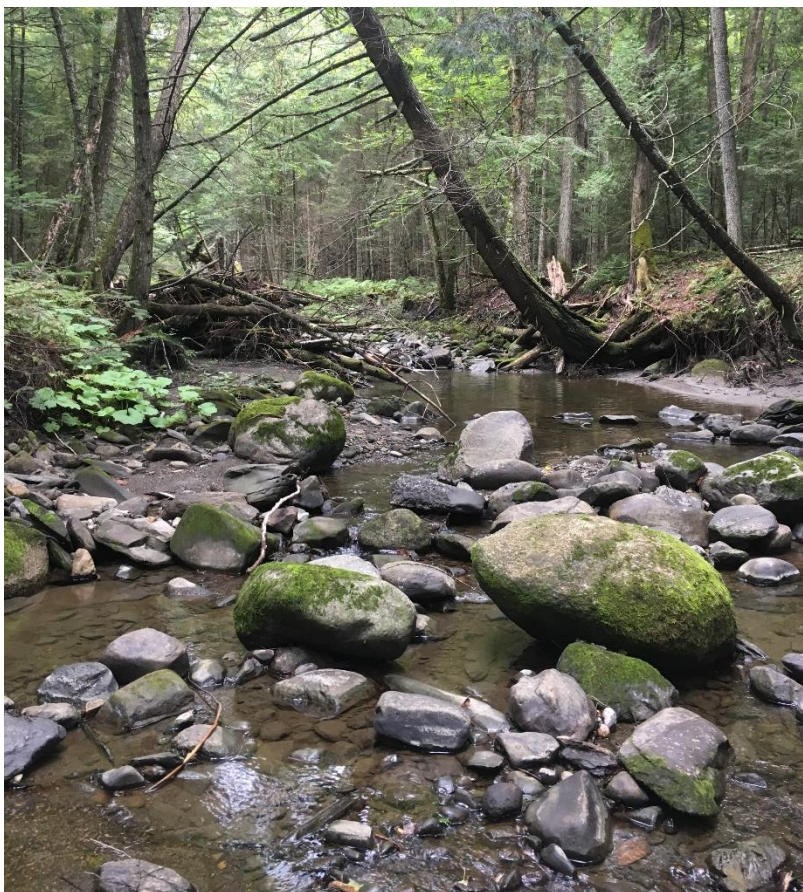


LaRosa Partnership Program

Partner Guide



VERMONT DEPARTMENT OF
ENVIRONMENTAL CONSERVATION
WATERSHED
MANAGEMENT DIVISION
MONITORING & ASSESSMENT PROGRAM

Monitoring & Assessment Program, Watershed Management Division

Vermont Department of Environmental Conservation

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Introduction

A collaborative, partnership model is integral to the achievement of the LaRosa Partnership Program (LPP). Its overall goal is to provide meaningful water quality monitoring data for both the Vermont Department of Environmental Conservation (VT DEC) and LaRosa partner organizations through community science. Each LaRosa partner has a unique understanding of their watershed and offers insight into local water quality concerns through their individual goals and research questions that fit underneath the umbrella of the broader LPP monitoring categories. The VT DEC greatly values the work of the LPP, the passion LaRosa partners share for water quality monitoring, and the time and effort LaRosa partners and volunteer monitors have invested to collect information on the health of Vermont's rivers and streams. To date, LPP has collected over 107,000 samples in every major watershed across Vermont and partnered with over 50 watershed and lake associations, water monitoring groups, conservation commissions, and Natural Resource Conservation Districts.

The purpose of this document is to serve as a guide for participating or potential partners who are part of LPP. It provides all the necessary information and guidance on LPP procedures as well as the responsibilities and expectations for participation in this program. To learn more about the program, see additional educational or training materials, access data, newsletters, and water quality assessment reports, visit our website at <https://dec.vermont.gov/watershed/map/monitor/larosa>.

About the LaRosa Partnership Program

Since 2003, the LaRosa Partnership Program (LPP) has helped watershed and lake associations, Natural Resource Conservation Districts, conservation commissions, and other monitoring groups across Vermont implement new and ongoing surface water monitoring projects. LaRosa partner organizations and their volunteers collect water samples that are analyzed for total phosphorus, total nitrogen, and total chloride in the spring and summer each year. The laboratory chemical analysis of these samples is conducted by the Vermont Agriculture and Environmental Laboratory (VAEL) and funded through the VT DEC's Clean Water Initiative Program (CWIP).

This community-based water quality monitoring facilitates opportunities for partner organizations and the public to interact with their streams and rivers firsthand, learn about water quality issues, and identify areas for potential protection or restoration. Additionally, the LPP data improves our understanding of the river dynamics and variations in water quality conditions on a spatial and temporal basis. It strengthens the database to determine changes in water quality or water pollution problems in the watershed.

The sampling conducted by LaRosa partners improves water quality the geographic extent of monitoring and helps achieve the VT DEC's water monitoring goals outlined in the [Water Quality Monitoring Program Strategy](#). The VT DEC considers and monitors all three components of stream health – biological, chemical, and physical. LPP aims to improve the characterization

of and fill in data gaps regarding the water chemistry component. LPP focuses on four monitoring categories described in the LPP [Monitoring Matrix](#) with the following objectives: (1) identify potentially high-quality waters; (2) sample lake tributaries to assess their contribution to phosphorus loading in lakes; (3) identify stressed or impaired waters and refine the extent and source of the stressor; and (4) evaluate the effectiveness remediation efforts. LPP data is also intended to assist participating partners along with local, state, and federal governments in restoration efforts, effective financial resource allocation, and watershed planning. Additionally, data visualization tools are generated from these data and distributed via LaRosa partner organizations and the LPP website for educational and outreach purposes.

Roles and Responsibilities

The roles and responsibilities described below are a summary of (but are not limited to) the following general expectations for participation in and administration of the LaRosa Partnership Program.

LPP Staff

1. Establish and uphold the LPP water quality monitoring timeline and sampling design; update the QAPP and LPP Partner Guide; maintain and recruit partners for participation in the program.
2. Communicate with, support, and train partners in LPP procedures through regular interactions, website updates, monthly newsletters, an annual training, and potential site visits with partners.
3. Distribute monitoring site nomination materials to LaRosa partners; solicit site nominations; select sites in accordance with the [Site Selection Criteria](#); share the final site selection list for partner confirmation and approval.
4. Develop a standardized LaRosa ID for each site; create a map and maintain an organized list of all LPP water quality monitoring sites.
5. Complete VAEL pre-season administrative tasks: update project numbers and contacts; order bottles and sampling supplies; submit the VAEL Sample Submission Plan; set sampling and sample pick-up schedules with partners; and pre-log samples in WinLIMS.
6. Organize and distribute sampling supplies to partners; orchestrate and conduct biweekly pick-ups and deliver samples to VAEL.
7. Ensure sampling protocols are followed; answer partner questions; provide technical support; and resolve any partner concerns.
8. Track and manage samples, VAEL order information, and flow data; identify and resolve sample errors as needed, and coordinate interactions with VAEL.
9. Review data and follow data QA/QC protocols; share data with partners; and provide data visualization figures.

Partner Organizations

1. Maintain familiarity with sites and their general water quality conditions; scope out potential sampling sites; confirm site coordinates and gain permission to access property if necessary.
2. Nominate sampling sites via the Site Nomination Form; ensure nominated sites meet the Site [Nomination Criteria](#); rank nominated sites and explain nominated site priority based on organizational monitoring goals; and confirm selected sites.
3. Attend the Annual Partner Training; follow the LPP sampling plan, timeline, and all sampling, safety, and QAQC procedures throughout the season.
4. Recruit, organize, and train volunteers as needed to conduct sampling throughout the season.
5. Label sample bottles and distribute supplies to volunteers as needed.
6. Complete VAEL field sheets for each sampling event; organize and check sampling information for accuracy and completeness before sample pick-up throughout the season.
7. Coordinate sample pick-up locations with LPP staff; store samples prior to pick-up according to sample preservation protocol.
8. Track and manage sample and flow data throughout the season including sample time and date, sample collector, flow observation submissions, and any additional information including errors, changes to protocols, or unusual or circumstantial details that could impact sample results.
9. Submit flow data via Survey123 and work with LPP staff to resolve any sampling or procedural issues.
10. Work with LPP staff to review and QAQC data for accuracy and error identification.

2022 Program Timeline

Dates*	LaRosa Partner Responsibilities	VT DEC Responsibilities
12/06/2021	Site nomination process begins: work with watershed planners to develop site nominations.	Distribute Monitoring Site Nomination Form and materials. Share DEC nominated sites with LaRosa partners if applicable.
01/07/2022	Site nominations due: partners send site nominations to LPP staff (CC watershed planners).	
01/07/2022 - 02/14/2022		LPP Site Selection Team (SST) reviews nominated sites and applies selection criteria.
2/17/2022		LPP staff share finalized list of selected sites with partners and send Annual Partner Training doodle poll and Season Prep Info Form.
Mid-Feb. - March	Review selected sites and complete season prep information.	Update QAPP, Partner Guide, and training materials as needed; inventory and order supplies; complete VAEL pre-season administrative tasks.
03/04/2022	Program participation and sampling site confirmation, new site names, Annual Partner Training doodle poll, & Season Prep Info Form due.	
March - April	Plan and prepare for the sampling season.	Update site info and assign new site location IDs; log samples; distribute training materials to partners; organize bottles, VAEL field sheets, bottle labels, and safety equipment into boxes for each partner; finalize sample pick-up route and locations with LaRosa partners.
03/29/2022	LPP Annual Partner Training 1pm - 4pm	
Week of April 4 th	Train volunteers and distribute supplies if applicable.	Test drive sample pick-up route and drop off supplies to partners.
4/16/2022	2022 sampling season begins	
Week of April 25 th - Week of August 1 st	Biweekly sample pick-ups: <ul style="list-style-type: none"> • Tuesday, April 26th and Thursday, April 28th • Tuesday, May 10th and Thursday, May 12th • Tuesday, May 24th and Thursday, May 26th • Tuesday, June 7th and Thursday, June 9th • Tuesday, June 21st and Thursday, June 23rd • Tuesday, July 5th and Thursday, July 7th • Tuesday, July 19th and Thursday, July 21st • Tuesday, August 2nd and Thursday, August 4th 	
08/08/2022	2022 sampling season ends	

Dates*	LaRosa Partner Responsibilities	VT DEC Responsibilities
Sept. - Nov. 2022	Assist LPP staff with QAQC of 2022 data.	Data QAQC process; upload to Vermont Integrated Watershed Information System (IWIS)
Dec. 2022		Power BI data visualization figures published on website

*Specific dates are tentative and may be subject to change.

Training and Communications

In addition to regular communications via email, LPP uses the website and monthly newsletters to keep partners up to date on all important program information and announcements as well as provide resources and materials. An annual training will be held to prepare partners for the sampling season and train everyone in the monitoring procedures and protocols.

LPP Website

The LPP [website](#) provides information that includes but is not limited to:

- Program announcements and [newsletters](#)
- An interactive map of LPP water quality monitoring sites
- Reports for viewing and downloading [LPP data](#)
- Educational and training [materials](#)
- A list of [current and past LaRosa partners](#)
- Previous [water quality reports](#) from partners

Newsletters

LPP monthly newsletters include updates, reminders, important program information or announcements, and answers to frequently asked questions. [Previous newsletters](#) can be found on the LPP website.

Annual Partner Training

The annual training will occur in late March. The meeting will be held in-person at VAEL and virtually. LPP staff will orient past and new partners to topics including but not limited to:

- Season schedule and sample pick-up information
- High flow sampling
- Sample bottles and sampling supplies
- Laboratory field sheets and bottle labels
- Field safety
- Field sampling protocols
- Quality assurance
- Nitrogen acidification, sample preservation, and storage
- Flow observations
- Survey123 app

The slide show presentation used in the training is [linked](#) on the LPP website.

