2019 Watershed Management Bureau in Review: Program achievements and data quality report

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2019 Watershed Management Bureau in Review: Program achievements and data quality report

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Executive Summary

In 2019, the New Hampshire Department of Environmental Services (NHDES) Watershed Management Bureau (WMB) operated more than 20 programs to monitor, protect and restore the state's surface waters, including its lakes and ponds, rivers and streams, coastal waters, wetlands, and public bathing facilities. The diverse nature of these programs is exemplified by activities ranging from monitoring water quality to managing exotic species, sampling beaches to funding vessel waste disposal facilities, and supporting nonpoint source pollution control activities to inspecting pools and spas. In all cases, these programs are designed to promote the health of one of New Hampshire's most valuable natural resources: water.

A key element to the success of each program is the availability of a modern laboratory. The Jody Connor Limnology Center (JCLC) serves as the primary hub for field survey preparations and for water sample processing and tracking. In 2019, the JCLC processed over 11,000 water quality samples and approximately 400 identifications of biological organisms. The laboratory's capabilities range from simple tests of pH in water to the determination of mercury content in fish tissue. In addition, Colby-Sawyer College maintains a satellite laboratory to provide water analysis capabilities in cases where samples cannot be transported to Concord before they expire. Collectively, these laboratories are critical to the success of two volunteer surface water quality monitoring programs that monitored over 180 lakes and ponds and 3,000 river miles in 2019.

In 2019, more than 100,000 data records were collected from the state's surface waters by the WMB. With such a high volume of data, the maintenance and management of data quality is critical. Data quality is ensured through detailed, program-specific Quality Assurance Project Plans (QAPPs) and Standard Operating Procedures (SOPs). These documents outline specific procedures to confirm the acceptance of strictly high-quality data. NHDES maintains a catalog of these documents and updates them as dictated by the U.S. Environmental Protection Agency (EPA).

NHDES's Environmental Monitoring Database (EMD) houses millions of unique data points from over 46,000 monitoring stations and 800 individual projects. Data generated by the WMB are entered into the EMD via automated lab imports, batch uploads and manual entry. Applicable data are flowed to the EPA's Water Quality Exchange (WQX). The EMD is vital to the fulfillment of the WMB’s data management needs and responsibilities.

The aforementioned data is used for a variety of management purposes that are coordinated by numerous WMB programs. These activities include the synthesis of assessment reports, the completion of Total Maximum Daily Loads, and the pursuit of other methods to protect and restore water quality. While these programs are not strictly related to data collection and quality assurance for water quality parameters, they each keep track of metrics to document program success and output.

The following report describes the various program activities within the WMB that collected data, utilized the facilities of the JCLC in 2019, or provided services to the public. The report is organized into three sections; the first section provides individual program summaries in a standardized template for quick reference; the second section includes an account of the various quality assurance efforts that have been undertaken; and the third section provides a brief description of the lab and field safety measures that are in place.

I. WATERSHED AMBIENT MONITORING PROGRAM SUMMARIES

1.1 Jody Connor Limnology Center (JCLC)

Challenges Addressed: The JCLC practices rigorous science to ensure that water quality data can be used by communities and industry to make informed decisions about lake and river management. The JCLC also has the capacity to respond to water quality emergencies such as toxic algal blooms and chemical spills. The JCLC provides the necessary equipment, expertise, and space to process thousands of water quality samples and conduct field work associated with surface water assessments throughout the state.

Data usage: Data processed through the JCLC is used to complete surface water quality assessments, issue public health advisories, complete waterbody-specific reports, comply with regulatory activities and investigate general surface water quality concerns.

Approach: The JCLC provides equipment, analytical services and sampling services to support probability-based, targeted and trend monitoring activities.

Parameters measured: The JCLC and the Colby-Sawyer College Satellite Laboratory (CSC) provide analysis for approximately 25 chemical and physical parameters, as well as more than half a dozen biological parameters.

Method of data collection: Discrete samples are analyzed by JCLC staff. Continuous data records are generated by the deployment of remote water quality sensors.

Achievements: In 2019, the JCLC and CSC laboratories processed 14,636 chemical records. The JCLC analyzed 395 biological samples and made 2,368 species-specific identifications. For more specific information about the achievements of the JCLC in 2019, see Section 2.2 below.

Quality Assurance Measures: The JCLC and CSC laboratories each maintain a laboratory manual detailing quality assurance measures and procedures for each specific analysis. In-lab quality assurance measures include blanks, duplicate analyses, continuing calibration verification (CCV) samples and spikes, as appropriate. An in-depth summary of all quality assurance measures can be found in Section II of this report.

Funding: General Funds (1000 Account) and Federal Funds (Account 7602).

Program needs: Vital roles within the JCLC are shared amongst Watershed Management Bureau (WMB) monitoring staff. The Lab Safety Officer, Quality Assurance and Quality Control (QA/QC) Officer, and Data Administrator all share ambient monitoring program responsibilities. The JCLC took a small step by hiring a dedicated intern to manage JCLC analysis and data entry operations this past summer, which was quite successful. A full-time staff person assigned to assume these important functions in the JCLC would be a good next step.

A recent upgrade to Access 2016 caused several issues in the JCLC Database; these issues took a few months to iron out. Access databases are not supported by the Department of Information Technology (DoIT) and this issue highlighted the need for a more robust database. Since the JCLC database plays a critical role in the management of the sample load outlined above, the JCLC would benefit from an update to the database or its complete replacement.

1.2 Volunteer Lake Assessment Program (VLAP)

Challenges Addressed: VLAP works with lake associations to assess and protect the health of New Hampshire's lakes and ponds. Over 500 volunteers monitor summer water quality conditions at approximately 170 lakes. These data allow for the identification of potential problems so the problems can be mitigated before they impact recreation or fishing. VLAP reports are routinely requested by realtors and lakefront property buyers.

Data usage: Data generated through VLAP are utilized annually to create approximately 180 individual lake reports. VLAP is a primary source of lake and pond data, which is utilized to complete surface water quality assessments for the federally required section 305(b) / 303(d) water quality report. VLAP data are also utilized by the New Hampshire Department of Environmental Services (NHDES) to complete Total Maximum Daily Loads (TMDLs) and watershed management plans. Finally, VLAP data are utilized by lake associations and organizations to apply for grant funds.

Approach: VLAP conducts trend monitoring via repetitive visits to a set of established sampling locations annually or on an established schedule for the purpose of tracking water quality parameters over time.

Parameters measured: VLAP measures a total of 13 chemical and biological parameters including pH, conductivity, turbidity, apparent color, chloride, total phosphorus, alkalinity, *E. coli*, dissolved oxygen, temperature, transparency, chlorophyll-*a* and phytoplankton (including cyanobacteria).

Method of data collection: VLAP collects discrete samples at multiple in-lake and tributary stations.

Achievements: In 2019, VLAP and the CSC Satellite Laboratory accomplished the following:

- 475 individual sampling events conducted by volunteers and VLAP biologists.
- 185 lake deep spots and 500 river/stream stations monitored.
- 16,274 individual chemical and biological sample results generated.
- Approximately 3,700 hours collecting water quality samples.
- Approximately $96,000 value of volunteer time collecting water quality samples.

Quality Assurance Measures: VLAP operates under an EPA-approved Quality Assurance Project Plan (QAPP), RFA# 19074, dated April 2019. VLAP is required to update the plan once every five years and submit it to the U.S. Environmental Protection Agency (EPA) for approval. VLAP is also required to complete an annual program audit detailing any deviations from the methods and data criteria stated in the QAPP and the resolutions to those deviations.

Funding: General Fund (1000 Account).

Program needs: VLAP receives requests from lake associations and WMB staff to add lakes or increase monitoring capacity to supplement the development of water quality plans and to better understand current lake conditions. VLAP is at its maximum capacity and can no longer accept new lakes. Additional staff would be necessary to provide expanded services, support operations in the JCLC and complete annual biologist visits at participating lakes.

1.3 Volunteer River Assessment Program (VRAP)

Challenges Addressed: VRAP was initiated in 1998 to promote awareness of the importance of maintaining water quality in New Hampshire's rivers and streams. VRAP volunteers monitor water quality from May through October in rivers and streams throughout the state, allowing NHDES to analyze water quality trends, identify potential problems and fix them before they cause degradation to water quality.

Data usage: VRAP is primarily a data procurement mechanism to determine whether rivers or streams are impaired or potentially-impaired based on surface water quality standards and designated uses (e.g., swimming, fishing and aquatic life support). Data collected through VRAP are used to develop the federally required section 305(b)/303(d) water quality report. Almost 40% of the surface water quality assessments of riverine assessment units included in the 2018 303(b) report were provided by VRAP. These data contributed to the assessment of over 3,000 miles of rivers and streams.

Approach: VRAP conducts trend monitoring via repetitive visits to established sampling locations on an established schedule. Targeted monitoring is also conducted to investigate suspected sources of pollution or to measure water quality impacts as they relate to changes in the landscape (such as development).

Parameters measured: VRAP measures field parameters including dissolved oxygen, pH, turbidity, specific conductance, water temperature and flow. Laboratory parameters include *E. coli*, nutrients, chloride, and chlorophyll-*a*.

Method of data collection: VRAP collects discrete samples at multiple river and riverine impoundment stations.

Achievements: In 2019, data generated by VRAP volunteers are summarized as follows:

- 34 VRAP groups supported.
- 250 river/stream stations monitored across 3,000 miles of streams.
- 7,500 individual chemical and biological sample results generated.

Quality Assurance Measures: VRAP operates under an EPA-approved QAPP dated May 17, 2017. VRAP is required to update the plan once every five years and submit it to EPA for approval. VRAP is in the process of updating the QAPP. VRAP is also required to complete an annual program audit detailing any deviations from the methods and data criteria stated in the QAPP and the resolutions to those deviations.

Funding: Federal Funds (Account 7602).

Program needs: The day-to-day operations of VRAP are currently done by a part -ime staff member. If this position were to be made full time, it would reduce the need for assistance from current full-time staff, reduce turnover in the current part-time position and provide consistency in program operations.

1.4 River Trend Monitoring Program (RTMP)

Challenges Addressed: RTMP began in the early 1970s. Prior to 2012, it was known as the Ambient River Monitoring Program (ARMP). In 2013, NHDES updated its surface water monitoring strategy to include 40 river and stream stations that are visited three to five times per year. The revised monitoring network includes approximately 20 new stations that span a wide range of watershed sizes, levels of development, and geographic locations. Data collected since 1990 are maintained in NHDES' Environmental Monitoring Database (EMD). The RTMP is implemented directly by NHDES staff and measures water quality in rivers and streams throughout the state. Ultimately, this data is used by many programs both internal and external to the bureau.

Data usage: RTMP is primarily a data procurement mechanism to determine whether river or stream conditions are declining, improving or remaining stable over time. The data are also used to assess if river segments are impaired or potentially impaired based on surface water quality standards and designated uses (e.g., swimming, fishing and aquatic life support). Data collected through RTMP are used to develop the federally required section 305(b) / 303(d) water quality report.

Approach: RTMP conducts trend monitoring via repetitive visits to established sampling locations with the purpose of tracking water quality parameters over time. RTMP also conducts confirmation monitoring to determine if waterbodies can be removed from the 303(d) list. Additionally, RTMP conducts targeted monitoring of previously unsampled waterbodies to gain additional information about the condition of New Hampshire's surface waters. Targeted sampling is done by sampling locations chosen from 10-digit hydrologic drainage units (HUC 10) using a predetermined schedule.

