream Brown Trout habitat. They are also well adapted to deep, cold-water lakes within certain temperature limits. In streams, Rainbow Trout prefer water temperatures similar to those favored by Brown Trout, from 54°F to 66°F, while lake-dwellers select waters between 45°F and 64°F. The maximum tolerable water temperature is 77°F, but some populations may be able to withstand temperatures in the low eighties for short periods of time. Rainbow Trout are more sensitive than other salmonids to very high or low pH levels, especially acidic conditions. A pH range of 6.5 to 8.0 is considered optimal and adults can tolerate levels from 5.5 to 9.0. Natural reproduction is not successful in waters with pH less than 6. (VFWD 2022b)

Optimal physical stream habitat for Rainbow Trout consists of the following:

- A relatively stable flow of clear, cold water;
- A rocky bottom in riffle-run areas, with no silt;
- Having as many pools as there are riffles;
- Areas of slow, deep water and abundant in-stream cover; and,
- Stable banks with a lot of plant growth.

Adult Rainbow Trout use the largest, and often the deepest, parts of the water pools, especially during low summer flows and winter freezing. Both adults and juveniles also use "pocket water" (slack, slow water in otherwise fast-flowing riffles) in riffles, often found behind or under large rocks or woody debris. They will all use undercut banks, overhanging vegetation, rocks, pool depth, water turbulence, and woody debris as a cover to protect them from predators. (VFWD 2022b)

Life expectancy of Rainbow Trout is highly variable over its range but is generally three to five years, sometimes longer in lake populations. Growth rates in Vermont streams are similar to those of Brook Trout, but they tend to grow larger due to their greater life span. They generally reach 4 to 6 inches after two years, 6 to 9 inches by their third year, and 8 to12 inches by their fourth year. As with other species of trout, rainbow trout populations in lakes grow faster: four-year-old fish attain lengths of 13 to 17 inches or more. Rainbow trout in streams generally become mature during their second or third year, whereas lake fish tend to mature later. They spawn almost exclusively in streams. Unlike brook trout and brown trout, most rainbow trout spawn in the spring (usually March through May in Vermont) triggered by rising spring flows and warmer water temperatures. Selective breeding in hatcheries has produced strains that spawn in the fall months or other times of the year. When the female is ready to reproduce, she digs a small hole, usually in the fine gravel at the tail of a pool. Water temperatures for incubation range from 45°F to 54°F. The eggs will hatch in 28 to 49 days. Fry emerge from the gravel about two weeks after hatching and congregate in schools in the calm areas near the edges of the stream channel. After several weeks, the fry grow more territorial and the schools disperse. By the end of their first year, juvenile Rainbow Trout move into the more swiftly flowing riffle areas. (VFWD 2022b)

Rainbow Trout consume a wide variety of foods, depending on availability. Stream populations tend to prefer drifting aquatic and terrestrial insects while lake populations may feed more on microscopic animals and bottom-dwelling organisms such as worms, crustaceans, aquatic insect larvae, mussels, clams, and crawfish. They will shift more to smaller fish as they reach about 12 inches in length. (VFWD 2022b)

Rainbow Trout were also introduced into Vermont waters beginning in the late 1800s. Over the years they have become an important component of the state's fisheries in both river and lake habitats. These fisheries exist today as a result of natural reproduction, stocking, or a combination of the two. However, while brown trout eventually established wild populations throughout much of the state, wild Rainbow Trout populations are noticeably absent from the large watersheds of southeastern Vermont. Even though Rainbow Trout have been, and continue to be, stocked extensively in this region, these waters characteristically have low alkalinity, a condition that does not support rainbow trout reproduction. Consequently Rainbow Trout fisheries in the southeast region are dependent on stocking. Notable exceptions include numerous small, lowland watersheds draining into the Connecticut River. It is believed that these small watersheds provide spawning habitat for the Connecticut River population. Typically these small spawning streams have drainage areas less than 20 square miles. Lake populations of Rainbow Trout in the Northeast Kingdom are the only areas in Vermont that are supported entirely or in part by natural reproduction. As noted for stream populations, alkalinity is also a factor limiting the distribution of wild populations in Vermont lakes and ponds. The inability of many of the state's lake and pond populations to be supported to some extent by natural reproduction can also be attributed to the lack of suitable spawning habitat. Lake-residing fish must have access to streams offering suitable spawning and nursery habitat in order to maintain a wild population. In the absence of quality spawning streams, most lake populations must be maintained by stocking (VFWD 2022b).

Brook Trout - Brook trout are members of the char family. They prefer small spring fed streams and ponds with sand or gravel bottom and vegetation. They spawn over gravel in either streams or lakes, with ground water percolation or in the spring fed areas in lakes. Young brook trout feed on plankton and progress to insects until they are adults. Brook trout can grow to over 2 feet in length and weigh up to 15 pounds in the Great Lakes. In streams, they are typically 6 to 15 inches, and weigh 1 to 5 pounds. As spawning season approaches the colors of brook trout greatly intensify, especially in males whose flanks and belly become orange-red with a black stripe along each side. Brook trout spawn over gravel in either streams or lakes, with ground water percolation or in the spring fed areas in lakes.

Pre-spawning courtship of the brook trout begins with the male attempting to drive a female toward suitable gravel habitat to facilitate spawning. A receptive female chooses a spot and digs a redd. While the female brook trout is digging, the male brook trout continues his courtship activity, darting alongside the female and quivering, swimming over and under her and rubbing the female with his fins. The male spends a great deal of time driving off other males during this process. After spawning, the female brook trout covers the eggs by sweeping small pebbles at the downstream edge of the redd upstream. Once the eggs are covered, the female moves upstream to the end of the redd and then begins digging a new redd.

Brook trout normally mature in two years but may spawn after one year. These fish spawn between September and October. Brook trout fry will emerge sometime between February and April. Young brook trout normally seek shelter in submerged aquatic vegetation or shallow water near the shoreline. (USFWS 2022a)

Invasive

Landlocked Atlantic salmon were once abundant in the northern lake Champlain, but habitat degradation and over-fishing destroyed the native population by 1850. Lake trout populations were also in decline. Sporadic stockings of both species in the late 1800s failed to restore populations or fisheries. Native lake trout were gone by 1929. No further restoration attempts were made until 1958 when Vermont and New York began stocking small numbers of lake trout, and in the early 1960s when New York began stocking a few salmon fry (USFWS 2001).

These efforts were able to produce limited, recreational fisheries for lake trout, landlocked Atlantic salmon, brown trout and steelhead/rainbow trout through coordinated stockings, but soon it determined the nonnative sea lamprey was exerting a major adverse impact on their populations and associated recreational fisheries. Sea lamprey attacks were also evident on other important species such as walleye. These impacts had social and economic consequences for the surrounding communities. It became apparent that sea lamprey control would be needed to achieve fishery management objectives and improve the economic gains from recreational fishing. Sea lamprey have access to approximately 8.0 miles of the Missisquoi River to the Swanton Dam. Technical considerations developed during the 2001 Final Supplemental Environment Impact Statement for Long-Term Program of Sea Lamprey Control in Lake Champlain as prepared by the USFWS in cooperation with VDFW and New York State Department of Environmental Conservation (NYDEC) included the following: (USFWS 2001)

> *"The Swanton Dam acts as a barrier to sea lamprey movement further up the Missisquoi River. The effectiveness of the dam in Swanton as a sea lamprey barrier should be maintained. The abandoned millrace on the west side of the dam should be inspected for barrier effectiveness. Presently, some leakage does exist around the deteriorating stop-logs at the head of the millrace that may, if not maintained, allow sea lamprey access to eight miles of the river and two tributaries above the dam. In 2001, one spawning-phase sea lamprey was trapped below the stop-log dam, suggesting that they may be attracted to the millrace discharge (USFWS, Essex Junction, Vermont, unpublished data). No other barriers are proposed for the Missisquoi River."* (USFWS 2001)

Furthermore, the "Missisquoi River Control Strategy" developed is as follows:

> *"Technically feasible control methods for the Missisquoi River include barrier maintenance and TFM or TFM/niclosamide application. The Swanton Dam would be maintained as a barrier to sea lamprey and trapping at the dam would continue. Should future larval assessment surveys reveal a need for control below the dam, lampricide application will be considered. Several endangered and threatened species documented in the Missisquoi River require mitigation measures to minimize potential nontarget impacts due to a lampricide treatment. As other control methods become feasible for use on the Missisquoi River the sea lamprey control strategy will be reevaluated. The following sea lamprey control strategy is recommended: 1. Maintain the Swanton Dam as a sea lamprey barrier. 2. Apply TFM or a TFM/niclosamide combination at river mile 8.0 (Swanton Dam) if sea lamprey populations warrant control. Applications will follow the*

> *Service's "TOP:011.1A Interim Protocol for Conducting Treatments of Streams with Populations of Young-of-Year Lake Sturgeon (Acipenser fluvescens)" in Klar and Schleen (1999). The time interval between treatments would likely be four years. This interval could be adjusted should sea lamprey surveys indicate slow recolonization or early metamorphosis."* (USFWS 2001)

Benthic Macroinvertebrates

Benthic macroinvertebrates are small aquatic animals and the aquatic larval stages of insects. They include dragonfly and stonefly larvae, snails, worms, and beetles. They lack a backbone, are visible without the aid of a microscope, and are found in and around water bodies during some period of their lives. Benthic macroinvertebrates live part or most of their life cycle attached to submerged rocks, logs, and vegetation (USEPA Undated). These organisms provide a link between a system's primary productivity and its aquatic consumers through the conversion of plant biomass to consumable energy. Benthic macroinvertebrates are useful indicators of water quality because many species have a wide range of tolerances to pollution; Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddis flies) (EPT) species are highly sensitive to pollution. Furthermore, EPT species are high-quality forage for a variety of freshwater fish species.

As part of its water quality monitoring, Vermont DEC Division of Watershed Management has completed some macroinvertebrate sampling in the Lower Missisquoi River. Some discussion can be found in Section 6.1. Full data sets can be found in Appendix D.

Freshwater Mussels

There are 17 species of freshwater mussels native to Vermont's streams, rivers, ponds, and lakes. Mussels are invertebrate animals, bivalves, in the class Mollusca. They are related to freshwater and marine clams, and, more distantly, snails. Mussels and clams are in the mollusk class Pelecypoda. One species of mussel, the eastern pearlshell, is in the family Margaritiferidae. All other native Vermont mussels are in the family Unionidae. One non-native species, the zebra mussel, in the family Dreissenidae, is presently found in Lake Champlain (Fichtel 1995).

Unionid mussels and the eastern pearlshell spend their adult lives situated in the bottom substrates of streams or lakes feeding on microscopic plants and animals. They are sedentary, rarely moving more than a few meters in a lifetime. They feed by filtering algae, diatoms, and plankton from the water column. Because of their sedentary nature and filter-feeding habit, mussels are considered to be good indicators of water quality. The lifespans of freshwater mussels varies considerably by species from 15-100 years (Fichtel 1995)

Squawfoot (*Strophitus undulates*) – The Squawfoot has a wide distribution in Vermont. The Squawfoot is a small to medium-sized mussel (70 mm [2.8 inches] in length). The largest squawfoots observed by the authors in Vermont were 105 mm (4.2 inches). The periostracum is black or brown, and rays are not generally visible. The nacre is bluishwhite with a brown ventral border and a pinkish cast in the beak cavity. The lateral hinge teeth are absent. The pseudocardinal hinge teeth are represented only by a slight swelling on the hinge line. In the Missisquoi River and Stone Bridge Brook, where the Squawfoot overlaps in distribution with the cylindrical floater, it can be distinguished by that species by beak sculpture. Squawfoot beak sculpture consists of 4-5 concentric ridges parallel to the growth lines. Substrate is variable, but the Squawfoot appears to be most common aggregates of gravel and sand (Fichtel 1995).

A VTDEC Letter 02/22/22 to the FERC regarding the Highgate Falls Hydropower Project (P-2574) provides a list of rare, threatened or endangered species in the vicinity of the project which include the following mussels:

- Downstream of Swanton Dam
  - Cylindrical Papershell (Anodontoides ferussacianus)
  - Pocketbook (Lampsilis ovata)
  - Fluted-shell (Lasmigona costata)
  - Fragile Papershell (Leptodea fragilis)
  - Black Sandshell (Ligumia recta)
  - Pink Heelsplitter (Potamilus alatus)
  - Giant Floater (Pyganodon grandis)
- Between Highgate Falls and Swanton Village
  - Fluted-shell (Lasmigona costata)
  - Cylindrical Papershell (Anodontoides ferussacianus)
  - Giant Floater (Pyganodon grandis)
  - Pocketbook (Lampsilis ovata)
  - Black Sandshell (Ligumia recta)

It is unclear the methods in which the VTDEC is aware of these species; however, the applicant looks forward to further engagement on the presence and needs of these species.

VANR Assemblage

In a February 22, 2022 letter from VTDEC to FERC (Appendix A of the letter) regarding the upstream Highgate Falls (P-2547) relicensing VTDEC provided species assemblage data with periodicity for the river reach between Highgate Falls and the Swanton Dam as well as the river reach below Swanton Dam. The information from VTDEC is provided in Figure 10 and Figure 11.

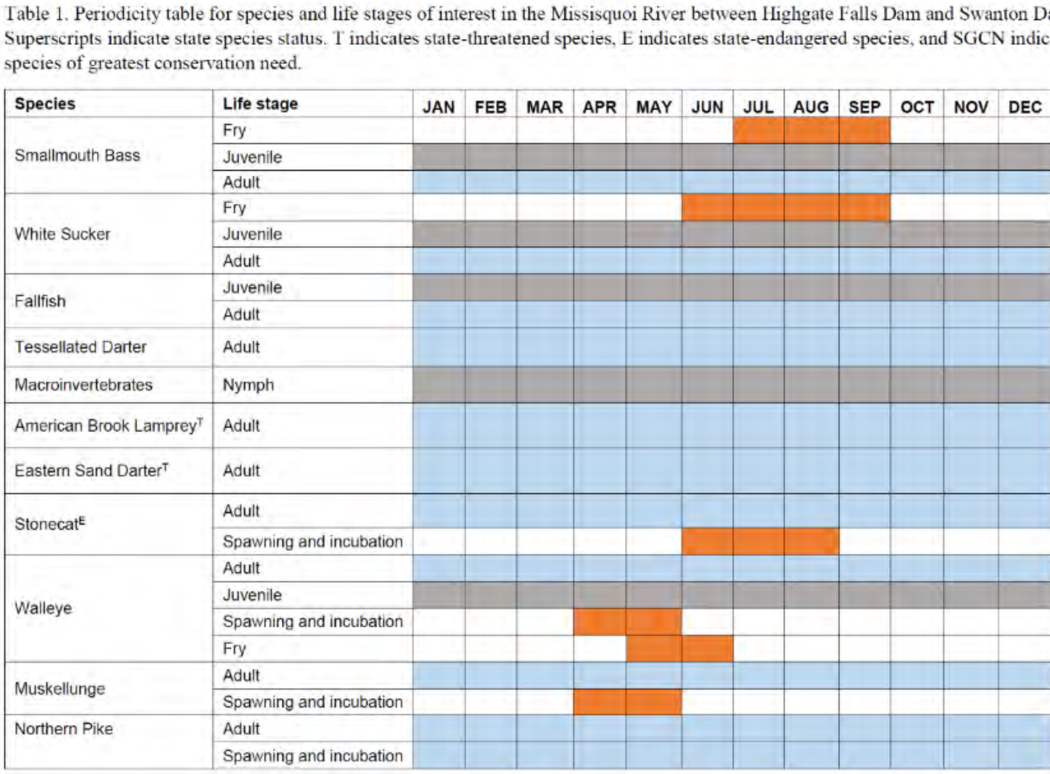


Table 1. Periodicity table for species and life stages of interest in the Missisquoi River between Highgate Falls Dam and Swanton Dam. Superscripts indicate state species status. T indicates state-threatened species, E indicates state-endangered species, and SGCN indicates Vermont species of greatest conservation need.

Species	Life stage	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Smallmouth Bass	Fry												
	Juvenile												
	Adult												
White Sucker	Fry												
	Juvenile												
	Adult												
Fallfish	Juvenile												
	Adult												
Tessellated Darter	Adult												
Macroinvertebrates	Nymph												
American Brook Lamprey[T]	Adult												
Eastern Sand Darter[T]	Adult												
Stonecat[E]	Adult												
	Spawning and incubation												
Walleye	Adult												
	Juvenile												
	Spawning and incubation												
	Fry												
Muskellunge	Adult												
	Spawning and incubation												
Northern Pike	Adult												
	Spawning and incubation												

Figure 10. Fisheries information for river reach upstream of Swanton Dam Part 1 (VTDEC Letter 02/22/22)

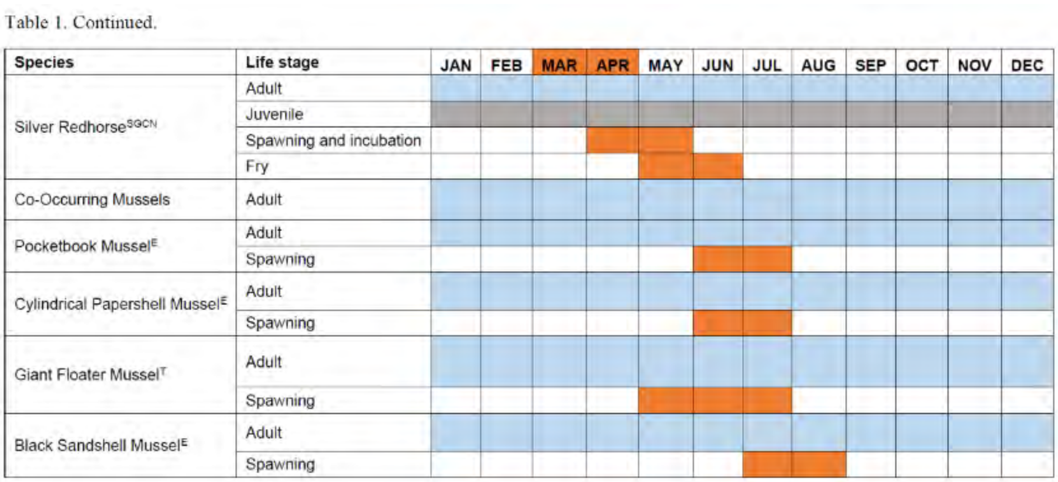


Table 1. Continued.

Species	Life stage	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Silver Redhorse[SGCN]	Adult												
	Juvenile												
	Spawning and incubation												
	Fry												
Co-Occurring Mussels	Adult												
Pocketbook Mussel[E]	Adult												
	Spawning												
Cylindrical Papershell Mussel[E]	Adult												
	Spawning												
Giant Floater Mussel[T]	Adult												
	Spawning												
Black Sandshell Mussel[E]	Adult												
	Spawning												

Figure 11. Fisheries information for river reach upstream of Swanton Dam Part 2 (VTDEC Letter 02/22/22)

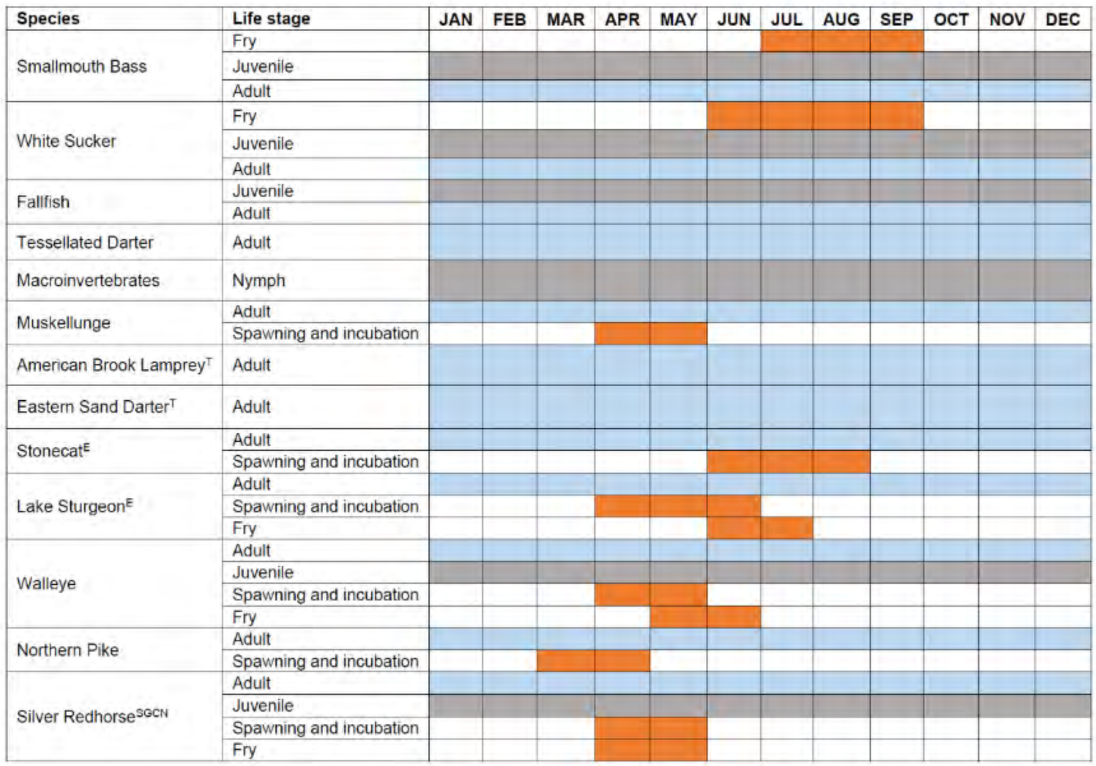


Table 2. Periodicity table for species and life stages of interest in the Missisquoi River below Swanton Dam. Superscripts indicate state species status. T indicates state-threatened species, E indicates state-endangered species, and SGCN indicates Vermont species of greatest conservation need. ** indicates that this mussel uses Freshwater Drum as its sole known host.

Species	Life stage	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Smallmouth Bass	Fry												
	Juvenile												
	Adult												
White Sucker	Fry												
	Juvenile												
	Adult												
Fallfish	Juvenile												
	Adult												
Tessellated Darter	Adult												
Macroinvertebrates	Nymph												
Muskellunge	Adult												
	Spawning and incubation												
American Brook Lamprey[T]	Adult												
Eastern Sand Darter[T]	Adult												
Stonecat[E]	Adult												
	Spawning and incubation												
Lake Sturgeon[E]	Adult												
	Spawning and incubation												
	Fry												
Walleye	Adult												
	Juvenile												
	Spawning and incubation												
	Fry												
Northern Pike	Adult												
	Spawning and incubation												
Silver Redhorse[SGCN]	Adult												
	Juvenile												
	Spawning and incubation												
	Fry												

Figure 12. Fisheries information for river reach downstream of Swanton Dam Part 1 (VTDEC Letter 02/22/22)

Table 2. Continued.

Species	Life stage	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Greater Redhorse[SGCN]	Adult												
	Juvenile												
	Spawning and incubation												
	Fry												
Shorthead Redhorse[SGCN]	Adult												
	Juvenile												
	Spawning and incubation												
	Fry												
Quillback	Adult												
Landlocked Atlantic Salmon	Adult												
Longnose Gar	Adult												
Co-Occurring Mussels	Adult												
Fluted-shell Mussel[E]	Adult												
	Spawning												
Giant Floater Mussel[T]	Adult												
	Spawning												
Black Sandshell Mussel[E]	Adult												
	Spawning												
Fragile Papershell Mussel[E**]	Adult												
	Spawning												
Pink Heelsplitter Mussel[E**]	Adult												
	Spawning												

Figure 13. Figure 14. Fisheries information for river reach downstream of Swanton Dam Part 2 (VTDEC Letter 02/22/22)

Project Effects

It is anticipated that the development of the project will have a positive effect on the fishery resource by providing fish passage over the Swanton Dam where there is currently no passage. The applicant will work with Federal and State Fishery Agencies to design safe, effective and timely fish passage for migratory species to reach the desired spawning habitat. Throughout the process the design will carefully consider the impacts of lamprey accessing the same habitat.

6.4 Wildlife & Botanical Resources

The project area is located in the Champlain Lowlands ecological region. The Southern Vermont Piedmont is a variable region, with a cool climate in the northern hills, and some of the warmest temperatures in Vermont recorded in Vernon. The topography comprises gentle, rolling hills that rise from the Connecticut River Valley to meet the Green Mountains.

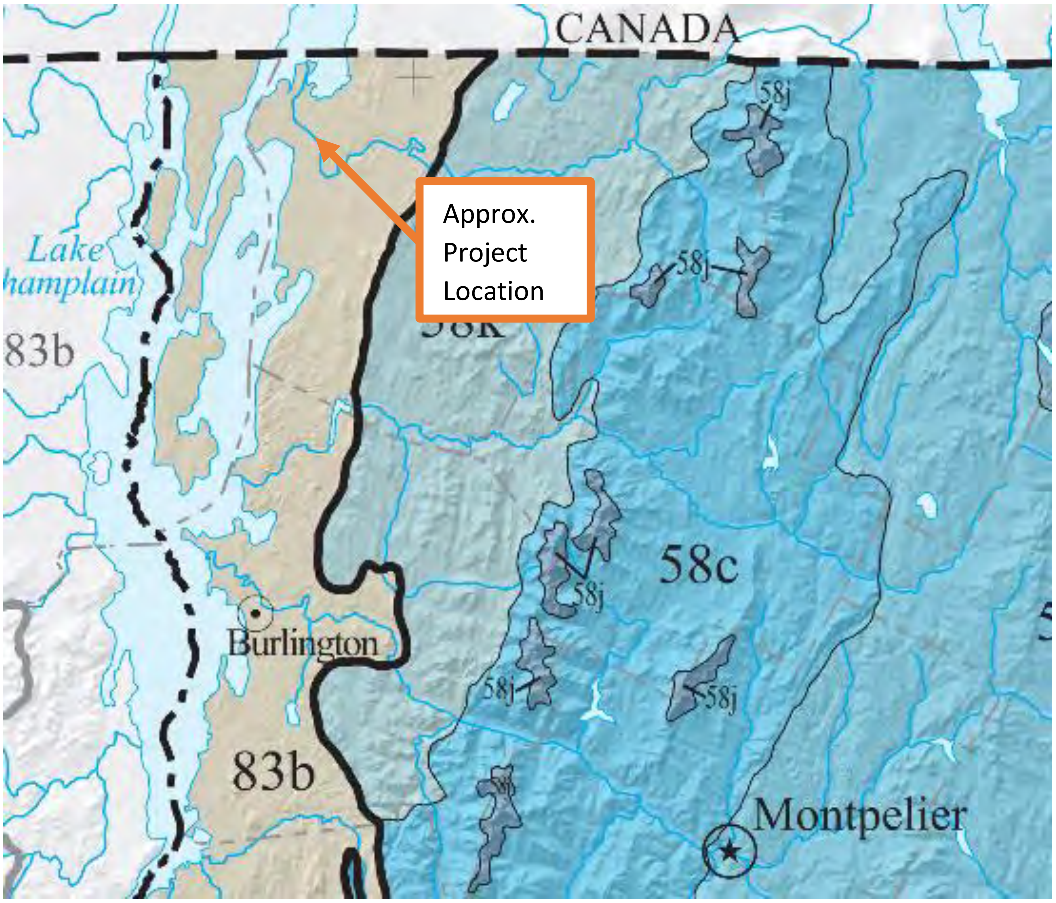


Figure 15. Eco-Regions of Vermont (USGS 2009)

The Champlain Lowlands ecoregion is the northernmost expression of the Great Valley, a limestone depression that extends along the entire length of the Appalachian Mountains. The Champlain Lowlands separate the Adirondack Mountains to the west from the Green Mountains to the east. The region's low elevation and the lake itself moderate the climate. During the Pleistocene, the basin contained Glacial Lake Vermont, and, at its maximum depth, glacial melt water lapped at beach lines over 600 feet above sea level. Glacial melt water also deposited sand, silt, and clay sediments into the lake that cover the valley floor today. The moderate climate and the lake bed soils make the Champlain Lowlands the prime agricultural region in Vermont. Mesic Inceptisols and Alfisols are typical. The lake effect keeps temperatures warmer in the fall and cooler in the spring, and the growing season is about 150 days, which is four to six weeks longer than in the Green Mountains. The glacial deposits create distinctive plant communities, such as the pine/oak heath sandplain forest, the valley clayplain forest, and the white pine/red oak/black oak forest, that are endangered due to farmland clearing and urban and recreational development. The vegetation communities have some stronger alliances to the St. Lawrence valley and the Great Lakes lowlands than to the hilly New England regions to the east. Some unique swamp, marsh, and other wetland communities also occur here. Lake Champlain provides drinking water to communities inside and outside of the Champlain basin. Since 1823, a canal has transferred Lake Champlain water south into New York's Hudson River basin. Most of Lake Champlain's water flows north through the Richelieu River to the St. Lawrence River. (USGS 2009)

Botanical Resources

Forest cover in northern Vermont consists of a mix of northern hardwoods and transition hardwoods with greater presence of oaks. Northern hardwood forests feature American beech, yellow birch, and sugar maple, and some red maple, white ash, and American basswood. There is also some eastern hemlock, in hemlock-northern hardwood forests. Warmer south- and west-facing slopes have mesic red-oak northern hardwood forests, with northern red oak, sugar maple, American basswood, American beech, and eastern Hemlock. There is also some white pine-red oak-black oak forest. Dry ridgetops feature red pine, and some dry oak-hickory-northern hardwood forest with red oak, white oak, shagbark hickory, eastern white pine, and hophornbeam. Small areas of spruce-fir forest can be found at the highest peaks.

Wildlife Resources

The Champlain Lowlands provides habitat for a diversity of wildlife species. Diverse habitats such as wetlands, forests, and fields support a variety of species.

Mammals potentially present in the vicinity of the project are those commonly found throughout the region that are adapted to living near humans and urban areas. Raccoon, skunk, muskrat, porcupines, white-tailed deer, woodchucks, squirrels, mice, bats, and rabbits. Larger mammals that require extensive habitat or species that require solitude such as moose and black bear prefer less developed areas and are likely scarce in the immediate vicinity of the project but present in the adjacent areas. Table 16 lists typical mammals that may be in the general vicinity of the project area.

Table 16. Typical Mammals Potentially in the General Vicinity of the Project Area (IN 2022)

Common Name	Scientific Name
American Beaver	*Castor canadensis*
American Black Bear	*Ursus americanus*
Big Brown Bat	*Eptesicus fuscus*
Common Raccoon	*Procyon lotor*
Eastern Chipmunk	*Tamias striatus*
Eastern Gray Squirrel	*Sciurus carolinensis*
Groundhog	*Marmota monax*
Meadow Vole	*Microtus pennsylvanicus*
Striped Skunk	*Mephitis mephitis*
Virginia Opossum	*Didelphis virginiana*
White-footed Mouse	*Peromyscus leucopus*
White-tailed Deer	*Odocoileus virginianus*
Woodland Vole	*Microtus pinetorum*

Avifauna

The diversity of the habitats in the area provide breeding, migratory stopover, and wintering habitat for a diversity of avifauna including songbirds, resident species, water birds, and waterfowl. Table 17 lists bird species potentially occurring in the vicinity of the project.

Table 17. Avian Species Potentially Occurring in the Vicinity of the Project (IN 2022)

Common Name	Scientific Name
American Crow	*Corvus brachyrhynchos*
American Goldfinch	*Spinus tristis*
American Robin	*Turdus migratorius*
American White-winged Scoter	*Melanitta deglandi*
American Woodcock	*Scolopax minor*
Aves	*Aves*
Bald Eagle	*Haliaeetus leucocephalus*
Baltimore Oriole	*Icterus galbula*
Barred Owl	*Strix varia*
Belted Kingfisher	*Megaceryle alcyon*
Black-and-white Warbler	*Mniotilta varia*
Blue-winged Warbler	*Vermivora cyanoptera*
Bonaparte's Gull	*Chroicocephalus philadelphia*
Broad-winged Hawk	*Buteo platypterus*
Brown Thrasher	*Toxostoma rufum*
Canada Goose	*Branta canadensis*
Carolina Wren	*Thryothorus ludovicianus*
Cedar Waxwing	*Bombycilla cedrorum*
Chipping Sparrow	*Spizella passerina*
Common Eider	*Somateria mollissima*
Common Merganser	*Mergus merganser*
Common Yellowthroat	*Geothlypis trichas*
Double-crested Cormorant	*Phalacrocorax auritus*
Eastern Bluebird	*Sialia sialis*
Eastern Kingbird	*Tyrannus*
Eastern Phoebe	*Sayornis phoebe*
European Starling	*Sturnus vulgaris*
Field Sparrow	*Spizella pusilla*
Great Blue Heron	*Ardea herodias*
Great Egret	*Ardea alba*
Greater White-fronted Goose	*Anser albifrons*
Green Heron	*Butorides virescens*
Hawks and Buzzards	*Buteo*
Hermit Thrush	*Catharus guttatus*
Hooded Merganser	*Lophodytes cucullatus*
House Finch	*Haemorhous mexicanus*
House Wren	*Troglodytes aedon*
Indigo Bunting	*Passerina cyanea*

Lanius borealis	*Lanius borealis*
Lincoln's Sparrow	*Melospiza lincolnii*
Northern Cardinal	*Cardinalis cardinalis*
Northern Flicker	*Colaptes auratus*
Northern Yellow-shafted Flicker	*Colaptes auratus luteus*
Olive-sided Flycatcher	*Contopus cooperi*
Osprey	*Pandion haliaetus*
Perching Birds	*Passeriformes*
Peregrine Falcon	*Falco peregrinus*
Pileated Woodpecker	*Dryocopus pileatus*
Pine Grosbeak	*Pinicola enucleator*
Pine Siskin	*Spinus pinus*
Red-bellied Woodpecker	*Melanerpes carolinus*
Red-shouldered Hawk	*Buteo lineatus*
Red-tailed Hawk	*Buteo jamaicensis*
Red-winged Blackbird	*Agelaius phoeniceus*
Rock Pigeon	*Columba livia*
Rose-breasted Grosbeak	*Pheucticus ludovicianus*
Ruby-throated Hummingbird	*Archilochus colubris*
Ruffed Grouse	*Bonasa umbellus*
Scarlet Tanager	*Piranga olivacea*
Snow Bunting	*Plectrophenax nivalis*
Snow Goose	*Anser caerulescens*
Snowy Egret	*Egretta thula*
Snowy Owl	*Bubo scandiacus*
Song Sparrow	*Melospiza melodia*
Tufted Titmouse	*Baeolophus bicolor*
Wild Turkey	*Meleagris gallopavo*
Woodpecker	*Dryobates pubescens*
Yellow-rumped Warbler	*Setophaga coronata*

Reptiles and amphibians are present in the waterways of Vermont. Wetlands are important breeding habitats for amphibians. Upland woodland habitats are also important for terrestrial reptiles and amphibians during the non-breeding periods of their life cycle. Table 18 lists the species of amphibians potentially occurring in the vicinity of the project during breeding or their entire life cycle.

Table 19 lists the species of reptiles potentially occurring in the vicinity of the project.

Table 18. Amphibian Species Potentially Occurring in the vicinity of the Project (IN 2022)

Common Name	Scientific Name
American Toad	*Anaxyrus americanus*
American Water Frogs	*Lithobates*
Eastern American Toad	*Anaxyrus americanus americanus*
Eastern Newt	*Notophthalmus viridescens*
Eastern Red-backed Salamander	*Plethodon cinereus*

Gray Tree Frog	*Hyla versicolor*
Green Frog	*Lithobates clamitans*
Northern Two-lined Salamander	*Eurycea bislineata*
Pickerel Frog	*Lithobates palustris*
Spotted Salamander	*Ambystoma maculatum*
Spring Peeper	*Pseudacris crucifer*
Wood Frog	*Lithobates sylvaticus*

Table 19.Reptillian Species Potentially Occurring in the Vicinity of the Project (IN 2022)

Common Name	Scientific Name
Common Garter Snake	*Thamnophis sirtalis*
Common Snapping Turtle	*Chelydra serpentina*
Dekay's Brownsnake	*Storeria dekayi*
Eastern Garter Snake	*Thamnophis sirtalis sirtalis*
Eastern Milksnake	*Lampropeltis triangulum*
Eastern Painted Turtle	*Chrysemys picta*
Painted Turtle	*Chrysemys picta*

Project Effects

The proposed hydropower project is not anticipated to have any long-term adverse effects on wildlife and botanical resources.

6.5 Floodplains, Wetlands, Riparian & Littoral Habitats

Floodplains

Flood mapping from the Federal Emergency Management Agency (FEMA) of the project is shown in Figure 17. Identified floodplain resources occur in association with the Missisquoi River and include areas upstream and downstream of the dam. The full FEMA map plates and excerpt from the Flood Insurance Study are included as Appendix F.