Site Visits

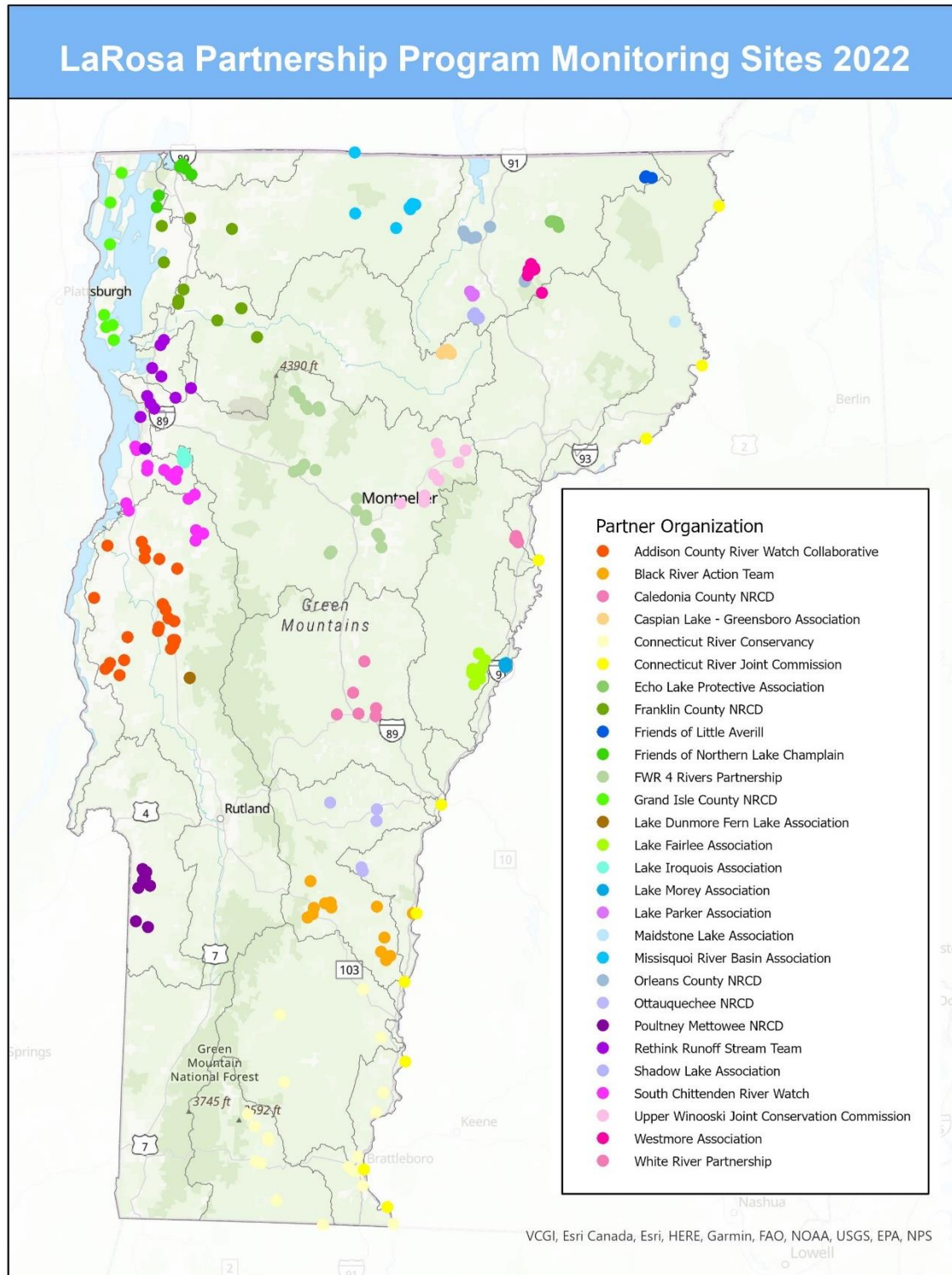
LPP staff will meet with as many partners as possible during the 2022 sampling season. Staff will review sampling protocol at an LPP monitoring site, field sheet data recording, flow observations, and sample preservation. This will allow staff and partners to become more familiar with each other, their stream sites and provide or receive assistance or feedback. LPP staff may also take additional samples to provide supplemental quality assurance data.

Sampling Sites

LPP monitors water bodies that fit under one or more of the categories described in the LPP [Monitoring Matrix](#). This could include impaired and state priority waters, waters on which minimal or no monitoring has been performed in the past, high-quality waters with the potential for reclassification, waters where an existing or suspected water quality problem needs further assessment or where the causes of known problems remain undiagnosed, and waters where a new management practice or remediation project has been or will be implemented.

Stream sites are selected based on the shared goals of the VT DEC and the LaRosa partner organizations. Sites are nominated by LaRosa partners through the Site Nomination Form provided to partners in early December. Final sites are selected from these nominations by a designated team of VT DEC staff experts based on the program capacity (funds available for water sample analysis and staff time to administer program) and site selection criteria outlined in the following sections. Most sites are monitored for at least 3 years to establish baseline data on water quality conditions.

Figure 1. 2022 LPP Site Map



All established LPP sites and associated site details can be viewed by partner organization and exported via the [Monitoring Site Details Report](#).

Site Naming

Sampling sites are named in VAEI's WinLIMS database as the Customer Sample ID which uses a standardized [6-digit Location ID]-[partner-given LaRosa ID] format (e.g., 522445-LFB0.5). The 6-digit-Location ID is provided by the VT DEC to all sites in the Vermont Integrated Watershed Information System (IWIS) database. It is a unique identifier used in the database to track each site and its associated data. The partner given LaRosa ID is a name provided by the partner to identify their site in a way that is understandable to the project coordinator and volunteers. Guidance for creating the LaRosa ID can be found in [Appendix A](#).

Site Nomination and Selection Process

In summary, the site selection process proceeds as follows:

1. Site nominations are solicited from internal VT DEC programs through the Monitoring Site Nomination Form and nominated based on the [Site Nomination Criteria](#).
2. The Monitoring Site Nomination Form is distributed to the LaRosa partners. Partners have approximately one month to work with their watershed planner to nominate sites based on the nomination criteria and submit their forms to LPP staff.
3. Potential VT DEC nominated sites within an existing LaRosa partner's monitoring region are suggested to partners as soon as possible to include in their nominations. These sites are only suggestions and are **not** required to be nominated by the partner. Sites that are a shared priority for both VT DEC and partner organizations will be higher priority candidates for selection.
4. The LPP Site Selection Team reviews all the nominated sites submitted by partners and selects the final sites and parameters to be monitored from these site nominations according to the [Site Selection Criteria](#) and [Monitoring Matrix](#).
5. The final list of sites and the parameters to be monitored at these sites are typically released by mid- to late February. LPP staff will confirm selected sites with partners, solicit names for any new sites, and provide necessary pre-season information, training, preparation, and supplies before the start of the sampling season.

Site Nomination Criteria

All sites being nominated by partners should meet the following conditions:

1. Partners are familiar with the site, its location, and general water quality conditions. Nominated sites must have landowner permission to access or be accessible from a public right of way, such as a bridge.
2. The site meets a [Monitoring Matrix](#) category, criteria, and sampling design.
 - a. All nominated sites must fit under one of the monitoring matrix categories.
 - b. For categories B and C, sites must be identified as a monitoring priority through one of the following: [Tactical Basin Plans](#) or [Lake Score Card](#) or [2020 Stressed Rivers List](#) or [2020 Impaired Waters List](#).

- c. For Categories A, B and C, sites must demonstrate significant data gaps where VT DEC lacks monitoring or the data is > 10 years old.
3. Chemical parameters of total phosphorus (TP), total nitrogen (TN), and/or total chloride (TCl) are appropriate for the monitoring goals of the site.
4. The partner is capable of meeting sampling design: biweekly sampling from April to August with a goal of 8 sampling events and 2 high flow events if conditions allow at all selected sites.
5. The site is a perennial stream, likely to be flowing throughout the spring and summer under normal flow conditions.

LPP Site Capacity

Due to LPP's limited financial and human resources, it is not possible to select all the sites nominated by the LaRosa partners. Some sites will inevitably not be chosen for monitoring each season. The exact number of sites that are selected and cut during the site selection process varies from year to year depending on the total number of sites submitted from all potential partner organizations. Typically, 23 - 30 partners participate in any given year, and the number of nominations per partner ranges from two to forty sites with an average of 11 sites. LPP does its best to be equitable across all partners when cutting sites while also prioritizing sites that best meet the shared goals of the VT DEC *and* partners.

Partner Input in the Selection Process

The Site Selection Team (SST) highly values the input and local expertise of the partners when making the difficult decisions of which sites to prioritize for selection over others. The SST takes the partners' priorities and goals into account when selecting sites through the Site Nomination Form. This form includes a section for partners to rank and explain their assessment of each site's monitoring priority and share the purpose and significance of monitoring that site. For this reason, assigning different priorities (1, 2, or 3) and providing concise but thorough explanations for each nominated site is not only greatly appreciated but key to informing the site selection process.

Site Selection Criteria

Once LPP staff have received all nominations, final sites approved for sampling during the monitoring season will be selected from the list of nominated sites by the LPP Site Selection Team based on the following criteria:

1. Meets the site nomination criteria as outlined [above](#)
2. Provides statewide spatial distribution of sites
3. Fits within the budget (\$100,000 in 2022 for analysis) and LPP staff time constraints

Sites that meet the following criteria will be prioritized:

1. Existing sites sampled during the previous year that have less than 3 years of recent data

- a. Sites that have more than 3 years of recent data should have a significant change in land use or management that is likely to result in water quality changes
2. Sites directly linked to a TMDL (total maximum daily load) process in impaired watersheds
3. Sites that are nominated by both a partner and a VT DEC program

The Site Selection Team (SST) is comprised of LPP staff and representatives from various DEC programs who are experts on Vermont's water quality issues. SST decisions will be informed by the partner priorities described in the Site Nomination Form; the DEC's monitoring goals and strategies; past data, if available; and input from Watershed Management Division (WSMD) staff and Watershed Planners.

Sampling Design

Sampling will occur every 10 – 14 days from mid-April through early August with a minimum of eight regularly scheduled sampling events and two high flow sampling events. Sampling can occur on the days of the week that best suit your organization's schedule, and samples can be stored until pick-up by LPP staff. Sampling close to the pick-up date is preferred to reduce the likelihood that water chemistry parameter holding times are exceeded.

Sampling Plan:

- Eight biweekly regularly scheduled samples from April – August.
- Two high flow samples induced from runoff and/or rain events.
 - Ideally collected at peak flow toward the end of the storm while the rain is still falling, but safety is the priority. **Do not sample if flows endanger your safety.**
 - Can be collected any day of the week to capture flow conditions
 - Collecting two high flow samples may not be possible, especially if it is an abnormally dry year or difficult logistically.
- Collect first samples beginning after April 16th and last samples before August 2nd or 4th, 2022, depending on your organization's sample pick-up day.
- For 2022, LPP staff will pick-up samples from your designated drop-off location biweekly on either Tuesdays or Thursdays and deliver them to the Vermont Agriculture and Environmental Lab (VAEL).

Parameters

LPP will focus on monitoring **total phosphorus, total nitrogen, and total chloride**, as well as **flow level** and **flow type**. These parameters indicate the presence of pollutants from a range of potential sources, including direct discharges, eroding banks and roads, stormwater (dirt roads, lawn fertilizer, pet waste, wildlife droppings), manure, agricultural fertilizers, road salt, dust suppressants and atmospheric deposition. These parameters have longer hold times (28 days), which will provide flexibility for sampling and sample pick-up while meeting sample hold times. Flow information is crucial to interpreting and using the chemistry data effectively because it indicates what the base flow concentrations are and potential pollution sources. For example,

chloride concentrations in streams are typically diluted under high flows, but a high chloride concentration under a high flow may indicate a specific source such as runoff, direct discharge, and/or contaminated groundwater.

Total phosphorus is required at all sites due to the widespread concern of point and nonpoint source contributions regulated by the Lake Champlain Phosphorus TMDL. Total nitrogen is supplemental but useful to determine if sites are influenced by agricultural activities or for those sites subject to the Connecticut River TMDL. Chloride helps to understand if total phosphorus concentrations are related to transportation or agriculture inputs. Typically, chloride is elevated on streams where road salt may have infiltrated groundwater (typically near roads or salt sheds).

High Flow Event Sampling

High flow events occur when water levels are well above an average level of flow (greater than or equal to these levels only 25% of the time) due to rainfall or runoff from snowmelt. The stream will appear full from bank to bank (“bank full flow”), but it is not yet spilling onto the floodplain. If the water levels are spilling over the banks, the flow level is at flood stage. These conditions generally occur during spring and fall but can occur due to rainfall at any time of year. With high flow event sampling, our goal is to capture the range of concentrations impacting the stream. Often high flow conditions occur with noticeable turbidity from sediment transported by runoff. The biggest nitrogen and phosphorus loads tend to occur during high flow events, while high chloride can occur in high, moderate, or low flow conditions, depending on the source.

When to Sample High Flows

Collect high flow samples at any time throughout the season during a high flow event. The goal is to collect two separate high flow events over the sampling season. If possible, sampling should be conducted while waters are rising steadily versus when they start to fall. Safety is always the top priority, so **never sample if the flows pose a danger to you or volunteers**, particularly during flood conditions or when flash flooding may occur.

Under drought conditions, a rain or runoff event may not cause streams to flow above a moderate level. However, the rain or runoff event may meet the goals to sample a high flow event. When determining if a storm is big enough to induce a high flow, generally look for at least **0.5-1 inch of rain** falling in a 24-hour period prior to sampling. The smaller the stream and watershed, the less rain is needed to cause high flows. “Flashier” and more extreme rapidly rising and falling flows are often seen in these small streams, but more moderate flows occur in the larger, higher order rivers. While we would prefer to capture true high flows, it is better to have some data from samples collected during the highest flows possible rather than none. Especially later in the season, try to capture a high flow sample whenever a storm has the potential to cause elevated flows.

The high flow sample should be collected in addition to the regular sample within the two-week interval between sample pick-ups. **The high flow sample does not take the place of the regular sample.** If a high flow event happens to fall on a regular sampling day, then you will need to take the regular sample once flow returns to base flow to keep to the sampling schedule and maintain ten total sampling events. Due to the long hold times of the parameters, samples taken at any time in between sample pick-ups can be stored until the next pick-up.

LPP QAPP

The LPP Quality Assurance Project Plan (QAPP) is a technical document required by the Environmental Protection Agency (EPA) that describes the specifications for a project's design and implementation to ensure the overall project goals and quality control objectives are met. This includes defining the primary objectives and rationale of the LPP, sampling methods, quality assurance protocols, and data management, assessment, and reporting processes. This document is written and updated by LPP staff, and all LPP projects are included in its scope. It covers much of the same information included in this Partner Guide, but a copy of the LPP QAPP can be provided by request.