Parameters measured: RTMP measures field parameters including dissolved oxygen, pH, turbidity, specific conductance, water temperature and flow. These parameters are collected via instantaneous measurements and deployable multi-parameter dataloggers. Laboratory parameters include *E. coli*, nutrients (nitrogen and phosphorus), chloride, chlorophyll-*a*, metals, cations and other parameters as needed.

Method of data collection: RTMP collects discrete and continuous samples at multiple river and riverine impoundment stations.

Achievements: In 2019, over 2,500 individual chemical and biological sample results were generated by RTMP.

Quality Assurance Measures: RTMP operates under an EPA-approved QAPP dated from 2015. RTMP is required to update the plan once every five years and submit it to EPA for approval. The RTMP is also required to complete an annual program audit detailing any deviations from the methods and data criteria stated in the QAPP and resolutions to those deviations.

Funding: Federal Funds (Account 7602).

Program needs: RTMP requires continued financial support for laboratory and equipment costs. Annual costs to process water quality samples through this program are approximately $25,000. The equipment used by this program includes both handheld meters and multi-parameter dataloggers that require regular maintenance and replacement. A recently identified limitation is the lack of funding for laboratory analyses for contaminants of emerging concern, such as PFAS. These tests tend to be very expensive.

1.5 Lake Trophic Survey Program (LTSP)

Challenges Addressed: LTSP was initiated in the mid-1970s to provide basic information about hundreds of lakes and ponds in New Hampshire. This program continued for over thirty years until 2008, when it was discontinued. The LTSP was reinitiated by the WMB in 2013 to generate periodic data for a portion of New Hampshire's lakes and ponds that are not included in one of the volunteer monitoring programs. The original purpose of the program remains: to determine a trophic rating and gather basic data for a lake or pond. Trophic ratings help determine to what level the water quality in a lake or pond needs to be regulated and track, over the long term, the health trend of the waterbody.

Data usage: LTSP establishes a lake trophic rating and determines if waterbodies meet their designated uses as dictated by the federally required section 305(b)/303(d) water quality report.

Approach: Lakes are selected from a schedule of targeted watersheds on a rotational basis (eight 10-digit hydrologic drainage units annually). The selection process is conducted by several biologists in the WMB and is guided, in part, by the age of available water quality data, public accessibility and recreational use of the waterbody.

Parameters measured: At the deep site of a lake, a dissolved oxygen/temperature profile is collected and the degree of stratification is assessed. Secchi depth is measured. A composite water sample from the mid-metalimnion is collected and analyzed for Chlorophyll-*a*, and a plankton haul is collected to mid-metalimnion depth. A discrete mid-epilimnion sample is collected and analyzed for alkalinity, pH, conductivity, apparent color, chloride, calcium, magnesium, NO_2 nitrogen, NO_3 nitrogen, TKN nitrogen, total phosphorus, sodium, sulfate, silica and dissolved organic carbon. Beginning in 2016 for newly selected waterbodies, spring sampling after ice-out (when possible) and a shoreline habitat survey (collected at 10 stations around the perimeter of each waterbody) were conducted. The data are used characterize the condition of the shoreline and nearshore habitat.

Method of data collection: The LTSP collects discrete samples.

Achievements: In 2019, 30 lakes were sampled by LTSP. Ten of the 30 were new for 2019, and sampling on the remaining 20 was initiated in either 2017 or 2018. Overall, a total of 604 chemical records were generated. Additionally, ten summary reports were finalized from the 2016 selection of lakes.

Since the LTSP participated in the 2017 National Lakes Assessment (NLA), it has been conducting intensification samples using NLA protocols and random drawings to sample a total of 50 New Hampshire lakes. This effort was concluded in the 2019 sampling season, and a report on this effort is expected in late 2020 or early 2021.

Quality Assurance Measures: LTSP's QAPP which was approved by the EPA in 2015. All analyses are performed in accordance with the JCLC Laboratory Manual or the Department of Health and Human Services (DHHS) Water Laboratory's National Environmental Laboratory Accreditation Conference (NELAC) certification.

Funding: General Funds (1000 Account) and Federal Funds (Account 7602).

Program needs: The LTSP requires continued financial support in order to maintain current staffing levels, laboratory analysis funds, and field equipment costs. It is important to note, however, that there are often 50 or more candidate lakes with data that are 20 years or older. At the current level of support, the program is only able to select 10 new lakes each year for sampling. At this pace, the NHDES will not be able update the data on all lakes and ponds in New Hampshire without increased capacity for sampling.

1.6 Biomonitoring

Challenges Addressed: The Biomonitoring Program was established in 1995 to determine the ability of the state's surface waters to support a healthy community of aquatic organisms. Sampling is conducted each year in the summer and fall, and it serves to satisfy federal water quality reporting requirements under sections 303(d)/305(b) of the Clean Water Act. To date, sampling by the Biomonitoring Program has primarily focused on rivers and streams.

Data usage: Data produced through the Biomonitoring Program are used to complete water quality assessments; these assessments determine whether rivers or streams are impaired or potentially impaired based on surface water quality standards and designated uses (e.g. aquatic life support). Biological data are used in the development of water quality standards, in regulatory decision-making. Data collected through the biomonitoring program are used to develop the federally required section 305(b) / 303(d) water quality report. The data are also used, in the tracking of site-specific trends in biological conditions and in the characterization of the variability associated with macroinvertebrate data.

Approach: Beginning in 2013, the Biomonitoring Program expanded to support three elements of the NHDES surface water quality monitoring strategy: trend, synoptic (targeted) and probability-based monitoring. Trend monitoring is conducted in collaboration with RTMP and encompasses the annual monitoring of approximately 28 long-term stations. Synoptic monitoring selects stations within eight to ten HUC 10 watersheds each year.

In 2019, the Biomonitoring Program assisted other WMB staff with deployment and retrieval of 23 water temperature loggers and with the completion of water quality monitoring at 40 trend monitoring sites and 25 synoptic monitoring sites between May and October. At 38 of these locations (28 trend, 10 synoptic), Biomonitoring staff coordinated the collection of macroinvertebrate data. With assistance from WMB staff, rock baskets were deployed and then retrieved approximately 8 weeks later. Collection of fish data occurred during 76 sampling events (9 trend, 51 synoptic, 16 probability) at 71 different locations. For the fifth consecutive year, NHDES and the New Hampshire Fish and Game Department (NHFG) worked cooperatively to conduct fish surveys at several trend sites. The Biomonitoring Program assisted NHFG with Brook Trout, Alewife and Blueback Herring surveys.

Parameters measured: Fish, macroinvertebrates, dissolved oxygen, pH, specific conductance, water temperature, flow, physical habitat characteristics and various laboratory-generated water chemistry parameters.

Method of data collection: Data are collected using continuous measures and surveys of water quality. Sample types include: discrete samples (chemical water quality parameters, stream flow), continuous samples (physical water quality parameters), and surveys (macroinvertebrates, fish, algae, habitat, gradient, sediment/pebble).

Achievements: In 2019, the Biomonitoring Program collected the following data:

- Temperature Loggers: Assisted WMB staff with the deployment and retrieval of 23 water temperature loggers.
- Water Quality: Assisted WMB staff with water quality monitoring at 40 trend and 25 synoptic monitoring sites.
- Macroinvertebrate Samples: Deployed and retrieved 118 samples from 42 sample sites (>26,000 data points).
- Fish Surveys: Surveyed 76 sample sites (>26,000 data points).

Quality Assurance Measures: The Biomonitoring Program operates under the RTMP QAPP (Section 1.4). The Biomonitoring Program is also required to complete a bi-annual program audit detailing any deviations from the methods and data criteria stated in the QAPP and resolutions to those deviations. Specifics on the Biomonitoring Program's QA/QC efforts can be found in Section 2.4.

Funding: Federal Funds (Account 7602).

Program needs: The Biomonitoring Program requires continued support for sample processing, supplies, and equipment on an annual basis. Although expensive, the program would be enhanced by microalgal sampling and toxological analysis.

1.7 Fish Tissue Mercury Monitoring Program

Challenges Addressed: The Fish Tissue Mercury Monitoring Program collects data on the mercury content in the tissue of freshwater fish species within the State of New Hampshire. The source of mercury contamination is from airborne stack emissions; some emissions occur regionally and other emissions are blown in by prevailing winds from the west. This makes mercury contamination of fish a widespread problem in New Hampshire.

Data usage: The data are used to conduct risk assessments for mercury exposure from fish consumption. Risk assessments are used to update statewide and, if appropriate, waterbody-specific fish consumption advisories. The data are also used to track trends for the mercury content in fish tissue over time. A summary report was initiated in 2015 and finalized in 2018. The report includes data from 1992 through 2017.

Approach: Data is collected through trend and targeted monitoring. Most samples are supplied by volunteers who deliver fish from the lake on which they live or often fish. Additional fish may be obtained through specific studies related to regulatory changes designed to reduce the deposition of atmospheric mercury. Additionally, certain waterbodies have been targeted for long-term sample collection as a part of broader trend monitoring procedures.

Parameters measured: Mercury content in fish tissue is expressed as milligram of elemental mercury per kilogram of fish, weight and length of the fish.

Method of data collection: Discrete samples are analyzed by staff for mercury content.

Achievements: Typically, over 100 fish are analyzed annually. A report (R-WD-17-22) titled *"Status and trends of mercury in fish tissue in New Hampshire waterbodies, 1992-2016"* was released in 2018.

Quality Assurance Measures: The scale used to determine fish weight is inspected and certified annually by a third party (contractor). Blanks, duplicates, CCV and spikes are performed in accordance with JCLC laboratory manual protocols.

Funding: General Fund (1000 Account).

Program needs: A revised sampling design must be established in order to maintain consistency in the number of fish analyzed, waterbodies sampled and fish species assessed. Implementation of the revised design requires collaboration from NHFG. The Milestone DMA-80 used to analyze fish tissue is 15 years old and starting to develop problems; Milestone considers this instrument obsolete, which means that it will become more difficult for NHDES to attain replacement parts as time goes on. A new replacement machine will cost over $40,000.

1.8 Acid Rain Deposition Program

Challenges Addressed: The Acid Rain Deposition Program collects data on acid rain deposition and determines its effects on sensitive lakes and ponds. Acid deposition results from regional and westerly power plant stack emissions as well as from automotive emissions.

Data usage: Data are used to conduct trend analysis on the effects of acid rain deposition and to determine the effectiveness of air pollution regulations. Data have been used by NHFG to make stocking decisions on acid-sensitive ponds and lakes. In 2015, a summary report was completed based on data collected from the mid-1980s through 2014.

Approach: Data is collected through trend monitoring. Lakes and ponds included in this monitoring program have been monitored consistently in excess of 30 years. Twenty ponds are sampled by WMB staff, and 10 remote ponds are sampled cooperatively by NHFG during helicopter stocking events. Rain is also collected in Concord, NH, and it is analyzed to verify source inputs to lakes and ponds.

Parameters measured: Samples from lakes and ponds are analyzed for pH, acid neutralizing capacity, conductivity, color, sulfate, nitrate and chloride. Rain samples collected in Concord are analyzed for pH, nitrate, sulfate and total phosphorus.

Method of data collection: Discrete samples are analyzed by JCLC staff. Samples are collected from specified lake outlets in the spring and fall. Rain event samples are collected at NHDES headquarters in Concord, NH.

Achievements: Twenty lakes and ponds are sampled twice per year, 10 helicopter-stocked lakes are sampled once per year during stocking activities, and rain is sampled every time there is a rain event significant enough to yield the volume necessary for testing. In 2019, data generated by the Acid Rain Deposition Program are summarized as follows:

- 346 chemical records were generated to support the lake monitoring effort.
- 66 rain events were sampled.
- 267 analyses were performed.

