LaRosa Partnership Program

Partner Guide

VERMONT

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

Rivers Program, Watershed Management Division

Vermont Department of Environmental Conservation

2024

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Introduction

The overall purpose of the LaRosa Partnership Program (LPP) is to provide meaningful water quality monitoring data for both the Vermont Department of Environmental Conservation (VT DEC) and LPP partner organizations through community science. A collaborative partnership model is integral to the achievement of this purpose. 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 115,000 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.

This document serves as a comprehensive guide for participating or potential LPP partners. It is the primary resource where all information pertaining to LPP procedures and the responsibilities and expectations for participation in this program can be found. To learn more about the participating organizations in the program, view program updates, and access additional educational or training materials, data, newsletters, and water quality assessment reports, visit our website at https://dec.vermont.gov/watershed/map/monitor/larosa.

LaRosa Partnership Program Overview and Goals

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 surface water monitoring projects. LaRosa partner organizations and their volunteers collect water samples that are analyzed for total phosphorus, total nitrogen, and 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 and monitor water quality issues and where they may be occurring, and identify areas in need of protection or remediation. The data collected through LPP is mutually beneficial to the Department of Environmental Conservation (DEC) and partner organizations by improving our understanding of the variations in water quality conditions in Vermont streams across a spatial and temporal basis. LPP data assists participating partners along with local, state, and federal governments in remediation efforts, effective resource allocation, and watershed planning. Furthermore, data visualization tools are generated from these data and distributed via LaRosa partner organizations and the LPP website for educational and outreach purposes.

By improving the geographic extent and frequency of water quality monitoring, the sampling conducted by LaRosa partners strengthens the VT DEC's database and furthers the achievement of 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 five monitoring categories described in the LPP Monitoring Matrix with the following objectives: (1) characterize watershed conditions upstream of wastewater treatment facilities; (2) sample lake tributaries to assess their contribution to nutrient and chloride loading in lakes; (3) identify potentially high-quality waters; (4) identify stressed or impaired waters and/or refine the extent and/or source of the stressor; and (5) evaluate the effectiveness of remediation efforts.

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 standardized sampling design; update the Quality Assurance Project Plan (QAPP), LPP Partner Guide, and other program resources; maintain and recruit partners for participation in the program.
2. Communicate with, support, and train partners in LPP procedures through regular interactions, website updates, newsletters, annual training, and potential site visits with partners.
3. Distribute monitoring materials to LaRosa partners to solicit site nominations; select sites in accordance with the Site Selection Criteria; share the final site selection list for partner confirmation and approval.
4. Create a map of all LPP water quality monitoring sites and maintain an organized and up-to-date list of all sites and associated information.
5. Complete VAEL pre-season administrative tasks: update project numbers and contacts; order sampling containers and other supplies; submit the VAEL Sample Submission Plan; pre-log samples in the lab management system, WinLIMS.
6. Update and maintain the Survey123 Flow Observation Form and Flow Data Dashboard
7. Organize and distribute sampling supplies to partners; orchestrate and conduct biweekly pick-up and delivery of samples to VAEL.
8. Schedule quality assurance sampling; track and manage samples, VAEL order information, and flow data; identify and resolve sample errors as needed; and coordinate interactions with VAEL.

9. Ensure sampling protocols are followed; answer partner questions; provide technical support; and resolve any partner concerns throughout the sampling season.
10. Review data and follow data quality assurance protocols; publish and share data with partners via the Vermont Integrated Watershed Information System database; and provide data visualization figures.

Partner Organizations

1. Maintain familiarity with sites and their general water quality conditions; suggest and 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 quality assurance procedures throughout the season.
4. Recruit, organize, and train volunteers as needed to conduct sampling in accordance with all sampling, safety, and quality assurance procedures.
5. Label sample tubes and distribute supplies to volunteers as needed.
6. Coordinate sample pick-up locations with LPP staff; store samples prior to pick-up according to sample preservation protocol; check all sampling information and sample labels for accuracy and completeness before sample pick-up.
7. Complete VAEL field sheets for each sampling event including sample time and date, sample collector, and any additional information including errors, changes to protocols, or unusual or circumstantial details that could impact sample results; track and maintain your own records of this information as well.
8. Track and manage flow data throughout the season via the Flow Data Dashboard; submit or ensure all flow observations have been submitted by volunteers via the Survery123 smartphone app or webform.
9. Review preliminary chemical analysis results sent by VAEL throughout the season for unusual or suspect data; work with LPP staff to resolve any sampling or procedural issues and quality assure data for accuracy and error identification.

2024 Program Timeline

Dates*	LaRosa Partner Responsibilities	VT DEC Responsibilities
Early November		Distribute Internal Monitoring Site Nomination Form to VTDEC staff.
Early December	Site nomination process begins: work with watershed planners to develop site nominations.	Distribute Partner Monitoring Site Nomination Form, list of preapproved sites, and VTDEC nominated sites if applicable.
Mid-January	Site nominations due.	
Mid-January – mid-February		LPP Site Selection Team (SST) reviews nominated sites and applies selection criteria.
End of February		LPP staff share finalized list of selected sites with partners and send Annual Partner Training doodle poll and Season Prep Info Form.
February – 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.
03/11/2024	Season Prep Info Form due.	Compile season prep form info, prepare for Annual Partner Training
March – mid-April	Plan and prepare for the sampling season. Train and coordinate volunteers as needed.	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.
TBD- end of March – early April	LPP Annual Partner Training	
April	Train volunteers and distribute supplies if applicable.	Test drive sample pick-up route and drop off supplies to partners.
Week of 4/15/2024	Sampling season begins.	
Week of April 30th - Week of August 6th	Biweekly sample pick-ups: • April 30, May 2 • May 14, May 16 • May 28, May 30 • June 11, June 13 • June 25, June 27 • July 9, July 11 • July 23, July 25 • August 6, August 8	
Sept. - Feb.	Assist LPP staff with QAQC of data as needed.	Data QAQC process; publish data to Vermont Integrated Watershed Information System database when complete

*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 newsletters to keep partners up to date on all important program information and announcements as well as provide resources and materials. An annual training is held to prepare partners for the sampling season and train project coordinators in the monitoring procedures and protocols. The training is recorded and slides from the presentation are posted on the website.

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
- Links to the Flow Observation Survey123 Form and Flow Data Dashboard
- Reports for viewing and downloading LPP data and link to the PowerBI data visualization tool
- Educational and training materials
- A list of current and past LaRosa partners
- Previous water quality reports written by 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 usually occurs in late March or early April. The meeting can be attended both in-person at VAEL and virtually. LPP staff will orient past and new partners to topics including but not limited to:

- Program updates and changes
- Season schedule and sample pick-up information
- Sample tubes and sampling supplies
- Laboratory field sheets and sample labels
- Field safety
- Field sampling protocols
- Quality assurance
- Nitrogen acidification, sample preservation, and storage
- Flow observation protocols
- Survey123 app and Flow Observation Form

The slide show presentation used in the training is linked on the LPP website under the Training & Education section. Contact LPP staff for a recording of the training.

Site Visits

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

Sampling Sites

LPP monitors river and stream sampling sites suggested by partners that fit under one or more of the categories described in the LPP Monitoring Matrix. The partners can choose any sampling location that is of interest within Vermont provided that the proposed site meets the Site Nomination Criteria and aligns with a Monitoring Matrix category and its requirements. This could include impaired and state priority waters, waters where 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, or waters where a major new management practice or remediation project has been or will be implemented. It is strongly encouraged that partner groups work with their watershed planner for input when choosing sites to nominate.

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

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 VAEL'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. **All LaRosa IDs must be under 25 characters in length**. 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 Internal Monitoring Site Nomination Form and nominated by VT DEC staff based on the Site Nomination Criteria.

2. **The Monitoring Site Nomination Form is distributed to LaRosa partners.**

   To speed up the site selection process, this form includes a list of preapproved sites sampled the previous year that LPP staff have pre-determined need additional monitoring (generally sites with fewer than 3 years of data collected). Partners may opt in or out of monitoring these sites again. Preapproved sites confirmed by partners will bypass the site selection process and be selected for sampling during the upcoming season. Existing sites not on the preapproved list or new sites never monitored before **should still be nominated and *will* be considered during the site selection process**. Partners have approximately one month to work with their watershed planner to nominate sites 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. These sites are only suggestions and are ***not*** required to be chosen 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 and selects the final sites and parameters** to be monitored according to the Site Selection Criteria and Monitoring Matrix.

5. **The final list of sites and the parameters to be sampled is 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 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.
3. Chemical parameters of total phosphorus (TP), total nitrogen (TN), and/or chloride (Cl) are appropriate for the monitoring goals of the site.
4. The partner organization can fulfill the sampling design: bi-weekly sampling from April to August with a goal of 8 total sampling events. Samplers must also make flow level and flow type observations during each sample event.
5. The site is on 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 typically 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, 20 - 30 partners participate in any given year, and the number of nominations per partner ranges from one to forty sites with an average of approximately 10 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.

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. The final site list fits within the budget and LPP staff time constraints
3. Provides statewide and equitable distribution of sites

Sites that meet the following criteria will be prioritized:

1. Sites that are nominated by both a partner and a VT DEC program.
2. Sites filling data gaps where VT DEC does not already have existing data, there is no recent data, or a significant change has occurred in the watershed.
3. Sites that best meet the shared goals of the VT DEC and partners as informed by the monitoring matrix and the partner priority rankings and explanations provided in the site nomination form
4.

Site Selection Team

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.

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 detailed in the Site Nomination Form into account when selecting sites. 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.

Sampling Design

Sampling occurs biweekly from mid-April through early August with a goal of eight regularly scheduled sampling events. Ideally, two of these eight sampling events will be targeting high flow events. Generally, sampling should occur on the same day(s) of the week unless you are targeting a high flow event. Sampling can occur on any day(s) of the week that best suits your organization's schedule, and samples can be stored until pick-up by LPP staff regardless of when during two-week sample period they were collected. Sampling closer to the pick-up date is preferred to reduce the likelihood that water chemistry parameter hold times are exceeded.

Sampling Plan:

- Eight biweekly regularly scheduled samples from April – August.
    - Can be collected any day of the week to capture flow conditions
    - Includes 2 high flow samples induced from snowmelt runoff and/or rain events
    - Collecting two high flow samples may not be possible, especially if it is an abnormally dry year or difficult logistically.
- LPP staff will pick-up samples from your designated drop-off location biweekly on either Tuesdays or Thursdays (unless otherwise arranged) and deliver them to the Vermont Agriculture and Environmental Lab (VAEL).

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 upon request.

Parameters

LPP will focus on monitoring **total phosphorus, total nitrogen, and chloride**, as well as **flow level** and **flow type observations**. 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. 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 a direct discharge or source. Or, sites with high phosphorus but low nitrogen may have sediment and erosion issues.

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 water quality is affected by agricultural activities or for sites subject to the Connecticut River TMDL. Chloride helps to understand if total phosphorus concentrations are related to road 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.