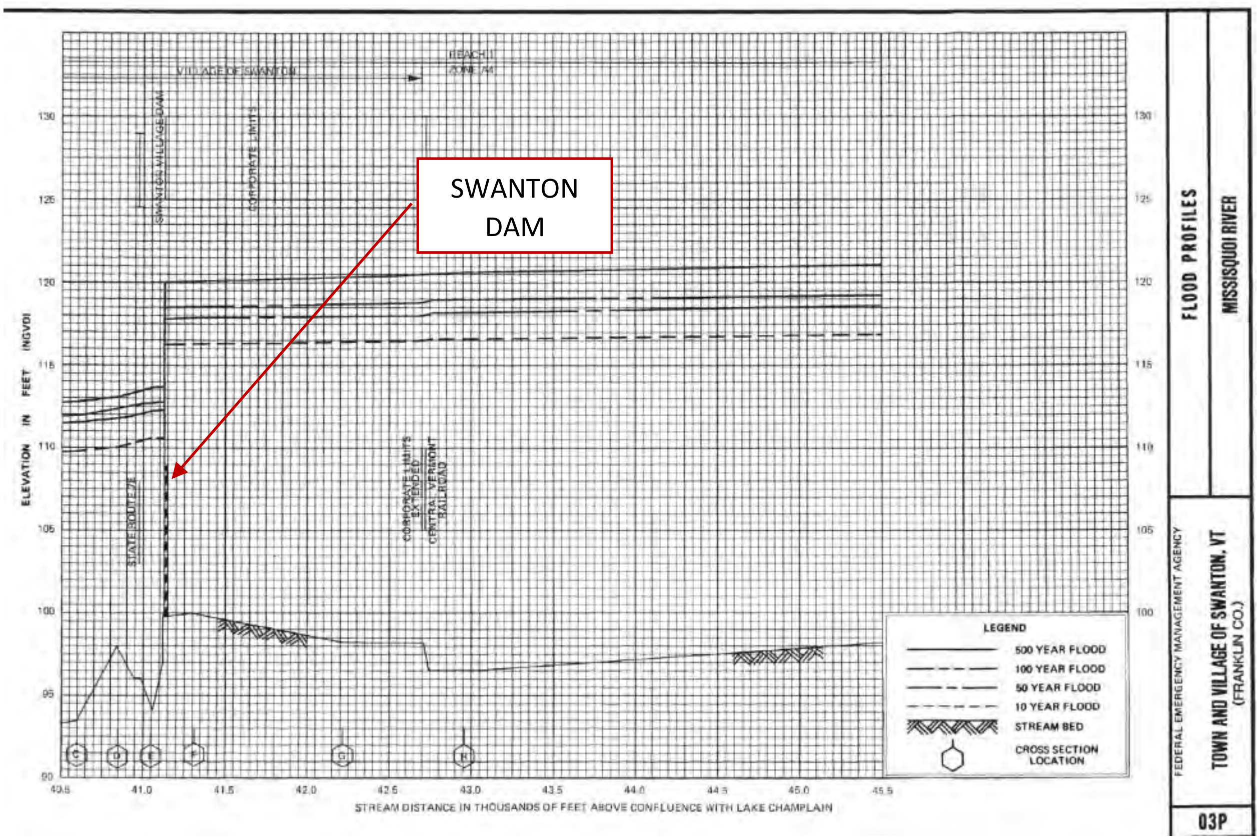


Figure 16. FEMA Flood Insurance Study Town of Swanton, October 18, 1982

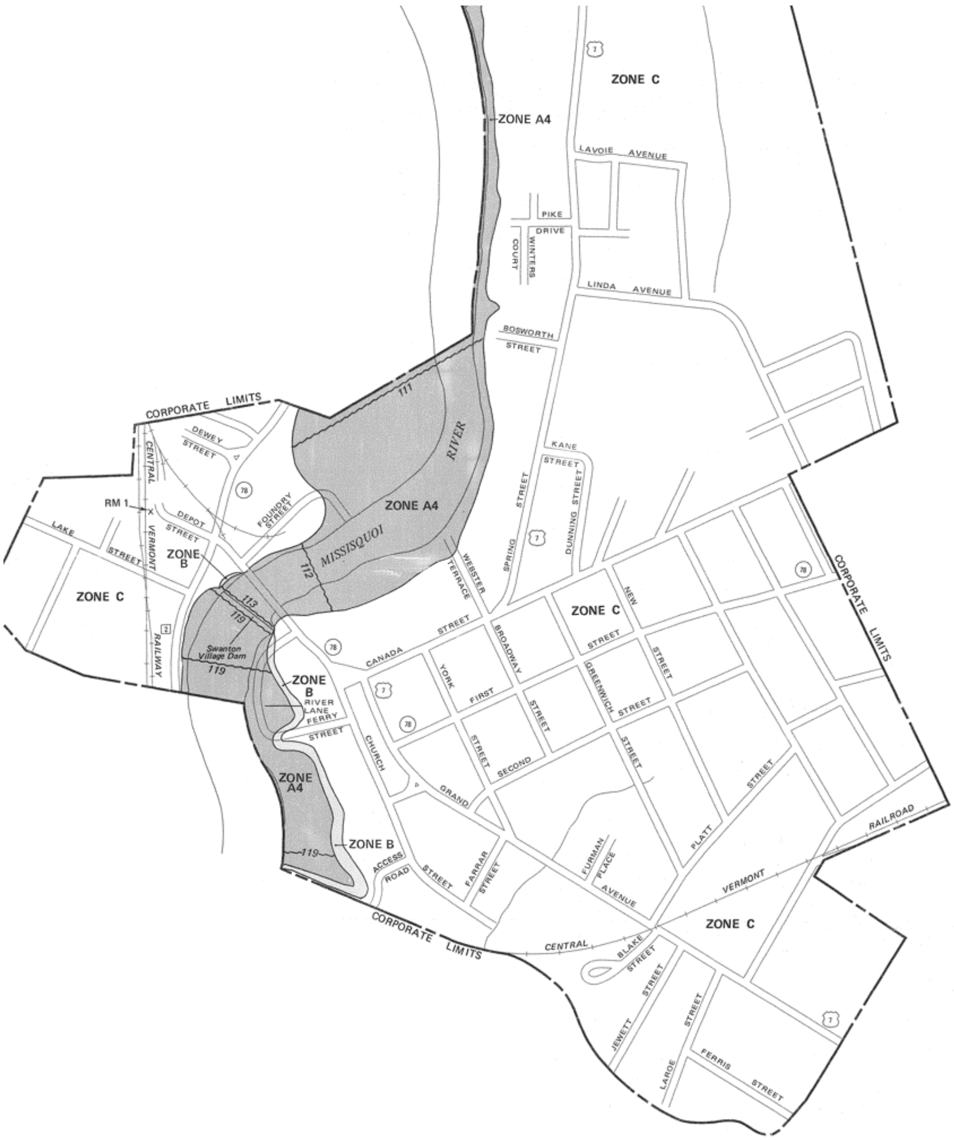


Figure 17. FEMA Mapping Project Area (5006000001B) March 16, 1983

The full FEMA map and channel profile can be found in Appendix F.

Wetlands

Wetlands in the project area are all riverine. Information from the USFWS National Wetlands Inventory (NWI) was reviewed and can be seen in Figure 18.

Figure 18. USFWS Wetlands Mapper Project Area Wetlands

The following descriptions of each wetland's classification type were taken from the USFWS interactive viewer and correspond to Figure 18.

- *R2UBH*

System Riverine (R): The Riverine System includes all wetlands and deep-water habitats contained within a channel, with two exceptions: (1) wetlands dominated by trees, shrubs, persistent emergents, emergent mosses, or lichens, and (2) habitats with water containing ocean-derived salts of 0.5 ppt or greater. A channel is an open conduit either naturally or artificially created which periodically or continuously contains moving water, or which forms a connecting link between two bodies of standing water.

Subsystem Lower Perennial (2): This Subsystem is characterized by a low gradient. There is no tidal influence, and some water flows all year, except during years of extreme drought. The substrate consists mainly of sand and mud. Oxygen deficits may sometimes occur. The fauna is composed mostly of species that reach their maximum abundance in still water, and true planktonic organisms are common. The gradient is lower than that of the Upper Perennial Subsystem and the floodplain is well developed.

Class Unconsolidated Bottom (UB): Includes all wetlands and deep-water habitats with at least 25% cover of particles smaller than stones (less than 6-7 cm), and a vegetative cover less than 30%.

Water Regime Permanently Flooded (H): Water covers the substrate throughout the year in all years.

- *PEM1C*

System Palustrine(P):The Palustrine System includes all non-tidal wetlands dominated by trees, shrubs, persistent emergents, emergent mosses or lichens, and all such wetlands that occur in tidal areas where salinity due to ocean-derived salts is below 0.5 ppt. It also includes wetlands lacking such vegetation, but with all of the following four characteristics: (1) area less than 8 ha (20 acres); (2) active wave-formed or bedrock shoreline features lacking; (3) water depth in the deepest part of basin less than 2.5 m (8.2 feet) at low water; and (4) salinity due to ocean-derived salts less than 0.5 ppt.

Class Emergent (EM): Characterized by erect, rooted, herbaceous hydrophytes, excluding mosses and lichens. This vegetation is present for most of the growing season in most years. These wetlands are usually dominated by perennial plants. Subclass Persistent (1): Dominated by species that normally remain standing at least until the beginning of the next growing season. This subclass is found only in the Estuarine and Palustrine systems. Water Regime Seasonally Flooded(C):Surface water is present for extended periods especially early in the growing season, but is absent by the end of the growing season in most years. The water table after flooding ceases is variable, extending from saturated to the surface to a water table well below the ground surface.

- PFO1C

System Palustrine(P):The Palustrine System includes all non-tidal wetlands dominated by trees, shrubs, persistent emergents, emergent mosses or lichens, and all such wetlands that occur in tidal areas where salinity due to ocean-derived salts is below 0.5 ppt. It also includes wetlands lacking such vegetation, but with all of the following four characteristics: (1) area less than 8 ha (20 acres); (2) active wave-formed or bedrock shoreline features lacking; (3) water depth in the deepest part of basin less than 2.5 m (8.2 feet) at low water; and (4) salinity due to ocean-derived salts less than 0.5 ppt. Class Forested(FO):Characterized by woody vegetation that is 6 m tall or taller. Subclass Broad-Leaved Deciduous(1):Woody angiosperms (trees or shrubs) with relatively wide, flat leaves that are shed during the cold or dry season; e.g., black ash (Fraxinus nigra). Water Regime Seasonally Flooded(C):Surface water is present for extended periods especially early in the growing season, but is absent by the end of the growing season in most years. The water table after flooding ceases is variable, extending from saturated to the surface to a water table well below the ground surface.

Riparian

Riparian habitat within the project area is confined to the area adjacent to the Missisquoi River. This linear habitat feature forms the terrestrial boundary interface with riverine habitats and follows the river's course. Within the project area these habitats are limited in lateral extent by the topography and/or adjacent land use and development. Tree species present within these riparian habitats are typical of Vermont as discussed in Section 6.4.

Littoral

Minimal Littoral zone lacustrine or palustrine wetland resources were identified by the NWI mapping. The area around the reservoir has generally gentle slopes and may be subject to bank overtopping events as noted in the FEMA mapping. However, under normal conditions, flows are generally contained within the channel which has a stable, well defined bank.

Project Effects

It is not anticipated that the project development will have an impact on the extent and or function of the existing floodplain resources within or in the vicinity of the project. Even with the addition of two feet of flashboards, the water level will be contained within the existing banks and the proposed water surface elevations are within the normal flood levels. In the event of a flood, the flashboards will fail/lower and not contribute to any incremental flooding. There are no anticipated project related impacts to river flows or project operations. Since these processes are the primary drivers of wetland formation and maintained as well as riparian and littoral zone habitat dynamics there are no anticipate project related impacts to these resources.

6.6 Rare, Threatened & Endangered Species

Federal

The Endangered Species Act (ESA) of 1973 provides a framework to conserve and protect endangered and threatened species and their habitats. (USFWS 2021c) Under the ESA species may be listed as either endangered or threatened. Endangered means a species in danger of extinction throughout all or a significant portion of its range. "Threatened" means a species is likely to become endangered within the foreseeable future (USFWS 2017).

The USFWS's online Information Planning and Consultation (IPAC) system was reviewed on March 13, 2022 to identify species that are listed as Federally threatened or endangered. As part of the IPAC review, an official species list was requested for the project area. The result of the official species list is that there are two federally listed species that could potentially occur within the project area. However, that there are no critical habitats within the project area. See Appendix G for the full IPAC report. The species identified are as follows:

Northern Long-Eared Bat (*Myotis septentrionalis*) – Status is Threatened

The northern long-eared bat is a medium-sized bat about 3 to 3.7 inches in length but with a wingspan of 9 to 10 inches. As its name suggests, this bat is distinguished by its long ears, particularly as compared to other bats in its genus, Myotis, which are actually bats noted for their small ears (Myotis means mouse-eared). The northern long-eared bat is found across much of the eastern and north central United States and all Canadian provinces from the Atlantic coast west to the southern Northwest Territories and eastern British Columbia. The species' range includes 37 states. White-nose syndrome, a fungal disease known to affect bats, is currently the predominant threat to this bat, especially throughout the Northeast where the species has declined by up to 99 percent from pre-white-nose syndrome levels at many hibernation sites. Although the disease has not yet spread throughout the northern long-eared bat's entire range (white-nose syndrome is currently found in at least 25 of 37 states where the northern long-eared bat occurs), it continues to spread. Experts expect that where it spreads, it will have the same impact as seen in the Northeast (USFWS 2022b).

During summer, northern long-eared bats roost singly or in colonies underneath bark, in cavities, or in crevices of both live and dead trees. Males and non-reproductive females may also roost in cooler places, like caves and mines. This bat seems opportunistic in selecting roosts, using tree species based on suitability to retain bark or provide cavities or crevices. It has also been found, rarely, roosting in structures like barns and sheds. Northern long-eared bats spend winter hibernating in caves and mines, called hibernacula. They typically use large caves or mines with large passages and entrances; constant temperatures; and high humidity with no air currents. Specific areas where they hibernate have very high humidity, so much so that droplets of water are often seen on their fur. Within hibernacula, surveyors find them in small crevices or cracks, often with only the nose and ears visible. (USFWS 2022b)

Northern long-eared bats emerge at dusk to fly through the understory of forested hillsides and ridges feeding on moths, flies, leafhoppers, caddisflies, and beetles, which they catch while in flight using echolocation. This bat also feeds by gleaning motionless insects from vegetation and water surfaces (USFWS 2022b).

Breeding begins in late summer or early fall when males begin swarming near hibernacula. After copulation, females store sperm during hibernation until spring, when they emerge from their hibernacula, ovulate, and the stored sperm fertilizes an egg. This strategy is called delayed fertilization. After fertilization, pregnant females migrate to summer areas where they roost in small colonies and give birth to a single pup. Maternity colonies, with young, generally have 30 to 60 bats, although larger maternity colonies have been observed. Most females within a maternity colony give birth around the same time, which may occur from late May or early June to late July, depending on where the colony is located within the species' range. Young bats start flying by 18 to 21 days after birth. Adult northern long-eared bats can live up to 19 years (USFWS 2022b).

Monarch Butterfly (Danaus plexippus) – Status Candidate

Adult monarch butterflies are large and conspicuous, with bright orange wings surrounded by a black border and covered with black veins. The black border has a double row of white spots, present on the upper side of the wings. Adult monarchs are sexually dimorphic, with males having narrower wing venation and scent patches. The bright coloring of a monarch serves as a warning to predators that eating them can be toxic.

During the breeding season, monarchs lay their eggs on their obligate milkweed host plant (primarily Asclepias spp.), and larvae emerge after two to five days. Larvae develop through five larval instars (intervals between molts) over a period of 9 to 18 days, feeding on milkweed and sequestering toxic chemicals (cardenolides) as a defense against predators. The larva then pupates into a chrysalis before emerging 6 to 14 days later as an adult butterfly. There are multiple generations of monarchs produced during the breeding season, with most adult butterflies living approximately two to five weeks; overwintering adults enter into reproductive diapause (suspended reproduction) and live six to nine months.

In many regions where monarchs are present, monarchs breed year-round. Individual monarchs in temperate climates, such as eastern and western North America, undergo long-distance migration, and live for an extended period of time. In the fall, in both eastern and western North America, monarchs begin migrating to their respective overwintering sites. This migration can take monarchs distances of over 3,000 km and last for over two months. In early spring (February-March), surviving monarchs break diapause and mate at the overwintering sites before dispersing. The same individuals that undertook the initial southward migration begin flying back through the breeding grounds and their offspring start the cycle of generational migration over again (USFWS 2021c).

<u>State</u>

The State of Vermont protects Endangered Species under Vermont Statute Annotated Chapter 10 (Conservation and Development) Chapter 123 (Protection of Endangered Species) (State of VT 2021).

The Vermont Open Geo-data Portal has a GIS layer titled "Rare, Threatened and Endangered". The Summary description of this layer is as follows:

> *Rare, Threatened and Endangered Species information. Note: This updated dataset does NOT include Significant Natural Community Data. Please download this data separately. The Vermont Fish and Wildlife Department's Natural Heritage Inventory (NHI) maintains a database of rare, threatened and endangered species and natural (plant) communities in Vermont. The Department*

> *is a member of the network of Natural Heritage Programs and Conservation Data Centres network that collaborates with NatureServe, which is the umbrella organization. The Element Occurrence (EO) records that form the core of the Natural Heritage Inventory database include information on the location, status, characteristics, numbers, condition, and distribution of elements of biological diversity using established Natural Heritage Methodology developed by NatureServe and The Nature Conservancy. An Element Occurrence (EO) is an area of land and/or water in which a species or natural community is, or was, present. An EO should have practical conservation value for the Element as evidenced by potential continued (or historical) presence and/or regular recurrence at a given location. For species Elements, the EO often corresponds with the local population, but when appropriate may be a portion of a population or a group of nearby populations (e.g., metapopulation). For community Elements, the EO may represent a stand or patch of a natural community, or a cluster of stands or patches of a natural community. Because they are defined on the basis of biological information, EOs may cross jurisdictional boundaries. An Element Occurrence record is a data management tool that has both spatial and tabular components including a mappable feature and its supporting database. EOs are typically represented by bounded, mapped areas of land and/or water or, at small scales, the centroid point of this area. EO records are most commonly created for current or historically known occurrences of natural communities or native species of conservation interest. (State of VT 2021a)*

Separately, Vermont Open Geodata Portal has a GIS layer titled “Vermont Significant Communities”. The summary description of this layer is as follows:

> *Vermont Significant Natural Communities. Note: This dataset no longer includes Rare, Threatened, and Endangered Species data. Please download this dataset separately. The Vermont Fish and Wildlife Department's Natural Heritage Inventory (NHI) maintains a database of rare, threatened and endangered species and natural (plant) communities in Vermont. The Department is a member of the network of Natural Heritage Programs and Conservation Data Centers network that collaborates with NatureServe, which is the umbrella organization. The Element Occurrence (EO) records that form the core of the Natural Heritage Inventory database include information on the location, status, characteristics, numbers, condition, and distribution of elements of biological diversity using established Natural Heritage Methodology developed by NatureServe and The Nature Conservancy. An Element Occurrence (EO) is an area of land and/or water in which a species or natural community is, or was, present. An EO should have practical conservation value for the Element as evidenced by potential continued (or historical) presence and/or regular recurrence at a given location. For species Elements, the EO often corresponds with the local population, but when appropriate may be a portion of a population or a group of nearby populations (e.g., metapopulation). For community Elements, the EO may represent a stand or patch of a natural community, or a cluster of stands or patches of a natural community. Because they are defined on the basis of biological information, EOs may cross jurisdictional boundaries. An Element Occurrence record is a data management tool that has both spatial and tabular components including a mappable feature and its supporting database. EOs are typically represented by bounded, mapped areas of land and/or water or, at small scales, the centroid point of this area. EO records are most commonly created for current or historically known occurrences of natural communities or native species of conservation interest. (State of VT 2021b)*

VANR layers were updated on March 12, 2021, according to the Vermont Open Geodata Portal. Both layers were plotted relative to the Swanton Project. As shown in Figure 19 there are both RTE Species and Significant Natural Communities within the project area. The exact species are not disclosed within the GIS layers.

Figure 19. VT ANR Rare, Threatened & Endangered Species (top) and VT ANR Significant Natural Communities (bottom)

In a February 22, 2022 letter from VTDEC to FERC (Appendix B) regarding the upstream Highgate Falls (p-2547) relicensing VTDEC provided State RTE Species in the project area as shown in Figure

Highgate Falls Hydroelectric Project – FERC No. 2547
Rare, Threatened or Endangered Taxa
January 9, 2020

APPENDIX B

A tabular summary of rare, threatened, or endangered taxa present within the potential area of project influence. This covers Atlas records that can also be viewed at http://anrmaps.vermont.gov/websites/anra5/ .

Scientific Name	Common Name	State Rank	State Protection Status	Last Observation
Between Highgate Falls and Swanton Village Dam				
Lasmigona costata	Fluted-shell	S2	E	1998
Anodontoides ferussacianus	Cylindrical Papershell	S1S2	E	1998
Moxostoma macrolepidotum	Shorthead Redhorse	S2		2011-07
Pyganodon grandis	Giant Floater	S2S3	T	8/15/2013
Lethenteron appendix	American Brook Lamprey	S1	T	2013
Moxostoma valenciennesi	Greater Redhorse	S1		2011-07
Moxostoma anisurum	Silver Redhorse	S2		2000
Noturus flavus	Stonecat	S1	E	2011
Ammocrypta pellucida	Eastern Sand Darter	S1	T	2011
Lethenteron appendix	American Brook Lamprey	S1	T	2013
Lampsilis ovata	Pocketbook	S2	E	7/17/2014
Ligumia recta	Black Sandshell	S1	E	1998
Anemone multifida var. multifida	Early Thimbleweed	S1	E	1873
Between Enosburg Falls and Highgate Falls (potentially influenced by Sheldon Springs project)				
Anodontoides ferussacianus	Cylindrical Papershell	S1S2	E	8/22/1983
Hypericum ascyron	Great St. John's-wort	S2	T	8/25/1992
Lathyrus palustris	Marsh Vetchling	S2	T	7/30/2008
Allium canadense var. canadense	Wild Garlic	S1	T	7/15/1983
Elymus macgregorii	MacGregor's Wild Rye	SH		8/18/1972
Monarda punctata	Dotted Horsemint	S1		2012
Anodontoides ferussacianus	Cylindrical Papershell	S1S2	E	8/22/1983

Figure 20. RTE information Part 1 (VTDEC Letter 02/22/22)

Highgate Falls Hydroelectric Project – FERC No. 2547
Rare, Threatened or Endangered Taxa
January 9, 2020

A tabular summary of rare, threatened, or endangered taxa present within the potential area of project influence. This covers Atlas records that can also be viewed at http://anrmaps.vermont.gov/websites/anra5/ Continued.

Scientific Name	Common Name	State Rank	State Protection Status	Last Observation
Downstream of Swanton Village Dam				
Acipenser fulvescens	Lake Sturgeon	S1	E	1990
Ammocrypta pellucida	Eastern Sand Darter	S1	T	2011
Anodontoides ferussacianus	Cylindrical Papershell	S1S2	E	1998
Apalone spinifera	Spiny Softshell (Turtle)	S1	T	6/29/2013
Carpiodes cyprinus	Quillback	S1		2001
Ichthyomyzon unicuspis	Silver Lamprey	S2?		2013
Lampsilis ovata	Pocketbook	S2	E	7/17/2014
Lasmigona costata	Fluted-shell	S2	E	1998
Leptodea fragilis	Fragile Papershell	S2	E	7/17/2014
Lethenteron appendix	American Brook Lamprey	S1	T	2013
Ligumia recta	Black Sandshell	S1	E	1998
Moxostoma anisurum	Silver Redhorse	S2		2000
Moxostoma macrolepidotum	Shorthead Redhorse	S2		2011-07
Moxostoma valenciennesi	Greater Redhorse	S1		2011-07
Najas gracillima	Slender Naiad	S2		8/27/1929
Necturus maculosus	Mudpuppy	S2		10/14/2014
Notropis heterolepis	Blacknose Shiner	S1		8/14/1985
Noturus flavus	Stonecat	S1	E	2011
Potamilus alatus	Pink Heelsplitter	S2	E	7/17/2014
Pyganodon grandis	Giant Floater	S2S3	T	8/15/2013

Figure 21. RTE information Part 2 (VTDEC Letter 02/22/22)

Project Effects

Although the Northern Long-eared bat and Monarch Butterfly are reported to occur in the general area, there are no known occurrences within the project area. The flashboards are proposed to raise the normal water surface elevation by two feet, the water level is within the normal hydraulic range of the river.

The VTDEC summary of RTE species is important information in starting to understand complexities of the project area. However, it is important to have up-to-date, site specific information. Therefore, the Applicant will work with VTDEC to establish a new list for the project.

6.7 Recreation & Land Use

Recreation

Franklin County has approximately 4,819 acres of municipal parks and open spaces available for recreation. Within these facilities there are 11 designated picnic areas, 12 playgrounds, 11 miles of hiking trail, three miles of walking/biking trail, and two miles of trail for snowshoeing and cross-country skiing. There are also dozens of outdoor athletic facilities for activities such as basketball, lacrosse, tennis, and more. The Vermont Department of Forests, Parks, and Recreation operates the 26.4 mile-long Missisquoi Valley Rail Trail from Richford to St. Albans, a portion of which runs through Franklin County (SCORP 2014).

The Missisquoi River offers recreationists the opportunity for canoeing, swimming, fishing, picnicking, hunting, and nature trails. At the project site, fishing and canoeing are the main recreational uses. There is an informal canoe portage and fishing access area upstream and downstream of the project. Marble Mill Park, located just downstream of the proposed project and developed with funding from Interior through the Land and Water Conservation Fund (LWCF), provides picnic and playground facilities.

Land Use

A majority of the lands within the Missisquoi River drainage basin are undeveloped wooded areas or agricultural areas. The percentage of urban developed area within the Missisquoi drainage area is approximately 3.5 percent with an average percent impervious area of 0.76 percent. The drainage basin includes about 2.8 percent of waterbodies and wetlands. (Stream Stats 2022 a). The watershed is approximately 66 percent forested and 25 percent agricultural. (VANR 2013)

The principal features of the proposed Swanton project will be located in downtown Swanton Vermont and is entirely within an urban area historically known for its industrial use.

Project Effects

It is not anticipated that development of the hydropower project will have any impact to the existing recreational and land uses. The dam is an existing structure and the proposed project will be operated in run-of-river mode.

6.8 Cultural & Historic Resources

The Town of Swanton was chartered in 1736 as one of the New Hampshire Land Grants by Benning Wentworth, the governor of the Province of New Hampshire. In 1790 the first dam at the falls was completed. In 1812 the first trestle bridge was built at the falls and Joseph Atkinson built the first marble mill. By 1824 the village consisted of a meeting house, two school houses, three taverns, five stores, a grist mill, five saw mills, two fulling mills, two wooden mills, four marble mills, a forge, and about 75 dwellings. See Figure 22 for a view of the falls and Marble Mill.

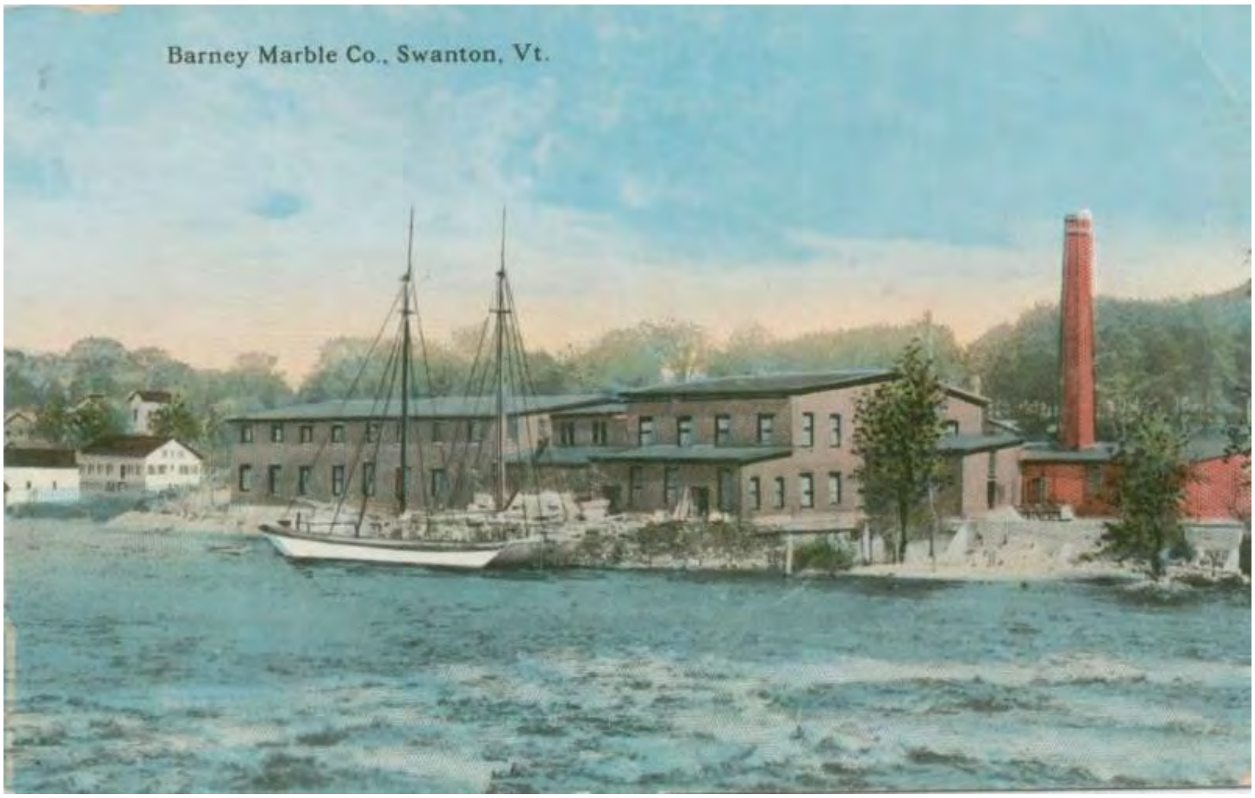


Figure 22. Barney Marble Co. Swanton, VT (SHS 2022)

In 2013, human artifacts dating from 7,000 years ago were found near the Missisquoi River, including a Neville-type stone object that may have been attached to a spear (Murray 2013).

In 1994 the Swanton Village Historic District was formed which abuts the dam location. A description of the district includes the following and is shown in Figure 23:

> *The town's growth was insured by its location at Swanton Falls on the Missisquoi River on whose eastern bank the historic district lies. The Falls wexethe power source for marble, planning, sash and grist mills, many of which, had they not been demolished, would lie in the historic district. Several foundations of these mills remain in the historic district. Swanton's economy was also supported by tanneries lime works, and munitions production.*

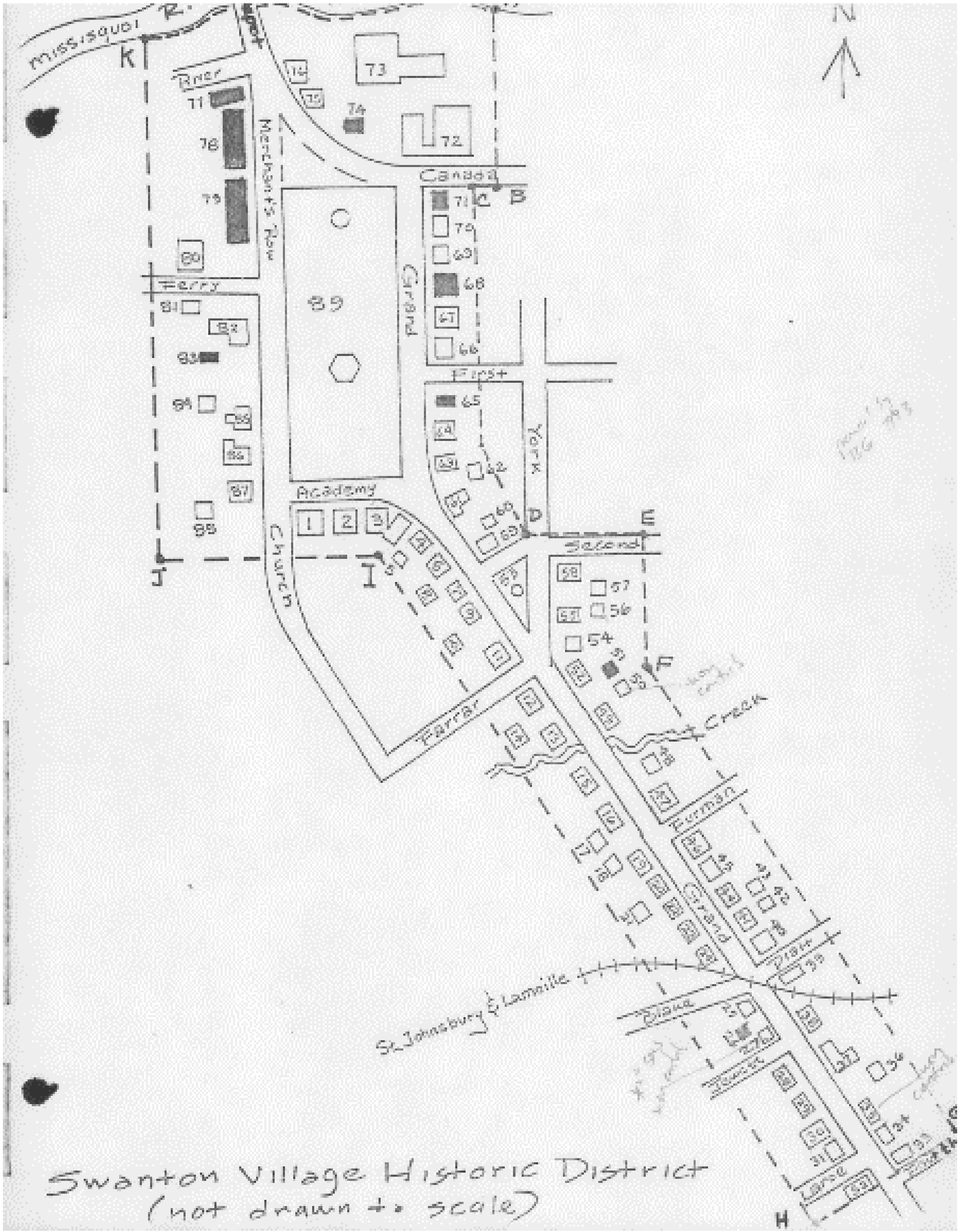


Figure 23. Swanton Village Historic District (SHPO 2008)

Separately, the dam was nominated for the State Register of Historic Places and is described as follows:

The current dam that crosses the Missisquoi River in Swanton, Vermont was built circa 1929 to replace an earlier heavy timber frame dam, which had been in place since the late 18lh century. The naturally occurring falls at this location made the site a key spot to which a number of communities would stake claim. Native people occupied the site for hundreds of years prior to European contact, only to be removed in the mid-18th century by French settlers. As a site of European and later Colonial inhabitation, and throughout its early years of settlement, the area surrounding Swanton Falls would support a variety of activities and peoples. With the building of a dam in the late 18th century, that use would explode, and continue to grow for the next century and a half, supporting a vibrant town and village center. As the ownership of the falls changed hands, the use of the inherent waterpower grew more complex. Among the industries once powered by the Swanton Dam were sawmills, gristmills, marble mills, woolen mills, tanneries, iron works, and ammunitions manufacturing. Opportunities such as boating, fishing, swimming, and ice harvesting, both above and below the dam were also important community uses created by the dam. After World War II, as industry began to leave Vermont, many of the mills which were powered by the dam closed or left town. Between the 1920's and 1940's the town and village of Swanton purchased the last remaining mill buildings on the east and west side of the river respectively and with them, the water rights and ownership of the dam. It was during this time that a concrete gravity dam was erected approximately ten to fifteen feet downriver from the older heavy timber dam. Over the years that followed all but one of the former mill buildings was demolished and today the dam survives as one of the last reminders of a long history of settlement, water-use, and industry on the banks of the Missisquoi River (SHPO 2008).

Project Effects

It is not anticipated that the development and operation of the proposed project will have an impact on the historic or cultural resources of the area. If anything, utilization of the dam for the purpose of power generation is consistent with the historic use and preservation.

