Massachusetts Department of Environmental Protection (MassDEP)

Division of Watershed Management (DWM)

Watershed Planning Program (WPP)

8 New Bond Street

Worcester, MA

CN 509.0

1. **Overview**

**Background:**

Sodium chloride (NaCl) is applied to roadways in winter as a deicer. Mattson and Godfrey (1994) found that road salt is the major source of salt loading to Massachusetts streams. Chloride (Cl-) levels have also been correlated with impervious surfaces and urbanization (Wallace and Biastoch, 2016). Chloride is a recognized contaminant with potential to impair waterbodies and impact biological communities. It has also been shown to contribute to year-round elevated Cl- levels (Todd and Kaltenecker, 2012).

**Purpose:**

This plan involves collection of continuous conductivity data in order to estimate chloride levels using DEP’s conductivity-chloride regression at 10 stream locations in the Nashua Watershed. This collection will take place starting in November 2020 through October 2021. Estimated chloride data will help assess how seasonal road salt (NaCl) applications may affect surface water quality. This study will collect continuous conductivity data for 1) application of the MA correlation between specific conductivity and chloride; and (2) analysis of data for comparison to EPA ambient criteria for acute and chronic toxicity.

**Sampling & Analysis:**

Continuous conductivity data will be collected using HOBO U24 freshwater data loggers. Attended, discrete quality control (QC) readings will be taken at each visit using separate YSI/Hydrolab multiprobe instruments. On three of the survey rounds, water samples will be collected for chloride (only) and analyzed by the WES lab.

**Data Analysis:**

Conductivity data will be analyzed using WPP’s chloride regression tool, which was previously verified, to estimate ambient chloride levels.

**Locations:**

This study will occur at locations in the Nashua Watershed, in close vicinity to Worcester, MA, choosing from the following list of water bodies:

|  |  |  |
| --- | --- | --- |
| Jackstraw Brook (Jacks) | Eames Brook (Eames) | Sudbury River (SudUP) |
| Piccadilly Brook (Picca) | Sudbury River (SudFram) | Whitehall Brook (WhiteFruit) |
| Sudbury River (SudAsh) | Concord River (Conc) | Hop Brook (HopGolf) |
| Baiting Brook (Bait) | Beaver Brook (Beaver) | Cold Harbor Brook (ColdH) |
|  |  |  |

The study will focus on waterbodies based on their proximity to major roadways, routes, intersections, and/or high salt deposit areas, as well as proximity to drinking water wells.

1. **Project Definition and Background**

**2.1 Project Goals and Objectives**

The data collected in this study will help the Massachusetts Department of Environmental Protection (MassDEP) - Division of Watershed Management (DWM), Watershed Planning Program, (WPP) identify potential impacts of road salt on freshwater bodies. From this study, WPP can better understand how road salt, urbanization, and/or other factors affect chloride concentrations of adjacent waterbodies, aquatic biotic health, and drinking water supplies. The results of this study have the potential to influence DEP water quality alert levels for chloride and provide baseline data for potential future development of Total Maximum Daily Loads (TMDLs). The sampling objectives for this study are:

1. Estimate chloride levels in-stream by collecting continuous conductivity data at approx. 13 stations using HOBO U24 conductivity loggers during the period of November 2020 through October 2021. The data will then be used by applying the MA correlation between specific conductivity and chloride.
2. Analyze resulting data to determine if estimated concentrations exceed MA state surface water quality standards (EPA ambient criteria for chloride).
3. **Surface Water Quality Monitoring**

**3.1 Standard Operating Procedures**

This SAP will be implemented consistent with DWM’s EPA-approved programmatic Quality Assurance Program Plan (QAPP) for surface water monitoring in 2020/2024 (CN 520.1), and the project-specific QAPP for Chloride Monitoring & Assessment (CN 539.0).