The LPP sampling plan aims to include the collection of two high flow samples per season at all sites if possible (this is not a requirement as LPP staff recognize this is difficult to achieve). 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 highest nitrogen and phosphorus loads tend to occur during high flow events, while chloride is often lower due to dilution depending on the source.

Things to Remember about High Flow Sampling:

1. Safety is a number one priority – **DO NOT SAMPLE if water or weather conditions are dangerous, particularly if the stream is at flood stage!**
2. **The high flow sample will replace your regular sample** – **only collect one sample at each site per sample period**. If a high flow event happens to fall on your regular sampling day, it counts as one of the 8 biweekly samples AND as one of the two high flow samples**.** Therefore, you do not need to collect any more samples for that sample period.
    a. **If rain is predicted outside of your regularly scheduled sample day, do your best to adjust your sampling schedule to capture the high flow event**. It still replaces your regular sampling event and you do not need to collect any more samples for that sample period.
    b. If you already collected samples for a sampling period and **a rain event occurs later, no need to collect additional samples that sample period.** You will likely capture a rain event later in the season.
3. **Sample all sites even if only some experience high flows** – don't skip samples.

4. Not all sites will experience two high flows and not all partners are able to target high flow samples logistically. This is okay. Over the course of the three years a sample site is monitored, chances are that a high flow will occur at that site during sampling at some point to provide the necessary information about the range of conditions experienced at that site.

When to Sample High Flows

Collect high flow samples at any time throughout the season during a high flow event. You will likely need to look at the weather forecast and adjust your sample day to capture a rain event (if possible – it is understood that larger organizations with multiple sample teams likely won't be able to accommodate uncertain plans based on weather and last-minute sampling date changes). 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.

Ideally, high flow sampling is conducted while waters are rising steadily versus when they start to fall toward the end of a rain event. Safety is always the top priority, so **NEVER sample if the flows pose a danger to you or volunteers**, particularly during flood conditions, when flows are greater than knee height and very swift, or when flash flooding or thunderstorms may occur.

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. Under drought conditions, a rain or runoff event may not cause streams to flow above a moderate or even low level in extreme drought. However, the rain or runoff event may still meet the goals of sampling a high flow event. Especially later in the season, try to capture a high flow sample whenever a rain event has the potential to cause elevated flows. Websites like USGS's National Water Dashboard and weather websites can give you an idea of how much rain fall has occurred and how high the streams are flowing in real time.

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 demonstration 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 specifically 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:

- Sampling Checklist
- Sample collection tubes from VAEL
- Styrofoam or plastic test tube racks
- Pre-printed sample tube 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 (if sampling nitrogen)
- River dippers if you are sampling very wide and/or deep streams

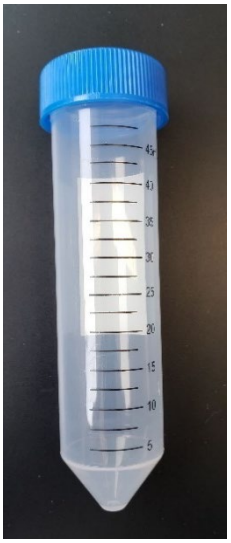
Sample Collection Containers

Sample containers play an extremely important role in sample quality. A specific container is designated for each parameter (Figure 1). In the field, it is important to use the correct sample tube for each sample and to correctly label all containers to avoid confusion when the samples are brought to the laboratory. Store empty sample tubes with the caps on before use. **Never re-use sample tubes.**

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

Figure 1. Sample container photos for LPP parameters

TP glass tube



TN centrifuge tube

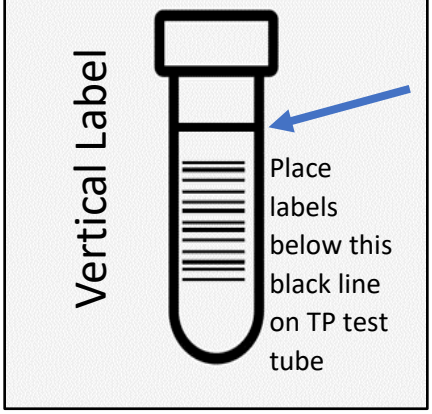
Cl centrifuge tube

Sample Labels

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

1. Ensure tubes are clean and dry.
2. Secure labels to the correct container 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 (Figure 2).

Figure 2. TP label placement



Sample labels consist of the parameter to be measured, the VAEL Sample ID and the Customer Sample ID (Figure 3). The **parameter** at the top of the label indicates which test will be run by VAEL on this sample. Each parameter has a designated sample container (Figure 1) that should match the parameter on the label.

The **Customer Sample ID** appears second on the label and is the site name that you and any volunteers recognize and use to identify the site. 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 **VAEL Sample ID** is generated by VAEL and appears below the Customer Sample ID in bold. This number consists of the 7-digit order number starting with two digits representing the year (22 in Figure 3 for the year 2022) that corresponds with the sample event. The order number is the same for all samples collected during a sample event. Each of the eight required sample events 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 VAEL sample ID for each parameter sampled. Field duplicates have different final three digits from the regular sample.

Figure 3. Example chloride label

VAEL Field Sheets

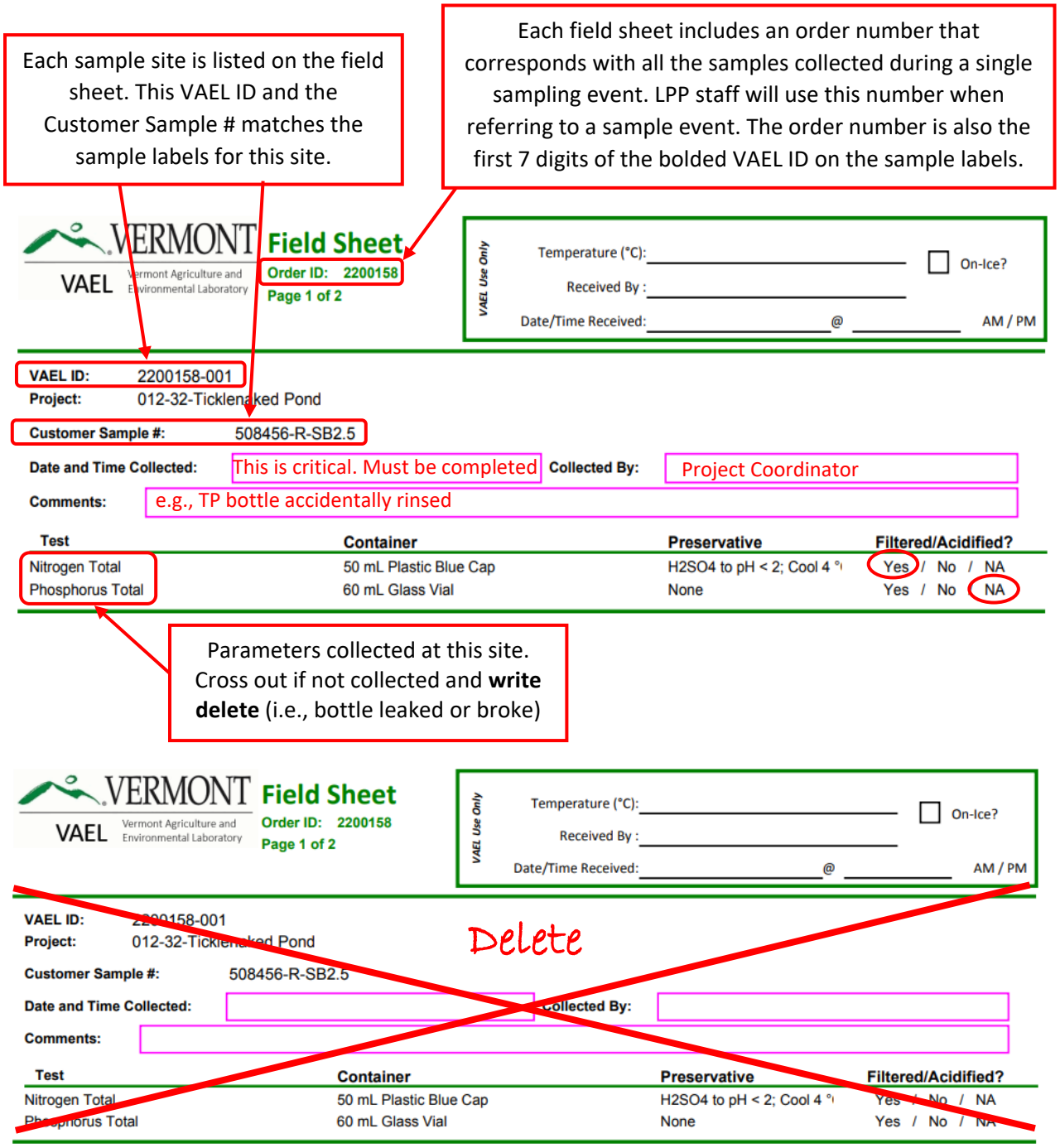
The VAEL field sheets or sample login sheets are provided by VAEL and are required to be submitted with all samples. Samples cannot be processed by the lab without a completed field sheet. Each sample event will correspond with a field sheet and order number. **These must match the order number on the bottle labels that are being submitted.** Contact LPP staff if the wrong labels with mismatching order numbers were used. 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:

- Samples are labeled with the correct site name, parameter label, and VAEL Sample ID for that order
- **date** and **time** (specify am or pm) of sampling – this is especially critical and must be completed for each sample or it will not be analyzed
- project coordinator name
- comments on any errors, changes, or unusual observations during the sampling
- **indicate if any samples were not collected**. Cross out the specific parameters listed under the Sample ID that were not taken or lost and write "delete". Cross out the whole sample section if the site was not sampled at all and write "delete". **It is important to**

include the word delete if a sample was lost or not collected, otherwise the lab needs permission to remove a sample. If the sample will be collected later, make note of this.

Figure 4. Example VAEL field sheets



Example of a sample site not visited/sampled: Reasons for not sampling include flood or dangerous conditions, dry conditions, or flow levels so low that the stream is more of a series of stagnant puddles

or a sample cannot be collected without contamination. Please explain specifics in the comments section.