6.9 Socioeconomic Resources

The population of Swanton, VT was 6,701 in 2020 and 6,472 in 2010 indicating a slight increase in population. Approximately 21.8% of the population is under 18 years old, 14.6% of the population is over 65 years old and 63.8% of the population is between 18 and 65 years old. The median household income in 2020 dollars is $67,783.

Additional census information can be found in Appendix H.

Project Effects

It is anticipated that development of the project will provide a positive benefit through the use of local staff and contractors both during construction and long term. It is also a source of renewable clean energy available for the local power grid.

6.10 Aesthetic Resources

Swanton Dam is located in an urban development area within the heart of Swanton, VT. The project is visible from Merchant's Row Road.

Photo 1. View of Swanton Dam from Merchant's Row Road (Google Street View)

The primary aesthetic resources within the project area is the water falling over the dam. A minimum flow of 1" of water over the dam (20 cfs) is proposed.

Project Effects

It is not anticipated that development of the hydropower project will have any impacts to the aesthetic resources in the project area.

6.11 Tribal Resources

Vermont's Native history started 12,900 years ago when people called the Paleo-Indians first moved into the land, now called Vermont. Since these earliest occupations nearly 13,000 years ago, Native communities have continually lived in Vermont. Native knowledge, experience, and traditions have deeply influenced many aspects of Vermont's rich history (VCNAA 2021).

The Abenaki are one of the Algonquian-speaking peoples of northeastern North America. Ethnologists have classified the Abenaki by geographic groups: Western Abenaki and Eastern Abenaki. Within those groups there are several bands. The Eastern Abenaki are generally located in Maine while the Western Abenaki are located in Vermont, New Hampshire and Southern Quebec.

There are no Federally recognized Tribes in the State of Vermont. (NCSL 2021a) However, there are four Tribes recognized by the State of Vermont as follows (NCSL 2021b):

- Elnu Abenaki Tribe (http://elnuabenakitribe.org/)
- Nulhegan Band of the Coosuk Abenaki Nation (https://abenakitribe.org/)
- Koasek Abenaki Tribe (https://koasek-abenaki.com/)
- Missisquoi Abenaki Tribe (https://www.abenakination.com/)

On April 22, 2011 the Elnu Abenaki Tribe and Nulhegan Abenaki Tribe received tribal recognition by the State of Vermont. On May 7, 2012 The Koasek Band of the Kao Abenaki Nation and Abenaki Nation at Missisquoi received tribal recognition by the State of Vermont (VCNAA 2021).

Outreach to all four Abenaki tribal bands listed above will be completed as part of project development.

Project Effects

There are no known identified sacred tribal sites or lands within the project area and no federal reservations in the vicinity of the Project. It is not anticipated that the use of an existing dam will have any impacts to the tribal resources.

7.0 Preliminary Issues, Studies, Comprehensive Plans

Preliminary Issues

Throughout Section 6, a discussion or statement of the potential effect of the potential project on resources as made. Table 20 summarizes those findings.

Table 20. Summary Potential Effect of the proposed Swanton Project and Proposed Studies

Resource	Potential Impact
Water	Minimal impact. Run of River Operations. Existing Dam. Proposed DO/Temp Study.
Geology & Soils	Minimal impact. Existing Dam.
Fish & Aquatic	Known migratory species in vicinity of project. Project will provide improvement over existing condition through construction of fish passage facilities. Proposed fish passage study.
Wildlife & Botanical	Minimal impact. Run of River Operations. Existing Dam. Proposed mussel study to better understand site specific colonies.
Floodplain, Wetlands, Riparian & Littoral Habitat	Minimal impact. Run of River Operations. Existing Dam.
RTE Species	Minimal impact. Run of River Operations. Existing Dam.
Recreation & Land Use	Minimal impact. Run of River Operations. Existing Dam.
Cultural & Historic	Minimal impact. Run of River Operations. Existing Dam.
Socioeconomic	Minimal impact. Run of River Operations. Existing Dam.
Aesthetic	Minimal impact. Run of River Operations. Existing Dam. Proposed 1” spill in accordance with typical State request.
Tribal	Minimal impact. Run of River Operations. Existing Dam.

Licensee Proposed Studies

Applicant is proposing the following studies:

- *Water Quality*
- *Fish Passage*
- *Mussel Assemblage*

Relevant Qualifying Federal and State Comprehensive Plans

In March 2021, FERC published a document listing every comprehensive plan by State. (FERC 2021) There are a total of 46 comprehensive plans in effect for the State of Vermont. Based on a review of these plans, it appears that the following are relevant to the project.

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- Vermont Department of Fish and Wildlife. 2018. The Vermont Plan for Brook, Brown, and Rainbow Trout. Montpelier, Vermont. January 2018.
- Vermont Department of Forests, Parks and Recreation. 2013. Vermont State Comprehensive Outdoor Recreation Plan (SCORP): 2014-2018. Montpelier, Vermont. August 2013.

8.0 PURPA Benefits

The Applicant is not seeking benefits under 210 for the Public Utility Regulatory Policies Act of 1987.

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APPENDIX A – PROJECT MAPS


-10.79°
MAGNETIC NORTH
TRUE NORTH
SWANTON, VT
UNITED STATES / CANADIAN BORDER
PROJECT LOCATION
MISSISQUOI RIVER
LAKE CHAMPLAIN
LOWER SWANTON P-XXXXX
MARCH 12, 2022
STONE RIDGE HYDRO, LLC
LOCUS SHEET 1 OF 1
SCALE 1:100000
WE ARE HYDRO
413-362-5410

EXISTING HIGH GATEFALLS PROJECT FERC P-2547
-10.79°
MAGNETIC NORTH
TRUE NORTH
Legend
Project Boundary
VTPARCELS_Highgate
VTPARCELS_Swanton
SEE SHEET 2 FOR DETAILS OF PROJECT DEVELOPMENT AREA
BOUNDARY AROUND RESERVOIR FOLLOWS EL. 110 MSL
LOWER SWANTON P-XXXXX
MARCH 12, 2022
STONE RIDGE HYDRO, LLC
BOUNDARY SHEET 1 OF 2
SCALE 1:10000
WE ARE HYDRO
413-362-5410

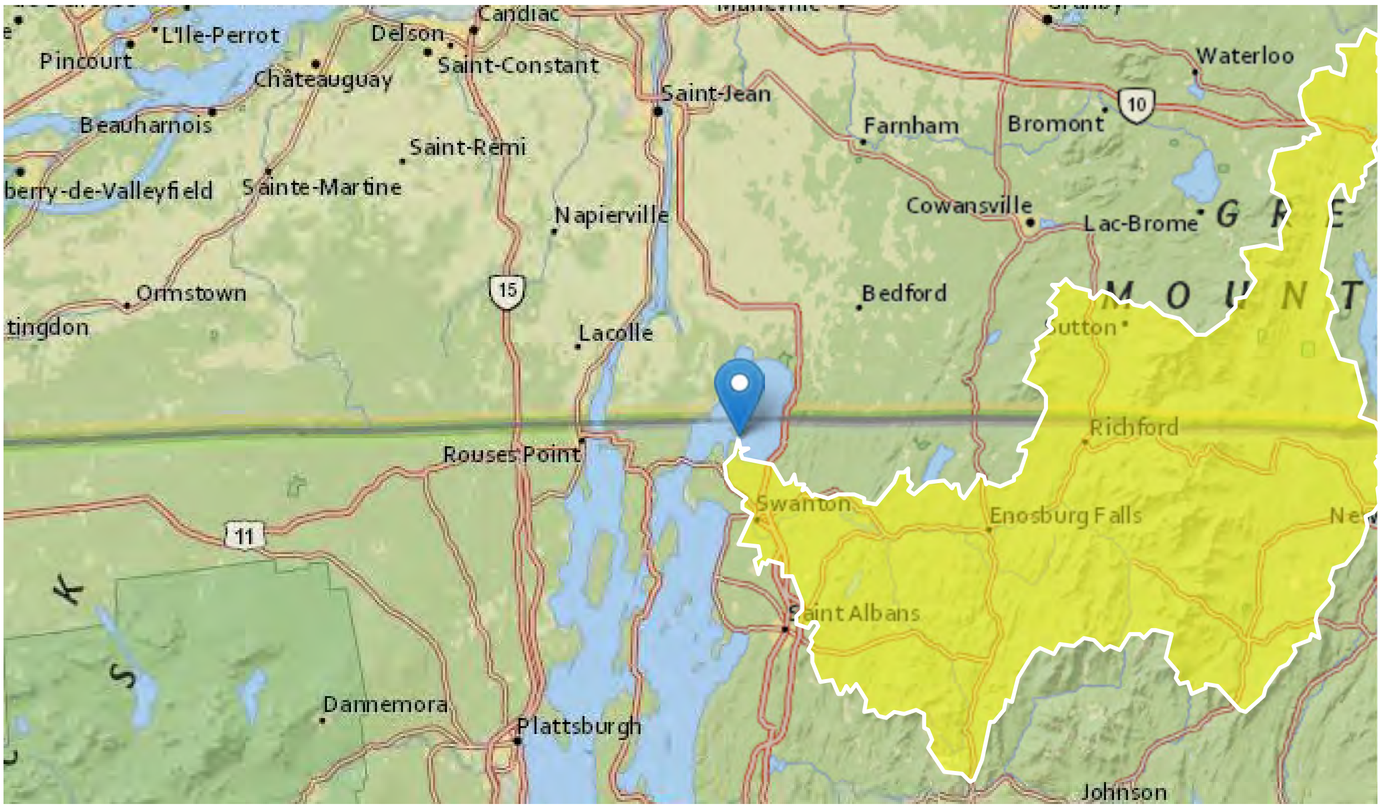

PARCEL NO. FO0005
MAP / LOT: 98 / 121
OWNER: DAVID FOSGATE JR
STATUS: APPLICANT PLANS TO
AQUIRE RIGHTS AS NEEDED
FISH PASSAGE
TAILRACE
TRANSMISSION LINE
SUBSTATION
DAM
POWERHOUSE
INTAKE
STRUCTURE
BOUNDARY AROUND RESERVOIR
FOLLOWS EL. 110 MSL
PARCEL NO. ME0001
BOOK / PAGE: N/A
OWNER: VILLAGE OF SWANTON, MARBLE MILL PARK
STATUS: APPLICANT PLANS TO AQUIRE RIGHTS AS NEEDED
-10.79°
MAGNETIC NORTH
TRUE NORTH
Legend
Project Boundary
VTPARCELS_Highgate
VTPARCELS_Swanton
LOWER SWANTON P-XXXXX
MARCH 12, 2022
STONE RIDGE HYDRO, LLC
SHEET 2 OF 2
SCALE 1:1000
WE ARE HYDRO
413-362-5410

-10.79°
MAGNETIC NORTH
TRUE NORTH
Legend
Project Boundary
Rare%2C_Threatened%2C_and_Endangered_Species
LOWER SWANTON P-XXXXX
MARCH 12, 2022
RARE, THREATENED, ENDANGERED
ELEVATION SHEET 1 OF 1
SCALE 1:10000
WE ARE HYDRO
413-362-5410

APPENDIX B – STREAM STATS REPORTS

StreamStats Report

Region ID: VT
Workspace ID: VT20220411130637670000
Clicked Point (Latitude, Longitude): 44.99506, -73.14908
Time: 2022-04-11 09:06:58 -0400



Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
CENTROIDX	Basin centroid horizontal (x) location in state plane coordinates	490010	meters
CENTROIDY	Basin centroid vertical (y) location in state plane units	272057.2	meters
DRNAREA	Area that drains to a point on a stream	862	square miles
EL1200	Percentage of basin at or above 1200 ft elevation	27.4	percent
LC06STOR	Percentage of water bodies and wetlands determined from the NLCD 2006	2.84	percent

Parameter Code	Parameter Description	Value	Unit
LC11DEV	Percentage of developed (urban) land from NLCD 2011 classes 21-24	3.49	percent
LC11IMP	Average percentage of impervious area determined from NLCD 2011 impervious dataset	0.76	percent
OUTLETX	Basin outlet horizontal (x) location in state plane coordinates	448825	feet
OUTLETY	Basin outlet vertical (y) location in state plane coordinates	277405	feet
PRECPRIS10	Basin average mean annual precipitation for 1981 to 2010 from PRISM	48.6	inches

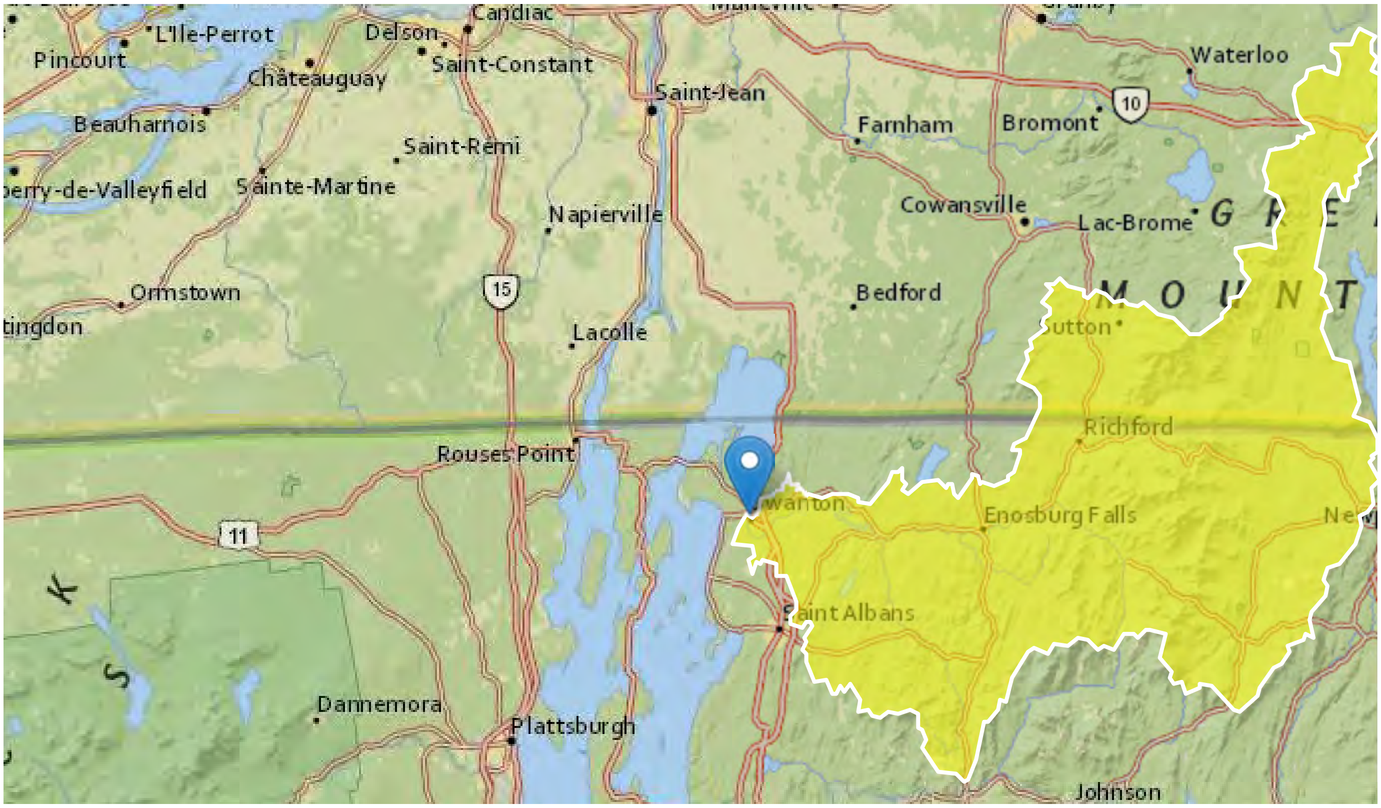
General Disclaimers

The delineation point is in an exclusion area. WARNING! Some of this stream's watershed is in Canada. Not all basin characteristics needed to solve the peak flow regression equations are available.

Application Version: 4.8.1
StreamStats Services Version: 1.2.22
NSS Services Version: 2.1.2

StreamStats Report Swanton Hydropower Project

Region ID: VT
Workspace ID: VT20220411131003393000
Clicked Point (Latitude, Longitude): 44.92060, -73.12788
Time: 2022-04-11 09:10:26 -0400



Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
CENTROIDX	Basin centroid horizontal (x) location in state plane coordinates	490505.7	meters
CENTROIDY	Basin centroid vertical (y) location in state plane units	272047.4	meters
DRNAREA	Area that drains to a point on a stream	852	square miles
EL1200	Percentage of basin at or above 1200 ft elevation	27.7	percent
LC06STOR	Percentage of water bodies and wetlands determined from the NLCD 2006	2.22	percent

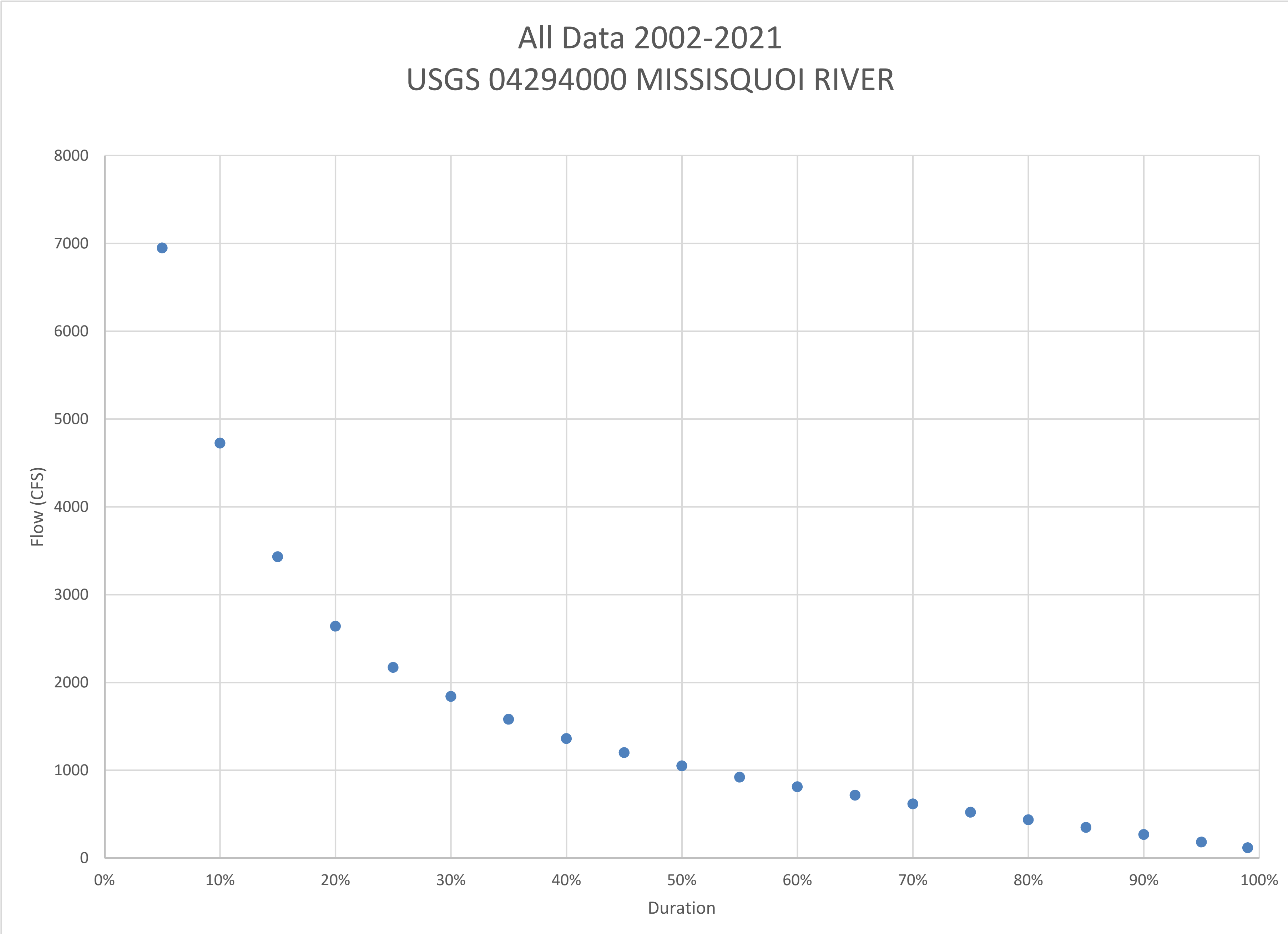
Parameter Code	Parameter Description	Value	Unit
LC11DEV	Percentage of developed (urban) land from NLCD 2011 classes 21-24	3.35	percent
LC11IMP	Average percentage of impervious area determined from NLCD 2011 impervious dataset	0.71	percent
OUTLETX	Basin outlet horizontal (x) location in state plane coordinates	450435	feet
OUTLETY	Basin outlet vertical (y) location in state plane coordinates	269125	feet
PRECPRIS10	Basin average mean annual precipitation for 1981 to 2010 from PRISM	48.7	inches

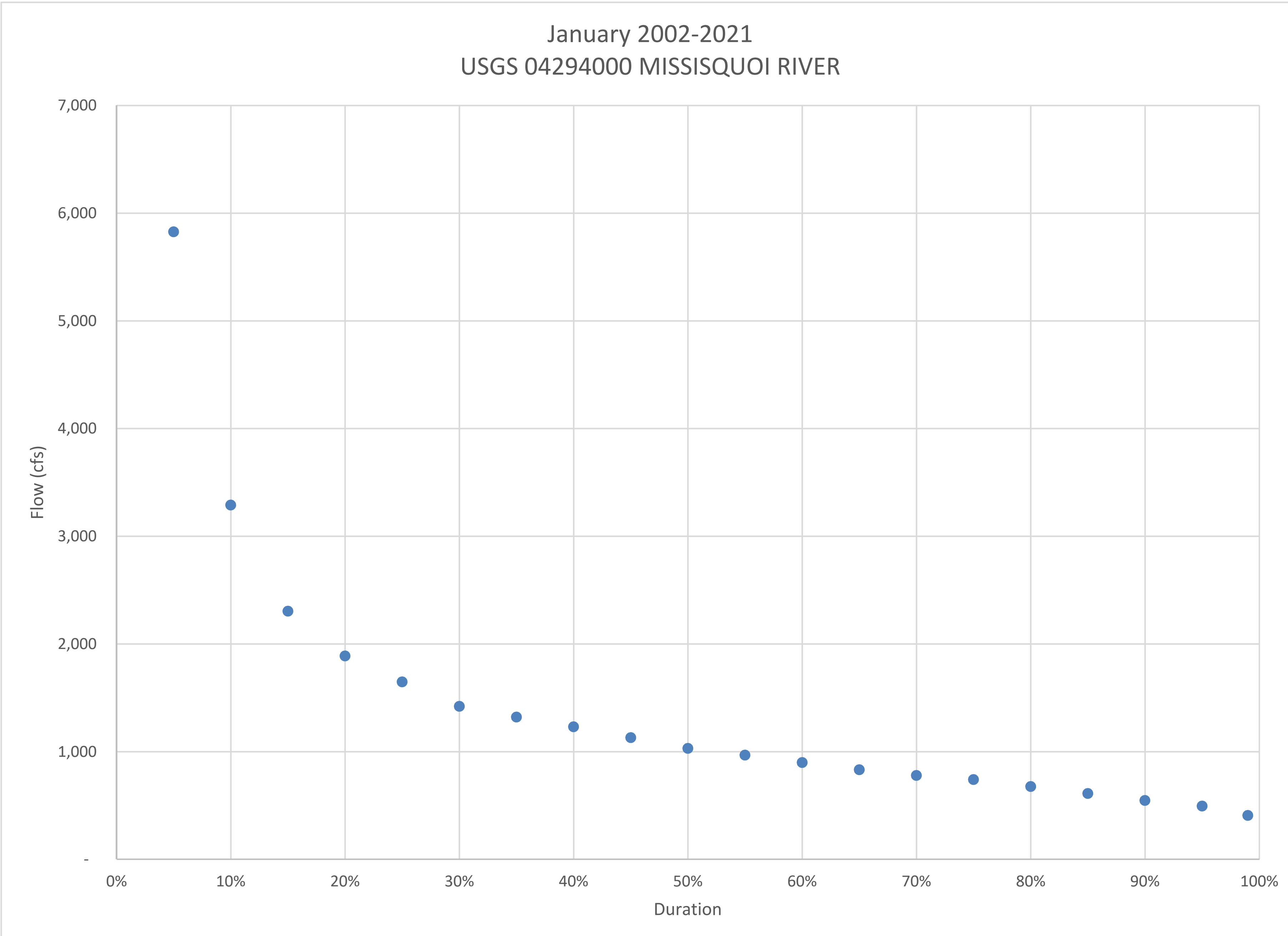
General Disclaimers

The delineation point is in an exclusion area. WARNING! Some of this stream's watershed is in Canada. Not all basin characteristics needed to solve the peak flow regression equations are available.

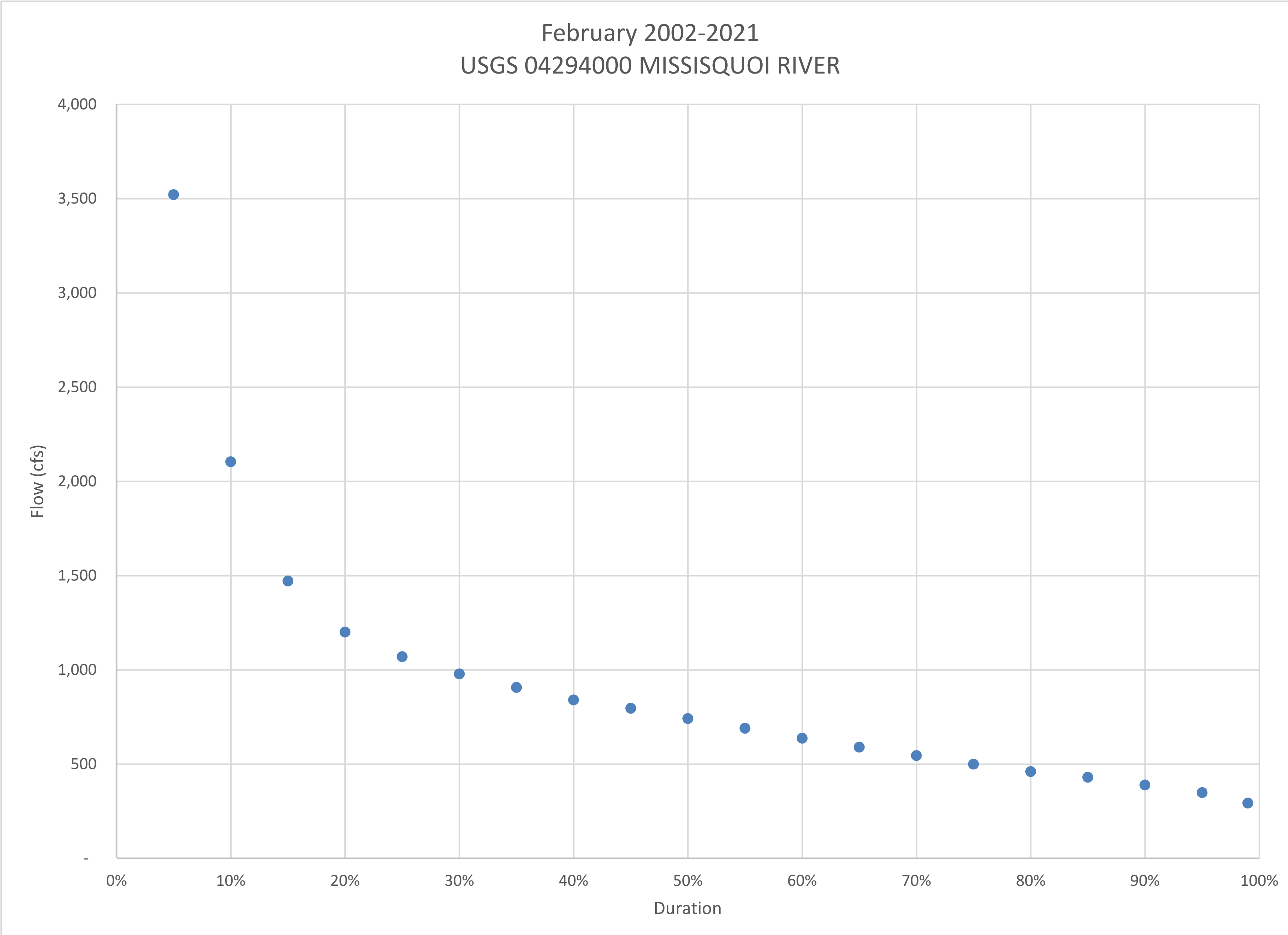
Application Version: 4.8.1
StreamStats Services Version: 1.2.22
NSS Services Version: 2.1.2

APPENDIX C – MONTHLY FLOW DURATION CURVES

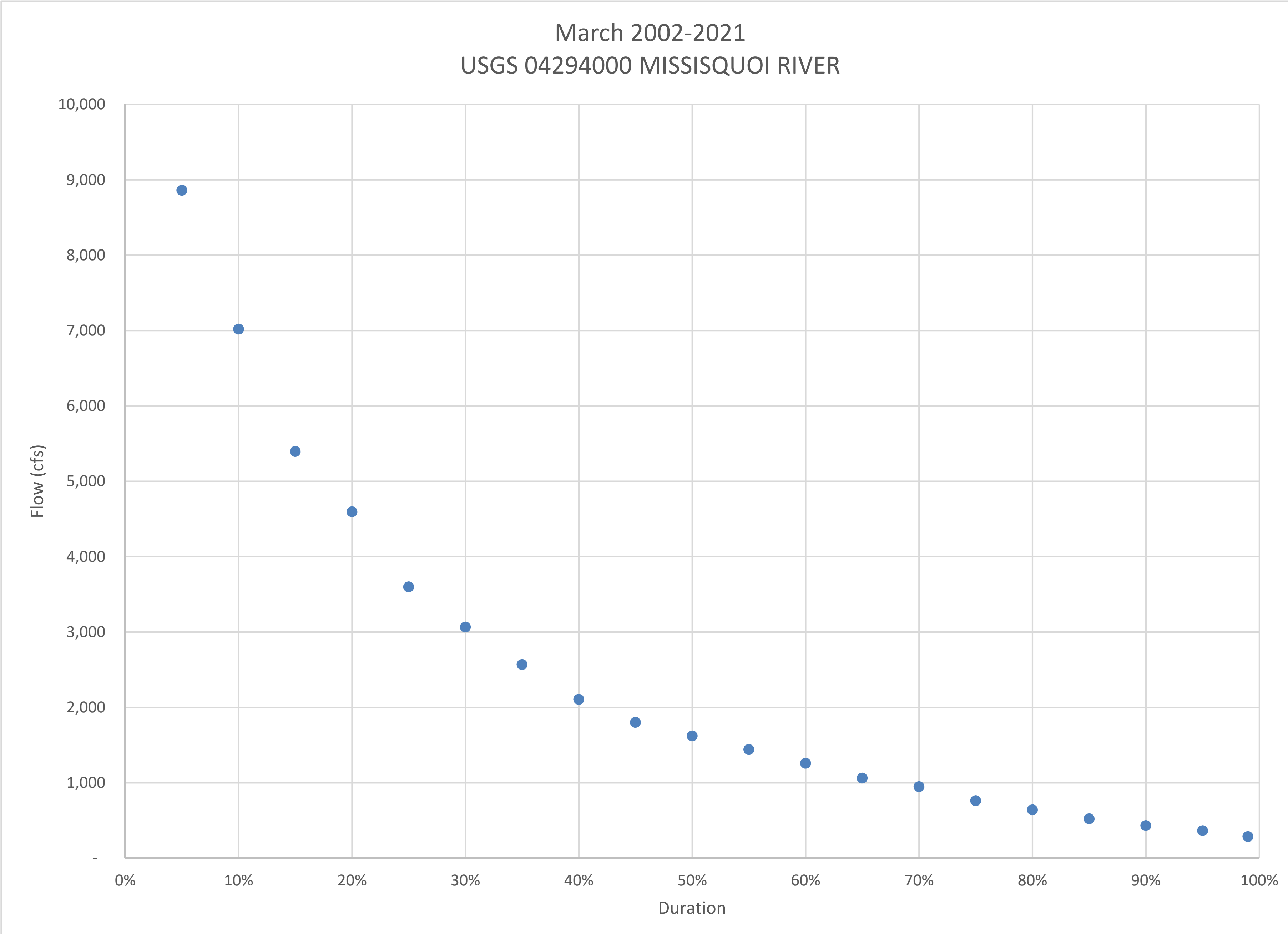

All Data 2002-2021
USGS 04294000 MISSISQUOI RIVER
Flow (CFS)
8000
7000
6000
5000
4000
3000
2000
1000
0
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Duration



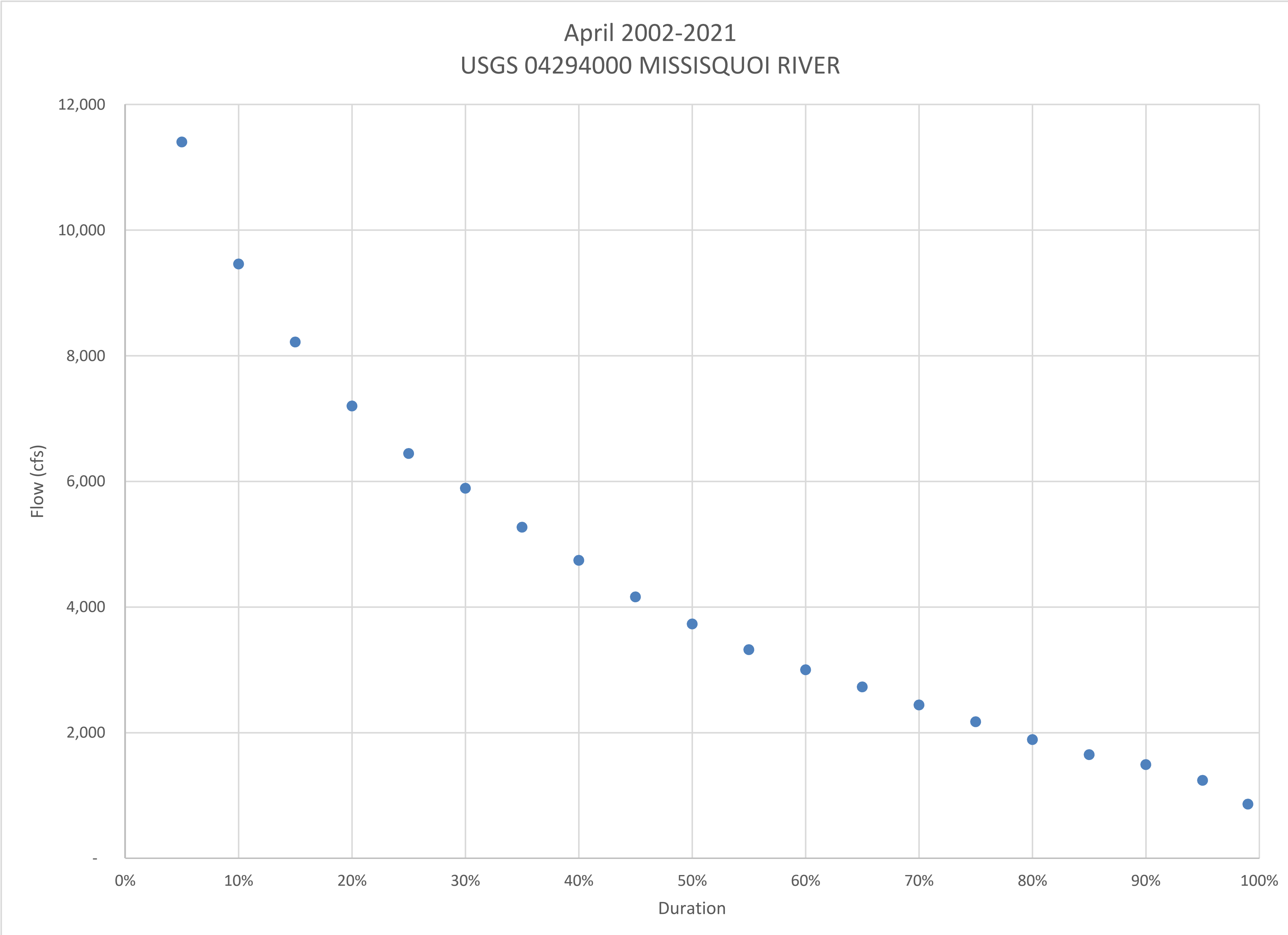
January 2002-2021
USGS 04294000 MISSISQUOI RIVER
7,000
6,000
5,000
4,000
3,000
2,000
1,000
-
Flow (cfs)
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Duration