Quality Assurance Measures: The Acid Rain Deposition Program operates under the LTSP QAPP (Section 1.5), which was approved by the EPA in 2015.

Funding: General Funds (1000 Account) and Federal Funds (Account 7602).

Program needs: The Acid Rain Deposition Program requires continued support to meet current staffing needs, to fund laboratory analyses and to maintain access to functional equipment.

1.9 Surface Water Quality Complaints

Challenges Addressed: Investigate concerns reported to the WMB by staff and the public which have the potential to impact surface water quality.

Data usage: Data are evaluated to determine if an issue or water quality violation exists. If an issue exists, there may be administrative action taken by NHDES or a referral to another agency to take action.

Approach: If an investigator deems that monitoring is warranted, targeted sampling is conducted at strategically located stations. All complaints are logged into a complaint module of the EMD.

Parameters measured: The parameters measured depend on the nature of the complaint.

Method of data collection: Data is collected via continuous monitoring or discrete samples, depending on the nature of the complaint.

Achievements: In 2019, 64 complaints were received, and 41 of those 64 complaints were investigated. Samples were processed for 18 individual complaints in the JCLC.

Quality Assurance Measures: Quality assurance measures depend on the parameter being measured, and they must comply with the JCLC Laboratory Manual or DHHS Water Laboratory protocols.

Funding: General Funds (1000 Account).

Program needs: This program is administered by one member of the staff who has other duties. In the summer when monitoring activities are at their maximum, resources for field investigations and sampling are limited. Necessary resources include vehicles and sampling equipment.

1.10 Public Bathing Facility Program (PBFP)

Challenges Addressed: RSA 485A:26 requires NHDES to operate a year-round statewide PBFP to ensure public health and safety at bathing facilities such as pools and spas. The PBFP works to minimize health risks and safety concerns for New Hampshire residents and visitors who use public pool and spa facilities. Exposure to contaminated, poorly-managed and poorly-maintained pool and spa water in New Hampshire has resulted in lung, skin, ear, and eye infections, as well as gastric illness caused by pool chemicals, airborne pathogens or waterborne pathogens such as Legionella, Cryptosporidium, Giardia, Staphylococcus, Norovirus and E. Coli. The program has established standards of design to ensure that water quality is regularly sampled and analyzed, construction designs to provide for safe use, and protocols to ensure that scheduled maintenance is regularly performed.

Data usage: Data generated through the PBFP are used to evaluate facility compliance with state and federal public health and safety laws, to determine enforcement actions, to prioritize seasonal/regional inspections, to shape educational outreach efforts and to make historical comparisons to evaluate program effectiveness. The U.S. Center for Disease Control makes periodic requests for data from PBFP to study chlorinated aquatic venues.

Approach: The PBFP uses a targeted monitoring approach. The PBFP conducts periodic routine inspections to evaluate public health and safety, and it responds to illness complaints.

Parameters measured: The PBFP measures a total of 10 chemical and biological parameters. In-situ analysis includes temperature, pH, free chlorine, total chlorine, combined chlorine, bromine, turbidity, total dissolved solids, cyanuric acid, hardness and alkalinity. Field samples are submitted to DHHS's Public Health Laboratory (PHL) for *E. coli* and total coliform analysis.

Method of data collection: PBFP collects discrete samples at public bathing facilities statewide.

Achievements: In 2019, PBFP achieved the following:

- Inspected 251 facilities.
- Collected 431 samples for chemical and microbial analysis.
- Identified 143 water quality violations.
- Identified 95 safety/facility violations.
- Issued 12 Letters of Deficiencies.
- Issued 42 Notices of Deficiencies.
- Issued 12 full design permits for new construction.

Quality Assurance Measures: PBFP follows and updates the PBFP Field Inspection QA & SOP manual (last updated 5/23/2017). PBFP staff follow JCLC QA measures for specific analyses. PBFP is also required to complete an annual program audit detailing any deviations from the methods and data criteria stated in the QA manual and resolutions to those deviations.

Funding: General Funds (1000 Account).

Program Needs: This program needs a dedicated account and higher fees for inspection and design to adequately staff the program. Long sought after database updates and the incorporation of e-enterprise practices must be realized for a significant boost in efficiency. The effectiveness of this program will be dictated by the ability to increase the inspection rate, effectively manage data, and provide a broad education/outreach initiative directed at pool owners and operators.

1.11 Public Beach Inspection Program (PBIP)

Challenges Addressed: The mission of the PBIP is to protect the health of residents and visitors who swim at New Hampshire's public beaches by collecting water from coastal and freshwater beaches to test for fecal bacteria. During the summer swim season, NHDES personnel monitor 100 freshwater public bathing beaches on a monthly, bi-monthly or weekly basis and 16 coastal beaches on a weekly, bi-weekly or bi-monthly basis according to a tiered monitoring plan that varies annually. When bacteria counts at designated public beaches are higher than the state criteria, an advisory is issued within approximately 24 hours of sampling to notify the public of potential health risks. The program also responds to complaints about cyanobacteria blooms and posts advisories during extreme bloom events.

Data usage: The primary function of the data collected by the PBIP is to identify the public beaches where potential health risks are present. Bacteria counts inform the severity of public health advisories. Over time, data from the PBIP are used to determine impairments for the 303(d) list of impaired waters. Cyanobacteria data also help to inform the safety of surface waters that supply public drinking water.

Approach: PBIP uses a targeted approach. Samples are collected at individual beaches based on a predetermined schedule. The analysis results guide daily posting decisions for alerts regarding public health and safety. Follow-up sampling is conducted as necessary at beaches with advisories until fecal bacterial levels fall below state criteria.

Parameters measured: The main parameters measured are fecal bacteria (*E. coli* – freshwater beaches; enterococci – coastal beaches). Beach inspections also measure temperature and salinity, record the number of bathers, waterfowl, and dogs, and assess the general conditions of the beach and water. Additionally, water clarity, coastal tide levels and any other concerns or comments are noted during visits to beaches.

Method of data collection: Discrete data points are collected during each beach visit.

Achievements: In 2019, PBIP achieved the following:

- Collected 2,068 bacteria samples (not including duplicates; 210) from New Hampshire beaches.
- For freshwater beaches:
    - Collected 1,291 bacteria samples, with 60 fecal bacteria advisories.
    - Issued 34 cyanobacteria advisories.
- For coastal beaches:
    - Collected 777 bacteria samples, with three fecal bacteria advisories from two of the beaches.
- A lean event was implemented for the PBIP in 2019 to reevaluate programmatic needs. The following determinations were made:
    - Certain freshwater beaches need to be monitored more frequently.
    - A separate program should be designated to effectively monitor cyanobacterial blooms.
    - In December of 2019, an additional WMB position was granted to meet the needs of monitoring for harmful algal and cyanobacterial blooms. This new position will allow the WMB to advance techniques for monitoring blooms while allowing the Beach Program Coordinator to focus of achieving the goals of the Federal BEACH Act.

Quality Assurance Measures: PBIP operates under an EPA-approved QAPP which was updated in 2017 (RFA# 17075).

Funding: Federal Funds (Org. Code: 2065; approximately $190,000 per year).

Program needs: It is necessary to research new and innovative techniques for modeling and understanding elevated levels of bacteria at beaches to advance the PBIP. There is an immediate need to hire a Beach Program Coordinator who can provide technical assistance and data management skills to evaluate the trends of beach conditions in New Hampshire.

1.12 Clean Vessel Act (CVA) Program

Challenges Addressed: The New Hampshire CVA program works to ensure that wastewater from boats is disposed of properly. Given the vast and growing number of boaters in New Hampshire, education is much more important than enforcement. The program works with marinas and the boating public to educate boat owners about how to manage sewage and graywater in a way that protects New Hampshire's surface water quality. The program provides funding for mobile and stationary pumpout facilities to ensure that plenty of options for wastewater offload are available.

Data usage: The location, availability, and operation status of stationary and mobile pumpout resources is tracked. This information is provided to the public boating community, and it is used internally to identify potential CVA funding assistance opportunities. Additionally, data from the mobile pumpout services is collected and stored. There is also an Access database that houses boat inspection information.

Approach: Targeted information is collected annually about stationary and mobile pumpout resources through grantees, contractors, and facility owners. The CVA program offers grants year-round to help keep pumpouts operational.

Parameters measured: Information collected may include the location of the pumpout resource, whether it is stationary or mobile, marina amenities, pumpout system mechanical information, system availability, usage fee collected (if any), participant contact information, vessel name, vessel type, and estimated wastewater gallons pumped. Information for the boat inspection database is collected from individual boat registrations and wastewater systems that include graywater and marine sanitation devices. Details on location, dates of inspections and/or re-inspections, and compliance/non-compliance issues are documented by the boat inspector.

Method of data collection: Staff use data sheets for site visits of stationary facilities. Grantees are required to document boater information and wastewater estimates in logbooks in order to receive annual reimbursement for upkeep costs. The mobile pumpout services collect information using a physical receipt during each service. The boat inspection program collects data on physical forms or may enter data directly into a laptop if one is available.

Achievements: In 2019, the program accomplished the following:

- The northern coast and Great Bay mobile pumpout boat documented about 981 captain hours, 339 serviced boats, and approximately 9,772 gallons of wastewater pumped.
- The Hampton Harbor pumpout boat documented about 205 captain hours, 234 serviced boats, and approximately 3,851 gallons of sewage pumped.
- Since 2002, the mobile pumpout services have pumped off approximately 199,385 gallons of boater wastewater.

Quality Assurance Measures: Input from data sheets, logbooks, and receipts are verified either by the seasonal intern or by the CVA program coordinator. Boat inspection database entries are reviewed either by the boat inspection program staff or by the CVA program coordinator.

Funding: Federal Funds (Org. Code 2061; SFY 2019 $305,090).

Program Needs: Currently the program funds 50% of a full-time staff position (the program coordinator) and a summer intern position. In 2018 and 2019, the boat inspector position was vacant. Typically, the inspector position works weekends, about 5 hours a week or less. The summer intern position was filled in 2018 and 2019 after many years of vacancy. Future goals include reviewing staff needs and increasing the percent of time for the full-time staff position. The boat inspector position was difficult to fill due to its limited hours, and the limited hours resulted in decreased effectiveness of the position. It may be beneficial to the inspection program overall to increase the hours of the boat inspector position or for the program coordinator position to assume the boat inspection responsibilities.

1.13 Exotic Species Program

Challenges Addressed: The primary purpose of New Hampshire's Exotic Aquatic Plant Program is to "prevent the introduction and further dispersal of exotic aquatic weeds and to manage or eradicate exotic aquatic weed infestations in the surface waters of the state" (RSA 487:17, II). Aquatic invasive species are a constant threat to the ecological, biological, recreational and economic values of New Hampshire's waterbodies. Infestations lead to waterbody impairments and reductions in the value of the resources.

Data usage: Data generated through the Exotic Species Program guide control activities on waterbodies. Data are also used to track concentrations of aquatic herbicides that may be used in various waterbodies and to determine the presence/absence of invasive aquatic plants in waterbodies.

Approach: The Exotic Species Program uses a trend monitoring approach. Repetitive visits are made to infested waterbodies to track infestations (size, density, distribution) over time. Targeted water quality monitoring may also be performed to document conditions before, during, and after the implementation of control practices.

Parameters measured: The Exotic Species Program surveys plant location, density and percent cover annually on infested waters. Water depth, clarity, dissolved oxygen concentrations, herbicide concentrations, nutrient concentrations, temperature and turbidity may also be monitored.

Method of data collection: Data are collected via discrete samples and observations at multiple stations in lakes and ponds for plant surveys, or as needed for special studies. Dataloggers are occasionally deployed for continuous data collection of parameters like dissolved oxygen.