Sampling Protocols

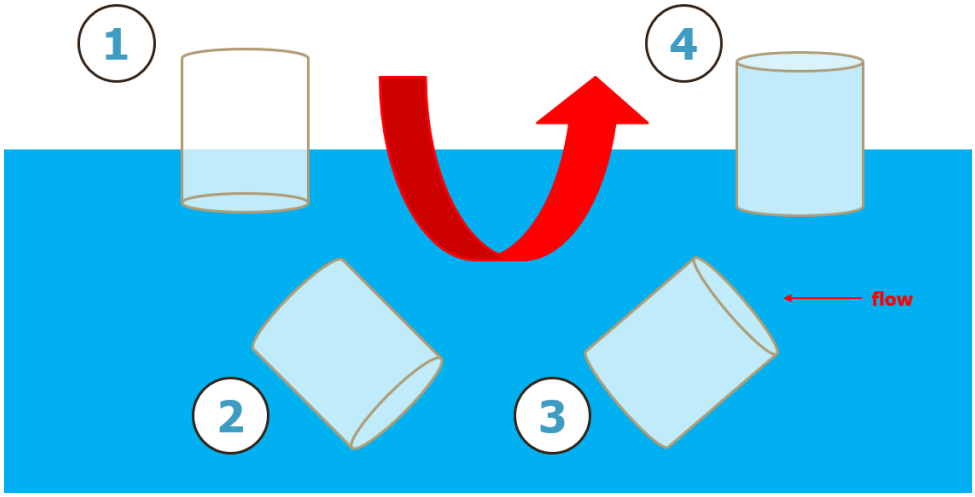
The protocols described in this section should be followed as closely as possible to ensure the collection of reliable and consistent water quality data. Please see the Stream Sampling Checklist for a summarized list of tasks to be completed during every stream sampling field visit.

Grab Samples

1. Avoid touching the inside of bottles and caps.
2. After ensuring safe conditions, wade into the stream as near to the center of flow as water depth and speed allow while maintaining safety.
3. Wait for any disturbed sediment to flow downstream.
4. **Rinse** plastic bottles for **nitrogen** and **chloride** and their caps **three times** before taking the sample.
    a. Dump rinse water downstream.
    b. Glass test tubes for **phosphorus should not be rinsed**.
5. Take samples 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.
6. 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. Try to fill at or above the required fill line in one go- this is especially important for TP samples.

Figure 5. Diagram of proper sample collection technique



7. Pour off samples to the required volume before capping if you overfilled the bottle. 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 quick water addition or fill the cap with sample water to pour into the bottle.
    b. Fill plastic centrifuge tubes for TN and Cl up to the 50mL line. *If you make a mistake when sampling, you may redo a **TN or Cl** sample.*
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.

After samples are collected and capped, Total Nitrogen samples 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. Ice packs typically are not as effective at cooling samples. **TP and Cl samples do not need to be stored on ice.**

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. 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 3 times with river water. Never wash or rinse the inside with soap. Store the dipper head covered with a plastic or Ziploc bag in between uses.
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 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. Store the bucket covered in a bag in between uses.
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 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.

When Not to Sample

- **Do not sample if weather, flow, or other conditions are or may become unsafe.** You can return to the site another time or skip this sample event.
- **Do not sample if the flow level is so low** that the stream is more of a series of stagnant, disconnected puddles or you cannot sample without stirring up sediment and contaminating the sample.
    - Note that this **does not pertain to "slow winder"** very slow moving, typically wetland streams, which may not have visible stream flow but are flowing slightly and are often deep enough to sample.
    - This may or may not pertain to sites backed up due to a culvert or beaver dam. **As long as there is some flow going through the culvert or dam, you may collect a sample.** Use your best judgement and make a note when in doubt. Photos are also very helpful.
- **If a site is located close to the confluence of the stream with a larger river, lake, or pond, and water is backing up** into your sampling site (which happens usually during high flows and/or windy days), do not sample in your typical location. **You can move a couple hundred feet upstream as needed to collect a sample where the flow is no longer backed up.**

QAQC Samples & Protocols

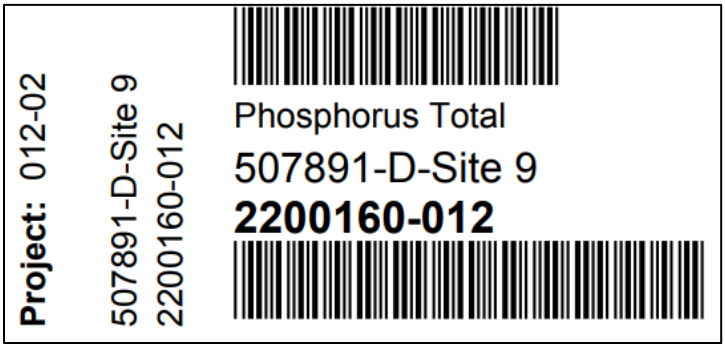
Quality Assurance/Quality Control (QAQC) samples consist of duplicate samples that make up 10% of your samples. There are two different types of QAQC samples: field duplicates and blanks which are described in detail below.

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. Variations may be due to contamination or environmental variation in the stream conditions. Extra bottles for field duplicates will be provided for all parameters sampled (TP, TN, and/or Cl). LPP staff will predetermine the scheduling for field duplicate sampling. Field duplicates cannot be skipped, and predetermined locations should not be changed unless the LPP coordinator is notified.

The goal of collecting 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



Blanks

Blanks are bottles filled with deionized water and have previously been used to determine if there is contamination in the equipment or occurring during sample storage and transportation. As a cost saving measure, LPP decided to remove blanks from the QAQC process except during LPP staff site visits. Partners are no longer 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 Cl 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. **Acidification needs to occur within 24 hours of sample collection**, or the sample will not be properly preserved. **Do not perform acidifications in the field and always have running water accessible nearby.**

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 appropriate disposable gloves, safety glasses, and clothing.** Wear closed-toe shoes and clothing that covers the arms and legs but is not too baggy around your lower arms and wrists. Tie hair back if it is long. **Do not put gloved hands near eyes or mouth**.
2. Secure nitrogen samples (blue cap) upright in a sample rack in a location to facilitate easy and safe dispensing of acid **near a sink or shower to flush any spilled acid**. Ensure no pets or children are around while performing the acidification. **NEVER PERFORM ACIDIFICATION IN THE FIELD.**
3. Uncap all samples to be acidified before opening the acid container.
4. Carefully remove the acid dispenser from its secondary container and unscrew the cap.
5. **Dispense 2 drops of 98% sulfuric acid into each sample**, taking care not to splash or dip the dropper into the sample.
6. **Immediately recap the acid dropper** and return it to the secondary container.
7. Cap all the acidified samples. Be sure the caps are threaded properly.
8. Once each sample is capped, gently invert each sample bottle 5 times to mix.
9. Store in a safe refrigerated location or on ice until sample pick-up. If acid or samples spilled, change out gloves before touching any door handles.
    a. **Label samples as hazardous and do not store near food or drink.**
10. Carefully remove gloves so as not to touch exterior side of glove with bare hands and dispose in a sealed plastic bag in the trash. **Do not reuse or put used gloves back in with the clean gloves.**
11. Wash your hands thoroughly with soap and water.

Spilled Acid Protocols

If acid comes into contact with your skin, clothes, or eyes, immediately flush the area with water for at least 15 minutes and immediately contact a medical professional.

If you spill the concentrated acid or acidified sample on a surface, immediately wipe up the spill with an absorbing material such as a paper towel (wearing gloves!). Thoroughly rinse the area where the spill occurred with water. Dispose of acid-soaked materials and gloves in a sealed plastic bag in the trash.

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 flow conditions at the time of sample collection to provide more context for the resulting TP/TN/Cl values when interpreting water chemistry data.** This can aid in source identification. For example, a high chloride concentration under low flow may indicate groundwater contributions. Additionally, only base flow measurements are used when applying the Vermont Water Quality Standards.

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 useability of water sample data 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 requires 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.

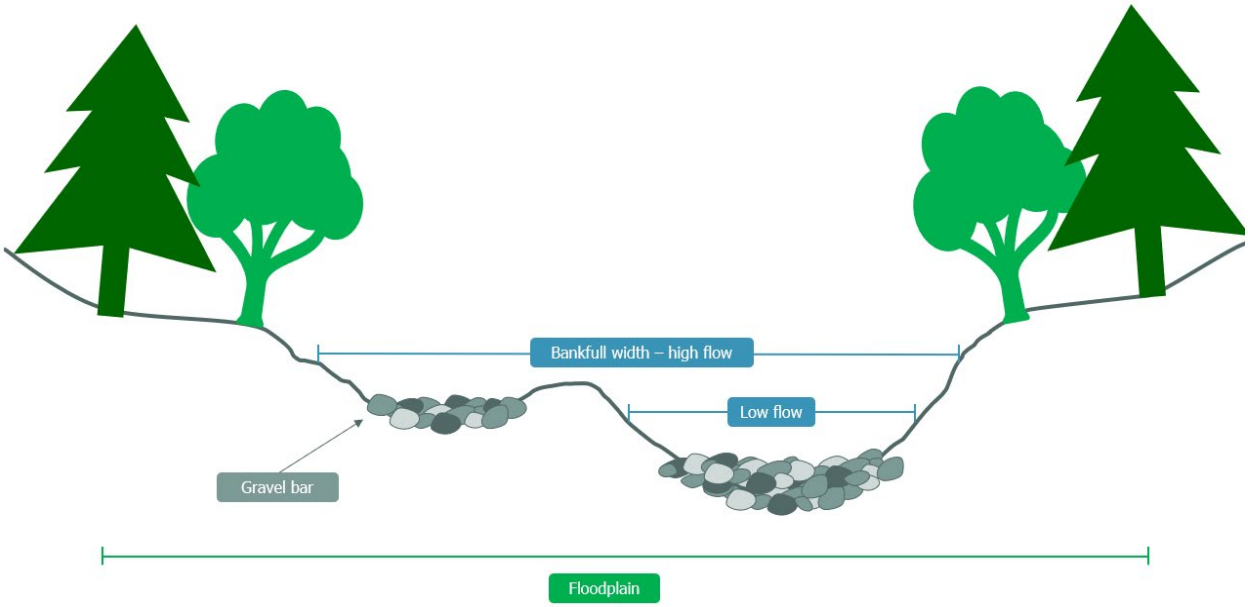
Flow Level

Flow level can be described as:

- Low
- Moderate
- High
- Flood

A diagram of stream flow levels in an example stream is provided in Figure 7. Example photos of different flow conditions can be found on the LPP website under the Training and Education section.

Figure 7. Diagram of stream flow levels in an example 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 top of the sharp incline of the stream bank.
- May also occur when flow speed is very slow even if the water level is at the top 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”) and water is moving very quickly, 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.**

Flow level does not simply refer to how high the water is reaching up the sides of the stream bank (although it often correlates). **Flow level refers to both the volume of water in the stream and the speed the water is flowing.** Streams may be full bank to bank, or bank full, but if the water is passing through very slowly, the flow level would likely be moderate, not high. High volumes of water but slow speeds of flow typically occur with low gradient wetland streams, or when a stream is backed up by an undersized or blocked culvert or beaver dam.