HOBO U24 Conductivity Loggers will be deployed at the selected water quality monitoring stations in the Nashua Watershed in Central MA. These deployments will be performed in order to collect continuous conductivity at fixed, 30-minute, recording intervals. The HOBO units will be used in accordance with the Watershed Planning Program’s *Standard Operating Procedure for Continuous Conductivity Monitoring* (CN 349.0) and the manufacturer’s instructions. The loggers’ sensor faces will be cleaned before each intermittent data collection shuttle-technology download.

YSI/Hydrolab multiprobes will be used for QC purposes approximately every 2nd month between ~November 2020 and October 2021 at each of the stations. This quality control will be conducted primarily to collect data on temperature, depth, and specific conductivity. HOBO conductivity data will be transformed to specific conductance and then reviewed to compare to Hydrolab specific conductance data.

Water samples collected on three of the surveys for chloride will be collected in HDPE bottles using standard WPP sampling protocols as defined in the program QAPP. Samples will be delivered to the WES lab for analysis using method SM 4500-Cl E, within 14 days of receipt.

**3.2 Non-Direct Measurements**

To better interpret data from the study, the following information may also be collected:

* Road salt use recorded by Massachusetts Department of Transportation and area towns to estimate

chloride loading

* Land use area (agriculture, developed, natural, wetland, and impervious cover) for each station
* Weather statistics

**3.3 Data Analyses**

Conductivity data will be corrected to specific conductivity and used to estimate ambient chloride levels using the DWP’s chloride assessment tool, previously verified for this study and in accordance with Standard Operating Procedure CN 349.0. Once available, final data will be summarized in a Technical Memorandum (project-specific or bundled into a larger report).

**3.4 Design Rationale and Sampling Locations**

Specific sampling locations are shown below. In general, sites were selected to be representative of typical urban and suburban conditions. In certain cases, a site may have been selected based on indications of historically high levels of chloride or due to site proximity to a suspected high salt loading area or salt storage area, or a drinking water well or withdrawal point. Of the sites proposed, none lie in any AUs that are currently impaired for aquatic life use due to chloride.

Map

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Figure 1. Map of 2020-2021 Concord Watershed Chloride Sites

**Site: Jacks (Jackstraw Brook; Unique ID: W3016; AU ID: MA82A-28)**

Jackstraw Brook has a 2.14 km2 watershed contributing to this sample site. The land use in the contributing watershed is 45% urban, 14% impervious, and has 18 km of roads. A PWS supply is at this location (Westborough Water Supply – 2328000) and Jackstraw Brook is also a DFW (Massachusetts Division of Fisheries and Wildlife) CFR (Coldwater Fishery Resource). This location will also be sampled as part of the 2021 WPP Targeted Monitoring Project.

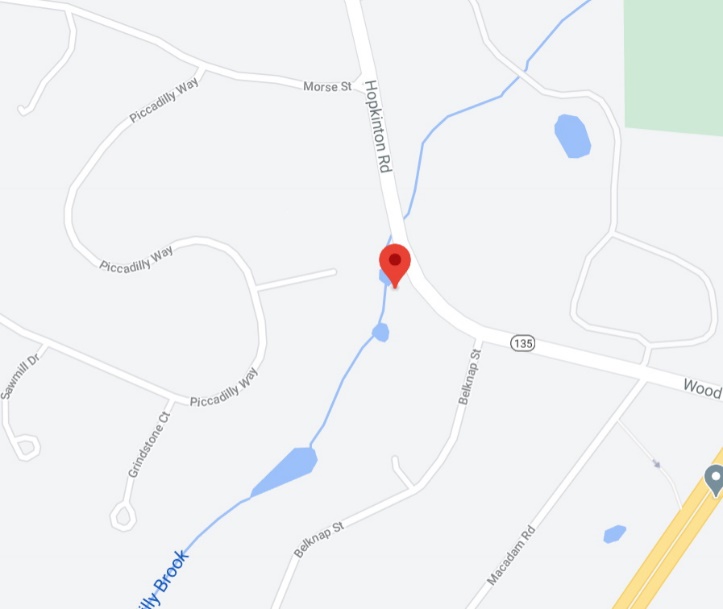
Map of Jackstraw Brook Site



**Site: Picca (Piccadilly Brook Unique ID: W3017, AU ID: MA82A-30)**

Piccadilly Brook, at this location, has a 2km2 contributing watershed. There are 18km of roads within this watershed. The land use in the watershed is 45% urban, and 14% impervious. Piccadilly Brook is a DFW CFR and there is a PWS (Public Water Supply) upstream of this site.