Achievements: In 2019, the Exotic Species Program collected the following data:

- A total of 90 waterbodies infested (dating back to 1970).
- One new infestation of a state-listed aquatic invasive plant (spiny naiad, *Najas minor*) was documented in Country Pond in Newton. A new Asian clam infestation was documented in Little Island Pond, Pelham.
- 218 plant identifications.
- >80 field inspections (GPS).
- 47 pet store inspections.

Quality Assurance Measures: Activities performed by the Exotic Species Program are described in the QAPP for the program, which was approved in 2014 by EPA, with an update and revision approved by EPA in 2019. It is currently under review and revision in advance of a renewal of the plan.

Funding: State Fee Funds derived from boat registrations total approximately $893,000 annually.

Program Needs: Additional funding is needed to expand control efforts. Currently, just under half of the waterbodies with infestations are being managed. Grant awards for management are provided by the state, but local entities assume at least 60% of the cost of management at the municipal or non-profit level.

1.14 Chloride Reduction efforts

Challenges Addressed: Chlorides are toxic to aquatic organisms, plants and to the infrastructure that supports our roads and bridges. NHDES has documented increasing chloride pollution in both lakes and rivers over the past 20 years. The primary source of those chlorides is road salt used for winter road maintenance. NHDES has established a number of programs to address this issue, including implementation monitoring for the TMDL for chloride for water bodies in the vicinity of the I-93 corridor from Massachusetts to Manchester, NH and a voluntary commercial salt applicator certification program (Green SnowPro or GSP). Each of these programs has been successful in their respective efforts to reduce chloride contamination of the environment.

Data usage: The data is used to determine compliance with the I-93 TMDL and to judge the success of the commercial salt applicator program.

Approach:

- Continuous datasonde monitoring at four stations along the I-93 corridor.
- Handheld measurements and grab samples are collected at one site weekly and at all sites every three weeks.
- Datasonde QA/QC checks, data download and maintenance every six weeks.
- Over 1,200 approved certificates for salt applicators.

Parameters measured: The TMDL implementation monitoring program measures temperature, specific conductance and chloride. The chloride samples are processed and tested at the JCLC**.** The GSP program collects salt application data as part of the application for certification as specified in RSA 489-C.

Method of data collection: The TMDL implementation monitoring program collects continuous data via datasonde monitoring at four stations along the I-93 corridor and discrete data via grab samples collected at the same stations. The GSP program collects data about salt application habits via electronic (PDF or Word attachments) forms, facsimile, or the direct mailing of hard copy applications.

Achievements:

- 34,000-35,000 data points collected per station per year along the I-93 corridor.
- Over 1,200 certified salt applicator certificates issued by GSP since 2011.

Quality Assurance Measures: A full description of all the data quality control measures for the TMDL implementation monitoring program are contained in a 2006 EPA-approved QAPP, the 2018 ARMP QAPP and updated field SOPs for the I-93 Implementation monitoring program. Certified Salt Applicators must apply for certification annually and must meet the requirements listed in the RSA.

Funding: NHDES has expended all of the funding dedicated to the TMDL and monitoring by NHDOT as part of the I-93 study. Additional monitoring funds may become available as a result of the future Exit 4A project. The Commercial Certified Salt Applicator Program became fee-based as of June 2018. Application costs are tiered and written into the RSA. These funds support a part time Salt Reduction Coordinator position.

Program Needs: The part-time GSP Salt Reduction Coordinator position was filled in August 2018. The position is tasked with processing hundreds of applications each year, planning for the annual Salt Symposium, organizing and hosting full and refresher training courses, assisting with database development, and conducting outreach, education, evaluation and implementation of new marketing opportunities. The scope of work associated with this program merits a full-time coordinator position.

1.15 NHDES Shellfish Program

Challenges Addressed: The mission of the Shellfish Program is to ensure that the shellfish harvested in New Hampshire meet standards for human consumption. The program monitors coastal waters for bacteria, viruses and algal blooms that produce biotoxins which can accumulate to potentially fatal levels in shellfish. The program creates the regulatory conditions that allow the commercial shellfish industry to legally harvest and engage in interstate commerce. Recently, the commercial shellfish industry has grown rapidly in New Hampshire, adding 2-3 commercial aquaculture farms per year since 2011. In 2019 there were 28 oyster farms, four oyster upwellers and five blue mussel farms. The program also ensures the safety of recreational shellfishing.

Data usage: Data generated by the Shellfish Program are used to prepare and update Sanitary Survey reports for the eight major shellfish growing areas in the state's jurisdiction. Data generated by the program are also used to make daily and weekly management decisions regarding which harvesting areas are open or closed based on current information on public health threats such as red tide levels, recent rainfall, boating and mooring surveys and more. These decisions are communicated to the public through a hotline message and internet-based tools.

Approach: The Shellfish Program implements a systematic random sampling program to maintain updated bacteria data on 70 monitoring stations in the state's tidal waters. Data from event-based seawater and shellfish tissue testing after pollution events (such as heavy rainfall events) are used to supplement the ambient program and to support management decisions. Additional monitoring programs include Harmful Algal Bloom Monitoring, the Shoreline Survey Program, new monitoring programs focused on *Vibrio* bacteria risk assessment and on viral indicators of sewage pollution.

Parameters measured: Seawater and shellfish tissue sampling programs document fecal coliform bacteria, water temperature, salinity and other observations; phytoplankton monitoring and biotoxin levels in blue mussels and other shellfish species; water temperatures near commercial oyster farms and *Vibrio* bacteria levels in oysters; and Male Specific Coliphage (virus) levels in municipal wastewater treatment facility effluent, as well as in oysters, softshell clams, and blue mussels.

Achievements: In 2019, the Shellfish Program accomplished the following:

- 50 rounds of sampling on tidal waters.
- 1,032 seawater samples collected.
- 17 rounds of sampling in response to rainfall events.
- 104 red tide samples collected.
- 639 commercial harvesting decisions generated.
- 111 wastewater treatment facility calls evaluated.
- 62 harvesting hotline updates implemented.
- 1,985 properties surveyed and tracked for pollution.
- 10 marina/mooring field surveys performed.
- 882 pollution sources tracked.
- 35 rounds of pollution source sampling completed.

Quality Assurance Measures: The Shellfish Program operates under three EPA-approved QAPPs, dated May 2013, addressing ambient monitoring, Red Tide monitoring and Shoreline Survey monitoring. All three are currently being redrafted for the 5-year updates. The "Red Tide" monitoring QAPP is being revised into a "Harmful Algal Bloom" QAPP that will incorporate new monitoring programs involving weekly sampling and enumeration of selected marine phytoplankton. The Shellfish Program is also required to complete a program audit every other year detailing any deviations from the methods and data criteria stated in the QAPPs and resolutions to those deviations.

Funding: General Fund (Org. Code 1523; FY 2020 $438,758).

Program Needs: Increased capacity for offshore/nearshore monitoring of Harmful Algal Blooms needs to be developed. Increased capacity for managing growing commercial aquaculture industry is also needed.

1.16 Special Studies

Challenges Addressed: Special studies are directed by short-term monitoring efforts to collect data for the purposes of evaluating the environmental impact of a temporary event (such as construction), to answer a specific scientific question, to evaluate a data collection method, or to solve a specific problem within a waterbody or watershed.

Data usage: The primary use of data is to fulfill the goal of the study. Any ambient monitoring data will be available for other programs to use via upload to the EMD.

Approach: Special studies generally use a targeted monitoring approach.

Parameters measured: The parameters measured are determined by the study design.

Method of data collection: The method(s) of data collection are determined by the study design.

Achievements: In 2019, the following achievements were made in support of special studies:

- Extra lake habitat surveys were conducted to accentuate the dataset collected by the LTSP.
- Seventy habitat surveys were conducted on seven waterbodies.
- Seven special studies were in progress involving the JCLC, including:
    - 15 analyses for the Hothole Pond Special Study.
    - 33 analyses for the Nippo Lake Special Study.
    - 14 analyses for the Silver Lake Special Study.
    - 27 analyses for the Spiny Water Flea monitoring project.
    - 348 analyses for the Lake Regional Monitoring Network.
    - 25 analyses for the River Regional Monitoring Network.
    - 47 analyses for additional waterbody data collection.

Quality Assurance Measures: Quality assurance measures are determined by the study design.

Funding: Various funding sources support WMB special studies.

Program Needs: There are no specific needs at this time.

1.17 Wetland Monitoring Program

Challenges Addressed: Currently, NHDES has no wetland-specific water quality criteria for the completion of assessments under the Clean Water Act section 305(b). Wetland monitoring using the protocols described below began in 2014 and 2015 under an EPA Wetland Program Development Grant (WPDG) to identify tools and criteria for wetland condition assessment in New Hampshire. Included among the protocols and assessment methods applied were Maine Department of Environmental Protection's (MDEP) protocols for its predictive model for wetland assessment, based on macroinvertebrate sampling of lacustrine and other open freshwater wetlands. Sampling continued in 2016 and 2017 under a second WPDG. A total of 44 wetland sampling surveys were completed. During 2016, NHDES also participated in the National Wetland Condition Assessment effort, sampling 12 additional wetlands using EPA protocols.

Data usage: Data produced through the Wetlands Monitoring Project are being used to evaluate the applicability of several tools for the assessment of wetland conditions in New Hampshire.

Approach: Targeted for sampling were lacustrine aquatic bed wetlands and palustrine emergent and aquatic bed wetlands representing a range of human disturbance. Sampling was conducted between late June and mid-August of each field season.

Parameters measured: Parameters measured by the Wetlands Monitoring Project include aquatic macroinvertebrate community composition, vegetation community composition, the physical and chemical characteristics of water (including nutrients, chloride, pH, specific conductance, temperature, alkalinity), and landscape condition. GIS tools were used to evaluate landscape condition.

Method of data collection: Discrete biological and water samples were collected as described below:

- Field analyses: Took instantaneous measurements of field parameters including dissolved oxygen, pH, turbidity, specific conductance and water temperature at three locations in each wetland.
- Water grab samples: Collected one grab sample in each wetland and analyzed the sample for nutrients (nitrate-nitrite, total Kjeldahl nitrogen, total phosphorus), chloride, chlorophyll-a, dissolved organic carbon and alkalinity.
- Macroinvertebrate samples: Sampled benthic macroinvertebrates using a dip-net, from a canoe or by wading, at three locations in each wetland (three "replicate" samples).
- Landscape analysis: Collected information on physical habitat parameters (land use, terrain, dominant plant species, presence of invasive plant species, and substrate composition).
- Ecological Integrity Assessment (EIA): Applied the rapid assessment protocols developed by the New Hampshire Natural Heritage Bureau, which includes a GIS-based landscape analysis, stressor evaluation, as well as vegetation-based surveys that can support the application of Floristic Quality Assessment methods (FQA).
- Wetland Human Disturbance Assessment (WHDA): Conducted a rapid survey of each wetland, the surrounding landscape within 100 feet and the surrounding landscape within the watershed of the assessment area.
- Vegetation sampling: Sampled aquatic vegetation with a shrub rake at three locations within each wetland, or surveyed vegetation at three locations and at shoreline areas present to support the application of FQA.

Achievements: From 2014 to 2017, the Wetland Monitoring Program collected data at 44 sampling visits (42 distinct wetlands). Two wetlands were visited twice to address the low total abundance or generic richness of the initial macroinvertebrate samples.