Safety in the Field

- Carry a cell phone while sampling, sample with a partner, and always let someone else know where you are, when you intend to return, and what to do if you do not return on time.
- Honor private property rights. Never cross a landowner's property without permission.
- **Never wade in swift or high water.** Do not wade if depth is greater than knee-deep. Do not monitor if the stream is at flood stage.
- Have a first aid kit on hand. Preferably, at least one team member should have First Aid/CPR certification. Have a medical form for each volunteer monitor including emergency contacts, insurance, and pertinent health information such as allergies or other health conditions.
- Be aware of the nearest hospital and how to get there from the sampling area.
- Listen to weather reports. Never monitor if severe weather is predicted or if a storm occurs.
- Do not walk on unstable stream banks. Disturbing these banks is dangerous, may accelerate erosion and lead to a collapse.
- Be aware of animals and plants: watch for dogs, farm animals, wildlife, and insects such as ticks, mosquitoes, and hornets. Watch for poison ivy, poison parsnip, chervil, and other skin-irritating vegetation.
- Follow all safety guidance when handling sulfuric acid for total nitrogen sample preservation: follow protocols, [watch](#) the nitrogen acidification training video, read the [Safety Data Sheet](#), always wear safety goggles and gloves, and do not touch face or eyes

with gloved hands. To ensure safety, only the project coordinators and select volunteers trained and approved by LPP staff should handle TN acidification.

Sampling Supplies

Prior to the start of the sampling season, you will receive kits of sampling supplies. These kits will include:

- Sample collection bottles from VAEL
- 250 mL square bottle for total phosphorus laboratory duplicate sampling
- Styrofoam or plastic test tube racks
- Pre-printed bottle labels with both the LPP LaRosa ID and the VAEL Sample ID
- VAEL field sheets to be submitted with samples by the project coordinator
- Acid kits with acid dropper, safety glasses, and nitrile disposable gloves (only for partners sampling nitrogen)

Sample Bottles

Sample bottles play an extremely important role in sample quality. Certain parameters require certain bottles (Figure 2). In the field, it is important to use the correct containers for the correct parameters, and to correctly label all containers to avoid confusion when the samples are brought to the laboratory. Never re-use sample bottles.

- **Total phosphorus (TP)** – 50mL glass tube – white cap and **black line**.
- **Total chloride (TCl)** – 50mL plastic centrifuge tubes – **GREEN cap**.
- **Total nitrogen (TN)** – 50mL plastic centrifuge tubes – **BLUE cap**.

Figure 2. Sample container photos for LPP parameters



TP glass tube



TN centrifuge tube

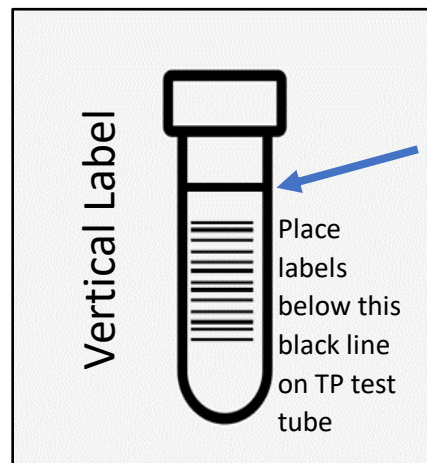


TCl centrifuge tube

Sample Labels

Sample kits will include pre-printed labels, but they will not come applied to the bottles. You will have to attach them to the correct containers **before going out into the field**.

1. Ensure bottles are clean and dry.
2. Secure labels to the correct bottle type for the parameter on the label.
3. Place the labels **vertically**. The barcode scanner cannot read horizontal labels due to the curvature.
4. TP labels should be placed **below the black fill line** on the glass tube.



Sample labels consist of the parameter to be measured, the VAEI Sample ID and the Customer Sample ID (Figure 3). The **parameter** at the top of the label indicates which test will be run by VAEI on this sample. Each parameter has a designated sample bottle (see above) that should match the parameter on the label.

The **Customer Sample ID** is established by the LPP staff and will appear second on the label. It is formatted as a 6-digit Location ID – QC code – LaRosa ID. The QC (quality check) code indicates if the sample is a regular sample (R) or duplicate (D).

The **VAEI Sample ID** is generated by VAEI and appears below the Customer Sample ID in bold. This number consists of the 7-digit order number starting with 22 (for the year 2022) that corresponds with the sample event. Each of the ten required sample events (both regular and high flow) is associated with its own order number. The three digits following the order number represent the sample's place in that order. Sites with multiple parameters will have the same VAEI sample ID for each parameter sampled. Field duplicates have a unique final three digits from the regular sample.

Figure 3. Example TCI label



Field Sheets

The field sheets are provided by VAEL and required to be submitted with all samples. Each sample event will correspond with a field sheet and order number. See Figure 4 for an example of a field sheet. The original field sheets should always remain with the project coordinator for final completion. Copies can be made and distributed to volunteers as needed.


Volunteer project coordinators must review and provide **all the following information** on the VAEL field sheets, or the samples may be rejected by VAEL:

- the correct sample Site ID
- **date and time** of sampling – this is especially critical and must be completed for each sample
- project coordinator name
- comments on any errors, changes, or unusual observations during the sampling
- **indicate if any samples are not collected.** Cross out the specific parameters listed under the Sample ID that were not taken or lost. Cross out the whole sample section if the site was not sampled at all. If the sample will be collected later, make note of this.

Figure 4. Example VAEL field sheets

Each sample site is listed on the field sheet. This VAEL ID and the Customer Sample # matches the sample bottle labels for this site.

Each field sheet includes an order number that corresponds with all the samples collected during a single sampling event. LPP staff will use this number when referring to a sampling event. The order number is also the first 7 digits of the sample VAEL ID.



Field Sheet
Order ID: 2200158
Page 1 of 2

VAEL Use Only

Temperature (°C): _____ ☐ On-Ice?

Received By: _____

Date/Time Received: _____ @ _____ AM / PM

VAEL ID: 2200158-001
Project: 012-32-Ticklenaked Pond

Customer Sample #: 508456-R-SB2.5


Date and Time Collected: This is critical. Must be completed Collected By: Project Coordinator

Comments: e.g., TP bottle accidentally rinsed

Test	Container	Preservative	Filtered/Acidified?
Nitrogen Total	50 mL Plastic Blue Cap	H2SO4 to pH < 2; Cool 4 °	Yes / No / NA
Phosphorus Total	60 mL Glass Vial	None	Yes / No / NA

Parameters collected at this site. Cross out if not collected (i.e., bottle leaked or broke)

Example of a sample site not visited/sampled: If the site will be sampled later, write “will arrive later.”



VERMONT
VAEL Vermont Agriculture and
Environmental Laboratory

Field Sheet
Order ID: 2200158
Page 1 of 2

VAEL Use Only

Temperature (°C): _____ ☐ On-Ice?

Received By: _____

Date/Time Received: _____ @ _____ AM / PM

VAEL ID: 2200158-001
 Project: 012-32-Ticklenaked Pond
 Customer Sample #: 508456-R-SB2.5
 Date and Time Collected: _____ Collected By: _____
 Comments: _____

Test	Container	Preservative	Filtered/Acidified?
Nitrogen Total	50 mL Plastic Blue Cap	H2SO4 to pH < 2; Cool 4 °C	Yes / No / NA
Phosphorus Total	60 mL Glass Vial	None	Yes / No / NA

Sampling Protocols

The protocols described in this section should be followed as closely as possible to ensure the collection of reliable and consistent water quality data. Please see the [Stream Sampling Checklist](#) for a summarized list of tasks to be completed during every stream sampling field visit.

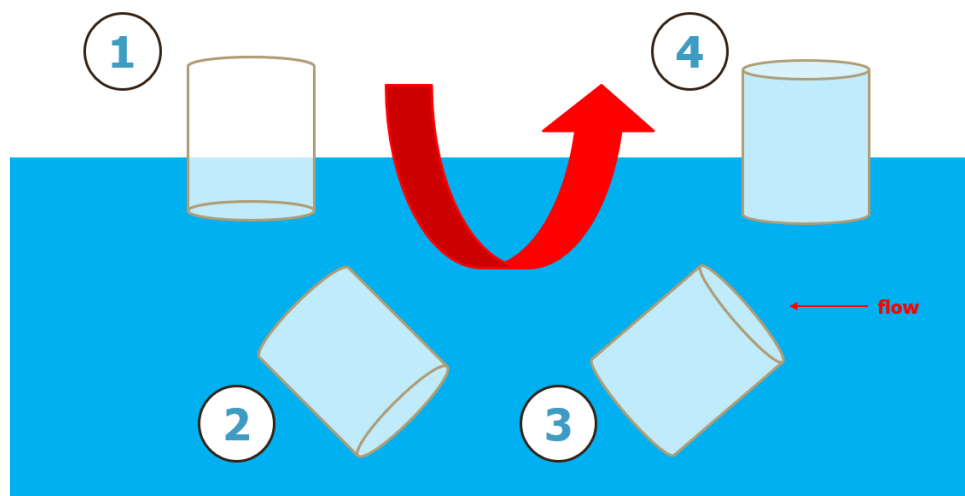
Grab Samples



1. Take samples near the center of streamflow and mid-way between the surface and bottom of the stream. Try not to disturb the bottom sediment of the stream when taking the sample, and always take the sample facing upstream.
2. Avoid touching the inside of bottles and caps.
3. Wait for any sediment disturbed when wading in to flow downstream.
4. Plastic bottles for **nitrogen** and **chloride** and their caps **should be rinsed three times** before taking the sample.
 - a. Dump rinse water downstream.
 - b. Glass test tubes for **phosphorus should not be rinsed**.

5. Open sample containers should be placed upside down over water, and water should be sampled in a “U” shape against the flow of water, away from the body. See Figure 5 below.

Figure 5. Diagram of proper sample collection technique



6. Pour off samples to the required volume before capping. A slight flicking motion of the wrist is the best way to remove limited amounts of water
 - a. This is especially important for phosphorus samples – fill glass bottles to the black line indicating 50 mLs.
 - i. If you pour off a phosphorus sample below the fill line, **do not redo the whole sample!** Either dip the bottle back into the water for a second or fill the cap with sample water to pour into the bottle.
 - b. Fill plastic centrifuge tubes for TN and TCI up to the 50mL line. Make sure to leave space in the TN tube for the addition of sulfuric acid during nitrogen acidification.
7. Make sure all lids are threaded properly and tightened to avoid leakage.
8. Make note of anything unusual that happened during sampling which may affect the result, or anything that was changed during the process, such as labels, site locations, parameters collected, etc.

After samples are collected and capped, they should be placed into a cooler with bagged ice. Free ice in a cooler should be avoided. Sample containers and tubes are not guaranteed to be leak-free, therefore, samples that contact melted ice are at risk of contamination.

River Dippers and Bucket Samples

If a site is too deep or difficult to wade in, you can use a river dipper to reach farther into the stream to collect the sample water from the shoreline. To create your own, attach a 1-Liter HDPE plastic bottle to a PVC pipe or other pole using zip ties. If there is a bridge or road crossing over the sampling location, a sturdy 2-gallon HDPE bucket firmly attached to a rope can be gently lowered over the center of the stream flow to collect a sample.

If using a river dipper, adhere to the following protocol:

1. Rinse out the river dipper bottle three times with river water. Never wash or rinse the inside with soap.
2. Collect river water by using the pole to reach out into the center of the stream flow and dipping the 1-L bottle into the stream using the same U-shaped motion pictured above for grab samples.
3. Use the river water in the river dipper bottle to rinse out the individual, smaller sample bottle and cap (if rinsing is required) three times.
 - a. Dump rinse water downstream.
 - b. Avoid touching the inside of bottles and caps.
 - c. Avoid contact between the rims of the river dipper bottle and the sample bottle.
 - d. Remember, **do not rinse** the TP bottle.
4. Pour water from the river dipper bottle into the sample bottle to the designated fill line.
 - a. Only fill a sample bottle if there is enough water remaining in the river dipper to completely fill the bottle to the required fill line. **Do not fill part way.** Instead, empty the bottle and repeat step 2 to collect more water to completely fill the sample with one river dipper sample collection.
 - b. Multiple sample bottles can be rinsed and filled at a time from a single river dipper bottle collection provided there is enough to completely fill each sample bottle.
5. **Repeat steps 1-4 when collecting a field duplicate** (this does not apply to lab duplicates). This includes rinsing the river dipper three times again.
6. Make sure all lids are threaded properly and tightened to avoid leakage.
7. Make note of anything unusual that happened during sampling which may affect the result, or anything that was changed during the process, such as labels, site locations, parameters collected, etc.

If using a bucket, adhere to the following protocol:

1. Rinse out your bucket three times with river water. Never wash or rinse the inside with soap.

2. Collect river water by lowering the bucket into the center of the stream flow and collecting enough surface water to fill all samples bottles. Make sure bucket does not touch the stream bottom. If it does, dump water and rinse 3 times again.
3. Gently raise the bucket back up to the samplers.
4. Gently pour water from the bucket into the sample bottle to rinse it and the cap (if rinsing is required) three times.
 - a. Remember, **do not rinse** the TP bottle.
 - b. Avoid touching the inside of bottles and caps.
 - c. Avoid contact between the rims of the river dipper bottle and the sample bottle.
5. Gently pour water from the bucket into the sample bottle to the designated fill line.
6. Repeat steps 4 and 5 for all parameters collected at that site.
7. **Repeat steps 1-6 when collecting a field duplicate** (this does not apply to lab duplicates). This includes rinsing the bucket again three times.
8. Make sure all lids are threaded properly and tightened to avoid leakage.
9. Make note of anything unusual that happened during sampling which may affect the result, or anything that was changed during the process, such as labels, site locations, parameters collected, etc.