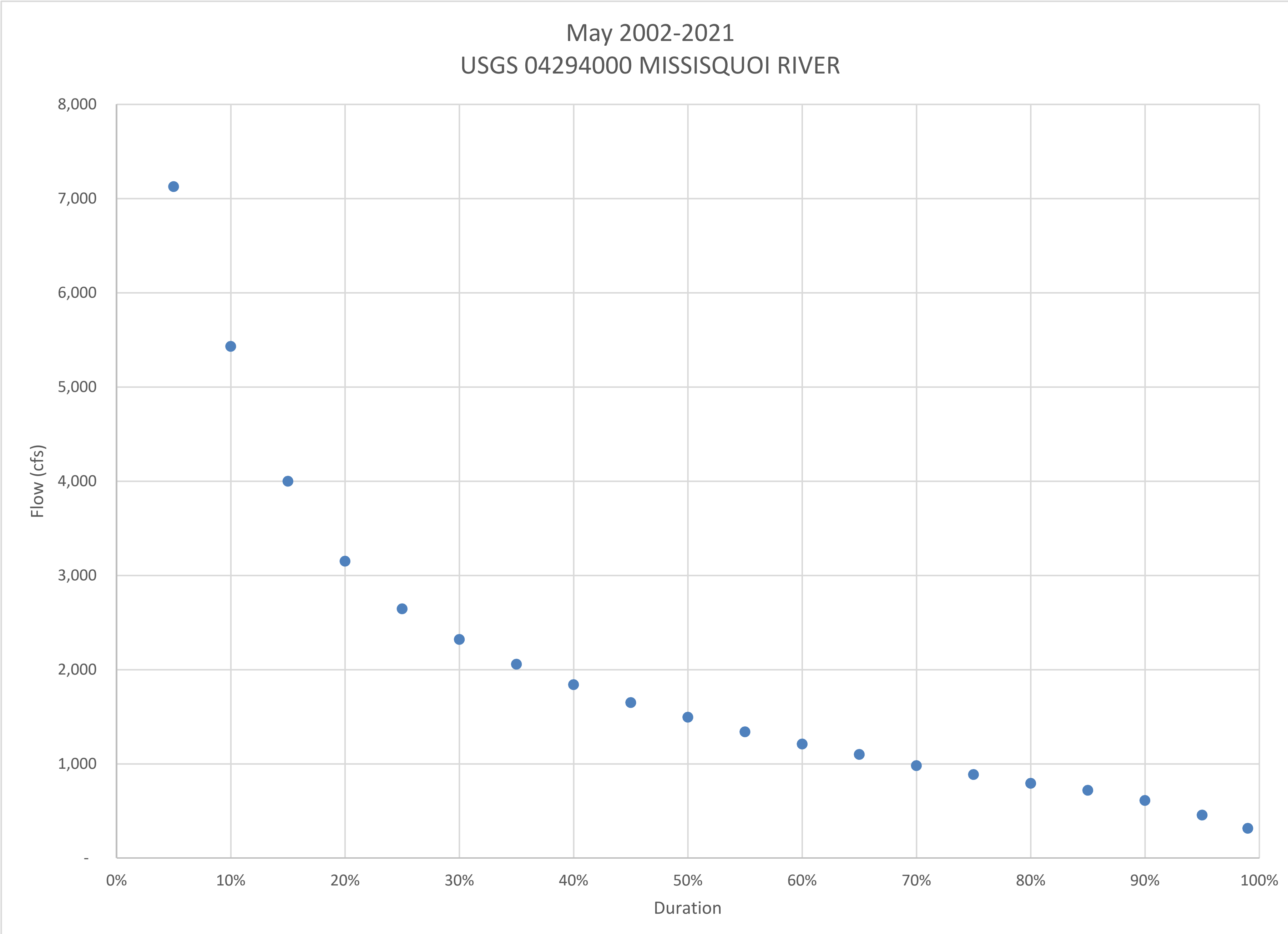


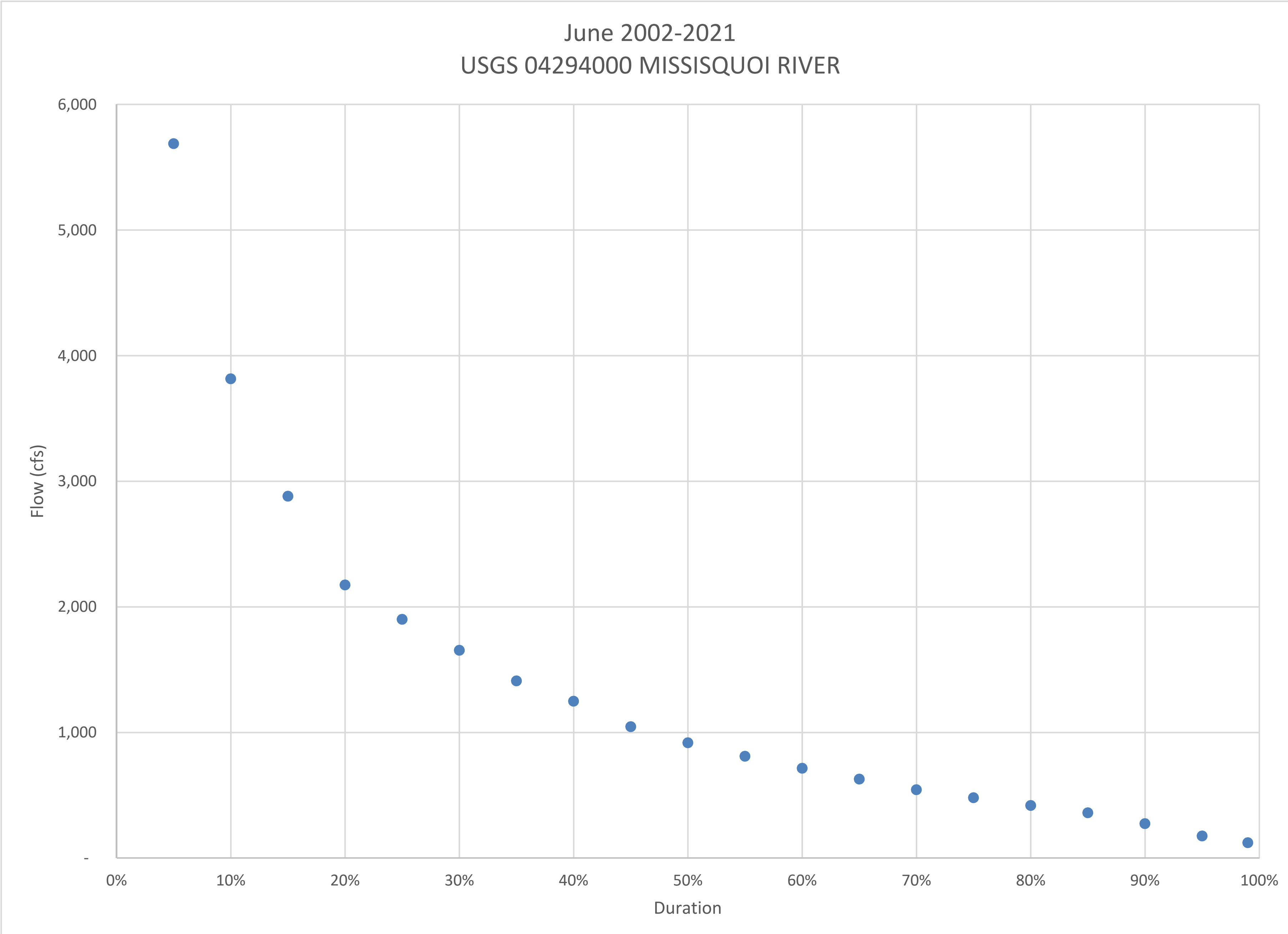
February 2002-2021
USGS 04294000 MISSISQUOI RIVER
Flow (cfs)
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
-
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Duration

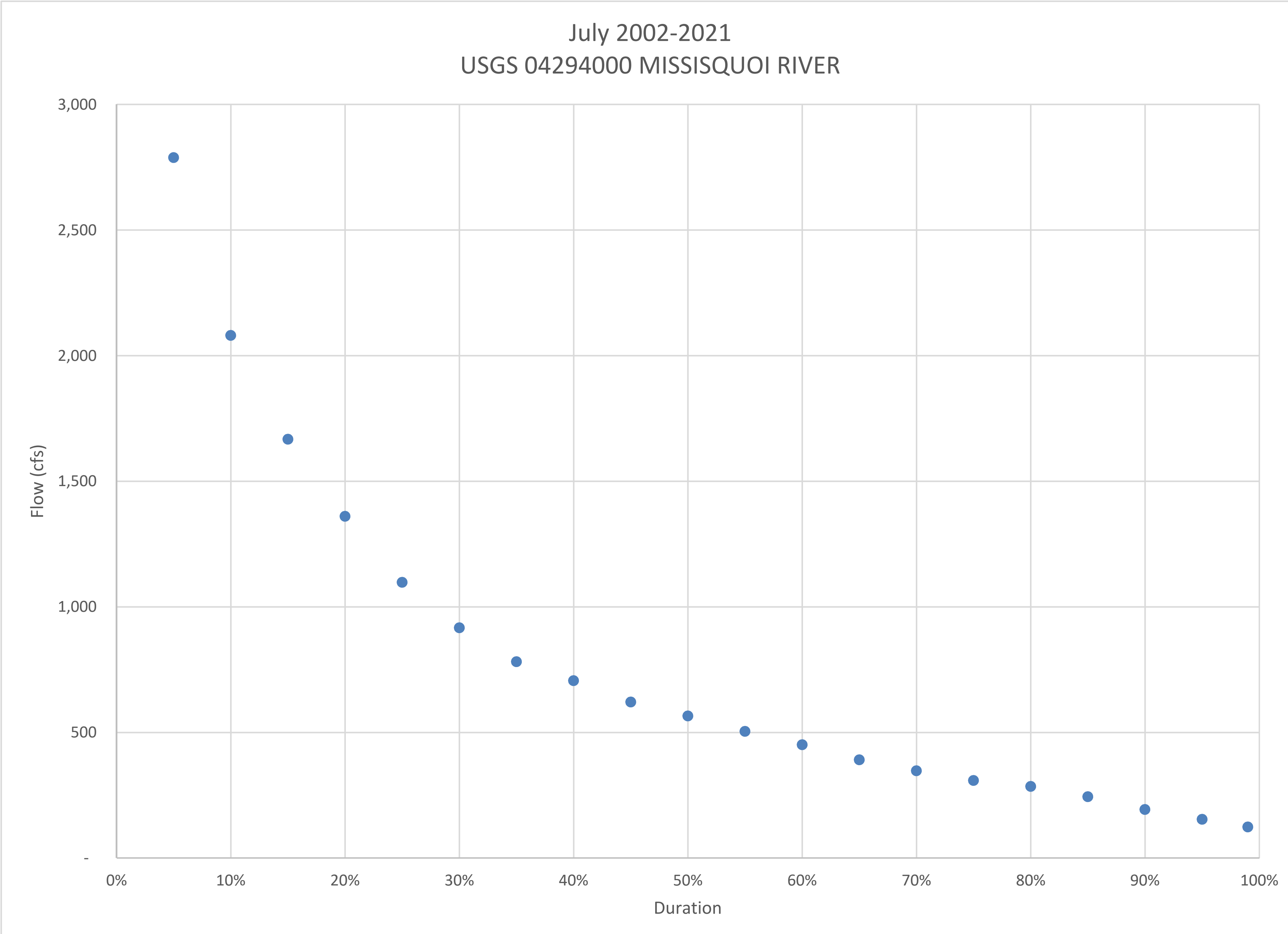


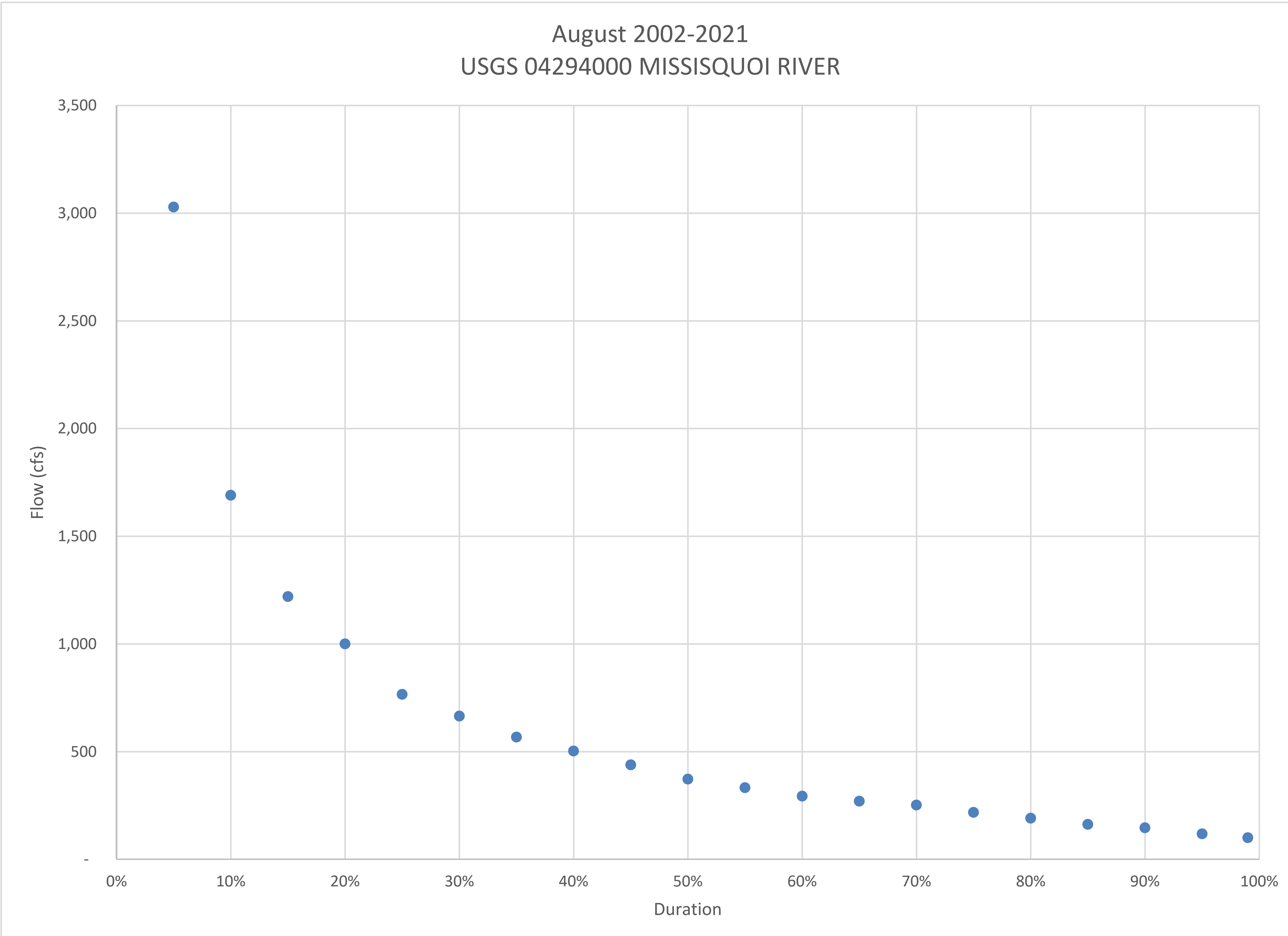
March 2002-2021
USGS 04294000 MISSISQUOI RIVER
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
-
Flow (cfs)
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Duration


April 2002-2021
USGS 04294000 MISSISQUOI RIVER
12,000
10,000
8,000
6,000
4,000
2,000
-
Flow (cfs)
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Duration

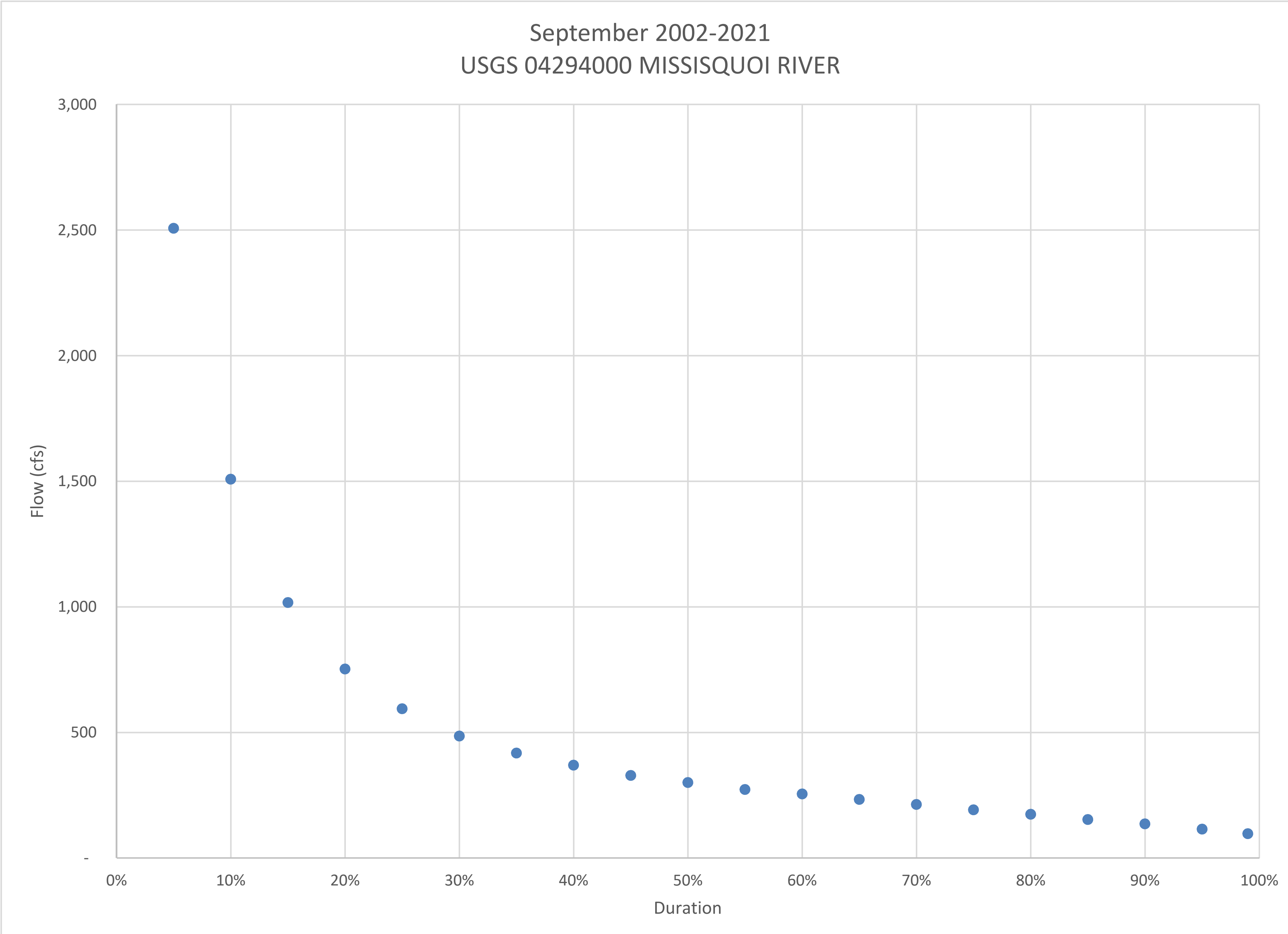

May 2002-2021
USGS 04294000 MISSISQUOI RIVER
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
-
Flow (cfs)
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Duration


June 2002-2021
USGS 04294000 MISSISQUOI RIVER
6,000
5,000
4,000
3,000
2,000
1,000
-
Flow (cfs)
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Duration

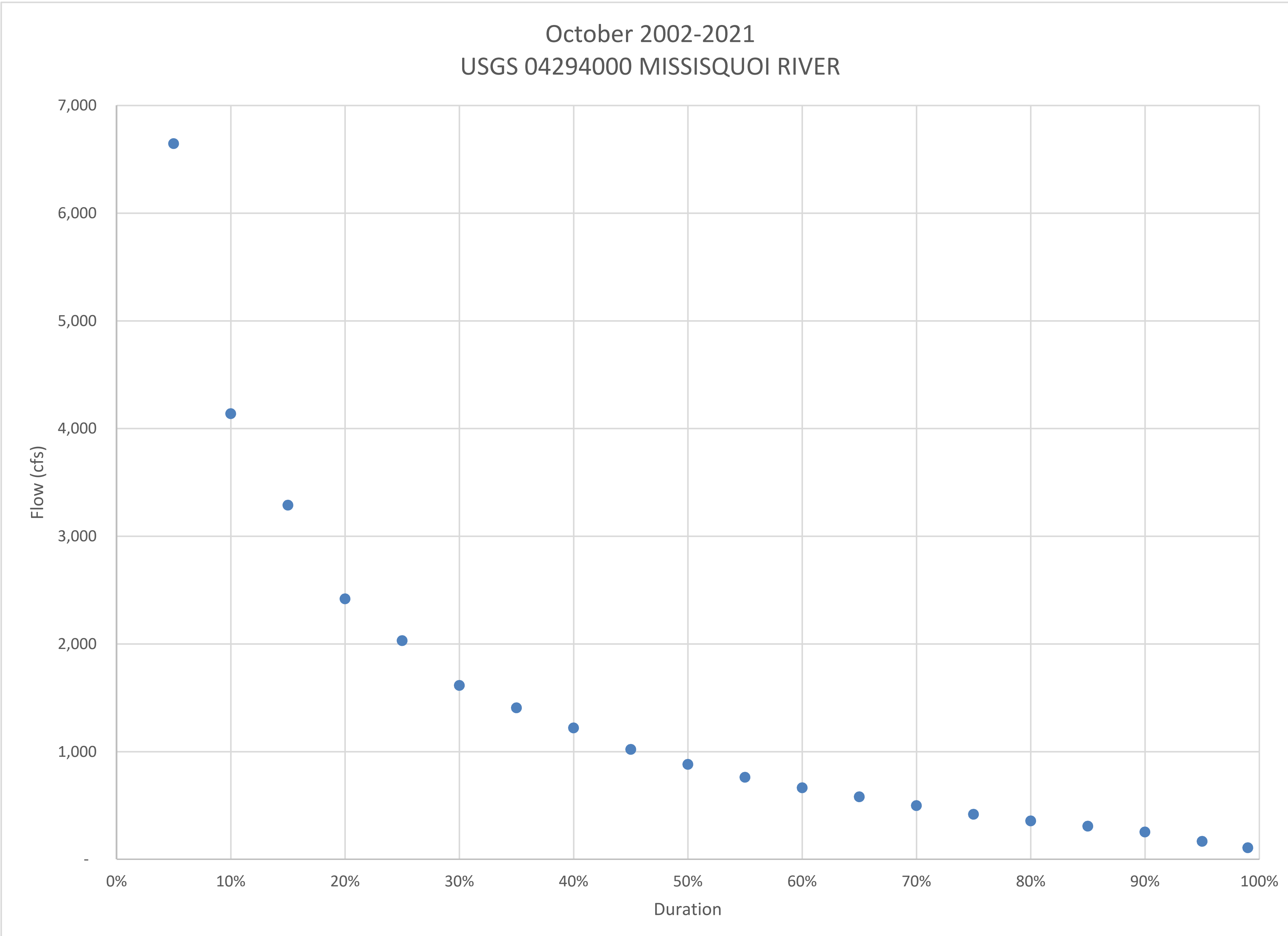

July 2002-2021
USGS 04294000 MISSISQUOI RIVER
3,000
2,500
2,000
1,500
1,000
500
-
Flow (cfs)
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Duration



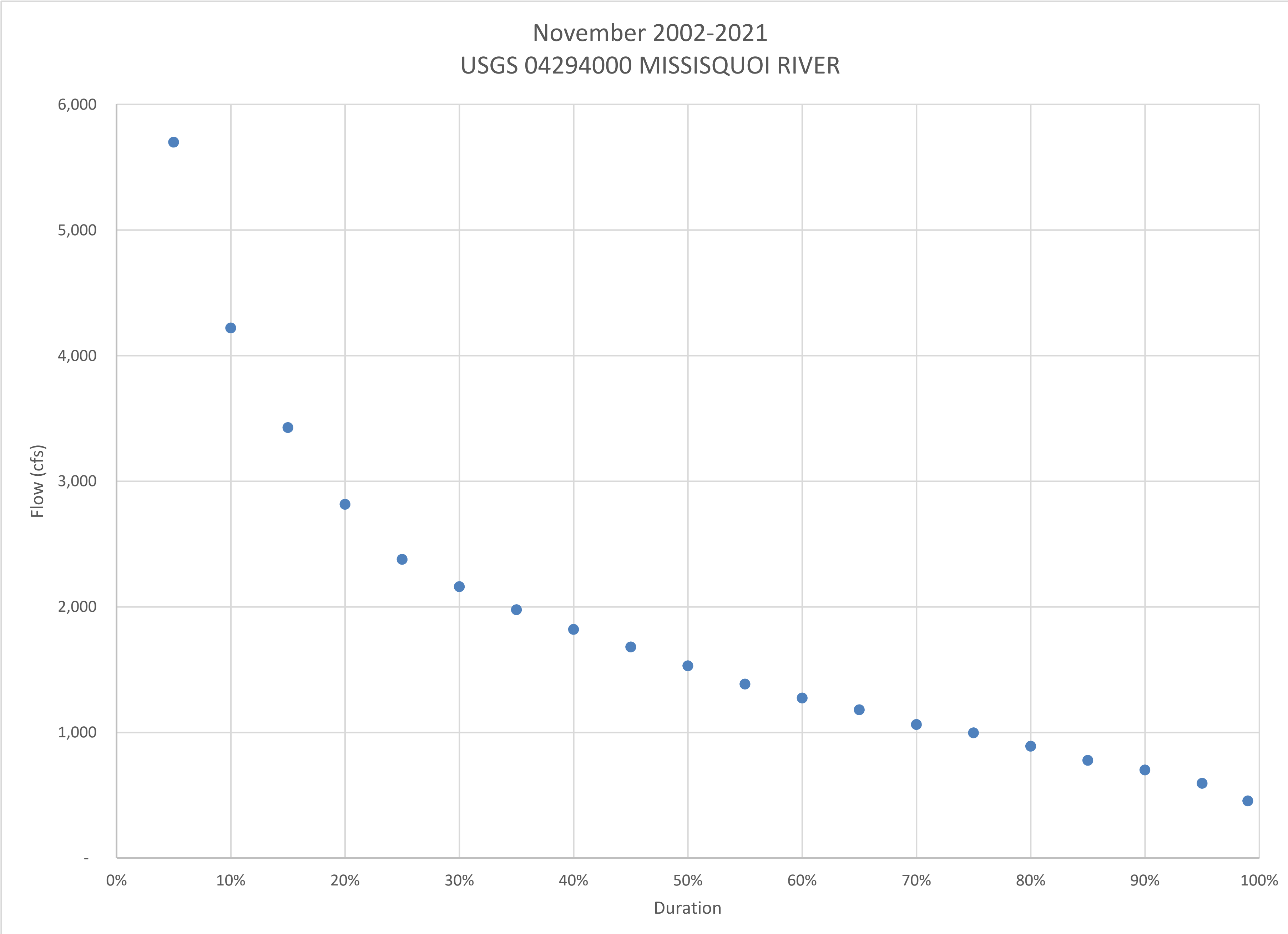
August 2002-2021
USGS 04294000 MISSISQUOI RIVER
3,500
3,000
2,500
2,000
1,500
1,000
500
-
Flow (cfs)
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Duration

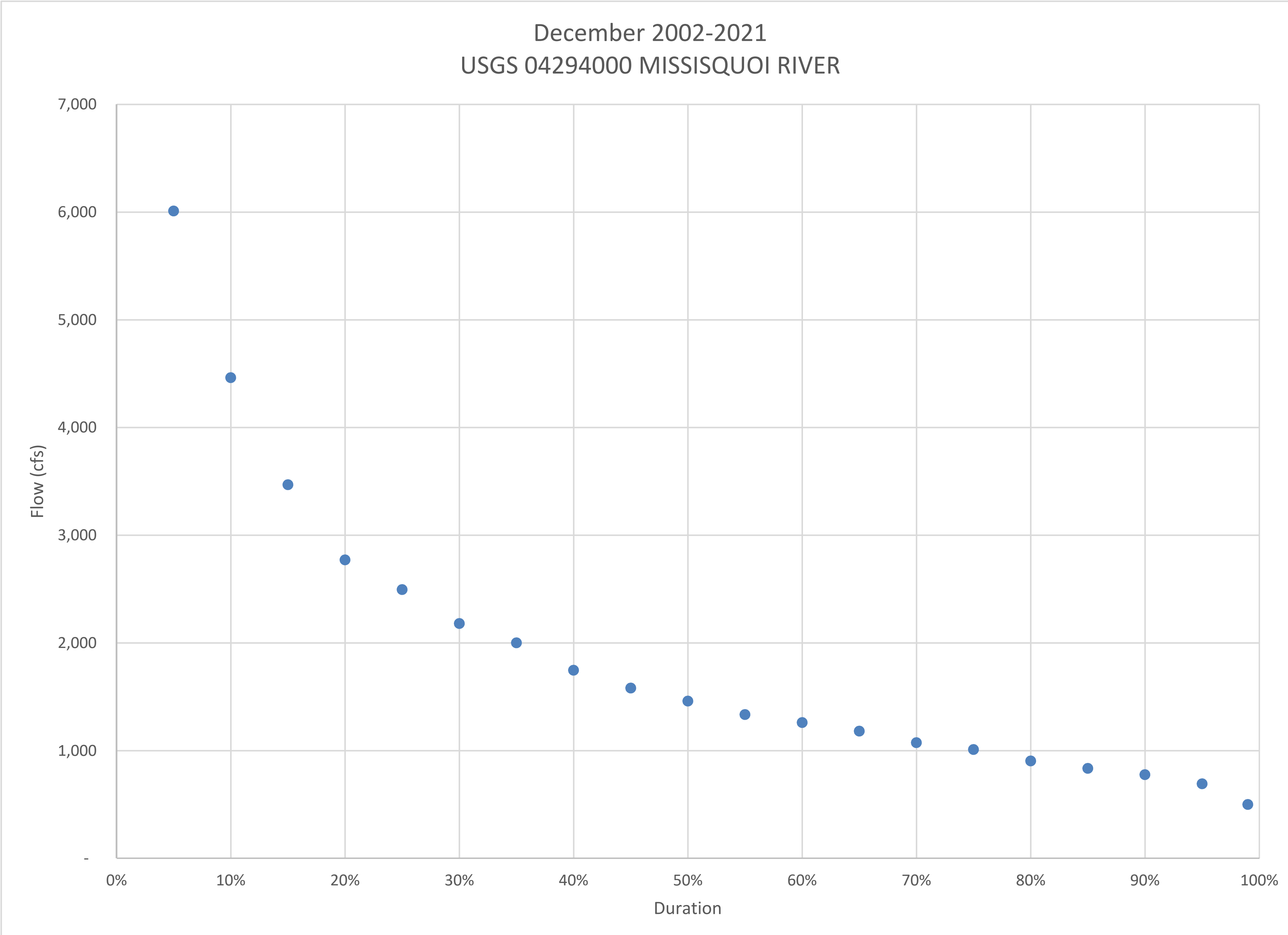


September 2002-2021
USGS 04294000 MISSISQUOI RIVER
3,000
2,500
2,000
1,500
1,000
500
-
Flow (cfs)
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Duration



October 2002-2021
USGS 04294000 MISSISQUOI RIVER
7,000
6,000
5,000
4,000
3,000
2,000
1,000
-
Flow (cfs)
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Duration


November 2002-2021
USGS 04294000 MISSISQUOI RIVER
Flow (cfs)
6,000
5,000
4,000
3,000
2,000
1,000
-
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Duration


December 2002-2021
USGS 04294000 MISSISQUOI RIVER
Flow (cfs)
7,000
6,000
5,000
4,000
3,000
2,000
1,000
-
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Duration

APPENDIX D – RAW DATA SHEETS VTANR WATER QUALITY SAMPLING SITES

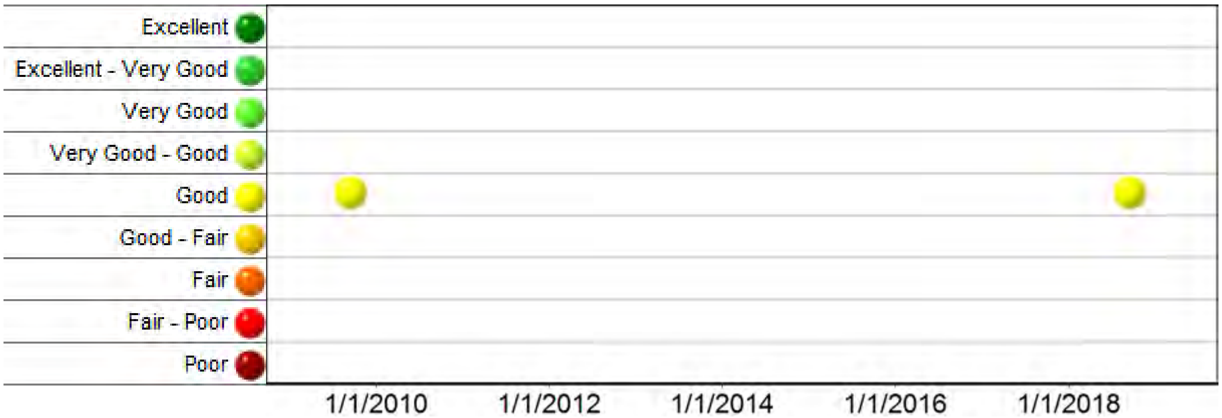
Monitoring Site Summary - River/Stream

Missisquoi River

River Mile: 18.2
Upstream of bridge on Machia Rd.
Highgate, VT (44.92700, -72.98800)

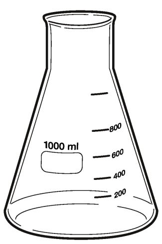
Macroinvertebrate Assessment

Macroinvertebrate population Assessments are a measure of the biological integrity of the macroinvertebrate community and an indicator of the health of the aquatic biota. (For More Details)



Water Quality Measurements

Chemical and physical parameters provide a “snapshot” of current conditions and are used to detect changes in water quality and to make determinations about a waterbody and its watershed. (For More Details)



Characteristic	Description	Trend	Max	Mean	Min
Chloride (mg/L)	At elevated values mostly from deicing		12.5	12.5	12.5
Conductivity (umho/cm)			150.9	148.3	144.0
Nitrogen (mg/L)	Nutrient that may fuel algae blooms		0.4	0.4	0.4
pH	Acidity		8.2	8.0	7.8
Phosphorus (ug/L)	Nutrient that may fuel algae blooms		15.5	14.5	13.5
Turbidity (NTU)	Measure of suspended sediment		3.8	2.6	1.5

Habitat Observations

Observations on the physical condition of the waterbody can be useful in determining the habitat type present and if watershed stressors have degraded its ability to support a healthy community of aquatic biota. (For More Details)

Observation Date: 9/24/2018

Habitat Type: Riffle

Embeddedness Estimated %: 30

Canopy %: 20

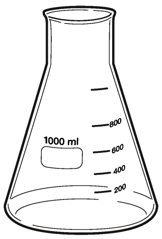
Monitoring Site Summary - River/Stream

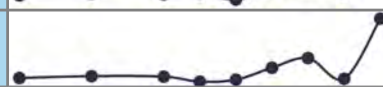
Missisquoi River

Swanton Johns Bridge, Rt 7 crossing
Swanton, VT (44.91056, -73.10611)

Water Quality Measurements

Chemical and physical parameters provide a "snapshot" of current conditions and are used to detect changes in water quality and to make determinations about a waterbody and its watershed. (For More Details)



Characteristic	Description	Trend	Max	Mean	Min
Nitrogen (mg/L)	Nutrient that may fuel algae blooms		0.9	0.5	0.3
Phosphorus (ug/L)	Nutrient that may fuel algae blooms		88.3	35.0	12.1
Turbidity (NTU)	Measure of suspended sediment		25.0	7.5	1.1