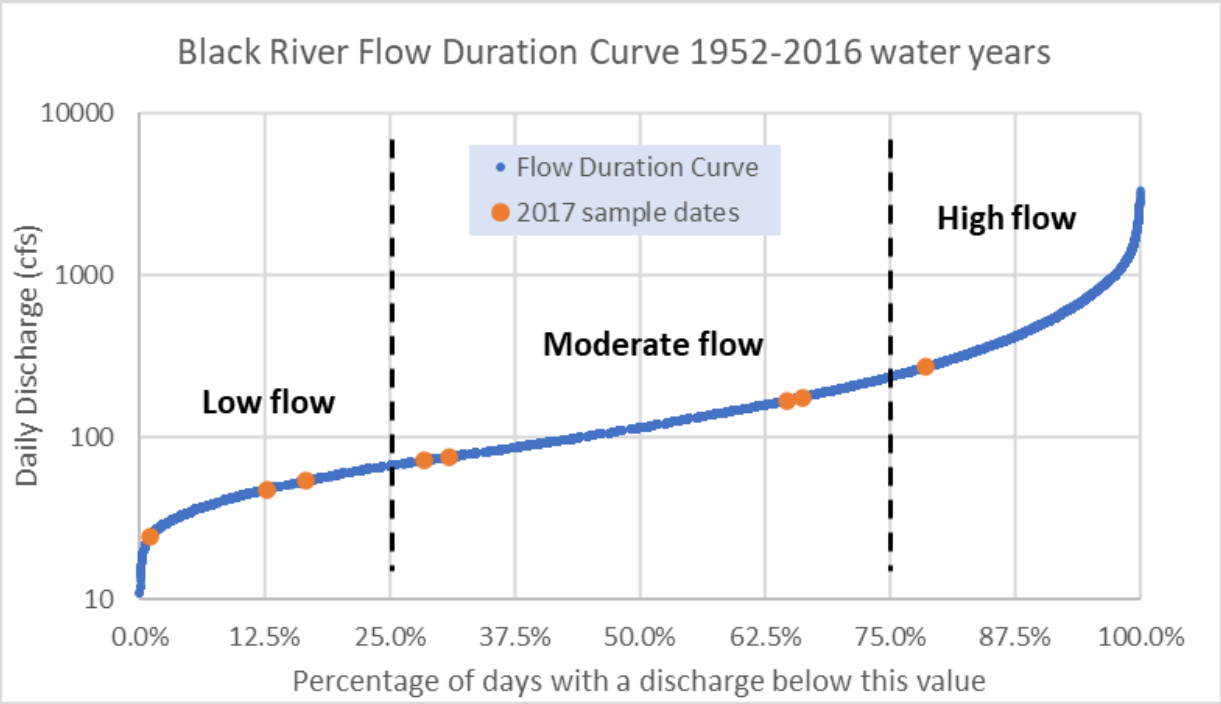
Note that flow level is a subjective observation that is based on your understanding of what typical, low, or high flows look like at a specific stream site. The above are guidelines for how a typical stream may look during each of the flow levels but may not be the case for all streams.

Another way to determine flow levels is using a flow duration curve. While this is not possible to create in the field, it is a useful tool for understanding flow levels quantitatively. The flow duration curve below (Figure 8) shows the daily discharge (a measure of flow) measured by a stream gage passing through the Black River, and the percent of days the stream discharges over time were below a given 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 delineated 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 measured discharge value by its percentile on the graph. As can be seen by the sample dates marked in orange (Figure 8), 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 8. Example Flow Duration Curve



Flow Type

Flow type can be described as:

- Base flow
- Freshet
- Hydro

Base flow – A stream's flow is at a relatively constant level at the time of sampling, neither 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 low, moderate, and less commonly, high flow levels, but not under a "flood" level. The USGS maintains the National Water Dashboard which has real-time streamflow data. The hydrographs associated with the gages mapped on this dashboard are useful tools 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 or decrease in flow and 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 co-occur with low, moderate, or high flow levels**.

Freshet events can last for hours to days depending on the intensity of the event and the size of the watershed. Generally, as little as **0.1 inches of rain fall in a 24-hour period prior to sampling is enough to induce a freshet event**. Heavy rain or snowmelt will result in longer lasting freshet events. **The smaller the stream and watershed, the less rain/snowmelt is needed to cause freshet flows.** "Flashier" and more extreme rapidly rising and falling flows are often seen in these small streams as well, so the stream will return to stable flow levels faster than larger steams (usually within 24 hours depending on the amount of rain/snowmelt). More moderate flow level rises occur in the larger, higher order rivers during freshet events, and the freshet event can take longer to occur after the rain or snow melt begins but last longer after it ends (up to 24-48 or more hours depending on the amount of rain).

Hydro flow – A stream's flow level is rapidly rising *solely* due to the abrupt release of water from an upstream man-made 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.

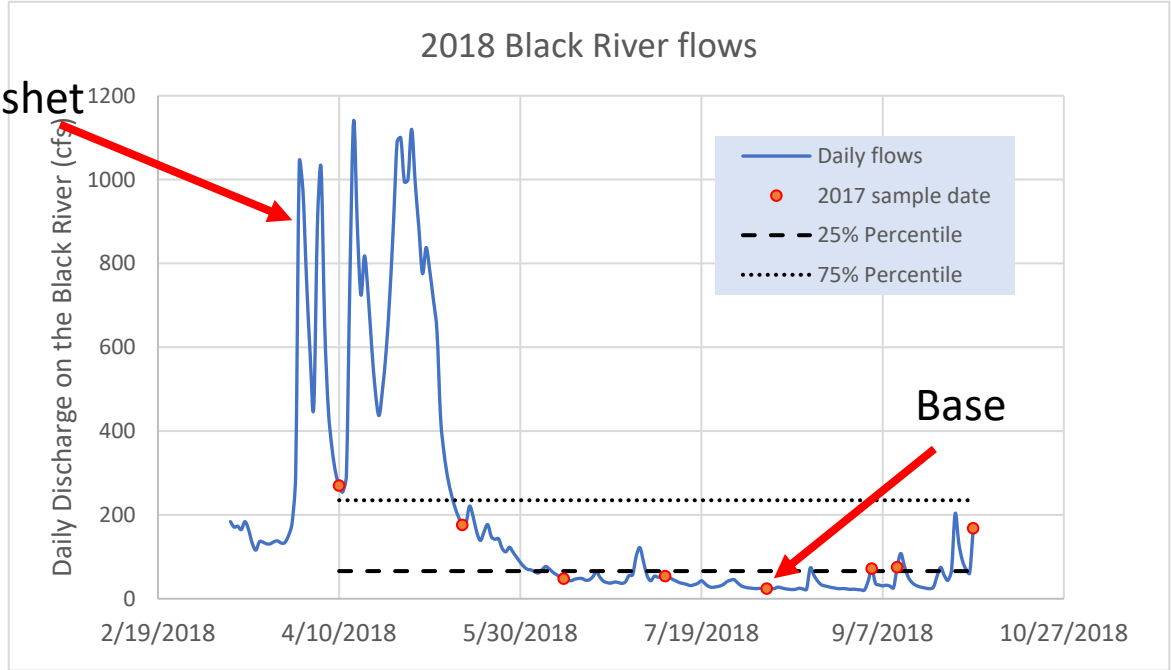
Note: the occurrence of natural freshet flows in direct response to rainfall or snowmelt are still possible below such facilities.

If any site has dried up, flow has ceased, or is too low to sample, both flow level and flow type would be recorded as "No Flow". Note that no flow does not pertain to very slow moving, low gradient, typically wetland streams, which may not have visible stream flow but are flowing slightly and are often deep enough to sample.

Figure 9 presents a hydrograph of the 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 (below the dashed line), moderate (between the lines), and high flow levels (above the dotted line), freshet events can occur with all three flow levels. Note that the highest 25% of flow conditions would all be classified as freshet. **High flow level and base flow type can co-occur, but it is uncommon**. Typically, this only occurs when ground water levels are very high due to a nearby groundwater spring or frequent heavy rain and saturated soils that last for long periods of time.

Figure 9. Hydrograph of 2018 daily flows in the Black River indicating freshet and base flow types



Flow Data Submission

Survey123

An ArcGIS Survey123 form will be used to collect flow observations. The LPP Flow Data Form can be submitted using **both computers and smartphones** and therefore should be easily accessible. There are two ways the Flow Data Survey123 Form can be completed:

1. In the field while sampling via an app on a smartphone, computer, or other device used by samplers
2. Via the computer app or web browser after sampling based on data recorded on paper in the field

Volunteer samplers can submit the form on their own, or they can provide the flow data to their project coordinators who can submit the form on their behalf. If you opt for the latter option, please make sure the volunteers record all the necessary information required to complete the form.

The survey must be submitted once per site for every sampling event. Sites where a duplicate sample was taken do not need a second flow observation. **If a site was 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.

Regardless of the method used, project coordinators are responsible for ensuring that all flow observations are completed at every site (even if no sample was collected) and submitted in a timely manner. Flow submissions can be tracked and viewed via the Flow Data Dashboard, which is updated live with any flow observations submitted via the Survey123 form throughout the season. See the Flow Data Dashboard section of this document for more details.

Accessing the Flow Observation Survey123 Form

Before going out in the field, please ensure that you and/or all volunteer samplers have access to the LPP Flow Data Survey123 Form. This can be accessed both via the app, ArcGIS Survey123, and through a webform on your browser. While the Survey123 app can be used offline, **the LPP specific Flow Data Form must be downloaded into the app for the first time over an internet or data connection** before going out in the field. After the LPP Flow Data Form is downloaded into the app for the first time, it will be available in the app and can be completed offline without cell service or internet for all subsequent uses. **You can download the LPP Flow Data Survey123 Form to your preferred device (phone, tablet, or computer) using the direct link or QR code in Figure 10.**

Figure 10. LPP Flow Data Survey123 Form QR code

https://arcg.is/1PXuTe0

Once you have accessed the link, you may decide whether to open the LPP Flow Data survey directly in the Survey123 app or in your web browser. **The app is free and can be downloaded on most devices including smartphones *and computers*** via the Microsoft store (Windows computer users), Apple App store (iPhone and Mac users), or Google Play store (Android users). **It is not necessary to have an ArcGIS account to use the app.**

If you choose to open the form in your web browser, be aware that **the webform cannot be submitted without internet connection and does not have all the features of the app** such as editing a previously submitted form. For this reason, **the app is the preferred method for accessing the Flow Observation survey form.**

Ideally, flow data should be submitted directly in the field via the app Survey123. The app can be used offline and without cell service and has additional features such as allowing edits to previously submitted surveys or copying an existing survey to a new one to save time when submitting many surveys at once. However, we understand that everyone has different levels of comfort and access regarding the use of smartphones or computers in the field.

For those that are uncomfortable or unable to use Survey123 app in the field, **there is also the option to use the app and all its features at any location of your choice *after sampling* using most devices (this includes computers as well as smartphones or tablets)**. If you do not have a device where you can download the app and you do not need its additional features, you may use the webform instead in any internet browser. However, the webform can only be completed over an internet connection, so keep this in mind.

For video tutorials on how to use both the Survey123 app and webform, as well as the additional features of the app such as using the outbox to save forms offline or editing a previously submitted form, please visit the Flow Observations section of the Training and Education portion of the LPP website.