QAQC Samples & Protocols

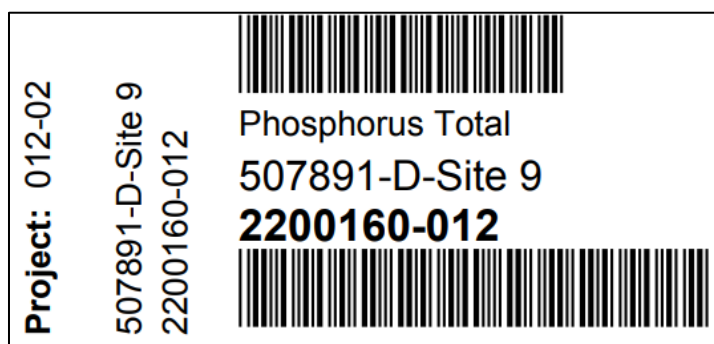
Quality Assurance/Quality Control (QAQC) samples consist of duplicate samples that make up 10% of your samples. There are two different types of duplicate samples: field duplicates and laboratory duplicates, described in detail below.

Field Duplicates

Field duplicates help to determine the amount of variation that occurs in the field. By collecting two samples in the same manner but in different bottles, results show the range of variation in a particular parameter. This may be due to contamination, flow. Extra bottles for field duplicates will be provided for all parameters sampled (TP, TN, and/or TCI). LPP staff will predetermine the scheduling for field duplicate sampling. Field duplicates cannot be skipped, and predetermined locations should not be changed.

The goal of taking field duplicates is to mimic the regular sampling process exactly. Field duplicates for each parameter sampled at the site should be collected immediately after the regular samples at the same location and in the same manner. This includes rinsing the sample collection bottle if required (do not rinse TP field duplicate bottles but do rinse a river dipper or bucket used to fill the duplicate samples). Field duplicates must be taken at the assigned sites on the bottle label. If a duplicate is mistakenly collected at the wrong site, please let LPP staff know as this will affect the data quality assurance later. These samples are labeled with a “-D-” for duplicate (instead of “-R-” for regular) on the sample label pictured in Figure 6.

Figure 6. Field duplicate sample label



Laboratory Duplicates

Laboratory duplicates help to determine if there are any laboratory errors. The laboratory takes two sub-samples from the original sample collected, separately analyzes both using the same methods, and compares the results for quality assurance. Laboratory duplicates are taken for 10% of all parameters sampled, but **only phosphorus laboratory duplicates must be collected in the field by partners**. This is because there is not enough sample water in a single TP tube to split the sample and conduct TP analysis twice, so a second sample is needed to complete the lab duplicate TP analysis. **Sampling protocol for TP laboratory duplicates is different than the sampling protocol for TP field duplicates** (Figures 7 & 8). Field duplicates are two separate samples collected one after the other, and each sample bottle contains a discrete stream sample (Figure 8). To collect a lab duplicate, a single parent sample is collected in a larger plastic square container and then poured into the two separate regular and lab duplicate bottles (Figure 7). This ensures the two samples are as similar as possible because they come from the same parent sample.

Figure 7. Diagram of total phosphorus lab duplicate collection process

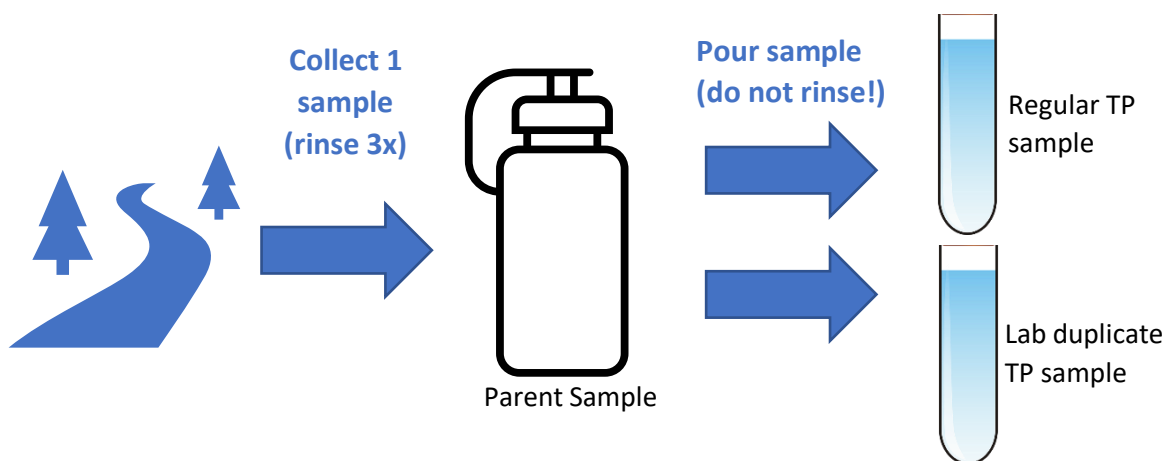
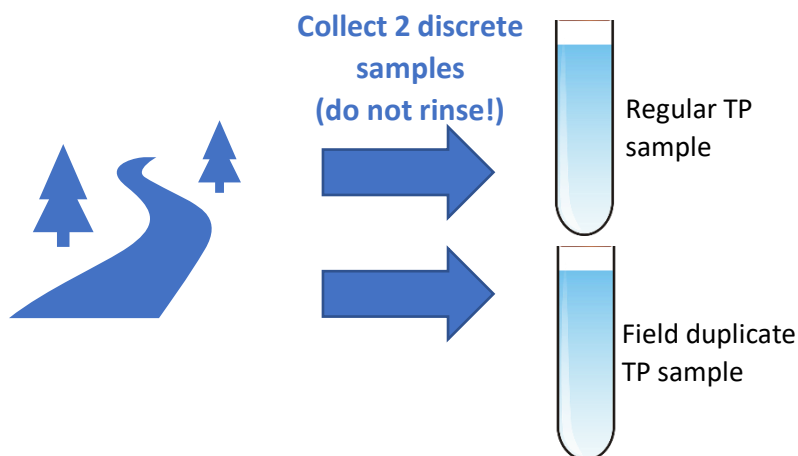


Figure 8. Diagram of total phosphorus field duplicate collection process



Collecting TP lab duplicates is required and cannot be skipped. Partners with fewer than 15 sites only need to collect one lab duplicate per sample event. Partners with 15 or more sites will collect 10% of the total number of sites rounded to a whole number per sample event. VAEI will provide extra TP lab duplicate bottles and one 250ml square bottle at no additional cost. You will receive them in your boxes of glass TP tubes pre-labeled with a sticker that says, "Collect sample for duplicate" and a blank space for the Lab Sample ID. Partners must check the box for "TP" and write in the associated regular Lab Sample ID (found on the field sheet or associated regular bottle label) followed by the word "Dup". An example laboratory duplicate label is provided in Figure 9 below.

Figure 9. Example laboratory duplicate label

<input checked="" type="checkbox"/> TP or <input type="checkbox"/> DP (please check one) DUPLICATE for LAB USE Lab Sample ID # 2200160-009 Dup
--

Because the purpose of lab duplicates is to determine laboratory error and not field sampling errors, **they do not need to be randomly assigned to specific sampling sites**. Therefore, LPP staff suggest that project coordinators collect the lab duplicates at the **same** site(s) throughout the season to minimize confusion between field and lab duplicates. For partners who coordinate volunteer samplers, choose a site or sites assigned to your most trusted and capable volunteer(s) and train and task them with collecting lab duplicates.

To correctly sample laboratory TP duplicates, please follow this procedure:

1. Write in the Lab Sample ID that matches the regular TP sample label on the lab duplicate label. Check the box for “TP”. Do this ahead of time. See Figure 9.
2. **Rinse the square plastic bottle with ambient river water three times.** If you are using a river dipper or bucket, use the river dipper bottle or bucket instead of the square bottle.
 - a. Dump rinsed water downstream.
 - b. If using a river dipper, make sure there is enough water remaining in the river dipper bottle to completely fill both the regular TP and lab duplicate TP sample. If not, proceed to step 3.
3. Collect a sample with the square plastic bottle from the center of stream flow following the same protocol as described in the [Grab Sample Section](#). If using a river dipper or bucket, collect the sample the same as usual (described in the [River Dipper and Bucket Sampling Section](#)).
4. Carefully pour the water from the square bottle into both TP bottles (the regular sample and the laboratory duplicate) to the black line. Unlike the square bottle, **neither TP bottle should be rinsed.**

Blanks

Blanks have previously been used to determine if there is contamination between sites. However, LPP has decided to remove blanks from the QAQC process except during LPP staff site visits. Partners will no longer be required to sample blanks in the field.

Sample Storage and Preservation

All samples should be kept in a safe location where they are unlikely to leak, break, spill, or be contaminated until they are picked up by WSMD staff or dropped off at VAEL. Make sure the samples are labeled clearly, kept away from food or drink, and stored where they are unlikely to be tampered with by anyone inadvertently. This is particularly important for acidified total nitrogen samples which are hazardous.

TP and TCI samples can be stored at room temperature, but TN samples must be stored around 4°C. They must be put on ice or refrigerated as soon as possible after collection. They also need to be acidified to a pH of less than 2.0 with 98% sulfuric acid. The acidification needs to occur within 24 hours of sample collection, or the sample will not be properly preserved. Avoid performing acidifications in the field.

Sulfuric acid is a hazardous chemical that should be handled carefully. To ensure safety, only the project coordinators and select volunteers trained by LPP staff should perform acidification.

Before using the sulfuric acid to acidify TN samples:

- Attend the annual training and view the TN acidification demonstration [video](#) on the [LPP website](#).
- Read the [Safety Data Sheet](#) (SDS).
- Sign and return the acidification safety agreement to LPP staff.
- Always wear disposable gloves and safety glasses when handling chemicals.

Acidification Procedure

1. Put on safety goggles and gloves. Never put gloved hands near eyes or mouth.
2. Secure the sample to facilitate easy and safe dispensing of acid. Use a test tube rack if available.
3. Remove the acid dropper bottle from the secondary container and uncap carefully.
4. Dispense 2 drops of 98% sulfuric acid into the sample container.
5. Immediately recap the acid dropper and replace back in the secondary container.
6. Securely cap the acidified samples and gently invert 5 times to mix.
7. Carefully remove gloves so as not to touch exterior side of glove with bare hands and dispose in a safe container.
8. If you spill the acid, absorb acid on surfaces with a paper towel and dispose of it in a plastic bag. If you spill acid on your skin or clothes, wash thoroughly with water.
9. Wash hands thoroughly after acidification is complete.

Flow Observations

Flow (discharge magnitude) is an essential observation made during the collection of water samples from rivers and streams. The water quality of a river or stream can change dramatically during and immediately following a precipitation or snow melt event. It is important to consider the concentration of a parameter and the duration of flow conditions at the time of sample collection. For example, a high chloride concentration under low flow may indicate groundwater contributions.

A quantitative discharge measurement in a gaged stream is the most precise method and necessary when collecting water quality samples for loading studies. However, a two-part qualitative stream flow observation of flow level and flow type can greatly increase the value of a water sample result when this is not possible.

The VT DEC records these stream flow related observations (flow level and flow type) during the collection of a stream sample and strongly recommends its use in conjunction with all stream water quality sampling. The VT DEC incorporates this information into the Vermont Integrated Watershed Information System (IWIS) online database.

You can access the [USGS Current Water Data for VT](#) to find real time data and graphs of flow conditions for gauged streams in Vermont.

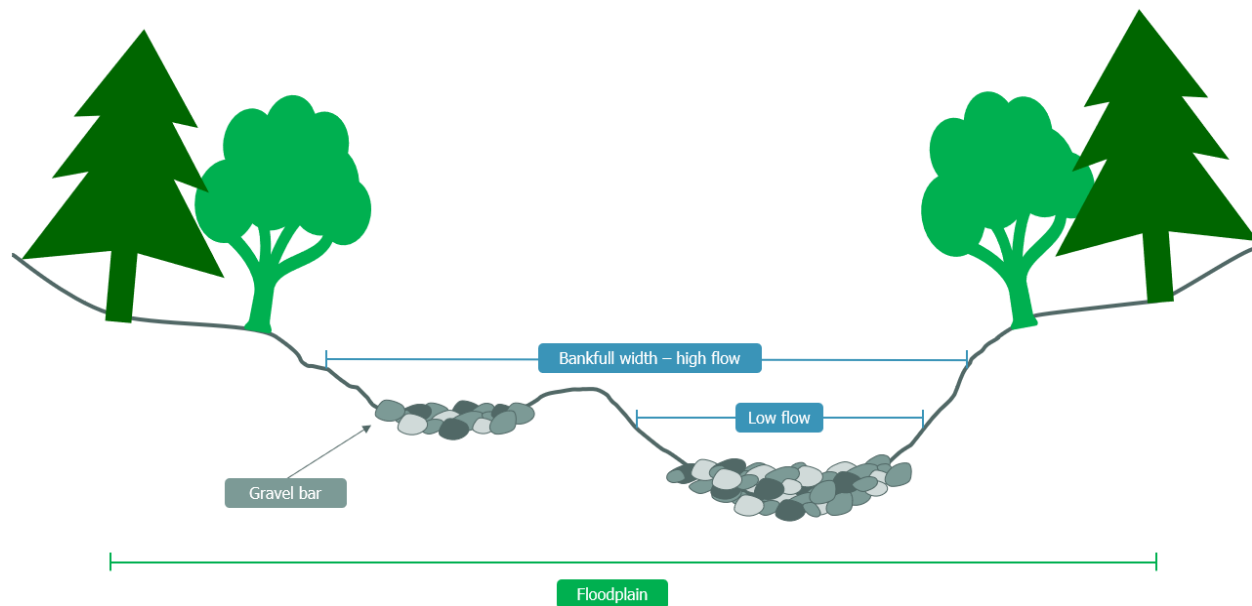
Flow Level

Flow level can be described as:

- Low
- Moderate
- High
- Flood

A diagram of stream flow levels in a sample stream is provided in Figure 10.