Visit Date	Start Time	Location Name	Project ID	Collection Method	Depth (m)	Chlorophyll-a	Conductivity	Dissolved Chloride	Dissolved Phosphorus	pH	Temperature	Total Chloride
						ug/l	umho/cm	mg/l	ug/l	None	deg C	mg/l
3/18/1990	1015	Missisquoi River	ChampDFS	CompDH59								3.9
3/19/1990	1512	Missisquoi River	ChampDFS	CompDH59								3.8
3/22/1990	1125	Missisquoi River	ChampDFS	CompDH59								6.7
3/23/1990	1050	Missisquoi River	ChampDFS	CompDH59								7.4
3/24/1990	1050	Missisquoi River	ChampDFS	CompDH59								6.1
3/24/1990	1052	Missisquoi River	ChampDFS	CompDH59								6.1
3/25/1990	1125	Missisquoi River	ChampDFS	CompDH59								7.2
3/28/1990	1412	Missisquoi River	ChampDFS	CompDH59								7.3
3/31/1990	1345	Missisquoi River	ChampDFS	CompDH59								7.9
4/2/1990	1130	Missisquoi River	ChampDFS	CompDH59								8
4/3/1990	1106	Missisquoi River	ChampDFS	CompDH59								7.3
4/4/1990	1150	Missisquoi River	ChampDFS	CompDH59								7.8
4/5/1990	1330	Missisquoi River	ChampDFS	CompDH59								6.1
4/8/1990	1030	Missisquoi River	ChampDFS	CompDH59								6.2
4/8/1990	1035	Missisquoi River	ChampDFS	CompDH59								6.3
4/9/1990	1446	Missisquoi River	ChampDFS	CompDH59								6.6
4/11/1990	1121	Missisquoi River	ChampDFS	CompDH59								7.6
4/12/1990	1334	Missisquoi River	ChampDFS	CompDH59								6
4/16/1990	1340	Missisquoi River	ChampDFS	CompDH59								5.9
4/18/1990	1115	Missisquoi River	ChampDFS	CompDH59					15			5.6
4/19/1990	1320	Missisquoi River	ChampDFS	CompDH59					23			5.9
4/21/1990	1200	Missisquoi River	ChampDFS	CompDH59					30			6.8
4/26/1990	1132	Missisquoi River	ChampDFS	CompDH59					12			5.7
4/28/1990	1232	Missisquoi River	ChampDFS	CompDH59					16			5.8
5/4/1990	1229	Missisquoi River	ChampDFS	CompDH59					12			6.8
5/9/1990	1327	Missisquoi River	ChampDFS	CompDH59					12			7.4
5/11/1990	1258	Missisquoi River	ChampDFS	CompDH59					12			7.7
5/14/1990	1255	Missisquoi River	ChampDFS	CompDH59					19			5.7
5/16/1990	1126	Missisquoi River	ChampDFS	CompDH59					13			5.7
5/18/1990	1125	Missisquoi River	ChampDFS	CompDH59					12			5.9

Total Nitrogen	Total Phosphorus
mg/l	ug/l
	303
	111
	64
	75
	58
	61
	66
	28
	24
	35
	65
	98
	141
	35
	36
	28
	172
	127
	26
	26
	86
	40
	29
	27
	24
	35
	32
	37
	29
	25

Visit Date	Start Time	Location Name	Project ID	Collection Method	Depth (m)	Chlorophyll-a	Conductivity	Dissolved Chloride	Dissolved Phosphorus	pH	Temperature	Total Chloride
						ug/l	umho/cm	mg/l	ug/l	None	deg C	mg/l
5/21/1990	1317	Missisquoi River	ChampDFS	CompDH59					14			5.8
5/22/1990	1142	Missisquoi River	ChampDFS	CompDH59					12			5.2
5/30/1990	1142	Missisquoi River	ChampDFS	CompDH59					9			6.3
6/4/1990	1210	Missisquoi River	ChampDFS	CompDH59					7			7.9
6/11/1990	1310	Missisquoi River	ChampDFS	CompDH59					7			8
6/17/1990	1149	Missisquoi River	ChampDFS	CompDH59					8			7.8
6/19/1990	1242	Missisquoi River	ChampDFS	CompDH59					10			8
6/22/1990	1430	Missisquoi River	ChampDFS	CompDH59					19			6.4
6/25/1990	1128	Missisquoi River	ChampDFS	CompDH59					13			7.1
6/28/1990	1215	Missisquoi River	ChampDFS	CompDH59					12			7.1
6/28/1990	1217	Missisquoi River	ChampDFS	CompDH59					12			7.1
7/1/1990	1224	Missisquoi River	ChampDFS	CompDH59					11			8.1
7/4/1990	1125	Missisquoi River	ChampDFS	CompDH59					24			6.7
7/5/1990	1323	Missisquoi River	ChampDFS	CompDH59					76			5.83
7/9/1990	1234	Missisquoi River	ChampDFS	CompDH59					27			5.09
7/23/1990	1305	Missisquoi River	ChampDFS	CompDH59					8			9.3
7/24/1990	1000	Missisquoi River	ChampDFS	CompDH59					8			10.8
8/6/1990	1245	Missisquoi River	ChampDFS	CompDH59					8			8.7
8/8/1990	1325	Missisquoi River	ChampDFS	CompDH59					13			9.2
8/10/1990	1210	Missisquoi River	ChampDFS	CompDH59					17			7.1
8/13/1990	1206	Missisquoi River	ChampDFS	CompDH59					32			5.6
8/27/1990	1135	Missisquoi River	ChampDFS	CompDH59					8			8.7
9/25/1990	1147	Missisquoi River	ChampDFS	CompDH59					9			8.7
10/1/1990	1134	Missisquoi River	ChampDFS	CompDH59					14			10
10/5/1990	1236	Missisquoi River	ChampDFS	CompDH59					18			6.8
10/11/1990	1135	Missisquoi River	ChampDFS	CompDH59					21			7.3
10/12/1990	1245	Missisquoi River	ChampDFS	CompDH59					26			6.7
10/15/1990	1319	Missisquoi River	ChampDFS	CompDH59					26			4.8

Total Nitrogen	Total Phosphorus
mg/l	ug/l
	32
	41
	20
	16
	16
	20
	21
	34
	25
	28
	26
	25
	44
	430
	48
	23
	29
	28
	27
	30
	60
	15
	22
	26
	60
	42
	43
	80

Visit Date	Start Time	Location Name	Project ID	Collection Method	Depth (m)	Chlorophyll-a	Conductivity	Dissolved Chloride	Dissolved Phosphorus	pH	Temperature	Total Chloride
						ug/l	umho/cm	mg/l	ug/l	None	deg C	mg/l
10/18/1990	1125	Missisquoi River	ChampDFS	CompDH59					19			5.4
10/19/1990	1220	Missisquoi River	ChampDFS	CompDH59					51			6.6
10/23/1990	1330	Missisquoi River	ChampDFS	CompDH59					14			5.3
10/25/1990	1422	Missisquoi River	ChampDFS	CompDH59					26			3.8
10/29/1990	1310	Missisquoi River	ChampDFS	CompDH59					10			5.3
10/30/1990	1140	Missisquoi River	ChampDFS	CompDH59					12			5.5
11/7/1990	1225	Missisquoi River	ChampDFS	CompDH59					13			6.6
11/12/1990	1210	Missisquoi River	ChampDFS	CompDH59					30			5.2
11/27/1990	1210	Missisquoi River	ChampDFS	CompDH59					10			5
2/8/1991	1200	Missisquoi River	ChampDFS	CompDH59					27			9
2/20/1991	1320	Missisquoi River	ChampDFS	CompDH59					12			9.6
2/28/1991	0900	Missisquoi River	ChampDFS	CompDH59					14			7.1
3/4/1991	1330	Missisquoi River	ChampDFS	CompDH59					25			5
3/4/1991	1333	Missisquoi River	ChampDFS	CompDH59					23			5
3/5/1991	1230	Missisquoi River	ChampDFS	CompDH59					23			3.8
3/11/1991	1445	Missisquoi River	ChampDFS	CompDH59					12			5.6
3/19/1991	1115	Missisquoi River	ChampDFS	CompDH59					14			5.9
3/26/1991	1130	Missisquoi River	ChampDFS	CompDH59					19			9
3/28/1991	1220	Missisquoi River	ChampDFS	CompDH59					22			8
3/29/1991	1220	Missisquoi River	ChampDFS	CompDH59					20			5
4/4/1991	1125	Missisquoi River	ChampDFS	CompDH59					13			6.2
4/5/1991	1215	Missisquoi River	ChampDFS	CompDH59					12			6
4/9/1991	1235	Missisquoi River	ChampDFS	CompDH59					13			3.3
4/10/1991	1305	Missisquoi River	ChampDFS	CompDH59					13			3.7

Total Nitrogen	Total Phosphorus
mg/l	ug/l
	20
	136
	33
	140
	27
	24
	35
	64
	27
	52
	28
	27
	298
	304
	272
	23
	32
	44
	117
	270
	29
	24
	86
	240

Visit Date	Start Time	Location Name	Project ID	Collection Method	Depth (m)	Chlorophyll-a ug/l	Conductivity umho/cm	Dissolved Chloride mg/l	Dissolved Phosphorus ug/l	pH None	Temperature deg C	Total Chloride mg/l
4/11/1991	1210	Missisquoi River	ChampDFS	CompDH59					16			3.8
4/16/1991	1045	Missisquoi River	ChampDFS	CompDH59					8			5.8
4/22/1991	1140	Missisquoi River	ChampDFS	CompDH59					14			6.4
5/2/1991	1310	Missisquoi River	ChampDFS	CompDH59					11			6.6
5/2/1991	1313	Missisquoi River	ChampDFS	CompDH59					10			6.6
5/7/1991	1220	Missisquoi River	ChampDFS	CompDH59					11			5.7
5/27/1991	1305	Missisquoi River	ChampDFS	CompDH59					9			7.2
7/9/1991	1245	Missisquoi River	ChampDFS	CompDH59					24			9.9
8/5/1991	1215	Missisquoi River	ChampDFS	CompDH59					8			12.5
8/6/1991	1100	Missisquoi River	ChampDFS	CompDH59					8			12.5
8/19/1991	1515	Missisquoi River	ChampDFS	CompDH59					7			8.4
9/16/1991	1215	Missisquoi River	ChampDFS	CompDH59					17			8.9
9/19/1991	1116	Missisquoi River	ChampDFS	CompDH59					18			8.6
9/26/1991	1140	Missisquoi River	ChampDFS	CompDH59					32			5.8
10/7/1991	1220	Missisquoi River	ChampDFS	CompDH59					45			4.4
10/16/1991	1220	Missisquoi River	ChampDFS	CompDH59					15			5.7
10/16/1991	1222	Missisquoi River	ChampDFS	CompDH59					15			5.6
11/12/1991	1225	Missisquoi River	ChampDFS	CompDH59					9			7.7
4/13/1992	1200	Missisquoi River	ChampDFS	CompDH59					20			7.8
4/23/1992	1430	Missisquoi River	ChampDFS	CompDH59					20			3.6
4/24/1992	1220	Missisquoi River	ChampDFS	CompDH59					20			3.7
4/25/1992	1355	Missisquoi River	ChampDFS	CompDH59					19			4.5
11/4/1992	1045	Missisquoi River	ChampMon	CompDH59					79			8
11/17/1992	0920	Missisquoi River	ChampMon	CompDH59					14			6.1
11/24/1992	1030	Missisquoi River	ChampMon	CompDH59					60			7.2
4/6/1993	1215	Missisquoi River	ChampMon	CompDH59					85			9.53

Total Nitrogen	Total Phosphorus
mg/l	ug/l
	128
	23
	63
	23
	23
	24
	80
	25
	20
	28
	36
	22
	36
	35
	130
	27
	25
	18
	78
	570
	136
	85
0.88	196
0.46	30
0.96	288
0.71	98

Visit Date	Start Time	Location Name	Project ID	Collection Method	Depth (m)	Chlorophyll-a ug/l	Conductivity umho/cm	Dissolved Chloride mg/l	Dissolved Phosphorus ug/l	pH None	Temperature deg C	Total Chloride mg/l
4/13/1993	1045	Missisquoi River	ChampMon	CompDH59					15			4.4
4/20/1993	1045	Missisquoi River	ChampMon	CompDH59					15			5.5
4/22/1993	1000	Missisquoi River	ChampMon	CompDH59					19			6
4/27/1993	1145	Missisquoi River	ChampMon	CompDH59					15			5.3
7/8/1993	1215	Missisquoi River	ChampMon	CompDH59					17			9.6
8/2/1993	1115	Missisquoi River	ChampMon	CompDH59					26			4.6
8/25/1993	1235	Missisquoi River	ChampMon	CompDH59					7			10.2
9/24/1993	1115	Missisquoi River	ChampMon	CompDH59					8			8.8
11/5/1993	1115	Missisquoi River	ChampMon	CompDH59					33			9.9
11/29/1993	1130	Missisquoi River	ChampMon	CompDH59					26			7.9
3/29/1994	1410	Missisquoi River	ChampMon	CompDH59					32			10.6
4/7/1994	1110	Missisquoi River	ChampMon	CompDH59					24			6
4/12/1994	1130	Missisquoi River	ChampMon	CompDH59					14			4.8
4/15/1994	1445	Missisquoi River	ChampMon	CompDH59					12			3.1
4/19/1994	1300	Missisquoi River	ChampMon	CompDH59					9			4.1
5/4/1994	1215	Missisquoi River	ChampMon	CompDH59					10			4.4
5/17/1994	1315	Missisquoi River	ChampMon	CompDH59					18			7.1
8/19/1994	1200	Missisquoi River	ChampMon	CompDH59					16			9.2
9/27/1994	1145	Missisquoi River	ChampMon	CompDH59					8			7.1
11/2/1994	1015	Missisquoi River	ChampMon	CompDH59					17			9.5
12/8/1994	1020	Missisquoi River	ChampMon	CompDH59					23			4
12/8/1994	1045	Missisquoi River	ChampMon	CompDH59					22			4
12/15/1994	1110	Missisquoi River	ChampMon	CompDH59					11			5.9
12/15/1994	1125	Missisquoi River	ChampMon	CompDH59					14			6
3/17/1995	1125	Missisquoi River	ChampMon	CompDH59					15		0.3	5.2
3/23/1995	1050	Missisquoi River	ChampMon	CompDH59					11		1.2	4.7
6/12/1995	1020	Missisquoi River	ChampMon	CompDH59		8.75	95		12		18.3	6.5
6/12/1995	1020	Missisquoi River	ChampMon	CompDH59					22			6.4

Total Nitrogen	Total Phosphorus
mg/l	ug/l
0.57	68
0.54	64
0.65	68
0.49	49
0.38	18
0.61	45
0.41	15
0.39	21
0.87	62
0.41	124
1.02	56
0.94	154
0.81	124
0.74	131
0.67	65
0.56	27
0.8	80
0.42	28
0.46	18
0.44	42
0.79	66
0.78	101
0.68	20
0.72	20
0.83	118
0.82	65
0.52	30
	29

Visit Date	Start Time	Location Name	Project ID	Collection Method	Depth (m)	Chlorophyll-a	Conductivity	Dissolved Chloride	Dissolved Phosphorus	pH	Temperature	Total Chloride
						ug/l	umho/ cm	mg/l	ug/l	None	deg C	mg/l
7/18/1995	1500	Missisquoi River	ChampMon	CompDH59		3.5	165		7			10.9
11/2/1995	1045	Missisquoi River	ChampMon	CompDH59		1.11	43		14		5.9	5.9
11/15/1995	1140	Missisquoi River	ChampMon	CompDH59		1.6	62		26		2.3	6.1
1/25/1996	1125	Missisquoi River	ChampMon	CompDH59			94		30		1.5	7.7
2/22/1996	1030	Missisquoi River	ChampMon	CompDH59			128		87		2.5	11.1
2/22/1996	1115	Missisquoi River	ChampMon	CompDH59			132		96			11.1
3/15/1996	1140	Missisquoi River	ChampMon	CompDH59			135		26		2	9.9
3/22/1996	1130	Missisquoi River	ChampMon	CompDH59			95		19		2.4	6.8
4/16/1996	1200	Missisquoi River	ChampMon	CompDH59			71		19			7.95
4/17/1996	1125	Missisquoi River	ChampMon	CompDH59			97		19		4.2	7.51
4/23/1996	1450	Missisquoi River	ChampMon	CompDH59			52		12			3.38
4/26/1996	1125	Missisquoi River	ChampMon	CompDH59			54		24		12	4.84
4/30/1996	1320	Missisquoi River	ChampMon	CompDH59			52		13		12	5.34
7/16/1996	1300	Missisquoi River	ChampMon	CompDH59		4.1	128		31		21	9.6
7/16/1996	1300	Missisquoi River	ChampMon	CompDH59								
8/2/1996	1330	Missisquoi River	ChampMon	CompDH59		7.02			8	7.81		7.5
10/22/1996	1030	Missisquoi River	ChampMon	CompDH59		3.51	138		34	7.77	8.2	10.3
10/22/1996	1030	Missisquoi River	ChampMon	CompDH59								
11/6/1996	1000	Missisquoi River	ChampMon	CompDH59			116		13	6.82	7	8.2
12/3/1996	1010	Missisquoi River	ChampMon	CompDH59			52		44	7.09	2.6	3.8
12/3/1996	1015	Missisquoi River	ChampMon	CompDH59			51		45	7.09	2.6	3.8
2/28/1997	1030	Missisquoi River	ChampMon	CompDH59			82		30	7.51	0	8.6
2/28/1997	1030	Missisquoi River	ChampMon	CompDH59								
3/3/1997	1100	Missisquoi River	ChampMon	CompDH59			66		34	7.33	0.5	6.1
3/3/1997	1100	Missisquoi River	ChampMon	CompDH59								
4/1/1997	1010	Missisquoi River	ChampMon	CompDH59			65		23	7.26	3	5.9
4/1/1997	1010	Missisquoi River	ChampMon	CompDH59								
4/7/1997	1030	Missisquoi River	ChampMon	CompDH59			61		19	7.44	7.5	5.1

Total Nitrogen	Total Phosphorus
mg/l	ug/l
0.42	18
0.5	31
0.63	57
1.21	156
1.52	136
1.64	149
1.17	62
0.87	48
0.727	54
1.04	226
0.51	93
0.75	68
0.56	34
1.2	75
	66
0.54	29
0.79	130
	170
0.68	24
0.88	226
0.86	220
0.98	53
	53
0.76	118
	150
0.98	91
	95
0.82	140

Visit Date	Start Time	Location Name	Project ID	Collection Method	Depth (m)	Chlorophyll-a ug/l	Conductivity umho/cm	Dissolved Chloride mg/l	Dissolved Phosphorus ug/l	pH None	Temperature deg C	Total Chloride mg/l
4/7/1997	1030	Missisquoi River	ChampMon	CompDH59								
4/21/1997	1150	Missisquoi River	ChampMon	CompDH59			72		12	7.47	7.5	5.9
4/21/1997	1150	Missisquoi River	ChampMon	CompDH59								
4/29/1997	1115	Missisquoi River	ChampMon	CompDH59			61		9	7.5	8	4.5
4/29/1997	1115	Missisquoi River	ChampMon	CompDH59								
5/7/1997	1110	Missisquoi River	ChampMon	CompDH59			81		38	7.74	8	6.1
5/7/1997	1110	Missisquoi River	ChampMon	CompDH59								
7/16/1997	0915	Missisquoi River	ChampMon	CompDH59			62		33	7.16	20	3.2
7/16/1997	0915	Missisquoi River	ChampMon	CompDH59								
7/16/1997	0940	Missisquoi River	ChampMon	CompDH59			65		36	7.21	20	3.4
8/14/1997	1045	Missisquoi River	ChampMon	CompDH59			140		11	7.67	22	10.6
8/22/1997	1430	Missisquoi River	ChampMon	CompDH59			102		18	7.52	20.5	6.9
8/28/1997	1100	Missisquoi River	ChampMon	CompDH59			86		20	7.45	20	5.8
8/28/1997	1115	Missisquoi River	ChampMon	CompDH59			86		19	7.41	20	5.9
9/30/1997	1150	Missisquoi River	ChampMon	CompDH59			149		14	7.7	14.8	10.9
9/30/1997	1150	Missisquoi River	ChampMon	CompDH59								
9/30/1997	1200	Missisquoi River	ChampMon	CompDH59			147		16	7.66	14.8	10.9
11/3/1997	1045	Missisquoi River	ChampMon	CompDH59			99		16	7.6	9.5	8.1
11/3/1997	1045	Missisquoi River	ChampMon	CompDH59								
11/3/1997	1050	Missisquoi River	ChampMon	CompDH59			106		16	7.57	9.5	8.1
11/10/1997	0955	Missisquoi River	ChampMon	CompDH59		0.99	100		25	7.45	6	7
11/10/1997	0955	Missisquoi River	ChampMon	CompDH59								
11/10/1997	1000	Missisquoi River	ChampMon	CompDH59		0.91	98		18	7.45	6	7
1/9/1998	1010	Missisquoi River	ChampMon	CompDH59			59		14	7.15	0.5	4.8
3/11/1998	1055	Missisquoi River	ChampMon	CompDH59			72		22	7.16	1	6.5
3/11/1998	1115	Missisquoi River	ChampMon	CompDH59			66		21	7.13	1	6.5
3/30/1998	1120	Missisquoi River	ChampMon	CompDH59			48		15	7.26	9	3
4/2/1998	1015	Missisquoi River	ChampMon	CompDH59			48		18	7.26	6	3.8

Total Nitrogen	Total Phosphorus
mg/l	ug/l
	180
0.61	36
	46
0.61	47
	51
1	278
	300
0.73	460
	620
0.59	480
0.65	27
0.59	40
0.52	33
0.55	34
0.57	31
	27.4
0.55	32
0.62	79
	93.6
0.66	81
0.65	55
	52.6
0.62	55
1.4	660
0.8	156
0.84	154
0.53	167
0.62	212

Visit Date	Start Time	Location Name	Project ID	Collection Method	Depth (m)	Chlorophyll-a ug/l	Conductivity umho/cm	Dissolved Chloride mg/l	Dissolved Phosphorus ug/l	pH None	Temperature deg C	Total Chloride mg/l
6/1/1998	1130	Missisquoi River	ChampMon	CompDH59			135		8	7.8		10.7
6/1/1998	1135	Missisquoi River	ChampMon	CompDH59			130		9	7.67		10.7
6/15/1998	1150	Missisquoi River	ChampMon	CompDH59		5.29	109		10	7.8	19	8
6/15/1998	1200	Missisquoi River	ChampMon	CompDH59		4.76	106		10	7.72	19	8
6/18/1998	1110	Missisquoi River	ChampMon	CompDH59			90		13	7.19	19.8	5.7
7/1/1998	1055	Missisquoi River	ChampMon	CompDH59		4.55	99		20	7.88	20.5	6.1
7/9/1998	1125	Missisquoi River	ChampMon	CompDH59			132		26	7.57	20	8.5
8/12/1998	1030	Missisquoi River	ChampMon	CompDH59			148		12	7.8	24.5	9.7
8/12/1998	1045	Missisquoi River	ChampMon	CompDH59			145		12	7.68	24.5	9.7
8/25/1998	1145	Missisquoi River	ChampMon	CompDH59			118		13	7.73	22	7.4
9/16/1998	1100	Missisquoi River	ChampMon	CompDH59			108		15	7.8	18	7.4
9/16/1998	1120	Missisquoi River	ChampMon	CompDH59			106		16	7.77	18	7.6
9/28/1998	1145	Missisquoi River	ChampMon	CompDH59			138		19	7.77		8.9
9/28/1998	1155	Missisquoi River	ChampMon	CompDH59			139		19	7.79		8.8
1/25/1999	1030	Missisquoi River	ChampMon	CompDH59			59		32	7.25		6.1
1/25/1999	1035	Missisquoi River	ChampMon	CompDH59			59		31	7.23		5.8
3/23/1999	1400	Missisquoi River	ChampMon	CompDH59			77		61.6	7.53	2	7.9
3/31/1999	1050	Missisquoi River	ChampMon	CompDH59			65		13.5	7.15		4.9
3/31/1999	1105	Missisquoi River	ChampMon	CompDH59			65		13.7	7.15		5.4
4/9/1999	1055	Missisquoi River	ChampMon	CompDH59			56		10	7.5	6	3.7
5/10/1999	1050	Missisquoi River	ChampMon	CompDH59		12.12	96		7	7.76	16	8
5/10/1999	1100	Missisquoi River	ChampMon	CompDH59		14.54	93		8	7.71	16	7.4
5/20/1999	1100	Missisquoi River	ChampMon	CompDH59			86		5	7.56	16	8.3
5/20/1999	1110	Missisquoi River	ChampMon	CompDH59			89		9	7.57	16	8.3
9/20/1999	1040	Missisquoi River	ChampMon	CompDH59		1.94	67		29	7.28	15	5.1
9/20/1999	1055	Missisquoi River	ChampMon	CompDH59		1.94	68		30	7.25	15	5.4
10/25/1999	1045	Missisquoi River	ChampMon	CompDH59			64		33	7.13	6	4.7
10/25/1999	1100	Missisquoi River	ChampMon	CompDH59			62		35	7.15	6	5.1

Total Nitrogen	Total Phosphorus
mg/l	ug/l
0.57	29
0.55	28
0.39	26
0.4	26
0.47	58
0.57	50
0.82	59
0.51	82
0.52	80
0.58	26
0.54	36
0.53	34
0.73	113
0.79	149
1.26	240
1.14	247
0.82	208
0.55	77
0.57	75
0.71	54
0.54	24
0.56	24
0.47	87
0.44	28
0.8	71
0.77	70
0.57	82
0.57	83

Visit Date	Start Time	Location Name	Project ID	Collection Method	Depth (m)	Chlorophyll-a	Conductivity	Dissolved Chloride	Dissolved Phosphorus	pH	Temperature	Total Chloride
						ug/l	umho/cm	mg/l	ug/l	None	deg C	mg/l
11/22/1999	1100	Missisquoi River	ChampMon	CompDH59			57		23	7.3	6	5.6
11/22/1999	1110	Missisquoi River	ChampMon	CompDH59			58		24	7.25	6	5.6
2/29/2000	1040	Missisquoi River	ChampMon	CompDH59			57		22	6.93	1	7.6
2/29/2000	1055	Missisquoi River	ChampMon	CompDH59			59		20	6.98	1	7
3/10/2000	1055	Missisquoi River	ChampMon	CompDH59			58		24	7.05	0	5.9
3/10/2000	1105	Missisquoi River	ChampMon	CompDH59			57		19	7.03	0	5.8
3/27/2000	1040	Missisquoi River	ChampMon	CompDH59			56		10	7.3	4	5.1
3/27/2000	1050	Missisquoi River	ChampMon	CompDH59			55		8	7.14	4	5
3/29/2000	1015	Missisquoi River	ChampMon	CompDH59			46		14	7.08	3	4.4
3/29/2000	1030	Missisquoi River	ChampMon	CompDH59			45		23	7.07	3	4.4
4/4/2000	1125	Missisquoi River	ChampMon	CompDH59			63		14	7.26	5.5	5.8
4/6/2000	1000	Missisquoi River	ChampMon	CompDH59			49		13	7.16	4.5	4.5
4/24/2000	1045	Missisquoi River	ChampMon	CompDH59			71		20	7.51	5.5	7
5/11/2000	1030	Missisquoi River	ChampMon	CompDH59		2.73	61		34	7.47	11.5	4.7
5/12/2000	1105	Missisquoi River	ChampMon	CompDH59			64		24	7.46	13.5	5.1
5/19/2000	1045	Missisquoi River	ChampMon	CompDH59		2.09	78		17	7.51	13	6.9
5/25/2000	1040	Missisquoi River	ChampMon	CompDH59			84		11	7.8		7.6
6/7/2000	1030	Missisquoi River	ChampMon	CompDH59		4.73	97		7	7.74	16	8.4
7/17/2000	1115	Missisquoi River	ChampMon	CompDH59		14.55	99		15	7.93	22.5	7.9
8/17/2000	1050	Missisquoi River	ChampMon	CompDH59		5.64	131		7	7.75	20	12.2
8/17/2000	1105	Missisquoi River	ChampMon	CompDH59		4.36	130		8	7.72	20	11.9
11/15/2000	0930	Missisquoi River	ChampMon	CompDH59			88		24		5	7
11/15/2000	0945	Missisquoi River	ChampMon	CompDH59			90		21		5	7.1
11/27/2000	1100	Missisquoi River	ChampMon	CompDH59			111		11		3	9.1
11/27/2000	1110	Missisquoi River	ChampMon	CompDH59			111		11		3	9

Total Nitrogen	Total Phosphorus
mg/l	ug/l
0.65	64
0.5	64
1.17	196
1.14	203
0.59	307
0.59	262
0.57	42
0.64	45
0.59	197
0.64	202
0.56	93
0.5	79
0.57	88
0.87	233
0.64	111
0.59	33
0.55	29
0.48	19
0.69	31
1.19	20
1.19	20
0.74	45
0.72	45
0.58	19
0.61	19

Visit Date	Start Time	Location Name	Project ID	Collection Method	Depth (m)	Chlorophyll-a ug/l	Conductivity umho/cm	Dissolved Chloride mg/l	Dissolved Phosphorus ug/l	pH None	Temperature deg C	Total Chloride mg/l
12/18/2000	1115	Missisquoi River	ChampMon	CompDH59			89		43	7.28	0	9.46
4/9/2001	1050	Missisquoi River	ChampMon	CompDH59				11.4	48		0	
4/12/2001	1035	Missisquoi River	ChampMon	CompDH59								
4/16/2001	1315	Missisquoi River	ChampMon	CompDH59			67	6.1	21	7.19	3	
4/17/2001	1205	Missisquoi River	ChampMon	CompDH59								
4/23/2001	1100	Missisquoi River	ChampMon	CompDH59			42	2.5	17	7.14	8	
4/24/2001	1110	Missisquoi River	ChampMon	CompDH59								
4/25/2001	1045	Missisquoi River	ChampMon	CompDH59			41	2.9	19	7.09	7	
4/25/2001	1055	Missisquoi River	ChampMon	CompDH59			42	3	22	7.09	7	
4/26/2001	1055	Missisquoi River	ChampMon	CompDH59								
4/26/2001	1100	Missisquoi River	ChampMon	CompDH59								
4/27/2001	1210	Missisquoi River	ChampMon	CompDH59			50	3.5	12	7.27	14	
7/2/2001	1130	Missisquoi River	ChampMon	CompDH59		1.91	141	11.8	13	7.64		
7/2/2001	1140	Missisquoi River	ChampMon	CompDH59		1.99	142	11.8	13	7.62		
3/4/2002	1110	Missisquoi River	ChampMon	CompDH59			99	9.2	27	7.92	0	
4/1/2002	1050	Missisquoi River	ChampMon	CompDH59			85	8.3	17	7.76	4.2	
4/2/2002	1105	Missisquoi River	ChampMon	CompDH59							5	
4/3/2002	1015	Missisquoi River	ChampMon	CompDH59			70	6.6	16	7.58		
4/3/2002	1025	Missisquoi River	ChampMon	CompDH59			70	6.8	17	7.59		
4/10/2002	1050	Missisquoi River	ChampMon	CompDH59			88	8.2		7.4		
4/10/2002	1100	Missisquoi River	ChampMon	CompDH59			89	8.2	9	7.43		
4/11/2002	1130	Missisquoi River	ChampMon	CompDH59							6	
4/11/2002	1135	Missisquoi River	ChampMon	CompDH59							6	
4/15/2002	1115	Missisquoi River	ChampMon	CompDH59			50	3.7	14	7.61	9.2	
4/16/2002	1045	Missisquoi River	ChampMon	CompDH59								
5/3/2002	1145	Missisquoi River	ChampMon	CompDH59			84	6.6	22	7.2		
5/3/2002	1155	Missisquoi River	ChampMon	CompDH59			83	7.3	22	7.19		
5/7/2002	1110	Missisquoi River	ChampMon	CompDH59								
5/14/2002	1035	Missisquoi River	ChampMon	CompDH59			99	8.1	11	7.64	11	

Total Nitrogen	Total Phosphorus
mg/l	ug/l
1.55	321
1.48	150
	251
0.94	97
	76
0.92	176
	147
0.88	97
0.91	94
	67
	69
0.77	42
0.71	25
0.74	24
1.23	102
0.98	68
	84
0.82	55
0.84	53
0.81	41
0.86	56
	50
	47
0.82	93
	114
0.74	56
0.75	56
	24
0.68	57

Visit Date	Start Time	Location Name	Project ID	Collection Method	Depth (m)	Chlorophyll-a ug/l	Conductivity umho/cm	Dissolved Chloride mg/l	Dissolved Phosphorus ug/l	pH None	Temperature deg C	Total Chloride mg/l
5/15/2002	1115	Missisquoi River	ChampMon	CompDH59								
5/15/2002	1120	Missisquoi River	ChampMon	CompDH59								
5/24/2002	1330	Missisquoi River	ChampMon	CompDH59		0.63	94	6.7	10	7.56	14	
5/24/2002	1345	Missisquoi River	ChampMon	CompDH59		0.76	92	6.9	8	7.51	14	
6/6/2002	1145	Missisquoi River	ChampMon	CompDH59		6.05	78	4.7	47		18.5	
6/12/2002	1035	Missisquoi River	ChampMon	CompDH59			101	5.6	61	7.67		
6/13/2002	1100	Missisquoi River	ChampMon	CompDH59								
6/13/2002	1110	Missisquoi River	ChampMon	CompDH59								
6/28/2002	1230	Missisquoi River	ChampMon	CompDH59								
10/14/2002	1130	Missisquoi River	ChampMon	CompDH59			142		15	7.44		
3/24/2003	1045	Missisquoi River	ChampMon	CompDH59			72	6.7	35	7.13	4	
3/26/2003	1140	Missisquoi River	ChampMon	CompDH59			72	5.3	19	7.19		
4/14/2003	1050	Missisquoi River	ChampMon	CompDH59								
4/16/2003	1045	Missisquoi River	ChampMon	CompDH59			75	6.6	10	7.35	6.5	
4/23/2003	1140	Missisquoi River	ChampMon	CompDH59			84	7	8	7.81	8	
4/28/2003	1110	Missisquoi River	ChampMon	CompDH59			79	6.2	13	7.3	9	
5/13/2003	1100	Missisquoi River	ChampMon	CompDH59		1.77	89	7.7	19	7.61	13	
5/14/2003	1035	Missisquoi River	ChampMon	CompDH59								
5/30/2003	1055	Missisquoi River	ChampMon	CompDH59		2.85					15	
7/24/2003	1100	Missisquoi River	ChampMon	CompDH59		3.04	156	11.7	9	7.61	23.5	
8/7/2003	0915	Missisquoi River	ChampMon	CompDH59		4.34	111	7.5	14	7.39	23	
9/29/2003	1035	Missisquoi River	ChampMon	CompDH59		2.01	163	13.3	7	7.74	17	
10/16/2003	1100	Missisquoi River	ChampMon	CompDH59								
10/22/2003	1115	Missisquoi River	ChampMon	CompDH59			84	6.2	55	7.31	6	
10/28/2003	1015	Missisquoi River	ChampMon	CompDH59			73	4.8	47	7.23	7.5	
11/20/2003	1035	Missisquoi River	ChampMon	CompDH59			83	6.2	58	7.41	5	

Total Nitrogen	Total Phosphorus
mg/l	ug/l
	92
	87
0.56	68
0.58	21
1.52	380
2.06	544
	206
	202
	50
0.82	38
1.25	99
1.3	376
	35
0.69	41
0.8	24
0.71	60
0.67	73
	71
	25
0.64	18
0.56	45
0.43	16
	22
1.1	167
0.99	313
1.1	291