Map of Piccadilly Brook Site



**Site: SudAsh (Sudbury River, Unique ID: W3018, AU ID: MA82A-25)**

The Sudbury River, at this site, has a 56 km2 watershed containing 404 km of roads. The contributing watershed is 35% urban land use, with 13% impervious cover. This site is slated for WPP Targeted Monitoring in the summer of 2021.

Map of Sudbury River (Ashland) Site

**Diagram

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**Site: Bait (Baiting Brook, Unique ID: W3019, AU ID: TBD)**

Baiting Brook, at this site, has a 5.5 km2 watershed containing 37 km of roads. The contributing watershed is 39% urban, with 13% impervious surface. This site will receive further examination pin the summer of 2021 as part of WPP Targeted Monitoring efforts.

Map of Baiting Brook Site

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**Site: Eames (Eames Brook, Unique ID: W0839, AU ID: MA82A-13)**

Eames Brook has a 2 km2 watershed at this site. The contributing watershed has 21.5 km of roads and is 67% urban with 38% impervious surface. This site will also be sampled during the summer of 2021 as part of WPP’s Targeted Monitoring Project.

Map of Eames Brook Site

Map

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**Site: SudFram (Sudbury River, Unique ID: W3021, AU ID: MA82A-26)**

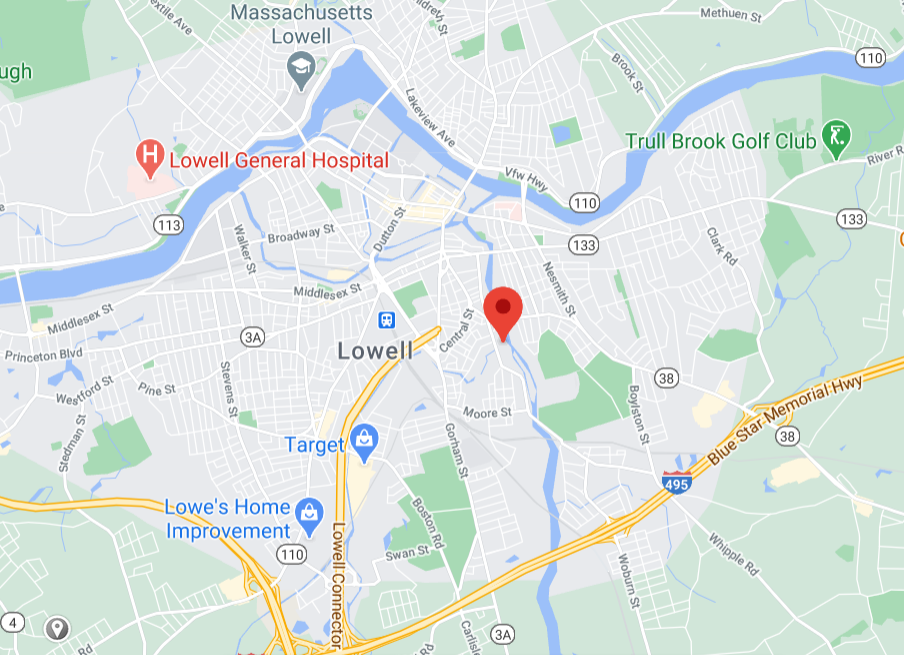
The Sudbury River, at this site, occupies a 209 km2 watershed. This watershed contains 286 km of roads and is 41% urban with 17% impervious land use.

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**Site: Conc (Concord River, Unique ID: W3022, AU ID: MA82A-08)**

Concord River, at this site, occupies a 644 km2 watershed. This watershed contains 4976 km of roads, and is 39% urban, with 13% impervious surface.