Figure 10. Diagram of stream flow levels in a sample stream



Low – Stream conditions are low relative to the entire range of flows experienced at site (less than or equal to these levels 25% of the time or the 25th percentile).

- Generally, these occur during late winter (January-February) and summer (July-September).
- Often the streambed is partially dry with gravel bars exposed, and it is possible to walk along the edge of a dry streambed.

Moderate –Stream is at a mid-level or average streamflow conditions, or most typical flows experienced in the stream (levels experienced 25-75% of the time).

- Can occur at any time of year.
- ~90- 100% of the stream bed is under water, but the water has not yet risen to the sharp incline of the stream bank.

High –Stream is well-above an average level of flow (greater than or equal to these levels only 25% of the time or the 75th percentile).

- Generally, this occurs during spring and fall but can occur due to rainfall any time of year.
- Stream is full from bank to bank (“bank full flow”) but not spilling onto floodplain.

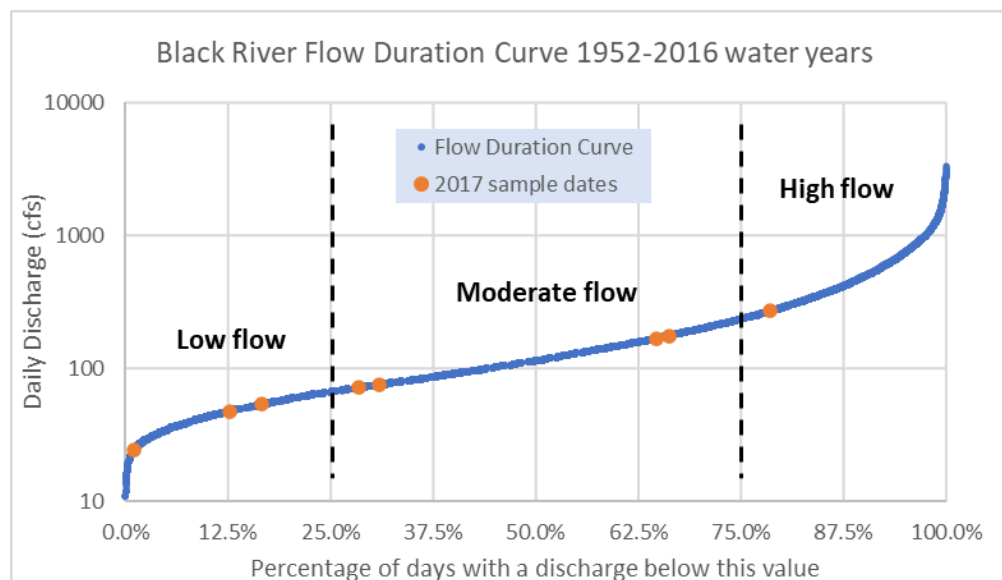
Flood: Stream is exceeding bank full levels and accessing floodplain (if exists).

- Generally, this occurs less than 5% of time.
- Also indicated by submergence or active transport of terrestrial and woody vegetation.
- **Do not sample during flood conditions due to safety.**

Example [photos](#) of different flow conditions can be found on the LPP website under the [Training and Education](#) section.

Another way to determine flow levels is using a flow duration curve. While this is not possible to do in the field, it is a useful tool for understanding flow levels quantitatively. The flow duration curve below (Figure 11) shows the daily discharge (a measure of flow), or the volume of water measured by a stream gage passing through the Black River, and the percent of days the stream discharges over time were below the measured discharge on a particular day. This graph shows a curve of the full range of conditions experienced by the river over time, and the flow levels can be calculated using the percentages on the x-axis (i.e., low flow = 25% lowest discharge values, moderate flow = middle 50% of discharge values, high flow = highest 25% of discharge values). From this curve, the flow level can be determined for any given discharge value by its percentile on the graph. As can be seen by the sample dates marked in orange, most samples collected occurred during a low or moderate flow and one sample was collected during a high flow. Different streams can have different shaped flow curves, but most have this general shape.

Figure 11. Example Flow Duration Curve



Flow Type

Flow type can be described as:

- Baseflow
- Freshet
- Hydro

Base flow – A stream’s flow is at a relatively constant level at the time of sampling, not rising nor dramatically falling in direct response to a rainfall event or snow melt runoff. Subsurface flows account for almost all water reaching streams. The hydrographs of nearby gaged streams have not begun to rise, have fallen to a similar level of that before the flow level rise began, or have leveled off to a steady but higher flow level. A base flow can exist under both low and moderate flow levels, but not under a “high” or “flood” streamflow level. The USGS maintains WaterWatch web site which has real-time streamflow data at <http://waterwatch.usgs.gov/?m=real&r=vt>. This map and the hydrographs of current and recent conditions are a useful tool in identifying base flow conditions.

Freshet flow – A stream’s flow is actively rising or falling in response to a rain event or snow melt. The hydrograph of a stream shows an increase in flow, has not leveled off to the pre-event flow levels or stabilized to slightly higher than pre-event levels. Streams can be turbid under these conditions due to stormwater runoff and increased re-suspension of stream bed sediments. Freshet flow can occur under low, moderate, or high flow levels.

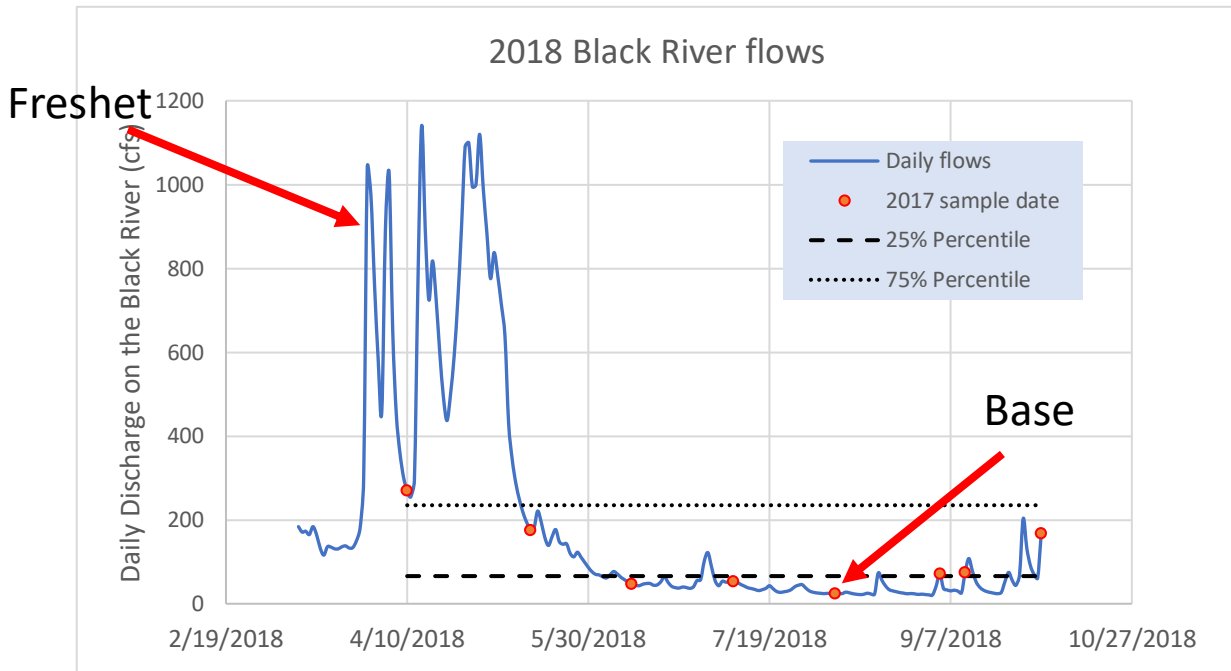
Hydro flow – A stream’s flow level is rapidly rising *solely* due to the abrupt release of water from an upstream dam. A rise in streamflow with no recent precipitation or snowmelt events and when similar rises are not observed for local stream gauges are good indicators of artificial releases from dams. The Vermont Natural Resources Atlas, available at <http://anrmaps.vermont.gov/websites/anra/>, also contains a watershed protection layer depicting known dams throughout the state, including whether they are operated for generation of electricity.

Note: the occurrence of natural freshet flows in direct response to rainfall or snowmelt are still possible below such facilities.

If any of your sites has ceased to flow, both flow level and flow type would be recorded as “No Flow”.

Figure 12 presents discharges in the Black River over time and demonstrates how the flow changes drastically in a season. Sharp inclines in the daily flow line indicate an increase in flow due to a freshet event caused by either rain or snow melt runoff. The highest flows occurred in April and May, while the lowest flows occurred in the summer and early fall. As demonstrated by the percentile lines on the graph that show the distinction between low, moderate, and high flow levels, freshet events can occur under all three flow levels.

Figure 12. Hydrograph of 2018 daily flows in the Black River indicating freshet and base flow types



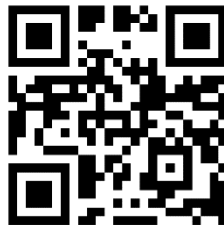
Flow Data Submission

Survey123

Before going out in the field, **please ensure** that you and all volunteer samplers have access to the LPP Flow Data Survey via Survey123. This can be accessed both via the smartphone app Survey123 and through a webform on your browser. Please access the survey via the smart phone direct link or QR code in Figure 13 below:

Figure 13. Survey123 QR code

<https://arcg.is/1PXuTe0>



It is not necessary to have an ArcGIS account to access the LPP Flow Data Survey. Once you have accessed the link, you may decide whether to open the LPP Flow Data survey directly in the Survey123 smartphone app or in your web browser. The LPP Flow Data Survey can be submitted using **both computers and smartphones** and therefore should be easily accessible.

Ideally, flow data should be submitted directly in the field via the smartphone app Survey123. However, we understand that everyone has different levels of comfort and access regarding the use of smartphones in the field. For those that are uncomfortable or unable to use Survey123 in the field, whether this be project coordinators or volunteers, there are separate options for flow data submission.

Survey123 Smartphone App

Using the app Survey123 allows partners to submit flow observations directly from the field. Once downloaded, the LPP Flow Data survey will be available directly within the Survey123 app. To submit flow observations, please adhere to the following instructions:

1. Open the Survey123 app.
2. Click “Continue without signing in”.
3. Choose “LPP Flow Data Survey 2022”.
4. Click “Collect”.
5. The date and time of observation will be filled in automatically.
6. Fill out the survey with all required fields.
7. Capture photos of the site, facing both upstream and downstream.
8. Provide any additional notes or necessary information.
9. Once your survey is complete, click the “V” at the bottom right of the screen.
 - a. If you are missing any necessary information, Survey123 will prompt you to fill in required fields before allowing survey submission.
10. If your device is **online**, click “**Send now**”
11. If your device is **offline**, click “**Save in Outbox**”

Note: If data is submitted via the Survey123 smartphone app while offline, all samplers will need to return to the app after sampling to **ensure that there are no results remaining in their outbox**. This is **essential** to ensure that we have flow data for all samples.

Survey123 Webform

If a project coordinator is managing multiple volunteers who have varying levels of comfort with using a smartphone in the field, the Survey123 webform is an option that can be used to submit all flow observations after observations have been recorded in the field. This webform can be filled out on any browser on computers, tablets, or smartphones. The format of the LPP Flow Data Survey is identical to that in the Survey123 app and will require the same steps outlined for the smartphone app [above](#). However, given that project coordinators will not be submitting the survey directly from the field, upstream and downstream photos will not be required. The survey must be submitted once per site for every sampling event.

If a site is not sampled for any reason, it is still necessary to submit flow observations. Partner flow observations can help LPP staff understand why a site wasn’t sampled (e.g., due to flooding or drought) and provide necessary context throughout the QAQC process.

If project coordinators or volunteers choose to use the Survey123 webform, project coordinators are required to gather all flow data from every sampler and ensure that the web form is completed for every site. Complete flow data will include:

- Whether or not a site was sampled
- Partner organization
- Sampler Name
- Site ID
- Lab Sample ID
- Date and time of observation
 - Please note that Survey123 will prepopulate the date and time when you open the LPP Flow Data Survey. Coordinators filling in the survey via webform after field sampling has already occurred will need to **input the correct date and time** to ensure data accuracy.
- Flow level
- Flow type
- Visible turbidity

It will not be possible to submit the webform without the required information above.

If neither the smartphone app or webform works for project coordinators, partners may record flow observations directly on field sheets and submit them to LPP staff along with samples during sample pick-up. LPP staff will then input this flow data manually. Given LPP staff's limited time, please use field sheet submission as a last option. To streamline this process, the Survey123 smartphone app and webform are LPP staff's preferred method of flow data submission. Regardless of the method used, project coordinators are responsible for ensuring that all flow observations are completed at every site and submitted in a timely manner.

Training Resources

[Annual Training PowerPoint Slides](#)

[Stream Sampling Checklist](#)

[Water Quality Sampling Video by Addison County River Watch Collaborative](#)

[Flow Observation Guidelines](#)

[Flow Observation Photos](#)

[Nitrogen Acidification Training Video](#)

[USGS Water Science School](#)

VAEL

The [Vermont Agriculture and Environmental Laboratory \(VAEL\)](#) conducts sample analysis for all LPP samples. In order to submit samples to VAEL, field sheets and sample labels are required. LPP staff will provide these supplies to project coordinators and how to use them.