Visit Date	Start Time	Location Name	Project ID	Collection Method	Depth (m)	Chlorophyll-a	Conductivity	Dissolved Chloride	Dissolved Phosphorus	pH	Temperature	Total Chloride
						ug/l	umho/cm	mg/l	ug/l	None	deg C	mg/l
11/20/2003	1050	Missisquoi River	ChampMon	CompDH59			74	6.2	58	7.42	5	
3/26/2004	1045	Missisquoi River	ChampMon	CompDH59				10.6	67	7.23	2	
3/26/2004	1055	Missisquoi River	ChampMon	CompDH59				10.5	65	7.24	2	
3/31/2004	1035	Missisquoi River	ChampMon	CompDH59							3	
4/2/2004	1030	Missisquoi River	ChampMon	CompDH59			57	4.3	13	7.3	4	
4/14/2004	1100	Missisquoi River	ChampMon	CompDH59			91	7.2	16	7.45	5.5	
4/16/2004	1010	Missisquoi River	ChampMon	CompDH59								
4/16/2004	1015	Missisquoi River	ChampMon	CompDH59								
4/20/2004	1100	Missisquoi River	ChampMon	CompDH59			41	3.7	12	7.32	8	
4/22/2004	1035	Missisquoi River	ChampMon	CompDH59								
5/25/2004	1045	Missisquoi River	ChampMon	CompDH59			118	7.6	16	7.62	15	
5/27/2004	1045	Missisquoi River	ChampMon	CompDH59								
6/2/2004	1110	Missisquoi River	ChampMon	CompDH59		2.17	101	6.5	13	7.46	14	
6/25/2004	1110	Missisquoi River	ChampMon	CompDH59		3.93	136	9.2	9	7.68	19.5	
7/8/2004	1115	Missisquoi River	ChampMon	CompDH59			142	9.7	11	7.84	23	
7/20/2004	1110	Missisquoi River	ChampMon	CompDH59		3.02	95	5.3	27	7.61	21	
7/23/2004	1035	Missisquoi River	ChampMon	CompDH59								
8/13/2004	1135	Missisquoi River	ChampMon	CompDH59		3.8	73	3.5	48	7.53	17	
8/30/2004	1100	Missisquoi River	ChampMon	CompDH59							22	
8/31/2004	1055	Missisquoi River	ChampMon	CompDH59			77	3.3	41	7.6	18.5	
9/9/2004	1045	Missisquoi River	ChampMon	CompDH59							17.5	
9/10/2004	1110	Missisquoi River	ChampMon	CompDH59			91	4.5	44	7.87	15	
10/6/2004	1100	Missisquoi River	ChampMon	CompDH59			147	9.1	7	7.98	12	
3/29/2005	1105	Missisquoi River	ChampMon	CompDH59			132	13.5	29.7	7.58	1	
4/1/2005	1040	Missisquoi River	ChampMon	CompDH59			82	5.88	32.6	7.37	0.5	
4/3/2005	1030	Missisquoi River	ChampMon	CompDH59			72	7.08	21.2	7.4	2	
4/4/2005	1120	Missisquoi River	ChampMon	CompDH59								
4/7/2005	1100	Missisquoi River	ChampMon	CompDH59								
4/8/2005	1120	Missisquoi River	ChampMon	CompDH59			59	4.38	16.9	7.22	4.5	

Total Nitrogen	Total Phosphorus
mg/l	ug/l
1.04	290
1.17	220
1.23	240
	72
0.69	82
0.78	83
	65
	53
0.59	56
	41
0.79	88
	51
0.5	31
0.6	26
0.57	20
0.59	48
	40
0.74	290
	74
0.91	389
	25
0.71	160
0.65	16
1.04	57.6
1.27	368
1.17	432
	200
	78.2
0.7	172

Visit Date	Start Time	Location Name	Project ID	Collection Method	Depth (m)	Chlorophyll-a	Conductivity	Dissolved Chloride	Dissolved Phosphorus	pH	Temperature	Total Chloride
						ug/l	umho/cm	mg/l	ug/l	None	deg C	mg/l
4/14/2005	1110	Missisquoi River	ChampMon	CompDH59								
4/21/2005	1050	Missisquoi River	ChampMon	CompDH59			70	4.74	9.1	7.47	9	
4/25/2005	1045	Missisquoi River	ChampMon	CompDH59			68	5.39	16.4	7.4	7	
4/26/2005	1040	Missisquoi River	ChampMon	CompDH59								
4/28/2005	1230	Missisquoi River	ChampMon	CompDH59			87	6.88	14.3	7.49	9	
4/29/2005	0950	Missisquoi River	ChampMon	CompDH59								
5/2/2005	1040	Missisquoi River	ChampMon	CompDH59								
5/3/2005	1035	Missisquoi River	ChampMon	CompDH59								
5/23/2005	1100	Missisquoi River	ChampMon	CompDH59		3.31						
5/24/2005	1055	Missisquoi River	ChampMon	CompDH59			111	7.66	6.41	7.78	14	
6/15/2005	1130	Missisquoi River	ChampMon	CompDH59		9.38	127	8.4	11	7.64	23.5	
9/1/2005	1055	Missisquoi River	ChampMon	CompDH59		3.01	174	12.5	22.5	7.58	22	
10/17/2005	1105	Missisquoi River	ChampMon	CompDH59			58	3.18	33.3	7.25	10	
10/18/2005	1050	Missisquoi River	ChampMon	CompDH59								
10/24/2005	1100	Missisquoi River	ChampMon	CompDH59								
10/26/2005	1115	Missisquoi River	ChampMon	CompDH59			82	4.96	30.2	7.44	5	
10/27/2005	1055	Missisquoi River	ChampMon	CompDH59								
11/17/2005	1040	Missisquoi River	ChampMon	CompDH59			84	4.99	76.6	7.57	5	
11/18/2005	1030	Missisquoi River	ChampMon	CompDH59								
12/1/2005	1035	Missisquoi River	ChampMon	CompDH59								
1/19/2006	1025	Missisquoi River	ChampMon	CompDH59			56	5.35	31.4	7.17	0	
2/6/2006	1050	Missisquoi River	ChampMon	CompDH59			69	5.46	26	7.4	0	
3/14/2006	1040	Missisquoi River	ChampMon	CompDH59			69	5.64	23.5	7.44	1	
4/3/2006	1050	Missisquoi River	ChampMon	CompDH59								

Total Nitrogen	Total Phosphorus
mg/l	ug/l
	37.6
0.47	33.9
0.58	67.1
	44.9
0.5	32.1
	92.5
	46.3
	39.3
	21.4
0.38	17.9
0.64	67.2
0.58	43.2
0.89	336
	162
	73.6
0.56	71.4
	92.4
1.03	238
	84
	79.9
0.94	372
0.84	206
1.13	157
	70

Visit Date	Start Time	Location Name	Project ID	Collection Method	Depth (m)	Chlorophyll-a	Conductivity	Dissolved Chloride	Dissolved Phosphorus	pH	Temperature	Total Chloride
						ug/l	umho/ cm	mg/l	ug/l	None	deg C	mg/l
4/4/2006	1045	Missisquoi River	ChampMon	CompDH59			53	3.9	13.3	7.55	4	
4/24/2006	1040	Missisquoi River	ChampMon	CompDH59								
5/15/2006	1110	Missisquoi River	ChampMon	CompDH59								
5/17/2006	1050	Missisquoi River	ChampMon	CompDH59								
5/19/2006	1025	Missisquoi River	ChampMon	CompDH59			84	5.31	28.8	7.7	12	
5/22/2006	1100	Missisquoi River	ChampMon	CompDH59							9	
6/12/2006	1135	Missisquoi River	ChampMon	CompDH59			67	4.56	29	7.55	13	
6/27/2006	1050	Missisquoi River	ChampMon	CompDH59			129	8.02	31.5	7.78	21	
7/12/2006	1055	Missisquoi River	ChampMon	CompDH59			106	6.13	10.7	7.88	24	
7/17/2006	1125	Missisquoi River	ChampMon	CompDH59							26	
8/18/2006	1120	Missisquoi River	ChampMon	CompDH59			121	7.11	11.6	7.79	22	
8/21/2006	1050	Missisquoi River	ChampMon	CompDH59								
9/13/2006	1030	Missisquoi River	ChampMon	CompDH59				9.49				
10/23/2006	1045	Missisquoi River	ChampMon	CompDH59							5	
10/30/2006	1025	Missisquoi River	ChampMon	CompDH59								
11/15/2006	1045	Missisquoi River	ChampMon	CompDH59								
3/15/2007	1120	Missisquoi River	ChampMon	CompDH59								
3/15/2007	1125	Missisquoi River	ChampMon	CompDH59								
3/23/2007	1320	Missisquoi River	ChampMon	CompDH59			91	8	23.7	7.35	3.5	
3/26/2007	1130	Missisquoi River	ChampMon	CompDH59			73	5.95	24.9	7.47	0	
3/26/2007	1140	Missisquoi River	ChampMon	CompDH59			80	6.11	26.6	7.45	0	
3/27/2007	1125	Missisquoi River	ChampMon	CompDH59			76	5.73	18.2	7.22	2.5	
3/28/2007	0945	Missisquoi River	ChampMon	CompDH59								
3/28/2007	0950	Missisquoi River	ChampMon	CompDH59								
4/4/2007	1040	Missisquoi River	ChampMon	CompDH59			59	4.25	15.9	7.42	2	
4/16/2007	1140	Missisquoi River	ChampMon	CompDH59			90	7.06	22.5	7.43	3.5	
4/17/2007	1120	Missisquoi River	ChampMon	CompDH59			66	4.98	22.7	7.56	2.5	
4/18/2007	1055	Missisquoi River	ChampMon	CompDH59								

Total Nitrogen	Total Phosphorus
mg/l	ug/l
0.6	49.6
	22.4
	20.1
	33
1	179
	137
0.59	184
0.94	83.1
0.65	25.2
	24.4
0.68	19.7
	27
	21.4
	69.9
	106
	110
	170
	169
1.07	75.5
0.96	76.6
0.99	78.9
1.13	230
	350
	316
0.79	57.9
0.89	93.2
0.84	181
	84.3

Visit Date	Start Time	Location Name	Project ID	Collection Method	Depth (m)	Chlorophyll-a ug/l	Conductivity umho/cm	Dissolved Chloride mg/l	Dissolved Phosphorus ug/l	pH None	Temperature deg C	Total Chloride mg/l
4/23/2007	0955	Missisquoi River	ChampMon	CompDH59			54	3.55	11.5	7.2	8	
4/24/2007	1125	Missisquoi River	ChampMon	CompDH59								
5/17/2007	1100	Missisquoi River	ChampMon	CompDH59			68	4.39	22.9	7.48	9	
8/3/2007	1030	Missisquoi River	ChampMon	CompDH59			125	9.06	9.11	7.88	27	
8/10/2007	1025	Missisquoi River	ChampMon	CompDH59								
8/20/2007	1145	Missisquoi River	ChampMon	CompDH59				6.76				
8/31/2007	1005	Missisquoi River	ChampMon	CompDH59			116	7.63	13.2	7.66	19.5	
10/24/2007	1100	Missisquoi River	ChampMon	CompDH59			111	6.36	79.3	7.51	12.5	
1/10/2008	1125	Missisquoi River	ChampMon	CompDH59			54	3.36	21.6	7.24	2	
4/2/2008	1110	Missisquoi River	ChampMon	CompDH59			74	4.61	36.1	7.45	1	
4/7/2008	1025	Missisquoi River	ChampMon	CompDH59								
4/9/2008	1150	Missisquoi River	ChampMon	CompDH59			66	4.88	15.2	7.03	8	
4/10/2008	1045	Missisquoi River	ChampMon	CompDH59								
4/14/2008	1140	Missisquoi River	ChampMon	CompDH59			51	3.95	13.6	7.27	4	
4/18/2008	1135	Missisquoi River	ChampMon	CompDH59								
4/21/2008	1045	Missisquoi River	ChampMon	CompDH59			54	3.59	11.2	7.35	10	
4/30/2008	1130	Missisquoi River	ChampMon	CompDH59			87	5.89	15.2	7.43	8	
6/11/2008	1100	Missisquoi River	ChampMon	CompDH59			86	5.17	20.6	7.54	22	
7/9/2008	1145	Missisquoi River	ChampMon	CompDH59			124	8.14	9.9	7.79	25.5	
7/21/2008	1045	Missisquoi River	ChampMon	CompDH59								
7/24/2008	1325	Missisquoi River	ChampMon	CompDH59			107	5.9	49	7.52	21	
7/25/2008	1435	Missisquoi River	ChampMon	CompDH59								
8/4/2008	1055	Missisquoi River	ChampMon	CompDH59			85	4.8	25.3	7.58	18.5	
8/7/2008	1320	Missisquoi River	ChampMon	CompDH59			88	5.23	22.3	7.58	21	
8/8/2008	1145	Missisquoi River	ChampMon	CompDH59								
9/2/2008	1250	Missisquoi River	ChampMon	CompDH59			132	7.88	11.5	7.8	18	
9/15/2008	1135	Missisquoi River	ChampMon	CompDH59			162	9.84	10.9	7.79		
9/30/2008	1135	Missisquoi River	ChampMon	CompDH59			146	8.98	8.18	7.94		

Total Nitrogen	Total Phosphorus
mg/l	ug/l
0.65	49.3
	80.6
0.86	132
0.46	15.7
	57.5
	17.2
0.55	34.8
1.12	286
0.84	144
1.04	262
	57
0.57	86.2
	109
0.58	78.2
	36.6
0.54	41.8
0.57	42.4
0.87	127
0.51	22.1
	65.9
0.88	110
	193
0.46	106
0.5	66.5
	102
0.4	17.2
0.56	17
0.45	15.5

Visit Date	Start Time	Location Name	Project ID	Collection Method	Depth (m)	Chlorophyll-a	Conductivity	Dissolved Chloride	Dissolved Phosphorus	pH	Temperature	Total Chloride
						ug/l	umho/ cm	mg/l	ug/l	None	deg C	mg/l
10/30/2008	1000	Missisquoi River	ChampMon	CompDH59								
3/12/2009	0955	Missisquoi River	ChampMon	CompDH59								
3/30/2009	1205	Missisquoi River	ChampMon	CompDH59			48	4.44	14.9	7.19	2.8	
3/31/2009	1020	Missisquoi River	ChampMon	CompDH59								
4/6/2009	1055	Missisquoi River	ChampMon	CompDH59								
4/7/2009	1135	Missisquoi River	ChampMon	CompDH59				5.48	19.3		3.3	
5/8/2009	1115	Missisquoi River	ChampMon	CompDH59								
5/11/2009	1135	Missisquoi River	ChampMon	CompDH59			51	3.53	30	7.01	10	
5/29/2009	1045	Missisquoi River	ChampMon	CompDH59								
6/30/2009	1530	Missisquoi River	ChampMon	CompDH59				3.84	42.1			
8/20/2009	1145	Missisquoi River	ChampMon	CompDH59			86	6.89	14.4	6.92	25.6	
8/27/2009	1050	Missisquoi River	ChampMon	CompDH59			109	8.46	14.6	7.55	22.2	
9/3/2009	1120	Missisquoi River	ChampMon	CompDH59			114	9.16	12.1	7.97	21.7	
9/11/2009	1045	Missisquoi River	ChampMon	CompDH59			121	9.47	9.72	7.99	20	
10/26/2009	1115	Missisquoi River	ChampMon	CompDH59								
12/4/2009	1130	Missisquoi River	ChampMon	CompDH59			56	2.81	27.1	6.89	6.1	
3/15/2010	1200	Missisquoi River	ChampMon	CompDH59			85	5.91	21.8	6.7	1.1	
3/22/2010	1130	Missisquoi River	ChampMon	CompDH59								
3/23/2010	1150	Missisquoi River	ChampMon	CompDH59			75	5.23	21.8	7.19	2.2	
3/24/2010	1035	Missisquoi River	ChampMon	CompDH59								
3/30/2010	1220	Missisquoi River	ChampMon	CompDH59								
3/31/2010	1120	Missisquoi River	ChampMon	CompDH59			80	5.42	18.8	7.35	3.3	
4/19/2010	1220	Missisquoi River	ChampMon	CompDH59								
4/30/2010	1245	Missisquoi River	ChampMon	CompDH59			100	6.77	29	7.53	9	
6/29/2010	1125	Missisquoi River	ChampMon	CompDH59								
8/4/2010	1150	Missisquoi River	ChampMon	CompDH59			93	4.27	63.8	7.44	20.5	
8/20/2010	1130	Missisquoi River	ChampMon	CompDH59				6.98	12.4		22.2	
8/27/2010	1135	Missisquoi River	ChampMon	CompDH59			143	8.62	14.1	8.03	21.1	

Total Nitrogen	Total Phosphorus
mg/l	ug/l
	180
	108
0.65	130
	109
	79.6
0.78	101
	22.5
0.75	152
	21.7
1.05	137
0.46	20.1
0.52	20.7
0.49	17.6
0.42	13
	78.4
0.74	168
0.67	82.1
	33
0.75	136
	189
	58.4
0.64	70.8
	49
0.72	63.4
	30.4
1.24	394
0.32	16.9
0.46	17.4

Visit Date	Start Time	Location Name	Project ID	Collection Method	Depth (m)	Chlorophyll-a ug/l	Conductivity umho/cm	Dissolved Chloride mg/l	Dissolved Phosphorus ug/l	pH None	Temperature deg C	Total Chloride mg/l
9/9/2010	1155	Missisquoi River	ChampMon	CompDH59			147	9.15	11.8	7.64	20	
9/24/2010	1110	Missisquoi River	ChampMon	CompDH59			131	8.68	10.1	7.85	15	
10/1/2010	1230	Missisquoi River	ChampMon	CompDH59				6.89	74.7		15	
10/18/2010	1150	Missisquoi River	ChampMon	CompDH59								
11/9/2010	1135	Missisquoi River	ChampMon	CompDH59								
12/2/2010	1120	Missisquoi River	ChampMon	CompDH59			102	5.91	68.7	7.12	3.9	
12/13/2010	1115	Missisquoi River	ChampMon	CompDH59								
3/14/2011	1245	Missisquoi River	ChampMon	CompDH59								
3/18/2011	1005	Missisquoi River	ChampMon	CompDH59			107	8.79	34.2	6.69	1	
3/22/2011	1230	Missisquoi River	ChampMon	CompDH59			80	7.03	18.2	6.97	0	
4/5/2011	1240	Missisquoi River	ChampMon	CompDH59			92	7.54	20.7	7.04	1.1	
4/6/2011	1130	Missisquoi River	ChampMon	CompDH59								
4/11/2011	1155	Missisquoi River	ChampMon	CompDH59				3.65	15.9	6.49	7.2	
4/12/2011	1055	Missisquoi River	ChampMon	CompDH59								
4/15/2011	1205	Missisquoi River	ChampMon	CompDH59								
4/18/2011	1210	Missisquoi River	ChampMon	CompDH59			67	4.7	23.1	6.99	2.8	
4/21/2011	0935	Missisquoi River	ChampMon	CompDH59								
4/26/2011	1005	Missisquoi River	ChampMon	CompDH59								
4/27/2011	1040	Missisquoi River	ChampMon	CompDH59			61	3	46.3	6.89	10	
4/28/2011	1015	Missisquoi River	ChampMon	CompDH59								
4/29/2011	1140	Missisquoi River	ChampMon	CompDH59								
5/4/2011	1105	Missisquoi River	ChampMon	CompDH59								
5/5/2011	1115	Missisquoi River	ChampMon	CompDH59			69	3.26	32.2	7.36	7.2	
5/16/2011	1210	Missisquoi River	ChampMon	CompDH59			80	4.17	38.1	7.1	10.5	
5/17/2011	1125	Missisquoi River	ChampMon	CompDH59								
5/27/2011	0945	Missisquoi River	ChampMon	CompDH59								
7/21/2011	1200	Missisquoi River	ChampMon	CompDH59			133	8.07	17.5	7.41	26.1	
7/26/2011	1235	Missisquoi River	ChampMon	CompDH59			177	9.32	17.6	7.68	25	

Total Nitrogen	Total Phosphorus
mg/l	ug/l
0.51	15.4
0.36	14.2
0.97	404
	54.1
0.68	64.2
1.16	340
1.11	184
	61.8
0.93	83
0.69	43.9
0.68	67.5
	162
0.83	477
	358
	58.2
0.64	69.9
	123
	24.2
1.22	785
	266
	270
	304
0.57	132
0.67	110
	111
	212
0.64	22.6
0.54	23.9

Visit Date	Start Time	Location Name	Project ID	Collection Method	Depth (m)	Chlorophyll-a	Conductivity	Dissolved Chloride	Dissolved Phosphorus	pH	Temperature	Total Chloride
						ug/l	umho/cm	mg/l	ug/l	None	deg C	mg/l
8/5/2011	1010	Missisquoi River	ChampMon	CompDH59				8.57	16.5		25	
8/24/2011	1150	Missisquoi River	ChampMon	CompDH59			137	H 9.4	H 12.2	7.25	23	
9/6/2011	1030	Missisquoi River	ChampMon	CompDH59				H 3.76	37.8			
9/30/2011	1155	Missisquoi River	ChampMon	CompDH59				6.43	H 30.9		19	
10/3/2011	1110	Missisquoi River	ChampMon	CompDH59								
3/9/2012	1000	Missisquoi River	ChampMon	CompDH59				6.274	39.3		1.5	
3/14/2012	1230	Missisquoi River	ChampMon	CompDH59								
3/15/2012	1130	Missisquoi River	ChampMon	CompDH59			62	4.513	16.2	6.46	3.5	
3/19/2012	1105	Missisquoi River	ChampMon	CompDH59								
3/22/2012	1210	Missisquoi River	ChampMon	CompDH59								
4/10/2012	0945	Missisquoi River	ChampMon	CompDH59			117	7.586	8.86	7.06	6	
4/11/2012	1105	Missisquoi River	ChampMon	CompDH59								
4/23/2012	1200	Missisquoi River	ChampMon	CompDH59			95	6.626	9.49	7.07	10	
4/24/2012	0930	Missisquoi River	ChampMon	CompDH59								
5/9/2012	1125	Missisquoi River	ChampMon	CompDH59			95	6.271	10.3	7.19	16	
5/10/2012	1235	Missisquoi River	ChampMon	CompDH59								
5/16/2012	1100	Missisquoi River	ChampMon	CompDH59								
5/30/2012	0900	Missisquoi River	ChampMon	CompDH59			133	7.145	10.5	7.08	22	
6/19/2012	1115	Missisquoi River	ChampMon	CompDH59			126	7.971	5.94	7.36	23.5	
6/28/2012	0920	Missisquoi River	ChampMon	CompDH59								
7/20/2012	1110	Missisquoi River	ChampMon	CompDH59			114	6.561	10.4	7.34	25	
7/24/2012	1110	Missisquoi River	ChampMon	CompDH59								
8/24/2012	0935	Missisquoi River	ChampMon	CompDH59			171	10.418	H 9.1	7.52	24	
9/5/2012	1200	Missisquoi River	ChampMon	CompDH59				H 9.291	29.4		20.5	
9/19/2012	0910	Missisquoi River	ChampMon	CompDH59								
12/3/2012	1005	Missisquoi River	ChampMon	CompDH59								
12/5/2012	0955	Missisquoi River	ChampMon	CompDH59								
12/11/2012	1130	Missisquoi River	ChampMon	CompDH59								

Total Nitrogen		Total Phosphorus	
mg/l		ug/l	
	0.71		26.1
H	0.46	H	20.1
H	0.59		165
	0.55	H	63.3
		H	101
	1.549		466
			167
	0.843429		124
			73.6
			44.9
	0.6112		30.7
			57.7
	0.458		27.3
			67.1
	0.460667		25.1
			30.1
			21.9
	0.5432		46.2
	0.4456		13.8
			50.5
	0.5072		21.8
			24.8
H	0.3888	H	14.1
H	1.3588	H	600
			34.2
			83.9
			70.5
			63.1

Visit Date	Start Time	Location Name	Project ID	Collection Method	Depth (m)	Chlorophyll-a	Conductivity	Dissolved Chloride	Dissolved Phosphorus	pH	Temperature	Total Chloride
						ug/l	umho/ cm	mg/l	ug/l	None	deg C	mg/l
1/15/2013	1215	Missisquoi River	ChampMon	CompDH59								
1/31/2013	1025	Missisquoi River	ChampMon	CompDH59								
3/13/2013	1335	Missisquoi River	ChampMon	CompDH59								
4/2/2013	1115	Missisquoi River	ChampMon	CompDH59								
4/10/2013	1000	Missisquoi River	ChampMon	CompDH59			89	6.636	10.5	7.5	5	
4/11/2013	1200	Missisquoi River	ChampMon	CompDH59								
4/17/2013	1045	Missisquoi River	ChampMon	CompDH59				5.893	10.3		7	
4/18/2013	1120	Missisquoi River	ChampMon	CompDH59								
5/22/2013	1010	Missisquoi River	ChampMon	CompDH59								
5/23/2013	1200	Missisquoi River	ChampMon	CompDH59			125	7.33	14.7	7.13		
5/24/2013	1135	Missisquoi River	ChampMon	CompDH59								
5/28/2013	1140	Missisquoi River	ChampMon	CompDH59								
6/26/2013	1125	Missisquoi River	ChampMon	CompDH59								
8/6/2013	0955	Missisquoi River	ChampMon	CompDH59			140	6.66	23.8	7.3	22	
8/12/2013	0935	Missisquoi River	ChampMon	CompDH59			150	7.31	20.7	7.07	23	
8/21/2013	0945	Missisquoi River	ChampMon	CompDH59				8.56	10.7		24	
8/29/2013	1230	Missisquoi River	ChampMon	CompDH59				10.3	11.9			
9/12/2013	1020	Missisquoi River	ChampMon	CompDH59								
9/13/2013	0925	Missisquoi River	ChampMon	CompDH59								
11/19/2013	1030	Missisquoi River	ChampMon	CompDH59								
3/31/2014	1300	Missisquoi River	ChampMon	CompDH59								8.76
4/3/2014	1150	Missisquoi River	ChampMon	CompDH59			82		70.3	7.1	0	8
4/7/2014	1145	Missisquoi River	ChampMon	CompDH59							2.2	
4/8/2014	1155	Missisquoi River	ChampMon	CompDH59			69		37	6.82		6.88
4/14/2014	1030	Missisquoi River	ChampMon	CompDH59								
4/16/2014	1200	Missisquoi River	ChampMon	CompDH59			37		15.2	7.06	1.1	3.18
4/17/2014	1140	Missisquoi River	ChampMon	CompDH59								
4/23/2014	0950	Missisquoi River	ChampMon	CompDH59			62		11.4	7.04		5.54
5/2/2014	0945	Missisquoi River	ChampMon	CompDH59								

Total Nitrogen		Total Phosphorus
	mg/l	ug/l
		105
		32.2
	1.36	360
	0.676	66.2
	0.606	61.2
		84.4
	0.628	98.1
		83.6
		19.7
	0.66	78.6
		139
	0.741	250
	0.868	33.8
	0.696	30.3
	0.551	26.8
	0.446	20.5
H	0.474	19.3
H	0.561	26.7
	1.092	153
		180
	1.32	133
	1.23	132
		98.5
	0.94	290
		102
	1.24	497.5
		244
	0.6	45.5
		64.2

Visit Date	Start Time	Location Name	Project ID	Collection Method	Depth (m)	Chlorophyll-a ug/l	Conductivity umho/cm	Dissolved Chloride mg/l	Dissolved Phosphorus ug/l	pH None	Temperature deg C	Total Chloride mg/l
5/5/2014	1150	Missisquoi River	ChampMon	CompDH59			73		16.6	6.78	6.6	6.35
7/7/2014	1135	Missisquoi River	ChampMon	CompDH59			116		28.5	7.18	22.2	8.79
7/21/2014	1225	Missisquoi River	ChampMon	CompDH59			113		12.9	7.39	26	8.26
7/29/2014	1145	Missisquoi River	ChampMon	CompDH59								
8/14/2014	1400	Missisquoi River	ChampMon	CompDH59					18.3		17.7	7.63
9/11/2014	0950	Missisquoi River	ChampMon	CompDH59			175		6.97	7.28		9.58
11/6/2014	1025	Missisquoi River	ChampMon	CompDH59			134		16.1	7.42		7.74
11/25/2014	1000	Missisquoi River	ChampMon	CompDH59								
4/10/2015	1015	Missisquoi River	ChampMon	CompDH59								
4/13/2015	1250	Missisquoi River	ChampMon	CompDH59			75		17.5	7.77	10.5	6.248
4/14/2015	0905	Missisquoi River	ChampMon	CompDH59			67		17.7	8.13	6	5.122
4/22/2015	1050	Missisquoi River	ChampMon	CompDH59					13.1			6.405
4/23/2015	1310	Missisquoi River	ChampMon	CompDH59								
5/13/2015	1315	Missisquoi River	ChampMon	CompDH59			119		13.4	8.46		7.398
5/31/2015	1035	Missisquoi River	ChampMon	CompDH59								
6/1/2015	1100	Missisquoi River	ChampMon	CompDH59			170		31.8	7.56	17.2	8.397
6/2/2015	1100	Missisquoi River	ChampMon	CompDH59			92		45	7.48	13.1	7.034
6/10/2015	1210	Missisquoi River	ChampMon	CompDH59			96		54	7.69	18	5.937
6/22/2015	1050	Missisquoi River	ChampMon	CompDH59			133		39.7	8.1	20.1	7.371
7/2/2015	1155	Missisquoi River	ChampMon	CompDH59								
7/20/2015	1000	Missisquoi River	ChampMon	CompDH59								
8/3/2015	1120	Missisquoi River	ChampMon	CompDH59			165		29.6	8.13	24	8.886
8/12/2015	1220	Missisquoi River	ChampMon	CompDH59							22.2	
8/24/2015	1105	Missisquoi River	ChampMon	CompDH59			151		20	8.29	26.9	10.68
9/22/2015	1120	Missisquoi River	ChampMon	CompDH59			131		18.9	8.11	20.2	8.393
10/1/2015	1010	Missisquoi River	ChampMon	CompDH59			140		44.7	8.25	14.7	7.696
10/26/2015	0940	Missisquoi River	ChampMon	CompDH59			176		15.6	8.21	8.5	9.481
10/30/2015	1145	Missisquoi River	ChampMon	CompDH59					64.8		8.5	5.53

Total Nitrogen	Total Phosphorus
mg/l	ug/l
0.64	63.1
1.17	47.1
0.71	21.8
1.1	106
0.53	30.9
0.65	13.4
0.45	28.2
0.54	48.9
0.84	62.2
0.8	102
0.88	218
0.67	61.3
0.66	54.1
0.45	36.3
0.71	46.5
0.98	73.7
1.39	137
1.45	373.2
1.44	400
1.13	52.3
1.33	140
0.83	46.7
0.64	44.3
0.53	29.9
0.5	30.8
0.79	99
0.47	32.6
0.96	206

Visit Date	Start Time	Location Name	Project ID	Collection Method	Depth (m)	Chlorophyll-a	Conductivity	Dissolved Chloride	Dissolved Phosphorus	pH	Temperature	Total Chloride
						ug/l	umho/ cm	mg/l	ug/l	None	deg C	mg/l
12/3/2015	0920	Missisquoi River	ChampMon	CompDH59								
1/11/2016	0950	Missisquoi River	ChampMon	CompDH59								
2/17/2016	1120	Missisquoi River	ChampMon	CompDH59								
2/25/2016	1000	Missisquoi River	ChampMon	CompDH59			96		30.9	6.66	0.9	7.83
3/10/2016	0935	Missisquoi River	ChampMon	CompDH59			101		15.4	6.11	2.6	8.18
3/17/2016	1140	Missisquoi River	ChampMon	CompDH59							4.9	
3/29/2016	1015	Missisquoi River	ChampMon	CompDH59			99		19.1	7.36	4.4	7.07
4/8/2016	1010	Missisquoi River	ChampMon	CompDH59			112		14.5	7.74	3	7.89
4/12/2016	1010	Missisquoi River	ChampMon	CompDH59			102		14.6	7.8	3.9	6.47
6/6/2016	1045	Missisquoi River	ChampMon	CompDH59			161		11.2	8.03	22.7	10.6
7/18/2016	1015	Missisquoi River	ChampMon	CompDH59			172		13.9	8.17	26.2	9.88
8/10/2016	1040	Missisquoi River	ChampMon	CompDH59			170		16.7	8.43	27.4	10.1
9/7/2016	1035	Missisquoi River	ChampMon	CompDH59			172		18.1	8.27	23	8.49
9/27/2016	1020	Missisquoi River	ChampMon	CompDH59			214		12.4	8.38	19.8	11.4
11/4/2016	1120	Missisquoi River	ChampMon	CompDH59							7.6	
12/1/2016	1040	Missisquoi River	ChampMon	CompDH59								
2/24/2017	1015	Missisquoi River	ChampMon	CompDH59					66.4			8.1
2/26/2017	1215	Missisquoi River	ChampMon	CompDH59			76		20.8	7.3	2.4	6.39
3/2/2017	0955	Missisquoi River	ChampMon	CompDH59			99		21.9	7.96	2.8	6.88
4/5/2017	1140	Missisquoi River	ChampMon	CompDH59			80		36.5	7.72	3.2	6
4/7/2017	1105	Missisquoi River	ChampMon	CompDH59							3.3	
4/11/2017	0900	Missisquoi River	ChampMon	CompDH59			84		13.9	7.62	7.6	4.98
4/12/2017	1035	Missisquoi River	ChampMon	CompDH59			54		12.3	7.33	7.6	3.41
4/17/2017	1115	Missisquoi River	ChampMon	CompDH59			94		13.6		8.9	4.16
4/21/2017	0940	Missisquoi River	ChampMon	CompDH59								
5/2/2017	1150	Missisquoi River	ChampMon	CompDH59			128		28.4	7.74	11.1	6.91
5/16/2017	0910	Missisquoi River	ChampMon	CompDH59			110		11.2	6.99	13.7	8.11
6/7/2017	1100	Missisquoi River	ChampMon	CompDH59			153		J 11.5	7.36	14.8	8.99
6/20/2017	1035	Missisquoi River	ChampMon	CompDH59							24	
6/30/2017	1035	Missisquoi River	ChampMon	CompDH59			157		22.3	8.04	19.7	8.11

Total Nitrogen	Total Phosphorus
mg/l	**ug/l**
1	106
1.13	124
1.09	84.6
0.97	340
0.79	41.7
0.72	65.7
0.9	199
0.96	99.1
0.69	86.7
0.84	26.3
0.67	18.8
0.46	25.7
0.82	28.3
0.62	16.1
0.56	28.2
0.63	68.4
1.05	234
1.61	868
0.79	166
0.78	208
0.77	283.8
0.46	82.5
0.42	112
0.45	89.9
0.47	34.9
0.9	95.7
0.54	20.1
0.6	43.5
0.85	29.1
0.94	48.8

Visit Date	Start Time	Location Name	Project ID	Collection Method	Depth (m)	Chlorophyll-a	Conductivity	Dissolved Chloride	Dissolved Phosphorus	pH	Temperature	Total Chloride
						ug/l	umho/cm	mg/l	ug/l	None	deg C	mg/l
7/3/2017	1205	Missisquoi River	ChampMon	CompDH59			133		36.3	7.94	20.5	6.19
7/25/2017	1005	Missisquoi River	ChampMon	CompDH59			376		18.3	7.58	22	8.66
8/11/2017	0935	Missisquoi River	ChampMon	CompDH59			325		14.5	8.57	23.2	7.77
9/1/2017	0915	Missisquoi River	ChampMon	CompDH59			182		15.9	8.97	18.6	9.88
9/5/2017	0940	Missisquoi River	ChampMon	CompDH59			155		12.4	7.54	18.6	11.5
9/15/2017	1020	Missisquoi River	ChampMon	CompDH59			156		16.9	7.75	19.3	8.05
10/4/2017	0945	Missisquoi River	ChampMon	CompDH59			176		18.3	7.72	17.8	12.9
10/27/2017	1105	Missisquoi River	ChampMon	CompDH59								
10/31/2017	1035	Missisquoi River	ChampMon	CompDH59			365		27.7	7.53	10.7	7.41
2/21/2018	1000	Missisquoi River	ChampMon	CompDH59					43.1	7.64	0.9	9.83
3/30/2018	1020	Missisquoi River	ChampMon	CompDH59					34.6	7.79	2.9	11
4/5/2018	0940	Missisquoi River	ChampMon	CompDH59								
4/14/2018	1245	Missisquoi River	ChampMon	CompDH59					16.4	7.77	2.7	8.49
4/17/2018	1010	Missisquoi River	ChampMon	CompDH59								
4/25/2018	1050	Missisquoi River	ChampMon	CompDH59					10.7	7.3	9.1	5.65
4/26/2018	1025	Missisquoi River	ChampMon	CompDH59					15.4	7.48	7.5	4.79
4/27/2018	0930	Missisquoi River	ChampMon	CompDH59					15.6		6.5	3.88
4/30/2018	1035	Missisquoi River	ChampMon	CompDH59					24.6	7.38	6.2	4.63
5/4/2018	1045	Missisquoi River	ChampMon	CompDH59								
6/26/2018	1040	Missisquoi River	ChampMon	CompDH59					17.8	7.76	23	8.57
7/24/2018	1025	Missisquoi River	ChampMon	CompDH59					11.3	8.15	26.4	13.2
8/24/2018	1030	Missisquoi River	ChampMon	CompDH59					10.3	8.45	23.6	12.2
9/11/2018	1115	Missisquoi River	ChampMon	CompDH59								
10/12/2018	1050	Missisquoi River	ChampMon	CompDH59					20.3	8.23	13.8	8.53
11/4/2018	0950	Missisquoi River	ChampMon	CompDH59								
11/5/2018	1035	Missisquoi River	ChampMon	CompDH59					39.7	7.67	4.9	5.22
4/1/2019	1220	Missisquoi River	ChampMon	CompDH59								
4/2/2019	1020	Missisquoi River	ChampMon	CompDH59			91	7.14	20	7.78	0.3	