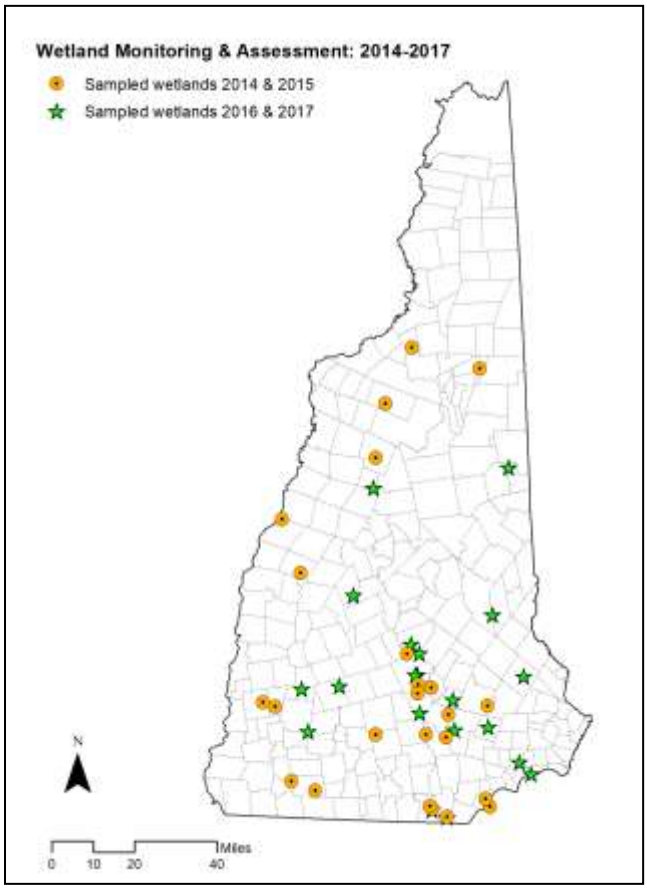
- NHDES developed detailed aquatic plant sampling protocol and provided training to MDEP biomonitoring staff for their use with biomonitoring.
- The MDEP predictive model assigned attainment cases to 32 of 44 sampled wetlands. Low abundance or low generic richness affected the ability to assign attainment classes to 12 wetlands.
- The application of two rapid assessments (EIA and WHDA) and FQA metrics have provided useful information about indicators of disturbance that can continue to be used and refined in future work. The correlation between the EIA-Land Use Index scores and chloride levels provides strong support for the potential to use the Land Use Index alone as a screening level tool for targeted sampling.

- Analyses of the four years of sampling data may identify additional metrics or tools for wetland condition assessment and potential criteria.
- This study represents NHDES's initial efforts to collect macroinvertebrate and water quality data specifically in wetlands. The resulting data have started to fill a gap in our knowledge of New Hampshire's wetlands.

Quality Assurance Measures: The Wetland Monitoring Program quality assurance protocols are described in the project-specific QAPP developed in 2014 and updated in 2016, covering physical, chemical, biological and landscape data collection used to evaluate wetland condition. All data were quality assured by applying specific measures as specified in the EPA-approved QAPP.

Funding: EPA WPDGs funded the majority of this wetland monitoring and assessment work. Match resources were partially provided by a Wetlands Bureau staff person who participated on the sampling team.

Program Needs: After completion of the 2017 field season and subsequent analysis and report, no funding was sought for additional monitoring and assessment work. Further work to develop wetland-specific water quality standards will require more funding (and match).



1.18 Surface Water Quality Assessments (305(b)/303(d))

Challenges Addressed: The water quality status of New Hampshire's surface waters are reported in accordance with Section 305(b) and 303(d) of the Clean Water Act (CWA), and New Hampshire Statutes Chapter 485-A:4.XIV. Per the CWA, assessments are to be completed biennially on even-numbered years.

Data usage: Assessments are viewed and used by the general public, local, state and federal agencies, as well as non-governmental organizations. Assessment results are formally sent to EPA for transmital to Congress. All assessment results are made availiable to the public via the program website and a web-based data mapper.

Assessments determine if a waterbody meets its designated uses. Waters that do not meet one or more designated use are considered impaired. In cases where a waterbody meets one or more of its designated uses, protection measures may be an appropriate management action. The Surface Water Quality Assessment Program (SWQAP) does not take any actions based upon the attainment determinations, but rather provides that information to other programs. Impaired waters become eligible for 319 restoration funds. Impairment status may influence certain permitting actions.

Approach: Asessments are conducted in a step-wise fashion. First, the Supplemental Assessment Database (SADB) manages all imported sample data and performs the initial sample level water quality standard comparisons. Next, each waterbody/parameter combination is summarized in bulk, and those bulk assessments are quality assured by a second individual. Third, the detailed lists of waterbodies with significant changes and/or borderline assessments are subjected to detailed review using a tool that allows all samples to be paired up with weather and flow data. Finally, all new impairments and de-impairments are vetted through professional staff to confirm that the data are sufficient to support those decisions.

Method of data collection: The primary source of data for the assessments is the EMD. Every two years, as part of the assessment process, a snapshot of "recent" samples is imported to the SADB for processing and tracking. The snapshot includes discrete and continuous data records.

Achievement: For 2018 cycle, the SWQAP reviewed the following to complete designated use support decisions:

- 246 different project sources of data.
- 8,971 monitored stations.
- 411,744 individual sampling events.
- 368,475 day/parameter combinations from datalogger record sets.
- 1,702,300 individual chemical and biological grab sample results.
- 3,980,623 individual water quality standard comparisons were made.

Quality Assurance Measures: In addition to the quality assurance methods of each of the data sources, the assessment is guided by set of standard procedures called the Consolidated Assessment and Listing Methodology (CALM). More information about CALM is available on the Surface Water Quality Assessment publications website.

In summary, assessments are conducted in a few steps. First, the SADB manages all imported sample data and performs the initial sample level water quality standard comparisons. Second, each waterbody/parameter combination is summarized in bulk and those bulk assessments are quality assured by a second individual. Third, the detailed lists of waterbodies with significant changes and/or borderline assessments are subjected to detailed review using a tool that allows all samples to be paired up with weather and flow data. Finally, all new impairments and de-impairments are vetted through professional staff to confirm that the data are sufficient to support those decisions.

Funding: Federal Funds (Org. Code: 7602).

Program Needs: The process of the biennial vetting of assessments through NHDES professional staff could be leaned.

1.19 Total Maximum Daily Load (TMDL) Program

Challenges Addressed: The TMDL Program develops pollution budgets for impaired waters. TMDLs have been developed for rivers/streams and lakes/ponds. In the past several years, the focus of TMDL development has been on bacteria and nutrient impairments.

Data usage: The TMDL Program uses the EMD to estimate nutrient loads and develop the estimated reductions necessary to achieve water quality targets. As needed, supplemental data is collected to develop, update and/or confirm existing data.

Approach: Data used in the development of TMDLs are targeted to the specific waterbody of interest or those draining into or out of the waterbody of interest.

Method of data collection: When necessary, the TMDL program collects discrete and continuous data in lakes, ponds, rivers and streams to develop each TMDL project. When samples are collected, they are done so following the applicable EPA-approved programmatic QAPP(s).

Achievement: Since 2000, EPA has approved 946 TMDLs in New Hampshire. In 2017, EPA approved the Northeast Regional Mercury TMDL, which accounted for 5,124 additional TMDLs.

Quality Assurance Measures: The TMDL program uses data in the EMD that has been collected in adherence to an EPA-approved programmatic QAPP. The TMDL program is also required to complete an annual program audit detailing any deviations from the methods and data criteria and resolutions to those deviations.

Funding: Federal Funds (Org. Code: 7602)

Program Needs: The program would benefit from additional staff resources to assist in the development of TMDLs.

1.20 Rivers and Lakes Management and Protection Programs

Challenges Addressed: The Rivers and Lakes Management and Protection Programs provide a mechanism for public recognition and management of important state waterbodies. In addition, it participates in the development and implementation of statewide surface water management policies.

Data usage: The Instream Flow (ISF) Program uses stream flow data to determine when management actions are needed, including water use restrictions and flow releases on designated rivers for which protected instream flows have been established. The Program also measures river stage and flow to develop rating curves for locations without stream gages.

Method of data collection: Continuous data records are obtained for stream flow and water temperature. Discrete field measurements of stream velocity, stream depth and width are collected to estimate streamflow when gages are not available.

Achievements:

- 1 New ISF Program environmentalist position to develop water management plans for all Designated Rivers.
- 19 Designated Rivers; 1,010 total Designated River miles.
- 22 Local River Management Advisory Committees (LACs).
- 200+ active volunteers.
- Approximately 8,656 volunteer hours donated on behalf of rivers in 2018 valued at over $223,000 to the State.
- 220 Permit applications reviewed by local citizens in 2019.
- 14 State-owned surplus land disposals reviewed in 2019 ensuring that public access to state waters is maintained.
- 39 Letters of testimony submitted during the 2019 New Hampshire legislative session by the state-wide LACs, and one by NHDES on behalf of the LACs.

Program staff worked with the Rivers Management Advisory Committee (RMAC) to successfully recommend an amendment to 2019 House Bill 228 to change the appointing body for LAC members from the NHDES Commissioner to the RMAC, reducing administrative burden on both the Commissioner and individual LAC members.

Also in 2019, community members from around the Saco and Swift rivers joined forces to establish the Saco-Swift Rivers Local Advisory Committee. This combined LAC has taken on the duties of the long-inactive Saco River LAC as well as the flagging Swift River LAC, and it began reviewing permits during its first two meetings.

Quality Assurance Measures: Stream flow measurements are assessed by repeated measurements to evaluate the variability of individual measurements and to estimate the overall accuracy of the results.

Funding: General Funds (Org. Code: 1518; FY 2019 $398,639) and Federal Funds (Org. Code: 7602; FY 2019 $107,075).

Program Needs: Having received approval for one new full time environmentalist position in FY 2020, the ISF Program remains in need of one additional full time biologist to evaluate fish, wildlife, and riparian plant community health in order to develop a long-term monitoring protocol to determine the effectiveness of program implementation. Additional contract funds of $100,000 to $175,000 per year, depending on the length of the river under development, are also needed for hiring consultants to develop protected instream flows at the rate of one river per year, which is critical to expanding the program to all 19 designated rivers in the state as mandated in RSA 483. Currently, one river and one river segment have been largely completed and are being actively evaluated and managed to maintain protected flows, and protected instream flow studies have begun on a third river.

The Lakes Management and Protection Program requires funding for a Lakes Coordinator in order to provide support to the Lakes Management Advisory Committee and lake management efforts throughout the state. The Lakes Program is currently unfunded.

1.21 Coastal Program

Challenges Addressed: The Coastal Program protects clean water, restores coastal habitats, and helps make communities more resilient to flooding and other natural hazards through staff assistance and funding to 42 coastal towns and cities as well as other local and regional groups. Coastal areas are especially vulnerable to storm surge, flooding and sea level rise, which puts coastal infrastructure, property and habitats at risk. The Coastal Program helps local decision-makers to minimize damage from and increase preparedness for these natural hazards.

Achievement: The Coastal Program funded and provided staff support for a dune restoration project for that has engaged 43 community leaders and local community members in Hampton and Seabrook planting workshops. The resiliency of the dunes has been increased with fencing, planting 20,000 plants in two acres of remnant dunes, and collecting monitoring data. The Coastal Program also initiated, funded and staffed the development of the New Hampshire Coastal Viewer, which houses 150 coastal resources and hazards-related spatial data sets for better decision-making at the state and local level.

Funding: Federal Funds (The Coastal Program is funded by The National Oceanic and Atmospheric Administration). Org. Code 3642; Received $1,053,000 for FFY17.

Program Needs: The Coastal Program requires continued funding and staff support to help communities prepare for coastal hazards through grants, technical assistance, outreach and training.