Delivering Samples to the Laboratory

- LPP staff will pick up samples and field sheets every two weeks from a designated location. Samples should be collected as close to the pick-up date as possible to decrease the possibility of the samples exceeding their hold times.
 - Sample parameters have a “hold time” – a maximum time allowed after sample collection that parameters are required to be analyzed by before compromising the quality of the data.
- Upon pick-up, LPP staff will compare the samples listed on the field sheet to the bottles and labels provided for pick up. Any questions or deviations of the samples from the information on the field sheet will be noted.
- Project coordinators that choose to deliver samples directly to VAEL must review and submit field sheets and bottle labels. Go to the front door of VAEL building located at the following address:
163 Admin Drive, Randolph Center, VT 05061.
- Sample Receiving is located immediately to the right upon entry to the building.
- Sample Receiving can accept samples between the hours of 8 am and 4:30 pm.
- For after-hours sample drop-off coordination, please contact the lab at (802) 636-7474.

Deliver samples to the laboratory well before their hold times. See Table 1 for each parameter’s hold time.

Table 1. Hold times for phosphorus, nitrogen, and chloride

Parameter	Hold Time	Sample Preservation Required
Total Nitrogen	28 days (must be acidified within 24 hours of sampling)	Acidification/Refrigeration $\leq 6^{\circ}\text{C}$
Total Phosphorus	28 days	Room Temperature (can be refrigerated with TN samples but not required)
Total Chloride	28 days	Room Temperature (can be refrigerated with TN samples but not required)

Checking Samples into the Laboratory

- If LPP staff deliver samples to VAEL, they will review field sheets before submitting to Sample Receiving staff.
- Take the time to review the field sheet paperwork and make hand-written changes as needed.
 - Cross out any samples or parameters that were not collected.
 - Make note of samples to be collected on a later date if applicable.
 - Verify that the **date and time** of sampling is noted for each sample site.
- After checking through the field sheets, **all samples should remain in the cooler with the field sheets.**
- Someone from Sample Receiving will complete sample check in by again comparing the field sheets to the samples received. They will verify that the samples that should have arrived, did arrive.
- Once samples have been verified by VAEL Sample Receiving staff, the samples/parameters are entered into the WinLIMS data management system, which shows lab personnel that new samples are available for analysis.
- If an error in the field sheets is found, Sample Receiving or LPP staff will contact the project coordinator for clarification.

Sample Pick-up/Drop-off

LPP staff will provide sample pick-up and delivery to VAEL every two weeks during the sampling season. Partners will store samples until the specified pick-up day. LPP staff may establish regional sample-storage locations to make sample pick-up more efficient. Partners may partner with the Lay Monitoring Program (LMP) for pick-up or arrange a separate drop-off location. Partners may also deliver samples to VAEL themselves, provided they communicate in advance with LPP staff and samples are transported to VAEL before their hold times expire. The hold times for LPP's parameters are 28 days, which allows for flexibility in sample pick-up.

Data

When sample analysis for a VAEL order is complete, VAEL will send an email with a PDF attachment of the preliminary results. All samples on the order must be submitted to complete and finalize the order results. This will generally occur within 30 days of sample submission to the lab. These preliminary results have been quality assured by VAEL, but not by LPP staff, and are subject to change. **Please do not distribute these results or refer to them in any conclusive way.** The VAEL quality assurance process only verifies the precision and accuracy of laboratory tests and does not catch errors with mislabeled samples, field duplicates, incorrect dates, or other sampling or data recording issues. A LPP specific review by LPP staff and partners familiar with the sampling that occurred and typical conditions for each site is needed before results can be published and shared.

Data Review

All LPP data goes through intensive review by VT DEC staff to ensure quality and accuracy. Throughout the season, it is the responsibility of the project coordinator to monitor preliminary results (emailed in PDF format by VAEL as sample analysis is completed) for abnormalities or potential sample mix-ups. Once VAEL has completed all sample chemical testing for the season, LPP staff will begin a preliminary review of all LPP data by organizing each partner's data separately in Quality Control (QC) excel sheets. These documents contain all results from the previous sampling season, formatted by LPP staff in a way that makes each dataset easier to understand and review. LPP staff **highlight QAQC duplicate pairs in blue** and calculate relative percent difference (RPD) for all duplicate pairs on a separate tab. RPD is further explained in [Appendix C](#). LPP staff will also **flag any failed duplicate pairs and suspect results in red**.

During the fall, partners may request these QC excel sheets with the understanding that these data have not undergone the full quality assurance process. Therefore, partners who choose to share this data must inform all viewers that the **results are preliminary**. LPP staff may also share QC excel sheets with partners to ask partners about any issues that come up during the initial data review, including but not limited to, errors in sampling dates, sample mix-ups, failed duplicate pairs, or any outlying or suspicious values.

After LPP staff have completed this initial review, all data undergoes a second review before being finalized. Results are uploaded to the VT DEC Watershed Data Portal, run through a series of error tests, and reviewed a second time to identify and evaluate any remaining errors. Once this second review has been completed, the results have passed the LPP QAQC process. The data is then available from the Vermont Integrated Watershed Information System ([IWIS](#)) and accessible to the public.

Ideally, LPP staff will complete the data review process during the winter following each sampling season. However, the timing of this may vary depending on VT DEC staff capacity.

Data Access & Presentation

To access LPP water chemistry data from previous years, please visit the [Data and Reports](#) section of the LPP website. All LPP data is published and stored in the Watershed Management Division's database, [IWIS](#) (Vermont Integrated Watershed Information System). LPP data will be quality assured and published in the IWIS database following the sample season at which point all LPP data access reports will be updated except for the Power BI tool which may take longer to upgrade and update.

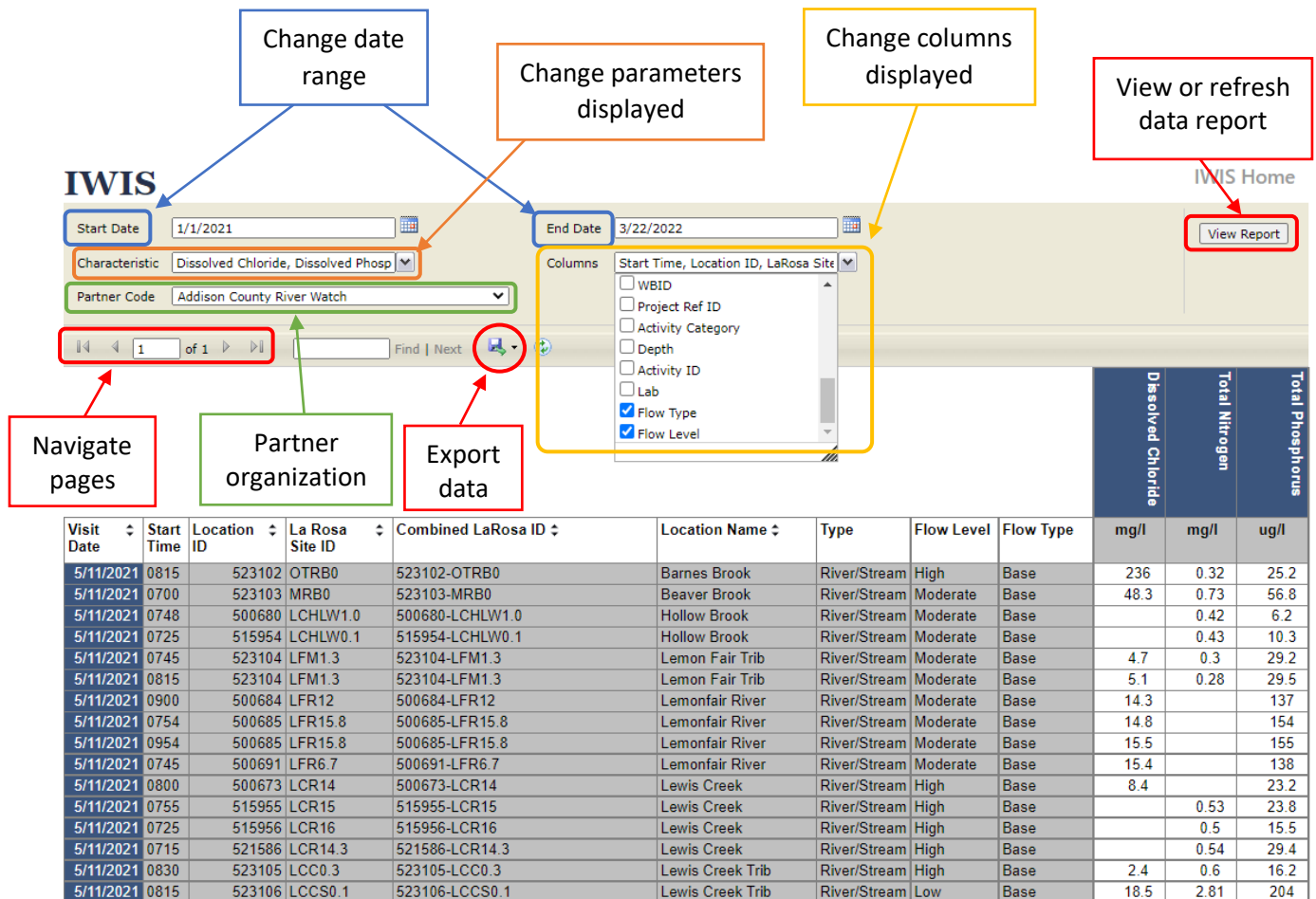
There are currently several different ways to access LPP data:

1. Water Chemistry Data Report

For all historical LPP data organized by each partner organization, use the [Water Chemistry Data Report](#) linked under the [LPP Data and Reports](#) section of the LPP website. This is the easiest way to access and organize all your organization's LPP water chemistry and flow

data. Partners can download the data as a chosen file type (e.g., Word, Excel, CSV, or PDF) as well as change the default parameters, dates, and column categories displayed using the dropdown menus. The combined LaRosa ID (this is the full ID with the 6-digit Location ID – LaRosa ID), flow level, and flow type are included in this report in the columns drop down menu. Please note that LPP chloride measurements were reported as total chloride prior to 2021 and total chloride after 2021, so both parameters need to be checked in the Characteristic column. Due to the solubility of chloride in water, these are equivalent measurements. See Figure 14 below for a visual of this report.

Figure 14. Diagram of the LPP Water Chemistry Data Report



2. Microsoft Power BI Data Visualization Tool

As of 2021, VT DEC has taken on the task of presenting LPP data in a way that is accessible, visually appealing, and easy to understand. The first iteration of this process is in the form of an interactive data graphing tool through the platform Microsoft Power BI. This [Power BI data display](#) is an evolving tool that will be added to and revised over time. LPP and WSMD staff aim to develop and improve the presentation of LPP data in a way most conducive for

partners and the public to use and share. Read more details on the Power BI tool in the [following section](#).

3. IWIS (Vermont Integrated Watershed Information System) Site Search

Any individual LPP sites can also be searched in [IWIS](#) using just the 6-digit Location ID (see [Appendix A](#) for more explanation of the Location ID) to view all data for that particular site. IWIS has multiple different reports that can be accessed from the site search results (Figure 15).

Figure 15. Example IWIS search result

Sites	Site Reports
Barnes Brook - 523102 Description: Barnes Brook at Hannaford Career Center Type: River/Stream , Town: Middlebury , WBID: VT03-04 , LaRosa: OTRB0	Google Maps ANR Atlas Monitoring Site Summary Water Quality / Chemistry

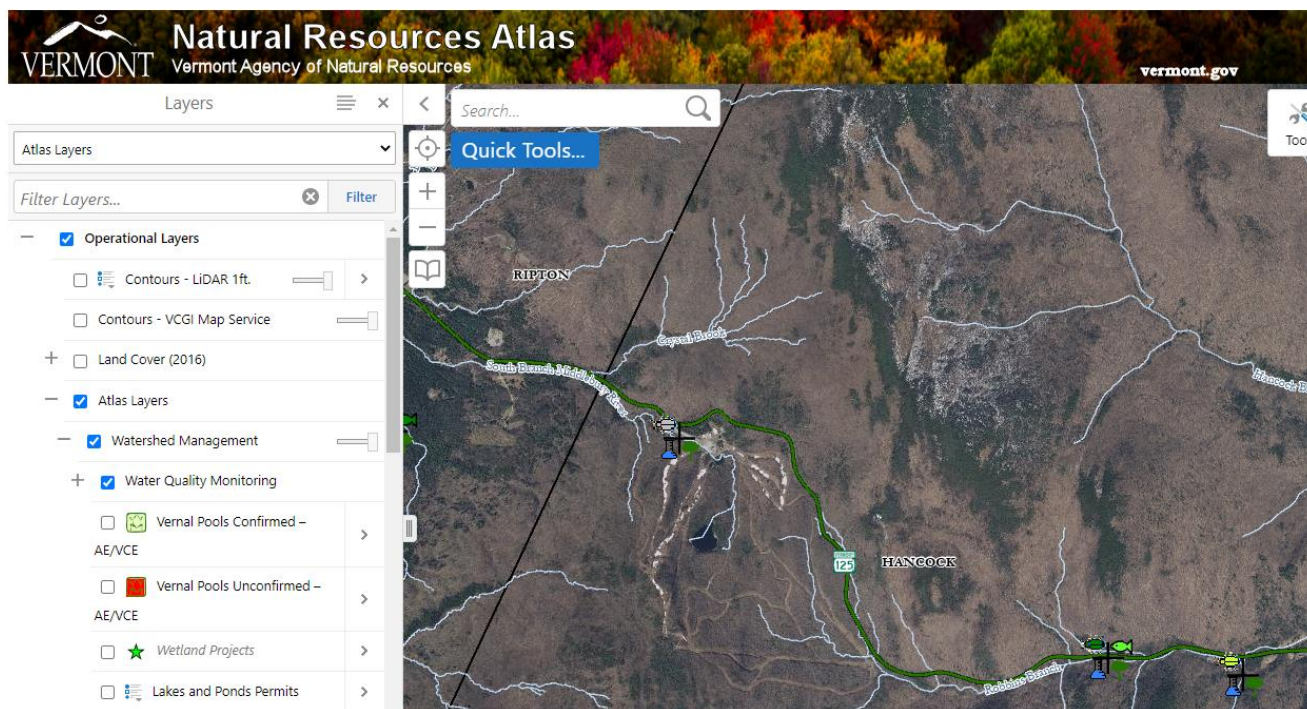
- The site location can be mapped using either the Google Maps or ANR Atlas site reports.
- The monitoring site summary shows an at-a-glance summary of the site data and parameters monitored. If a LaRosa site is also a DEC monitored site, additional data collected such as macroinvertebrate, habitat, and fish assessments will appear here.
- The IWIS Water Quality/Chemistry report (Figure 15) shows all data points collected at the site and works similarly to the LPP Water Chemistry Data Report (Figure 14). This will also include any additional water chemistry data collected by the DEC's biomonitoring section.