Total Nitrogen	Total Phosphorus
mg/l	ug/l
0.97	78
0.67	24.8
0.54	21.9
0.52	20.8
0.67	24.4
0.55	21.5
0.5	23.6
0.52	35.7
0.58	63
1.5	740
1.27	242
0.82	336
0.93	293.4
0.81	72.3
0.48	32.1
0.81	179.5
0.79	243
0.79	177
0.58	86.3
0.56	22.7
0.49	22.8
0.39	16
0.36	14.3
0.57	34.6
1.41	157
1.03	89.6
0.95	242
0.9	154

Visit Date	Start Time	Location Name	Project ID	Collection Method	Depth (m)	Chlorophyll-a ug/l	Conductivity umho/cm	Dissolved Chloride mg/l	Dissolved Phosphorus ug/l	pH None	Temperature deg C	Total Chloride mg/l
4/10/2019	1020	Missisquoi River	ChampMon	CompDH59			103	7.2	22	7.81	1.2	
4/15/2019	1010	Missisquoi River	ChampMon	CompDH59			79	4.72	16	7.85	4.2	
4/17/2019	1105	Missisquoi River	ChampMon	CompDH59								
4/20/2019	0840	Missisquoi River	ChampMon	CompDH59			98	6.14	14	8		
4/28/2019	0925	Missisquoi River	ChampMon	CompDH59			102	6.02	26	7.78		
5/10/2019	1015	Missisquoi River	ChampMon	CompDH59			125	8.11	17	7.78		
6/6/2019	1005	Missisquoi River	ChampMon	CompDH59			140	8.49	12	7.89		
6/21/2019	0920	Missisquoi River	ChampMon	CompDH59			178	9.75	11	7.83		
7/16/2019	0945	Missisquoi River	ChampMon	CompDH59			190	11.9	J 14	7.78	26.1	
8/16/2019	1025	Missisquoi River	ChampMon	CompDH59			175	11.1	11	8.03	22.9	
9/11/2019	1005	Missisquoi River	ChampMon	CompDH59			168	9.82	17	8.25	19.3	
9/23/2019	1035	Missisquoi River	ChampMon	CompDH59			186	10.6	10	8.06	19.3	
10/2/2019	1015	Missisquoi River	ChampMon	CompDH59			153	8.83	67	7.67	13.7	
10/8/2019	1005	Missisquoi River	ChampMon	CompDH59			147	8.86	23	7.78		
10/18/2019	0925	Missisquoi River	ChampMon	CompDH59			181	10.7	44	6.97		
11/1/2019	1020	Missisquoi River	ChampMon	CompDH59			93	4.32	62	7.66		
3/11/2020	0950	Missisquoi River	ChampMon	CompDH59			92	5.4	29.7	7.74		
3/19/2020	0940	Missisquoi River	ChampMon	CompDH59							1.5	
6/19/2020	1115	Missisquoi River	ChampMon	CompDH59			164	10.6	10.4	8.4	21.3	
7/14/2020	0940	Missisquoi River	ChampMon	CompDH59			171	9.9	14.5	8.15	24.7	
8/5/2020	1110	Missisquoi River	ChampMon	CompDH59			166	9.8	10.6	7.77	24.1	
8/26/2020	0950	Missisquoi River	ChampMon	CompDH59			182	10.5	13.3	7.95	21.2	
9/22/2020	1210	Missisquoi River	ChampMon	CompDH59			200	12.9	8.9	8.02	16.7	
3/12/2021	1215	Missisquoi River	ChampMon	CompDH59			283	14.7			3.4	
3/24/2021	1015	Missisquoi River	ChampMon	CompDH59			150	6.2	19	7.26	4.4	
3/26/2021	0945	Missisquoi River	ChampMon	CompDH59			89	4	15.1	7.04	6.4	
3/27/2021	1055	Missisquoi River	ChampMon	CompDH59			86	4.3	23.8	7.08	4.8	
4/30/2021	1315	Missisquoi River	ChampMon	CompDH59			163	9	12.4	7.43	9.9	
5/1/2021	0925	Missisquoi River	ChampMon	CompDH59				7	36.4			

Total Nitrogen		Total Phosphorus
mg/l		ug/l
0.74		78
0.59		122
0.58		64
0.67		85
0.7		83
0.65		31
0.42		22
0.59		24
0.72		22
0.46	J	18
0.44	J	20
0.41		18
1.29		288
0.65		53
0.97		87
2.45		1320
1.23		369
0.69		31.6
0.54		23.7
0.66		21.4
0.47	J	24.1
0.5		19.8
0.35		15.3
2.13		141
0.73		64.5
0.7		153
0.96		288
1.42		21.8
1.12		170

Visit Date	Start Time	Location Name	Project ID	Collection Method	Depth (m)	Chlorophyll-a ug/l	Conductivity umho/cm	Dissolved Chloride mg/l	Dissolved Phosphorus ug/l	pH None	Temperature deg C	Total Chloride mg/l
6/22/2021	0900	Missisquoi River	ChampMon	CompDH59				12.9	9.2			
7/9/2021	0925	Missisquoi River	ChampMon	CompDH59				16.2	5.1			
10/27/2021	0935	Missisquoi River	ChampMon	CompDH59				12.1	14			
11/1/2021	0930	Missisquoi River	ChampMon	CompDH59				12.1	24.5			
12/7/2021	1100	Missisquoi River	ChampMon	CompDH59				11.5				

Total Nitrogen	Total Phosphorus
mg/l	ug/l
0.6	17.4
0.56	17.8
0.58	28.8
1.04	91.4
1.36	73

Visit Date	Start Time	Location Name	Project ID	Collection Method	Depth (m)	Total Nitrogen	Total Phosphorus	Turbidity
						mg/l	ug/l	NTU
6/1/2005		Missisquoi River	LaRosaVM	BottleGrab	0.2	0.29	20.3	2.59
6/29/2005		Missisquoi River	LaRosaVM	BottleGrab	0.2	0.5	43.9	7.42
7/13/2005		Missisquoi River	LaRosaVM	BottleGrab	0.2	0.81	37	
7/27/2005		Missisquoi River	LaRosaVM	BottleGrab	0.2	0.5	20.4	1.86
8/10/2005		Missisquoi River	LaRosaVM	BottleGrab	0.2	0.48	35.1	1.02
8/24/2005		Missisquoi River	LaRosaVM	BottleGrab	0.2	0.46	16.5	4.21
9/7/2005		Missisquoi River	LaRosaVM	BottleGrab	0.2	0.58	33.2	2.91
9/21/2005		Missisquoi River	LaRosaVM	BottleGrab	0.2	0.45	29.4	4.51
10/5/2005		Missisquoi River	LaRosaVM	BottleGrab	0.2	0.41	19.9	1.78
10/5/2005		Missisquoi River	LaRosaVM	BottleGrab	0.2	0.33	21.6	1.77
10/19/2005		Missisquoi River	LaRosaVM	BottleGrab	0.2	0.49	62.4	19.7
5/17/2006		Missisquoi River	LaRosaVM	BottleGrab	0.2	0.4	27.5	7.21
5/31/2006		Missisquoi River	LaRosaVM	BottleGrab	0.2	0.65	26.9	4.87
6/14/2006		Missisquoi River	LaRosaVM	BottleGrab	0.2	0.5	42.9	11
6/28/2006		Missisquoi River	LaRosaVM	BottleGrab	0.2	0.6	55.3	16.3
7/12/2006		Missisquoi River	LaRosaVM	BottleGrab	0.2	0.65	33.8	5.5
7/26/2006		Missisquoi River	LaRosaVM	BottleGrab	0.2	0.79	42.7	9.37
8/9/2006		Missisquoi River	LaRosaVM	BottleGrab	0.2		36.9	5.96
8/23/2006		Missisquoi River	LaRosaVM	BottleGrab	0.2	0.63	33.1	5.11
9/6/2006		Missisquoi River	LaRosaVM	BottleGrab	0.2	0.53	23.2	3.89
9/20/2006		Missisquoi River	LaRosaVM	BottleGrab	0.2	0.51	20.3	2.68
10/4/2006		Missisquoi River	LaRosaVM	BottleGrab	0.2	0.57	35.1	6.35
10/18/2006		Missisquoi River	LaRosaVM	BottleGrab	0.2	0.66	27.7	4.29
5/16/2007		Missisquoi River	LaRosaVM	BottleGrab	0.2	0.64	24.7	J 4.67
5/30/2007		Missisquoi River	LaRosaVM	BottleGrab	0.2	0.64	31.6	J 5.71
6/13/2007		Missisquoi River	LaRosaVM	BottleGrab	0.2	0.52	23.5	J 4.3
6/13/2007		Missisquoi River	LaRosaVM	BottleGrab	0.2	0.51	23.2	J 3.76
6/27/2007		Missisquoi River	LaRosaVM	BottleGrab	0.2	0.71	23.4	J 5.61

Visit Date	Start Time	Location Name	Project ID	Collection Method	Depth (m)	Total Nitrogen mg/l	Total Phosphorus ug/l	Turbidity NTU
7/11/2007		Missisquoi River	LaRosaVM	BottleGrab	0.2	1.07	68.5	J 9.67
7/25/2007		Missisquoi River	LaRosaVM	BottleGrab	0.2	J 0.5	23.5	J 3.05
8/8/2007		Missisquoi River	LaRosaVM	BottleGrab	0.2	0.74	59.5	J 27.6
8/22/2007		Missisquoi River	LaRosaVM	BottleGrab	0.2	0.45	22	J 5.65
9/5/2007		Missisquoi River	LaRosaVM	BottleGrab	0.2	0.48	23.9	J 3.47
9/19/2007		Missisquoi River	LaRosaVM	BottleGrab	0.2	0.5	27	J 1.86
10/3/2007		Missisquoi River	LaRosaVM	BottleGrab	0.2	0.51	24.4	J 1.9
10/17/2007		Missisquoi River	LaRosaVM	BottleGrab	0.2	0.45	30.4	J 5.13

Monitoring Site Summary - River/Stream

Missisquoi River

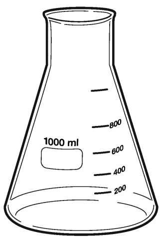
River Mile: 7.8

Immediately below the Swanton Dam on southeast bank. Upstream of Swanton WWTF discharge.

Swanton, VT (44.92083, -73.12639)

Water Quality Measurements

Chemical and physical parameters provide a "snapshot" of current conditions and are used to detect changes in water quality and to make determinations about a waterbody and its watershed. (For More Details)



Characteristic	Description	Trend	Max	Mean	Min
Conductivity (umho/cm)			180.0	180.0	180.0
Nitrogen (mg/L)	Nutrient that may fuel algae blooms		0.9	0.5	0.3
pH	Acidity		7.9	7.9	7.9
Phosphorus (ug/L)	Nutrient that may fuel algae blooms		109.0	42.0	17.6
Turbidity (NTU)	Measure of suspended sediment		23.1	4.9	1.0

Habitat Observations

Observations on the physical condition of the waterbody can be useful in determining the habitat type present and if watershed stressors have degraded its ability to support a healthy community of aquatic biota. (For More Details)

Observation Date: 7/28/1997

Habitat Type: Run

Canopy %:

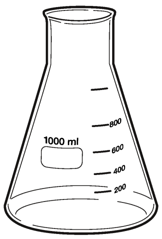
Monitoring Site Summary - River/Stream

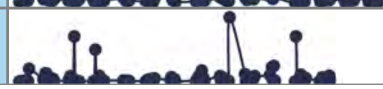
Missisquoi River

Swanton, Monument Rd
Highgate, VT (44.94583, -73.14667)

Water Quality Measurements

Chemical and physical parameters provide a "snapshot" of current conditions and are used to detect changes in water quality and to make determinations about a waterbody and its watershed. (For More Details)



Characteristic	Description	Trend	Max	Mean	Min
Nitrogen (mg/L)	Nutrient that may fuel algae blooms		1.4	0.6	0.3
Phosphorus (ug/L)	Nutrient that may fuel algae blooms		250.0	36.0	13.9
Turbidity (NTU)	Measure of suspended sediment		112.0	8.5	1.7

Macroinvertebrate Site Summary - River/Stream

Missisquoi River

Upstream of bridge on Machia Rd.
Highgate, VT (44.92700, -72.98800)
Stream Type: Warm Water Medium Gradient

Macroinvertebrate Community Metrics

Macroinvertebrate Community Assessments are based primarily on eight metrics of the Macroinvertebrate community. These include metrics of abundance, species richness, and indexes of Sensitive to tolerant species ratios. (For More Details)

Date	Density	Richness	EPT Richness	PMA-O	B.I.	Oligo.	EPT/EPT + Chiro	PPCS-F	Community Assessment
9/24/2009	4744	46.0	26.0	77.7	3.76	0.34	0.94	0.42	Good
9/24/2018	4020	42.0	26.0	79.6	3.82	0.00	0.99	0.32	Good
Scoring Guideline for a WWMG Stream of Water Quality Class B(2)									
	≥ 300	≥ 30	≥ 16	≥ 45	≤ 5.4	≤ 12	≥ 0.45	≥ 0.4	**Full Support**
	≥ 250	≥ 28	≥ 15	≥ 40	≤ 5.65	≤ 14.5	≥ 0.43	≥ 0.35	**Indeterminate**
	< 250	< 28	< 15	< 40	> 5.65	> 14.5	< 0.43	< 0.35	**Non-Support**

APPENDIX E – NRCS SOILS REPORT

United States Department of Agriculture

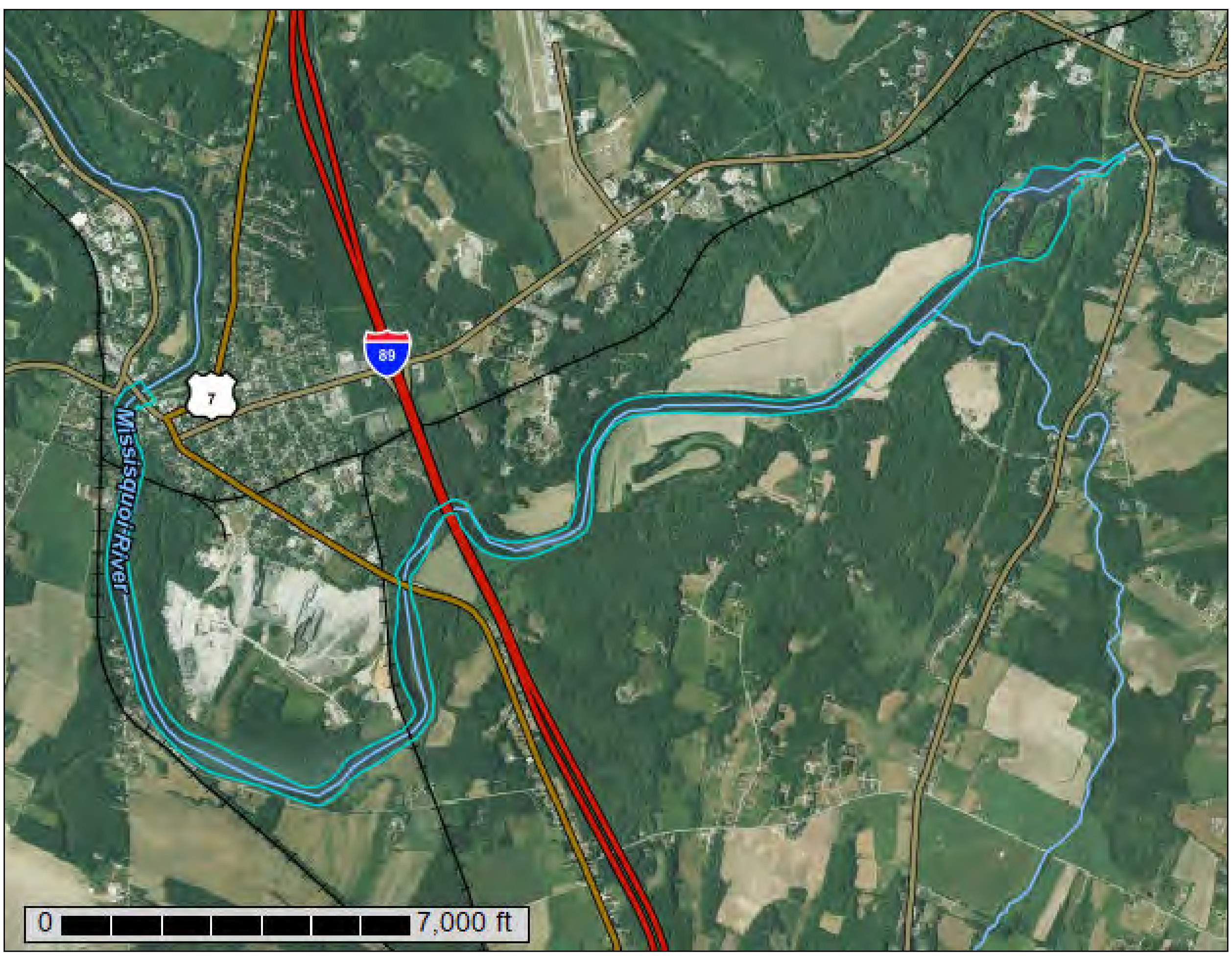
NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for

Franklin County, Vermont



April 12, 2022

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

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Contents

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

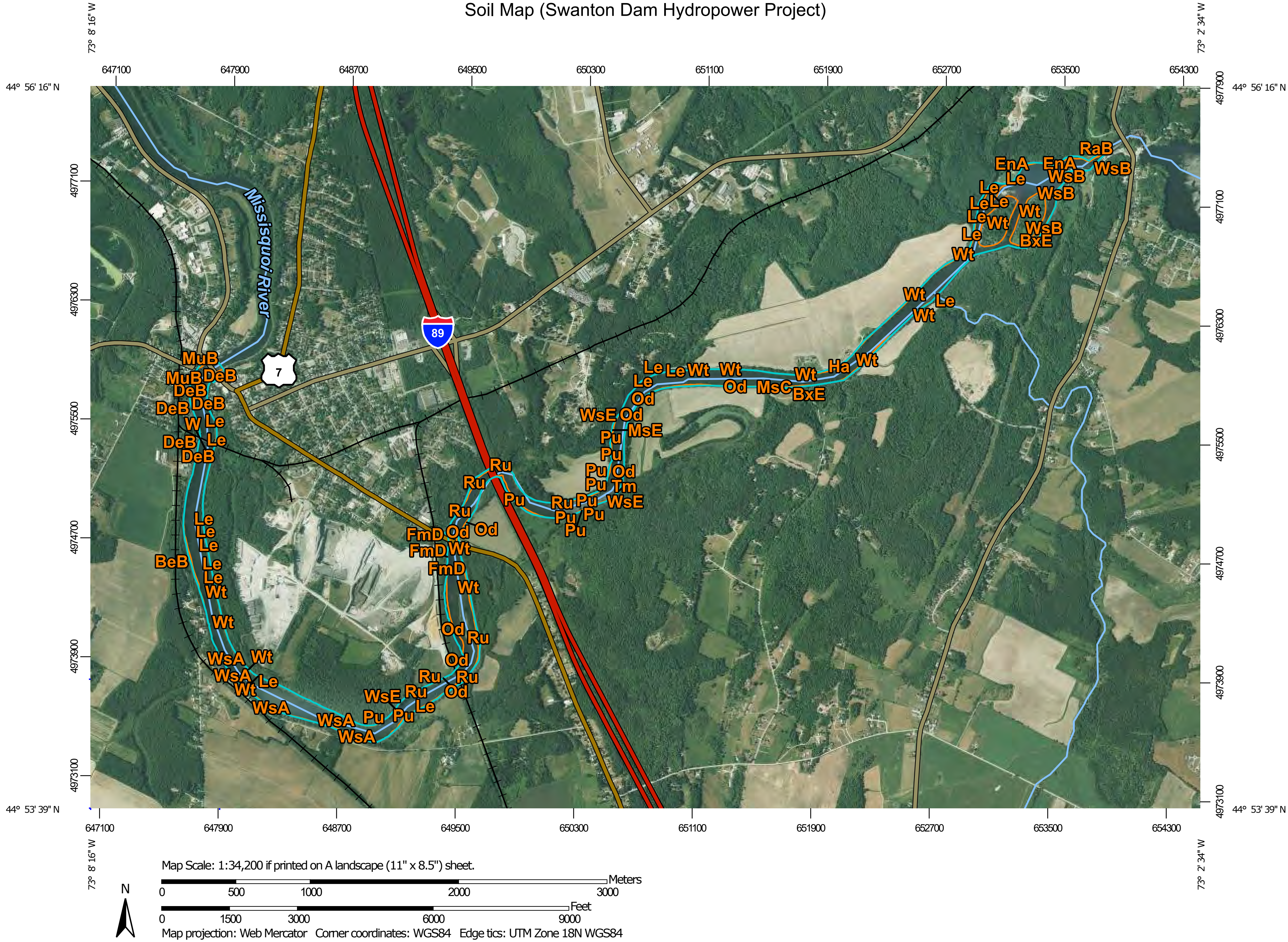
Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Custom Soil Resource Report
Soil Map (Swanton Dam Hydropower Project)



MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:20,000.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Franklin County, Vermont
Survey Area Data: Version 25, Sep 7, 2021

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Jun 18, 2020—Jun 20, 2020

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend (Swanton Dam Hydropower Project)

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
AuA	Au Gres loamy fine sand, 0 to 6 percent slopes	0.0	0.0%
BeB	Belgrade silt loam, 2 to 8 percent slopes	0.8	0.3%
BxE	Buxton silt loam, 25 to 45 percent slopes	0.2	0.1%
DeB	Deerfield loamy fine sand, 0 to 8 percent slopes	1.4	0.4%
EnA	Enosburg loamy fine sand, 0 to 3 percent slopes	0.5	0.2%
FmD	Farmington-Rock outcrop complex, 15 to 60 percent slopes	0.2	0.1%
Ha	Hadley silt loam	0.7	0.2%
Le	Limerick silt loam	4.3	1.3%
MsC	Missisquoi loamy sand, 8 to 15 percent slopes	0.2	0.1%
MsD	Missisquoi loamy sand, 15 to 25 percent slopes	0.2	0.1%
MsE	Missisquoi loamy sand, 25 to 60 percent slopes	0.4	0.1%
MuB	Munson silt loam, 3 to 8 percent slopes	0.1	0.0%
Od	Ondawa variant silt loam	4.1	1.3%
Pu	Podunk variant silt loam	2.3	0.7%
RaB	Raynham silt loam, 3 to 8 percent slopes	0.5	0.1%
Ru	Rumney variant silt loam	1.8	0.6%
Tm	Terric Medisaprists	0.1	0.0%
W	Water	276.7	85.6%
WsA	Windsor loamy fine sand, 0 to 3 percent slopes	0.8	0.2%
WsB	Windsor loamy fine sand, 3 to 8 percent slopes	0.4	0.1%
WsE	Windsor loamy fine sand, 25 to 60 percent slopes	0.4	0.1%
Wt	Winooski silt loam	27.3	8.4%
Totals for Area of Interest		**323.2**	**100.0%**

Map Unit Descriptions (Swanton Dam Hydropower Project)

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Franklin County, Vermont

AuA—Au Gres loamy fine sand, 0 to 6 percent slopes

Map Unit Setting

National map unit symbol: 9g69
Elevation: 90 to 1,200 feet
Mean annual precipitation: 30 to 50 inches
Mean annual air temperature: 37 to 52 degrees F
Frost-free period: 90 to 180 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Au gres and similar soils: 75 percent
Minor components: 25 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Au Gres

Setting

Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Sandy glaciofluvial deposits

Typical profile

H1 - 0 to 9 inches: loamy fine sand
H2 - 9 to 22 inches: fine sand
H3 - 22 to 60 inches: fine sand

Properties and qualities

Slope: 0 to 6 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat poorly drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): High to very high (6.00 to 20.00 in/hr)
Depth to water table: About 6 to 18 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 4.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4w
Hydrologic Soil Group: A/D
Ecological site: F142XA006NY - Acidic Moist Outwash Frigid
Hydric soil rating: No

Minor Components

Wareham

Percent of map unit: 7 percent
Landform: Depressions
Hydric soil rating: Yes

Eldridge

Percent of map unit: 6 percent
Hydric soil rating: No

Enosburg

Percent of map unit: 6 percent
Landform: Depressions
Hydric soil rating: Yes

Deerfield

Percent of map unit: 6 percent
Landform: Deltas, terraces
Hydric soil rating: No

BeB—Belgrade silt loam, 2 to 8 percent slopes

Map Unit Setting

National map unit symbol: 9g6b
Elevation: 90 to 1,200 feet
Mean annual precipitation: 30 to 50 inches
Mean annual air temperature: 37 to 52 degrees F
Frost-free period: 90 to 180 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Belgrade and similar soils: 65 percent
Minor components: 35 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Belgrade

Setting

Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Coarse-silty glaciolacustrine deposits

Typical profile

H1 - 0 to 5 inches: silt loam
H2 - 5 to 22 inches: silt loam
H3 - 22 to 60 inches: silt loam

Properties and qualities

Slope: 2 to 8 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Moderately well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.06 to 2.00 in/hr)
Depth to water table: About 18 to 42 inches

Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: High (about 9.1 inches)

Interpretive groups
Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: B/D
Ecological site: F142XB018VT - Moist Lake Plain
Hydric soil rating: No

Minor Components

Raynham
Percent of map unit: 10 percent
Landform: Depressions
Hydric soil rating: Yes

Eldridge
Percent of map unit: 10 percent
Hydric soil rating: No

Tisbury
Percent of map unit: 5 percent
Hydric soil rating: No

Munson
Percent of map unit: 5 percent
Hydric soil rating: No

Buxton
Percent of map unit: 5 percent
Hydric soil rating: No

BxE—Buxton silt loam, 25 to 45 percent slopes

Map Unit Setting
National map unit symbol: 9g6j
Elevation: 90 to 1,200 feet
Mean annual precipitation: 30 to 50 inches
Mean annual air temperature: 37 to 52 degrees F
Frost-free period: 90 to 180 days
Farmland classification: Not prime farmland

Map Unit Composition
Buxton and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Buxton

Setting

Landform: Terraces
Landform position (three-dimensional): Riser
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Clayey glaciolacustrine deposits

Typical profile

H1 - 0 to 9 inches: silt loam
H2 - 9 to 16 inches: silt loam
H3 - 16 to 31 inches: silty clay
H4 - 31 to 60 inches: silty clay

Properties and qualities

Slope: 25 to 45 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Moderately well drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately high (0.00 to 0.20 in/hr)
Depth to water table: About 18 to 36 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: High (about 9.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: D
Ecological site: F142XA012NY - Rich Lacustrine Terraces Frigid
Hydric soil rating: No

Minor Components

Munson

Percent of map unit: 10 percent
Hydric soil rating: No

Belgrade

Percent of map unit: 3 percent
Hydric soil rating: No

Tisbury

Percent of map unit: 2 percent
Hydric soil rating: No

DeB—Deerfield loamy fine sand, 0 to 8 percent slopes

Map Unit Setting

National map unit symbol: 9g6x
Elevation: 90 to 1,200 feet
Mean annual precipitation: 30 to 50 inches
Mean annual air temperature: 37 to 52 degrees F
Frost-free period: 90 to 180 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Deerfield and similar soils: 75 percent
Minor components: 25 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Deerfield

Setting

Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Sandy glaciofluvial deposits

Typical profile

H1 - 0 to 8 inches: loamy fine sand
H2 - 8 to 18 inches: sand
H3 - 18 to 60 inches: sand

Properties and qualities

Slope: 0 to 8 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Moderately well drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): High to very high (6.00 to 20.00 in/hr)
Depth to water table: About 18 to 36 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 3.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3w
Hydrologic Soil Group: A
Ecological site: F142XB003VT - Moist Outwash
Hydric soil rating: No

Minor Components

Wareham

Percent of map unit: 5 percent
Landform: Depressions
Hydric soil rating: Yes

Duane

Percent of map unit: 5 percent
Hydric soil rating: No

Covington

Percent of map unit: 5 percent
Landform: Depressions
Hydric soil rating: Yes

Swanton

Percent of map unit: 5 percent
Landform: Depressions
Hydric soil rating: Yes

Windsor

Percent of map unit: 5 percent
Landform: Terraces
Hydric soil rating: No

EnA—Enosburg loamy fine sand, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 9g72
Elevation: 90 to 1,000 feet
Mean annual precipitation: 30 to 50 inches
Mean annual air temperature: 45 to 52 degrees F
Frost-free period: 120 to 180 days
Farmland classification: Prime farmland if drained

Map Unit Composition

Enosburg and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Enosburg

Setting

Landform: Outwash terraces, deltas
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Sandy glaciofluvial deposits over loamy glaciolacustrine deposits

Typical profile

H1 - 0 to 7 inches: loamy fine sand

H2 - 7 to 22 inches: loamy fine sand
H3 - 22 to 60 inches: silt loam

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Poorly drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.60 in/hr)
Depth to water table: About 0 to 12 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Moderate (about 8.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3w
Hydrologic Soil Group: C/D
Ecological site: F142XB004VT - Wet Outwash Depression
Hydric soil rating: Yes

Minor Components

Eldridge

Percent of map unit: 5 percent
Hydric soil rating: No

Raynham

Percent of map unit: 5 percent
Landform: Depressions
Hydric soil rating: Yes

Wareham

Percent of map unit: 5 percent
Landform: Depressions
Hydric soil rating: Yes

FmD—Farmington-Rock outcrop complex, 15 to 60 percent slopes

Map Unit Setting

National map unit symbol: 9g77
Elevation: 90 to 4,400 feet
Mean annual precipitation: 30 to 60 inches
Mean annual air temperature: 30 to 52 degrees F
Frost-free period: 30 to 180 days
Farmland classification: Not prime farmland

Map Unit Composition

Farmington and similar soils: 45 percent
Rock outcrop: 40 percent

Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Farmington

Setting

Landform: Ridges
Landform position (two-dimensional): Summit, shoulder, backslope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Coarse-loamy till

Typical profile

H1 - 0 to 4 inches: loam
H2 - 4 to 14 inches: loam
R - 14 to 24 inches: unweathered bedrock

Properties and qualities

Slope: 15 to 60 percent
Depth to restrictive feature: 10 to 20 inches to lithic bedrock
Drainage class: Somewhat excessively drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Low to high (0.01 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 5 percent
Available water supply, 0 to 60 inches: Very low (about 1.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: D
Ecological site: F142XB010NY - Shallow Rich Till Upland
Hydric soil rating: No

Description of Rock Outcrop

Setting

Landform: Ridges
Landform position (two-dimensional): Summit, shoulder, backslope
Down-slope shape: Convex
Across-slope shape: Convex

Typical profile

R - 0 to 60 inches: unweathered bedrock

Properties and qualities

Depth to restrictive feature: 0 inches to lithic bedrock
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Low to very high (0.01 to 20.00 in/hr)
Available water supply, 0 to 60 inches: Very low (about 0.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8s

Hydric soil rating: Unranked

Minor Components

St. albans

Percent of map unit: 10 percent
Hydric soil rating: No

Galway

Percent of map unit: 2 percent
Hydric soil rating: No

Massena

Percent of map unit: 2 percent
Hydric soil rating: No

Georgia

Percent of map unit: 1 percent
Hydric soil rating: No

Ha—Hadley silt loam

Map Unit Setting

National map unit symbol: 9g7f
Elevation: 90 to 1,000 feet
Mean annual precipitation: 30 to 50 inches
Mean annual air temperature: 45 to 52 degrees F
Frost-free period: 120 to 180 days
Farmland classification: Prime farmland if protected from flooding or not frequently flooded during the growing season

Map Unit Composition

Hadley and similar soils: 70 percent
Minor components: 30 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Hadley

Setting

Landform: Flood plains
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Concave
Parent material: Coarse-silty alluvium

Typical profile

H1 - 0 to 8 inches: silt loam
H2 - 8 to 32 inches: very fine sandy loam
H3 - 32 to 60 inches: silt loam

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: About 48 to 72 inches
Frequency of flooding: FrequentNone
Frequency of ponding: None
Available water supply, 0 to 60 inches: High (about 9.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 1
Hydrologic Soil Group: B
Ecological site: F145XY001MA - Silty High Floodplain
Hydric soil rating: No

Minor Components

Winooski

Percent of map unit: 25 percent
Landform: Flood plains
Hydric soil rating: No

Ondawa, variant

Percent of map unit: 5 percent
Landform: Flood plains
Hydric soil rating: No

Le—Limerick silt loam

Map Unit Setting

National map unit symbol: 9g7p
Elevation: 90 to 1,200 feet
Mean annual precipitation: 30 to 50 inches
Mean annual air temperature: 37 to 52 degrees F
Frost-free period: 90 to 180 days
Farmland classification: Farmland of statewide importance, if drained

Map Unit Composition

Limerick and similar soils: 65 percent
Minor components: 35 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Limerick

Setting

Landform: Flood plains

Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Coarse-silty alluvium

Typical profile
H1 - 0 to 8 inches: silt loam
H2 - 8 to 18 inches: silt loam
H3 - 18 to 60 inches: silt loam

Properties and qualities
Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Poorly drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: About 0 to 18 inches
Frequency of flooding: FrequentNone
Frequency of ponding: None
Available water supply, 0 to 60 inches: Very high (about 13.3 inches)

Interpretive groups
Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3w
Hydrologic Soil Group: B/D
Hydric soil rating: Yes

Minor Components

Rumney, variant
Percent of map unit: 20 percent
Landform: Flood plains
Hydric soil rating: Yes

Saco
Percent of map unit: 8 percent
Landform: Depressions on flood plains
Hydric soil rating: Yes

Winooski
Percent of map unit: 7 percent
Landform: Flood plains
Hydric soil rating: No

MsC—Missisquoi loamy sand, 8 to 15 percent slopes

Map Unit Setting
National map unit symbol: 9g84
Elevation: 90 to 1,200 feet
Mean annual precipitation: 30 to 50 inches
Mean annual air temperature: 37 to 52 degrees F

Frost-free period: 90 to 180 days
Farmland classification: Farmland of local importance

Map Unit Composition

Missisquoi and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Missisquoi

Setting

Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Sandy glaciofluvial deposits

Typical profile

H1 - 0 to 5 inches: loamy sand
H2 - 5 to 12 inches: loamy sand
H3 - 12 to 35 inches: gravelly coarse sand
H4 - 35 to 60 inches: gravelly coarse sand

Properties and qualities

Slope: 8 to 15 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Excessively drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): High to very high (6.00 to 20.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Very low (about 2.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4s
Hydrologic Soil Group: A
Hydric soil rating: No

Minor Components

Windsor

Percent of map unit: 3 percent
Landform: Terraces
Hydric soil rating: No

Deerfield

Percent of map unit: 3 percent
Landform: Deltas, terraces
Hydric soil rating: No

Colton

Percent of map unit: 3 percent
Landform: Terraces
Hydric soil rating: No

Hinesburg

Percent of map unit: 2 percent
Hydric soil rating: No

Adams, moderately deep variant

Percent of map unit: 2 percent
Landform: Terraces
Hydric soil rating: No

Wareham

Percent of map unit: 2 percent
Landform: Depressions
Hydric soil rating: Yes

MsD—Missisquoi loamy sand, 15 to 25 percent slopes

Map Unit Setting

National map unit symbol: 9g85
Elevation: 90 to 1,200 feet
Mean annual precipitation: 30 to 50 inches
Mean annual air temperature: 37 to 52 degrees F
Frost-free period: 90 to 180 days
Farmland classification: Not prime farmland

Map Unit Composition

Missisquoi and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Missisquoi

Setting

Landform: Terraces
Landform position (three-dimensional): Riser
Down-slope shape: Concave, convex
Across-slope shape: Concave, convex
Parent material: Sandy glaciofluvial deposits

Typical profile

H1 - 0 to 5 inches: loamy sand
H2 - 5 to 12 inches: loamy sand
H3 - 12 to 35 inches: gravelly coarse sand
H4 - 35 to 60 inches: gravelly coarse sand

Properties and qualities

Slope: 15 to 25 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Excessively drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): High to very high (6.00 to 20.00 in/hr)

Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Very low (about 2.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: A
Hydric soil rating: No