Survey123 App

The Survey123 app allows you to submit flow observations both directly from the field on your smartphone or at home from your computer or tablet after sampling. The specific LPP Flow Data Form must be downloaded the first time you open the app via the link in Figure 10, but after the initial download, the LPP Flow Data Form will remain on your device within the Survey123 app and can be used on or offline. **To submit flow observations via the app, please adhere to the following instructions:**

1. Download and open the Survey123 app on your preferred device.
2. Click "Continue without signing in".
3. If this is the first time you are opening the app, you may get a notification that you have no survey forms. This is okay, you will just need to download the LPP Flow Data Survey using the link in Figure 10 in your device web browser or the Figure 10 QR code using the QR reader in the search bar at the top of the screen in the Survey123 app.
4. Select "open in the Survey123 field app" once you have followed the link to the LPP Flow Data Survey. The survey will automatically open in the app.
5. After opening the Survery123 app with the LPP Flow Observation Survey loaded, choose "LPP Flow Data" in the app home screen.
6. Click "Collect".
7. The date and time of observation will be filled in automatically. **This can be changed manually if not completing at the time of sampling.**
8. Fill out the survey with all required fields (marked with a red *).
9. Capture photos of the site if possible (the app will automatically open your camera) facing both upstream and downstream. Photos can also be uploaded from your device.
10. Provide any additional notes or necessary information.
11. Once your survey is complete, click the "**√**" 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.
12. If your device is **online**, click "**Send now**"
13. If your device is **offline**, click "**Save in Outbox**"

a. Note you will have to return to the app once you are back in service or with internet and click on the Outbox to submit the surveys.

For a visual demonstration, please watch the Survey123 app video tutorial in the Training and Education portion of the LPP website

Note: If data is submitted via the Survey123 app while offline, all samplers will need to return to the app after sampling once back in service or connected to internet to **ensure that there are all results remaining in their outbox are sent**. This is **essential to ensure that we have flow data for all samples**.

Survey123 Webform

The Survey123 webform is an option that can be used to submit all flow observations after sampling as long as observations have been recorded in some other way in the field. The webform can be filled out on any internet browser and does not require downloading an app, but it **does require internet access**. The webform does not have all the same features as the app, and you cannot view your form once it has been submitted. If these features are not needed, then the webform is a good alternative for those who cannot or do not wish to download the app. Remember that a smartphone is not required to use the app, and the app can also be downloaded on your computer or tablet and completed after sampling as well (this is preferred if possible).

The format of the LPP Flow Data form is otherwise identical in the web browser version as the Survey123 app and will require most of the same steps outlined for the app. However, given that project coordinators or volunteers will likely not be submitting the survey directly from the field, upstream and downstream photos will not be required.

To submit flow observations via a web browser, please adhere to the following instructions:

1. Click the LPP Flow Data Survey link in Figure 10 or copy and paste the URL into your device web browser. Select “open in browser” once the link loads.
2. Once the survey loads, fill out the survey with all required fields (marked with a red *).
3. The date and time of observation will be filled in automatically with the time/date you are completing the survey. **This must be changed manually if not completed at the time of sampling.**
4. **The site coordinates will also need to be entered in manually** if not completed at the place of sampling.
5. Photos can also be uploaded from your device if you have them saved there but are not required.
6. Provide any additional notes or necessary information.
7. Once your survey is complete, click “Submit”.
    a. If you are missing any necessary information, Survey123 will prompt you to fill in required fields before allowing survey submission.

b. Note that you cannot submit via the web browser form if you do not have internet or cell service, and your entries may not be saved in the form.

Submitting flow data after sampling

If project coordinators or volunteers choose to submit flow data forms after sampling, they are required to record and gather all flow data in the field from every sampler and ensure that the form is completed for every sample site. While this can be done via a web browser, it is still strongly recommended that you download the Survey123 app on your computer and submit flow data forms via the app. This is because the app has additional features such as viewing submitted forms, editing forms, and copying a form to a new one to make completing multiple submissions easier. These features are particularly helpful for coordinators submitting multiple flow data forms on behalf of all their volunteers.

Complete flow data will include:

- Partner organization
- Site ID
- Date and time of observation
    - Please note that Survey123 will prepopulate the date and time when you open the LPP Flow Data Form. Those filling in the survey after field sampling has already occurred will need to **input the correct date and time** to ensure data accuracy.
- The location coordinates of the sample site are not required, but allow the site to show up in the proper location on the Flow Data Dashboard, so are strongly recommended
- Sample status - whether or not a site was sampled and if not, why not
- Flow level
- Flow type
- Visible turbidity

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

Training Resources

2023 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

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.

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 train them in how to use them.

Delivering Samples to the Laboratory

- Take the time to review the field sheet paperwork and make hand-written changes as needed to save LPP staff time tracking down missing samples or changes.
    - Cross out any samples or parameters not collected and **write delete**.
    - Make note of samples to be arriving later if applicable.
    - Verify that the **date and time** of sampling is noted and correct for each sample site.
- 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 (see Table 1).
- 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. They **accept samples between the hours of 8 am and 4:30 pm**. For after-hours sample drop-off coordination, please call VAEL at (802) 636-7474.
    - 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.

- If an error in the field sheets is found, Sample Receiving or LPP staff will contact the project coordinator for clarification.
- **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 ≤ 6°C
Total Phosphorus	28 days	Room Temperature (can be refrigerated with TN samples but not required)
Chloride	28 days	Room Temperature (can be refrigerated with TN samples but not required)

Stream Sample Analysis Results

VAEL chemists conduct specific protocols to analyze LPP water samples for total phosphorus, total nitrogen, and chloride using the methods described in this complete list of VAEL lab tests.

When sample analysis for an order of samples is complete, VAEL will send partners an email with a PDF attachment of the preliminary results. All samples listed in the order must be analyzed and released by VAEL staff to distribute the results. This generally takes about 30 days from submission to the lab but can take longer especially if samples are not submitted all at once.

The preliminary results sent via PDF email attachment have not been quality assured 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, switched samples, field duplicates, incorrect dates, or other sampling or information 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. Data may be removed or marked as suspect due to contamination or protocol errors that if left in the dataset as is could be misleading.

LPP project coordinators *should* screen these VAEL PDFs of sample results for any glaringly erroneous or suspect values throughout the sampling season. Consistent anomalies in the data may indicate improper sampling methods or contamination that should be addressed as soon as possible. In particular, check for:

- outlying values that are very high or low compared to other values found at that site throughout the season;
    - Keep in mind that rain and runoff events often cause significantly higher values for TP and TN, so unusually high values for samples collected during a freshet event are expected and don't necessarily indicate invalid results;
- wildly differing duplicate samples (beyond 20-30% difference between values);
- any signs that a sample may have accidentally been mislabeled or collected at the wrong site.

LPP Data Review

All LPP data goes through intensive review by VT DEC staff to ensure quality and accuracy. This includes both the qualitative flow observations and the chemistry data. Throughout the season, it is the responsibility of the project coordinator to monitor preliminary results (emailed in PDF format by VAEL and the Flow Data Dashboard) for abnormalities or potential sample mix-ups and report these to LPP staff.

Once VAEL has completed all sample chemical testing for the season, LPP staff will begin a review of all LPP data by organizing each partner's data in tables using R statistical software or in excel. LPP staff calculate summary statistics for each site and relative percent difference (RPD) for all duplicate pairs. RPD is further explained in Appendix C. LPP staff will also flag any failed duplicate pairs and suspect results. 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.

Partners may request their data in an excel or CSV format with the understanding that these data have not completed the full quality assurance process. Therefore, partners who receive this data must keep it within their organization and inform all viewers that the **results are preliminary and should not be shared with the public**. LPP staff may also share data with partners to ask 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. Partners are welcome to conduct their own quality assurance processes, and please contact LPP staff if any errors or issues are noted.

After LPP staff have completed this initial review, all data undergoes a second review before publication. 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 published to the Vermont Integrated Watershed Information System (IWIS) where it is viewable and shareable for partners and the general public. **Please use the official datasets published in IWIS for distribution and analysis.** Accessing LPP data is described in the next section.

Chemistry & Flow Data Access & Presentation

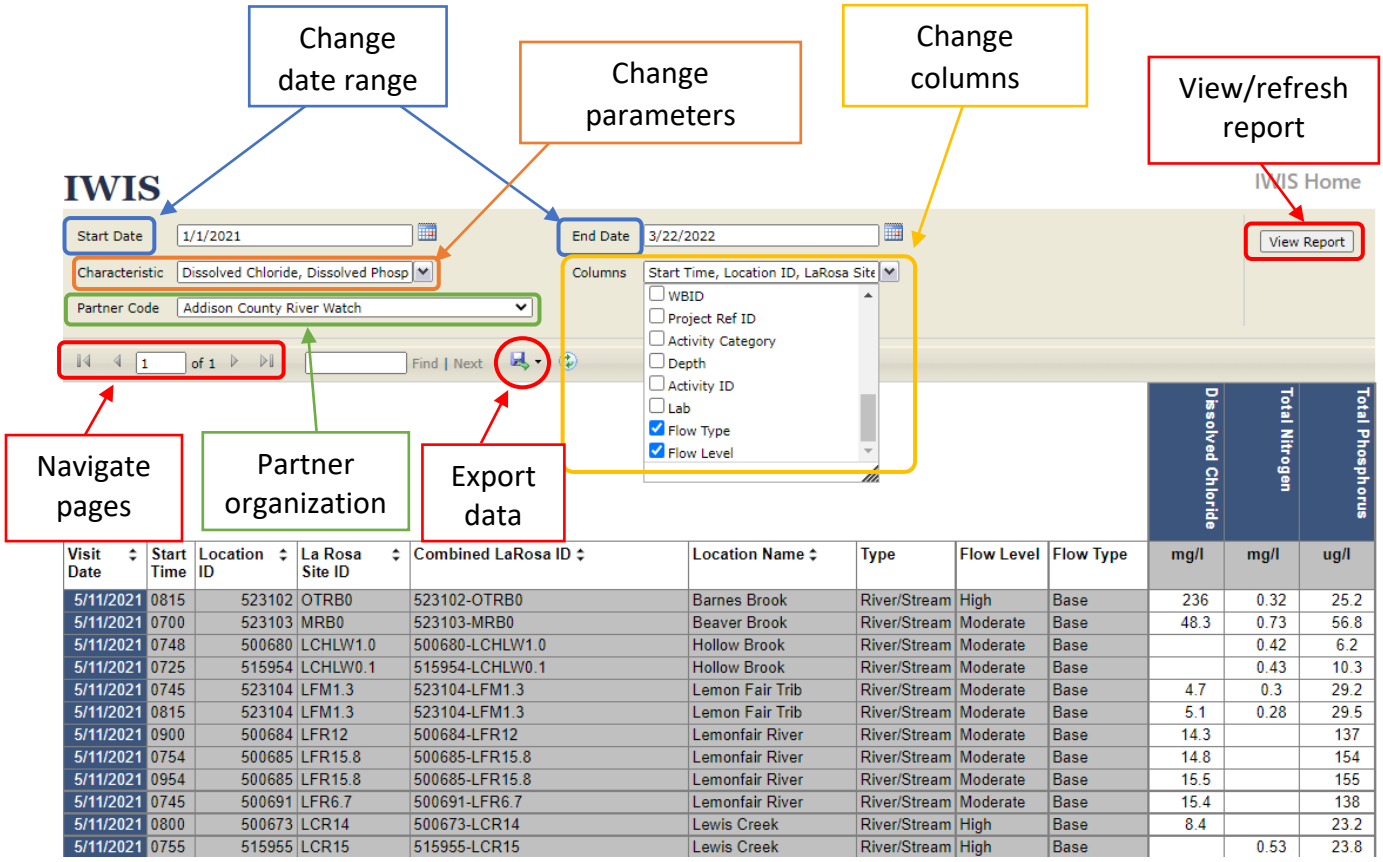
To access LPP water chemistry data from previous years, please visit the Data and Reports section of the LPP website. All LPP data is published and stored in the Watershed Management Division's database, IWIS (Vermont Integrated Watershed Information System). LPP data will be quality assured and published 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 at once in a tabular format. 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. See Figure 11 below for a visual of this report.