4. ANR Natural Resources Atlas Web Map

The [ANR Atlas map](#) displays site locations as well as many additional geographic layers with environmental features that the Vermont Agency of Natural Resources tracks, manages, monitors, permits, or regulates. There are also GIS tools that can be utilized within the Atlas for basic functions such as plotting points or measuring distance as well as some more complex ones such as "Delineate watershed" and "Summarize landcover." An individual site can be accessed on the map most easily through the IWIS site search ANR Atlas link (Figure 15), but all monitoring sites are included in the Water Quality Monitoring Layer nested under Watershed Management (be sure to zoom in to a high enough scale for sites to

appear on the map). See Figure 16. This layer also includes all sites monitored by the Watershed Management Division including Lakes and Ponds Lay Monitoring sites and the Monitoring and Assessment Program's biomonitoring sites.

Figure 16. ANR Natural Resources Atlas



5. LPP Monitoring Site Details Report

This report shows a [list of monitoring sites](#), their associated information, and years monitored on the LPP website (Figure 17). Monitoring sites are grouped by partner.

Figure 17. Example LPP Monitoring Site Details Report

Partner ID: Addison County River Watch View Report						
1 of 1 Find Next						
Partner ID	Location Name	Latitude	Longitude	Town	Location Description	Sampled Years
500676-LCR19.5	Lewis Creek	44.22380	-73.06332	Starksboro	At Parsonage Rd Bridge	2003, 2004, 2005, 2006, 2007, 2008, 2012, 2013
500682-LFR0	Lemonfair River	44.06385	-73.24644	Weybridge	At Weybridge Rd. bridge, upstream of Lemon Fair River's confluence with Otter Creek	2003, 2004, 2005, 2008, 2012, 2013
500690-LFR3.7	Lemonfair River	44.01991	-73.23663	Weybridge	At Lemon Fair Rd/Mountain Rd. bridge	2003, 2004, 2005, 2006, 2007
500692-LFT0.1	Unnamed Tributary to Lemonfair River	43.87200	-73.26870	Shoreham	Tributary of LFR at Murray Rd Bridge, at confluence of unnamed tributary with Richville Pond.	2003, 2004, 2005
500701-MIR1	Middlebury River	43.96191	-73.14198	Middlebury	At Goodrich Farm Pasture	2003, 2004
500714-NHR5	New Haven River	44.09265	-73.10695	New Haven	At Munger St. Bridge	2003, 2004, 2005, 2008, 2016, 2017
500716-NHR8	New Haven River	44.12936	-73.08342	Bristol	Located above first bridge below Bristol.	2003, 2004, 2005, 2006, 2007
500747-NHR9	New Haven River	44.15455	-73.08332	Bristol	At South St. Bridge	2003, 2004, 2005, 2006, 2007, 2008, 2013

Microsoft Power BI Data Visualization Tool

The Power BI tool is currently comprised of four pages, each with a map of the sites and a different data figure. The [Power BI tool](#) can be accessed via the LPP website on the [Data and Reports](#) page.

Page One: Water Chemistry Scatter Plots

This page displays a map of a given partner organization's sites and basic scatter plots of the concentrations measured for each sample taken at those sites over time for a given parameter (Figure 18). For data collected in 2021 and later, the shape and color of the points in the scatter plot indicate flow type (triangle or square) and level (red, blue, or yellow). Data from years prior to 2021 when no flow data were collected appear as black diamonds. Additionally, you can customize the information displayed in the scatterplot based on the partner organization (ProjectName), the water body (LocationName), parameter (CharacteristicID), and year(s) you select using the dropdown menus next to each field (Figure 18). A single site's information can also be viewed by clicking on its red site symbol on the map. Multiple sites can be selected by holding the control key (Ctrl) while clicking each site's location symbol. Multiple years can also be selected in the year dropdown menu using this same method of holding the control key. The menu selections can be cleared and reset by clicking the eraser icon that appears to the right above the dropdown arrow when you hover your computer mouse over the menu.

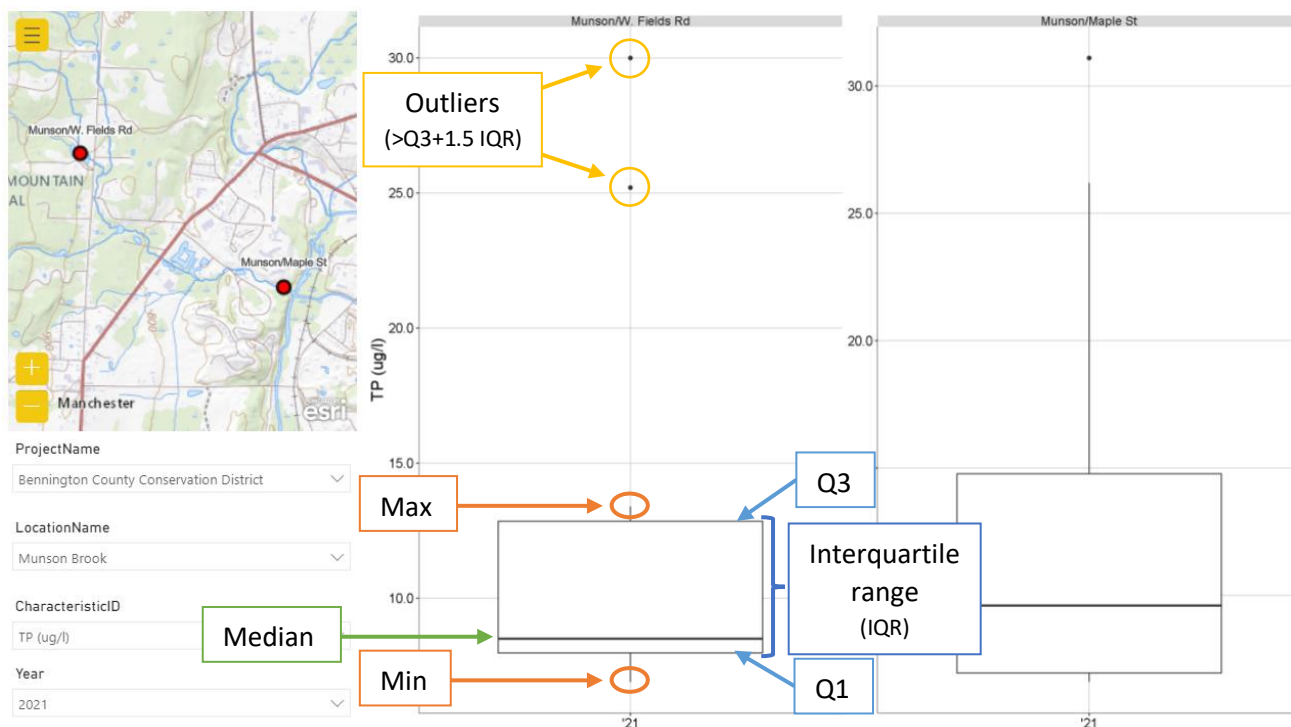
Figure 18. Example Power BI Water Chemistry Scatter Plot



Page Two: Water Chemistry Box Plots Over Time

Page two displays the same water chemistry data as page one except as box plots instead of scatter plots (Figure 19). The map and dropdown menus allow you to change the data displayed the same as on page one. The box plots provide a snapshot of the range and spread of parameter concentrations experienced in a season and give a clearer picture of variations in stream conditions at a site over time. The sample parameter concentrations are summarized with the minimum, maximum, median, 25th percentile (Q1), and 75th percentile (Q3) points for all the given parameter concentrations recorded at the given site(s) throughout the year selected (Figure 19). If multiple years are selected, one box plot will be displayed per year. Outliers are determined to be any data points that are greater in value than 1.5 times the interquartile range ($Q3 - Q1$) above Q3 or below Q1 (Figure 19). Outliers are marked with a dot outside of the box. This [Khan Academy video](#) is available on the LPP website for more information on creating box plots.

Figure 19. Example Power BI Water Chemistry Box Plot

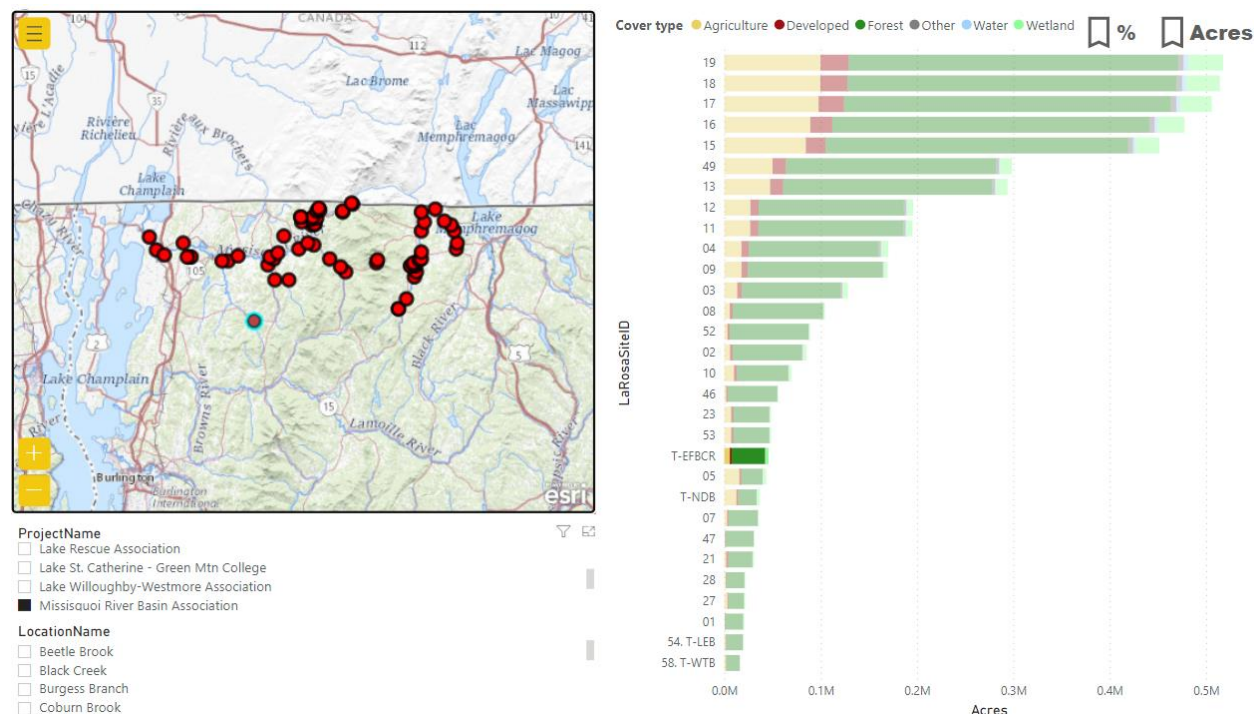


Page Three: Land Use Bar Charts

This page shows bar charts indicating the amount (in percent or acre) of land categorized by use type in the watershed around a given site (Figure 20). Land use categories include agriculture, developed, forest, water, wetland, and other. The unit of land use cover (percent or acre) can be selected at the top right of the bar chart. Clicking on a site or sites on the map highlights the

associated percentage bar to the right in the bar chart. These data indicate which land uses might be influencing water quality in the watershed around a sampling site or waterbody.