Map of Concord River Site



**Site: Beaver (Beaver Brook, Unique ID: W3023, AU ID: MA51-07)**

Beaver Brook, at this site, occupies an 8.6 km2 watershed. This watershed contains 87 km of roads and is 69% urban with 20% impervious surface. This site will be sampled during the 2021 WPP Targeted Monitoring Project.

Map of Beaver Brook Site



**Site: SudUP (Sudbury River, Unique ID: W0832, AU ID: MA82A-01)**

The Sudbury River, upstream of the Fruit Street bridge, and input from the wetland, occupies a 29 km2 watershed. It contains 200 km of roads. It is 33% urban, with 13% impervious surface.

Map of Sudbury River (Upstream of Fruit Street) site

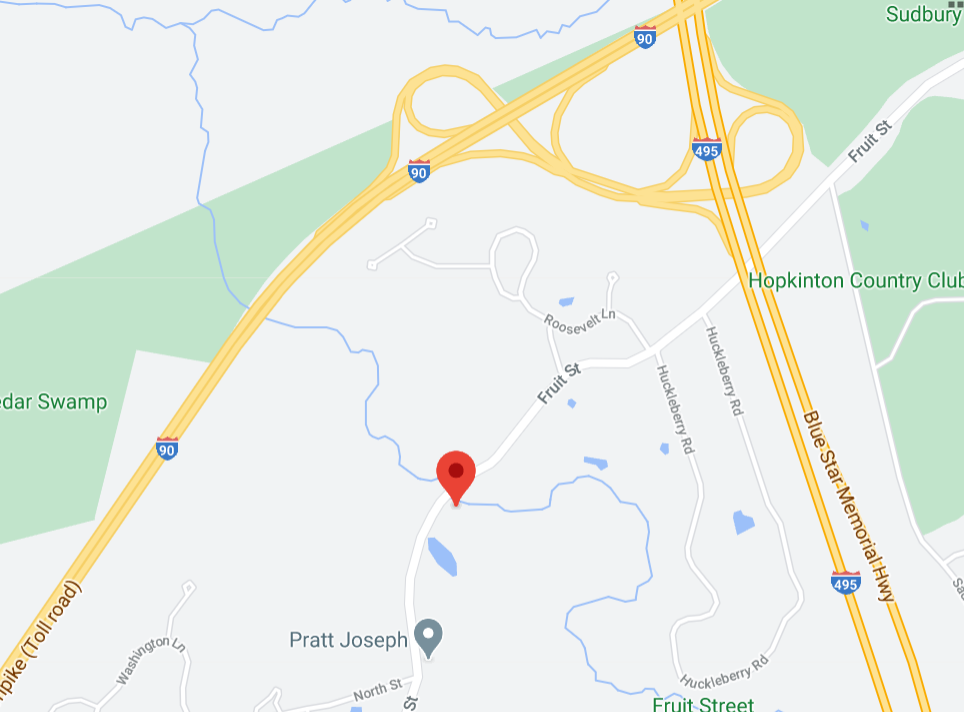
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**Site: WhiteFruit (Whitehall Brook, Unique ID: W0833, AU ID: MA82A-11)**

Whitehall Brook is an ORW (Outstanding Resource Water). There are four PWS wells, as well as the Whitehall Reservoir within the contributing watershed to this site. The watershed, at this site, is 10.5 km2, and contains 50 km of roads. The watershed contributing to this site 17% urban and is 4% impervious.

Map of Whitehall Brook Site



**Site: HopGolf (Hop Brook, Unique ID: W3025, AU ID: MA82B-20)**

Hop Brook, at this site, has a 12 km2 watershed at this location. The contributing watershed contains 118 km of roads. It is also 56% urban, and 24% impervious. The DFW has designated this stream a CFR.