II. NHDES WATERSHED BUREAU DATA QUALITY CONTROL

2.1 Watershed Bureau QAPPs and Standard Operating Procedures(SOPs)

The New Hampshire Department of Environmental Services (NHDES) Watershed Management Bureau (WMB) maintains several Quality Assurance Project Plans (QAPPs) and Standard Operating Procedures (SOPs) (Table 1). QAPPs are documents submitted to and approved by the U.S. Environmental Protection Agency (EPA) which define the scope of a monitoring project including what is to be monitored, how it is to be monitored, and the procedures to be carried out to ensure data quality. SOPs outline specific procedures for things such as field data collection, laboratory sample handling, sample preparation and sample analysis.

Table 1: Current Watershed Bureau QAPPs and SOPs

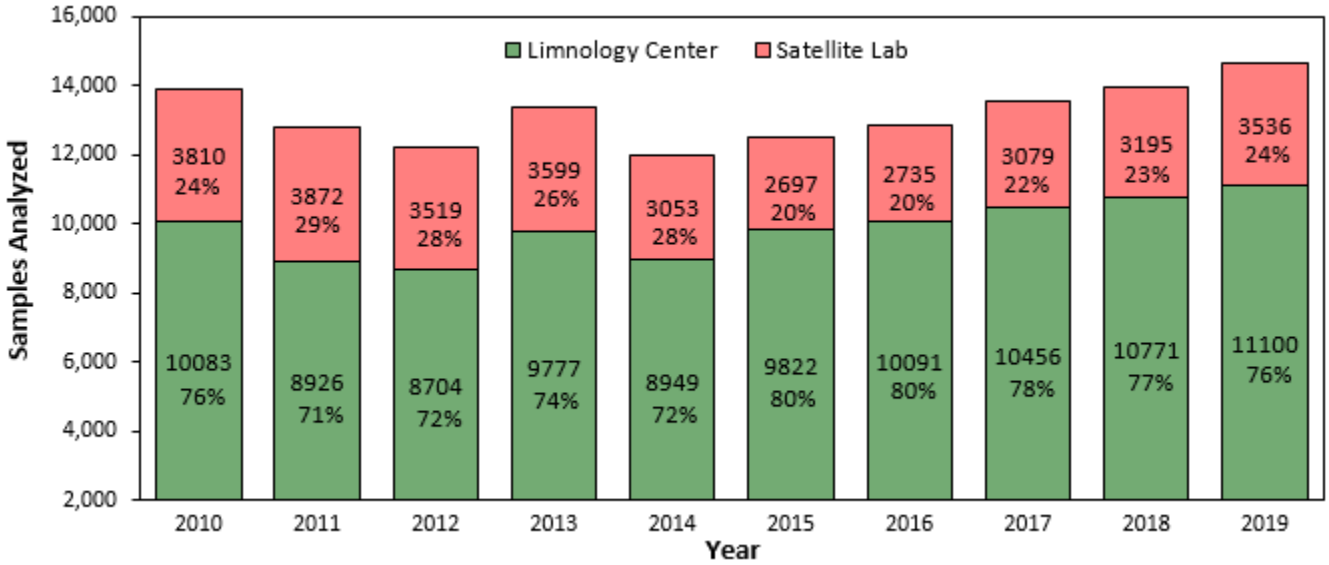
Program Name	Document Title	Type	Year Created	Last Update
Jody Connor Limnology Center	NHDES Jody Connor Limnology Center. Laboratory Manual	SOP	2001	2019
Lake Assessment Program and Special Projects	Lake Assessment Programs Quality Assurance Plan	QAPP	2015	2015
Volunteer Lake Assessment Program	NHDES Volunteer Lake Assessment Program Quality Assurance Project Plan RFA 19074	QAPP	2003	2019
Beach Inspection Program	NHDES Beach Program Generic Quality Assurance Project Plan; RFA #NH17075	QAPP	2003	2017
Shellfish Program	Quality Assurance Project Plan for Shellfish Ambient Water Quality Monitoring	QAPP	2002	2013
Shellfish Program	Quality Assurance Project Plan for Shellfish Sanitary Surveys	QAPP	2002	2013
Shellfish Program	Quality Assurance Project Plan for Paralytic Shellfish Poisoning Monitoring	QAPP	2002	2013
Exotic Species Program	NHDES Exotic Species Program Quality Assurance Project Plan	QAPP	2014	2019

2.2 Jody Connor Limnology Center (JCLC)

JCLC staff processed 11,100 chemical analyses in 2019 and continued the modest trend towards an increasing sample load over the past few years (Figure 1). Additionally, 7,139 samples were collected by JCLC programs in 2019 but were analyzed by Department of Health and Human Services – Public Health Lab (DHHS-PHL). This represents an increase of roughly 100 analyses from 2018.

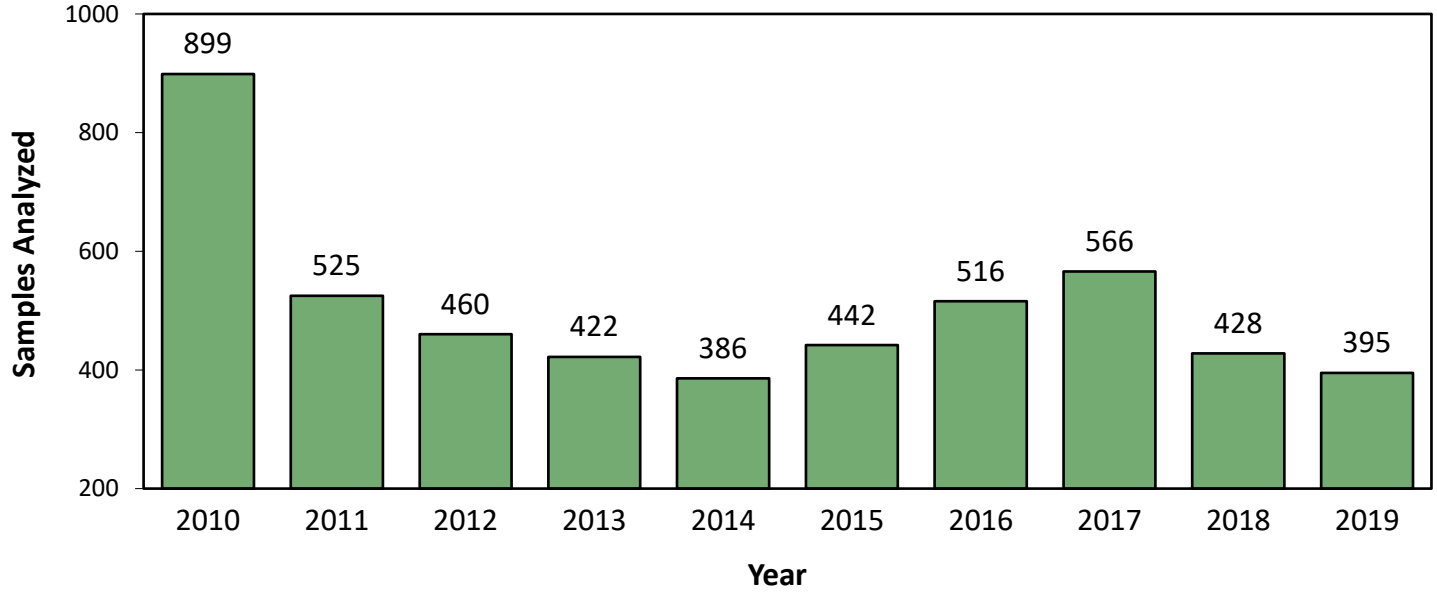
JCLC provides volunteer monitors with additional services by making available and providing oversight to a satellite laboratory at Colby-Sawyer College (CSC). The laboratory is a cooperative effort between CSC and the Lake Sunapee Protective Association (LSPA). In 2019, 3,536 chemical analyses were processed at the CSC satellite laboratory, an increase of over 300 analyses from 2018. The main reason for the increase is that the CSC lab gained the capability to conduct chloride and color analyses in 2018, and in 2019 they made the analyses available to all of the lakes they serve.

Figure 1: Satellite vs JCLC Analysis 2010-2019.



The JCLC also processes and identifies biological samples of phytoplankton, zooplankton, cyanobacteria, and macrophytes. The number of annual biological analyses performed has hovered between 400 and 500 for several years. In 2019, 395 biological samples were processed in the JCLC; this was within the processing range of 2011 (Figure 2). These samples are time consuming to process and most often require microscopic examinations by trained staff to complete taxonomic identifications.

Figure 2: NHDES JCLC Total Annual Biological Analyses.



2.2.1 JCLC and Satellite Lab Data Quality Objectives

Quality control (QC) is an important component to assure the production of high quality data. At both the JCLC and the CSC satellite lab, QC samples are processed regularly. Over 2,700 QC sample analyses were conducted by the two laboratories in 2019.

The JCLC and the CSC satellite laboratory met their data quality objective (DQO) requirement of completing replicate analyses on 10% of the processed samples. Since establishing this DQO in 1999, the cumulative laboratory replicate percentage has surpassed the 10% requirement each year. The two laboratories also continued to follow both

Continuing Calibration Verification (CCV) (Table 2) and Critical Range (CR) criteria (Table 3). The CCV and CR processes verify that the laboratory equipment and personnel are all meeting established standards and confirm that high quality, reliable data are being produced. Furthermore, based on a required 2019 NHDES Quality Assurance (QA) Self-Audit, both labs were found to have excellent systems in place to ensure that high quality data were being produced; the only recommendation was to update the link to the JCLC Lab Manual in the NHDES QAPP library file. The next self-audit will be completed in early 2021.

Table 2: JCLC and CSC Laboratory CCV Acceptance Criteria

Parameter	Frequency	CCV Standard	Acceptance Limit
pH and Alkalinity	10% or at the end of the day's analyses, whichever comes first	6.0 pH	+/- 0.1 pH unit
Conductivity		100 µS/cm	+/- 10% = 90-110 µS/cm
Chloride		100 mg/l	+/- 15% = 85-115 mg/L
Turbidity		10 NTU	+/- 10% = 9-11 NTUs
Color Hanna		50 CPU	+/- 10 CPU
Total Phosphorus*		50 PPB	+/- 10%

* CSC lab only

Table 3: JCLC and CSC Laboratory Duplicate CR Criteria

Parameter	Acceptance Limit	Parameter	Acceptance Limit
pH	+/- .5 units	Chlorophyll-a	+/- 3.0 µg/L= 3mg/m3
Alkalinity	+/- 1.20 mg/L	T. Phosphorus*	+/- 0.004 mg/L
Conductivity	< 10%	Color Hanna	+/- 10 CPU
Turbidity	0-20 NTU: +/- 1	Color Nessler	+/- 2.0 CPUs
	>20-100 NTU: +/- 3	Chloride	< 15%
	>100 NTU +/- 10	E. coli*	< 5% of count

* CSC lab only

2.2.2 JCLC Laboratory

As a result of requirements set forth in the NHDES Quality Management Plan (QMP), the JCLC began to track new staff training in 2003. Tracking staff training is a critical component to verify competency on equipment use, DQO procedures, CR and CCV procedures. Over the past two field seasons, the JCLC has improved intern training in laboratory procedures. Now each newly hired intern attends a full day training session consisting of JCLC lab procedures and safety, database entry and sample login procedures. The training also includes an afternoon of hands-on, practical training using JCLC bench meters with oversight by full time JCLC staff. As part of this training, each intern has to pass a competency check on each meter in the JCLC.