Figure 20. Example Power BI Land Use Bar Chart



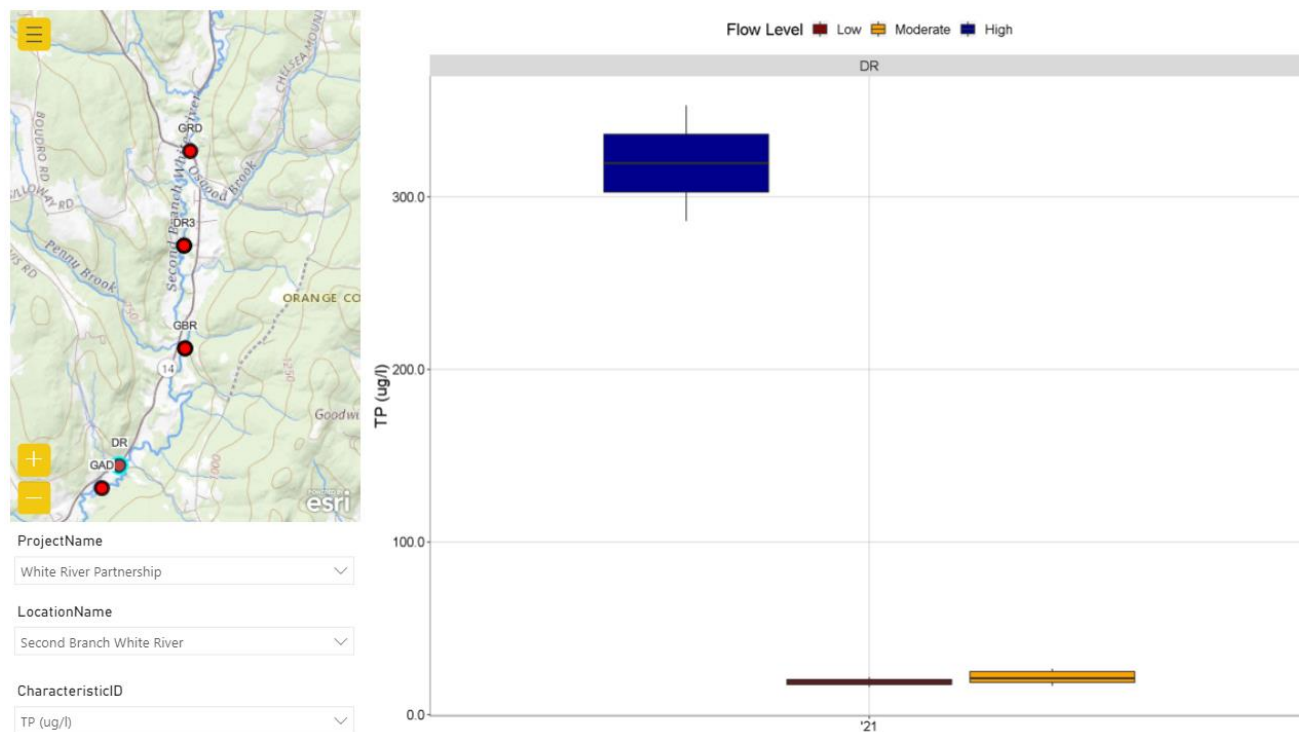
Page Four: Flow Level Box Plots

On this page, the parameter concentrations measured for each sample at a given site throughout a selected year are separated by the flow level associated with the samples (low, medium, or high) (Figure 21). A color-coded box plot summarizes the parameter concentrations measured under each flow level condition for the given year. Flow observations were not required until 2021, so flow level box plots are currently only available for 2021. Additional years of flow data will become available as more flow observations are collected in the future. Like the page two box plots, this figure shows the range and spread of parameter concentrations experienced in a season and indicates the variations in parameter concentrations under each flow level. Looking at parameter concentrations under different flow conditions can indicate information about the nature and source of a potential pollutant. For example, high chloride concentrations under low flow conditions may indicate a groundwater source.

Because LPP only collects a limited number of samples at a site in a year, it is possible that not enough data points are captured under each flow level to make a complete box plot. If only one data point was collected under a particular flow level, it will appear as a line on the plot. At some sites, there may not have been any samples collected under certain flow levels for that year, so no box plot will appear for that flow level. When there are at least two but fewer than

five data points within a flow level category (not enough to determine a min, max, median, Q1, and Q3), the existing data points are used to interpolate the remaining values in the box plot. Any missing median and quartile values are typically set at evenly spaced intervals between the existing data points that become the minimum and maximum (or median if available). You can recognize when the box plot has been interpolated because the spread of the data typically looks very uniform from top to bottom with the median and quartiles exactly evenly spaced throughout the box plot (see the high flow box plot in Figure 21).

Figure 21. Example Power BI Flow Level Box Plot



Common Errors

On any page, if there is no data available, an error message will be displayed. This usually indicates that either the site or waterbody was not sampled in the year selected, the parameter selected was not sampled at the site(s) or in the year(s) selected, or there were no flow data collected at the selected site(s) because it was not sampled in 2021 or later (this only applies on page four). The pages sometimes take time to load, so wait several seconds after switching sites or parameters for data to appear. Sometimes, the “no data available” message occurs because waterbodies selected under one organization remain selected even when the organization is changed. It is good practice to clear all options selected in the dropdown menu when switching partner organizations. If you run into any other errors, please contact LPP staff. This iteration of the Power BI report is not the final version, and LPP staff will improve it as time and resources allow.

Appendix A: Site Naming Guidelines

LaRosa Partnership Program sampling sites are named using a standardized format:

(6-digit Location ID) - (Partner given LaRosa ID)

Examples of existing site names:

- 502699-MONTHS
- 505509-DRMONTREC
- 515978-STEVEB
- 522456-STATEST
- 522458-OLDCCLUB

The 6-digit-Location ID is provided prior to sampling by the VT DEC to all sites in WSMD's Integrated Watershed Information System (IWIS). It is a unique identifier used in the database to track each site and its associated data. The partner given LaRosa ID is a name provided by the partner to identify their site in a way understandable to the project coordinator and the volunteers.

The Vermont Department of Environmental Conservation's official sampling site naming protocol is to use river names and river miles (e.g., Ranch Brook 1.5). This has the benefit of providing a specific location along a stretch of river. However, this can be challenging for many watershed groups to calculate and, if not done consistently and correctly, can lead to errors.

For this reason, partners can create unique LaRosa IDs for sites at their discretion, provided they meet the following LPP guidelines:

1. Use local landmarks for reference.
 - This can include but is not limited to a road name of a cross street or a local feature such as a bridge.
2. Site name should be intuitive and easily understood for both samplers and LPP staff.
 - e.g., If a site along the Black River is named "Wylie Hill Road", it should be obvious that this is the site located along the main stem at Wylie Hill Road.
3. Abbreviate names when possible while still maintaining clarity.

Please **avoid**:

1. Numbering sites (Stearns 1, Stearns 2, Stearns 3, etc.), as it leads to confusion due to the VT DEC naming convention of using river names and river miles.
 - e.g., You have two sites named Stearns 2 and Stearns 3 and need to add another site located between them. In this case, it would become Stearns 2.5, which can quickly lead to confusion. Some would read this as, "the site 2.5 miles from the mouth of Stearns Brook" rather than, "the site in between the second and third sites on Stearns Brook."

2. Naming multiple sites on a tributary “Upper Trib,” “Middle Trib,” and “Lower Trib.”
 - Groups may eventually need to name additional sites on the same tributary, which can lead to confusion (e.g., “Upper Upper Trib”)
3. Naming a mainstem site in reference to a nearby tributary; groups may want to sample the tributary in the future, and this will lead to confusion between sites
4. Naming sites in reference to landowners
 - This helps to avoid any conflicts if problems are identified via sampling.

If sites are moved upstream or downstream or into another water body, they **must** be given **new site names**. Site names should never be re-used. This is very important. It is also very important that site names - whether codes or names - be entered consistently and correctly at all stages.

Appendix B: Monitoring Matrix

Monitoring Category	Monitoring Goal	Criteria (all need to be met)	Parameters	Sampling Design
A. Identify streams with potential to meet Very High Quality (VHQ) standards [A(1) or B(1)] as defined in Vermont Water Quality Standards or suspected to become stressed or impaired	<ol style="list-style-type: none"> 1. Identify streams considered VHQ. 2. Identify streams that may be or could become stressed or impaired. 	<ol style="list-style-type: none"> 1. Streams that have little to no data, data > 10 years old, or where there have been or will be landscape changes. 2. Community interest in the protection of, or local concerns about water quality conditions. 3. Perennial streams large enough to sample year-round for biological sampling. 	<ol style="list-style-type: none"> 1. Total Chloride 2. Total Phosphorus 3. Total Nitrogen 4. Flow level & category 	<p>Bi-weekly sampling</p> <p>From April 16th to August 8th</p> <p>Minimum of 8 sampling events + 2 high flow events.</p>
B. Lake tributary sampling	<ol style="list-style-type: none"> 1. Identify tributaries that may be contributing to increasing nutrient concentrations on lakes. 	<ol style="list-style-type: none"> 1. Tributaries to lakes with increasing nutrient trends. Refer to the Lakes Score Card. 2. Commitment of 3-4 years of sampling by watershed organization. 		
C. TMDL waters sampling, or source identification for the potential listing of stressed rivers, tributaries, or lakes	<ol style="list-style-type: none"> 1. Refine the extent of stressed and impaired waters. 2. Identify source areas contributing to stressed or impaired conditions to support targeted remediation and/or Best Management Practices (BMP) implementation. 	<ol style="list-style-type: none"> 1. Streams or streams draining to waters identified as stressed or impaired. 		
D. Site remediation effectiveness monitoring	<ol style="list-style-type: none"> 1. Evaluate water quality improvements after the implementation of significant remediations 	<ol style="list-style-type: none"> 1. Pre-implementation sample collection for at least one year prior to project. 2. Evidence of a planning process supporting the project. 3. Sample collection after implementation of high impact remediation project to be located in a small watershed or widespread remediation in a small to moderate sized watershed. 4. Above and below sampling if possible. 5. Commitment of 3-4 years of sampling by watershed organization. 6. Commitment by MAP and Watershed Planners to assist with long-term data analysis and reporting. 		

Appendix C: Relative Percent Difference (RPD)

RPD helps determine the precision of duplicate pairs. This is also called relative change. To determine RPD, the regular sample value is compared to the field duplicate sample value. RPD is expressed as:

$$RPD = \frac{|R1 - R2|}{\left(\frac{R1 + R2}{2}\right)} \times 100,$$

where

R1 is sample 1, and

R2 is sample 2.

R1 and *R2* are your sample and field duplicate values. RPD is found by dividing the difference between the sample and field duplicate by the average of the two.

LPP uses RPD to evaluate duplicate pairs and determine whether there may have been any errors in field sampling. A relatively large RPD may indicate issues such as contamination. This process is integral to ensuring that LPP water chemistry data is of high quality.

LPP has different acceptable RPD limits according to the parameter's variability, outlined below:

Parameter	Acceptable RPD
Total Chloride (TCI)	10%
Total Nitrogen (TN)	20%
Total Phosphorus (TP)	30%

If the RPD of a duplicate pair is above the corresponding acceptable value, it fails.

Please note: If a duplicate pair has failed, this does not necessarily mean that the sample result will be discarded. A failed duplicate pair can indicate important information about a sampling event and may still be valuable to include in the IWIS database.

In addition, RPD is expected to be higher between duplicate pairs of lower values when compared to duplicate pairs of higher values. For example, a nitrogen duplicate pair of 0.1 mg-N/L and 0.2 mg-N/L would result in an RPD of 66.7%. Considering the Acceptable RPD value for nitrogen is 20%, this pair would fail. However, the absolute difference between the two samples is only 0.1 mg-N/L. Therefore, failed duplicate pairs at very low values will generally be accepted.

Appendix D: LPP Staff Contact Information

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Appendix E: Additional Resources

Vermont Water Quality Resources:

[USGS Current Water Data for Vermont](#)

[Vermont Water Quality Standards](#)

[Vermont Surface Water Management Strategy](#)

[Vermont Volunteer Surface Monitoring Guide](#)

[Assessment and Listing for Vermont's Waters](#)

[Vermont Surface Water Assessment and Listing Methodology](#)

Other Water Quality Resources:

[US Geological Survey StreamStats](#)

[WikiWatershed: Freshwater Stewardship Web tools](#)

LPP Stream Sampling Checklist

Please be sure to complete all steps on this checklist every time you go out to collect water quality samples at a LPP monitoring site.

Before Going into the Field:

- ☐ Check the weather, pack a cell phone and first-aid kit, and be aware of all safety precautions

Do not sample if flood conditions are predicted.

- ☐ Gather supplies including a cooler with ice; labelled sample bottles; field and/or laboratory duplicate bottles if applicable; VAEL field sheets; Survey123 device or flow observation sheet; pen/pencil; river dipper, bucket, or 250mL lab dup bottle if applicable
-

When Collecting Samples:

- ☐ Face upstream & wait for disturbed sediment to flow downstream

- ☐ Avoid touching insides of bottles or caps

- ☐ Rinse sample bottles if applicable (not TP!) and dump rinsing water downstream

This includes river dipper bottles/buckets!

- ☐ Collect samples for all parameters in U-shaped motion in the center of streamflow

- ☐ Pour off samples to required fill volume (50mL line for centrifuge tubes, black line for glass)

If you overpour a TP sample, do not redo it, use the cap to add more water

- ☐ Collect any duplicates, rinse duplicate sample bottles if applicable

- ☐ Field duplicates (highlighted yellow and labelled with “-D-“ on the field sheets/labels)

Collect for all parameters

Rinse river dipper/bucket in between regular and duplicate samples

- ☐ Lab duplicates (VAEL lab dup label) - only needed for TP at certain sites

Rinse the parent sample bottle before sampling but do not rinse the TP bottles

- ☐ Ensure all caps are threaded correctly and closed tightly

- ☐ Complete the VAEL field sheet with DATE and TIME, noting if Nitrogen samples were acidified. Make note of any changes, errors, or unusual occurrences

- ☐ Take flow level/flow type observations and record in Survey123 app or on flow sheet
-

After Sampling:

- ☐ Store samples upright in safe location

- ☐ Acidify any TN samples and store on ice

- ☐ Submit any flow observations still in the outbox in the Survey123 app or submit a Survey123 via your browser for each site, whether or not the site was sampled (<https://arcg.is/8TP9b>)
-