Figure 11. Diagram of LPP Water Chemistry Data Report



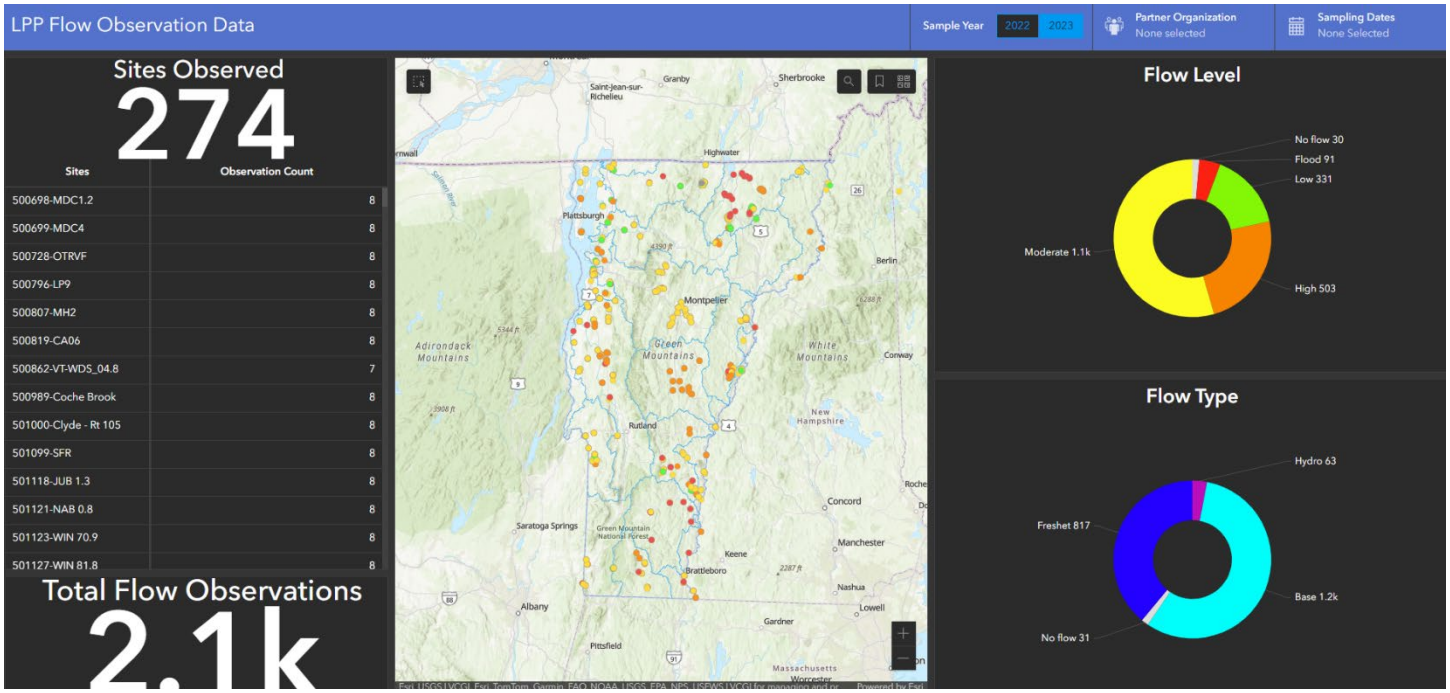
Visit Date	Start Time	Location ID	La Rosa Site ID	Combined LaRosa ID	Location Name	Type	Flow Level	Flow Type	Dissolved Chloride mg/l	Total Nitrogen mg/l	Total Phosphorus ug/l
5/11/2021	0815	523102	OTRB0	523102-OTRB0	Barnes Brook	River/Stream	High	Base	236	0.32	25.2
5/11/2021	0700	523103	MRB0	523103-MRB0	Beaver Brook	River/Stream	Moderate	Base	48.3	0.73	56.8
5/11/2021	0748	500680	LCHLW1.0	500680-LCHLW1.0	Hollow Brook	River/Stream	Moderate	Base		0.42	6.2
5/11/2021	0725	515954	LCHLW0.1	515954-LCHLW0.1	Hollow Brook	River/Stream	Moderate	Base		0.43	10.3
5/11/2021	0745	523104	LFM1.3	523104-LFM1.3	Lemon Fair Trib	River/Stream	Moderate	Base	4.7	0.3	29.2
5/11/2021	0815	523104	LFM1.3	523104-LFM1.3	Lemon Fair Trib	River/Stream	Moderate	Base	5.1	0.28	29.5
5/11/2021	0900	500684	LFR12	500684-LFR12	Lemonfair River	River/Stream	Moderate	Base	14.3		137
5/11/2021	0754	500685	LFR15.8	500685-LFR15.8	Lemonfair River	River/Stream	Moderate	Base	14.8		154
5/11/2021	0954	500685	LFR15.8	500685-LFR15.8	Lemonfair River	River/Stream	Moderate	Base	15.5		155
5/11/2021	0745	500691	LFR6.7	500691-LFR6.7	Lemonfair River	River/Stream	Moderate	Base	15.4		138
5/11/2021	0800	500673	LCR14	500673-LCR14	Lewis Creek	River/Stream	High	Base	8.4		23.2
5/11/2021	0755	515955	LCR15	515955-LCR15	Lewis Creek	River/Stream	High	Base		0.53	23.8

2. LPP Flow Data Dashboard

This visual display of the flow observations collected by samplers is linked on the main LPP webpage and updates in real time as samplers submit their Survey123 Flow Observation forms. This dashboard is particularly useful for project coordinators reviewing flow submissions submitted separately by multiple volunteers. It consists of a map of where flow observations were collected (note that some locations may be inaccurate depending on where and how the form was submitted), a table summarizing site names and the number of observations collected, as well as pie charts indicating the number of sites categorized in each flow level and flow type (Figure 12). The data can be presented based on the partner organization, sample event number, date, flow level/type or viewed all together for a statewide display of flow conditions. Individual form submissions can be viewed as well by clicking on each map point.

A video tutorial on how to use the Flow Data Dashboard can be found on the LPP website main page.

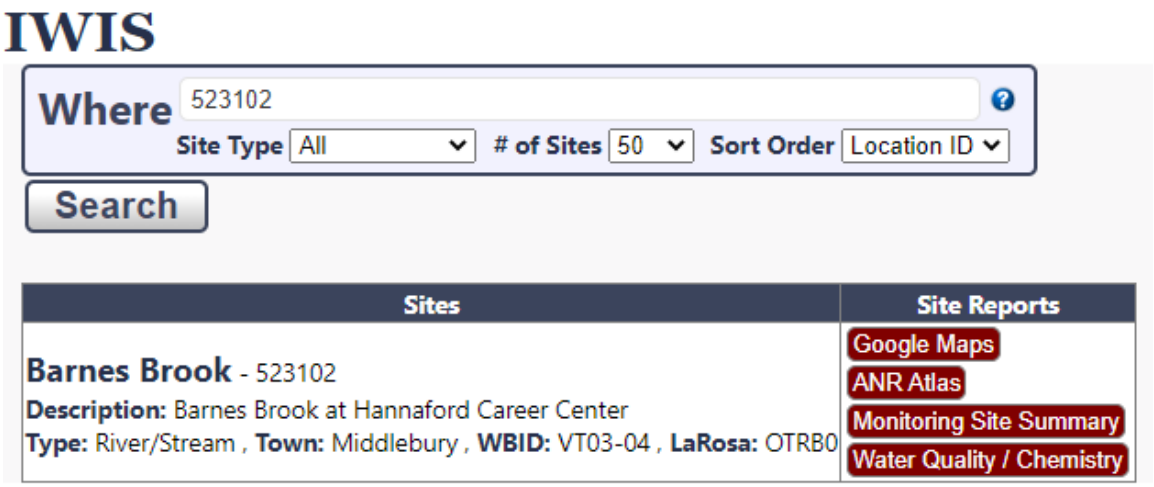
Figure 12. Example LPP Flow Data Dashboard View



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

Data for any individual LPP site can be retrieved from IWIS using just the 6-digit Location ID (see Appendix A for more explanation of the Location ID). IWIS has multiple different reports that can be accessed from the site search results (Figure 13).