The JCLC and CSC-LSPA lab analyze two aliquots (replicates) from the same sample as a QC for at least 10% (Table 4). Replicate samples processed in the JCLC are evaluated using split mean range (SMR) and relative percent difference (RPD) measures; these results are used to demonstrate consistency in data quality. The SMR is the range and the RPD is the percent difference which is calculated when a replicate QC analysis is performed. Depending on analysis factors (such as the range of the analytical instrument used), either a SMR or RPD is calculated for each QC sample. The JCLC generates SMR/RPDs as a quantitative measure to ensure that replicate ranges are consistent with historical SMRs/RPDs. In 2019, all parameters exhibited SMRs or RPDs that were well within the acceptable range established for the parameter (Table 4). Finally, over 98% of laboratory replicates met established critical range criteria for their respective parameters.

Table 4: 2019 calendar year JCLC chemical analyses quality assurance summary.

Parameter	2019 Replicate Analyses	2019 Sample Analyses	2019 Replicate Percent	Mean Relative Percent Difference or Split Mean Range					
				2014	2015	2016	2017	2018	2019
Alkalinity (ANC) mg/L (Range)	60	542	11.07	0.42	0.58	0.56	0.49	0.27	0.16
Apparent Color cpu (Range)	14	127	11.02	0.78	1.05	0.53	0.69	0.71	0.71
Color in Water - Hanna (Range)	51	441	11.56				4.32	5.09	4.51
Chloride mg/L (Range)	235	2078	11.31	0.55	0.88	1.55	1.53	1.89	1.46
Chlorophyll-a mg/L (Range)	80	635	12.60	0.29	0.60	0.46	0.38	0.54	0.51
Conductivity µmhos/cm (RPD)	269	2419	11.12	1.41	1.03	1.33	1.38	1.78	1.61
Mercury mg/L (Range)	8	53	15.09	0.04	0.02	0.03	0.01	0.05	0.02
pH units (Range)	278	2485	10.96	0.25	0.40	0.12	0.27	0.07	0.06
Turbidity NTU (Variable Range)	251	2242	11.20	0.13	0.14	0.16	0.13	0.14	0.18

2.2.3 Satellite Laboratory

The CSC-LSPA Satellite Laboratory continues to be well-operated and serves as a model for producing high quality data in support of NHDES' volunteer water quality monitoring programs. In 2018, the lab gained the ability to analyze for chloride and color. It will take a few years to establish a SMR trend for the new parameters. Specifically, with very limited data, the SMR for color increased substantially from 1.25 to 6.79 between 2018 and 2019, respectively (Table 5). However, in 2018 the CSC-LSPA lab processed color samples only from Lake Sunapee. This gave them a consistent and low-color group of samples to analyze which would lend itself to a low SMR. In 2019, color analysis was offered for the first time to other lakes which the lab serves; this led to a wider range of color in the waterbodies that were sampled. Additionally, the meter used to analyze these samples reports color to the nearest 10 CPU. A lack of precision in the instrument lends the data to larger SMRs. The CSC-LSPA lab has consistently met or exceeded the replicate DQO for all parameters since 2008 (Table 5). In addition, the 2019 SMR remained consistent with previous years (Table 5). Finally, 98% of CSC-LSPA lab replicates met established CR criteria for their respective parameters.

Table 5: 2019 calendar year CSC-LSPA Laboratory chemical analyses quality assurance summary.

Parameter	2019 Replicate Analyses	2019 Sample Analyses	2019 Replicate Percent	Mean Relative Percent Difference or Split Mean Range					
				2014	2015	2016	2017	2018	2019
Alkalinity (ANC) mg/L (Range)	7	75	9.33	0.42	0.70	0.36	0.28	0.63	0.11
Color in Water (Hanna) (Range)	28	254	11.02					1.25	6.79
Chloride (Range)	55	493	11.16					1.82	0.68
Chlorophyll-a mg/L (Range)	15	110	13.64	0.42	0.32	0.11	0.37	0.53	0.16
Conductivity µmhos/cm (RPD)	87	622	13.99	0.17	0.20	0.87	1.54	1.37	1.46
pH units (Range)	85	620	13.71	0.11	0.19	0.04	0.07	0.05	0.07
Turbidity NTU (Range)	85	620	13.71	0.18	0.19	.07	0.23	0.28	0.17
E. coli counts/100ml (Range)	7	76	11.84	0.47	0.00	0.00	.33	1.62	0.44
Total Phosphorus µg/L (Range)	101	666	15.17	2.8	3.5	1.5	1.0	0.8	0.6

2.3 Volunteer Lake Assessment Program (VLAP)

VLAP participation has remained fairly stable since 2016. In 2019, VLAP received four requests from lake associations wishing to join the program. However, due to resource constraints, VLAP cannot accept new lakes at this time. Since 2018, the total number of requests to participate has increased, likely due to increased concern over noticeable changes in water quality, plant and algae growth, and concerns of climate impacts to New Hampshire lakes. This resulted in an increase in the number of sampling events and volunteer participation (Table 6). This has also resulted in a significant increase in results generated during the past 20 years (Figure 3 and Table 7).

Table 6: Program Participation.

Year	# of volunteers	# of lakes	New or returning lakes	# of deep spots	# of annual bio visits	# of volunteer sampling events	Total # sampling events*	Est. # of volunteer hours	Monetary value of vol. hrs.	# of individual sample results generated
2019	500	177	0	185	119	356	475	~3717	$95,749	16,274

Figure 3: Analytical Results Generated for VLAP, 1999-2019.

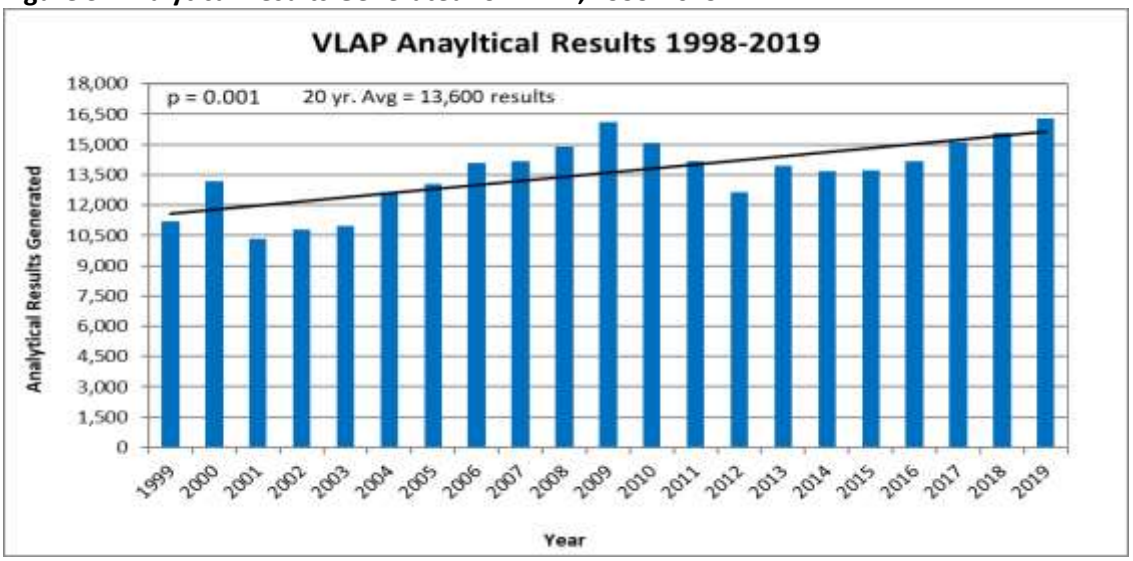


Table 7: Number of VLAP Sample Results Generated by Parameter and by Laboratory (2019).

Lab	Alkalinity	Apparent Color	Chlorophyll-a	Cl-	Apparent Color	DO-Temp. Profile	*E. coli*	TN	pH	Phyto-plankton	Secchi Disk	Secchi Scope	TP	Turbidity
CSC-LSPA*	75	254	110	493	622	52	76		620		55	95	666	620
NHDES**	407	424	425	1245	2291	241	401	7	2213		373	367	2053	2211
Total	**482**	**678**	**535**	**1738**	**2847**	**293**	**477**	**7**	**2833**		**428**	**462**	**2719**	**2831**

* = The Colby Sawyer College - Lake Sunapee Protective Association Satellite Laboratory

** = NHDES JCLC and NH DHHS Water Analysis Laboratory. The NH DHHS Laboratory analyzes the total phosphorus and *E. coli* samples, while pH, ANC, conductivity, chloride, turbidity, chlorophyll, and phytoplankton are analyzed in the JCLC, and Secchi disk depth is measured in the field.

2.3.1 Quality Assurance and Quality Control Management:

The Generic VLAP QAPP was submitted to the EPA in 2019 for its five-year review and revision. The VLAP QAPP review was completed, and the QAPP was approved by the EPA in June 2019. The QAPP, which outlines the SOPs for sample collection, sample analysis, data management, data assessment and data reporting, was followed by all NHDES JCLC and satellite laboratory staff during the 2019 sampling season. Volunteer monitors were trained at the Annual VLAP Refresher Workshops and during the annual biologist visit to ensure that each monitoring group followed the SOPs for sample collection as outlined in the QAPP.

2.3.2 Quality Assurance and Quality Control:

The VLAP QAPP specifies that Quality Assurance and Quality Control (QA/QC) samples, including field duplicate samples, are collected and analyzed for specific parameters sampled through the program. However, the majority of volunteers from the lakes and ponds participating in the program do not collect field duplicate samples as standard practice. This is due to the following reasons:

1. Long-term water quality trend analysis, not a single sample result, is used for decision-making within NHDES.
2. There are no available funds within NHDES to pay for the analysis of VLAP QA/QC samples, including total phosphorus and *E. coli* duplicate samples.

Therefore, in 2002, the VLAP Coordinator, Biology Section QA/QC Officer, and the JCLC Director concluded that the field collection and laboratory analysis of QA/QC samples, as outlined in the VLAP QAPP, will be incorporated into the program as feasible under the existing program structure and the operating constraints of the JCLC.

Specifically, volunteer monitoring groups that decide to pursue additional federal grant programs and wish to use VLAP monitoring activities as a match are required to conduct QA/QC sampling in accordance to the VLAP QAPP. In this case, the JCLC agrees to run these additional QA/QC samples, but the volunteer monitoring group is required to bear the additional cost, as necessary.

2.3.3 VLAP Duplicate Sampling:

In 2019, VLAP biologists assisted volunteer monitors in collecting duplicate sets of samples from the hypolimnion (lower layer) and one tributary (Table 8). These duplicate samples were analyzed in the JCLC for conductivity, turbidity, pH, and chloride (if applicable). On a weekly basis during the season, each biologist collected one duplicate dissolved oxygen/temperature profile and one duplicate chlorophyll-a sample at lake deep spots during the annual lake visits.

The duplicate samples are compared not just to the total number of routine samples conducted during the biologist visits, but to results from the whole program. This routinely meets a seven to eight percent duplicate range rather than a ten percent range. However, if compared with the number of samples generated during biologist visits only, it would be well above the ten percent range.

Table 8: VLAP Duplicate Quality Assurance Samples Collected (2019).