Minor Components

Colton

Percent of map unit: 3 percent
Landform: Terraces
Hydric soil rating: No

Deerfield

Percent of map unit: 3 percent
Landform: Deltas, terraces
Hydric soil rating: No

Hinesburg

Percent of map unit: 3 percent
Hydric soil rating: No

Adams, moderately deep variant

Percent of map unit: 2 percent
Landform: Terraces
Hydric soil rating: No

Wareham

Percent of map unit: 2 percent
Landform: Drainageways
Hydric soil rating: Yes

Windsor

Percent of map unit: 2 percent
Landform: Terraces
Hydric soil rating: No

MsE—Missisquoi loamy sand, 25 to 60 percent slopes

Map Unit Setting

National map unit symbol: 9g86
Elevation: 90 to 1,200 feet
Mean annual precipitation: 30 to 50 inches
Mean annual air temperature: 37 to 52 degrees F
Frost-free period: 90 to 180 days
Farmland classification: Not prime farmland

Map Unit Composition

Missisquoi and similar soils: 76 percent
Minor components: 24 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Missisquoi

Setting

Landform: Terraces
Landform position (three-dimensional): Riser
Down-slope shape: Concave, convex
Across-slope shape: Concave, convex
Parent material: Sandy glaciofluvial deposits

Typical profile

H1 - 0 to 5 inches: loamy sand
H2 - 5 to 12 inches: loamy sand
H3 - 12 to 35 inches: gravelly coarse sand
H4 - 35 to 60 inches: gravelly coarse sand

Properties and qualities

Slope: 25 to 60 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Excessively drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): High to very high (6.00 to 20.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Very low (about 2.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: A
Hydric soil rating: No

Minor Components

Deerfield

Percent of map unit: 4 percent
Landform: Deltas, terraces
Hydric soil rating: No

Wareham

Percent of map unit: 4 percent
Landform: Drainageways
Hydric soil rating: Yes

Adams, moderately deep variant

Percent of map unit: 4 percent
Landform: Terraces
Hydric soil rating: No

Windsor

Percent of map unit: 4 percent

Landform: Terraces
Hydric soil rating: No

Colton

Percent of map unit: 4 percent
Landform: Terraces
Hydric soil rating: No

Hinesburg

Percent of map unit: 4 percent
Hydric soil rating: No

MuB—Munson silt loam, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 9g87
Elevation: 90 to 1,200 feet
Mean annual precipitation: 30 to 50 inches
Mean annual air temperature: 37 to 52 degrees F
Frost-free period: 90 to 180 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Munson and similar soils: 68 percent
Minor components: 32 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Munson

Setting

Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear, concave
Across-slope shape: Linear, concave
Parent material: Coarse-silty glaciolacustrine deposits over clayey glaciolacustrine deposits

Typical profile

H1 - 0 to 8 inches: silt loam
H2 - 8 to 14 inches: silt loam
H3 - 14 to 40 inches: silty clay loam

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat poorly drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately high (0.00 to 0.20 in/hr)
Depth to water table: About 6 to 24 inches
Frequency of flooding: None

Frequency of ponding: None
Available water supply, 0 to 60 inches: Moderate (about 7.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3w
Hydrologic Soil Group: C/D
Hydric soil rating: No

Minor Components

Raynham

Percent of map unit: 10 percent
Landform: Depressions
Hydric soil rating: Yes

Scantic

Percent of map unit: 10 percent
Landform: Depressions
Hydric soil rating: Yes

Belgrade

Percent of map unit: 4 percent
Hydric soil rating: No

Swanton

Percent of map unit: 4 percent
Landform: Knolls
Hydric soil rating: Yes

Buxton

Percent of map unit: 4 percent
Hydric soil rating: No

Od—Ondawa variant silt loam

Map Unit Setting

National map unit symbol: 9g89
Elevation: 90 to 1,200 feet
Mean annual precipitation: 30 to 50 inches
Mean annual air temperature: 37 to 52 degrees F
Frost-free period: 90 to 180 days
Farmland classification: Prime farmland if protected from flooding or not frequently flooded during the growing season

Map Unit Composition

Ondawa, variant, and similar soils: 65 percent
Minor components: 35 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Ondawa, Variant

Setting

Landform: Flood plains
Landform position (three-dimensional): Tread
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Coarse-loamy alluvium over sandy and gravelly alluvium

Typical profile

H1 - 0 to 7 inches: silt loam
H2 - 7 to 27 inches: silt loam
H3 - 27 to 60 inches: gravelly fine sand

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: FrequentNone
Frequency of ponding: None
Available water supply, 0 to 60 inches: Moderate (about 7.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 1
Hydrologic Soil Group: B
Hydric soil rating: No

Minor Components

Podunk, variant

Percent of map unit: 20 percent
Landform: Flood plains
Hydric soil rating: No

Hadley

Percent of map unit: 5 percent
Landform: Flood plains
Hydric soil rating: No

Rumney, variant

Percent of map unit: 5 percent
Landform: Depressions on flood plains
Hydric soil rating: Yes

Winooski

Percent of map unit: 5 percent
Landform: Flood plains
Hydric soil rating: No

Pu—Podunk variant silt loam

Map Unit Setting

National map unit symbol: 9g8j
Elevation: 90 to 1,200 feet
Mean annual precipitation: 30 to 50 inches
Mean annual air temperature: 37 to 52 degrees F
Frost-free period: 90 to 180 days
Farmland classification: Prime farmland if protected from flooding or not frequently flooded during the growing season

Map Unit Composition

Podunk, variant, and similar soils: 75 percent
Minor components: 25 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Podunk, Variant

Setting

Landform: Flood plains
Landform position (three-dimensional): Tread
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Coarse-loamy alluvium over sandy and gravelly alluvium

Typical profile

H1 - 0 to 8 inches: silt loam
H2 - 8 to 20 inches: silt loam
H3 - 20 to 60 inches: loamy fine sand

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Moderately well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: About 18 to 36 inches
Frequency of flooding: FrequentNone
Frequency of ponding: None
Available water supply, 0 to 60 inches: Moderate (about 6.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2w
Hydrologic Soil Group: C
Hydric soil rating: No

Minor Components

Winooski

Percent of map unit: 10 percent
Landform: Flood plains
Hydric soil rating: No

Rumney, variant

Percent of map unit: 10 percent
Landform: Depressions on flood plains
Hydric soil rating: Yes

Ondawa, variant

Percent of map unit: 5 percent
Landform: Flood plains
Hydric soil rating: No

RaB—Raynham silt loam, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 9g8k
Elevation: 90 to 1,200 feet
Mean annual precipitation: 30 to 50 inches
Mean annual air temperature: 37 to 52 degrees F
Frost-free period: 90 to 180 days
Farmland classification: Prime farmland if drained

Map Unit Composition

Raynham and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Raynham

Setting

Landform: Terraces
Down-slope shape: Concave, linear
Across-slope shape: Concave, linear
Parent material: Coarse-silty glaciolacustrine deposits

Typical profile

H1 - 0 to 7 inches: silt loam
H2 - 7 to 17 inches: silt loam
H3 - 17 to 60 inches: silt loam

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Poorly drained
Runoff class: Very high

Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 0 to 24 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 5 percent
Available water supply, 0 to 60 inches: High (about 11.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3w
Hydrologic Soil Group: C/D
Ecological site: F144AY019NH - Wet Lake Plain
Hydric soil rating: Yes

Minor Components

Belgrade

Percent of map unit: 5 percent
Hydric soil rating: No

Binghamville

Percent of map unit: 5 percent
Landform: Depressions
Hydric soil rating: Yes

Eldridge

Percent of map unit: 5 percent
Hydric soil rating: No

Scantic

Percent of map unit: 2 percent
Landform: Depressions
Hydric soil rating: Yes

Munson

Percent of map unit: 2 percent
Hydric soil rating: No

Birdsall

Percent of map unit: 1 percent
Landform: Depressions
Hydric soil rating: Yes

Ru—Rumney variant silt loam

Map Unit Setting

National map unit symbol: 9g8m
Elevation: 90 to 1,200 feet
Mean annual precipitation: 30 to 50 inches
Mean annual air temperature: 37 to 52 degrees F
Frost-free period: 90 to 180 days

Farmland classification: Farmland of statewide importance, if drained

Map Unit Composition

Rumney, variant, and similar soils: 65 percent
Minor components: 35 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Rumney, Variant

Setting

Landform: Flood plains
Landform position (three-dimensional): Tread
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Coarse-loamy alluvium over sandy and gravelly alluvium

Typical profile

H1 - 0 to 7 inches: silt loam
H2 - 7 to 35 inches: silt loam
H3 - 35 to 60 inches: coarse sand

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Poorly drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: About 0 to 18 inches
Frequency of flooding: FrequentNone
Frequency of ponding: None
Available water supply, 0 to 60 inches: Moderate (about 8.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3w
Hydrologic Soil Group: B/D
Hydric soil rating: Yes

Minor Components

Limerick

Percent of map unit: 20 percent
Landform: Depressions on flood plains
Hydric soil rating: Yes

Wallkill, undrained

Percent of map unit: 5 percent
Landform: Depressions on flood plains
Hydric soil rating: Yes

Winooski

Percent of map unit: 5 percent
Landform: Flood plains
Hydric soil rating: No

Podunk, variant

Percent of map unit: 5 percent

Landform: Flood plains
Hydric soil rating: No

Tm—Terric Medisaprists

Map Unit Setting

National map unit symbol: 9g94
Elevation: 90 to 2,000 feet
Mean annual precipitation: 30 to 50 inches
Mean annual air temperature: 37 to 52 degrees F
Frost-free period: 90 to 180 days
Farmland classification: Not prime farmland

Map Unit Composition

Terric medisaprists, undrained, and similar soils: 65 percent
Minor components: 35 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Terric Medisaprists, Undrained

Setting

Landform: Bogs
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Woody organic material over loamy lacustrine deposits

Typical profile

O1 - 0 to 23 inches: muck
H1 - 23 to 60 inches: silt loam

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Very poorly drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): Low to high (0.01 to 2.00 in/hr)
Depth to water table: About 0 inches
Frequency of flooding: None
Frequency of ponding: Frequent
Available water supply, 0 to 60 inches: Very high (about 15.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 5w
Hydrologic Soil Group: B/D
Hydric soil rating: Yes

Minor Components

Carlisle, undrained

Percent of map unit: 20 percent
Landform: Bogs
Hydric soil rating: Yes

Birdsall

Percent of map unit: 5 percent
Landform: Depressions
Hydric soil rating: Yes

Peacham, undrained

Percent of map unit: 5 percent
Landform: Depressions
Hydric soil rating: Yes

Lyons

Percent of map unit: 5 percent
Landform: Depressions
Hydric soil rating: Yes

W—Water

Map Unit Composition

Water: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

WsA—Windsor loamy fine sand, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 9g9h
Elevation: 90 to 1,200 feet
Mean annual precipitation: 30 to 50 inches
Mean annual air temperature: 37 to 52 degrees F
Frost-free period: 90 to 180 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Windsor and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Windsor

Setting

Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear

Across-slope shape: Linear
Parent material: Sandy glaciofluvial deposits

Typical profile

H1 - 0 to 10 inches: loamy fine sand
H2 - 10 to 27 inches: loamy fine sand
H3 - 27 to 60 inches: fine sand

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Excessively drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): High to very high (6.00 to 20.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 4.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3s
Hydrologic Soil Group: A
Hydric soil rating: No

Minor Components

Deerfield

Percent of map unit: 5 percent
Landform: Deltas, terraces
Hydric soil rating: No

Eldridge

Percent of map unit: 5 percent
Hydric soil rating: No

Missisquoi

Percent of map unit: 5 percent
Landform: Terraces
Hydric soil rating: No

Hinesburg

Percent of map unit: 5 percent
Hydric soil rating: No

WsB—Windsor loamy fine sand, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 9g9j
Elevation: 90 to 1,200 feet
Mean annual precipitation: 30 to 50 inches

Mean annual air temperature: 37 to 52 degrees F
Frost-free period: 90 to 180 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Windsor and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Windsor

Setting

Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Convex, linear
Across-slope shape: Convex, linear
Parent material: Sandy glaciofluvial deposits

Typical profile

H1 - 0 to 10 inches: loamy fine sand
H2 - 10 to 27 inches: loamy fine sand
H3 - 27 to 60 inches: fine sand

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Excessively drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): High to very high (6.00 to 20.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 4.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3s
Hydrologic Soil Group: A
Hydric soil rating: No

Minor Components

Hinesburg

Percent of map unit: 5 percent
Hydric soil rating: No

Eldridge

Percent of map unit: 5 percent
Hydric soil rating: No

Missisquoi

Percent of map unit: 5 percent
Landform: Terraces
Hydric soil rating: No

Deerfield

Percent of map unit: 5 percent

Landform: Deltas, terraces
Hydric soil rating: No

WsE—Windsor loamy fine sand, 25 to 60 percent slopes

Map Unit Setting

National map unit symbol: 9g9m
Elevation: 90 to 1,200 feet
Mean annual precipitation: 30 to 50 inches
Mean annual air temperature: 37 to 52 degrees F
Frost-free period: 90 to 180 days
Farmland classification: Not prime farmland

Map Unit Composition

Windsor and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Windsor

Setting

Landform: Terraces
Landform position (three-dimensional): Riser
Down-slope shape: Concave, convex
Across-slope shape: Concave, convex
Parent material: Sandy glaciofluvial deposits

Typical profile

H1 - 0 to 10 inches: loamy fine sand
H2 - 10 to 27 inches: loamy fine sand
H3 - 27 to 60 inches: fine sand

Properties and qualities

Slope: 25 to 60 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Excessively drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): High to very high (6.00 to 20.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 4.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: A
Hydric soil rating: No

Minor Components

Missisquoi

Percent of map unit: 10 percent
Landform: Terraces
Hydric soil rating: No

Hinesburg

Percent of map unit: 5 percent
Hydric soil rating: No

Wt—Winooski silt loam

Map Unit Setting

National map unit symbol: 9g9n
Elevation: 90 to 1,000 feet
Mean annual precipitation: 30 to 50 inches
Mean annual air temperature: 45 to 52 degrees F
Frost-free period: 120 to 180 days
Farmland classification: Prime farmland if protected from flooding or not frequently flooded during the growing season

Map Unit Composition

Winooski and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Winooski

Setting

Landform: Flood plains
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Coarse-silty alluvium

Typical profile

H1 - 0 to 33 inches: silt loam
H2 - 33 to 60 inches: very fine sandy loam

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Moderately well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 6.00 in/hr)
Depth to water table: About 18 to 36 inches
Frequency of flooding: FrequentNone
Frequency of ponding: None

Available water supply, 0 to 60 inches: High (about 10.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2w
Hydrologic Soil Group: C
Hydric soil rating: No

Minor Components

Podunk, variant

Percent of map unit: 15 percent
Landform: Flood plains
Hydric soil rating: No

Limerick

Percent of map unit: 5 percent
Landform: Depressions on flood plains
Hydric soil rating: Yes

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APPENDIX F – FEMA FLOOD INFORMATION

100-Year Flood Boundary	ZONE A1
Zone Designations*	ZONE A5
100-Year Flood Boundary	ZONE B
500-Year Flood Boundary	
Base Flood Elevation Line With Elevation In Feet**	513
Base Flood Elevation in Feet Where Uniform Within Zone**	(EL 987)
Elevation Reference Mark	RM7×
Zone D Boundary	
River Mile	•M1.5

**Referenced to the National Geodetic Vertical Datum of 1929

*EXPLANATION OF ZONE DESIGNATIONS

ZONE	EXPLANATION
A	Areas of 100-year flood; base flood elevations and flood hazard factors not determined.
A0	Areas of 100-year shallow flooding where depths are between one (1) and three (3) feet; average depths of inundation are shown, but no flood hazard factors are determined.
AH	Areas of 100-year shallow flooding where depths are between one (1) and three (3) feet; base flood elevations are shown, but no flood hazard factors are determined.
A1-A30	Areas of 100-year flood; base flood elevations and flood hazard factors determined.
A99	Areas of 100-year flood to be protected by flood protection system under construction; base flood elevations and flood hazard factors not determined.
B	Areas between limits of the 100-year flood and 500-year flood; or certain areas subject to 100-year flooding with average depths less than one (1) foot or where the contributing drainage area is less than one square mile; or areas protected by levees from the base flood. (Medium shading)
C	Areas of minimal flooding. (No shading)
D	Areas of undetermined, but possible, flood hazards.
V	Areas of 100-year coastal flood with velocity (wave action); base flood elevations and flood hazard factors not determined.
V1-V30	Areas of 100-year coastal flood with velocity (wave action); base flood elevations and flood hazard factors determined.

NOTES TO USER

Certain areas not in the special flood hazard areas (zones A and V) may be protected by flood control structures.

This map is for flood insurance purposes only; it does not necessarily show all areas subject to flooding in the community or all planimetric features outside special flood hazard areas.

INITIAL IDENTIFICATION:
FEBRUARY 28, 1975
FLOOD HAZARD BOUNDARY MAP REVISIONS:
NOVEMBER 26, 1976

FLOOD INSURANCE RATE MAP EFFECTIVE:
MARCH 16, 1983
FLOOD INSURANCE RATE MAP REVISIONS:

Refer to the FLOOD INSURANCE RATE MAP EFFECTIVE date shown on this map to determine when actuarial rates apply to structures in the zones where elevations or depths have been established.

To determine if flood insurance is available in this community, contact your insurance agent, or call the National Flood Insurance Program, at (800) 638-6620.

APPROXIMATE SCALE
500 0 500 FEET

ELEVATION REFERENCE MARKS

REFERENCE MARK	ELEVATION IN FT. (NGVD)[1]	DESCRIPTION OF LOCATION
RM 1	137.2	Standard tablet set horizontal in platform at southwest corner of south end of depot, 1 foot west of southwest corner, 20 feet east of east rail, about level with platform.

[1]National Geodetic Vertical Datum of 1929

NATIONAL FLOOD INSURANCE PROGRAM

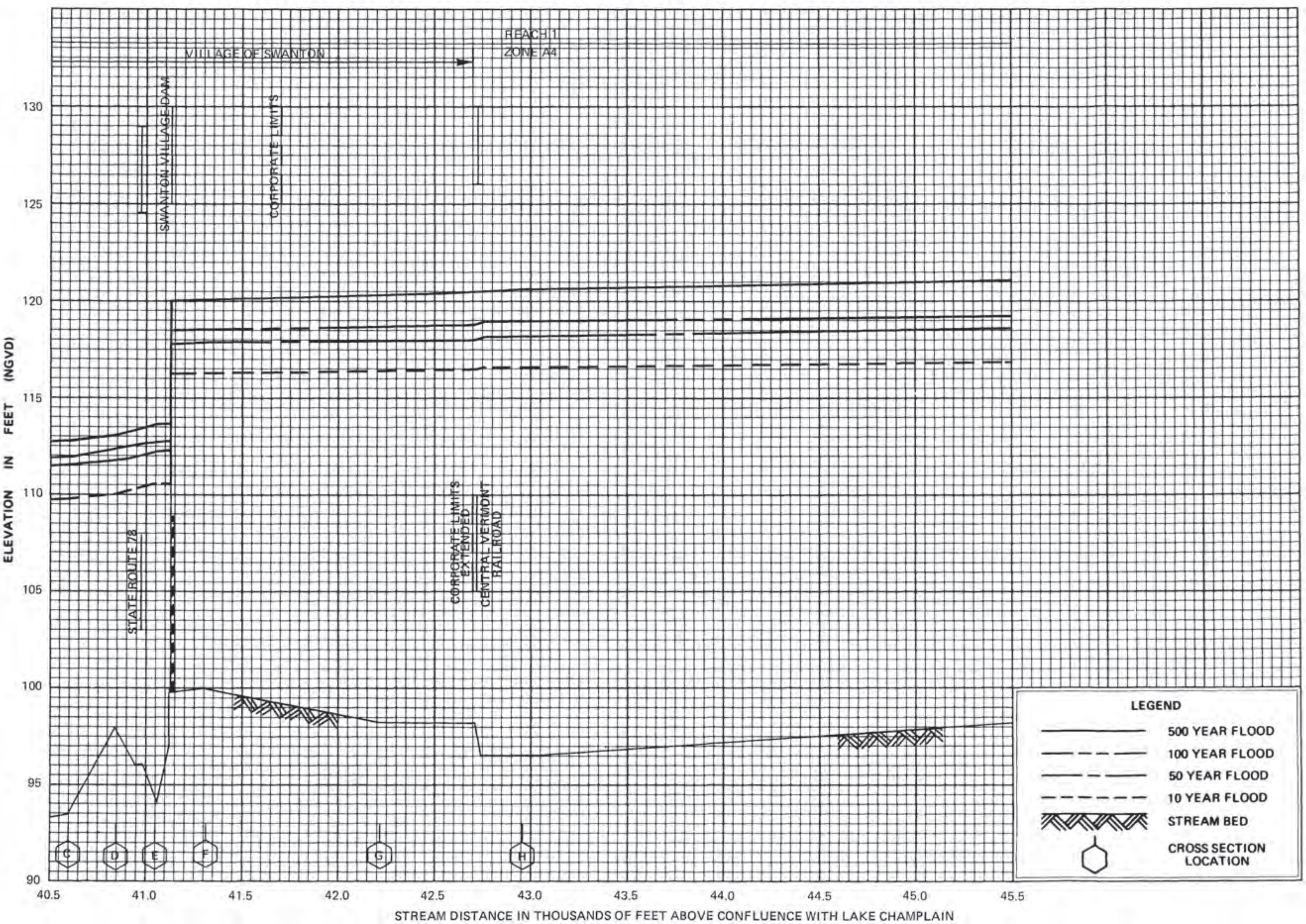
FIRM
FLOOD INSURANCE RATE MAP

VILLAGE OF
SWANTON, VERMONT
FRANKLIN COUNTY

ONLY PANEL PRINTED

COMMUNITY-PANEL NUMBER
500060 0001 B

EFFECTIVE DATE:
MARCH 16, 1983



FLOOD PROFILES

MISSISQUOI RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWN AND VILLAGE OF SWANTON, VT
(FRANKLIN CO.)

03P

APPENDIX G – IPAC REPORT

United States Department of the Interior

FISH AND WILDLIFE SERVICE
New England Ecological Services Field Office
70 Commercial Street, Suite 300
Concord, NH 03301-5094
Phone: (603) 223-2541 Fax: (603) 223-0104
http://www.fws.gov/newengland

In Reply Refer To: March 13, 2022
Project Code: 2022-0019167
Project Name: Lower Swanton

Subject: List of threatened and endangered species that may occur in your proposed project location or may be affected by your proposed project

To Whom It May Concern:

Please review this letter each time you request an Official Species List, we will continue to update it with additional information and links to websites may change.

About Official Species Lists

The purpose of the Act is to provide a means whereby threatened and endangered species and the ecosystems upon which they depend may be conserved. Federal and non-Federal project proponents have responsibilities under the Act to consider effects on listed species.

The enclosed species list identifies threatened, endangered, proposed, and candidate species, as well as proposed and final designated critical habitat, that may occur within the boundary of your proposed project and/or may be affected by your proposed project. The species list fulfills the requirements of the U.S. Fish and Wildlife Service (Service) under section 7(c) of the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 et seq.).

New information based on updated surveys, changes in the abundance and distribution of species, changed habitat conditions, or other factors could change this list. Please note that under 50 CFR 402.12(e) of the regulations implementing section 7 of the Act, the accuracy of this species list should be verified after 90 days. The Service recommends that verification be completed by visiting the ECOS-IPaC website at regular intervals during project planning and implementation for updates to species lists and information. An updated list may be requested by returning to an existing project's page in IPaC.

Endangered Species Act Project Review

Please visit the "**New England Field Office Endangered Species Project Review and Consultation**" website for step-by-step instructions on how to consider effects on listed species and prepare and submit a project review package if necessary:

https://www.fws.gov/newengland/endangeredspecies/project-review/index.html

NOTE Please do not use the **Consultation Package Builder** tool in IPaC except in specific situations following coordination with our office. Please follow the project review guidance on our website instead and reference your **Project Code** in all correspondence.

Additional Info About Section 7 of the Act
Under section 7(a)(2) of the Act and its implementing regulations (50 CFR 402 et seq.), Federal agencies are required to determine whether projects may affect threatened and endangered species and/or designated critical habitat. If a Federal agency, or its non-Federal representative, determines that listed species and/or designated critical habitat may be affected by the proposed project, the agency is required to consult with the Service pursuant to 50 CFR 402. In addition, the Federal agency also may need to consider proposed species and proposed critical habitat in the consultation. 50 CFR 402.14(c)(1) specifies the information required for consultation under the Act regardless of the format of the evaluation. More information on the regulations and procedures for section 7 consultation, including the role of permit or license applicants, can be found in the "Endangered Species Consultation Handbook" at:

http://www.fws.gov/endangered/esa-library/pdf/TOC-GLOS.PDF

In addition to consultation requirements under Section 7(a)(2) of the ESA, please note that under sections 7(a)(1) of the Act and its implementing regulations (50 CFR 402 et seq.), Federal agencies are required to utilize their authorities to carry out programs for the conservation of threatened and endangered species. Please contact NEFO if you would like more information.

Candidate species that appear on the enclosed species list have no current protections under the ESA. The species' occurrence on an official species list does not convey a requirement to consider impacts to this species as you would a proposed, threatened, or endangered species. The ESA does not provide for interagency consultations on candidate species under section 7, however, the Service recommends that all project proponents incorporate measures into projects to benefit candidate species and their habitats wherever possible.

Migratory Birds

In addition to responsibilities to protect threatened and endangered species under the Endangered Species Act (ESA), there are additional responsibilities under the Migratory Bird Treaty Act (MBTA) and the Bald and Golden Eagle Protection Act (BGEPA) to protect native birds from project-related impacts. Any activity, intentional or unintentional, resulting in take of migratory birds, including eagles, is prohibited unless otherwise permitted by the U.S. Fish and Wildlife Service (50 C.F.R. Sec. 10.12 and 16 U.S.C. Sec. 668(a)). For more information regarding these Acts see:

https://www.fws.gov/birds/policies-and-regulations.php

Please feel free to contact us at **newengland@fws.gov** with your **Project Code** in the subject line if you need more information or assistance regarding the potential impacts to federally proposed, listed, and candidate species and federally designated and proposed critical habitat.

Attachment(s): Official Species List

Attachment(s):

- Official Species List

Official Species List

This list is provided pursuant to Section 7 of the Endangered Species Act, and fulfills the requirement for Federal agencies to "request of the Secretary of the Interior information whether any species which is listed or proposed to be listed may be present in the area of a proposed action".

This species list is provided by:

New England Ecological Services Field Office
70 Commercial Street, Suite 300
Concord, NH 03301-5094
(603) 223-2541

Project Summary

Project Code: 2022-0019167
Event Code: None
Project Name: Lower Swanton
Project Type: Power Gen - Hydropower - FERC
Project Description: Hydroelectric Generation at Existing Dam
Project Location:

Approximate location of the project can be viewed in Google Maps: https://www.google.com/maps/@44.916038349999994,-73.12790819379924,14z

Counties: Franklin County, Vermont

Endangered Species Act Species

There is a total of 2 threatened, endangered, or candidate species on this species list.

Species on this list should be considered in an effects analysis for your project and could include species that exist in another geographic area. For example, certain fish may appear on the species list because a project could affect downstream species.

IPaC does not display listed species or critical habitats under the sole jurisdiction of NOAA Fisheries[1], as USFWS does not have the authority to speak on behalf of NOAA and the Department of Commerce.

See the "Critical habitats" section below for those critical habitats that lie wholly or partially within your project area under this office's jurisdiction. Please contact the designated FWS office if you have questions.

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1. NOAA Fisheries, also known as the National Marine Fisheries Service (NMFS), is an office of the National Oceanic and Atmospheric Administration within the Department of Commerce.

Mammals

NAME	STATUS
Northern Long-eared Bat *Myotis septentrionalis* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/9045	Threatened

Insects

NAME	STATUS
Monarch Butterfly *Danaus plexippus* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/9743	Candidate

Critical habitats

THERE ARE NO CRITICAL HABITATS WITHIN YOUR PROJECT AREA UNDER THIS OFFICE'S JURISDICTION.

APPENDIX H – SWANTON, VT CENSUS INFORMATION

QuickFacts

Franklin County, Vermont

QuickFacts provides statistics for all states and counties, and for cities and towns with a ***population of 5,000 or more***.

Table

All Topics	Franklin County, Vermont
Population Estimates, July 1 2021, (V2021)	**50,325**
PEOPLE	
Population	
Population Estimates, July 1 2021, (V2021)	**50,325**
Population estimates base, April 1, 2020, (V2021)	49,946
Population, percent change - April 1, 2020 (estimates base) to July 1, 2021, (V2021)	0.8%
Population, Census, April 1, 2020	49,946
Population, Census, April 1, 2010	47,746
Age and Sex	
Persons under 5 years, percent	5.8%
Persons under 18 years, percent	21.9%
Persons 65 years and over, percent	16.7%
Female persons, percent	50.2%
Race and Hispanic Origin	
White alone, percent	95.0%
Black or African American alone, percent (a)	0.7%
American Indian and Alaska Native alone, percent (a)	1.0%
Asian alone, percent (a)	0.8%
Native Hawaiian and Other Pacific Islander alone, percent (a)	Z
Two or More Races, percent	2.4%
Hispanic or Latino, percent (b)	1.7%
White alone, not Hispanic or Latino, percent	93.5%
Population Characteristics	
Veterans, 2016-2020	2,653
Foreign born persons, percent, 2016-2020	2.6%
Housing	
Housing units, July 1, 2019, (V2019)	22,835
Owner-occupied housing unit rate, 2016-2020	77.5%
Median value of owner-occupied housing units, 2016-2020	$219,200
Median selected monthly owner costs -with a mortgage, 2016-2020	$1,596
Median selected monthly owner costs -without a mortgage, 2016-2020	$595
Median gross rent, 2016-2020	$1,023
Building permits, 2020	196
Families & Living Arrangements	
Households, 2016-2020	19,045
Persons per household, 2016-2020	2.57
Living in same house 1 year ago, percent of persons age 1 year+, 2016-2020	89.9%
Language other than English spoken at home, percent of persons age 5 years+, 2016-2020	3.5%
Computer and Internet Use	
Households with a computer, percent, 2016-2020	88.1%
Households with a broadband Internet subscription, percent, 2016-2020	82.3%
Education	
High school graduate or higher, percent of persons age 25 years+, 2016-2020	91.1%
Bachelor's degree or higher, percent of persons age 25 years+, 2016-2020	26.5%
Health	
With a disability, under age 65 years, percent, 2016-2020	9.6%
Persons without health insurance, under age 65 years, percent	5.4%
Economy	
In civilian labor force, total, percent of population age 16 years+, 2016-2020	66.1%

In civilian labor force, female, percent of population age 16 years+, 2016-2020	63.6%
Total accommodation and food services sales, 2012 ($1,000) (c)	44,646
Total health care and social assistance receipts/revenue, 2012 ($1,000) (c)	D
Total manufacturers shipments, 2012 ($1,000) (c)	D
Total retail sales, 2012 ($1,000) (c)	628,627
Total retail sales per capita, 2012 (c)	$13,038
Transportation	
Mean travel time to work (minutes), workers age 16 years+, 2016-2020	25.6
Income & Poverty	
Median household income (in 2020 dollars), 2016-2020	$65,314
Per capita income in past 12 months (in 2020 dollars), 2016-2020	$31,305
Persons in poverty, percent	⚠ 8.9%

BUSINESSES

Businesses	
Total employer establishments, 2019	1,032
Total employment, 2019	13,163
Total annual payroll, 2019 ($1,000)	565,926
Total employment, percent change, 2018-2019	3.5%
Total nonemployer establishments, 2018	3,815
All firms, 2012	4,479
Men-owned firms, 2012	2,417
Women-owned firms, 2012	1,506
Minority-owned firms, 2012	139
Nonminority-owned firms, 2012	4,169
Veteran-owned firms, 2012	468
Nonveteran-owned firms, 2012	3,741

GEOGRAPHY

Geography	
Population per square mile, 2010	75.3
Land area in square miles, 2010	633.71
FIPS Code	50011

About datasets used in this table

Value Notes

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Fact Notes

- **(a)** Includes persons reporting only one race
- **(c)** Economic Census - Puerto Rico data are not comparable to U.S. Economic Census data
- **(b)** Hispanics may be of any race, so also are included in applicable race categories

Value Flags

- **-** Either no or too few sample observations were available to compute an estimate, or a ratio of medians cannot be calculated because one or both of the median estimates falls in the lowest or upper int open ended distribution.
- **F** Fewer than 25 firms
- **D** Suppressed to avoid disclosure of confidential information
- **N** Data for this geographic area cannot be displayed because the number of sample cases is too small.
- **FN** Footnote on this item in place of data
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QuickFacts data are derived from: Population Estimates, American Community Survey, Census of Population and Housing, Current Population Survey, Small Area Health Insurance Estimates, Small Area Income and F Estimates, State and County Housing Unit Estimates, County Business Patterns, Nonemployer Statistics, Economic Census, Survey of Business Owners, Building Permits.

QuickFacts

Swanton town, Franklin County, Vermont

QuickFacts provides statistics for all states and counties, and for cities and towns with a ***population of 5,000 or more***.

Table

All Topics	Swanton town, Franklin County, Vermont
Population Estimates, July 1 2021, (V2021)	**NA**
PEOPLE	
Population	
Population Estimates, July 1 2021, (V2021)	**NA**
Population estimates base, April 1, 2020, (V2021)	NA
Population, percent change - April 1, 2020 (estimates base) to July 1, 2021, (V2021)	NA
Population, Census, April 1, 2020	6,701
Population, Census, April 1, 2010	6,427
Age and Sex	
Persons under 5 years, percent	5.3%
Persons under 18 years, percent	21.8%
Persons 65 years and over, percent	14.6%
Female persons, percent	50.8%
Race and Hispanic Origin	
White alone, percent	94.8%
Black or African American alone, percent (a)	0.0%
American Indian and Alaska Native alone, percent (a)	1.1%
Asian alone, percent (a)	0.7%
Native Hawaiian and Other Pacific Islander alone, percent (a)	0.0%
Two or More Races, percent	3.3%
Hispanic or Latino, percent (b)	1.1%
White alone, not Hispanic or Latino, percent	94.6%
Population Characteristics	
Veterans, 2016-2020	409
Foreign born persons, percent, 2016-2020	2.6%
Housing	
Housing units, July 1, 2019, (V2019)	X
Owner-occupied housing unit rate, 2016-2020	82.2%
Median value of owner-occupied housing units, 2016-2020	$221,600
Median selected monthly owner costs -with a mortgage, 2016-2020	$1,578
Median selected monthly owner costs -without a mortgage, 2016-2020	$647
Median gross rent, 2016-2020	$893
Building permits, 2020	X
Families & Living Arrangements	
Households, 2016-2020	2,444
Persons per household, 2016-2020	2.67
Living in same house 1 year ago, percent of persons age 1 year+, 2016-2020	94.9%
Language other than English spoken at home, percent of persons age 5 years+, 2016-2020	2.4%
Computer and Internet Use	
Households with a computer, percent, 2016-2020	89.7%
Households with a broadband Internet subscription, percent, 2016-2020	88.5%
Education	
High school graduate or higher, percent of persons age 25 years+, 2016-2020	89.1%
Bachelor's degree or higher, percent of persons age 25 years+, 2016-2020	21.5%
Health	
With a disability, under age 65 years, percent, 2016-2020	10.0%
Persons without health insurance, under age 65 years, percent	4.2%
Economy	
In civilian labor force, total, percent of population age 16 years+, 2016-2020	64.2%

In civilian labor force, female, percent of population age 16 years+, 2016-2020	69.5%
Total accommodation and food services sales, 2012 ($1,000) (c)	5,194
Total health care and social assistance receipts/revenue, 2012 ($1,000) (c)	4,700
Total manufacturers shipments, 2012 ($1,000) (c)	D
Total retail sales, 2012 ($1,000) (c)	62,272
Total retail sales per capita, 2012 (c)	$9,676
Transportation	
Mean travel time to work (minutes), workers age 16 years+, 2016-2020	20.5
Income & Poverty	
Median household income (in 2020 dollars), 2016-2020	$67,783
Per capita income in past 12 months (in 2020 dollars), 2016-2020	$32,382
Persons in poverty, percent	⚠ 11.2%

BUSINESSES

Businesses	
Total employer establishments, 2019	X
Total employment, 2019	X
Total annual payroll, 2019 ($1,000)	X
Total employment, percent change, 2018-2019	X
Total nonemployer establishments, 2018	X
All firms, 2012	645
Men-owned firms, 2012	362
Women-owned firms, 2012	211
Minority-owned firms, 2012	F
Nonminority-owned firms, 2012	613
Veteran-owned firms, 2012	69
Nonveteran-owned firms, 2012	507

GEOGRAPHY

Geography	
Population per square mile, 2010	133.8
Land area in square miles, 2010	48.03
FIPS Code	5001171725

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