Figure 13. Example IWIS search result

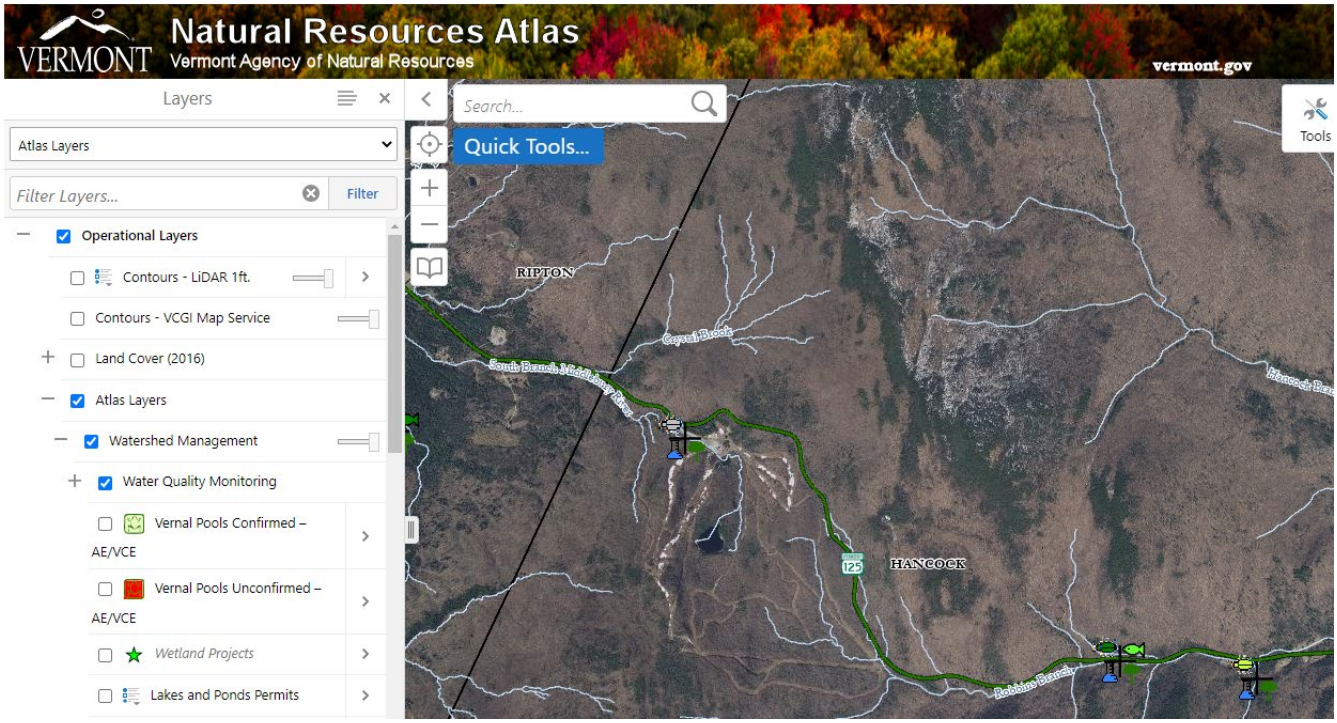


- The site location can be mapped using either the Google Maps or ANR Atlas site reports.
- The monitoring site summary shows an at-a-glance summary of the site data and parameters monitored. If a LaRosa site is also a DEC monitored site, additional data collected such as macroinvertebrate, habitat, and fish assessments will appear here.
- The IWIS Water Quality/Chemistry report (Figure 13) shows all data points collected at the site and works similarly to the LPP Water Chemistry Data Report (Figure 11). 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 13), but all monitoring sites in IWIS 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 14. This layer also includes all sites monitored by the Watershed Management Division including Lakes and Ponds Lay Monitoring sites and the Ambient Biomonitoring Network (ABN) sites sampled by Rivers Program staff.

Figure 14. 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 15). Monitoring sites are grouped by partner organization.

Figure 15. 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

6. 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, comprehensive, 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

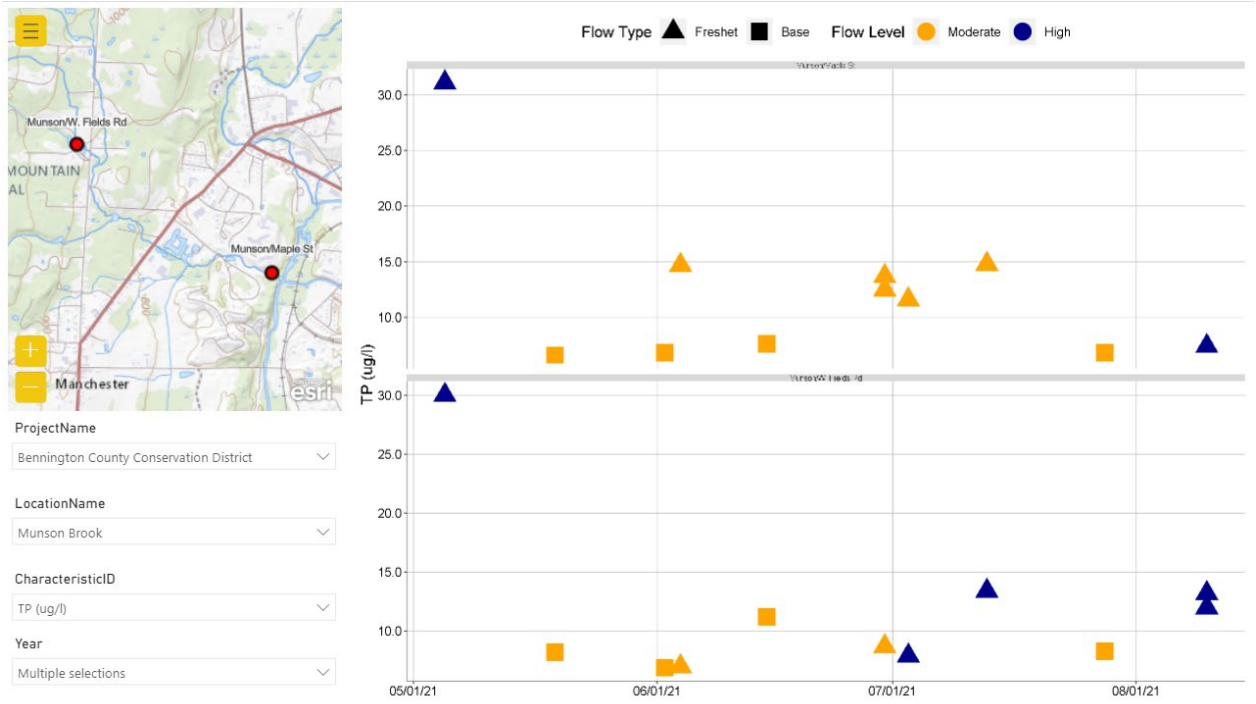
over time. LPP and WSMD staff aim to develop and improve the presentation of LPP data in a way most conducive for partners and the public to use and share. Read more details on the Power BI tool in the following sections.

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 16). 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 16). 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.

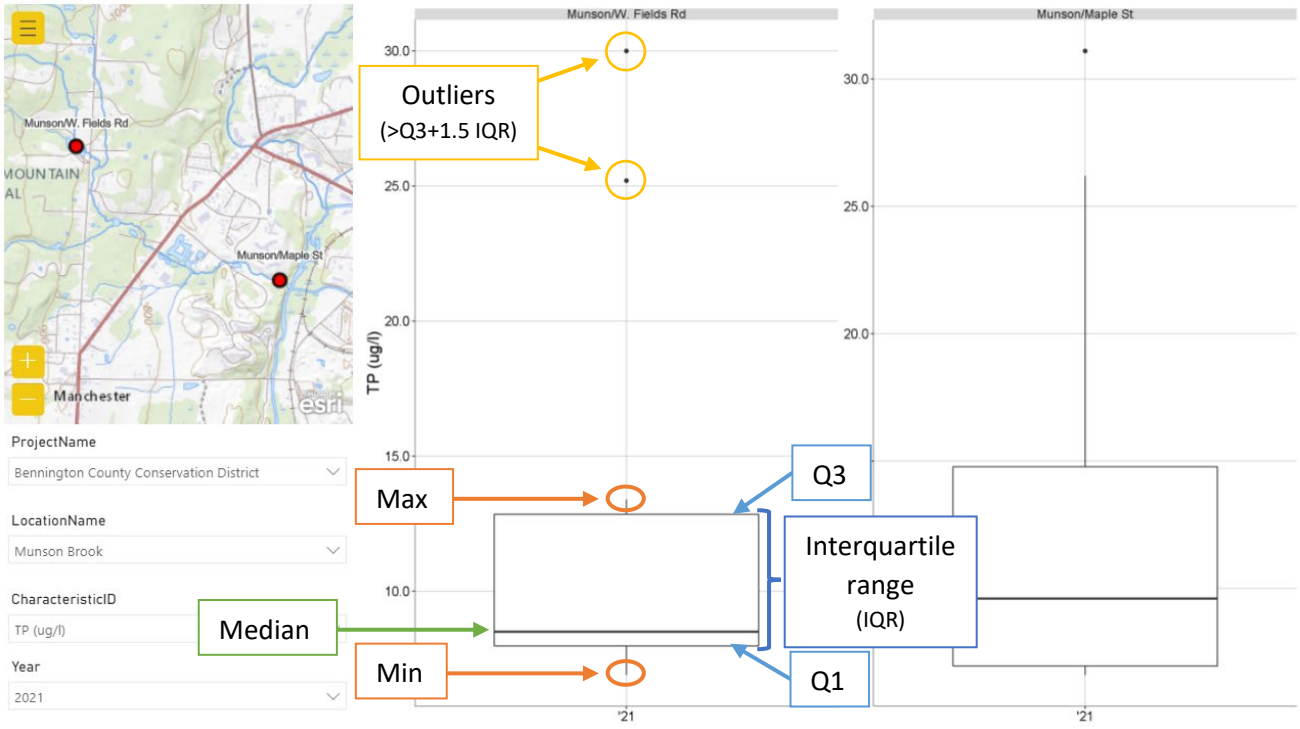
Figure 16. Example Power BI Water Chemistry Scatter Plot



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 17). The map and dropdown menus allow you to change the data displayed using the same methods as 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 17). 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 17). 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.

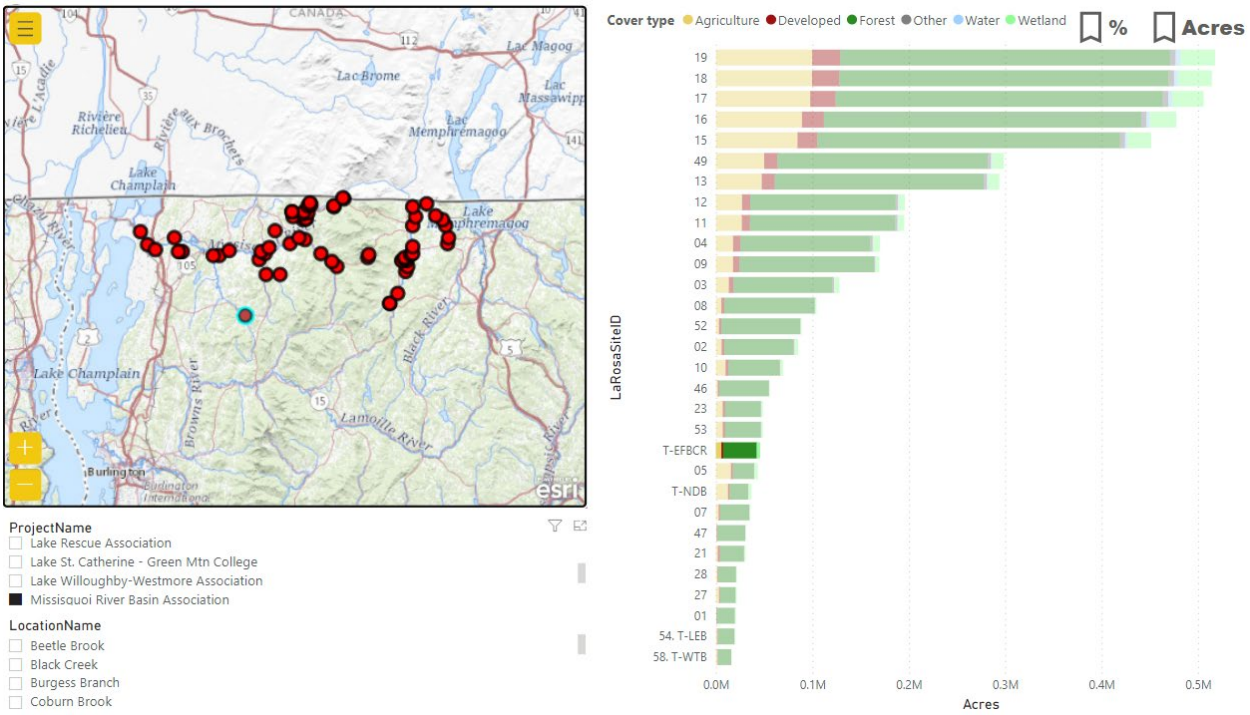
Figure 17. Example Power BI Water Chemistry Box Plot