Map of Hop Brook Site

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**Site: ColdH (Cold Harbor Brook, Unique ID: W3026, AU ID: MA82B-18)**

Cold Harbor Brook, at this site, has a 7 km2 watershed. The contributing watershed contains 60 km of roads. It is also 41% urban, and 14% impervious.

Map of Cold Harbor Brook Site

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Table 1. 2020-2021 Chloride Sampling and Survey Sites: Concord Watershed

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Site #** | **Waterbody** | **Site Name** | **Unique ID** | **GPS Coordinates**  **(Decimal Degree)** | **AU ID** | **Site Description/Location** |
| 1 | Jackstraw Brook | Jacks | W3016 | 42.25484, -71.6043 | MA82A-28 | near Upton Road, Westborough |
| 2 | Piccadilly Brook | Picca | W3017 | 42.25182, -71.5913 | MA82A-30 | near Wood Street, Westborough |
| 3 | Sudbury River | SudAsh | W3018 | 42.2596, -71.4557 | MA82A-25 | near Homer Avenue, Ashland |
| 4 | Baiting Brook | Bait | W3019 | 42.29212, -71.4398 | TBD | near Framingham State ballfield, Framingham |
| 5 | Eames Brook | Eames | W3020 | 42.28971, -71.4344 | MA82A-13 | near Sherwin Terrace, Framingham |
| 6 | Sudbury River | SudFram | W3021 | 42.306, -71.4314 | MA82A-26 | near Central Street, Framingham |
| 7 | Concord River | Conc | W3022 | 42.63424, -71.3016 | MA82A-08 | near Rogers Street, Lowell |
| 8 | Beaver Brook | Beaver | W3023 | 42.5956, -71.3504 | MA51-07 | near Boston Road, Chelmsford |
| 9 | Sudbury River | SudUP | W0832 | 42.26767, -71.5531 | MA82A-01 | upstream of Fruit Street, Hopkinton |
| 10 | Whitehall Brook | WhiteFruit | W0833 | 42.25623, -71.5709 | MA82A-11 | near Fruit Street, Hopkinton |
| 11 | Hop Brook | HopGolf | W3025 | 42.2868, -71.6475 | MA82B-20 | near Indian Meadow Golf Course, Westborough |
| 12 | Cold Harbor Brook | ColdH | W3026 | 42.33077, -71.6778 | MA82B-18 | near Reservoir Street, Northborough |

**References**

Hach Company. *Hydrolab DS5X, DS5, AND MS5: Water Quality Multiprobes User Manual, Edition 3*. 2006, Catalog Number 003078HY.

Map data ©2018 Google. *Google Earth Imagery*. Accessed October – November 2020.

MassDEP. *Quality Assurance Program Plan: Surface Water Monitoring & Assessment*. 2020, CN 520.1. Massachusetts Department of Environmental Protection, Division of Watershed Management-Watershed Planning Program 2020-2024.

MassDEP. *Quality Assurance Program Plan: Chloride Monitoring and Assessment*. 2020, CN 539.0. Massachusetts Department of Environmental Protection, Division of Watershed Management-Watershed Planning Program.

MassDEP. *Standard Operating Procedure: Continuous Conductivity Monitoring*. 2015, CN 349.0. Massachusetts Department of Environmental Protection, Division of Watershed Management.

Mattson M.D., and Godfrey P.J., *Identification of road salt contamination using multiple regression and GIS*: Environmental Management [ENVIRON. MANAGE.], vol. 18, no. 5, pp. 767-773, 1994.

Onset Computer Corporation. *HOBOware User’s Guide: Version 3.1*. 2010, Doc#: 12730-C, Part#: MAN-BHW-UG

Todd, A.K., and Kaltenecker, M.G., Warm season chloride concentrations in stream habitats of freshwater mussel species at risk. Environmental Pollution, Vol. 171, December 2012, pp.199-206.

Wallace, A.M., Biastoch, R.G. *Detecting Changes in the Benthic Invertebrate Community in Response to Increasing Chloride in Streams in Toronto, Canada*. Freshwater Science 35, no.1, March 2016: 353-363.