Parameter	Duplicate Samples (# of samples)	Routine Samples (overall # of samples for entire program)	# of Duplicate Samples as a Percentage of Total # Routine samples ((# Duplicate Samples/ # Routine Samples) *100)
Alkalinity*	21	482	4.3
Apparent Color (Epilimnion)	49	678	7.22
Chlorophyll-a	42	535	7.8
Chloride	94	1738	5.4
Conductivity	211	2847	7.4
Dissolved Oxygen Profile	36	293	12
pH	210	2833	7.4
Total Phosphorus**	40	2719	1.5
Turbidity	211	2831	7.5

* = During the Spring of 2002, the Biology Section QA Officer determined that it was not feasible for the JCLC to handle the additional workload of duplicate samples for Alkalinity and phytoplankton parameters. These analyses take much longer to conduct than the pH, turbidity, and conductivity analyses.
** = Volunteers are asked to collect and pay for duplicate sample analysis for phosphorus and *E. coli* on a voluntary basis. There is no internal funding source available to pay for the analysis of QA/QC samples that are processed in the NH DHHS Water Analysis Laboratory. All total phosphorus duplicate samples are conducted through the CSC-LSPA laboratory and paid for by the LSPA.

Field duplicate sample results were analyzed at the end of the season to determine if the RPD or CR for each parameter of interest exceeded the QA/QC standard outlined in the VLAP QAPP. In general, a low number and percentage of duplicate samples failed to meet the QA/QC standard during the 2019 sampling season (Table 9).

Table 9: VLAP Duplicate QA/QC Samples (2019).

Parameter	# of Duplicate Samples Collected	# of Duplicate Samples that did not meet QA/QC Standards	Percentage of Duplicate Samples that did not meet QA/QC Standards
Alkalinity*	21	0	0
Apparent Color	49	4	8.2
Chloride*	94	0	0
Chlorophyll-a*	42	3	7.1
Conductivity*	211	0	0
Dissolved Oxygen Profile***	36	0	0
pH*	210	0	0
Total Phosphorus*	40	3	7.5
Turbidity **	211	9	4.2

* = The QA/QC standard for duplicate ANC, chloride, chlorophyll, conductivity, pH and total phosphorus samples is the 20% Relative Percent Difference.
** = The QA/QC standard for duplicate turbidity standards is the critical range standard used in the NHDES JCLC.
*** = Individual dissolved oxygen duplicate profiles acceptance limit of +/- 2 mg/L.

2.3.4 VLAP Intern Training:

The training and assessment of the VLAP intern's ability to perform field sampling activities according to the program SOP is the responsibility of the Coordinator. At the beginning of the sampling season, the Coordinator trains or re-trains the intern in the proper field sampling SOPs, as outlined in Appendix C of the VLAP QAPP.

In 2019, one three-month and one six-month intern were hired to perform summer lake sampling. The VLAP Coordinator trained each intern and one additional biologist how to conduct VLAP sampling, annual visits, and laboratory sample analysis. The VLAP Coordinator assessed each individual's field sampling abilities using the "VLAP Intern Field Sampling Procedures Training Assessment Audit Evaluation Form." Each VLAP intern was not allowed to sample on their own with the volunteers until they performed the sampling tasks independently and successfully on at least three occasions. In addition, each VLAP intern was required to fulfill the JCLC training requirements before they were allowed to independently log-in and analyze samples in the JCLC.

2.3.4 VLAP Volunteer Training:

During the annual visit to the each lake or pond, the biologist (the VLAP coordinator, biologist, or one of the interns) conducts a "Sampling Procedures Assessment Audit" for each monitoring group. Specifically, the biologist observes the performance of each monitoring group and fills out an assessment audit form to document the ability of the volunteer monitors to follow the proper field sampling procedures (as outlined in the VLAP Monitor's Field Manual).

The assessment identifies areas of sample collection in which volunteer monitors are not following the proper procedures, and provides an opportunity for the biologist to retrain the volunteer monitors as necessary. This will ultimately ensure that samples collected by volunteer monitors are truly representative of actual lake and tributary

conditions. Overall, the assessments show that the majority of the monitoring groups follow the proper sampling techniques.

In 2011, it was necessary for VLAP to alter its schedule for annual biologist visits. The schedule for biologist visits changed from an annual visit at each lake to a biennial visit at each lake depending on a lake's name. In 2019, lake names beginning with M through Z received biologist visits.

To compensate for the lack of an annual biologist sampling procedure assessment audit, VLAP developed a training video for volunteers to view and review sampling procedures prior to sampling on their own. The video is posted on YouTube and a link is available via the VLAP website. The video has also proved to be a useful training tool during the VLAP annual refresher workshop. VLAP developed a Volunteer Monitor Field Sampling Procedure Checklist for volunteers to complete every time they sample without a biologist. The checklist acts as a self-audit for field sampling procedures to minimize improper sampling techniques, and it has been very successful. Volunteer feedback has been positive and resulted in overall better quality samples collected. The form will continue to be implemented in subsequent sampling seasons.

When volunteer monitors drop off samples at the NHDES JCLC and the CSC-LSPA Satellite Laboratory, the laboratory staff continue to use the sample receipt checklist to assess and document if the volunteer monitors followed proper sampling techniques when collecting the samples. Specifically, the purpose of the sample receipt checklist is to minimize, and hopefully eliminate, future re-occurrences of improper sampling techniques. When necessary, volunteer monitors were contacted by laboratory personnel with questions so that the samples could be logged into the system properly. In some cases, it was necessary to retrain volunteers in proper sample collection techniques, and, in a few severe cases, samples were not accepted for analysis.

2.4 Biomonitoring Program QA/QC

Fish identification data quality control measures relied on having an expert fish taxonomist on site during sampling. Any unknown species were documented with photos and/or retained for laboratory analysis and further consultation with other state agencies and partners. Several samples further analyzed for proper identification in 2019 included longnose sucker, common white sucker, sea lamprey ammocoetes and transformers, and young of year common shiners, fallfish, rainbow trout and brown trout.

All field data are reviewed for quality assurance and entered into the Biomonitoring Program's Ecological Data Application System (EDAS) database. Additional data checks for completeness and accuracy are performed prior to uploading data to the NHDES Environmental Monitoring Database (EMD) and later to the EPA's Water Quality Exchange (WQX) Database.

Macroinvertebrate data quality control measures rely on enumeration and identification by outside contractors, primary and quality control. In additional to in-house QC measures performed by the primary contractor, QC measures are performed by a separate QC contractor. Ten percent of all samples are sent to the QC contractor and re-picked to account for individuals missed by the primary contractor. If the primary contractor does not meet the required threshold (95% of individuals found during the initial pick), sorted debris from all samples are re-picked, with additional individuals identified and enumerated. In addition to re-picking the sorted debris, a voucher set of all individuals found in a given year is assembled by the primary contractor and sent to the QC contractor for identification. This is completed as a "blind" voucher set with voucher identifications sent to NHDES for review. Any discrepancies are reconciled, and data is updated to reflect any necessary corrections.

Taxonomy must be performed by a professional freshwater macroinvertebrate taxonomist who, at a minimum, holds and maintains for the duration of the contract a certification from the Society of Freshwater Science for eastern genera in group 1 (Crustacea and Arthropods other than EPT and Chironomidae), group 2 (Ephemeroptera, Plecoptera, and Trichoptera nymphs and larvae only) and group 3 (Chironomidae larvae only).

III. NHDES WATERSHED BUREAU SAFTEY PROCEEDURES

3.1 Watershed Bureau Safety Training

The Watershed Management Bureau (WMB) workload involves various types of work in multiple environments. Safety is of great importance, and guidelines and training are provided and revised as concerns and new methods arise. The New Hampshire Department of Environmental Services (NHDES) institutes agency-wide training in which the WMB participates.

Department-wide trainings cover topics such as Active Shooter Training, Defensive Driving and Cyber Security, the last of which covers the safety of our data and our business. Some of these training programs must be repeated every year; the defensive driving training must be repeated every three years at a minimum. All NHDES employees, whether full time, part time, or interns are required to pass these safety training programs.

Active Shooter Training is taken every year by staff and is one of the first things any new hire or intern is required to do. Cyber Security training does not deal with physical safety but with the safety of data and the department. Since we are a data driven bureau, the safety of our network and data is very important. This training must be taken yearly.

3.2 Watershed Bureau Vehicle and Watercraft Safety

Before any individual may operate a state vehicle, Defensive Driving training must be completed with a passing grade. Those individuals who use large vehicles or trailers are also required to take a safe backing course that addresses issues involving trailers, blind spots and trucks. Much of the work the WMB does requires trailering or using full-sized vehicles. Therefore, many WMB personnel are required to take this extra defensive driving training course. Each WMB vehicle is equipped with a first aid kit, insurance information and a written safety procedure in case of an accident. Trailer wiring and lights are inspected and tested annually each spring, and necessary repairs and replacements are made as soon as possible. All tires and spares are inspected, and worn tires are replaced.

Some of the workload done by the WMB requires the use and operation of boats. New Hampshire law requires all personal watercraft (PWC) or boat operators who are 16 years old or older and who are operating a motorboat over 25 horsepower to complete the New Hampshire Boater Safety Course and to carry a Safe Boating Certificate. The official NHDES policy goes a step further, as any employee who wishes to operate a NHDES power boat is required to take the course and obtain the certificate. This course covers basic watercraft rules and operation as well as the safety involved in the use of state boats. This training is offered by the state of New Hampshire's Department of Safety as an on-line course. WMB staff who routinely use our boats also accompany and train new personnel and interns in the operation of individual state-owned watercraft. This training covers canoes and kayaks as well as tiller steered outboards, steering-wheeled driven outboards, and a Diver Assisted Suction Harvester (DASH) unit.

All individuals are required to wear a personnel floatation device (PFD) whenever in a boat. To facilitate the comfortable use of PFDs, inflatable suspender style PFDs are purchased for all employees who commonly use boats as well as sufficient spares to accommodate those who need them on occasion. All of our boats carry a fire extinguisher and a noise-making device as well as extra PFDs. All power boats are equipped with a usage log to record usage time and note any issues.

3.3 Watershed Bureau Lab and Field Safety

The Jody Connor Limnology Center (JCLC) contains laboratory equipment and the associated chemicals necessary to analyze surface waters. As such, the JCLC has safety procedures and training that go beyond normal workplace safety. This training involves personnel protective equipment, the operation of laboratory equipment, and the safe handling and disposal of chemicals. Locations of fire extinguishers, acid spill kits, broken glass containers and other safety equipment are clearly displayed and labeled in the lab. Small group training is given to all new hires and interns of the WMB. A copy of the training manual can be found electronically on the NHDES network and in the NHDES JCLC Laboratory Manual. This manual is reviewed and updated yearly. The lab also includes a ventilation hood that is inspected regularly and a small chemical storage cabinet.

A majority of sampling and monitoring done by the WMB involves working in the field in both urban and remote sites. Working in the field requires yet another set of safety concerns. These include things like staff attire and protection from weather and field conditions. Wading in fast moving or deep water, insect and plant interactions, and interactions with the public also bring up safety concerns. These safety issues and procedures are addressed in the NHDES Standard Operating Procedure for Field Safety. However, each monitoring program within the WMB presents unique safety risks. For this reason, supervisors spend several days training staff on field and safety protocols for each specific program.

The Biomonitoring Program completes fish surveys regularly using backpack electroshocking units that discharge an electrical current into the water. To prevent injury, non-breathable waders and electrical gloves must be worn. Optional, but highly recommended additional personal equipment include a hat and polarized sunglasses. Electrofishing is strenuous work, and staff are encouraged drink fluids and eat food regularly to maintain proper hydration and energy levels. Staff typically work in teams of four and are in constant communication with each other during a sampling event and use simple code words to indicate start and stop of electrical discharge.

The WMB also has a few people certified as “Self Contained Underwater Breathing Apparatus” (SCUBA) divers. Most of this work involves NHDES response to aquatic invasive species. Their work is done in water less than thirty feet deep (one atmosphere), and most of these operations are in 10 feet of water or less. Diving operations are always done in pairs. Safety procedures can be found in the NHDES Water Division, WMB SCUBA Dive Safety Protocol.