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 18). 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 18. Example Power BI Land Use Bar Chart

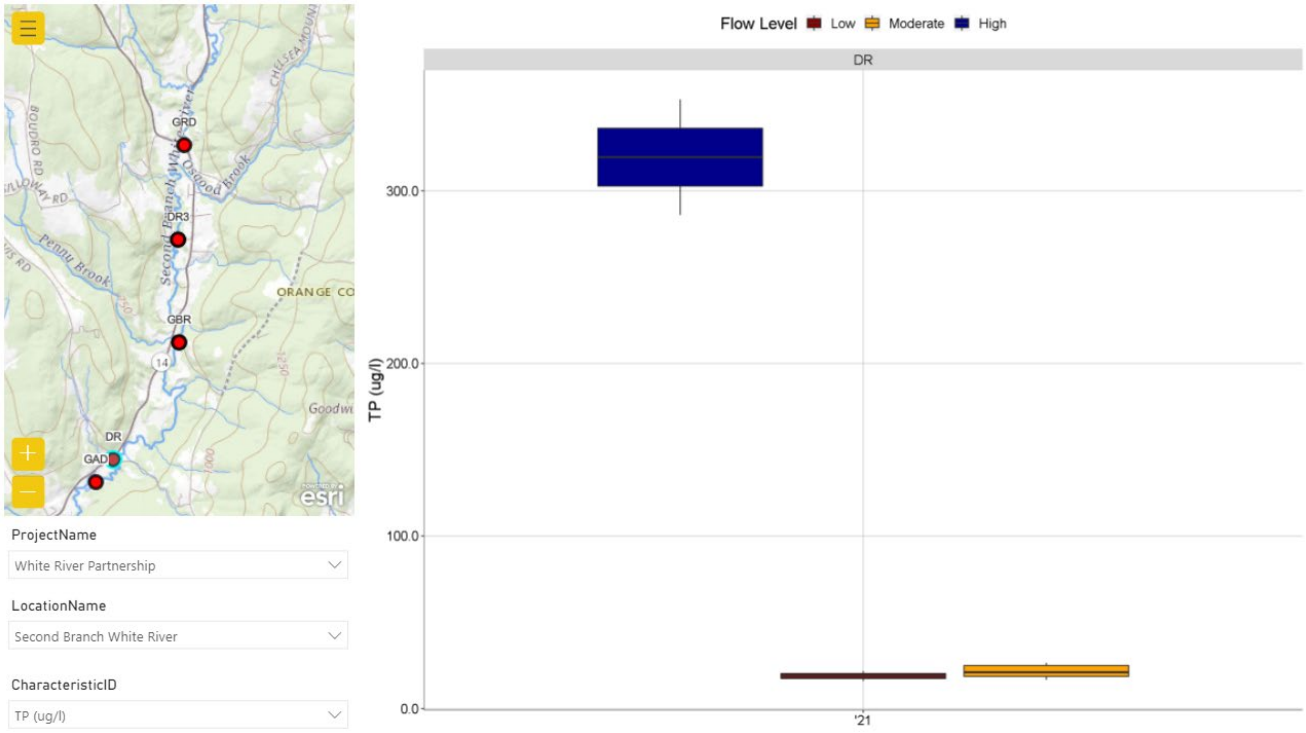


Page Four: Flow Level Box Plots

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 19). 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 19).

Figure 19. 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 also may have some glitches. 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
- 522456-STATEST
- 522458-OLDCCLUB

The 6-digit-Location ID is provided 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, LPP staff, and the volunteers.

Partners can create unique LaRosa IDs for sites at their discretion, provided they meet the following LPP guidelines:

1. Use distinctive nearby landmarks or features for reference.
    - This can include but is not limited to a road name of a cross street, a nearby building or local feature such as a bridge, business, community center, park, or school.
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 when possible while still maintaining clarity.
    - All LaRosa IDs must be less than 25 characters in length.

Please avoid:

1. Vague names that don't reference anything (e.g. Site 1, Site 2, Site 3, Trib 1, etc.)
2. Numbering sites (e.g. Stearns 1, Stearns 2, Stearns 3, etc.), as it leads to confusion
    - For example, you have two sites named Stearns 2 and Stearns 3 and add another site located in between these two sites the following year named Stearns 2.5. 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." This can quickly become confusing, especially if you add multiple sites between two existing sites.
3. Naming multiple sites in close proximity using river miles to identify sites (e.g. Stearns 2.5 is 2.5 miles from the mouth)

    - It is very easy to mix-up samples named this way since the bottle labels may be misread with a quick glance (e.g. Stearns 2.5 and Stearns 2.6- the 5 may be read as a 6 or vice versa).
4. 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")
5. 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.
6. Naming sites in reference to landowners (e.g. Joe Smith's farm)
    - This protects people's privacy and 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 and Location IDs**. Site names should never be re-used or kept the same if the sample location has changed by more than 0.1 miles.

Appendix B: Monitoring Matrix

Monitoring Category	Monitoring Goal	Criteria (all need to be met)	Parameters	Sampling Design
A. Monitor upstream of wastewater treatment facilities	1. Characterize nutrient loading and/or assimilative capacity of watersheds upstream of wastewater treatment facilities	1. Locations on river/stream upstream of wastewater treatment facility effluent discharges 2. Identified as a priority by VTDEC Wastewater Program 3. Ability and willingness to access and sample exact site location coordinates provided by VTDEC to align with existing VTDEC data	1. Total Phosphorus 2. Total Nitrogen (optional) 3. Chloride (optional) 4. Flow level & flow type observations	Bi-weekly sampling from April to August Total of 8 sampling events
B. Lake tributary sampling **Most sites in this category will now be sampled through the Lakes and Ponds Lay Monitoring Program (LMP).**	1. Identify tributaries that may be contributing to increasing nutrient or chloride concentrations in lakes **For questions about whether a site is under LMP or LPP, contact Meaghan Hickey (meaghan.hickey@vermont.gov)**	1. Tributaries to lakes with increasing nutrient trends; lake outlets will not be considered for monitoring 2. Commitment of 3-4 years of sampling by LaRosa partner 3. Identified in a Lake Watershed Action Plan or as a candidate for an LWAP by Lakes and Ponds Program; or identified by the Lake Score Card as a LMP lake		

		with increasing trends		
C. Identify streams with potential to meet Very High Quality (VHQ) standards [A(1) or B(1)] as defined in Vermont Water Quality Standards	1. Identify streams that are potentially VHQ	1. Sites that VTDEC has little to no data on, data > 10 years old, or where there have been or will be significant landscape changes 2. Community interest in the reclassification and/or protection of water quality conditions 3. Perennial river/stream large enough for biological sampling sample year-round		
D. Identification of rivers or streams that are potentially fair, poor, or impaired; or source identification for poor or impaired rivers or streams	1. Identify streams that are potentially fair, poor, or impaired waters 2. Refine the extent of waters that have been identified as fair, poor, or impaired 3. Identify source areas contributing to fair, poor, or impaired conditions to support targeted remediation efforts	1. Rivers or streams draining to or from waters identified as fair, poor, or impaired 2. Commitment of 3-4 years of sampling by LaRosa partner 3. Identified as a monitoring priority through one of the following: Tactical Basin Plans, Lake Watershed Action Plans, Lake Score Card, or the 2022 Impaired Waters List 4. Sites that VTDEC has little to no data on, data > 10 years old, or where there have been		

		or will be significant landscape changes		
E. Site remediation effectiveness monitoring	1. Evaluate water quality improvements after the implementation of significant remediations	1. Pre-implementation sample collection for at least one year prior to project		
		2. Evidence of a planning process supporting the project		
		3. High impact remediation project located in a small watershed; or widespread remediation in a small to moderate sized watershed		
		4. Up and downstream bracketed monitoring of remediations		
		5. Commitment of 3-6 years of sampling by LaRosa partner		
		6. Commitment of Watershed Planner (WP) 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
Chloride (Cl)	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

Meaghan Hickey, Environmental Analyst and LPP Program Coordinator

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Email: Meaghan.Hickey@vermont.gov

Michelle Graziosi, Biomonitoring Supervisor

Phone: (802) 490-6145

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Appendix E: Additional Resources

Vermont Water Quality Resources:

USGS Current Water Data for Vermont

USGS National Water Dashboard

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 or severe weather are predicted.

☐ Gather supplies including labelled sample tubes (don't forget duplicates!); field sheets; Survey123 device or flow observation recording sheet; pen/pencil; cooler with ice (if sampling TN); river dipper or bucket if applicable

When Collecting Samples:

☐ Avoid touching insides of sample tubes or caps

☐ Wade into center of stream flow (if safe)

☐ Face upstream & wait for disturbed sediment to flow downstream

☐ Rinse sample tubes **3x** 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 – be sure to fully fill the sample tube in one go, especially for TP samples

Do not collect if flow is so low you cannot sample without disturbing bottom sediment

☐ 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 for all parameters (highlighted yellow and labelled with "-D-")

- ☐ Rinse duplicate sample tubes (if not TP) before sampling
- ☐ ***Rinse river dipper/bucket in between regular and duplicate samples***

☐ Ensure all caps are threaded correctly and closed tightly

☐ Complete the VAEL field sheet with **DATE** and **TIME (include am or pm)**. Write **delete** for any samples not collected. Make note of any changes, errors, or unusual occurrences.

☐ Record flow level/flow type observations in Survey123 app or on paper. Photos are very helpful if possible!

After Sampling:

☐ Store samples in sample rack in safe location; immediately store TN samples on ice or in fridge

☐ Acidify any TN samples **after** returning from the field within 24 hours

☐ Submit any flow observations still in the outbox in the Survey123 app once in service or submit a Survey123 via your computer for each site, whether the site was sampled or not.

When Not to Sample:

- **If weather, flow, or other conditions are or may become unsafe**. You can return to the site another time or skip this sample event.
- **If the flow level is so low** that the stream is more of a series of stagnant, disconnected puddles or you cannot sample without stirring up sediment and contaminating the sample.
    - **Note that this does <u>not</u> pertain to very slow moving, typically wetland streams**, which may not have visible stream flow but are flowing slightly and are often deep enough to sample.
    - **This <u>may or may not</u> pertain to sites backed up due to a culvert or beaver dam**. If there is some flow going through the culvert or dam, you may collect a sample. Use your best judgement and make a note and take photos if possible.
- **If a site is located close to a confluence with a larger river, lake, or pond, and water is backing up** from the larger water body into your sampling site (which happens usually during high flows and/or on windy days), do not sample in your typical location. **You can move up to a couple hundred feet upstream as needed to collect a sample where the flow is no longer backed up.**